Super Power Series Book

Numbers Build Brighter Futures

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GANITA PRAKASH

FOR YOUNG THINKERS

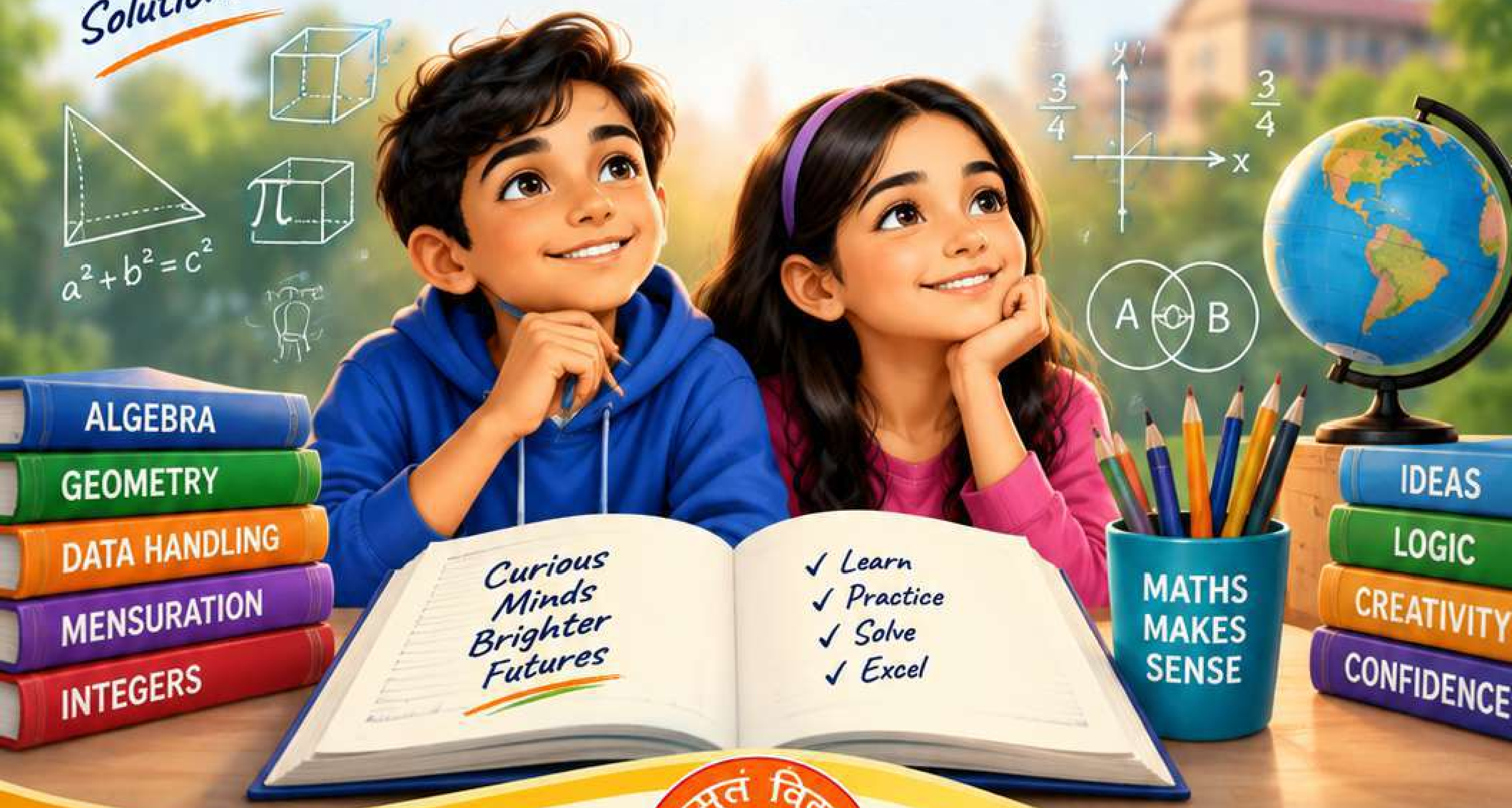
Study Material BOOK for 7th Standard Mathematics Subject

(PART 1)

Mathematics for a Brighter Tomorrow

Small Steps Big Solutions

Based on NCERT/CBSE Curriculum



अमृतं विद्या
Poornaprajna

Building Logical Minds for a Better World

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(PART 1)

(Prepared as per Poornaprajna Integrated Student Support Model)

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PREFACE

Ganita Prakash for Young Thinkers: Study Material Book for 7th Standard Mathematics Subject (Part 1) has been thoughtfully developed with the help of AI-driven GPTs, in accordance with the **Poornaprajna Integrated Student Support Model** to provide students with a systematic and learner-friendly approach to Mathematics. Based on the **NCERT/CBSE Curriculum**, Part 1 covers important areas such as **large numbers, arithmetic expressions, decimals, algebraic expressions, parallel and intersecting lines, number play, triangles, and fractions**, building a strong mathematical foundation.

The book goes beyond routine textbook learning by combining **concept summaries, important formulas and mathematical relationships, LOTS and HOTS questions, descriptive questions, application-oriented problems, and competitive-examination practice**. Its carefully structured activities and questions encourage students to **understand, calculate, reason, analyse, apply, and discover mathematical patterns**, while connecting Mathematics with meaningful real-life situations.

This study material is designed to support **7th Standard students in both CBSE school examinations and competitive examinations such as Olympiads**. By integrating strong conceptual learning with logical reasoning, problem-solving, higher-order thinking, and regular practice, the book aims to develop **mathematical confidence, accuracy, curiosity, creativity, and independent thinking**. We hope *Ganita Prakash for Young Thinkers* inspires every learner to **explore Mathematics with interest, think beyond formulas, enjoy solving challenges, and grow into a confident young mathematical thinker**.

Dr. P. S. Aithal
(www.psaithal.in)

7th Standard Maths Book Chapter 1

Chapter 1: LARGE NUMBERS AROUND US

1.1 Summary of the Chapter:

Summary of Chapter 1 – Large Numbers Around Us:

(1) **Understanding Large Numbers:** The chapter introduces large numbers through familiar real-life situations such as varieties of rice, populations, distances, and measurements. It develops an understanding of how large quantities can be visualised and compared.

(2) **Concept of One Lakh:** One lakh is written as **1,00,000** and is the smallest six-digit number. The chapter helps students understand its magnitude through examples involving days, population, and other everyday quantities.

(3) **Developing a Sense of Large Numbers:** Large measurements become easier to understand when compared with familiar quantities. Examples such as the height of the **Statue of Unity** and **Kunchikal waterfall** are used to develop this sense.

(4) **Reading and Writing Large Numbers:** Students learn to read and write large numbers using the **Indian place value system**, including the correct placement of commas for thousands, lakhs, and crores.

(5) **Place Value through the "Land of Tens":** Activities involving special calculator buttons such as **+10, +100, +1000**, etc., help students understand place value, number decomposition, and different ways of constructing the same number.

(6) **Efficient Representation of Numbers:** Through the "Creative Chitti" and "Systematic Sippy" activities, students explore different expressions for the same number and discover that using place values appropriately can minimise the number of operations required.

(7) **Lakhs, Crores, Millions and Billions:** The chapter compares the **Indian and American/International systems** of numeration. In the Indian system, digits are grouped in a **3-2-2-2 pattern**, while the International system follows a **3-3-3 pattern**.

(8) **Exact and Approximate Values:** Students learn that exact values are not always necessary. Depending on the situation, numbers can be **rounded up or rounded down** to obtain useful approximate values.

(9) **Nearest Values and Estimation:** Large numbers can be rounded to the nearest **thousand, ten thousand, lakh, ten lakh, or crore**. Estimation is also applied to addition and subtraction to judge the approximate size of answers before calculating exact values.

(10) **Patterns and Shortcuts in Multiplication:** The chapter explores convenient ways of multiplying numbers by regrouping and factorising them. For example, multiplication by **5 or 25** can be converted into simpler operations involving 10 or 100.

(11) **Number of Digits in Products:** Students investigate patterns between the number of digits in the factors and the possible number of digits in their product, encouraging mathematical reasoning rather than repeated calculation.

(12) **Applications of Large Numbers:** Real-world examples involving the **Earth–Sun distance, river discharge, populations, travel distances, animal weights, and environmental data** demonstrate how multiplication, division, estimation, and comparison of large numbers are useful in everyday life. The chapter concludes by encouraging students to solve imaginative problems involving very large quantities.

Key Learning Outcome:

By the end of the chapter, students should be able to **read, write, compare, estimate, round, represent, and perform calculations with large numbers**, as well as interpret them meaningfully in real-life situations. The chapter specifically covers **lakhs, crores, arabs, millions, and billions** and both Indian and International number systems.

1.2 Important Formulas:

Important Formulas / Mathematical Relationships:

The chapter does not contain many conventional formulas; instead, it uses important **number relationships, conversion rules, estimation methods, and multiplication/division shortcuts** for solving quantitative problems.

1. **Number of days in a lifetime**

Number of days = 365 × Number of years

If a person lives for $y$years:

$$\boxed{\text{Number of days} = 365y}$$

This relationship is directly introduced in the chapter.

2. **Number of items used/experienced over time**

$$\boxed{\text{Total items} = \text{Items per day} \times \text{Number of days}}$$

This can be used for problems such as tasting a certain number of rice varieties each day.

3. **Increase or difference between two quantities**

$$\boxed{\text{Increase} = \text{New value} - \text{Old value}}$$

For example, this is useful for comparing population figures between two years.

4. **Comparison of two quantities**

$$\boxed{\text{Difference} = \text{Larger quantity} - \text{Smaller quantity}}$$

This is useful for comparing heights, populations, distances and other large quantities.

5. **Number of times one quantity is as large as another**

$$\boxed{\text{Number of times} = \frac{\text{Larger quantity}}{\text{Smaller quantity}}}$$

The chapter encourages comparison with familiar quantities to develop a sense of large numbers.

6. **Place-value expansion**

A number can be represented as:

$$\boxed{N = (a \times 1) + (b \times 10) + (c \times 100) + (d \times 1000) + \cdots}$$

Example:

$$5072 = (5 \times 1000) + (0 \times 100) + (7 \times 10) + (2 \times 1)$$

The chapter also demonstrates that the same number can be decomposed in different ways.

7. **Number of button presses**

If a calculator increases by a fixed amount with each press:

$$\boxed{\text{Number of presses} = \frac{\text{Required number}}{\text{Value added per press}}}$$

Example: Number of $+1000$presses required to make 1,00,000:

$$1{,}00{,}000 \div 1000 = 100$$

8. **Important Indian number-system conversions**

$$\boxed{1 \text{ lakh} = 1{,}00{,}000 = 10^5}$$

$$\boxed{1 \text{ crore} = 1{,}00{,}00{,}000 = 10^7}$$

$$\boxed{100 \text{ lakhs} = 1 \text{ crore}}$$

$$\boxed{100 \text{ crores} = 1 \text{ arab}}$$

These relationships are central to large-number calculations.

9. **Indian–International number-system conversions**

$$\boxed{1 \text{ million} = 10 \text{ lakhs} = 10{,}00{,}000}$$
$$\boxed{10 \text{ million} = 1 \text{ crore}}$$
$$\boxed{1 \text{ billion} = 100 \text{ crores} = 1 \text{ arab}}$$

The chapter compares the Indian and American/International systems explicitly.

10. **Rounding/approximation rule**

For rounding to a required place:

$$\boxed{\text{Next digit} < 5 \Rightarrow \text{round down}}$$
$$\boxed{\text{Next digit} \geq 5 \Rightarrow \text{round up}}$$

The chapter particularly emphasizes choosing sensible approximate values according to the situation.

11. **Estimated sum and difference**

$$\boxed{\text{Estimated sum} \approx \text{Rounded first number} + \text{Rounded second number}}$$
$$\boxed{\text{Estimated difference} \approx \text{Rounded first number} - \text{Rounded second number}}$$

This method helps students judge whether an exact answer is reasonable.

12. **Multiplication by 5 – shortcut**

Since $5 = \frac{10}{2}$:

$$\boxed{N \times 5 = (N \div 2) \times 10}$$

Example:

$$116 \times 5 = 58 \times 10 = 580$$

13. **Multiplication by 25 – shortcut**

Since $25 = \frac{100}{4}$:

$$\boxed{N \times 25 = (N \div 4) \times 100}$$

Example:

$$824 \times 25 = (824 \div 4) \times 100 = 206 \times 100 = 20{,}600$$

14. **Multiplication by 125 – shortcut**

Since

$$125 = \frac{1000}{8},$$

therefore:

$$\boxed{N \times 125 = (N \div 8) \times 1000}$$

The chapter specifically provides $125 = \frac{1000}{8}$as a hint for quick multiplication.

15. **Number of digits in a product**

If one factor has $m$digits and another has $n$digits, their product generally has:

$$\boxed{m + n - 1 \text{ or } m + n \text{ digits}}$$

Example:

$$\text{2-digit} \times \text{2-digit} = \text{3-digit or 4-digit number}$$

The chapter develops this rule through patterns and reasoning.

16. **Total capacity**

$$\boxed{\text{Total capacity} = \text{Number of units} \times \text{Capacity per unit}}$$

Example from the chapter:

$$1 \text{ lakh buses} \times 50 \text{ persons} = 50 \text{ lakh persons}$$

17. **Distance travelled**

$$\boxed{\text{Distance} = \text{Distance travelled per day} \times \text{Number of days}}$$

For $y$years, ignoring leap years:

$$\boxed{\text{Distance} = \text{Distance per day} \times 365 \times y}$$

This relationship is useful for the chapter's Earth–Moon and Earth–Sun travel problems.

18. **Average quantity per unit**

$$\boxed{\text{Average per unit} = \frac{\text{Total quantity}}{\text{Number of units}}}$$

Examples include average distance travelled per day/hour and quantities produced over a given period.

Quick Formula Sheet

$$\boxed{\text{Days} = 365 \times \text{Years}}$$

$$\boxed{\text{Increase} = \text{New Value} - \text{Old Value}}$$

$$\boxed{\text{Times Bigger} = \frac{\text{Larger Quantity}}{\text{Smaller Quantity}}}$$

$$\boxed{\text{Total Quantity} = \text{Rate per Unit} \times \text{Number of Units}}$$

$$\boxed{\text{Average} = \frac{\text{Total Quantity}}{\text{Number of Units}}}$$

$$\boxed{N \times 5 = (N \div 2) \times 10}$$

$$\boxed{N \times 25 = (N \div 4) \times 100}$$

$$\boxed{N \times 125 = (N \div 8) \times 1000}$$

$$\boxed{1 \text{ lakh} = 10^5,\ 1 \text{ crore} = 10^7,\ 1 \text{ billion} = 10^9}$$

These are the **main formulas, relationships, and computational rules required for quantitative problems in Chapter 1, "Large Numbers Around Us."**

1.3 Fill-Up the Blank LOTS type questions with Answers: (35 Questions)

Fill-in-the-Blank Questions with Answers – LOTS Type:

Based on the uploaded **Ganita Prakash – Grade 7, Chapter 1: "Large Numbers Around Us."** The chapter introduces lakhs, crores, Indian and International number systems, approximation, place value, and multiplication patterns.

1. The smallest six-digit number is __________.
   Answer: 1,00,000
2. One lakh is written as __________.
   Answer: 1,00,000
3. One lakh has __________ zeroes.
   Answer: 5
4. The largest five-digit number is __________.
   Answer: 99,999
5. If leap years are ignored, there are __________ days in a year.
   Answer: 365
6. The number of days in $y$years can be calculated as __________.
   Answer: $365 \times y$
7. In the Indian place value system, 12,78,830 is read as __________.
   Answer: Twelve lakh seventy-eight thousand eight hundred thirty
8. The number name of 15,75,000 is __________.
   Answer: Fifteen lakh seventy-five thousand
9. One crore is written as __________.
   Answer: 1,00,00,000

10. One crore has __________ zeroes.
    Answer: 7
11. One crore is equal to __________ lakhs.
    Answer: 100
12. One arab is equal to __________ crores.
    Answer: 100
13. Ten lakhs is called one __________ in the International system.
    Answer: Million
14. Ten million is equal to one __________ in the Indian system.
    Answer: Crore
15. One billion is equal to __________ crores.
    Answer: 100
16. One arab is the same as one __________ in the International system.
    Answer: Billion
17. In the Indian system, digits are grouped from right to left in the pattern __________.
    Answer: 3-2-2-2…
18. In the International/American system, digits are grouped from right to left in the pattern __________.
    Answer: 3-3-3-3…
19. An approximated number greater than the actual number is obtained by rounding __________.
    Answer: Up
20. An approximated number less than the actual number is obtained by rounding __________.
    Answer: Down
21. The nearest lakh to 6,72,85,183 is __________.
    Answer: 6,73,00,000
22. The nearest crore to 6,72,85,183 is __________.
    Answer: 7,00,00,000
23. $116 \times 5 =$__________.
    Answer: 580
24. $824 \times 25 =$__________.
    Answer: 20,600
25. Multiplying a number by 5 can be done quickly by dividing it by 2 and then multiplying by __________.
    Answer: 10
26. The number 125 can be written as $1000 \div$__________.
    Answer: 8
27. The product of two 2-digit numbers can have either __________ or 4 digits.
    Answer: 3
28. The product of two 3-digit numbers can have either 5 or __________ digits.
    Answer: 6
29. One million is written as 1 followed by __________ zeroes.
    Answer: 6
30. One arab is written as 1 followed by __________ zeroes.
    Answer: 9
31. The distance between the Earth and the Moon given in the chapter is __________ **km**.
    Answer: 3,84,400 km

32. If a person travels 100 km every day, the distance travelled in 365 days is ___________ **km**.
    Answer: 36,500 km
33. If one bus can accommodate 50 people, one lakh buses can accommodate ___________ **lakh people**.
    Answer: 50
34. The height of the Statue of Unity mentioned in the chapter is about ___________ **metres**.
    Answer: 180 metres
35. Kunchikal waterfall is said to drop from a height of about ___________ **metres**.
    Answer: 450 metres
36. In the chapter, Somu is ___________ **metre tall**.
    Answer: 1
37. The Thoughtful Thousands calculator has only a ___________ button.
    Answer: +1000
38. The Tedious Tens calculator has only a ___________ button.
    Answer: +10
39. The Handy Hundreds calculator has only a ___________ button.
    Answer: +100
40. To make one lakh using only the +1000 button, it must be pressed ___________ times.
    Answer: 100

1.4 Fill-Up the Blank HOTS type questions with Answers: (30 Questions)

Fill-in-the-Blank Questions with Answers – HOTS Type:

The following questions are based on the chapter's emphasis on **large-number reasoning, place value, Indian and International number systems, estimation, approximation, efficient calculation, patterns in products, and real-life applications**.

1. If a person tastes 3 varieties of rice every day for 100 years, ignoring leap years, the total number of varieties tasted would be ___________.
   Answer: 1,09,500
   Reason: $3 \times 365 \times 100 = 1{,}09{,}500$.
2. The population of Chintamani increased from about 75,000 in 2011 to 1,06,000 in 2024. The increase is ___________.
   Answer: 31,000
3. If one floor of Somu's building is approximately 4 metres high, a 10-floor building would be approximately ___________ **metres** high.
   Answer: 40 metres
4. Since the Statue of Unity is about 180 m high, it is approximately ___________ **times** as tall as a 45 m building.
   Answer: 4 times
5. If the +1000 button is pressed 153 times, the displayed number will be ___________.
   Answer: 1,53,000
6. To obtain 97,600 using only a +100 button, the button must be pressed ___________ **times**.
   Answer: 976 times
7. Using the +1000 and +10 buttons, 5,070 can be obtained by pressing +1000 five times and +10 ___________ **times**.
   Answer: 7 times
8. If the +10,00,000 button is pressed 10 times, the resulting number is ___________.
   Answer: 1,00,00,000 (one crore)

9. One crore is 100 times one lakh. Therefore, 5 crore is equal to __________ **lakhs**.
   Answer: 500 lakhs
10. Since 1 arab = 100 crore, 3 arab is equal to __________ **crore**.
    Answer: 300 crore
11. In the International system, 50 lakh is equal to __________ **million**.
    Answer: 5 million
12. In the Indian system, 2 billion is equal to __________ **crore**.
    Answer: 200 crore
13. Comparing the two quantities, 30 thousand __________ 3 lakhs.
    Answer: <
14. Comparing 800 thousand and 8 million, 800 thousand __________ 8 million.
    Answer: <
15. A school has 732 people. If sweets are available only in packets of 50 and everyone must receive one, at least __________ **sweets** should be arranged.
    Answer: 750
    Reason: Rounding down would leave some people without sweets.
16. The nearest lakh to 3,87,69,957 is __________.
    Answer: 3,88,00,000
17. The nearest ten lakh to 3,87,69,957 is __________.
    Answer: 3,90,00,000
    The chapter demonstrates finding nearest thousand, ten thousand, lakh, ten lakh and crore for large numbers.
18. Without detailed multiplication, $2 \times 1768 \times 50$can be simplified to 1768×100, giving __________.
    Answer: 1,76,800
19. Using $125 = 1000 \div 8$, the product $72 \times 125$is __________.
    Answer: 9,000
20. By regrouping the factors, $125 \times 40 \times 8 \times 25$equals __________.
    Answer: 10,00,000
21. The smallest possible product of two 3-digit numbers is $100 \times 100 =$__________.
    Answer: 10,000
22. Therefore, the product of two 3-digit numbers cannot be a __________**-digit number**.
    Answer: 4-digit number
23. Following the digit-pattern rule, the product of two 5-digit numbers can have either __________ **or** __________ **digits**.
    Answer: 9 or 10 digits
24. Following the same reasoning, the product of an 8-digit number and a 3-digit number can have either __________ **or** __________ **digits**.
    Answer: 10 or 11 digits
25. The product of a 12-digit number and a 13-digit number can contain either __________ **or** __________ **digits**.
    Answer: 24 or 25 digits
26. If one lakh buses can carry 50 people each, their total capacity is __________ **people**.
    Answer: 50,00,000 (50 lakh)
27. If 5,000 ships each carry 2,500 passengers, their total capacity is __________ **passengers**.
    Answer: 1,25,00,000 (1 crore 25 lakh)
    This can be compared with Mumbai's population of more than 1 crore 24 lakh.

28. If Roxie travels 100 km every day for 10 years, ignoring leap years, she will travel __________ **km**.
    Answer: 3,65,000 km
29. Since the Earth–Moon distance given in the chapter is 3,84,400 km, after travelling 100 km daily for 10 years Roxie would still be __________ **km short** of the Moon.
    Answer: 19,400 km
30. If one sheet of paper weighs 5 g, then one lakh sheets would weigh __________ **kg**.
    Answer: 500 kg
31. If 250 babies are born every minute, the number born in one day would be __________.
    Answer: 3,60,000
    Reason: $250 \times 60 \times 24 = 3{,}60{,}000$.
32. If one coin is counted every second, the maximum number of coins counted in 24 hours is __________.
    Answer: 86,400
33. Therefore, at one coin per second, one million coins __________ be counted within a single day.
    Answer: cannot
34. A coin is 1 mm thick. Since the Statue of Unity is about 180 m high, approximately __________ **coins** would need to be stacked to reach the same height.
    Answer: 1,80,000 coins
    Reason: $180 \text{ m} = 1{,}80{,}000 \text{ mm}$.
35. A bird travels 13,560 km in approximately 11 days. Its approximate distance travelled per day is __________ **km**.
    Answer: 1,233 km (approximately)
36. If an albatross covers about 1,000 km per day, a journey of 12,000 km would take approximately __________ **days**.
    Answer: 12 days
37. If the population of a city is 76,068, an approximation of about 75,000 differs from the exact population by __________ **people**.
    Answer: 1,068 people
38. The exact value of $4{,}63{,}128 + 4{,}19{,}682$is __________.
    Answer: 8,82,810
39. The exact value of $14{,}63{,}128 - 4{,}90{,}020$is __________.
    Answer: 9,73,108
40. Since 1 billion equals 100 crore and 1 crore equals 100 lakh, one billion is equal to __________ **lakhs**.
    Answer: 10,000 lakhs

1.5 One-mark questions with Answers of LOTS Type: (35 Questions)

One-Mark Descriptive Questions with Answers – LOTS Type:

The following questions focus on **remembering and basic understanding** of the key concepts presented in the uploaded chapter, including large numbers, place-value systems, approximation, and multiplication patterns.

1. **What is one lakh written in numerals?**
   Answer: One lakh is written as **1,00,000**.
2. **How many zeroes are there in one lakh?**
   Answer: One lakh has **five zeroes**.
3. **What is one crore written in numerals?**
   Answer: One crore is written as **1,00,00,000**.

4. **How many zeroes are there in one crore?**
   Answer: One crore has **seven zeroes**.
5. **How many lakhs make one crore?**
   Answer: 100 lakhs make one crore.
6. **How many crores make one arab?**
   Answer: 100 crores make one arab.
7. **What is one million written in numerals?**
   Answer: One million is written as **1,000,000**.
8. **How many lakhs are equal to one million?**
   Answer: Ten lakhs are equal to one million.
9. **What is one billion equal to in the Indian number system?**
   Answer: One billion is equal to **one arab or 100 crores**.
10. **What are the two number-naming systems discussed in the chapter?**
    Answer: The chapter discusses the **Indian system and the American/International system**.
11. **How are digits grouped in the Indian place-value system?**
    Answer: Digits are grouped in a **3-2-2-2 pattern from right to left** in the Indian system.
12. **How are digits grouped in the American/International system?**
    Answer: Digits are grouped in a **3-3-3-3 pattern from right to left** in the American/International system.
13. **What is meant by an approximate value?**
    Answer: An approximate value is a value close to the exact number that gives a useful idea of its size.
14. **What is meant by rounding up a number?**
    Answer: Rounding up means taking an approximate number that is **greater than the actual number**.
15. **What is meant by rounding down a number?**
    Answer: Rounding down means taking an approximate number that is **less than the actual number**.
16. **Why are commas used while writing large numbers?**
    Answer: Commas are used to make large numbers **easier to read and identify according to place value**.
17. **Write 12,78,830 in words.**
    Answer: 12,78,830 is read as **twelve lakh seventy-eight thousand eight hundred thirty**.
18. **Write 15,75,000 in words.**
    Answer: 15,75,000 is read as **fifteen lakh seventy-five thousand**.
19. **How many thousands make one lakh?**
    Answer: 100 thousands make one lakh.
20. **How many hundreds make one lakh?**
    Answer: 1,000 hundreds make one lakh.
21. **What is the nearest lakh to 6,72,85,183?**
    Answer: The nearest lakh to 6,72,85,183 is **6,73,00,000**.
22. **What is the nearest crore to 6,72,85,183?**
    Answer: The nearest crore to 6,72,85,183 is **7,00,00,000**.
23. **What is the approximate height of the Statue of Unity given in the chapter?**
    Answer: The Statue of Unity is approximately **180 metres high**.
24. **What is the approximate height of Kunchikal waterfall given in the chapter?**
    Answer: Kunchikal waterfall drops from a height of about **450 metres**.

25. **What is the approximate distance between the Earth and the Moon given in the chapter?**
    Answer: The distance between the Earth and the Moon is approximately **3,84,400 km**.
26. **How many people can one lakh buses accommodate if each bus carries 50 people?**
    Answer: One lakh buses can accommodate **50 lakh people**.
27. **What shortcut can be used for multiplying a number by 5?**
    Answer: A number can be multiplied by 5 by **dividing it by 2 and then multiplying the result by 10**.
28. **What shortcut is shown in the chapter for multiplying a number by 25?**
    Answer: A number can be multiplied by 25 by **dividing it by 4 and multiplying the result by 100**.
29. **How many digits can the product of two 2-digit numbers have?**
    Answer: The product of two 2-digit numbers can have **three or four digits**.
30. **How many digits can the product of two 3-digit numbers have?**
    Answer: The product of two 3-digit numbers can have **five or six digits**.
31. **What is the population of Mumbai in 2011 according to the table in the chapter?**
    Answer: The population of Mumbai in 2011 was **1,24,42,373**.
32. **What was the estimated population of Chintamani in 2024?**
    Answer: The estimated population of Chintamani in 2024 was **1,06,000**.
33. **What is the population of Chintamani according to the 2011 Census as stated later in the chapter?**
    Answer: The exact population of Chintamani according to the 2011 Census is given as **76,068**.
34. **How many days are there in a year when leap years are ignored?**
    Answer: There are **365 days** in a year when leap years are ignored.
35. **What is the purpose of comparing large quantities with familiar quantities?**
    Answer: Comparing large quantities with familiar quantities helps us **understand or get a sense of their size**.
36. **What mathematical method can make some multiplications simpler?**
    Answer: Factorising and regrouping numbers can make multiplications simpler.

1.6 One-mark questions with Answers of HOTS Type: (30 Questions)

One-Mark Descriptive Questions with Answers – HOTS Type:
The following questions are based on the chapter's emphasis on **large-number reasoning, estimation, place value, comparison, number patterns, and application of multiplication**.

1. **If a person tastes 3 varieties of rice every day for 100 years, can the person taste one lakh varieties?**
   Answer: No, because the person would taste only **1,09,500 varieties**, which is more than one lakh.
   (Correction: Yes, 1,09,500 is greater than one lakh.)
2. **The population of Chintamani increased from about 75,000 in 2011 to 1,06,000 in 2024; by how much did it increase?**
   Answer: The population increased by approximately **31,000**.
3. **If Somu's building is about 40 m high, approximately how many times taller is the 180 m Statue of Unity?**
   Answer: The Statue of Unity is approximately **4.5 times** as tall as the building.

4. **Why can one lakh be considered both a large and a small number?**
   Answer: One lakh may seem large or small depending on the **quantity and context with which it is compared**.
5. **Can the number 12,345 be displayed using only a +1000 button? Give a reason.**
   Answer: No, because repeated additions of 1000 can produce only **multiples of 1000**.
6. **Can 12,300 be displayed using only a +100 button?**
   Answer: Yes, because pressing the +100 button **123 times gives 12,300**.
7. **Why can the Handy Hundreds calculator show some numbers that the Thoughtful Thousands calculator cannot?**
   Answer: The +100 calculator can form **multiples of 100 that are not necessarily multiples of 1000**.
8. **What is the minimum number of button presses required to make 5,072 using +1000, +100, +10 and +1 buttons?**
   Answer: The minimum is **14 presses: 5 + 0 + 7 + 2 = 14 presses**.
9. **Why does using place-value buttons usually minimise the number of clicks needed to form a number?**
   Answer: It minimises clicks because each digit directly tells us **how many times its corresponding place-value button is required**.
10. **If the +10,00,000 button is pressed 10 times, what number is obtained?**
    Answer: The result is **1,00,00,000, or one crore**.
11. **Which is greater: 500 lakhs or 5 million?**
    Answer: 500 lakhs is greater, because 500 lakhs equals 50 million.
12. **Which is greater: 640 crore or 60 billion?**
    Answer: 60 billion is greater, because 640 crore equals 6.4 billion.
13. **Why is it sensible for a school with 732 people to order 750 sweets rather than 700?**
    Answer: Rounding up to 750 ensures that **every person can receive a sweet**.
14. **Why should a telephone number not be rounded off?**
    Answer: A telephone number must be exact because **changing even one digit may connect to a different number**.
15. **Which estimate is closer to 4,63,128 + 4,19,682: 8 lakh or 9 lakh?**
    Answer: 9 lakh is closer because the exact sum is **8,82,810**.
16. **Without detailed calculation, is 14,63,128 − 4,90,020 greater or less than 10 lakh?**
    Answer: It is **less than 10 lakh**, because subtracting nearly 5 lakh from about 14.6 lakh gives about 9.7 lakh.
17. **Which city in the given table experienced a decrease in population between 2001 and 2011?**
    Answer: Kolkata experienced a decrease, from 45,72,876 to 44,86,679.
18. **Why is multiplying a number by 5 equivalent to dividing it by 2 and then multiplying by 10?**
    Answer: It works because **5 = 10 ÷ 2**, so both operations produce the same result.
19. **How can 72 × 125 be calculated quickly without long multiplication?**
    Answer: Since 125 = 1000 ÷ 8, **72 × 125 = 9 × 1000 = 9,000**.
20. **Can the product of two 2-digit numbers ever be a 5-digit number? Why?**
    Answer: No, because even the largest two 2-digit numbers have a product **less than 10,000**.
21. **Can multiplying two 3-digit numbers produce a 4-digit number?**
    Answer: No, because the smallest possible product is **100 × 100 = 10,000**, which has five digits.

22. **If one lakh buses each carry 50 people, can they accommodate Mumbai's population of more than 1 crore 24 lakh?**
    Answer: No, because one lakh buses can carry only **50 lakh people**, which is much less than Mumbai's population.
23. **Can Mumbai's population of about 1.24 crore fit into 5,000 ships if each ship carries 2,500 passengers?**
    Answer: Yes, because 5,000 ships can carry **1,25,00,000 passengers**, slightly more than Mumbai's population.
24. **If Roxie travels 100 km every day for 10 years, will she reach the Moon?**
    Answer: No, because she would travel about **3,65,000 km**, less than the Earth–Moon distance of 3,84,400 km.
25. **If 250 babies are born every minute, will one million babies be born in a day?**
    Answer: No, because 250 × 1,440 gives only **3,60,000 babies per day**.
26. **Can a person count one million coins in one day at one coin per second?**
    Answer: No, because one day has only **86,400 seconds**, so only 86,400 coins could be counted.
27. **If one sheet of paper weighs 5 g, what would one lakh sheets weigh?**
    Answer: One lakh sheets would weigh **5,00,000 g or 500 kg**, making them impossible for an ordinary person to lift together.
28. **What should be the last digit of the largest 10-digit multiple of 5 formed using digits 0–9 exactly once?**
    Answer: The last digit should be **0**, allowing the larger digits to occupy the higher place values.
29. **How many lakhs make one billion?**
    Answer: 10,000 lakhs make one billion because one billion equals 100 crore and each crore equals 100 lakhs.
30. **If a coin is 1 mm thick, approximately how many coins stacked vertically would equal the 180 m height of the Statue of Unity?**
    Answer: Approximately **1,80,000 coins** are required because 180 m equals 1,80,000 mm.

These **HOTS one-mark questions** require students to apply, compare, estimate, infer, justify, or identify patterns rather than merely recall facts from the chapter.

1.7 Two-mark questions with Answers of LOTS Type: (25 Questions)

Two-Mark Descriptive Questions with Answers – LOTS Type:
The following questions focus on understanding, recalling, explaining, and performing straightforward calculations using the concepts covered in the uploaded chapter, including large numbers, place value systems, approximation, and multiplication patterns.

1. What is one lakh? How is it written in numerals?
Answer:
1. One lakh is equal to **one hundred thousand**.
2. It is written as **1,00,000** and has five zeroes.

2. How many days are there approximately in 100 years, ignoring leap years?
Answer:
1. There are 365 days in a year, so the number of days in 100 years is **365 × 100**.
2. Therefore, there are approximately **36,500 days** in 100 years.

3. What was the approximate population of Chintamani in 2011 and 2024?
Answer:
1. The population of Chintamani in 2011 was approximately **75,000**.

2. Its estimated population in 2024 was **1,06,000**.

4. State the heights of the Statue of Unity and Kunchikal waterfall given in the chapter.

Answer:

1. The Statue of Unity is about **180 metres** high.
2. Kunchikal waterfall is said to drop from a height of about **450 metres**.

5. Why are commas used while writing large numbers?

Answer:

1. Commas separate the digits into appropriate place-value groups.
2. This makes large numbers **easier to read and understand**.

6. Write 12,78,830 and 15,75,000 in words.

Answer:

1. 12,78,830 is **twelve lakh seventy-eight thousand eight hundred thirty**.
2. 15,75,000 is **fifteen lakh seventy-five thousand**.

7. How many thousands and hundreds are required to make one lakh?

Answer:

1. **100 thousands** are required to make one lakh.
2. **1,000 hundreds** are required to make one lakh.

8. What buttons are available on the Creative Chitti calculator?

Answer:

1. Creative Chitti has **+1, +10, +100 and +1000** buttons.
2. It also has **+10,000, +1,00,000 and +10,00,000** buttons.

9. What is one crore? How many zeroes does it contain?

Answer:

1. One crore is equal to **100 lakhs**.
2. It is written as **1,00,00,000**, which is 1 followed by seven zeroes.

10. How are commas placed in the Indian and American systems?

Answer:

1. In the Indian system, digits are grouped from right to left in a **3-2-2-2… pattern**.
2. In the American system, digits are grouped in a **3-3-3-3… pattern**.

11. What are the equivalents of one million and one billion in the Indian system?

Answer:

1. **One million = ten lakhs**.
2. **One billion = one arab = one hundred crores**.

12. What is meant by rounding up and rounding down?

Answer:

1. **Rounding up** means choosing an approximate value greater than the actual number.
2. **Rounding down** means choosing an approximate value less than the actual number.

13. Give one example each of rounding up and rounding down from the chapter.

Answer:

1. A school with 732 people may order **750 sweets**, which is an example of rounding up.
2. An item costing ₹470 may be described as costing around **₹450**, which is an example of rounding down.

14. Find the nearest lakh and nearest crore of 6,72,85,183.

Answer:

1. The nearest lakh of 6,72,85,183 is **6,73,00,000**.
2. Its nearest crore is **7,00,00,000**.

15. What were the populations of Mumbai and New Delhi according to the 2011 data in the chapter?

Answer:

1. Mumbai had a population of **1,24,42,373**.

2. New Delhi had a population of **1,10,07,835**.

16. Explain the shortcut used in the chapter to calculate 116 × 5.

Answer:

1. Since multiplying by 5 is equivalent to multiplying by 10 and dividing by 2, **116 ÷ 2 = 58**.
2. Therefore, **58 × 10 = 580**, so 116 × 5 = **580**.

17. Explain how 824 × 25 can be calculated quickly.

Answer:

1. Since 25 = 100 ÷ 4, first divide 824 by 4 to get **206**.
2. Then multiply 206 by 100 to get **20,600**.

18. What can be said about the number of digits in the product of two 2-digit numbers?

Answer:

1. The product of two 2-digit numbers can have **three or four digits**.
2. Such products are at least 100 and always less than 10,000.

19. What can be said about the product of two 3-digit numbers?

Answer:

1. The product of two 3-digit numbers has **five or six digits**.
2. Therefore, multiplying two 3-digit numbers cannot produce a 4-digit product.

20. What is the approximate distance between the Earth and the Sun given in the chapter?

Answer:

1. The chapter represents the approximate distance as **2100 × 70,000 km = 14,70,00,000 km**.
2. It also states that the farthest distance is about **152 million kilometres**.

21. How much water does the Amazon River discharge into the Atlantic Ocean every second according to the activity?

Answer:

1. The quantity is obtained by calculating **6400 × 62,500**.
2. The result is **40,00,00,000 litres (400 million litres) per second**.

22. How many people can one lakh buses accommodate if each bus carries 50 people?

Answer:

1. The total capacity is calculated as **1 lakh** × **50**.
2. Therefore, one lakh buses can accommodate **50 lakh people**.

23. Why can the entire population of Mumbai not fit into one lakh buses carrying 50 people each?

Answer:

1. One lakh buses carrying 50 people each can accommodate only **50 lakh people**.
2. Mumbai's population is more than **1 crore 24 lakh**, so the buses are insufficient.

24. What is the distance between the Earth and the Moon, and how far would Roxie travel in one year at 100 km per day?

Answer:

1. The distance between the Earth and the Moon is **3,84,400 km**.
2. At 100 km per day, Roxie would travel **36,500 km in one year**.

25. State two important uses of approximation when working with large numbers.

Answer:

1. Approximation helps us understand **roughly how big or small a large quantity is**.
2. It also makes comparison and calculation involving large numbers easier when exact values are unnecessary.

1.8. Two-mark questions with Answers of HOTS Type: (15 Questions)

Two-Mark Descriptive Questions with Answers – HOTS Type:

The following questions require students to **analyse, reason, compare, estimate, apply concepts, and justify their answers** using ideas from the uploaded chapter. The chapter emphasizes understanding large numbers through comparisons, approximation, place-value systems, efficient calculations, and real-life situations.

1. A person tastes 3 different varieties of rice every day. Can the person taste one lakh varieties in 100 years? Justify.

Answer:

1. In 100 years, there are approximately $365 \times 100 = 36{,}500$days, so the person can taste $36{,}500 \times 3 = 1{,}09{,}500$varieties.
2. Since 1,09,500 is greater than 1,00,000, the person **can taste one lakh varieties** within 100 years.

2. Chintamani's population increased from about 75,000 in 2011 to 1,06,000 in 2024. By how much did it increase, and did it cross one lakh?

Answer:

1. The increase was $1{,}06{,}000 - 75{,}000 = 31{,}000$.
2. Yes, the population crossed one lakh by **6,000 people**.

3. A building has floors of approximately 4 metres each. How many floors would it need to be approximately as high as the 180-metre Statue of Unity?

Answer:

1. Number of floors required $= 180 \div 4 = 45$.
2. Therefore, a building of about **45 floors** would have approximately the same height as the Statue of Unity.

4. Why can one lakh be considered both a large and a small number?

Answer:

1. One lakh seems large when we think of **one lakh days**, which is about 274 years.
2. But it may seem smaller when more than one lakh people can be accommodated in a large cricket stadium.

5. A calculator has only a +100 button. Can it display 1,00,000? Explain.

Answer:

1. Yes, because $1{,}00{,}000 \div 100 = 1{,}000$.
2. Therefore, pressing the **+100 button 1,000 times** will display 1,00,000.

6. Creative Chitti wants to make 5,072. Give a method different from the two examples in the chapter.

Answer:

1. One possible expression is $(4 \times 1000) + (10 \times 100) + (7 \times 10) + (2 \times 1)$.
2. This gives $4{,}000 + 1{,}000 + 70 + 2 = 5{,}072$, showing that the same number can be constructed in different ways.

7. Why does the least number of button clicks on Systematic Sippy correspond to the place-value representation of a number?

Answer:

1. Using the **largest possible place-value button** avoids unnecessarily replacing one large unit with many smaller units.
2. Hence, using each place-value button according to the corresponding digit produces the number with the fewest clicks.

8. A student says that 100 lakhs and 1 crore are different quantities. Is the student correct? Justify.

Answer:

1. No, because **100 lakhs = 1,00,00,000**.
2. The number 1,00,00,000 is exactly **1 crore**, so both represent the same quantity.

9. Compare 500 lakhs and 5 million. Which is greater?
Answer:
1. Since 1 million = 10 lakhs, **5 million = 50 lakhs**.
2. Therefore, **500 lakhs > 5 million**, and 500 lakhs is ten times 5 million.

10. Why is it incorrect to round off a telephone number before making a call?
Answer:
1. A telephone number identifies a specific connection, so changing even one digit may connect to a different person or service.
2. Therefore, telephone numbers require **exact values rather than approximate values**.

11. A school has 732 students and staff members. Should the principal order 700 or 750 sweets if everyone needs one? Why?
Answer:
1. The principal should round **732 up to 750** because ordering only 700 sweets would leave 32 people without sweets.
2. Thus, rounding up is appropriate when the available quantity must be sufficient for everyone.

12. Roxie says $4,63,128 + 4,19,682$is near 8,00,000, while Estu says it is near 9,00,000. Whose estimate is closer?
Answer:
1. The exact sum is **8,82,810**, which is only 17,190 less than 9,00,000.
2. Therefore, **Estu's estimate of 9,00,000 is closer** than Roxie's estimate.

13. The population of Bengaluru increased from 43,01,326 in 2001 to 84,25,970 in 2011. Can we say that it almost doubled? Explain.
Answer:
1. Twice the 2001 population is $43{,}01{,}326 \times 2 = 86{,}02{,}652$.
2. Since 84,25,970 is fairly close to 86,02,652, Bengaluru's population **almost doubled**.

14. Without using long multiplication, find 72×125.
Answer:
1. Since $125 = 1000 \div 8$, we can calculate $72 \div 8 = 9$.
2. Therefore, $72 \times 125 = 9 \times 1000 = 9{,}000$.

15. Can the product of two 2-digit numbers ever be a 5-digit number? Justify without testing every possibility.
Answer:
1. Every 2-digit number is less than 100, so their product must be less than $100 \times 100 = 10{,}000$.
2. Therefore, the product can have only **3 or 4 digits**, never 5 digits.

16. Can multiplying two 3-digit numbers give a 4-digit product? Explain logically.
Answer:
1. The smallest 3-digit number is 100, and $100 \times 100 = 10{,}000$, which already has five digits.
2. Hence, the product of two 3-digit numbers **cannot be a 4-digit number**; it will have five or six digits.

17. One lakh buses can carry 50 passengers each. Why can they not accommodate Mumbai's entire 2011 population?
Answer:
1. One lakh buses can carry $1{,}00{,}000 \times 50 = 50{,}00{,}000$people.
2. Mumbai's population was more than **1 crore 24 lakh**, so 50 lakh seats are insufficient.

18. Could Mumbai's population fit into 5,000 ships if each ship carried about 2,500 passengers?
Answer:

1. The ships could carry $5{,}000 \times 2{,}500 = 1{,}25{,}00{,}000$passengers.
2. Since Mumbai's population was about **1,24,42,373**, it could approximately fit into 5,000 such ships.

19. Roxie travels 100 km every day. Could she cover the Earth–Moon distance of 3,84,400 km within 10 years?

Answer:

1. In 10 years, she would travel approximately $100 \times 365 \times 10 = 3{,}65{,}000$km.
2. Since 3,65,000 km is less than 3,84,400 km, she **would not reach the Moon within 10 years**.

20. If 250 babies are born every minute worldwide, will one million babies be born in one day?

Answer:

1. In one day, the number would be $250 \times 60 \times 24 = 3{,}60{,}000$babies.
2. Since 3,60,000 is less than 10,00,000, **one million babies would not be born in one day** at this assumed rate.

21. Can a person count one million coins in a day if one coin is counted every second?

Answer:

1. A day contains $24 \times 60 \times 60 = 86{,}400$seconds, so only 86,400 coins could be counted.
2. Since 86,400 is far less than 10,00,000, **one million coins cannot be counted in one day** at that rate.

22. If one sheet of paper weighs 5 g, could a person easily lift one lakh sheets together? Estimate the total weight.

Answer:

1. One lakh sheets would weigh $1{,}00{,}000 \times 5 = 5{,}00{,}000$g = **500 kg**.
2. Since 500 kg is extremely heavy for a person, one person **could not normally lift the entire stack at once**.

23. A coin is 1 mm thick. Approximately how many coins must be stacked to reach the 180 m height of the Statue of Unity?

Answer:

1. Since 180 m = 1,80,000 mm, the required number is $1{,}80{,}000 \div 1 = 1{,}80{,}000$coins.
2. Thus, approximately **1.8 lakh coins** stacked one above another would reach that height.

24. An albatross covers about 900–1,000 km per day. Approximately how long would a 12,000 km journey take?

Answer:

1. At about 1,000 km per day, $12{,}000 \div 1{,}000 = 12$days.
2. Therefore, the journey would take approximately **12–13 days**, depending on its daily distance.

25. A bar-tailed godwit travelled 13,560 km in about 11 days. Estimate its average distance travelled per day.

Answer:

1. The average distance is approximately $13{,}560 \div 11 \approx 1{,}233$km per day.
2. Thus, the bird travelled roughly **1,200–1,230 km each day**, showing how approximation makes large quantities easier to understand.

1.9. Three-mark questions with Answers of LOTS Type: (10 Questions)

Three-Mark Descriptive Questions with Answers – LOTS Type:

The following questions are based on the uploaded Grade 7 chapter and focus on **recall, understanding, straightforward calculation, and direct application** of the concepts covered in the chapter.

1. What is one lakh? Explain its numerical representation.

Answer:

1. One lakh is written as **1,00,000** in the Indian place value system.
2. It is the smallest six-digit number and consists of **1 followed by five zeroes**.
3. One lakh is equal to **100 thousands**.

2. Explain how commas are placed in the Indian place value system with an example.

Answer:

1. In the Indian system, commas are placed using the **3-2-2-2 pattern from right to left**.
2. The groups represent ones, thousands, lakhs, crores and higher places.
3. For example, **12,78,830** is read as *twelve lakh seventy-eight thousand eight hundred thirty*.

3. What is one crore? State its relationship with lakh.

Answer:

1. One crore is written as **1,00,00,000** in the Indian place value system.
2. It is represented by **1 followed by seven zeroes**.
3. **100 lakhs make 1 crore**.

4. State three differences between the Indian and American systems of naming numbers.

Answer:

1. The Indian system uses terms such as **lakh, crore and arab**, while the American system uses **million and billion**.
2. The Indian system groups digits in a **3-2-2-2 pattern**, whereas the American system uses a **3-3-3-3 pattern**.
3. For example, **1,00,00,000** is called *one crore* in the Indian system and **10,000,000** is called *ten million* in the American system.

5. Explain the relationship among thousand, lakh and crore.

Answer:

1. **100 thousands = 1 lakh**, so 1 lakh = 1,00,000.
2. **100 lakhs = 1 crore**, so 1 crore = 1,00,00,000.
3. Thus, a crore is **100 times a lakh**, while a lakh is 100 times a thousand.

6. What is meant by an approximate value? Give an example from the chapter.

Answer:

1. An approximate value is a value that is **close to the exact value** and gives us a general idea of the quantity.
2. The exact 2011 population of Chintamani was **76,068**.
3. It can be stated approximately as **75,000** when the exact number is not necessary.

7. What are rounding up and rounding down? Give examples.

Answer:

1. **Rounding up** means using an approximate number greater than the actual number; for example, 732 people may be rounded up to **750** while ordering sweets.
2. **Rounding down** means using an approximate number smaller than the actual number.
3. For example, an item costing ₹470 may be described as costing around **₹450**.

8. Find the increase in the population of Chintamani from 2011 to 2024.

Answer:

1. The population in 2011 was approximately **75,000**.
2. The estimated population in 2024 was **1,06,000**.
3. Therefore, the increase was **1,06,000 − 75,000 = 31,000 people**.

9. What is meant by the "nearest neighbours" of a large number? Explain with 6,72,85,183.

Answer:

1. Nearest neighbours are approximate values of a number to the nearest thousand, ten thousand, lakh, ten lakh, crore, etc.
2. For **6,72,85,183**, the nearest thousand is **6,72,85,000** and the nearest lakh is **6,73,00,000**.
3. Its nearest crore is **7,00,00,000**.

10. Explain how multiplication by 5 can be performed using multiplication by 10.

Answer:

1. Multiplying a number by 5 can be done by **dividing the number by 2 and then multiplying by 10**.
2. For example, $116 \div 2 = 58$.
3. Therefore, $116 \times 5 = 58 \times 10 = 580$.

11. Explain the shortcut used to calculate 824×25.

Answer:

1. Since $\mathbf{25 = 100 \div 4}$, multiplication by 25 can be performed by dividing by 4 and multiplying by 100.
2. $824 \div 4 = 206$.
3. Therefore, $824 \times 25 = 206 \times 100 = 20{,}600$.

12. State the pattern regarding the number of digits in the product of two 2-digit numbers.

Answer:

1. The smallest possible product of two 2-digit numbers is $10 \times 10 = 100$.
2. The product of any two 2-digit numbers is less than $100 \times 100 = 10{,}000$.
3. Therefore, the product of two 2-digit numbers can have **either 3 digits or 4 digits**.

13. Explain the relationship between lakh, million, crore and billion.

Answer:

1. **1 lakh = 1,00,000**, while **1 million = 10 lakhs**.
2. **1 crore = 1,00,00,000**, which is equal to **10 million**.
3. **1 billion = 100 crores = 1 arab**.

14. What does the chapter tell us about the population of Mumbai and the capacity of one lakh buses?

Answer:

1. Mumbai's population in the given data was more than **1 crore 24 lakhs**.
2. If one bus accommodates 50 people, one lakh buses can accommodate **50 lakh people**.
3. Therefore, the entire population of Mumbai **cannot fit into one lakh buses**.

15. Describe the Earth–Moon travel example given in the chapter.

Answer:

1. The distance between the Earth and the Moon is given as **3,84,400 km**.
2. The chapter considers a situation in which Roxie travels **100 km every day**.
3. It asks students to calculate the distance travelled in one year and ten years to determine whether she could reach the Moon.

16. State three facts about the Indian place value system discussed in the chapter.

Answer:

1. The Indian system uses number names such as **thousand, lakh, crore and arab**.
2. **1 lakh = 1,00,000** and **1 crore = 1,00,00,000**.
3. Its commas are placed according to the **3-2-2-2 pattern from right to left**.

17. What does the chapter say about the Statue of Unity and Kunchikal waterfall?

Answer:

1. The **Statue of Unity** in Gujarat is about **180 metres high**.

2. The **Kunchikal waterfall** in Karnataka is said to drop from a height of about **450 metres**.
3. The chapter uses these measurements to help students understand large quantities by **comparing them with familiar heights**.

18. What are the main ideas learned in the chapter *Large Numbers Around Us*?

Answer:

1. We learn to **read and write large numbers** such as lakhs, crores, millions and billions using Indian and International systems.
2. We learn to **round large numbers and compare unfamiliar quantities with familiar quantities** to understand their size.
3. We also learn to **factorise and regroup numbers to simplify multiplication** and solve real-life problems involving large numbers.

1.10. Three-mark questions with Answers of HOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers – HOTS Type:

The following questions require students to **analyse, reason, compare, estimate, justify, and apply** the concepts of large numbers presented in the chapter.

1. A person tastes 3 different varieties of rice every day. Can the person taste one lakh varieties in 100 years? Justify your answer.

Answer:

1. In 100 years, there are approximately $365 \times 100 = 36{,}500$days.
2. At 3 varieties per day, the person can taste $36{,}500 \times 3 = 1{,}09{,}500$varieties.
3. Therefore, the person **can taste one lakh varieties** within 100 years, ignoring leap years.

2. Roxie says that one lakh is a very large number, while Estu says it is not very large. Explain how both can be correct.

Answer:

1. One lakh is large when we think of **one lakh days**, which is approximately 274 years.
2. However, one lakh may appear smaller when we consider that a large stadium can accommodate more than one lakh people.
3. Therefore, whether one lakh seems large or small **depends on the context in which it is used**.

3. A school has 732 students and staff members. Should the principal order 700 or 750 sweets if everyone must receive one? Give reasons.

Answer:

1. Ordering 700 sweets would leave **32 people without sweets**.
2. Rounding 732 upward to 750 ensures that enough sweets are available for everyone.
3. Therefore, the principal should **round up and order 750 sweets** because shortage must be avoided.

4. A newspaper reports Chintamani's population as about 75,000 instead of the exact 76,068. Is this reasonable? Explain.

Answer:

1. The exact population given in the chapter is **76,068**, while 75,000 is an approximate value.
2. For giving readers a general idea of the size of the population, an exact figure may not be necessary.
3. Therefore, using **about 75,000** is reasonable when only an approximate understanding is required.

5. Can the entire population of Mumbai fit into one lakh buses if each bus carries 50 people? Justify mathematically.

Answer:

1. One lakh buses carrying 50 people each can accommodate $1{,}00{,}000 \times 50 = 50{,}00{,}000$, or **50 lakh people**.
2. Mumbai's population in the chapter is more than **1 crore 24 lakh**.
3. Since 50 lakh is much less than 1 crore 24 lakh, **the entire population cannot fit into one lakh buses**.

6. Roxie travels 100 km every day. Can she reach the Moon in 10 years if it is 3,84,400 km away?

Answer:

1. In one year, she would travel approximately $100 \times 365 = 36{,}500$km.
2. In 10 years, she would travel $36{,}500 \times 10 = 3{,}65{,}000$km.
3. Since **3,65,000 km < 3,84,400 km**, she would not reach the Moon in 10 years.

7. Explain why multiplying a number by 5 can be simplified by dividing it by 2 and multiplying by 10.

Answer:

1. Since $5 = \frac{10}{2}$, multiplying by 5 is equivalent to multiplying by 10 and dividing by 2.
2. For example, $116 \div 2 = 58$, and $58 \times 10 = 580$.
3. Hence, $116 \times 5 = 580$, showing that **factorisation and regrouping can simplify multiplication**.

8. Without testing every possibility, prove that the product of two 2-digit numbers can only have 3 or 4 digits.

Answer:

1. The smallest two-digit numbers are 10 and 10, whose product is $10 \times 10 = 100$, a **3-digit number**.
2. Every two-digit number is less than 100, so the product of any two such numbers must be less than $100 \times 100 = 10{,}000$.
3. Therefore, the product of two 2-digit numbers must contain **either 3 or 4 digits**.

9. A student claims that 500 lakhs is equal to 5 million. Analyse the statement and correct it.

Answer:

1. Since **10 lakhs = 1 million**, 500 lakhs must be divided by 10 to convert it into millions.
2. Thus, 500 lakhs $= 50$ million.
3. Therefore, the student's statement is **incorrect; 500 lakhs equals 50 million, not 5 million**.

10. If each sheet of paper weighs 5 grams, could a person reasonably lift one lakh sheets together? Explain.

Answer:

1. One lakh sheets would weigh $1{,}00{,}000 \times 5 = 5{,}00{,}000$grams.
2. This is equal to **500 kilograms** because 1,000 grams make 1 kilogram.
3. Therefore, an ordinary person **could not reasonably lift one lakh sheets together**, showing how large one lakh becomes in a real-life context.

11. If 250 babies are born every minute worldwide, determine whether one million babies would be born in one day.

Answer:

1. There are $24 \times 60 = 1{,}440$minutes in one day.
2. The number of babies born would be $250 \times 1{,}440 = 3{,}60{,}000$.

3. Since 3,60,000 is less than 10,00,000, **one million babies would not be born in one day** at this assumed rate.

12. Can a person count one million coins in a single day if one coin is counted every second? Justify.

Answer:

1. One day contains $24 \times 60 \times 60 = 86{,}400$seconds.
2. At one coin per second, only **86,400 coins** can be counted in one day.
3. Since 86,400 is far less than 10,00,000, **one million coins cannot be counted in a day** at this rate.

13. The population of Chintamani increased from about 75,000 in 2011 to 1,06,000 in 2024. Analyse this change.

Answer:

1. The approximate increase is $1{,}06{,}000 - 75{,}000 = 31{,}000$.
2. The population therefore crossed the **one-lakh mark** during this period.
3. This means that the 2024 population is about **31,000 greater** than the approximate 2011 population.

14. A student says that rounding should always be used because it makes calculations easier. Do you agree? Give reasons.

Answer:

1. Rounding is useful when we only need a **general idea or estimate** of a large quantity.
2. However, some situations, such as calling a telephone number, require the **exact number**, because a rounded number would be incorrect.
3. Therefore, rounding should be used **only when approximation is appropriate for the situation**.

15. Explain why the same number has different comma placements in the Indian and American systems.

Answer:

1. The Indian system groups digits from right to left in a **3-2-2-2… pattern**, corresponding to thousands, lakhs, crores and so on.
2. The American/International system groups digits uniformly in a **3-3-3-3… pattern**, corresponding to thousands, millions and billions.
3. Hence, comma positions differ even though **the numerical value represented remains exactly the same**.

6.11 Five-mark questions with Answers of LOTS Type: (12 Questions)

Five-Mark Descriptive Questions with Answers – LOTS Type:

These questions are based on the chapter concepts of **large numbers, Indian and International number systems, approximation, place value, multiplication patterns, and applications of large numbers**.

1. Explain the relationship among thousand, lakh, crore, million, billion and arab.

Answer:

1. **One thousand** = 1,000, which is 1 followed by 3 zeroes.
2. **One lakh** = 1,00,000, which is 1 followed by 5 zeroes.
3. **One million** = 1,000,000 = 10 lakhs.
4. **One crore** = 1,00,00,000 = 100 lakhs = 10 million.
5. **One arab** = 1,00,00,00,000 = 100 crores = 1 billion.

2. Explain how commas are placed and numbers are named in the Indian and American/International systems.

Answer:

1. In the **Indian system**, digits are grouped from right to left in a **3-2-2-2… pattern**.
2. The main periods used are ones, thousands, lakhs, crores and arabs.
3. In the **American/International system**, digits are grouped in a **3-3-3-3… pattern**.
4. The main periods used are ones, thousands, millions and billions.
5. Thus, the same number may have different comma placements and number names in the two systems.

3. Write the five nearest neighbours of 6,72,85,183 as given in the chapter.
Answer:

1. Nearest thousand = **6,72,85,000**.
2. Nearest ten thousand = **6,72,90,000**.
3. Nearest lakh = **6,73,00,000**.
4. Nearest ten lakh = **6,70,00,000**.
5. Nearest crore = **7,00,00,000**.

4. Explain exact and approximate values with suitable examples from the chapter.
Answer:

1. An **exact value** gives the actual and precise quantity.
2. An **approximate value** gives a number close to the actual quantity.
3. The exact 2011 population of Chintamani was **76,068**, while it can be approximately stated as **75,000**.
4. Rounding up gives a value greater than the actual number; for example, 732 people may require ordering **750 sweets**.
5. Rounding down gives a smaller approximate value; for example, ₹470 may sometimes be described as **around ₹450**.

5. Describe how the special calculators in the "Land of Tens" help us understand place value.
Answer:

1. **Thoughtful Thousands** has a +1000 button, so every press adds 1,000.
2. **Tedious Tens** has a +10 button, so every press adds 10.
3. **Handy Hundreds** has a +100 button, so every press adds 100.
4. **Creative Chitti** has buttons such as +1, +10, +100, +1000, +10000, +100000 and +1000000.
5. These calculators demonstrate that numbers can be formed in different ways using their **place values**.

6. Explain how factorisation and regrouping can make multiplication easier, using examples from the chapter.
Answer:

1. A multiplication can sometimes be simplified by expressing one factor in a convenient form.
2. Since $5 = \frac{10}{2}$, multiplying by 5 can be done by dividing by 2 and then multiplying by 10.
3. Thus, $116 \times 5 = (116 \div 2) \times 10$.
4. Therefore, $58 \times 10 = 580$, so $116 \times 5 = 580$.
5. Similarly, 824×25can be calculated using $25 = \frac{100}{4}$, giving **20,600**.

7. Explain the pattern in the number of digits obtained when numbers of different lengths are multiplied.
Answer:

1. A **1-digit** × **1-digit** multiplication gives a 1-digit or 2-digit product.
2. A **2-digit** × **1-digit** multiplication gives a 2-digit or 3-digit product.
3. A **2-digit** × **2-digit** multiplication gives a 3-digit or 4-digit product.

4. A **3-digit** × **3-digit** multiplication gives a 5-digit or 6-digit product.
5. Thus, the number of digits in a product is related to the number of digits in the two factors.

8. Describe five important facts about large numbers discussed in the chapter.

Answer:

1. One lakh days is approximately **274 years**.
2. One lakh people standing shoulder to shoulder could form a line about **38 km long**.
3. The cricket stadium in Ahmedabad has a seating capacity of **more than one lakh**.
4. Most humans have approximately **80,000 to 1,20,000 hairs** on their heads.
5. Some species of female fish can lay **nearly one lakh eggs at once**.

9. Explain, in five steps, whether one lakh buses can accommodate the entire population of Mumbai.

Answer:

1. Assume that one bus can accommodate **50 people**.
2. The number of buses available is **1,00,000**.
3. Therefore, total capacity = 1,00,000 × 50.
4. The buses can accommodate **50,00,000 or 50 lakh people**.
5. Since Mumbai's population is more than **1 crore 24 lakh**, one lakh buses cannot accommodate its entire population.

10. Explain how large numbers can be understood better by comparing them with familiar quantities.

Answer:

1. Large numbers and measurements are sometimes difficult to imagine directly.
2. Comparing them with familiar objects or quantities makes their size easier to understand.
3. The chapter compares **Somu's height and the height of his building** with larger structures.
4. The Statue of Unity is about **180 metres high**, while Kunchikal waterfall drops from about **450 metres**.
5. Such comparisons help students develop a practical **sense of large quantities and measurements**.

1.12 Five-mark questions with Answers of HOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – HOTS Type:

The following questions require students to **analyse, reason, estimate, compare, justify, and apply** the concepts of large numbers, approximation, place value, and multiplication from the chapter.

1. Roxie wants to taste one lakh varieties of rice in a lifetime of 100 years. If she tastes 3 varieties every day, determine whether she can taste all the varieties.

Answer – Five Steps:

1. Number of days in 100 years, ignoring leap years = $365 \times 100 = 36{,}500$days.
2. At 3 varieties per day, she can taste $36{,}500 \times 3$varieties.
3. Therefore, total varieties tasted = **1,09,500**.
4. Since $1{,}09{,}500 > 1{,}00{,}000$, she can taste all one lakh varieties.
5. She would have time to taste **9,500 varieties more** than one lakh at this rate.

2. The population of Chintamani was about 75,000 in 2011 and was estimated to be 1,06,000 in 2024. Analyse the change in population.

Answer – Five Steps:

1. Population in 2011 = **75,000**.

2. Estimated population in 2024 = **1,06,000**.
3. Increase = $1{,}06{,}000 - 75{,}000$.
4. Therefore, increase in population = **31,000**.
5. Hence, Chintamani's population increased considerably and crossed the **one-lakh mark** by 2024.

3. A school has 732 students, teachers and staff together. The principal needs to order one sweet for each person. Should the number be rounded to 700 or 750? Justify.

Answer – Five Steps:

1. The exact number of people is **732**.
2. Rounding down to 700 would provide sweets for only 700 people.
3. This would leave $732 - 700 = 32$people without sweets.
4. Rounding up to **750** provides enough sweets for everyone.
5. Therefore, the principal should order **750 sweets**, because rounding up is appropriate when a shortage must be avoided.

4. Roxie estimates that $4,63,128 + 4,19,682$is near 8,00,000, while Estu says it is near 9,00,000. Analyse their estimates and decide whose estimate is closer.

Answer – Five Steps:

1. Add the numbers: $4{,}63{,}128 + 4{,}19{,}682$.
2. The exact sum is **8,82,810**.
3. Difference from 8,00,000 = **82,810**.
4. Difference from 9,00,000 = **17,190**.
5. Therefore, **Estu's estimate is closer**, because 8,82,810 is much nearer to 9,00,000 than to 8,00,000.

5. Estu asks whether the entire population of Mumbai can fit into one lakh buses if each bus carries 50 people. Analyse and justify your answer.

Answer – Five Steps:

1. Number of buses = **1,00,000**.
2. Capacity of each bus = **50 people**.
3. Total capacity = $1{,}00{,}000 \times 50 = 50{,}00{,}000$people.
4. Mumbai's 2011 population was **1,24,42,373**, which is much greater than 50,00,000.
5. Therefore, **one lakh buses cannot accommodate the entire population of Mumbai**.

6. Roxie travels 100 km every day. Analyse whether she can cover the distance from the Earth to the Moon in 10 years.

Answer – Five Steps:

1. Distance travelled per day = **100 km**.
2. Distance travelled in one year = $100 \times 365 = 36{,}500$km.
3. Distance travelled in 10 years = $36{,}500 \times 10 = 3{,}65{,}000$km.
4. Distance from Earth to Moon = **3,84,400 km**.
5. Since $3{,}65{,}000 < 3{,}84{,}400$, Roxie **cannot reach the Moon in 10 years**; she would still be **19,400 km short**.

7. A person claims that one million babies cannot be born in a day if 250 babies are born every minute worldwide. Verify the claim.

Answer – Five Steps:

1. Number of babies born per minute = **250**.
2. Number of minutes in one hour = **60**.
3. Number of minutes in one day = $60 \times 24 = 1{,}440$.
4. Babies born in one day = $250 \times 1{,}440 = 3{,}60{,}000$.
5. Since **3,60,000 < 10,00,000 (one million)**, the claim is correct; one million babies would **not** be born in one day at this rate.

8. Can a person count one million coins in one day if one coin is counted every second? Analyse.

Answer – Five Steps:

1. One million coins = **10,00,000 coins**.
2. At one coin per second, 10,00,000 coins require **10,00,000 seconds**.
3. One day contains $24 \times 60 \times 60 = 86{,}400$seconds.
4. Therefore, only **86,400 coins** can be counted in one day.
5. Since $86{,}400 < 10{,}00{,}000$, it is **impossible to count one million coins in one day** at this rate.

9. Prove through reasoning that the product of two 2-digit numbers can only have 3 or 4 digits.

Answer – Five Steps:

1. The smallest 2-digit number is **10**.
2. The smallest possible product is $10 \times 10 = 100$, which has **3 digits**.
3. Every other product of two 2-digit numbers is at least 100.
4. Since every 2-digit number is less than 100, the product must be less than $100 \times 100 = 10{,}000$.
5. Hence, the product is at least 100 but less than 10,000, so it can have **only 3 or 4 digits**.

10. A bar-tailed godwit travelled 13,560 km in about 11 days without stopping. Estimate its average distance travelled per day and per hour.

Answer – Five Steps:

1. Total distance travelled = **13,560 km**.
2. Total travelling time = **11 days**.
3. Average distance per day = $13{,}560 \div 11 \approx 1{,}233$km.
4. Average distance per hour = $1{,}233 \div 24 \approx 51$km.
5. Therefore, the bird travelled approximately **1,233 km per day or 51 km per hour**, showing the remarkable scale of its non-stop migration.

1.13 Five-mark questions with Answers of Applied Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – Applied Type:

The following questions apply the chapter concepts of **large numbers, estimation, Indian and International place-value systems, multiplication, division, and comparison** to practical situations.

1. A school is organising a celebration for 2,368 students and staff members. Sweets are available only in boxes of 100. How many boxes should the school order? Explain why rounding is useful here.

Answer:

1. Total number of people = **2,368**.
2. 23 boxes contain $23 \times 100 = 2{,}300$sweets.
3. This is not enough, as **68 people would not receive sweets**.
4. Therefore, the school must round the requirement upward to **2,400 sweets** and order **24 boxes**.
5. This shows that in practical situations where shortage must be avoided, **rounding up is appropriate**.

2. A city had a population of 35,20,085 in 2001 and 55,70,585 in 2011. Find the increase and estimate it to the nearest lakh.

Answer:

1. Population in 2001 = **35,20,085**.
2. Population in 2011 = **55,70,585**.

3. Increase = $55{,}70{,}585 - 35{,}20{,}085$.
4. Increase = **20,50,500** people.
5. Therefore, the population increased by approximately **21 lakh people** when rounded to the nearest lakh.

3. A transport company has 1,00,000 buses, and each bus can carry 50 passengers. Can these buses carry the entire population of Mumbai, which was 1,24,42,373 in 2011?

Answer:

1. Number of buses = **1,00,000**.
2. Capacity of each bus = **50 passengers**.
3. Total capacity = $1{,}00{,}000 \times 50 = 50{,}00{,}000$passengers.
4. Mumbai's population = **1,24,42,373**, which is much greater than 50,00,000.
5. Therefore, **1 lakh buses cannot carry Mumbai's entire population**; more than twice that number of buses would be required.

4. A traveller covers 100 km every day. Determine whether the traveller can cover the Earth–Moon distance of 3,84,400 km in 10 years.

Answer:

1. Distance travelled each day = **100 km**.
2. Taking 365 days in a year, distance in one year = $100 \times 365 = 36{,}500$km.
3. Distance in 10 years = $36{,}500 \times 10 = 3{,}65{,}000$km.
4. Remaining distance = $3{,}84{,}400 - 3{,}65{,}000 = 19{,}400$km.
5. Therefore, the traveller **cannot reach the Moon in 10 years** and would still be **19,400 km short**.

5. A printing company packs 250 books in each carton. If a school network orders 480 cartons, calculate the total number of books using a convenient multiplication method. Express the answer in the Indian system.

Answer:

1. Number of books per carton = **250**.
2. Number of cartons = **480**.
3. Regroup the multiplication as $250 \times 480 = 25 \times 48 \times 100$.
4. Since $25 \times 48 = 1{,}200$, total books = $1{,}200 \times 100 = 1{,}20{,}000$.
5. Therefore, the company supplies **1,20,000 books**, read as **one lakh twenty thousand books**. The chapter encourages factorising and regrouping numbers to simplify multiplication.

6. A company reports its annual sales as ₹4,05,06,780. An international partner wants the number written using the International system. Write and read the number in both systems.

Answer:

1. The given number in the Indian system is **4,05,06,780**.
2. It is read as **four crore five lakh six thousand seven hundred eighty**.
3. Regrouping the same digits according to the International system gives **40,506,780**.
4. It is read as **forty million five hundred six thousand seven hundred eighty**.
5. Thus, the value remains unchanged; only the **comma placement and naming system** change.

7. A relief camp has 1,00,000 sheets of paper, each weighing 5 grams. Calculate their total weight and decide whether one person could reasonably lift them all together.

Answer:

1. Number of sheets = **1,00,000**.
2. Weight of each sheet = **5 g**.
3. Total weight = $1{,}00{,}000 \times 5 = 5{,}00{,}000$g.
4. Since 1,000 g = 1 kg, $5{,}00{,}000 \div 1{,}000 = 500$kg.

5. Therefore, the sheets together weigh **500 kg**, so one person could not reasonably lift them all at once.

8. An environmental study estimates that the Amazon River discharges 40,00,00,000 litres of water into the Atlantic Ocean every second. How much water would it discharge in 5 seconds and 1 minute?

Answer:

1. Water discharged per second = **40,00,00,000 litres**.
2. In 5 seconds = 40,00,00,000 × 5.
3. Therefore, discharge in 5 seconds = **2,00,00,00,000 litres**.
4. In 60 seconds = 40,00,00,000 × 60 = 24,00,00,00,000litres.
5. Thus, approximately **2,00,00,00,000 litres in 5 seconds** and **24,00,00,00,000 litres in one minute** would be discharged, illustrating the usefulness of large numbers in describing natural phenomena.

9. A 180-metre-high monument is to be represented using a stack of coins, each 1 mm thick. Calculate how many coins would be needed.

Answer:

1. Height of the monument = **180 m**.
2. Since 1 metre = 1,000 mm, 180 m = 1,80,000 mm.
3. Thickness of one coin = **1 mm**.
4. Number of coins required = 1,80,000 ÷ 1 = 1,80,000.
5. Therefore, approximately **1,80,000 coins** must be stacked to reach a height of 180 metres. The chapter applies this idea to the Statue of Unity.

10. A bird travels approximately 13,560 km in 11 days without stopping. Estimate the distance travelled per day and per hour.

Answer:

1. Total distance = **13,560 km**.
2. Total time = **11 days**.
3. Distance per day = 13,560 ÷ 11 ≈ 1,233km.
4. Distance per hour = 1,233 ÷ 24 ≈ 51km.
5. Therefore, the bird travels approximately **1,233 km per day** and **51 km per hour**, demonstrating how division and approximation can be applied to real-life data involving large quantities.

1.14 Multiple Choice Questions with answers for Olympiad type Competitive Exams:

Olympiad-Type Multiple Choice Questions with Answers:

These questions are based on the chapter concepts of large numbers, Indian and International number systems, approximation, place value, number formation, multiplication patterns, and real-life applications.

1. What is the difference between the smallest 6-digit number and the largest 5-digit number?

A) 1
B) 10
C) 100
D) 1,000

Answer: A) 1

Explanation: 1,00,000 − 99,999 = 1.

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2. A person tastes 3 different varieties of rice every day for 100 years, ignoring leap years. How many varieties will the person taste?

A) 36,500
B) 73,000
C) 1,09,500
D) 1,00,000
Answer: C) 1,09,500
Explanation: $3 \times 365 \times 100 = 1{,}09{,}500$.

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3. The number 5,04,085 is read as:
A) Five lakh forty thousand eighty-five
B) Five lakh four thousand eighty-five
C) Fifty lakh four thousand eighty-five
D) Five lakh four hundred eighty-five
Answer: B) Five lakh four thousand eighty-five

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4. How many thousands are required to make one lakh?
A) 10
B) 50
C) 100
D) 1,000
Answer: C) 100
Explanation: $100 \times 1{,}000 = 1{,}00{,}000$.

---

5. A calculator has only a +100 button. What is the minimum number of presses needed to display 97,600?
A) 97
B) 976
C) 9,760
D) 9760
Answer: B) 976
Explanation: $97{,}600 \div 100 = 976$.

---

6. Which expression represents 5,072 correctly?
A) $5 \times 1000 + 7 \times 100 + 2$
B) $5 \times 1000 + 7 \times 10 + 2$
C) $50 \times 1000 + 72$
D) $5 \times 100 + 7 \times 10 + 2$
Answer: B) $5 \times 1000 + 7 \times 10 + 2$
Explanation: $5000 + 70 + 2 = 5072$.

---

7. Using +1000, +100, +10 and +1 buttons, what is the minimum number of button presses required to make 5,072?
A) 14
B) 16
C) 18
D) 23
Answer: A) 14
Explanation: $5 + 0 + 7 + 2 = 14$button presses. The chapter connects minimum button presses with place-value notation.

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8. Which of the following represents one crore?

A) 1,00,000
B) 10,00,000
C) 1,00,00,000
D) 10,00,00,000
Answer: C) 1,00,00,000

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9. One million is equal to:
A) 1 lakh
B) 10 lakhs
C) 100 lakhs
D) 1,000 lakhs
Answer: B) 10 lakhs

---

10. Which statement is correct?
A) 1 crore = 10 lakhs
B) 1 crore = 100 lakhs
C) 1 crore = 1,000 lakhs
D) 1 crore = 10,000 lakhs
Answer: B) 1 crore = 100 lakhs

---

11. In the International system, the number 9,876,501,234 is read as:
A) 9 billion 876 million 501 thousand 234
B) 987 billion 650 million 1234
C) 9 million 876 billion 501 thousand 234
D) 98 billion 765 million 1 thousand 234
Answer: A) 9 billion 876 million 501 thousand 234

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12. Which comparison is correct?
A) 30 thousand > 3 lakhs
B) 500 lakhs < 5 million
C) 800 thousand < 8 million
D) 640 crore > 60 billion
Answer: C) 800 thousand < 8 million
Explanation: 800 thousand = 8,00,000, whereas 8 million = 80,00,000.

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13. What is 6,72,85,183 rounded to the nearest lakh?
A) 6,72,00,000
B) 6,73,00,000
C) 6,70,00,000
D) 7,00,00,000
Answer: B) 6,73,00,000

---

14. The exact value of $4{,}63{,}128 + 4{,}19{,}682$**is:**
A) 8,72,810
B) 8,82,810
C) 8,83,810
D) 9,82,810
Answer: B) 8,82,810

---

15. According to the population table in the chapter, which city had a lower population in 2011 than in 2001?
A) Bengaluru
B) Chennai
C) Kolkata
D) Pune
Answer: C) Kolkata
Explanation: Kolkata's population decreased from **45,72,876** in 2001 to **44,86,679** in 2011.

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16. Evaluate quickly: 72×125**.**
A) 8,000
B) 9,000
C) 9,500
D) 10,000
Answer: B) 9,000
Explanation: $125 = 1000/8$, so $72 \times 125 = (72 \div 8) \times 1000 = 9{,}000$.

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17. The product of two 3-digit numbers can have:
A) only 4 digits
B) only 5 digits
C) 4 or 5 digits
D) 5 or 6 digits
Answer: D) 5 or 6 digits
Explanation: The chapter identifies the general digit pattern for products.

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18. The approximate distance between the Earth and the Sun given by $2100 \times 70{,}000$**is:**
A) 14,70,000 km
B) 1,47,00,000 km
C) 14,70,00,000 km
D) 1,47,00,00,000 km
Answer: C) 14,70,00,000 km
Explanation: $2100 \times 70{,}000 = 147{,}000{,}000\text{km}$.

---

19. One lakh buses can accommodate 50 people each. What is their total passenger capacity?
A) 5 lakh
B) 10 lakh
C) 50 lakh
D) 5 crore
Answer: C) 50 lakh
Explanation: $1{,}00{,}000 \times 50 = 50{,}00{,}000 = 50\text{lakh}$ people.

---

20. A person counts one coin every second continuously. Can the person count 1 million coins in one day?
A) Yes, exactly
B) Yes, with time left
C) No, because only 86,400 coins can be counted
D) No, because only 36,500 coins can be counted

Answer: C) No, because only 86,400 coins can be counted
Explanation: One day has $24 \times 60 \times 60 = 86{,}400$seconds, which is much less than 1 million. The chapter poses this as a large-number thought experiment.

Additional Olympiad Challenge Questions
21. Using each digit from 0 to 9 exactly once, what must be the last digit of the largest possible multiple of 5?
A) 0
B) 5
C) 8
D) 9
Answer: A) 0
Explanation: A multiple of 5 must end in 0 or 5. Ending with 0 allows 9,876,543,210, which is larger than any arrangement ending in 5. The chapter specifically explores forming such 10-digit numbers.

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22. If 250 babies are born every minute, approximately how many are born in one day?
A) 36,000
B) 3,60,000
C) 36,00,000
D) 2,50,000
Answer: B) 3,60,000
Explanation: $250 \times 60 \times 24 = 3{,}60{,}000$.

---

23. If each coin is 1 mm thick, approximately how many coins are required to make a stack as high as the 180-metre Statue of Unity?
A) 18,000
B) 1,80,000
C) 18,00,000
D) 1,800
Answer: B) 1,80,000
Explanation: 180 m = 1,80,000 mm; therefore 1,80,000 coins are required.

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24. A bar-tailed godwit travelled 13,560 km in about 11 days. Its approximate average distance travelled per day was:
A) 123 km
B) 1,000 km
C) 1,233 km
D) 2,356 km
Answer: C) 1,233 km
Explanation: $13{,}560 \div 11 \approx 1{,}233$km per day.

---

25. Which of the following correctly shows the relationship among large-number units?
A) 1 lakh = 10 thousand; 1 crore = 10 lakh
B) 1 lakh = 100 thousand; 1 crore = 100 lakh
C) 1 lakh = 1,000 thousand; 1 crore = 10 lakh
D) 1 lakh = 10 thousand; 1 crore = 1,000 lakh
Answer: B) 1 lakh = 100 thousand; 1 crore = 100 lakh

Answer Key:

1-A, 2-C, 3-B, 4-C, 5-B, 6-B, 7-A, 8-C, 9-B, 10-B, 11-A, 12-C, 13-B, 14-B, 15-C, 16-B, 17-D, 18-C, 19-C, 20-C, 21-A, 22-B, 23-B, 24-C, 25-B

1.15 Best Practices Opportunity List from the Chapter: (10 Ideas)

"Best Practices" Opportunities for Teaching Chapter 1 – *Large Numbers Around Us*:
The chapter emphasizes understanding large numbers through real-life contexts, Indian and International number systems, estimation and rounding, comparison, efficient multiplication, and mathematical thought experiments.

No.	Best Practice	Suggested Classroom Implementation
1	**Connect Large Numbers with Real-Life Situations**	Introduce lakhs, crores, millions and billions using familiar examples such as city populations, stadium capacities, distances, heights and environmental data. This helps students develop a genuine *sense of magnitude* rather than merely memorising place values.
2	**Use a Place-Value and Number-System Comparison Chart**	Display Indian and International place-value charts side by side. Let students practise converting numbers such as **1 lakh = 100,000** and **1 crore = 10 million**, while observing the different comma-placement patterns. The chapter explicitly compares the 3-2-2 grouping of the Indian system with the 3-3-3 grouping of the International system.
3	**Conduct the "Calculator Button Challenge"**	Recreate the chapter's *Land of Tens* activity using cards or a digital calculator with buttons such as **+1, +10, +100, +1000**. Challenge students to construct a given number using the **minimum number of button presses**, thereby strengthening place-value understanding and strategic thinking.
4	**Develop Estimation Before Exact Calculation**	Before students perform addition, subtraction or multiplication with large numbers, ask them to predict an approximate answer. They can then calculate the exact answer and compare it with their estimate. This reinforces the chapter's distinction between exact and approximate values.
5	**Use Real Data for Mathematical Analysis**	Give students authentic data tables such as the city-population table in the chapter and ask them to rank, compare, estimate increases and identify trends. This integrates mathematics with data interpretation and develops analytical skills.
6	**Teach Large Numbers through Visual Comparison**	Ask students to compare unfamiliar quantities with familiar objects—for example, comparing the height of a building with the **Statue of Unity** or **Kunchikal waterfall**. Such visual comparisons make abstract large quantities easier to comprehend.
7	**Encourage Multiple Solution Strategies**	Instead of accepting only one procedure, ask students to find two or more ways of representing or calculating the same number. The chapter's *Creative Chitti* activities demonstrate how a number such as **5072** can be constructed in different ways.
8	**Promote Pattern Discovery in Multiplication**	Allow students to investigate products such as 11×11, 111×111, and products involving numbers with different digit lengths. Ask them to predict patterns before calculating. This develops mathematical reasoning and generalisation.

No.	Best Practice	Suggested Classroom Implementation
9	**Use "Think–Estimate–Calculate–Verify" as a Routine**	For every large-number problem, encourage students to follow four steps: **Think about the magnitude → Estimate → Calculate → Verify whether the answer is reasonable.** This reduces mechanical computation and encourages mathematical judgement.
10	**Introduce Mathematical Thought Experiments**	Pose interesting questions such as: *Can one million coins be counted in a day? Can Mumbai's population fit into one lakh buses? Could someone reach the Moon by travelling 100 km every day?* Students should make reasonable assumptions and justify their conclusions mathematically.
11	**Use Peer Discussion and Math Talk**	After solving challenging problems, have students explain *why* their strategy works to a partner or group. Encourage classmates to compare methods and identify the most efficient solution rather than focusing only on the final answer.
12	**End with Student-Created Challenges**	Ask students to create their own large-number puzzles, estimation questions or real-life problems and exchange them with classmates. The chapter itself encourages learners to create and share such questions, making this an effective student-centred consolidation activity.

Recommended Best-Practice Teaching Approach:
A particularly effective sequence for this chapter would be:
Real-life Context → Visualisation → Place-Value Activity → Estimation → Multiple Strategies → Pattern Discovery → Application Problem → Student-Created Challenge.
This approach shifts the lesson from simply **reading and calculating large numbers** toward **understanding their magnitude, reasoning with them, applying them to real situations, and communicating mathematical thinking**.

1.16 Innovations Opportunity List from the Chapter: (10 Ideas)

"Innovations" Opportunities for Teaching-Learning:
The chapter provides excellent opportunities for innovative learning because it connects large numbers with real-life quantities, place-value systems, estimation, patterns, data and mathematical thought experiments.

No.	Innovative Idea	Suggested Teaching-Learning Activity
1	**Digital "Land of Tens" Calculator Game**	Create a simple interactive calculator or game with only **+1, +10, +100, +1,000, +10,000 and +1,00,000** buttons. Students compete to generate a target number using the minimum number of clicks. This extends the chapter's *Creative Chitti* and *Systematic Sippy* activities.
2	**Large Number Virtual Museum**	Students create digital posters/slides containing fascinating large-number facts related to space, animals, rivers, population, environment and technology. The chapter itself uses examples such as the Earth–Sun distance, Amazon River discharge and blue-whale measurements.
3	**Indian vs International**	Students use a spreadsheet or simple coding tool to develop a **"Number Converter"** that displays a given number using

No.	Innovative Idea	Suggested Teaching-Learning Activity
	Number-System Converter	Indian and International comma systems and number names. This makes the comparison of lakhs/crores with millions/billions interactive.
4	**Population Data Detective**	Convert the population table in the chapter into a spreadsheet activity. Students compare city populations, calculate increases, rank cities and create graphs. They can then explain which cities experienced the largest changes.
5	**“Estimate First” Classroom Challenge**	Display large-number calculations without allowing students to calculate immediately. Teams first estimate whether the answer is closer to a lakh, ten lakhs, crore, etc. Points can be awarded for the closest reasonable estimate before finding the exact answer.
6	**AI-Assisted Large Number Quiz**	Under teacher supervision, students can use a generative-AI tool to create puzzles involving lakhs, crores, millions, rounding and estimation. Students must then **verify the AI-generated answers mathematically**, helping develop both mathematical reasoning and AI literacy.
7	**Large Numbers Around My School Project**	Students collect school-related numerical data—number of notebook pages used annually, litres of water consumed, meals served, steps walked, sheets printed, etc.—and extrapolate them to monthly/yearly values. They then express the results using Indian and International number systems.
8	**Human Place-Value Machine**	Give students digit cards and make them physically stand in positions representing ones, tens, hundreds, thousands, lakhs and crores. Moving students or comma cards demonstrates how the same digits are grouped differently in Indian and International systems.
9	**“Could It Really Happen?” Investigation**	Give groups unusual questions such as *Could we count one million coins in a day?*, *Could one lakh buses accommodate a city's population?*, or *How long would travelling to the Moon take?* Students make assumptions, calculate and defend their conclusions. This directly builds on the chapter's mathematical thought experiments.
10	**Pattern Detective Lab**	Students use calculators or spreadsheets to explore patterns such as **11 × 11, 111 × 111, 1111 × 1111** and predict subsequent results before verifying them. The activity encourages pattern recognition, conjecture and mathematical generalisation.
11	**QR-Code Mathematics Trail**	Place QR codes at different locations around the classroom or school. Each code reveals a large-number problem involving place value, estimation, comparison or multiplication. Solving one clue directs students to the next station, turning revision into a mathematical treasure hunt.
12	**Student-Created Math Challenge Studio**	Students design their own puzzles involving large numbers and challenge classmates to solve them. The chapter specifically encourages learners to create and share unusual large-number questions, making students **creators of mathematical problems rather than only solvers**.

Particularly Recommended Innovations:
For Grade 7, a strong combination would be **Digital Land of Tens + Population Data Detective + QR-Code Mathematics Trail + "Could It Really Happen?" Investigation + Student-Created Math Challenge Studio**.
These innovations can transform the chapter from routine numerical practice into **experiential, inquiry-based, technology-enabled, collaborative and problem-solving-oriented mathematics learning**.

1.17: Practicing Questions/Question Bank

A. Fill in the Blanks:

1. One lakh is written as __________.
   Answer: 1,00,000
2. One crore is equal to __________ **lakhs**.
   Answer: 100
3. One million is equal to __________ **lakhs**.
   Answer: 10
4. One crore has __________ **zeroes**.
   Answer: 7
5. One billion is equal to __________ **crore**.
   Answer: 100
6. In the Indian system, digits are grouped in a __________ pattern from right to left.
   Answer: 3-2-2-2...
7. In the International system, digits are grouped in a __________ pattern.
   Answer: 3-3-3-3...
8. 10,00,000 is read as __________.
   Answer: Ten lakh
9. The number immediately after 99,999 is __________.
   Answer: 1,00,000
10. 1,00,00,000 is read as __________.
    Answer: One crore
11. One arab is equal to __________ **crores**.
    Answer: 100
12. One lakh is __________ **times** one thousand.
    Answer: 100
13. The approximate population of Chintamani in 2024 given in the chapter is __________.
    Answer: 1,06,000
14. Rounding a number to a value greater than its actual value is called __________.
    Answer: Rounding up
15. 1,000,000 in the International system is called __________.
    Answer: One million

The chapter explicitly establishes the relationships among lakh, crore, million, arab and billion.

B. One-Mark Descriptive Questions:

1. **What is one lakh?**
   Answer: One lakh is 1,00,000, or 1 followed by five zeroes.
2. **How many thousands make one lakh?**
   Answer: 100 thousands make one lakh.
3. **How many lakhs make one crore?**
   Answer: 100 lakhs make one crore.
4. **Write 1 crore in figures.**
   Answer: 1,00,00,000.
5. **What is one million in the Indian system?**
   Answer: One million is equal to ten lakhs.
6. **How are commas placed in the Indian number system?**
   Answer: They are placed using the 3-2-2-2... grouping pattern from right to left.
7. **How are commas placed in the International system?**
   Answer: Digits are grouped in sets of three from right to left.
8. **What is approximation?**
   Answer: Approximation means expressing a number close to its exact value to give a general idea of its size.
9. **What is rounding up?**
   Answer: Rounding up means taking an approximate value greater than the actual number.
10. **What is rounding down?**
    Answer: Rounding down means taking an approximate value less than the actual number.
11. **Write 12,78,830 in words.**
    Answer: Twelve lakh seventy-eight thousand eight hundred thirty.
12. **How many zeroes are there in one arab?**
    Answer: There are nine zeroes in one arab.
13. **What is the nearest lakh to 6,72,85,183?**
    Answer: 6,73,00,000.
14. **What is the relationship between one arab and one billion?**
    Answer: One arab is equal to one billion.
15. **Why do we use commas while writing large numbers?**
    Answer: Commas make large numbers easier to read and identify their place values.

The chapter demonstrates both Indian and International number naming and comma placement.

C. Two-Mark Descriptive Questions:

1. **Differentiate between the Indian and International number systems.**
   Answer:
   - The Indian system uses lakh, crore and arab and follows a 3-2-2-2... grouping pattern.
   - The International system uses thousand, million and billion and follows a 3-3-3... grouping pattern.
2. **Explain the relationship between lakh and crore.**
   Answer:
   - One lakh = 1,00,000.
   - One crore = 100 lakhs = 1,00,00,000.
3. **Why is approximation useful when dealing with large numbers?**
   Answer:
   - It gives us a quick idea of the size of a quantity.
   - Exact values are not necessary in many everyday situations.
4. **When is rounding up more appropriate than rounding down? Give an example.**
   Answer: When enough items must be provided for everyone, rounding up is safer. For example, for 732 people, a principal may order 750 sweets rather than 700.
5. **Express one million and one billion in terms of the Indian system.**
   Answer:
   - One million = 10 lakhs.
   - One billion = 100 crores or 1 arab.
6. **Explain why one lakh may be considered a very large number in some situations but not in others.**
   Answer: One lakh days is an extremely long period, but one lakh hairs can fit on a person's head. Therefore, the perceived size of a number depends on what it represents.
7. **What is the difference between an exact value and an approximate value?**
   Answer: An exact value gives the precise quantity, whereas an approximate value gives a nearby convenient quantity.
8. **Find the increase in Chintamani's population from 75,000 in 2011 to 1,06,000 in 2024.**
   Answer: 1,06,000 − 75,000 = **31,000**.
9. **How can familiar objects help us understand large measurements?**
   Answer: Comparing an unfamiliar large measurement with something familiar helps us visualise its size and understand how many times larger it is.
10. **Why is place value important while reading large numbers?**
    Answer: Place value determines the value represented by each digit and helps us correctly read, write and compare large numbers.

D. Three-Mark Descriptive Questions:

1. **Explain the relationship among thousand, lakh and crore.**
   Answer:

- 1 lakh = 100 thousands = 1,00,000.
- 100 lakhs = 1 crore.
- Therefore, 1 crore = 1,00,00,000.

2. **Explain Indian and International comma placement with an example.**
Answer:
   - In the Indian system, commas follow the 3-2-2... pattern.
   - In the International system, commas follow the 3-3-3... pattern.
   - For example, 9876501234 becomes **9,87,65,01,234** in the Indian system and **9,876,501,234** in the International system.

3. **Why do we need exact values in some situations and approximate values in others?**
Answer:
   - Exact values are required where precision is important.
   - Approximate values are sufficient when we only need an idea of the size of a quantity.
   - For example, a population may be stated approximately, whereas a telephone number must be exact.

4. **Explain the "Land of Tens" activity. What mathematical concept does it develop?**
Answer:
   - Special calculators contain buttons such as +10, +100 and +1000.
   - Students repeatedly press these buttons to form given numbers.
   - The activity develops understanding of place value, number composition and relationships among tens, hundreds and thousands.

5. **Explain how large-number calculations can help us answer real-life questions.**
Answer:
   - We can make reasonable assumptions about a situation.
   - We use multiplication, division or estimation with large numbers.
   - The result helps determine whether a real-life situation is possible or reasonable.

6. **How can you determine whether Mumbai's population could fit into one lakh buses if each bus holds 50 people?**
Answer:
   - 1 lakh buses × 50 people = 50 lakh people.
   - Mumbai's population given in the chapter is more than 1 crore 24 lakh.
   - Therefore, one lakh buses would not be sufficient.

7. **Explain how factorisation and regrouping make multiplication easier.**
Answer:
   - A factor can be rewritten in a convenient form.

- The factors can then be regrouped to simplify calculations.
- For example, multiplication involving 5, 25 or 125 can be related to multiplication by 10, 100 or 1000.

8. **What pattern is observed in the number of digits in products?**
   Answer:
   - Two 1-digit numbers produce a 1- or 2-digit product.
   - Two 2-digit numbers produce a 3- or 4-digit product.
   - Two 3-digit numbers produce a 5- or 6-digit product.

E. Five-Mark Descriptive Questions:

1. Explain the Indian and International systems of numeration with suitable examples.

Answer:

1. The Indian system uses terms such as thousand, lakh, crore and arab.
2. Its digits are grouped in the 3-2-2-2... pattern from right to left.
3. The International system uses thousand, million and billion.
4. Its digits are grouped in sets of three.
5. For example, one crore is written **1,00,00,000** in Indian notation, while the same quantity is **10,000,000**, or ten million, in International notation.

2. Explain rounding and approximation of large numbers and their importance in everyday life.

Answer:

1. Approximation gives a convenient value close to an exact quantity.
2. Rounding up produces an approximate value greater than the actual value.
3. Rounding down produces an approximate value smaller than the actual value.
4. Approximation is useful for populations, distances and other large quantities where an exact value may not be necessary.
5. Exact numbers, however, are necessary in situations where precision is essential.

3. Explain how comparisons help us develop a sense of large numbers.

Answer:

1. Large numbers can be difficult to visualise directly.
2. Comparing them with familiar quantities makes them easier to understand.
3. For example, the chapter compares the height of the Statue of Unity with a building.
4. It also compares large populations with the capacities of buses and ships.
5. Such comparisons develop estimation, reasoning and number sense.

4. Explain how the chapter connects large numbers with real-life facts.

Answer:

1. Large numbers are connected with population data.
2. They are used to describe enormous distances such as the distance between the Earth and Sun.
3. Large quantities are used to discuss the discharge of water by the Amazon River.
4. The chapter also uses large numbers in examples involving blue whales and global plastic waste.
5. These examples demonstrate that large numbers are useful for understanding science, geography, environment and everyday life.

5. Describe how mathematical thought experiments can develop understanding of large numbers.

Answer:

1. A thought experiment begins with an interesting real-life question.
2. Reasonable assumptions are made about the situation.
3. Large-number calculations are performed in manageable stages.
4. The result is compared with the original condition to decide whether it is possible.
5. Questions such as counting one million coins in a day or travelling to the Moon help students develop estimation, logical reasoning and problem-solving skills.

These questions provide a balanced question bank covering **knowledge, understanding, numerical reasoning, application, estimation, place value, number systems and real-life problem solving** appropriate for Grade 7.

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7th Standard Maths Book Chapter 2

Chapter 2: ARITHMETIC EXPRESSIONS

2.1 Summary of the Chapter:

Summary of Chapter 2 – Arithmetic Expressions:

(1) **Arithmetic expressions** are mathematical phrases formed using numbers and operations such as addition (+), subtraction (−), multiplication (×), and division (÷). Every arithmetic expression has a definite **value** obtained by evaluating it.

(2) **Different expressions can have the same value.** For example, $10 + 2$, $15 - 3$, 3×4, and $24 \div 2$all have the value 12. Expressions can also be compared using **=, <, and** > according to their values.

(3) In **complex expressions** containing more than one operation, the order in which operations are performed is important. Mathematical rules, brackets, and the idea of terms help remove ambiguity and ensure that an expression is interpreted correctly.

(4) **Brackets** indicate which part of an expression must be evaluated first. For example, in $30 + (5 \times 4)$, the multiplication inside the brackets is performed first, giving $30 + 20 = 50$.

(5) An expression can be understood as a **sum of terms**. Terms are the parts separated by addition signs; subtraction can be rewritten as addition of the inverse. For example, $83 - 14$can be written as $83 + (-14)$, so its terms are 83 and −14.

(6) In addition, **swapping the terms does not change the sum**. Similarly, grouping terms differently does not change their total. These ideas are known as the **commutative property** and **associative property of addition**.

(7) When an expression contains multiplication or division along with addition, the **individual terms are evaluated first**, and their resulting values are then added. Bracketed expressions are evaluated before the remaining operations.

(8) While **removing brackets**, the sign before the brackets must be carefully considered. If brackets are preceded by a negative sign, the signs of the terms inside change; for example, $500 - (250 - 100) = 500 - 250 + 100$.

(9) If brackets are **not preceded by a negative sign**, the signs of the terms inside remain unchanged. Thus, $28 + (35 - 10)$can be written as $28 + 35 - 10$.

(10) The chapter develops the **distributive property of multiplication over addition and subtraction**. For example, $2 \times (43 + 24) = 2 \times 43 + 2 \times 24$, showing that a multiple of a sum can be written as the sum of the multiples.

(11) The distributive property also provides **efficient strategies for calculation**. For example, 63×18can be viewed as $(53 + 10) \times 18$, while 97×25can be written as $(100 - 3) \times 25$, making calculations easier.

(12) Throughout the chapter, **real-life situations, diagrams, reasoning activities, and "Figure it Out" exercises** are used to develop the ability to form, interpret, compare, simplify, and evaluate arithmetic expressions rather than relying only on mechanical calculation.

2.2 Important Formulas:

Important Formulas and Rules – Chapter 2: Arithmetic Expressions:

The following formulas/rules are useful for solving the quantitative problems in the uploaded chapter.

(1) **Basic Arithmetic Operations**
- Addition: $a + b$
- Subtraction: $a - b = a + (-b)$

- Multiplication: $a \times b$
- Division: $a \div b = \frac{a}{b}$, $b \neq 0$

  The chapter particularly uses the idea that subtraction can be rewritten as addition of the inverse.

(2) Comparison of Expressions

$$A = B,\ A > B,\ A < B$$

Expressions are compared by comparing their values.

(3) Commutative Property of Addition

$$\boxed{a + b = b + a}$$

Swapping the terms does not change their sum.

(4) Associative Property of Addition

$$\boxed{(a + b) + c = a + (b + c)}$$

Changing the grouping of terms does not change their sum.

(5) Addition of Several Terms

$$a + b + c + \cdots$$

Terms in an addition-only expression may be rearranged and grouped conveniently without changing the value.

(6) Brackets – Addition Before a Bracket

$$\boxed{a + (b + c) = a + b + c}$$

$$\boxed{a + (b - c) = a + b - c}$$

When brackets are not preceded by a negative sign, the signs of the terms inside remain unchanged.

(7) Brackets – Subtraction of a Sum

$$\boxed{a - (b + c) = a - b - c}$$

Example:

$$200 - (40 + 3) = 200 - 40 - 3$$

(8) Brackets – Subtraction of a Difference

$$\boxed{a - (b - c) = a - b + c}$$

Example:

$$500 - (250 - 100) = 500 - 250 + 100$$

Thus, when a bracket preceded by a negative sign is removed, the signs of the terms inside change.

(9) Distributive Property of Multiplication over Addition

$$\boxed{a(b + c) = ab + ac}$$

or

$$\boxed{(a + b)c = ac + bc}$$

Example:

$$2(43 + 24) = 2(43) + 2(24)$$

(10) Distributive Property of Multiplication over Subtraction

$$\boxed{a(b - c) = ab - ac}$$

or

$$\boxed{(a - b)c = ac - bc}$$

The chapter summarizes this as: **the multiple of a sum (difference) is the same as the sum (difference) of the multiples.**

11. **Taking a Common Factor**

    The distributive property can also be used in reverse:

$$\boxed{ab + ac = a(b + c)}$$
$$\boxed{ab - ac = a(b - c)}$$

Example:

$$10 \times 98 + 3 \times 98 = (10 + 3) \times 98$$

12. **Convenient Multiplication Using a Nearby Number**

$$\boxed{(a + b)c = ac + bc}$$

and

$$\boxed{(a - b)c = ac - bc}$$

For example:

$$63 \times 18 = (53 + 10) \times 18$$

and

$$97 \times 25 = (100 - 3) \times 25$$

These forms help simplify mental calculations.

Quick Formula Box

$$\boxed{\begin{array}{c} a - b = a + (-b) \\ a + b = b + a \\ (a + b) + c = a + (b + c) \\ a + (b - c) = a + b - c \\ a - (b + c) = a - b - c \\ a - (b - c) = a - b + c \\ a(b + c) = ab + ac \\ a(b - c) = ab - ac \\ ab + ac = a(b + c) \\ ab - ac = a(b - c) \end{array}}$$

These are the **key formulas/properties students should remember and understand** for solving the quantitative and reasoning-based problems in Chapter 2, *Arithmetic Expressions*.

2.3 Fill-Up the Blank LOTS type questions with Answers: (35 Questions)

Fill-in-the-Blank Questions with Answers – LOTS Type:

1. A mathematical phrase containing numbers and operations is called an __________ **expression**.
   Answer: Arithmetic
2. The number obtained after evaluating an arithmetic expression is called its __________.
   Answer: Value
3. The value of $13 + 2$is __________.
   Answer: 15
4. The symbol __________ is used to show that two expressions have the same value.
   Answer: $=$
5. The expression 3×4can be read as the __________ of 3 and 4.
   Answer: Product
6. Expressions can be compared using the signs $=, <$, and __________.
   Answer: $>$
7. In an expression containing brackets, the expression __________ the brackets is evaluated first.
   Answer: Inside

8. The value of $30 + (5 \times 4)$is __________.
   Answer: 50
9. The parts of an expression separated by a +sign are called __________.
   Answer: Terms
10. The expression $83 - 14$can be rewritten as $83 +$__________.
    Answer: (-14)
11. The terms of $83 - 14$are 83 and __________.
    Answer: -14
12. Swapping the terms in addition does not change the __________.
    Answer: Sum
13. The property which states that swapping the terms does not change the sum is called the __________ **property of addition**.
    Answer: Commutative
14. The property which states that grouping the terms differently does not change the sum is called the __________ **property of addition**.
    Answer: Associative
15. $200 - (40 + 3) = 200 - 40 -$__________.
    Answer: 3
16. The value of $100 - (15 + 56)$is ₹__________.
    Answer: 29
17. $500 - (250 - 100) = 500 - 250 +$__________.
    Answer: 100
18. When brackets preceded by a **negative sign** are removed, the signs of the terms inside the brackets __________.
    Answer: Change
19. $2 \times (43 + 24) = 2 \times 43 + 2 \times$__________.
    Answer: 24
20. $4 \times 5 + 3 \times 5 = (4 + 3) \times$__________.
    Answer: 5

Additional LOTS Fill-Ups for Practice

21. $10 \times 98 + 3 \times 98 = (10 + 3) \times$__________.
    Answer: 98
22. $14 \times 10 - 6 \times 10 = (14 - 6) \times$__________.
    Answer: 10
23. The multiple of a sum is equal to the __________ **of the multiples**.
    Answer: Sum
24. The multiple of a difference is equal to the __________ **of the multiples**.
    Answer: Difference
25. $63 \times 18 = (53 + 10) \times 18 = 53 \times 18 + 10 \times$__________.
    Answer: 18
26. If $53 \times 18 = 954$, then $63 \times 18 =$__________.
    Answer: 1134
27. 97×25 can be rewritten as (100 - __) times 25.
    Answer: 3
28. 97 times 25 = 100 - _____ times 25.
    Answer: 3
29. $5 \times (9 - 2) = 5 \times 9 - 5 \times$__________.
    Answer: 2
30. $(5 - 2) \times 7 = 5 \times 7 - 2 \times$__________.
    Answer: 7

These questions are **LOTS (Lower Order Thinking Skills)** because they primarily test **recall, recognition, direct computation, terminology, and straightforward application** of the concepts introduced in Chapter 2.

2.4 Fill-Up the Blank HOTS type questions with Answers: (30 Questions)

Fill-in-the-Blank Questions with Answers – HOTS Type:

1. Without directly evaluating both sides, $1023 + 125 < 1022 +$ _____because the second starting number is 1 less but the added number is 3 more.
   Answer: 128
2. $113 - 25 = 112 -$ _____because decreasing both the starting number and the number subtracted by 1 keeps the difference unchanged.
   Answer: 24
3. If $245 + 289$is compared with $246 + 285$, the greater expression is ___________.
   Answer: $245 + 289$
4. If $273 - 145$and $272 - 144$are compared without lengthy calculation, their relationship is ___________.
   Answer: $273 - 145 = 272 - 144$
5. In the expression $30 + 5 \times 4$, treating 5×4as one term gives the value ___________.
   Answer: 50
6. To represent 30 marbles together with 5 bags containing 4 marbles each unambiguously, the expression can be written as $30 +$___________.
   Answer: (5×4)
7. Irfan pays ₹100 for items costing ₹15 and ₹56. The correct expression for his change is $100 -$___________.
   Answer: $(15 + 56)$
8. If the expression $100 - (15 + 56)$is written without brackets, it becomes ___________.
   Answer: $100 - 15 - 56$
9. Without first evaluating the brackets, $200 - (40 + 3)$can be rewritten as ___________.
   Answer: $200 - 40 - 3$
10. When the brackets are removed from $500 - (250 - 100)$, the equivalent expression is ___________.
    Answer: $500 - 250 + 100$
11. The expression $28 + (35 - 10)$can be rewritten without brackets as ___________ because the brackets are not preceded by a negative sign.
    Answer: $28 + 35 - 10$
12. If $53 + (-16) = 37$, then $54 + (-16) =$___________, without recalculating from the beginning.
    Answer: 38
13. If $53 + (-16) = 37$, then $52 + (-16) =$___________.
    Answer: 36
14. If $53 + (-16) = 37$, then $53 + (-15) =$___________, because $-15$is one more than -16.
    Answer: 38
15. If $53 + (-16) = 37$, then $53 + (-17) =$___________, because $-17$is one less than -16.
    Answer: 36

16. The expression $2 \times (43 + 24)$can be rewritten as $2 \times 43 +$___________, showing that multiplication is distributed over addition.
    Answer: 2×24
17. Four rows of 5 scouts and three rows of 5 guides can be represented as $4 \times 5 + 3 \times 5$, which can be rewritten as ___________.
    Answer: $(4 + 3) \times 5$
18. Without calculating each product separately, $10 \times 98 + 3 \times 98 =$___________ $\times 98$.
    Answer: 13
19. Using the distributive property, $14 \times 10 - 6 \times 10$can be written as ___________.
    Answer: $(14 - 6) \times 10$
20. Given $53 \times 18 = 954$, the product 63×18can be found by adding $10 \times 18$to 954. Therefore, $63 \times 18 =$___________.
    Answer: 1134
21. To calculate 97×25efficiently, 97 can be expressed as $100 -$___________.
    Answer: 3
22. Using the distributive property, $97 \times 25 = 100 \times 25 -$___________.
    Answer: 3×25
23. Without ordinary multiplication, 104×15can be rewritten as $100 \times 15 +$___________.
    Answer: 4×15
24. To make 49×50easier to calculate mentally, it can be rewritten as $50 \times 50 -$___________.
    Answer: 1×50
25. Using the distributive property, $5 \times (9 - 2) = 5 \times 9 -$___________.
    Answer: 5×2
26. If $23 \times (17 - 9)$is expanded correctly, the result is 23×17___________ 23×9.
    Answer: $-$
27. The expressions $(34 - 28) \times 42$and $34 \times 42 - 28 \times 42$have ___________ values.
    Answer: Equal
28. If 33 students are arranged into groups of 5, the situation can be represented as $6 \times 5 +$___________, showing the students left over.
    Answer: 3
29. If four dosas cost ₹23 each and a ₹5 tip is added, the total-cost expression is $4 \times 23 + 5$, whose value is ₹___________.
    Answer: 97
30. An arrangement represented by two identical groups, each containing 5 and 3 objects, can be expressed as $2 \times (5 + 3)$, which is equivalent to $5 \times 2 +$___________.
    Answer: 3×2

These are **HOTS (Higher Order Thinking Skills)** fill-ups because students must **analyse relationships, transform expressions, reason about changes in terms, select equivalent expressions, and apply properties strategically**, rather than merely recall definitions or perform routine calculations.

2.5 One-mark questions with Answers of LOTS Type: (30 Questions)

One-Mark Descriptive Questions with Answers – LOTS Type:

1. **What is an arithmetic expression?**
   Answer: An arithmetic expression is a mathematical phrase involving numbers and arithmetic operations such as addition, subtraction, multiplication, or division.

2. **What is meant by the value of an arithmetic expression?**
   Answer: The value of an arithmetic expression is the number obtained when the expression is evaluated.
3. **What is the value of** $13 + 2$**?**
   Answer: The value of $13 + 2$is **15**.
4. **Which sign is used to show that an expression and its value are equal?**
   Answer: The **equality sign (=)** is used to show that an expression and its value are equal.
5. **Give one expression whose value is 12.**
   Answer: One expression whose value is 12 is 3×4.
6. **Which signs are used to compare arithmetic expressions?**
   Answer: The signs **=, <, and** > are used to compare arithmetic expressions.
7. **What should be evaluated first in an expression containing brackets?**
   Answer: The expression **inside the brackets** should be evaluated first.
8. **Find the value of** $30 + (5 \times 4)$**.**
   Answer: The value of $30 + (5 \times 4)$is **50**.
9. **What are terms in an arithmetic expression?**
   Answer: Terms are the parts of an expression separated by a **'+' sign**.
10. **What are the terms in** $12 + 7$**?**
    Answer: The terms in $12 + 7$are **12 and 7**.
11. **How can** $83 - 14$**be written as a sum of terms?**
    Answer: $83 - 14$can be written as $83 + (-14)$.
12. **What are the terms in** $83 - 14$**?**
    Answer: The terms in $83 - 14$are **83 and −14**.
13. **What happens to the sum when two terms are swapped?**
    Answer: The sum **does not change** when two terms are swapped.
14. **What is the commutative property of addition?**
    Answer: The commutative property states that swapping the terms does not change their sum.
15. **What is the associative property of addition?**
    Answer: The associative property states that changing the grouping of terms does not change their sum.
16. **Does the order of adding terms affect the value of an addition-only expression?**
    Answer: No, adding the terms in any order gives the **same value**.
17. **Write** $200 - (40 + 3)$**without brackets.**
    Answer: $200 - (40 + 3)$can be written as $200 - 40 - 3$.
18. **Find the value of** $200 - (40 + 3)$**.**
    Answer: The value of $200 - (40 + 3)$is **157**.
19. **Write** $100 - (15 + 56)$**without brackets.**
    Answer: $100 - (15 + 56)$can be written as $100 - 15 - 56$.
20. **Find the value of** $100 - (15 + 56)$**.**
    Answer: The value of $100 - (15 + 56)$is **29**.
21. **What happens to the signs of terms when brackets preceded by a negative sign are removed?**
    Answer: The **signs of the terms inside the brackets change** when such brackets are removed.
22. **Write** $500 - (250 - 100)$**without brackets.**
    Answer: $500 - (250 - 100)$can be written as $500 - 250 + 100$.

23. **What happens to the signs inside brackets when the brackets are not preceded by a negative sign?**
    Answer: The signs of the terms **do not change** when the brackets are removed.
24. **Write** $28 + (35 - 10)$**without brackets.**
    Answer: $28 + (35 - 10)$can be written as $28 + 35 - 10$.
25. **State the distributive property of multiplication over addition.**
    Answer: The distributive property over addition is $a(b + c) = ab + ac$.
26. **Express** $2(43 + 24)$**by removing the brackets.**
    Answer: $2(43 + 24)$can be written as $2 \times 43 + 2 \times 24$.
27. **State the distributive property of multiplication over subtraction.**
    Answer: The distributive property over subtraction is $a(b - c) = ab - ac$.
28. **Rewrite** $14 \times 10 - 6 \times 10$**by taking the common factor.**
    Answer: $14 \times 10 - 6 \times 10$can be written as $(14 - 6) \times 10$.
29. **How can** 97×25**be rewritten for easier calculation?**
    Answer: 97×25can be rewritten as $100 \times 25 - 3 \times 25$.
30. **If** $53 \times 18 = 954$**, what is** 63×18**?**
    Answer: $63 \times 18$is **1134**.

These questions are **LOTS (Lower Order Thinking Skills)** and focus mainly on **remembering, understanding, identifying, stating, rewriting, and performing direct calculations** from Chapter 2.

2.6 One-mark questions with Answers of HOTS Type: (30 Questions)

One-Mark Descriptive Questions with Answers – HOTS Type:

1. **Without lengthy calculation, which is greater:** $1023 + 125$**or** $1022 + 128$**?**
   Answer: $1022 + 128$is greater because its first number is 1 less but its added number is 3 more, giving a net advantage of 2.
2. **Why are** $113 - 25$**and** $112 - 24$**equal?**
   Answer: They are equal because both the starting number and the number being subtracted decrease by 1.
3. **Without detailed calculation, compare** $124 + 245$**and** $129 + 245$**.**
   Answer: $129 + 245$is greater because the same number 245 is added to a larger number.
4. **Why can** $30 + 5 \times 4$**represent 30 marbles plus 5 bags of 4 marbles each?**
   Answer: It represents the situation because 5×4gives the marbles in the bags and 30 represents the additional marbles.
5. **Why is** $30 + (5 \times 4)$**equal to 50 rather than 140?**
   Answer: It equals 50 because the bracketed multiplication 5×4must be evaluated before adding 30.
6. **Why is** $100 - (15 + 56)$**appropriate for finding the change from ₹100?**
   Answer: It is appropriate because the total cost of ₹15 and ₹56 must first be combined and then subtracted from ₹100.
7. **Why can** $83 - 14$**be treated as** $83 + (-14)$**?**
   Answer: It can be treated this way because subtracting a number is equivalent to adding its inverse.
8. **If** $6 + (-4) = 2$**, why does** $(-4) + 6$**also equal 2?**
   Answer: It also equals 2 because swapping the terms in addition does not change the sum.
9. **Can the terms of** $(-7) + 10 + (-11)$**be added in a different order without changing the answer? Why?**

Answer: Yes, the terms can be added in any order because changing their order does not change the sum.

10. **If a forgotten number 9055 must be included in a previously calculated sum, is it necessary to add all the numbers again?**
    Answer: No, 9055 can simply be added to the previous sum because terms in addition may be regrouped.
11. **Why does** $4 \times 23 + 5$ **correctly represent the cost of four ₹23 dosas plus a ₹5 tip?**
    Answer: It is correct because 4×23 gives the cost of the dosas and 5 represents the additional tip.
12. **Why does** $6 \times 5 + 3$ **represent 33 students arranged in groups of five?**
    Answer: It represents 33 students because six complete groups contain 30 students and 3 students remain.
13. **Why are brackets necessary in** $2 \times (5 + 3)$**?**
    Answer: The brackets are necessary because the sum $5 + 3$ must be treated as one complete group before multiplying it by 2.
14. **Why does** $200 - (40 + 3)$ **become** $200 - 40 - 3$ **when the brackets are removed?**
    Answer: It becomes $200 - 40 - 3$ because subtracting the sum of 40 and 3 means subtracting both terms.
15. **Why does** $500 - (250 - 100)$ **become** $500 - 250 + 100$**?**
    Answer: The -100 changes to $+100$ because removing brackets preceded by a negative sign changes the signs of the terms inside.
16. **Why does** $28 + (35 - 10)$ **become** $28 + 35 - 10$ **without changing the signs?**
    Answer: The signs remain unchanged because the brackets are not preceded by a negative sign.
17. **If** $53 + (-16) = 37$**, what happens to the value when 53 is replaced by 54?**
    Answer: The value increases by 1 and becomes 38 because one term has increased by 1.
18. **Why is** $2 \times (43 + 24)$ **equal to** $2 \times 43 + 2 \times 24$**?**
    Answer: They are equal because multiplication distributes over each term of the sum.
19. **How can** $4 \times 5 + 3 \times 5$ **be simplified without separately evaluating both products?**
    Answer: It can be simplified as $(4 + 3) \times 5$ by taking 5 as the common factor.
20. **Why is** $10 \times 98 + 3 \times 98$ **equal to** 13×98**?**
    Answer: It equals 13×98 because 10 groups and 3 groups of 98 together make 13 groups of 98.
21. **How can** $14 \times 10 - 6 \times 10$ **be simplified using a common factor?**
    Answer: It can be simplified as $(14 - 6) \times 10$ by taking 10 as the common factor.
22. **Given** $53 \times 18 = 954$**, how can** 63×18 **be found without multiplying from the beginning?**
    Answer: Add $10 \times 18 = 180$ to 954 to obtain $63 \times 18 = 1134$.
23. **Why is rewriting** 97×25 **as** $(100 - 3) \times 25$ **useful?**
    Answer: It is useful because multiplication by 100 is easier and the unwanted 3×25 can then be subtracted.
24. **Without evaluating both expressions fully, are** $(34 - 28) \times 42$ **and** $34 \times 42 - 28 \times 42$ **equal? Why?**
    Answer: Yes, they are equal because multiplication distributes over subtraction.
25. **Why is** $23 \times (17 - 9)$ **not equal to** $23 \times 17 + 23 \times 9$**?**
    Answer: They are not equal because multiplication over a difference requires subtraction, giving $23 \times 17 - 23 \times 9$.

26. **Which is greater,** $15 + 9 \times 18$**or** $(15 + 9) \times 18$**, and why?**
    Answer: $(15 + 9) \times 18$is greater because both 15 and 9 are effectively multiplied by 18 rather than only 9.
27. **How can** 95×8**be rewritten to make mental calculation easier?**
    Answer: It can be rewritten as $100 \times 8 - 5 \times 8$using the distributive property.
28. **How can** 104×15**be rewritten for quicker calculation?**
    Answer: It can be rewritten as $100 \times 15 + 4 \times 15$using the distributive property.
29. **How can** 49×50**be rewritten for easier mental calculation?**
    Answer: It can be rewritten as $50 \times 50 - 1 \times 50$by expressing 49 as $50 - 1$.
30. **Why is** $5 \times (4 + 3)$**not equal to** $5 \times 4 + 3$**?**
    Answer: They are not equal because in $5 \times (4 + 3)$, 5 multiplies both 4 and 3, while in $5 \times 4 + 3$, it multiplies only 4.

These **HOTS one-mark questions** require students to give a **brief one-sentence answer based on comparison, reasoning, interpretation, equivalence, bracket manipulation, or efficient calculation**, rather than simply recalling a definition.

2.7 Two-mark questions with Answers of LOTS Type: (25 Questions)

Two-Mark Descriptive Questions with Answers – LOTS Type:

1. What is an arithmetic expression? Give one example.

Answer:

1. An arithmetic expression is a mathematical phrase containing numbers and arithmetic operations.
2. For example, $13 + 2$is an arithmetic expression whose value is 15.

2. How can two arithmetic expressions be compared? Give an example.

Answer:

1. Arithmetic expressions are compared according to their values using $=$, $<$, or $>$.
2. For example, $10 + 2 > 7 + 1$because 12 is greater than 8.

3. Why are brackets used in arithmetic expressions?

Answer:

1. Brackets are used to specify clearly which part of an expression must be evaluated first.
2. For example, in $30 + (5 \times 4)$, $5 \times 4$is evaluated before adding 30.

4. What are terms in an arithmetic expression? Identify the terms in $12 + 7$**.**

Answer:

1. Terms are the parts of an expression separated by a $+$sign.
2. The terms in $12 + 7$are **12 and 7**.

5. Write $83 - 14$**as a sum of terms and identify its terms.**

Answer:

1. $83 - 14$can be written as $83 + (-14)$.
2. Therefore, its terms are **83 and −14**.

6. Explain the commutative property of addition with an example.

Answer:

1. The commutative property states that swapping the terms does not change their sum.
2. For example, $6 + (-4) = (-4) + 6 = 2$.

7. What is the associative property of addition?

Answer:

1. The associative property states that changing the grouping of terms does not change their sum.
2. Thus, three or more terms can be grouped conveniently while adding them.

8. How are expressions containing multiplication and addition evaluated using terms?
Answer:
1. The individual terms containing multiplication are evaluated first.
2. The resulting values of all the terms are then added together.

9. Four dosas cost ₹23 each and a ₹5 tip is given; write and evaluate the expression for the total amount.
Answer:
1. The required expression is $4 \times 23 + 5$.
2. Its value is $92 + 5 =$ ₹97.

10. How does the expression $6 \times 5 + 3$ represent 33 students?
Answer:
1. Six groups of five students contain $6 \times 5 = 30$ students.
2. Adding the remaining 3 students gives $30 + 3 = 33$.

11. Remove the brackets from $200 - (40 + 3)$ and find its value.
Answer:
1. Removing the brackets gives $200 - 40 - 3$.
2. Therefore, the value is $160 - 3 = 157$.

12. Find the change obtained from ₹100 after purchasing items costing ₹15 and ₹56.
Answer:
1. The required expression is $100 - (15 + 56) = 100 - 15 - 56$.
2. Therefore, the change received is **₹29**.

13. Remove the brackets from $500 - (250 - 100)$ and find its value.
Answer:
1. Removing the brackets gives $500 - 250 + 100$.
2. Therefore, the value of the expression is **350**.

14. What happens when brackets preceded by a negative sign are removed? Give an example.
Answer:
1. When such brackets are removed, the signs of the terms inside the brackets change.
2. For example, $500 - (250 - 100) = 500 - 250 + 100$.

15. Remove the brackets from $28 + (35 - 10)$ and find its value.
Answer:
1. Since the brackets are not preceded by a negative sign, it becomes $28 + 35 - 10$.
2. Therefore, its value is **53**.

16. Explain the distributive property of multiplication over addition with an example.
Answer:
1. The distributive property states that $a(b + c) = ab + ac$.
2. For example, $2(43 + 24) = 2 \times 43 + 2 \times 24$.

17. Express $4 \times 5 + 3 \times 5$ using a common factor and find its value.
Answer:
1. Taking 5 as the common factor gives $(4 + 3) \times 5$.
2. Therefore, $7 \times 5 = 35$.

18. Explain the distributive property of multiplication over subtraction with an example.
Answer:
1. The property can be written as $a(b - c) = ab - ac$.
2. For example, $14 \times 10 - 6 \times 10 = (14 - 6) \times 10$.

19. Given $53 \times 18 = 954$, find 63×18 using the method given in the chapter.
Answer:

1. $63 \times 18 = (53 + 10) \times 18 = 954 + 180$.
2. Therefore, $63 \times 18 = 1134$.

20. Show how 97×25can be rewritten for easier calculation.
Answer:

1. Write 97as $100 - 3$, giving $(100 - 3) \times 25$.
2. Using distribution, this becomes $100 \times 25 - 3 \times 25$.

21. Find 95×8using the distributive method.
Answer:

1. $95 \times 8 = (100 - 5) \times 8 = 100 \times 8 - 5 \times 8$.
2. Therefore, $95 \times 8 = 800 - 40 = 760$.

22. Find 104×15using a convenient expression.
Answer:

1. $104 \times 15 = (100 + 4) \times 15 = 100 \times 15 + 4 \times 15$.
2. Therefore, $104 \times 15 = 1500 + 60 = 1560$.

23. Find 49×50using a convenient expression.
Answer:

1. $49 \times 50 = (50 - 1) \times 50 = 50 \times 50 - 1 \times 50$.
2. Therefore, $49 \times 50 = 2500 - 50 = 2450$.

24. Expand $5 \times (9 - 2)$using the distributive property.
Answer:

1. $5 \times (9 - 2) = 5 \times 9 - 5 \times 2$.
2. Therefore, the expression has the value $45 - 10 = 35$.

25. Expand $(5 - 2) \times 7$using the distributive property.
Answer:

1. $(5 - 2) \times 7 = 5 \times 7 - 2 \times 7$.
2. Therefore, the expression has the value $35 - 14 = 21$.

2.8. Two-mark questions with Answers of HOTS Type: (25 Questions)

Two-Mark Descriptive Questions with Answers – HOTS Type:
1. Without fully calculating, compare $1023 + 125$and $1022 + 128$. Explain your reasoning.
Answer:

1. The second expression starts with 1 less but adds 3 more than the first expression.
2. Hence, $1022 + 128$is greater than $1023 + 125$by 2.

2. Explain why $113 - 25$and $112 - 24$have the same value without evaluating them separately.
Answer:

1. In the second expression, both the starting number and the number being subtracted are reduced by 1.
2. Therefore, the difference remains unchanged and $113 - 25 = 112 - 24$.

3. Mallesh evaluates $30 + 5 \times 4$as 50, while Purna gets 140; explain why Mallesh's interpretation is correct in the given situation.
Answer:

1. Five bags containing four marbles each contribute $5 \times 4 = 20$marbles, which must be combined with the 30 marbles.
2. Therefore, the situation is $30 + (5 \times 4) = 50$, not $(30 + 5) \times 4 = 140$.

4. Why is $100 - (15 + 56)$more appropriate than $100 - 15 + 56$for finding the change from ₹100?
Answer:

1. The costs ₹15 and ₹56 must both be deducted from the ₹100 paid.
2. Hence, $100 - (15 + 56) = 29$, whereas adding ₹56 after subtracting ₹15 does not represent the situation.

5. Explain why $6 + (-4)$**and** $(-4) + 6$**have the same value.**

Answer:

1. Swapping the two terms of an addition does not change their sum.
2. Therefore, by the commutative property, $6 + (-4) = (-4) + 6 = 2$.

6. Manasa obtained 11,749 after adding several numbers but forgot to include 9,055; does she need to start the addition again? Explain.

Answer:

1. No, she can add the forgotten number directly to her previously obtained total because terms can be regrouped in addition.
2. Her corrected total is $11{,}749 + 9{,}055 = 20{,}804$.

7. Thirty-three students are playing a grouping game; explain how $6 \times 5 + 3$**represents their arrangement when groups of five are formed.**

Answer:

1. Six complete groups of five account for $6 \times 5 = 30$students.
2. The remaining 3 students are added, giving $6 \times 5 + 3 = 33$.

8. Explain why $5 \times 2 + 3$**and** $2 \times (5 + 3)$**need not describe the same arrangement.**

Answer:

1. $5 \times 2 + 3$means two groups of 5 with 3 additional objects.
2. $2 \times (5 + 3)$means two complete groups, each containing $5 + 3$objects.

9. Explain why $200 - (40 + 3)$**becomes** $200 - 40 - 3$**when the brackets are removed.**

Answer:

1. Subtracting $40 + 3$from 200 means that both 40 and 3 must be taken away.
2. Therefore, $200 - (40 + 3) = 200 - 40 - 3 = 157$.

10. Why is $500 - (250 - 100)$**equal to** $500 - 250 + 100$**and not** $500 - 250 - 100$**?**

Answer:

1. The negative sign before the brackets changes the signs of both terms inside when the brackets are removed.
2. Hence, $-(250 - 100) = -250 + 100$, giving $500 - 250 + 100 = 350$.

11. Compare the effect of removing brackets in $28 + (35 - 10)$**and** $500 - (250 - 100)$**.**

Answer:

1. In $28 + (35 - 10)$, the signs remain unchanged because the brackets are not preceded by a negative sign.
2. In $500 - (250 - 100)$, the signs inside change, giving $500 - 250 + 100$.

12. If $53 + (-16) = 37$**, find** $54 + (-16)$**and explain without starting the calculation again.**

Answer:

1. The first term has increased from 53 to 54, while the other term remains unchanged.
2. Therefore, the value also increases by 1, from 37 to **38**.

13. Explain why $2 \times (43 + 24)$**and** $2 \times 43 + 2 \times 24$**have the same value.**

Answer:

1. Multiplying the complete sum by 2 is equivalent to multiplying each term of the sum by 2.
2. Therefore, $2(43 + 24) = 2 \times 43 + 2 \times 24$by the distributive property.

14. Show how $4 \times 5 + 3 \times 5$**can be calculated more efficiently.**

Answer:

1. Since both terms contain the common factor 5, the expression can be written as $(4+3)\times 5$.
2. Thus, $7\times 5=35$, avoiding two separate multiplications.

15. Explain why $10\times 98+3\times 98$ **can be written as** 13×98**.**

Answer:

1. The expression represents 10 groups of 98 together with another 3 groups of 98.
2. Hence, there are $10+3=13$ groups altogether, so the expression becomes 13×98.

16. How can $14\times 10-6\times 10$ **be simplified using reasoning rather than two separate multiplications?**

Answer:

1. Since 10 is common to both products, it can be written as $(14-6)\times 10$.
2. Therefore, the value is $8\times 10=80$.

17. Given $53\times 18=954$**, find** 63×18 **without performing the complete multiplication.**

Answer:

1. Since $63=53+10$, $63\times 18=53\times 18+10\times 18$.
2. Therefore, $954+180=1134$.

18. Suggest an efficient method to calculate 97×25 **and explain why it works.**

Answer:

1. Rewrite 97 as $100-3$, so $97\times 25=100\times 25-3\times 25$.
2. Therefore, the product is $2500-75=2425$.

19. Without using the standard multiplication procedure, find 104×15**.**

Answer:

1. Rewrite 104 as $100+4$, giving $104\times 15=100\times 15+4\times 15$.
2. Therefore, $1500+60=1560$.

20. Without fully evaluating both sides, determine whether $(34-28)\times 42$ **and** $34\times 42-28\times 42$ **are equal.**

Answer:

1. The distributive property states that multiplying a difference by a number equals the difference of the corresponding products.
2. Hence, $(34-28)\times 42=34\times 42-28\times 42$.

21. Explain why $23\times(17-9)$ **is not equal to** $23\times 17+23\times 9$**.**

Answer:

1. Since the expression inside the brackets is a difference, the products must also be subtracted.
2. The correct expansion is $23\times 17-23\times 9$, not $23\times 17+23\times 9$.

22. Which is greater: $15+9\times 18$ **or** $(15+9)\times 18$**? Explain without lengthy calculation.**

Answer:

1. In the first expression only 9 is multiplied by 18, whereas in the second both 15 and 9 contribute to the quantity multiplied by 18.
2. Therefore, $(15+9)\times 18$ is greater.

23. Find 95×8 **using a convenient nearby number and explain the method.**

Answer:

1. Since $95=100-5$, write $95\times 8=100\times 8-5\times 8$.
2. Therefore, $800-40=760$.

24. Find 49×50 **mentally by transforming the expression.**

Answer:

1. Since $49=50-1$, write $49\times 50=50\times 50-1\times 50$.
2. Therefore, $2500-50=2450$.

25. Explain why $5 \times (4 + 3) \neq 5 \times 4 + 3$.
Answer:
1. In $5 \times (4 + 3)$, 5 multiplies the entire sum and therefore multiplies both 4 and 3.
2. Thus, its equivalent form is $5 \times 4 + 5 \times 3$, not $5 \times 4 + 3$.

2.9. Three-mark questions with Answers of LOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers – LOTS Type:
Each answer is presented in three clear stages/steps.
1. Evaluate $30 + 5 \times 4$**by identifying its terms.**
Answer:
Stage 1: The terms of the expression are $30$and 5×4.
Stage 2: Evaluate the multiplication term: $5 \times 4 = 20$.
Stage 3: Add the terms: $30 + 20 = \boxed{50}$.
2. Irfan buys biscuits for ₹15 and toor dal for ₹56 and pays ₹100. Find the change he receives.
Answer:
Stage 1: Total cost of the items $= 15 + 56 =$ ₹71.
Stage 2: The expression for the change is $100 - (15 + 56)$.
Stage 3: Therefore, change $= 100 - 71 = \boxed{₹29}$.
3. Write $83 - 14$**as a sum of terms, identify the terms, and evaluate it.**
Answer:
Stage 1: Rewrite subtraction as addition: $83 - 14 = 83 + (-14)$.
Stage 2: The terms are $83$and -14.
Stage 3: Therefore, $83 + (-14) = \boxed{69}$.
4. Evaluate $28 - 7 + 8$**by writing it as a sum of terms.**
Answer:
Stage 1: Rewrite the expression as $28 + (-7) + 8$.
Stage 2: Add the first two terms: $28 + (-7) = 21$.
Stage 3: Therefore, $21 + 8 = \boxed{29}$.
5. Four friends order four dosas costing ₹23 each and give a ₹5 tip. Find the total amount paid.
Answer:
Stage 1: Cost of four dosas $= 4 \times 23 =$ ₹92.
Stage 2: Add the tip: $92 + 5$.
Stage 3: Therefore, the total amount paid is $\boxed{₹97}$.
6. There are 33 students in a game and they form groups of five. Explain the expression $6 \times 5 + 3$.
Answer:
Stage 1: Six complete groups contain $6 \times 5 = 30$students.
Stage 2: There are 3 students remaining outside the complete groups.
Stage 3: Therefore, the total number of students is $30 + 3 = \boxed{33}$.
7. Raghu buys 100 kg of rice and packs it into 2 kg packets; he already has four such packets. Find the total number of packets.
Answer:
Stage 1: Number of new packets $= 100 \div 2 = 50$.
Stage 2: Add the 4 packets he already has: $4 + 50$.
Stage 3: Therefore, Raghu has $\boxed{54}$packets altogether.

8. Remove the brackets and evaluate $200 - (40 + 3)$.
Answer:
Stage 1: Removing the brackets gives $200 - 40 - 3$.
Stage 2: Calculate $200 - 40 = 160$.
Stage 3: Therefore, $160 - 3 = \boxed{157}$.
9. Remove the brackets and evaluate $500 - (250 - 100)$.
Answer:
Stage 1: The negative sign before the brackets changes the signs inside, giving $500 - 250 + 100$.
Stage 2: Calculate $500 - 250 = 250$.
Stage 3: Therefore, $250 + 100 = \boxed{350}$.
10. Hira has 28 coins in one bag and 35 in another and gives away 10 coins from the second bag. Find how many coins remain.
Answer:
Stage 1: The situation is represented by $28 + (35 - 10)$.
Stage 2: Remove the brackets to get $28 + 35 - 10$.
Stage 3: Therefore, the number of coins left is $63 - 10 = \boxed{53}$.
11. Two friends each order a vegetable cutlet costing ₹43 and a rasgulla costing ₹24. Find their total bill.
Answer:
Stage 1: The cost for one person is $43 + 24 =$ ₹67.
Stage 2: For two people, the expression is $2 \times (43 + 24)$.
Stage 3: Therefore, the total bill is $2 \times 67 = \boxed{₹134}$.
12. Find the total number of children when 4 rows of 5 scouts and 3 rows of 5 guides march together.
Answer:
Stage 1: Number of scouts $= 4 \times 5 = 20$and guides $= 3 \times 5 = 15$.
Stage 2: The total is represented by $4 \times 5 + 3 \times 5$.
Stage 3: Therefore, $20 + 15 = \boxed{35}$children are marching.
13. Use the distributive property to evaluate $10 \times 98 + 3 \times 98$.
Answer:
Stage 1: Take 98 as the common factor: $(10 + 3) \times 98$.
Stage 2: Simplify the bracket: 13×98.
Stage 3: Therefore, the value is $\boxed{1274}$.
14. Use the distributive property to evaluate $14 \times 10 - 6 \times 10$.
Answer:
Stage 1: Take 10 as the common factor: $(14 - 6) \times 10$.
Stage 2: Simplify the bracket: 8×10.
Stage 3: Therefore, the value is $\boxed{80}$.
15. Given $53 \times 18 = 954$, find 63×18using the distributive property.
Answer:
Stage 1: Write $63 = 53 + 10$, so $63 \times 18 = (53 + 10) \times 18$.
Stage 2: Distribute: $53 \times 18 + 10 \times 18 = 954 + 180$.
Stage 3: Therefore, $63 \times 18 = \boxed{1134}$.
16. Find 97×25using a convenient arithmetic expression.
Answer:
Stage 1: Write $97 = 100 - 3$, so $97 \times 25 = (100 - 3) \times 25$.

Stage 2: Distribute to get $100 \times 25 - 3 \times 25 = 2500 - 75$.
Stage 3: Therefore, $97 \times 25 = \boxed{2425}$.
17. Find 95×8**using the distributive property.**
Answer:
Stage 1: Write $95 = 100 - 5$, so $95 \times 8 = (100 - 5) \times 8$.
Stage 2: Expand it as $100 \times 8 - 5 \times 8 = 800 - 40$.
Stage 3: Therefore, $95 \times 8 = \boxed{760}$.
18. Find 104×15**using the distributive property.**
Answer:
Stage 1: Write $104 = 100 + 4$, so $104 \times 15 = (100 + 4) \times 15$.
Stage 2: Expand it as $100 \times 15 + 4 \times 15 = 1500 + 60$.
Stage 3: Therefore, $104 \times 15 = \boxed{1560}$.
19. Find 49×50**using a convenient nearby number.**
Answer:
Stage 1: Write $49 = 50 - 1$, so $49 \times 50 = (50 - 1) \times 50$.
Stage 2: Expand it as $50 \times 50 - 1 \times 50 = 2500 - 50$.
Stage 3: Therefore, $49 \times 50 = \boxed{2450}$.
20. Expand and evaluate $5 \times (9 - 2)$**.**
Answer:
Stage 1: Apply the distributive property: $5 \times (9 - 2) = 5 \times 9 - 5 \times 2$.
Stage 2: Evaluate the products: $45 - 10$.
Stage 3: Therefore, the value is $\boxed{35}$.

2.10. Three-mark questions with Answers of HOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers – HOTS Type:
Each answer involves at least three stages of reasoning, comparison, transformation, or application.
1. Without directly adding both expressions, determine which is greater: $1023 + 125$**or** $1022 + 128$**. Explain your reasoning.**
Answer:
Step 1: Compare the first terms: 1022 is 1 less than 1023.
Step 2: Compare the second terms: 128 is 3 more than 125.
Step 3: The increase of 3 is greater than the decrease of 1, giving a net increase of 2.
Conclusion: Therefore, $\boxed{1022 + 128 > 1023 + 125}$.
2. Show without separate lengthy calculations why $113 - 25$**and** $112 - 24$**have the same value.**
Answer:
Step 1: In $112 - 24$, the first number is 1 less than 113.
Step 2: The number being subtracted is also 1 less than 25.
Step 3: Reducing both numbers by the same amount keeps their difference unchanged.
Conclusion: Hence, $\boxed{113 - 25 = 112 - 24}$.
3. Two students interpret $30 + 5 \times 4$**as 50 and 140 respectively; decide which interpretation matches 30 marbles plus five bags of four marbles each.**
Answer:
Step 1: Five bags containing four marbles each give $5 \times 4 = 20$marbles.
Step 2: These 20 marbles are added to the 30 separate marbles.
Step 3: Thus, the required expression is $30 + (5 \times 4) = 30 + 20$.
Conclusion: Therefore, the correct value is $\boxed{50}$, not 140.

4. Irfan has ₹100 and buys two items costing ₹15 and ₹56; explain why $100 - (15 + 56)$ **correctly represents his change.**
Answer:
Step 1: Both purchases together cost $15 + 56 = ₹71$.
Step 2: The entire ₹71 must be deducted from the ₹100 paid, so the expression is $100 - (15 + 56)$.
Step 3: Evaluate it as $100 - 71 = 29$.
Conclusion: Irfan receives $\boxed{₹29}$ as change.
5. Explain how the commutative and associative properties can make the addition of several terms easier.
Answer:
Step 1: The commutative property allows the terms to be rearranged without changing the sum.
Step 2: The associative property allows the rearranged terms to be grouped conveniently.
Step 3: Convenient pairs or groups can then be added first to simplify the calculation.
Conclusion: Thus, rearranging and regrouping terms can make a long addition easier without changing its value.
6. A student writes $200 - (40 + 3) = 200 - 40 + 3$**; identify the error and correct the expression.**
Answer:
Step 1: The bracket contains the sum $40 + 3$, and the whole sum is being subtracted from 200.
Step 2: Therefore, both 40 and 3 must be subtracted when the brackets are removed.
Step 3: The correct expression is $200 - 40 - 3 = 157$.
Conclusion: The student's error is changing -3 into $+3$; the correct answer is $\boxed{157}$.
7. A student removes the brackets in $500 - (250 - 100)$ **as** $500 - 250 - 100$**; analyse and correct the mistake.**
Answer:
Step 1: The brackets are preceded by a negative sign.
Step 2: When the brackets are removed, $+250$ becomes -250 and -100 becomes $+100$.
Step 3: Hence, $500 - (250 - 100) = 500 - 250 + 100 = 350$.
Conclusion: The correct value is $\boxed{350}$.
8. Compare the removal of brackets in $28 + (35 - 10)$ **and** $500 - (250 - 100)$**. What rule can you infer?**
Answer:
Step 1: $28 + (35 - 10)$ becomes $28 + 35 - 10$, so the signs inside remain unchanged.
Step 2: $500 - (250 - 100)$ becomes $500 - 250 + 100$, so the signs inside change.
Step 3: The difference occurs because the second bracket is preceded by a negative sign.
Conclusion: A negative sign before brackets changes the signs inside, while a positive sign does not.
9. If $53 + (-16) = 37$**, predict** $54 + (-16)$**,** $52 + (-16)$**, and** $53 + (-15)$ **without calculating each expression from the beginning.**
Answer:
Step 1: Increasing 53 by 1 increases the value by 1, so $54 + (-16) = 38$.
Step 2: Decreasing 53 by 1 decreases the value by 1, so $52 + (-16) = 36$.
Step 3: Changing -16 to -15 increases that term by 1, so $53 + (-15) = 38$.
Conclusion: The respective values are $\boxed{38, 36, 38}$.
10. Show why $2 \times (43 + 24)$ **and** $2 \times 43 + 2 \times 24$ **are equivalent.**
Answer:

Step 1: In $2 \times (43 + 24)$, the entire sum $43 + 24$is multiplied by 2.
Step 2: By the distributive property, 2 can multiply each term separately, giving $2 \times 43 + 2 \times 24$.
Step 3: Both forms give $86 + 48 = 134$.
Conclusion: Hence, $\boxed{2(43 + 24) = 2 \times 43 + 2 \times 24}$.

11. Scouts stand in 4 rows of 5 and guides in 3 rows of 5; use an arithmetic property to find the total efficiently.
Answer:
Step 1: The total is represented by $4 \times 5 + 3 \times 5$.
Step 2: Since 5 is common, apply the distributive property in reverse: $(4 + 3) \times 5$.
Step 3: Calculate $7 \times 5 = 35$.
Conclusion: Therefore, there are $\boxed{35}$children altogether.

12. Simplify $10 \times 98 + 3 \times 98$**without carrying out two separate multiplications. Explain the property used.**
Answer:
Step 1: Observe that 98 is a common factor in both terms.
Step 2: Factor out 98 to get $(10 + 3) \times 98 = 13 \times 98$.
Step 3: Calculate $13 \times 98 = 1274$.
Conclusion: The value is $\boxed{1274}$, obtained using the distributive property.

13. Simplify $14 \times 10 - 6 \times 10$**without evaluating the two products separately.**
Answer:
Step 1: Identify 10 as the common factor in both terms.
Step 2: Apply the distributive property in reverse to obtain $(14 - 6) \times 10$.
Step 3: Calculate $8 \times 10 = 80$.
Conclusion: Therefore, the expression has value $\boxed{80}$.

14. Given $53 \times 18 = 954$**, determine** 63×18**without performing standard multiplication.**
Answer:
Step 1: Notice that $63 = 53 + 10$.
Step 2: Therefore, $63 \times 18 = (53 + 10) \times 18 = 53 \times 18 + 10 \times 18$.
Step 3: Substitute the known value: $954 + 180 = 1134$.
Conclusion: Hence, $\boxed{63 \times 18 = 1134}$.

15. Devise a quick method to calculate 97×25**using a nearby round number.**
Answer:
Step 1: Express 97 as $100 - 3$.
Step 2: Apply the distributive property: $(100 - 3) \times 25 = 100 \times 25 - 3 \times 25$.
Step 3: Calculate $2500 - 75 = 2425$.
Conclusion: Therefore, $\boxed{97 \times 25 = 2425}$.

16. Find 104×15**mentally by transforming 104 into a convenient expression.**
Answer:
Step 1: Express 104as $100 + 4$.
Step 2: Use distribution: $(100 + 4) \times 15 = 100 \times 15 + 4 \times 15$.
Step 3: Calculate $1500 + 60 = 1560$.
Conclusion: Hence, $\boxed{104 \times 15 = 1560}$.

17. Find 49×50**mentally without using long multiplication.**
Answer:
Step 1: Express 49 as $50 - 1$.
Step 2: Write $(50 - 1) \times 50 = 50 \times 50 - 1 \times 50$.

Step 3: Calculate $2500 - 50 = 2450$.
Conclusion: Therefore, $\boxed{49 \times 50 = 2450}$.
18. Determine whether $(34 - 28) \times 42$**and** $34 \times 42 - 28 \times 42$**are equivalent without evaluating both completely.**
Answer:
Step 1: The first expression has 42 multiplying the difference $34 - 28$.
Step 2: By the distributive property, 42 can multiply both 34 and 28 separately.
Step 3: This gives $34 \times 42 - 28 \times 42$.
Conclusion: Therefore, the two expressions are $\boxed{\text{equivalent}}$.
19. A student claims $23 \times (17 - 9) = 23 \times 17 + 23 \times 9$**; analyse the claim and correct it.**
Answer:
Step 1: The operation inside the brackets is subtraction, not addition.
Step 2: Multiplication distributes over the difference as $23 \times 17 - 23 \times 9$.
Step 3: Thus, the plus sign used by the student must be replaced by a minus sign.
Conclusion: The correct form is $\boxed{23(17 - 9) = 23 \times 17 - 23 \times 9}$.
20. Compare $15 + 9 \times 18$**and** $(15 + 9) \times 18$**without performing full multiplication.**
Answer:
Step 1: In $15 + 9 \times 18$, only 9 is multiplied by 18.
Step 2: In $(15 + 9) \times 18$, both 15 and 9 contribute to the quantity multiplied by 18.
Step 3: The second expression therefore contains an additional contribution equivalent to $15 \times 18 - 15$.
Conclusion: Hence, $\boxed{(15 + 9) \times 18 > 15 + 9 \times 18}$.

2.11 Five-mark questions with Answers of LOTS Type: (12 Questions)

Five-Mark Descriptive Questions with Answers – LOTS Type:
Each answer contains five clear sentences/points suitable for a 5-mark question.
1. Explain arithmetic expressions, their values, and the role of brackets with suitable examples.
Answer:
1. An **arithmetic expression** is formed using numbers and arithmetic operations such as addition, subtraction, multiplication, and division.
2. The **value of an expression** is the number obtained after evaluating the expression.
3. Different arithmetic expressions can have the same value and can be compared using the symbols $=$, $<$, and $>$.
4. **Brackets** are used to indicate which part of a complex expression should be evaluated first.
5. For example, $30 + (5 \times 4) = 30 + 20 = 50$, where the expression inside the brackets is evaluated first.

2. Explain terms in an arithmetic expression and show how subtraction can be expressed as addition.
Answer:
1. An arithmetic expression can be viewed as being made up of different **terms**.
2. Subtraction can be rewritten as the addition of the inverse of a number.
3. For example, $83 - 14$can be rewritten as $83 + (-14)$.
4. Therefore, the terms of $83 - 14$are **83 and** -14.
5. Writing expressions as sums of terms helps us understand and manipulate arithmetic expressions more easily.

3. Explain the commutative and associative properties of addition and their usefulness.

Answer:
1. The **commutative property of addition** states that swapping two terms does not change their sum.
2. For example, $6 + (-4) = (-4) + 6$.
3. The **associative property of addition** states that changing the grouping of terms does not change their sum.
4. Hence, several terms in an addition expression can be rearranged and grouped conveniently.
5. These properties make calculations easier by allowing us to add convenient numbers or groups first.

4. Explain how brackets are removed when a sum is subtracted, using $200 - (40 + 3)$and $100 - (15 + 56)$.

Answer:
1. When a sum inside brackets is subtracted, each term inside the brackets is subtracted separately.
2. Thus, $200 - (40 + 3)$can be rewritten as $200 - 40 - 3$.
3. Its value is $200 - 40 - 3 = 157$.
4. Similarly, $100 - (15 + 56)$becomes $100 - 15 - 56$.
5. Therefore, $100 - (15 + 56) = 29$, showing that both terms inside the brackets are subtracted.

5. Explain how signs change when brackets preceded by a negative sign are removed.

Answer:
1. A negative sign before brackets affects all the terms contained inside the brackets.
2. When such brackets are removed, the signs of the terms inside are changed.
3. For example, $500 - (250 - 100)$becomes $500 - 250 + 100$.
4. Evaluating the expression gives $500 - 250 + 100 = 350$.
5. Thus, a positive term becomes negative and a negative term becomes positive when brackets preceded by a negative sign are removed.

6. Explain what happens when brackets are removed from $28 + (35 - 10)$and compare it with brackets preceded by a negative sign.

Answer:
1. In $28 + (35 - 10)$, the brackets are not preceded by a negative sign.
2. Therefore, the signs of the terms inside the brackets remain unchanged.
3. The expression becomes $28 + 35 - 10$.
4. Its value is $63 - 10 = 53$.
5. This differs from brackets preceded by a negative sign, where the signs of the terms inside are changed.

7. Explain the distributive property of multiplication over addition with a suitable example.

Answer:
1. The **distributive property** allows a number outside brackets to multiply each term inside the brackets.
2. In $2 \times (43 + 24)$, the number 2 multiplies both 43 and 24.
3. Therefore, $2 \times (43 + 24) = 2 \times 43 + 2 \times 24$.
4. This gives $86 + 48 = 134$.
5. Thus, a multiple of a sum is the same as the sum of the corresponding multiples.

8. Explain how the distributive property can be used in reverse to simplify $4 \times 5 + 3 \times 5$.

Answer:
1. In $4 \times 5 + 3 \times 5$, the number 5 is a common factor in both terms.
2. The common factor 5 can be taken outside the brackets.

3. Therefore, $4 \times 5 + 3 \times 5 = (4 + 3) \times 5$.
4. Simplifying gives $7 \times 5 = 35$.
5. Hence, using a common factor provides a convenient way to simplify the expression.

9. Explain the distributive property over subtraction using $14 \times 10 - 6 \times 10$.
Answer:
1. The distributive property can be applied to a **difference** as well as to a sum.
2. In $14 \times 10 - 6 \times 10$, 10 is the common factor.
3. Therefore, the expression can be written as $(14 - 6) \times 10$.
4. Simplifying gives $8 \times 10 = 80$.
5. Thus, a multiple of a difference is equal to the difference of the corresponding multiples.

10. Given $53 \times 18 = 954$, explain how to find 63×18using the distributive property.
Answer:
1. Write 63 as $53 + 10$.
2. Therefore, $63 \times 18 = (53 + 10) \times 18$.
3. Using the distributive property, this becomes $53 \times 18 + 10 \times 18$.
4. Substituting the known value gives $954 + 180$.
5. Hence, $63 \times 18 = \boxed{1134}$.

11. Explain how 97×25can be calculated efficiently using the distributive property.
Answer:
1. Since 97 is close to 100, write $97 = 100 - 3$.
2. Therefore, $97 \times 25 = (100 - 3) \times 25$.
3. Applying the distributive property gives $100 \times 25 - 3 \times 25$.
4. This becomes $2500 - 75$.
5. Hence, $97 \times 25 = \boxed{2425}$.

12. Explain how arithmetic expressions can represent real-life situations using the example of four dosas costing ₹23 each and a ₹5 tip.
Answer:
1. The cost of one dosa is ₹23, so the cost of four dosas is represented by 4×23.
2. The ₹5 tip is an additional amount and is therefore added to the cost.
3. The complete arithmetic expression is $4 \times 23 + 5$.
4. Evaluating it gives $92 + 5 = 97$.
5. Therefore, the total amount paid is $\boxed{₹97}$, showing how arithmetic expressions can model everyday situations.

2.12 Five-mark questions with Answers of HOTS Type: (15 Questions)

Five-Mark Descriptive Questions with Answers – HOTS Type:
Each question requires analysis, reasoning, comparison, transformation, or application. Each answer contains five clear points.

1. Without performing lengthy calculations, compare $1023 + 125$and $1022 + 128$. Justify your answer.
Answer:
1. Compare the first terms: 1022 is **1 less** than 1023.
2. Compare the second terms: 128 is **3 more** than 125.
3. Thus, the decrease of 1 in the first term is compensated by an increase of 3 in the second term.
4. The overall value of the second expression is therefore **2 more** than the first.
5. Hence, $\boxed{1022 + 128 > 1023 + 125}$, without needing to calculate both sums fully.

2. A student claims that $113 - 25$must be greater than $112 - 24$because 113 is greater than 112. Analyse the claim.

Answer:

1. Looking only at the first number is not sufficient when comparing two subtraction expressions.
2. In the second expression, 112 is 1 less than 113.
3. However, the number being subtracted, 24, is also 1 less than 25.
4. Decreasing both numbers in a subtraction by the same amount leaves the difference unchanged.
5. Therefore, the student's claim is incorrect and $\boxed{113 - 25 = 112 - 24}$.

3. Irfan buys two items costing ₹15 and ₹56 and pays ₹100. Explain why $100 - (15 + 56)$correctly represents his change and solve it.

Answer:

1. The two purchased items together cost $15 + 56 = ₹71$.
2. Since both amounts are spent, their total must be subtracted from ₹100.
3. Therefore, the situation is represented by $100 - (15 + 56)$.
4. Removing the brackets gives $100 - 15 - 56$, which has the same value.
5. Hence, Irfan receives $\boxed{₹29}$as change.

4. A student simplifies $500 - (250 - 100)$as $500 - 250 - 100$. Identify the mistake and obtain the correct answer.

Answer:

1. The student has failed to consider the negative sign before the brackets.
2. When brackets preceded by a negative sign are removed, the signs of the terms inside change.
3. Therefore, $500 - (250 - 100)$becomes $500 - 250 + 100$.
4. Evaluating the corrected expression gives $250 + 100 = 350$.
5. Hence, the student's simplification is incorrect and the correct value is $\boxed{350}$.

5. Compare $28 + (35 - 10)$and $500 - (250 - 100)$to explain how the sign before brackets affects their removal.

Answer:

1. In $28 + (35 - 10)$, the brackets are effectively preceded by a positive sign, so the signs inside remain unchanged.
2. Therefore, it becomes $28 + 35 - 10$.
3. In $500 - (250 - 100)$, the brackets are preceded by a negative sign.
4. Therefore, the signs inside change and the expression becomes $500 - 250 + 100$.
5. Hence, a **positive sign preserves the signs**, while a **negative sign changes the signs** when brackets are removed.

6. If $53 + (-16) = 37$, predict the values of $54 + (-16)$, $52 + (-16)$, $53 + (-15)$, and $53 + (-17)$without solving each from the beginning.

Answer:

1. Increasing 53 by 1 increases the value by 1, so $54 + (-16) = 38$.
2. Decreasing 53 by 1 decreases the value by 1, so $52 + (-16) = 36$.
3. Changing $-16$to -15increases the second term by 1, so $53 + (-15) = 38$.
4. Changing $-16$to -17decreases the second term by 1, so $53 + (-17) = 36$.
5. Thus, changing one term by a certain amount changes the value of the expression by the corresponding amount.

7. Two friends each buy an item costing ₹43 and another costing ₹24. Show two different expressions for their total expenditure and establish that they are equivalent.

Answer:

1. One friend's expenditure is represented by $43 + 24$.
2. For two friends, the total expenditure can therefore be written as $2 \times (43 + 24)$.
3. Using the distributive property, this becomes $2 \times 43 + 2 \times 24$.
4. Both expressions give $86 + 48 = 134$.
5. Hence, $\boxed{2(43 + 24) = 2 \times 43 + 2 \times 24 = ₹134}$, showing that the expressions are equivalent.

8. Scouts stand in 4 rows of 5 and guides stand in 3 rows of 5. Find the total using two methods and identify the property involved.

Answer:

1. Using separate groups, the total is $4 \times 5 + 3 \times 5$.
2. This gives $20 + 15 = 35$.
3. Since 5 is common to both terms, the expression can also be written as $(4 + 3) \times 5$.
4. This gives $7 \times 5 = 35$, the same result.
5. Therefore, $\boxed{4 \times 5 + 3 \times 5 = (4 + 3) \times 5 = 35}$, illustrating the distributive property.

9. Explain how $10 \times 98 + 3 \times 98$can be calculated efficiently without performing two separate multiplications.

Answer:

1. Observe that both terms contain the common factor 98.
2. Using the distributive property in reverse, combine the other factors as $10 + 3$.
3. Thus, $10 \times 98 + 3 \times 98 = (10 + 3) \times 98$.
4. The expression simplifies to $13 \times 98 = 1274$.
5. Hence, $\boxed{1274}$is obtained efficiently by using the common factor rather than two separate multiplications.

10. Given that $53 \times 18 = 954$, find 63×18without using long multiplication and explain your strategy.

Answer:

1. Notice that 63 is 10 more than 53, so $63 = 53 + 10$.
2. Rewrite the product as $(53 + 10) \times 18$.
3. Using the distributive property, this becomes $53 \times 18 + 10 \times 18$.
4. Using the known value, we get $954 + 180 = 1134$.
5. Therefore, $\boxed{63 \times 18 = 1134}$, and the known product has been used to avoid recalculating from the beginning.

11. Develop an efficient strategy to calculate 97×25without standard long multiplication.

Answer:

1. Since 97 is close to 100, express it as $100 - 3$.
2. Rewrite the product as $(100 - 3) \times 25$.
3. Apply the distributive property to obtain $100 \times 25 - 3 \times 25$.
4. This gives $2500 - 75 = 2425$.
5. Hence, $\boxed{97 \times 25 = 2425}$, and using the nearby round number 100 makes the calculation easier.

12. A student writes $23 \times (17 - 9) = 23 \times 17 + 23 \times 9$. Analyse the error and correct the solution.

Answer:

1. The operation inside the brackets is **subtraction**, so the distributive form must preserve subtraction.
2. The student has incorrectly replaced the subtraction sign with an addition sign.
3. The correct expansion is $23 \times (17 - 9) = 23 \times 17 - 23 \times 9$.

4. This gives $391 - 207 = 184$, which is also 23×8.
5. Therefore, the correct relation is $\boxed{23(17 - 9) = 23 \times 17 - 23 \times 9 = 184}$.

13. Without fully evaluating both expressions, determine whether $(34 - 28) \times 42$ and $34 \times 42 - 28 \times 42$ are equal.

Answer:

1. The first expression multiplies the difference $34 - 28$ by 42.
2. According to the distributive property, 42 can multiply each term of the difference separately.
3. Therefore, $(34 - 28) \times 42 = 34 \times 42 - 28 \times 42$.
4. Both expressions represent the same quantity even before their numerical values are calculated.
5. Hence, the two expressions are $\boxed{\text{equal}}$ by the distributive property of multiplication over subtraction.

14. Compare $15 + 9 \times 18$ and $(15 + 9) \times 18$ and explain why the brackets make a difference.

Answer:

1. In $15 + 9 \times 18$, only the term 9 is multiplied by 18 before 15 is added.
2. In $(15 + 9) \times 18$, the entire sum $15 + 9$ is multiplied by 18.
3. By distribution, the second expression becomes $15 \times 18 + 9 \times 18$.
4. Therefore, the second expression contains a much larger contribution from 15 than the first expression.
5. Hence, $\boxed{(15 + 9) \times 18 > 15 + 9 \times 18}$, showing how brackets can change the value of an expression.

15. Find 49×50 using a nearby convenient number and explain why the method is efficient.

Answer:

1. Since 49 is one less than 50, write $49 = 50 - 1$.
2. Thus, $49 \times 50 = (50 - 1) \times 50$.
3. Apply the distributive property to obtain $50 \times 50 - 1 \times 50$.
4. This gives $2500 - 50 = 2450$.
5. Therefore, $\boxed{49 \times 50 = 2450}$, and using 50 as a nearby convenient number makes mental calculation easier.

2.13 Five-mark questions with Answers of Applied Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – Applied Type:

1. A family visits a restaurant where 5 meals cost ₹120 each and 3 juice bottles cost ₹40 each. Write an arithmetic expression and find the total bill.

Answer:

1. Cost of 5 meals is represented by 5×120.
2. Cost of 3 juice bottles is represented by 3×40.
3. The total bill is represented by $5 \times 120 + 3 \times 40$.
4. Evaluating the expression gives $600 + 120 = 720$.
5. Therefore, the family has to pay **₹720**.
   This applies the chapter's use of arithmetic expressions to represent purchase situations.

2. A school arranges 8 rows of 12 boys and 7 rows of 12 girls for a programme. Find the total number of students using the distributive property.

Answer:

1. The number of boys is represented by 8×12.
2. The number of girls is represented by 7×12.
3. Therefore, the total is $8 \times 12 + 7 \times 12$.
4. Taking 12 as the common factor gives $(8 + 7) \times 12 = 15 \times 12$.
5. Hence, the total number of students is **180**.
   This applies the same grouping and distributive reasoning used for scouts and guides in the chapter.

3. Rohan has ₹1,000 and buys a school bag for ₹450 and books for ₹275. Write an expression, remove the brackets, and find the money left.

Answer:

1. The total expenditure is $450 + 275$.
2. The money left is represented by $1000 - (450 + 275)$.
3. Removing the brackets gives $1000 - 450 - 275$.
4. Evaluating the expression gives $550 - 275 = 275$.
5. Therefore, Rohan has **₹275** left.
   This applies the chapter's method of subtracting a sum and removing brackets.

4. A shop has 500 notebooks, sells 250 notebooks, and later receives back 40 notebooks from a cancelled order. Represent the situation using brackets and find the final stock.

Answer:

1. Selling 250 notebooks decreases the stock, while receiving 40 notebooks back increases it.
2. The situation can be represented as $500 - (250 - 40)$.
3. Removing the brackets changes the signs, giving $500 - 250 + 40$.
4. Evaluating the expression gives $250 + 40 = 290$.
5. Therefore, the shop finally has **290 notebooks**.
   This applies the chapter's rule for removing brackets preceded by a negative sign.

5. A school buys 98 notebooks for each of 13 classes. Use the distributive property to find the total number of notebooks without directly multiplying 13 × 98.

Answer:

1. Split 13 as $10 + 3$, so the expression becomes $(10 + 3) \times 98$.
2. Apply the distributive property to obtain $10 \times 98 + 3 \times 98$.
3. The two products are 980and 294.
4. Adding them gives $980 + 294 = 1274$.
5. Therefore, the school buys **1,274 notebooks**.
   This directly applies the chapter's distributive-property example involving $10 \times 98 + 3 \times 98$.

6. A bookshop sells 97 notebooks at ₹25 each. Find the total sales amount using a convenient nearby number.

Answer:

1. Since 97 is close to 100, write $97 = 100 - 3$.
2. Therefore, the sales amount is $(100 - 3) \times 25$.
3. Using the distributive property, this becomes $100 \times 25 - 3 \times 25$.
4. Evaluating gives $2500 - 75 = 2425$.
5. Hence, the total sales amount is **₹2,425**.

7. A school orders 104 mathematics books at ₹15 each. Find the total cost using the distributive property.

Answer:

1. Express 104 as the convenient sum $100 + 4$.
2. The total cost is therefore $(100 + 4) \times 15$.

3. Applying the distributive property gives $100 \times 15 + 4 \times 15$.
4. This equals $1500 + 60 = 1560$.
5. Therefore, the school has to pay **₹1,560**.

8. A teacher has 53 worksheets for each of 18 groups and later decides to prepare worksheets for 10 additional groups. Given $53 \times 18 = 954$, find the total worksheets needed for 63 groups.

Answer:

1. The new number of groups is $53 + 10 = 63$.
2. Therefore, the required number is $(53 + 10) \times 18$.
3. Using the distributive property, this becomes $53 \times 18 + 10 \times 18$.
4. Substituting the known value gives $954 + 180 = 1134$.
5. Hence, **1,134 worksheets** are required.

9. A farmer sells 9 kg of mangoes each day and his neighbour sells 11 kg each day for 7 days. Write an expression and find their combined weekly sale.

Answer:

1. The farmer sells 9×7kg in 7 days.
2. His neighbour sells 11×7kg in the same period.
3. Their combined sale is $9 \times 7 + 11 \times 7 = (9 + 11) \times 7$.
4. Simplifying gives $20 \times 7 = 140$.
5. Therefore, together they sell **140 kg of mangoes** in 7 days.

10. Binu earns ₹20,000 per month and spends ₹5,000 on rent, ₹5,000 on food, and ₹2,000 on other expenses. Find his savings for one year using an arithmetic expression.

Answer:

1. His total monthly expenditure is $5000 + 5000 + 2000 =$ ₹12,000.
2. His monthly savings are represented by $20000 - (5000 + 5000 + 2000)$.
3. Therefore, his monthly savings are $20000 - 12000 =$ ₹8,000.
4. His savings for 12 months are 12×8000.
5. Hence, Binu saves **₹96,000 in one year**.

2.14 Multiple Choice Questions with answers for Olympiad type Competitive Exams:

Olympiad-Type Multiple Choice Questions:

These questions emphasize logical reasoning, comparison of expressions, brackets, terms, distributive property, and efficient computation from the uploaded chapter.

1. Which of the following expressions has the greatest value?

A) $1023 + 125$
B) $1022 + 128$
C) $1024 + 124$
D) $1020 + 126$

Answer: B) $1022 + 128$

2. Which relation is correct?

A) $113 - 25 > 112 - 24$
B) $113 - 25 < 112 - 24$
C) $113 - 25 = 112 - 24$
D) Cannot be determined

Answer: C) $113 - 25 = 112 - 24$

3. The value of $30 + (5 \times 4)$is:

A) 50
B) 140
C) 170

D) 35
Answer: A) 50
4. If ₹15 and ₹56 are spent from ₹100, which expression correctly gives the amount left?
A) $100 - 15 + 56$
B) $100 + (15 - 56)$
C) $100 - (15 + 56)$
D) $(100 - 15) + 56$
Answer: C) $100 - (15 + 56)$
5. Which is the correct representation of $83 - 14$**as a sum of terms?**
A) $83 + 14$
B) $83 + (-14)$
C) $(-83) + 14$
D) $(-83) + (-14)$
Answer: B) $83 + (-14)$
6. Which property explains $8 + (-3) = (-3) + 8$**?**
A) Associative property
B) Distributive property
C) Commutative property
D) Multiplicative property
Answer: C) Commutative property
7. If the terms of an addition expression are rearranged and regrouped, its value:
A) always increases
B) always decreases
C) remains unchanged
D) becomes zero
Answer: C) remains unchanged
8. Four dosas cost ₹23 each and a ₹5 tip is added. Which expression gives the total payment?
A) $4 + 23 + 5$
B) $4 \times (23 + 5)$
C) $4 \times 23 + 5$
D) $23 \times 5 + 4$
Answer: C) $4 \times 23 + 5$
9. Which expression represents 33 students as six complete groups of five and three students remaining?
A) $6 + 5 \times 3$
B) $6 \times 5 + 3$
C) $6 \times (5 + 3)$
D) $5 \times 3 + 6$
Answer: B) $6 \times 5 + 3$
10. Which is equivalent to $200 - (40 + 3)$**?**
A) $200 - 40 + 3$
B) $200 + 40 - 3$
C) $200 - 40 - 3$
D) $200 + 40 + 3$
Answer: C) $200 - 40 - 3$
11. Which is equivalent to $500 - (250 - 100)$**?**
A) $500 - 250 - 100$
B) $500 + 250 - 100$

C) $500 - 250 + 100$
D) $500 + 250 + 100$
Answer: C) $500 - 250 + 100$
12. The value of $500 - (250 - 100)$**is:**
A) 150
B) 250
C) 350
D) 450
Answer: C) 350
13. Which expression is equivalent to $28 + (35 - 10)$**?**
A) $28 + 35 + 10$
B) $28 - 35 + 10$
C) $28 + 35 - 10$
D) $28 - 35 - 10$
Answer: C) $28 + 35 - 10$
14. If $53 + (-16) = 37$**, what is** $54 + (-16)$**?**
A) 36
B) 37
C) 38
D) 39
Answer: C) 38
15. If $53 + (-16) = 37$**, which expression has value 36?**
A) $54 + (-16)$
B) $53 + (-15)$
C) $52 + (-16)$
D) $54 + (-15)$
Answer: C) $52 + (-16)$
16. Which expression is equivalent to $2(43 + 24)$**?**
A) $2 \times 43 + 24$
B) $2 \times 43 + 2 \times 24$
C) $43 + 2 \times 24$
D) $2 + 43 + 24$
Answer: B) $2 \times 43 + 2 \times 24$
17. Which expression is equivalent to $4 \times 5 + 3 \times 5$**?**
A) $4 \times (5 + 3)$
B) $(4 + 3) \times 5$
C) $(4 \times 3) + 5$
D) $4 + 3 + 5$
Answer: B) $(4 + 3) \times 5$
18. Which of the following shows the distributive property correctly?
A) $a(b + c) = ab + c$
B) $a(b + c) = ab + ac$
C) $a(b + c) = a + b + c$
D) $a(b + c) = abc$
Answer: B) $a(b + c) = ab + ac$
19. Simplify $10 \times 98 + 3 \times 98$**.**
A) 10×101
B) 13×98
C) 30×98

D) 13×196
Answer: B) 13×98
20. Which is the most efficient equivalent form of $14 \times 10 - 6 \times 10$**?**
A) $(14 + 6) \times 10$
B) $(14 - 6) \times 10$
C) $14 \times (10 - 6)$
D) $8 + 10$
Answer: B) $(14 - 6) \times 10$
21. If $53 \times 18 = 954$**, then** 63×18**equals:**
A) 1034
B) 1114
C) 1134
D) 1154
Answer: C) 1134
22. Which is the best transformation for mentally calculating 97×25**?**
A) $(90 + 7) \times 25$
B) $(100 - 3) \times 25$
C) $97 \times (20 + 5)$
D) $(97 + 25) \times 1$
Answer: B) $(100 - 3) \times 25$
23. The value of 97×25**is:**
A) 2,325
B) 2,375
C) 2,425
D) 2,475
Answer: C) 2,425
24. Which transformation is most convenient for calculating 104×15**?**
A) $(100 + 4) \times 15$
B) $(104 + 15) \times 1$
C) $104 \times (10 - 5)$
D) $(100 - 4) \times 15$
Answer: A) $(100 + 4) \times 15$
25. What is 49×50**when calculated using** $49 = 50 - 1$**?**
A) 2,400
B) 2,450
C) 2,500
D) 2,550
Answer: B) 2,450
26. Which expression is equal to $5(9 - 2)$**?**
A) $5 \times 9 + 5 \times 2$
B) $5 \times 9 - 5 \times 2$
C) $5 \times 9 - 2$
D) $5 + 9 - 2$
Answer: B) $5 \times 9 - 5 \times 2$
27. Which pair of expressions is equivalent?
A) $23(17 - 9)$and $23 \times 17 + 23 \times 9$
B) $23(17 - 9)$and $23 \times 17 - 23 \times 9$
C) $23(17 - 9)$and $23 + 17 - 9$

D) $23(17-9)$and $23 \times 17-9$
Answer: B) $23(17-9)$**and** $23 \times 17-23 \times 9$
28. Which relation is correct?

$$(34-28) \times 42 \_\_ 34 \times 42-28 \times 42$$

A) $>$
B) $<$
C) $=$
D) Cannot be determined
Answer: C) $=$
29. Which is greater?
A) $15+9 \times 18$
B) $(15+9) \times 18$
C) Both are equal
D) Cannot be determined
Answer: B) $(15+9) \times 18$, because in this expression the entire sum $15+9$is multiplied by 18.
30. Two sellers sell 9 kg and 11 kg of mangoes respectively each day for 7 days. Which expression most efficiently gives their combined sale?
A) $9+11 \times 7$
B) $9 \times 11 \times 7$
C) $(9+11) \times 7$
D) $9+11+7$
Answer: C) $(9+11) \times 7$
Answer Key
1-B, 2-C, 3-A, 4-C, 5-B, 6-C, 7-C, 8-C, 9-B, 10-C, 11-C, 12-C, 13-C, 14-C, 15-C, 16-B, 17-B, 18-B, 19-B, 20-B, 21-C, 22-B, 23-C, 24-A, 25-B, 26-B, 27-B, 28-C, 29-B, 30-C.

2.15 Best Practices Opportunity List from the Chapter: (12 Ideas)

"Best Practices" Opportunities for Teaching – 7th Standard:
Based on the chapter's emphasis on **forming expressions, comparing expressions, brackets, terms, properties of addition, distributive property, and efficient calculations**, the following best practices can strengthen classroom teaching.

(1) **Concrete Situation → Expression → Solution:** Begin with familiar situations such as shopping bills, change, arranging students in groups, or buying food; ask students first to form the arithmetic expression and only then calculate its value. This mirrors the chapter's dosa-cost and student-grouping examples.

(2) **Expression Comparison Without Full Calculation:** Regularly give pairs of expressions and ask students to decide $<$, $>$, or $=$using reasoning rather than lengthy calculations. Students should verbally explain *why* one expression is greater or why two expressions are equal.

(3) **Bracket and Sign Practice:** Use short daily exercises in which students insert, remove, or interpret brackets, especially expressions such as $200-(40+3)$and $500-(250-100)$. Encourage students to explain how a negative sign before brackets affects the signs of the terms inside.

(4) **Term Identification Routine:** Before evaluating a complex expression, ask students to identify its individual **terms** and rewrite subtraction as addition of the inverse where appropriate. For example, $83-14$can be viewed as $83+(-14)$, with terms 83 and -14.

(5) **Property Discovery Through Patterns:** Instead of merely giving rules, let students discover the **commutative, associative, and distributive properties** by calculating equivalent expressions, rearranging terms, and observing that the values remain unchanged.
(6) **Multiple-Method Problem Solving:** Encourage students to solve the same problem in two different ways and compare the methods—for example, $4 \times 5 + 3 \times 5$and $(4 + 3) \times 5$. This builds understanding of equivalent expressions rather than dependence on memorised procedures.
(7) **Mental Mathematics Using the Distributive Property:** Develop a regular "mental maths minute" using convenient nearby numbers, such as $97 \times 25 = (100 - 3) \times 25$, $104 \times 15 = (100 + 4) \times 15$, and $49 \times 50 = (50 - 1) \times 50$. This helps students use arithmetic properties strategically.
(8) **Error Analysis as a Learning Strategy:** Present intentionally incorrect statements such as $500 - (250 - 100) = 500 - 250 - 100$and ask students to locate, explain, and correct the mistake. Such activities strengthen conceptual understanding of brackets and signs.
(9) **Think–Pair–Share for Expression Building:** Give a real-life situation to each student, allow individual thinking time, then have pairs compare the expressions they formed before sharing with the class. Emphasise that different-looking expressions may sometimes represent the same value, an idea developed throughout the chapter.
(10) **Progress from LOTS to HOTS:** Begin practice with identifying terms, evaluating expressions, and applying properties directly; then progress to comparing expressions, finding errors, constructing equivalent expressions, and solving application-based problems. This provides scaffolding while gradually developing mathematical reasoning.
(11) **Ask "Why?" Along With "What?":** After every important calculation, ask students to justify the step—for example, "Why did the sign change?", "Why can 98 be taken as a common factor?", or "Why are these expressions equal?" This shifts learning from mechanical calculation to reasoning.
(12) **Exit Ticket for Formative Assessment:** End the lesson with three quick tasks: **evaluate one expression, transform one expression, and explain one relationship**. The responses can help the teacher identify whether students need reinforcement in calculation, brackets, or arithmetic properties before proceeding.

2.16 Innovations Opportunity List from the Chapter: (12 Ideas)

"Innovations" Opportunities in Teaching–Learning – 7th Standard:
The chapter provides good opportunities for innovative activities around **constructing and comparing expressions, brackets, terms, sign changes, distributive property, and efficient mental computation**.
(1) **Expression Laboratory:** Create an "Arithmetic Expression Lab" using number cards, operation cards, and bracket cards. Students can physically rearrange the cards to create different expressions, calculate their values, and investigate how changing the position of brackets changes the answer. This makes the chapter's treatment of complex expressions and brackets highly visual and interactive.
(2) **Expression Detective Game:** Display two expressions and challenge students to determine whether the first is **greater than, less than, or equal to** the second without fully calculating them. Students earn additional points for explaining the shortest reasoning method, developing the comparison skills highlighted in the chapter.

(3) **Virtual Shopping Challenge:** Set up a simulated classroom shop with menus, stationery, groceries, prices, and play money. Students select several items, construct expressions for total expenditure and change, and solve them using brackets where necessary; this extends the chapter's real-life examples involving dosas and purchases.

(4) **Human Bracket Activity:** Assign students roles as numbers, operation signs, and brackets and ask them to physically arrange themselves into an arithmetic expression. Moving or removing the "bracket students" can demonstrate how expressions such as $500 - (250 - 100)$transform into $500 - 250 + 100$.

(5) **Build–Break–Rebuild Expressions:** Give students an expression such as $10 \times 98 + 3 \times 98$and ask them to "rebuild" it as $(10 + 3) \times 98$, or provide $2(43 + 24)$and ask them to "break" it into $2 \times 43 + 2 \times 24$. This turns the distributive property into an expression-transformation puzzle rather than a rule to memorise.

(6) **Mental-Maths Strategy Race:** Give problems such as 97×25, 104×15, and 49×50, but do not allow conventional long multiplication initially. Teams compete to discover efficient transformations using nearby round numbers and then explain why their strategies work.

(7) **"Spot the Mathematical Error" Digital Quiz:** Use a classroom presentation or digital quiz containing deliberately incorrect steps such as $200 - (40 + 3) = 200 - 40 + 3$. Students identify the error, correct it, and explain the relevant bracket rule, turning common misconceptions into learning opportunities.

(8) **Expression Story Creator:** Give students an arithmetic expression such as $6 \times 5 + 3$and ask them to create a real-life story that matches it; alternatively, provide a story and ask them to construct the expression. The chapter itself connects $6 \times 5 + 3$with grouping 33 students, making this a natural extension.

(9) **Property Discovery Wall:** Create separate classroom spaces for **commutative, associative, and distributive** patterns. Whenever students discover two equivalent expressions, they place their example under the appropriate property, gradually building a student-generated "Arithmetic Properties Wall."

(10) **Tinker-the-Terms Experiment:** Begin with a known result such as $53 + (-16) = 37$and let students predict what happens when one term increases or decreases by 1, 2, 5, or 10. Students can record patterns in a table and formulate their own observations about how changing a term affects the value of an expression.

(11) **Student-Designed Arithmetic Board Game:** Students can design a simple board game containing challenges such as **evaluate, compare, remove brackets, find the error, create an equivalent expression, and use the distributive property**. Different challenge levels can provide both routine and Olympiad-style reasoning practice based on the chapter.

(12) **QR-Based Expression Trail:** Place QR codes or numbered challenge cards around the classroom, with each station containing an expression-based problem. Students move through stations solving comparison, bracket, distributive-property, and mental-calculation challenges, making revision collaborative and activity-oriented.

These innovations can transform **Arithmetic Expressions** from a calculation-centred chapter into an **explore–reason–construct–apply** learning experience, while retaining the chapter's emphasis on understanding equivalent expressions and using arithmetic properties efficiently.

2.17: Practicing Questions/Question Bank

A. Suggested Fill-in-the-Blank Questions:

1. The numerical result obtained after evaluating an arithmetic expression is called its ________.
   Answer: Value

2. The symbols used to compare two expressions are ________, ________, and ________.
   Answer: $=, <, >$

3. $83 - 14$can be written as $83 +$________.
   Answer: (-14)

4. Swapping two terms in an addition does not change their ________.
   Answer: Sum

5. $200 - (40 + 3) = 200 - 40$________ 3.
   Answer: $-$

6. $500 - (250 - 100) = 500 - 250$________ 100.
   Answer: $+$

7. $2(43 + 24) = 2 \times 43 +$________.
   Answer: 2×24

8. $10 \times 98 + 3 \times 98 = (10 + 3) \times$________.
   Answer: 98

9. $14 \times 10 - 6 \times 10 = (14 - 6) \times$________.
   Answer: 10

10. $97 \times 25 = (100 - 3) \times 25 =$________.
    Answer: 2425

B. Suggested 1-Mark Descriptive Questions:

1. What is meant by the **value of an arithmetic expression**?
   Answer: The value is the numerical result obtained after evaluating the expression.

2. What are the terms in $83 - 14$?
   Answer: The terms are $83$and -14.

3. What happens to a sum when its terms are swapped?
   Answer: The sum remains unchanged.

4. Write $200 - (40 + 3)$without brackets.
   Answer: $200 - 40 - 3$.

5. Write $500 - (250 - 100)$without brackets.
   Answer: $500 - 250 + 100$.

6. State the distributive property of multiplication over addition.
   Answer: $a(b + c) = ab + ac$.

7. Factorise $4 \times 5 + 3 \times 5$.
   Answer: $(4 + 3) \times 5$.

8. Find 95×8using a convenient nearby number.
   Answer: $95 \times 8 = (100 - 5) \times 8 = 760$.

C. Suggested 2-Mark Descriptive Questions:

1. **What is an arithmetic expression? Give an example.**
   Answer: An arithmetic expression contains numbers connected by arithmetic operations. For example, $30 + (5 \times 4)$is an arithmetic expression with value 50.

2. **Explain why brackets are important in arithmetic expressions.**
   Answer: Brackets indicate which part of an expression should be treated together or evaluated first. Changing brackets can change the meaning and value of an expression.

3. **Explain why** $113 - 25 = 112 - 24$**.**
   Answer: Both the first number and the number being subtracted have decreased by 1. Therefore, their difference remains unchanged.

4. **Remove the brackets and evaluate** $200 - (40 + 3)$**.**
   Answer: $200 - (40 + 3) = 200 - 40 - 3$. Therefore, its value is 157.

5. **Use the distributive property to simplify** $10 \times 98 + 3 \times 98$**.**
   Answer: $10 \times 98 + 3 \times 98 = (10 + 3) \times 98$. Therefore, the value is $13 \times 98 = 1274$.

6. **How can** 49×50**be calculated mentally?**
   Answer: Write $49 = 50 - 1$, so $49 \times 50 = (50 - 1) \times 50$. Hence, the answer is $2500 - 50 = 2450$.

D. Suggested 3-Mark Descriptive Questions:

1. **Explain how subtraction can be viewed as addition using** $83 - 14$**.**
   Answer:
   1. Rewrite subtraction as addition of the inverse.
   2. Thus, $83 - 14 = 83 + (-14)$.
   3. Hence, the terms are $83$and -14.

2. **A person has ₹100 and spends ₹15 and ₹56. Find the amount remaining.**
   Answer:
   1. Write the expression $100 - (15 + 56)$.
   2. Total expenditure is ₹71.
   3. Therefore, the amount remaining is $\boxed{₹29}$.

3. **Explain the error in** $500 - (250 - 100) = 500 - 250 - 100$**.**
   Answer:
   1. The brackets are preceded by a negative sign.
   2. Therefore, the signs inside change when the brackets are removed.
   3. The correct expression is $500 - 250 + 100 = 350$.

4. **Show that** $2(43 + 24) = 2 \times 43 + 2 \times 24$**.**
   Answer:
   1. Apply the distributive property.
   2. $2(43 + 24) = 86 + 48$.
   3. Both forms therefore have the value $\boxed{134}$.

5. **Given** $53 \times 18 = 954$**, find** 63×18**without long multiplication.**
   Answer:

1. Write $63 = 53 + 10$.
2. Then $63 \times 18 = 53 \times 18 + 10 \times 18$.
3. Hence, $954 + 180 = \boxed{1134}$.

6. **Find** 104×15**using a convenient strategy.**
Answer:

1. Write $104 = 100 + 4$.
2. Then $(100 + 4) \times 15 = 1500 + 60$.
3. Therefore, $104 \times 15 = \boxed{1560}$.

E. Suggested 5-Mark Descriptive Questions:

1. **Explain how arithmetic expressions can be used to represent real-life situations, with a suitable example from the chapter.**
Answer:

1. Real-life quantities can be represented using numbers and arithmetic operations.
2. If four dosas cost ₹23 each, their cost is 4×23.
3. If a ₹5 tip is added, the expression becomes $4 \times 23 + 5$.
4. Evaluating gives $92 + 5 = 97$.
5. Therefore, the total payment is $\boxed{₹97}$.

2. **Explain how signs are affected while removing brackets, using two examples.**
Answer:

1. The sign immediately before the brackets determines how the signs inside are treated.
2. $28 + (35 - 10)$becomes $28 + 35 - 10$, so the signs remain unchanged.
3. $500 - (250 - 100)$becomes $500 - 250 + 100$.
4. Thus, a negative sign before brackets changes the signs of the terms inside.
5. Correct handling of signs is essential for maintaining the value of an expression.

3. **Explain the distributive property using** $4 \times 5 + 3 \times 5$**.**
Answer:

1. The expression contains two products with 5 as a common factor.
2. Therefore, $4 \times 5 + 3 \times 5 = (4 + 3) \times 5$.
3. Simplifying the bracket gives 7×5.
4. Its value is 35.
5. This illustrates how the distributive property can simplify calculations.

4. **Explain an efficient method for finding** 97×25**.**
Answer:

1. Observe that 97 is close to the convenient number 100.

2. Write $97 = 100 - 3$.
3. Therefore, $97 \times 25 = (100 - 3) \times 25$.
4. Distribute to obtain $2500 - 75$.
5. Hence, $97 \times 25 = \boxed{2425}$.

5. **Two sellers sell 9 kg and 11 kg of mangoes respectively each day for 7 days. Form an expression and find their total sale.**
Answer:
    1. The first seller's weekly sale is 9×7kg.
    2. The second seller's weekly sale is 11×7kg.
    3. Together, the expression is $9 \times 7 + 11 \times 7$.
    4. Using the distributive property, it becomes $(9 + 11) \times 7 = 20 \times 7$.
    5. Therefore, their combined sale is $\boxed{140 \text{ kg}}$.

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7th Standard Maths Book Chapter 3

Chapter 3: A PEEK BEYOND THE POINT

3.1 Summary of the Chapter:

Summary – Key Points:

(1) **Need for Smaller Units:** When accurate measurements are required, a whole unit can be divided into smaller equal parts. For example, a centimetre can be divided into **10 equal parts** to measure lengths more precisely.

(2) **Understanding Tenths:** Dividing one whole unit into **10 equal parts** gives **tenths**. Thus, each part is $\frac{1}{10}$, and **10 tenths make one whole**.

(3) **Understanding Hundredths:** Each tenth can again be divided into **10 equal parts**, giving hundredths. Therefore, **100 hundredths make one whole**, and 10hundredths make 1tenth.

(4) **Understanding Thousandths:** The same process can be extended further. Dividing a hundredth into 10 equal parts produces **thousandths**, showing that place values can continue to become smaller.

(5) **Decimal Place Value:** The decimal system is based on **10**. Moving one place to the left makes a place value **10 times larger**, while moving one place to the right makes it **10 times smaller**.

(6) **Decimal Point:** A **decimal point (.)** separates the whole-number part from the fractional part. The places to its right represent **tenths, hundredths, thousandths**, and so on.

(7) **Reading Decimals:** Decimal numbers can be read using the word **"point."** For example, **70.5** is read as *seventy point five*, **7.05** as *seven point zero five*, and **0.274** as *zero point two seven four*.

(8) **Fractions and Decimals:** Fractions with denominators such as **10, 100 and 1000** can be expressed conveniently as decimals. Thus, decimal notation is a natural extension of the Indian place-value system to quantities having fractional parts.

(9) **Locating Decimals on a Number Line:** Decimals can be represented accurately on a **number line** by repeatedly dividing intervals into equal parts. This helps students understand the relative position and size of decimal numbers.

(10) **Comparing Decimals:** To compare two decimals, begin with the digits having the **greatest place value** and move towards smaller place values until different digits are found. The number having the larger digit at the first differing place is greater.

(11) **Addition and Subtraction of Decimals:** Decimal quantities can be **added and subtracted using place values**, including regrouping between units, tenths and hundredths. They can also be converted completely into tenths or hundredths before calculation.

(12) **Decimals in Measurement and Daily Life:** Decimals are useful for converting and expressing measurements such as **millimetres, centimetres, metres, grams, kilograms, rupees and paise**. The chapter connects decimal concepts with practical situations involving **length, weight, money and everyday measurements**.

In Short:

The chapter develops the idea of going **"beyond the point"** by extending the place-value system from whole numbers to **tenths, hundredths and thousandths**. It teaches students to **read, write, locate, compare, add, subtract and apply decimals** confidently in mathematical and real-life situations.

3.2 Important Formulas:

Important Formulas / Rules for Solving Quantitative Problems:

1. **Tenths**

$$1 \text{ unit} = 10 \text{ tenths}$$
$$1 \text{ tenth} = \frac{1}{10} = 0.1$$

2. **Hundredths**

$$1 \text{ unit} = 100 \text{ hundredths}$$
$$1 \text{ hundredth} = \frac{1}{100} = 0.01$$
$$10 \text{ hundredths} = 1 \text{ tenth}$$

3. **Thousandths**

$$1 \text{ unit} = 1000 \text{ thousandths}$$
$$1 \text{ thousandth} = \frac{1}{1000} = 0.001$$
$$10 \text{ thousandths} = 1 \text{ hundredth}$$

4. **Fraction to Decimal Conversion**

$$\frac{a}{10} = a \div 10$$
$$\frac{a}{100} = a \div 100$$
$$\frac{a}{1000} = a \div 1000$$

Examples:

$$\frac{7}{10} = 0.7,\ \frac{45}{100} = 0.45,\ \frac{8}{1000} = 0.008$$

5. **Expanded Form of a Decimal**

$$abc.def = (a \times 100) + (b \times 10) + (c \times 1) + \left(d \times \frac{1}{10}\right) + \left(e \times \frac{1}{100}\right) + \left(f \times \frac{1}{1000}\right)$$

Example:

$$23.456 = 20 + 3 + \frac{4}{10} + \frac{5}{100} + \frac{6}{1000}$$

6. **Addition of Decimals**
   Align digits according to their **place values** and add:

$$a.b + c.d = (a + c) + (b + d) \text{ tenths}$$

Regroup whenever:

$$10 \text{ tenths} = 1 \text{ unit}$$

and

$$10 \text{ hundredths} = 1 \text{ tenth}$$

7. **Subtraction of Decimals**
   Align decimal points and subtract according to place value. When necessary:

$$1 \text{ unit} = 10 \text{ tenths}$$
$$1 \text{ tenth} = 10 \text{ hundredths}$$

8. **Equivalent Decimal Numbers**
   Adding zeros to the right of a decimal number does not change its value:

$$4.5 = 4.50 = 4.500$$

9. **Comparison of Decimals**
   Compare digits in order:

$$\text{Units} \rightarrow \text{Tenths} \rightarrow \text{Hundredths} \rightarrow \text{Thousandths}$$

The number having the greater digit at the **first differing place** is greater.

10. **Millimetre–Centimetre Conversion**

$$1\ \text{cm} = 10\ \text{mm}$$

Therefore,

$$1\ \text{mm} = 0.1\ \text{cm}$$
$$\text{cm} = \frac{\text{mm}}{10}$$
$$\text{mm} = \text{cm} \times 10$$

11. **Centimetre–Metre Conversion**

$$1\ \text{m} = 100\ \text{cm}$$

Therefore,

$$1\ \text{cm} = 0.01\ \text{m}$$
$$\text{m} = \frac{\text{cm}}{100}$$
$$\text{cm} = \text{m} \times 100$$

12. **Millimetre–Metre Conversion**

$$1\ \text{m} = 1000\ \text{mm}$$

Therefore,

$$1\ \text{mm} = 0.001\ \text{m}$$
$$\text{m} = \frac{\text{mm}}{1000}$$

13. **Gram–Kilogram Conversion**

$$1\ \text{kg} = 1000\ \text{g}$$

Therefore,

$$1\ \text{g} = 0.001\ \text{kg}$$
$$\text{kg} = \frac{\text{g}}{1000}$$
$$\text{g} = \text{kg} \times 1000$$

14. **Milligram–Gram Conversion**

$$1\ \text{g} = 1000\ \text{mg}$$

Therefore,

$$1\ \text{mg} = 0.001\ \text{g}$$
$$\text{g} = \frac{\text{mg}}{1000}$$

15. **Rupee–Paise Conversion**

$$1\ \text{rupee} = 100\ \text{paise}$$

Therefore,

$$1\ \text{paisa} = 0.01\ \text{rupee}$$
$$\text{rupees} = \frac{\text{paise}}{100}$$
$$\text{paise} = \text{rupees} \times 100$$

16. **Total Quantity**

For length, weight, money, or other quantities:

$$\text{Total} = \text{Quantity}_1 + \text{Quantity}_2 + \cdots$$

17. **Difference Between Two Quantities**

$$\text{Difference} = \text{Larger Quantity} - \text{Smaller Quantity}$$

18. **Change in a Quantity**

$$\text{Change} = \text{New Value} - \text{Original Value}$$

A positive result shows an **increase**, while a negative result shows a **decrease**.

19. **Decimal Sequence Rule**

If a fixed decimal is repeatedly added:

$$\text{Next Term} = \text{Previous Term} + \text{Common Change}$$

If a fixed decimal is repeatedly subtracted:

$$\text{Next Term} = \text{Previous Term} - \text{Common Change}$$

20. **General Place-Value Relation**

Moving one place to the **left**:

$$\text{Place Value} \times 10$$

Moving one place to the **right**:

$$\text{Place Value} \div 10$$

This is the central rule behind the chapter's decimal place-value system.

Quick Conversion Table

Conversion	Formula
mm to cm	mm ÷ 10
cm to mm	cm × 10
cm to m	cm ÷ 100
m to cm	m × 100
mm to m	mm ÷ 1000
g to kg	g ÷ 1000
kg to g	kg × 1000
mg to g	mg ÷ 1000
paise to rupees	paise ÷ 100
rupees to paise	rupees × 100

These formulas cover the main quantitative problem types in **Chapter 3 – A Peek Beyond the Point**, especially **decimal place value, operations, comparisons, measurement conversions, weight and money problems**.

3.3 Fill-Up the Blank LOTS type questions with Answers: (40 Questions)

Fill in the Blanks – LOTS Type:

1. When one unit is divided into **10 equal parts**, each part is called one __________.
   Answer: tenth
2. Ten one-tenths together make __________ whole unit.
   Answer: one
3. One-tenth is written as the fraction __________.
   Answer: $\frac{1}{10}$
4. The decimal form of $\frac{1}{10}$ is __________.
   Answer: 0.1
5. When one-tenth is divided into 10 equal parts, each smaller part is called one __________.
   Answer: hundredth
6. One hundredth is written as __________ in decimal notation.
   Answer: 0.01
7. __________ hundredths make one whole unit.
   Answer: 100
8. Ten hundredths are equal to one __________.
   Answer: tenth
9. One thousandth is written as the fraction __________.
   Answer: $\frac{1}{1000}$
10. The decimal form of one thousandth is __________.
    Answer: 0.001

11. The point used to separate the whole-number part from the fractional part is called the __________ point.
    Answer: decimal
12. In the decimal number **7.05**, the digit 5 is in the __________ place.
    Answer: hundredths
13. In the decimal number **0.274**, the digit 2 represents two __________.
    Answer: tenths
14. The decimal number **70.5** is read as seventy point __________.
    Answer: five
15. The decimal form of $\frac{5}{100}$ is __________.
    Answer: 0.05
16. The decimal form of $\frac{75}{100}$ is __________.
    Answer: 0.75
17. The number **4.5** can also be written as __________ without changing its value.
    Answer: 4.50
18. The decimal number **1.4** lies between the whole numbers __________ and __________.
    Answer: 1 and 2
19. While comparing decimal numbers, we begin by comparing digits having the __________ place value.
    Answer: highest
20. One centimetre is equal to __________ millimetres.
    Answer: 10
21. One millimetre is equal to __________ centimetre.
    Answer: 0.1
22. **5 mm** is equal to __________ cm.
    Answer: 0.5
23. **12 mm** is equal to __________ cm.
    Answer: 1.2
24. One metre is equal to __________ centimetres.
    Answer: 100
25. One centimetre is equal to __________ metre.
    Answer: 0.01
26. **15 cm** is equal to __________ m.
    Answer: 0.15
27. One kilogram is equal to __________ grams.
    Answer: 1000
28. One gram is equal to __________ kg.
    Answer: 0.001
29. **5 g** is equal to __________ kg.
    Answer: 0.005
30. **254 g** is equal to __________ kg.
    Answer: 0.254
31. One gram is equal to __________ milligrams.
    Answer: 1000
32. One milligram is equal to __________ gram.
    Answer: 0.001
33. One rupee is equal to __________ paise.
    Answer: 100

34. One paisa is equal to __________ rupee.
    Answer: 0.01
35. **75 paise** is equal to ₹__________.
    Answer: 0.75
36. In the decimal place-value system, each place is __________ times the place immediately to its right.
    Answer: 10
37. The decimal system is based on the number __________.
    Answer: 10
38. In **23.4**, the digit 4 is in the __________ place.
    Answer: tenths
39. **234 tenths** can be written as the decimal number __________.
    Answer: 23.4
40. To add or subtract decimal numbers conveniently, digits having the same __________ should be placed in the same column.
    Answer: place value

Answer Key – Quick Reference
1. tenth | **2.** one | **3.** 1/10 | **4.** 0.1 | **5.** hundredth | **6.** 0.01 | **7.** 100 | **8.** tenth | **9.** 1/1000 | **10.** 0.001 | **11.** decimal | **12.** hundredths | **13.** tenths | **14.** five | **15.** 0.05 | **16.** 0.75 | **17.** 4.50 | **18.** 1 and 2 | **19.** highest | **20.** 10 | **21.** 0.1 | **22.** 0.5 | **23.** 1.2 | **24.** 100 | **25.** 0.01 | **26.** 0.15 | **27.** 1000 | **28.** 0.001 | **29.** 0.005 | **30.** 0.254 | **31.** 1000 | **32.** 0.001 | **33.** 100 | **34.** 0.01 | **35.** 0.75 | **36.** 10 | **37.** 10 | **38.** tenths | **39.** 23.4 | **40.** place value

3.4 Fill-Up the Blank HOTS type questions with Answers: (40 Questions)

Fill in the Blanks – HOTS Type with Answers:
The following questions require students to **analyse, compare, convert, calculate, identify patterns, and apply decimal concepts** rather than simply recall facts.

1. A ribbon measures **3.7 m** and another measures **2.45 m**. Their total length is __________ m.
   Answer: 6.15 m
2. A pencil is **8.6 cm** long and an eraser is **3.25 cm** long. The pencil is __________ cm longer than the eraser.
   Answer: 5.35 cm
3. If **10 hundredths = 1 tenth**, then **70 hundredths = __________ tenths**.
   Answer: 7 tenths
4. A number has **4 units, 3 tenths and 6 hundredths**. Its decimal representation is __________.
   Answer: 4.36
5. The number **6.08** contains 6 units, __________ tenths and 8 hundredths.
   Answer: 0 tenths
6. If **3.5 = 3.50**, then the missing digit in **7.4 = 7.4___** is __________.
   Answer: 0
7. Of **4.05, 4.5 and 4.005**, the greatest decimal number is __________.
   Answer: 4.5
8. Of **0.9, 1.1, 1.01 and 1.11**, the decimal number closest to 1 is __________.
   Answer: 1.01
9. If **1.23** and **1.32** are compared place by place, the greater number is __________.
   Answer: 1.32

10. The decimal number **4.185** has 1 in the __________ place, 8 in the __________ place and 5 in the __________ place.
    Answer: tenths, hundredths, thousandths
11. If a unit is divided first into 10 equal parts and each of those parts is again divided into 10 equal parts, one unit contains __________ of the final smaller parts.
    Answer: 100
12. If one hundredth is divided into 10 equal parts, each resulting part is __________ of a unit.
    Answer: $\frac{1}{1000}$
13. A number is **5 units and 37 hundredths**. The same number written in decimal form is __________.
    Answer: 5.37
14. **234 tenths** is equivalent to the decimal number __________.
    Answer: 23.4
15. A length of **56 mm** is equal to __________ cm.
    Answer: 5.6 cm
16. A wire measuring **7.5 cm** has a length of __________ mm.
    Answer: 75 mm
17. A rope is **325 cm** long. Expressed in metres, its length is __________ m.
    Answer: 3.25 m
18. If **1 m = 1000 mm**, then **250 mm = __________ m**.
    Answer: 0.25 m
19. A packet weighs **1560 g**. Its weight in kilograms is __________ kg.
    Answer: 1.560 kg (or 1.56 kg)
20. If an object weighs **2.5 kg**, its weight in grams is __________ g.
    Answer: 2500 g
21. A vegetable basket contains **0.25 kg beans, 0.3 kg carrots and 0.5 kg potatoes**. Their combined weight is __________ kg.
    Answer: 1.05 kg
22. A person weighed **35.75 kg** in one month and **34.50 kg** in the next month. The decrease in weight is __________ kg.
    Answer: 1.25 kg
    These applications follow the chapter's quantitative exercises on decimal weights.
23. If **₹1 = 100 paise**, then **250 paise = ₹__________**.
    Answer: 2.50
24. An item costing **75 paise** has a price of ₹__________ when expressed in decimal form.
    Answer: 0.75
25. If a decimal number is increased from **2.75 to 3.00**, the increase is __________.
    Answer: 0.25
26. The missing number in the increasing sequence **4.4, 4.8, 5.2, 5.6, __________** is __________.
    Answer: 6.0
    The pattern increases by **0.4** each time.
27. If **0.4** is repeatedly added to **6.0**, the next two terms are **__________ and __________**.
    Answer: 6.4 and 6.8
28. The sum of **5.3 + 2.6** is __________.
    Answer: 7.9

29. The difference between **10.4 and 4.5** is __________.
    Answer: 5.9
30. The sum of **0.75 and 0.03** is __________.
    Answer: 0.78
    Addition and subtraction of such decimals are included among the chapter exercises.
31. If **3.81** and **13.800** are compared, the greater number is __________.
    Answer: 13.800
32. Among **3.56, 3.65 and 3.099**, the number closest to 4 is __________.
    Answer: 3.65
33. A decimal has **2 ones, 3 tenths and 5 hundredths**. Its value is __________.
    Answer: 2.35
34. A number has **1 hundred, 1 one and 1 hundredth**. Its decimal representation is __________.
    Answer: 101.01
35. If **10 hundredths make 1 tenth**, then **125 hundredths = __________** in decimal notation.
    Answer: 1.25
36. A student writes **4.50 > 4.5** because 4.50 has more digits. The correct relation is **4.50 __________ 4.5**.
    Answer: =
37. The decimal number exactly halfway between **2.4 and 2.6** is __________.
    Answer: 2.5
38. If **9.9** is written with two decimal places, it becomes __________.
    Answer: 9.90
39. A quantity changes from **6.25 units to 8.75 units**. The increase is __________ units.
    Answer: 2.50 units
40. If **1 kg = 1000 g**, then **0.254 kg** represents __________ grams.
    Answer: 254 g

Skills Tested:
These HOTS fill-ups assess students' ability to **interpret decimal place value, establish equivalence, compare and order decimals, perform addition and subtraction, recognise decimal sequences, and apply decimals to length, weight and money conversions**—the major quantitative applications developed in Chapter 3.

3.5 One-mark questions with Answers of LOTS Type: (40 Questions)

One-Mark Descriptive Questions with Answers – LOTS Type:

1. **What is one-tenth of a unit?**
   Answer: One-tenth of a unit is one of the 10 equal parts obtained by dividing a whole unit equally.
2. **How many tenths make one whole unit?**
   Answer: Ten tenths make one whole unit.
3. **How is one-tenth written as a decimal?**
   Answer: One-tenth is written as **0.1** in decimal form.
4. **What is one-hundredth of a unit?**
   Answer: One-hundredth is one of the **100 equal parts** of a whole unit.
5. **How many hundredths make one-tenth?**
   Answer: Ten hundredths make one-tenth.
6. **How is one-hundredth written in decimal form?**
   Answer: One-hundredth is written as **0.01**.

7. **What is one-thousandth of a unit?**
   Answer: One-thousandth is one of the **1000 equal parts** of a whole unit.
8. **How is one-thousandth written in decimal form?**
   Answer: One-thousandth is written as **0.001**.
9. **Why is the number system discussed in the chapter called the decimal system?**
   Answer: It is called the **decimal system** because it is based on the number 10.
10. **What is a decimal point?**
    Answer: A decimal point is the **point (.) used to separate the whole-number part from the fractional part** of a number.
11. **How is 70.5 read?**
    Answer: 70.5 is read as **seventy point five**.
12. **How is 7.05 read?**
    Answer: 7.05 is read as **seven point zero five**.
13. **What does the digit 2 represent in 0.274?**
    Answer: In **0.274**, the digit 2 represents **two tenths**.
14. **What does the digit 7 represent in 0.274?**
    Answer: In **0.274**, the digit 7 represents **seven hundredths**.
15. **What does the digit 4 represent in 0.274?**
    Answer: In **0.274**, the digit 4 represents **four thousandths**.
16. **What happens to place value when we move one place to the right?**
    Answer: The place value becomes **10 times smaller** when we move one place to the right.
17. **How many millimetres are there in one centimetre?**
    Answer: There are **10 millimetres** in one centimetre.
18. **How many centimetres are there in one metre?**
    Answer: There are **100 centimetres** in one metre.
19. **Express 1 mm in centimetres.**
    Answer: 1 mm = 0.1 cm.
20. **Express 1 cm in metres.**
    Answer: 1 cm = 0.01 m.
21. **How many grams make one kilogram?**
    Answer: 1000 grams make one kilogram.
22. **Express one gram in kilograms.**
    Answer: 1 g = 0.001 kg.
23. **How many milligrams make one gram?**
    Answer: 1000 milligrams make one gram.
24. **How many paise make one rupee?**
    Answer: 100 paise make one rupee.
25. **Express one paisa in rupees.**
    Answer: 1 paisa = ₹0.01.
26. **What is the decimal form of 75 paise in rupees?**
    Answer: 75 paise = ₹0.75.
27. **What is the purpose of using smaller units in measurement?**
    Answer: Smaller units are used to obtain **more accurate measurements**.
28. **Where does the decimal number 1.4 lie on the number line?**
    Answer: The decimal number **1.4 lies between 1 and 2** on the number line.
29. **How do we begin comparing two decimal numbers?**
    Answer: We begin by comparing the digits having the **highest place value**.

30. **What are equivalent decimals?**
    Answer: Equivalent decimals are decimal numbers that have **different forms but the same value**, such as 4.5 and 4.50.
31. **What is 234 tenths in decimal form?**
    Answer: 234 tenths = 23.4.
32. **What is the place value of 5 in 7.05?**
    Answer: The digit 5 in **7.05** is in the **hundredths place**.
33. **What is the place value of 4 in 23.4?**
    Answer: The digit 4 in **23.4** is in the **tenths place**.
34. **What is meant by 2.7 cm?**
    Answer: 2.7 cm means 2 centimetres and 7 tenths of a centimetre.
35. **How many hundredths are there in one whole unit?**
    Answer: There are **100 hundredths** in one whole unit.
36. **How many thousandths make one hundredth?**
    Answer: Ten thousandths make one hundredth.
37. **What is the decimal form of $\frac{5}{100}$?**
    Answer: The decimal form of $\frac{5}{100}$ is **0.05**.
38. **What is the decimal form of $\frac{9}{10}$?**
    Answer: The decimal form of $\frac{9}{10}$ is **0.9**.
39. **What is the main use of a number line while learning decimals?**
    Answer: A number line helps us **locate, understand and compare decimal numbers**.
40. **Name three fractional place values to the right of the decimal point.**
    Answer: The first three fractional place values are **tenths, hundredths and thousandths**.

3.6 One-mark questions with Answers of HOTS Type: (40 Questions)

One-Mark Descriptive Questions with Answers – HOTS Type:

1. **Why is 4.50 equal to 4.5 even though it has more digits?**
   Answer: 4.50 equals 4.5 because the zero added to the right does not change the value of the decimal.
2. **Which is greater, 1.23 or 1.32, and why?**
   Answer: 1.32 is greater because its tenths digit 3 is greater than the tenths digit 2 in 1.23.
3. **Which is greater, 1.009 or 1.090, and why?**
   Answer: 1.090 is greater because at the hundredths place 9 is greater than 0.
4. **Which number is closer to 1, 0.9 or 1.01?**
   Answer: 1.01 is closer to 1 because it is only 0.01 away, while 0.9 is 0.1 away.
5. **Why is 4.05 smaller than 4.5?**
   Answer: 4.05 is smaller because it has 0 tenths whereas 4.5 has 5 tenths.
6. **If 10 hundredths make one tenth, how many tenths are there in 80 hundredths?**
   Answer: 80 hundredths are equal to 8 tenths.
7. **A number has 5 units, 2 tenths and 7 hundredths; what is the number?**
   Answer: The required decimal number is **5.27**.
8. **How can 3.6 be written using hundredths without changing its value?**
   Answer: 3.6 can be written as 3.60, since 6 tenths equal 60 hundredths.

9. **Why is 7.05 different from 7.5?**
   Answer: 7.05 has 5 hundredths whereas 7.5 has 5 tenths, so their values are different.
10. **Which is greater, 0.8 or 0.69? Give a reason.**
    Answer: 0.8 is greater because 0.80 has 8 tenths while 0.69 has only 6 tenths.
11. **A pencil measures 3.7 cm and another measures 4.2 cm; how much longer is the second pencil?**
    Answer: The second pencil is **0.5 cm longer**.
12. **If 5.6 cm is converted into millimetres, what will its length be?**
    Answer: 5.6 cm is 56 mm because each centimetre contains 10 millimetres.
13. **A length is 325 cm; how can it be expressed in metres?**
    Answer: 325 cm = 3.25 m because 100 cm make one metre.
14. **If an object weighs 254 g, what is its weight in kilograms?**
    Answer: The object's weight is **0.254 kg** because 1000 g make one kilogram.
15. **A packet weighs 0.56 kg; what is its weight in grams?**
    Answer: The packet weighs **560 g** because 1 kg equals 1000 g.
16. **If an item costs 75 paise, how will its price be written in rupees?**
    Answer: The price is **₹0.75** because 100 paise make one rupee.
17. **A student says 4.050 is greater than 4.05 because it has more digits; is the student correct?**
    Answer: No, the student is not correct because 4.050 and 4.05 represent the same value.
18. **What number must be added to 2.75 to obtain 3.00?**
    Answer: 0.25 must be added to 2.75 to obtain 3.00.
19. **What number must be subtracted from 8.5 to obtain 6.2?**
    Answer: 2.3 must be subtracted from 8.5 to obtain 6.2.
20. **The sequence is 4.4, 4.8, 5.2, 5.6; what is the next term and why?**
    Answer: The next term is **6.0 because 0.4 is added to each preceding term**.
21. **Which is greater, 9.9 or 9.09, and why?**
    Answer: 9.9 is greater because 9.90 has 9 tenths whereas 9.09 has 0 tenths.
22. **What is the difference between 9.9 and 9.09?**
    Answer: The difference between **9.90 and 9.09 is 0.81**.
23. **If 0.75 kg and 0.25 kg are combined, what is their total weight?**
    Answer: Their total weight is **1.00 kg or 1 kg**.
24. **Why is 0.01 smaller than 0.1?**
    Answer: 0.01 is one hundredth whereas 0.1 is one tenth, and one hundredth is smaller than one tenth.
25. **How many thousandths are equivalent to 0.25?**
    Answer: 0.25 is equivalent to 250 thousandths.
26. **If a number is 23 tenths, how can it be expressed as a decimal?**
    Answer: 23 tenths = 2.3 because 20 tenths make 2 units and 3 tenths remain.
27. **A number lies exactly halfway between 4.4 and 4.6; what is the number?**
    Answer: The number exactly halfway between 4.4 and 4.6 is **4.5**.
28. **Which is the smallest among 4.5, 4.05 and 4.005?**
    Answer: 4.005 is the smallest because its fractional part is smaller than those of 4.05 and 4.5.
29. **Why can decimal numbers be compared from the highest place value towards the right?**
    Answer: We can do so because the **first place at which the digits differ determines which decimal number is greater**.

30. **A number contains 2 tenths, 7 hundredths and 4 thousandths; what is its decimal form?**
    Answer: Its decimal form is **0.274**.
31. **If 6.4 is increased by 0.1, what decimal is obtained?**
    Answer: 6.5 is obtained when 0.1 is added to 6.4.
32. **Which is closer to 4, 3.56 or 3.65?**
    Answer: 3.65 is closer to 4 because its difference from 4 is only 0.35.
33. **Why is 70.5 not the same as 7.05?**
    Answer: 70.5 has 7 tens and 5 tenths, while 7.05 has 7 units and 5 hundredths.
34. **If one hundredth is divided into 10 equal parts, what is each part called?**
    Answer: Each part is called **one thousandth or 0.001**.
35. **A student adds 0.25 kg, 0.30 kg and 0.50 kg; what total should the student obtain?**
    Answer: The student should obtain a total of **1.05 kg**.
36. **If 35.75 kg decreases to 34.50 kg, what is the decrease?**
    Answer: The decrease is **1.25 kg**.
37. **Which is greater, 2.567 or 2.675?**
    Answer: 2.675 is greater because its tenths digit 6 is greater than the tenths digit 5 in 2.567.
38. **If 10 mm equals 1 cm, what fraction of a centimetre is 3 mm?**
    Answer: 3 mm is $\frac{3}{10}$cm or 0.3 cm.
39. **Why are tenths and hundredths useful while measuring small differences in length?**
    Answer: Tenths and hundredths allow us to **represent measurements more precisely than whole units**.
40. **If a decimal number has more digits after the decimal point, must it always be greater?**
    Answer: No, the number of decimal digits alone does not determine its value; the digits must be compared according to place value.

3.7 Two-mark questions with Answers of LOTS Type: (30 Questions)

Two-Mark Descriptive Questions with Answers – LOTS Type:

1. **What is a tenth? How is it represented as a fraction and decimal?**
   Answer: (i) When one whole unit is divided into **10 equal parts**, each part is called one-tenth.
   (ii) One-tenth is written as $\frac{1}{10} = 0.1$.
2. **What is a hundredth? How is it represented as a decimal?**
   Answer: (i) When one whole unit is divided into **100 equal parts**, each part is called one-hundredth.
   (ii) One-hundredth is written as $\frac{1}{100} = 0.01$.
3. **State the relationship between tenths and hundredths.**
   Answer: (i) **One tenth is equal to 10 hundredths.**
   (ii) Therefore, **10 tenths = 100 hundredths = 1 whole unit**.
4. **What is a thousandth? Write its decimal representation.**
   Answer: (i) A thousandth is **one of 1000 equal parts of a whole unit**.
   (ii) It is written as $\frac{1}{1000} = 0.001$.

5. **What is a decimal point? What does it separate?**
   Answer: (i) A **decimal point (.)** is used in writing decimal numbers.
   (ii) It separates the **whole-number part from the fractional part**.
6. **Explain the place values of the digits in 7.05.**
   Answer: (i) In **7.05**, 7 represents **7 units** and 0 represents **0 tenths**.
   (ii) The digit 5 represents **5 hundredths**.
7. **Explain the place values of the digits in 0.274.**
   Answer: (i) In **0.274**, 2 represents **2 tenths** and 7 represents **7 hundredths**.
   (ii) The digit 4 represents **4 thousandths**.
8. **How does place value change as we move from one place to another in the decimal system?**
   Answer: (i) Moving one place to the **left** makes the place value 10 times greater.
   (ii) Moving one place to the **right** makes the place value 10 times smaller.
9. **Write 4 units, 4 tenths and 5 hundredths in decimal form and expanded form.**
   Answer: (i) The decimal form is **4.45**.
   (ii) Its expanded form is $4 + \frac{4}{10} + \frac{5}{100}$.
10. **How do you compare two decimal numbers?**
    Answer: (i) Compare the digits from the **highest place value**, beginning with the whole-number part.
    (ii) If they are equal, continue towards the right until the **first differing digit** is found.
11. **What are equivalent decimals? Give an example.**
    Answer: (i) Equivalent decimals are decimal numbers written differently but having the **same value**.
    (ii) For example, **4.5 = 4.50 = 4.500**.
12. **How are decimal numbers represented on a number line?**
    Answer: (i) The interval between two whole numbers can be divided into **10 equal parts to locate tenths**.
    (ii) These intervals can be divided further to locate **hundredths and thousandths** more precisely.
13. **How do you add two decimal numbers?**
    Answer: (i) Write the numbers so that digits of the **same place value and decimal points are aligned**.
    (ii) Add the digits column-wise and **regroup when necessary**.
14. **How do you subtract one decimal number from another?**
    Answer: (i) Arrange the decimal numbers so that the **same place values are in the same columns**.
    (ii) Subtract column-wise, **regrouping from the next higher place when required**.
15. **Why are smaller units needed while measuring objects?**
    Answer: (i) Some objects cannot be measured accurately using **whole units alone**.
    (ii) Dividing a unit into tenths and still smaller parts gives a **more precise measurement**.
16. **State the relationship between centimetres and millimetres.**
    Answer: (i) **1 centimetre = 10 millimetres**.
    (ii) Therefore, **1 millimetre = 0.1 centimetre**.
17. **State the relationship between metres and centimetres.**
    Answer: (i) **1 metre = 100 centimetres**.
    (ii) Therefore, **1 centimetre = 0.01 metre**.

18. **State the relationship between kilograms and grams.**
Answer: (i) **1 kilogram = 1000 grams**.
(ii) Therefore, **1 gram = 0.001 kilogram**.
19. **State the relationship between rupees and paise.**
Answer: (i) **1 rupee = 100 paise**.
(ii) Therefore, **1 paisa = ₹0.01**.
20. **Convert 75 paise into rupees and explain the conversion.**
Answer: (i) Since **100 paise = ₹1**, 75 paise means $\frac{75}{100}$of a rupee.
(ii) Therefore, **75 paise = ₹0.75**.
21. **Convert 35 mm into centimetres.**
Answer: (i) Since **10 mm = 1 cm**, divide 35 by 10.
(ii) Therefore, **35 mm = 3.5 cm**.
22. **Convert 250 cm into metres.**
Answer: (i) Since **100 cm = 1 m**, divide 250 by 100.
(ii) Therefore, **250 cm = 2.50 m = 2.5 m**.
23. **Convert 750 g into kilograms.**
Answer: (i) Since **1000 g = 1 kg**, divide 750 by 1000.
(ii) Therefore, **750 g = 0.750 kg = 0.75 kg**.
24. **What is the sum of 3.5 and 2.4? Show the calculation.**
Answer: (i) Adding the corresponding place values gives $3.5 + 2.4 = 5.9$.
(ii) Therefore, the required **sum is 5.9**.
25. **Find the difference between 8.7 and 3.2.**
Answer: (i) Subtracting corresponding place values gives $8.7 - 3.2 = 5.5$.
(ii) Therefore, the required **difference is 5.5**.
26. **How are fractions with denominators 10 and 100 written as decimals?**
Answer: (i) A fraction with denominator 10 is written using the **tenths place**, such as $\frac{7}{10} = 0.7$.
(ii) A fraction with denominator 100 is written using the **hundredths place**, such as $\frac{7}{100} = 0.07$.
27. **What is meant by a measurement of $2\frac{7}{10}$cm?**
Answer: (i) It means **2 whole centimetres and 7 tenths of a centimetre**.
(ii) In decimal notation, the same measurement is written as **2.7 cm**.
28. **Why is the decimal system called a base-10 system?**
Answer: (i) The decimal system is organised around **groups and powers of 10**.
(ii) Each place has **10 times the value of the place immediately to its right**.
29. **What happens when zero is added to the right end of a decimal number? Give an example.**
Answer: (i) Adding zero at the extreme right of the decimal part **does not change the number's value**.
(ii) For example, **3.5 = 3.50**.
30. **Write 23.4 in terms of units and tenths.**
Answer: (i) The number **23.4 contains 23 whole units and 4 tenths**.
(ii) It can also be expressed as **234 tenths**.

3.8. Two-mark questions with Answers of HOTS Type: (30 Questions)

Two-Mark Descriptive Questions with Answers – HOTS Type:

1. **Ravi says 4.50 is greater than 4.5 because it has more digits. Is he correct? Explain.**
   Answer: (i) No, Ravi is incorrect because adding a zero at the right end of a decimal does not change its value.
   (ii) Therefore, **4.50 = 4.5**.
2. **Which is greater, 3.56 or 3.65? Explain using place value.**
   Answer: (i) Both numbers have 3 units, but their tenths digits are 5 and 6 respectively.
   (ii) Since **6 tenths > 5 tenths, 3.65 > 3.56**.
3. **Which number is closer to 4: 3.56 or 3.65? Justify your answer.**
   Answer: (i) The distances from 4 are **0.44 and 0.35** respectively.
   (ii) Since 0.35 is smaller, **3.65 is closer to 4**.
4. **Why is 7.05 smaller than 7.5 even though both contain the digits 7 and 5?**
   Answer: (i) In 7.05, the digit 5 represents **5 hundredths**, while in 7.5 it represents **5 tenths**.
   (ii) Since 5 hundredths is smaller than 5 tenths, **7.05 < 7.5**.
5. **A number contains 4 units, 4 tenths and 5 hundredths. Find the number and explain its formation.**
   Answer: (i) The number is formed as $4 + \frac{4}{10} + \frac{5}{100}$.
   (ii) Therefore, its decimal representation is **4.45**.
6. **A student writes 0.8 < 0.75 because 8 is smaller than 75. Identify the error and correct it.**
   Answer: (i) The student has ignored place value; writing 0.8 as **0.80** makes comparison easier.
   (ii) Since 80 hundredths > 75 hundredths, **0.8 > 0.75**.
7. **How many hundredths are there in 2.5? Explain.**
   Answer: (i) Since **1 unit = 100 hundredths**, 2 units equal 200 hundredths and 5 tenths equal 50 hundredths.
   (ii) Therefore, **2.5 contains 250 hundredths**.
8. **A screw measures $2\frac{7}{10}$cm. Express its length as a decimal and explain.**
   Answer: (i) Seven-tenths of a centimetre is written as **0.7 cm**.
   (ii) Therefore, $2\frac{7}{10}$cm is **2.7 cm**.
9. **A line segment measures 48 mm. Express its length in centimetres and explain the conversion.**
   Answer: (i) Since **10 mm = 1 cm**, 48 mm is divided by 10.
   (ii) Therefore, **48 mm = 4.8 cm**.
10. **A ribbon is 2.35 m long and another is 1.4 m long. Find their total length.**
    Answer: (i) Write 1.4 as 1.40 and add: **2.35 + 1.40 = 3.75**.
    (ii) Therefore, the two ribbons have a **total length of 3.75 m**.
11. **A 5.75 m rope is cut by 2.4 m. How much rope remains?**
    Answer: (i) Writing 2.4 as 2.40 gives **5.75 − 2.40 = 3.35**.
    (ii) Therefore, **3.35 m of rope remains**.
12. **Why should decimal points be aligned while adding 3.45 and 2.6?**
    Answer: (i) Aligning decimal points places **units, tenths and hundredths in their correct columns**.
    (ii) Thus, $3.45 + 2.60 = 6.05$without mixing different place values.
13. **A student has ₹5.50 and receives ₹2.75 more. How much money does the student have now?**

Answer: (i) Adding the amounts gives **₹5.50 + ₹2.75 = ₹8.25**.
(ii) Therefore, the student now has **₹8.25**.

14. **An object weighs 750 g. Express its weight in kilograms and explain.**
Answer: (i) Since 1000 g make 1 kg, **750 g represents** $\frac{750}{1000}$**kg.**
(ii) Therefore, the object's weight is **0.750 kg or 0.75 kg**.
15. **A bag weighs 1.25 kg and another bag weighs 0.75 kg. Find their combined weight.**
Answer: (i) Adding the weights gives **1.25 + 0.75 = 2.00**.
(ii) Therefore, their combined weight is **2 kg**.
16. **A person's weight decreases from 35.75 kg to 34.50 kg. Find the decrease.**
Answer: (i) Subtracting the new weight from the earlier weight gives **35.75 − 34.50 = 1.25**.
(ii) Therefore, the person's weight decreased by **1.25 kg**.
17. **Arrange 4.5, 4.05 and 4.005 from smallest to greatest and justify your answer.**
Answer: (i) Writing them with equal decimal places gives **4.500, 4.050 and 4.005**.
(ii) Therefore, the ascending order is **4.005 < 4.05 < 4.5**.
18. **Find the decimal exactly halfway between 4.2 and 4.4. Explain your answer.**
Answer: (i) The difference between 4.2 and 4.4 is 0.2, and half of this difference is 0.1.
(ii) Therefore, the number halfway between them is **4.3**.
19. **The sequence is 4.4, 4.8, 5.2, 5.6, …. Find the next two terms and state the pattern.**
Answer: (i) Each term is obtained by **adding 0.4** to the previous term.
(ii) Therefore, the next two terms are **6.0 and 6.4**.
20. **Why is 0.1 greater than 0.01? Explain using hundredths.**
Answer: (i) One tenth is equivalent to **10 hundredths**, so 0.1 = 0.10.
(ii) Since 10 hundredths > 1 hundredth, **0.1 > 0.01**.
21. **A number is made of 3 units, 2 tenths and 8 hundredths. What happens if one more tenth is added?**
Answer: (i) The original number is **3.28**, and adding one tenth means adding 0.10.
(ii) Therefore, the new number is **3.38**.
22. **A number is made of 5 units and 125 hundredths. Express it as a decimal.**
Answer: (i) Since 100 hundredths make 1 unit, 125 hundredths equal **1.25 units**.
(ii) Therefore, $5 + 1.25 = 6.25$.
23. **A student says 101.01 means 101 units and 1 tenth. Is this correct? Explain.**
Answer: (i) No, because the first digit after the decimal is 0, representing **zero tenths**.
(ii) Thus, **101.01 represents 101 units and 1 hundredth**.
24. **How can you locate 4.185 more accurately on a number line?**
Answer: (i) First locate the interval containing 4.185 and repeatedly divide the required interval into **10 equal smaller parts**.
(ii) By moving through tenths, hundredths and thousandths, **4.185 can be located precisely**.
25. **If 250 paise and ₹1.75 are combined, what is the total amount in rupees?**
Answer: (i) Since 250 paise equals **₹2.50**, the total is ₹2.50 + ₹1.75.
(ii) Therefore, the combined amount is **₹4.25**.
26. **Which is greater, 2.567 or 2.675? Explain using the first differing place.**
Answer: (i) Both have 2 units, but their tenths digits are **5 and 6** respectively.
(ii) Since 6 > 5, **2.675 is greater than 2.567**.

27. **A measurement is 3.4 cm. Why can it also be written as 3.40 cm?**
Answer: (i) The value 3.4 means **3 units and 4 tenths**, while 3.40 means 3 units, 4 tenths and 0 hundredths.
(ii) Hence, **3.4 cm = 3.40 cm**, because the additional zero does not change the value.
28. **Two students obtain 5.9 and 5.90 as answers to the same problem. Can both answers be correct? Explain.**
Answer: (i) Yes, because **5.9 represents 5 units and 9 tenths**, while 5.90 represents the same quantity using hundredths.
(ii) Therefore, **5.9 = 5.90**, so both answers have the same value.
29. **Why are hundredths more useful than tenths for some precise measurements?**
Answer: (i) Hundredths divide a unit into **100 smaller equal parts**, whereas tenths divide it into only 10 parts.
(ii) Therefore, hundredths can represent **finer measurements** when tenths are not sufficiently precise.
30. **A decimal number increases from 6.75 to 8.20. Find the increase and explain the operation used.**
Answer: (i) To find the increase, subtract the original value from the new value: **8.20 − 6.75 = 1.45**.
(ii) Therefore, the decimal number has **increased by 1.45**.

3.9. Three-mark questions with Answers of LOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers – LOTS Type:
1. What are tenths? Explain their relation with a whole unit.
Answer:
1. When one whole unit is divided into **10 equal parts**, each part is called **one-tenth**.
2. One-tenth is written as $\frac{1}{10}$or **0.1**.
3. **10 tenths make one whole unit**.

2. What are hundredths? Explain their relationship with tenths and a whole.
Answer:
1. When each tenth is divided into **10 equal parts**, each smaller part is called **one-hundredth**.
2. One-hundredth is written as $\frac{1}{100}$or **0.01**.
3. **10 hundredths = 1 tenth**, and **100 hundredths = 1 whole**.

3. Explain the decimal place-value system.
Answer:
1. The decimal place-value system is based on the number **10**.
2. Moving one place to the left makes a place value **10 times greater**.
3. Moving one place to the right makes a place value **10 times smaller**.

4. Explain the place values of the digits in 0.274.
Answer:
1. The digit **2** is in the tenths place and represents **2 tenths**.
2. The digit **7** is in the hundredths place and represents **7 hundredths**.
3. The digit **4** is in the thousandths place and represents **4 thousandths**.

5. Write 4 units, 4 tenths and 5 hundredths in different forms.
Answer:
1. The number contains **4 units + 4 tenths + 5 hundredths**.
2. Its fractional expanded form is $4 + \frac{4}{10} + \frac{5}{100}$.
3. Its decimal form is **4.45**.

6. Explain how decimal numbers are read using 70.5, 7.05 and 0.274.
Answer:
1. **70.5** is read as **seventy point five**.
2. **7.05** is read as **seven point zero five**.
3. **0.274** is read as **zero point two seven four**.

7. Explain how decimal numbers are compared.
Answer:
1. First compare the digits at the **greatest place value**, starting with the whole-number part.
2. If they are equal, compare the digits successively in the **tenths, hundredths and further places**.
3. The number with the greater digit at the **first place of difference** is the greater decimal.

8. Explain how decimals are located on a number line.
Answer:
1. First identify the two whole numbers **between which the decimal lies**.
2. Divide the interval into **10 equal parts** to locate tenths and subdivide further for hundredths.
3. Further subdivision into equal parts can be used to locate **thousandths precisely**.

9. Explain how two decimal numbers are added.
Answer:
1. Write the decimal numbers so that digits having the **same place value are in the same column**.
2. Add the digits column by column, beginning from the **rightmost place**.
3. Regroup **10 hundredths as 1 tenth or 10 tenths as 1 unit** whenever required.

10. Explain how one decimal number is subtracted from another.
Answer:
1. Arrange the numbers so that their **decimal points and corresponding place values are aligned**.
2. Subtract the digits column by column from the **rightmost place**.
3. If necessary, regroup **one higher place into 10 parts of the next lower place**.

11. Explain the relationship between centimetres and millimetres.
Answer:
1. **One centimetre contains 10 millimetres**.
2. Therefore, **1 mm = 0.1 cm**.
3. To convert millimetres into centimetres, the number of millimetres is **divided by 10**.

12. Explain the relationship between metres and centimetres.
Answer:
1. **One metre contains 100 centimetres**.
2. Therefore, **1 cm = 0.01 m**.
3. To express centimetres in metres, the number of centimetres is **divided by 100**.

13. Explain the relationship between kilograms and grams using decimals.
Answer:
1. **One kilogram contains 1000 grams**.
2. Therefore, **1 gram = 0.001 kilogram**.
3. Hence, a weight such as **750 g can be written as 0.750 kg or 0.75 kg**.

14. Explain the relationship between rupees and paise using decimals.
Answer:
1. **One rupee contains 100 paise**.
2. Therefore, **1 paisa represents $\frac{1}{100}$ of a rupee or ₹0.01**.

3. Hence, **75 paise can be written as ₹0.75**.

15. Explain why smaller units are needed for accurate measurement.

Answer:
1. A whole unit may sometimes be **too large to measure an object accurately**.
2. Dividing a unit into tenths and hundredths helps us express **smaller measurements**.
3. Thus, decimal quantities such as **2.7 cm** can describe measurements more precisely.

16. Explain equivalent decimals with an example.

Answer:
1. Equivalent decimals are decimal numbers that have **the same value but may be written differently**.
2. Adding zeros at the extreme right of the decimal part **does not change its value**.
3. For example, **4.5 = 4.50 = 4.500**.

17. Describe the fractional places to the right of the decimal point.

Answer:
1. The first place to the right of the decimal point is the **tenths place**.
2. The second place is the **hundredths place**.
3. The third place is the **thousandths place**.

18. Explain how 2.7 cm represents a measurement.

Answer:
1. The number **2.7 cm** contains 2 whole centimetres and 7 tenths of a centimetre.
2. The 7 tenths can be written as $\frac{7}{10}$cm.
3. Therefore, $2\frac{7}{10}$**cm = 2.7 cm**.

19. Explain the decimal number 23.4 using place values.

Answer:
1. In **23.4**, the digit 2 represents **2 tens or 20**.
2. The digit 3 represents **3 units**, while the digit 4 represents **4 tenths**.
3. Thus, $23.4 = 20 + 3 + \frac{4}{10}$.

20. Explain how decimals are useful in everyday measurements.

Answer:
1. Decimals help represent quantities that are **smaller than whole units**.
2. They are useful for expressing measurements involving **length, weight and money**.
3. For example, measurements can be written as **2.7 cm, 0.75 kg or ₹0.75**.

3.10. Three-mark questions with Answers of HOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers – HOTS Type:

1. Riya says that 5.47 is greater than 5.7 because 47 is greater than 7. Is she correct? Justify.

Answer:
1. No, Riya is incorrect because decimal numbers must be compared according to **place value**, not by treating the decimal parts as whole numbers.
2. Writing 5.7 as **5.70** shows that 7 tenths is greater than 4 tenths.
3. Therefore, **5.70 > 5.47**, so 5.7 is greater.

2. Compare 4.5, 4.05 and 4.005 and arrange them in descending order.

Answer:
1. Write the decimals with equal decimal places as **4.500, 4.050 and 4.005**.
2. Comparing tenths, hundredths and thousandths shows that **4.500 > 4.050 > 4.005**.
3. Therefore, the descending order is **4.5 > 4.05 > 4.005**.

3. Which number is closer to 4: 3.56 or 3.65? Explain.

Answer:
1. The distance between 4 and 3.56 is $\mathbf{4 - 3.56 = 0.44}$.
2. The distance between 4 and 3.65 is $\mathbf{4 - 3.65 = 0.35}$.
3. Since $0.35 < 0.44$, **3.65 is closer to 4**.

4. A student says that 7.05 and 7.5 are equal because both contain the digits 7 and 5. Analyse the statement.

Answer:
1. In **7.05**, the digit 5 is in the hundredths place and represents **0.05**.
2. In **7.5**, the digit 5 is in the tenths place and represents **0.5**.
3. Therefore, the numbers are not equal and $\mathbf{7.05 < 7.5}$.

5. A screw measures $2\frac{7}{10}$cm. Express it as a decimal and in millimetres.

Answer:
1. Seven-tenths of a centimetre is **0.7 cm**, so $2\frac{7}{10}$cm = **2.7 cm**.
2. Since 1 cm = 10 mm, multiply 2.7 by 10 to get **27 mm**.
3. Therefore, the screw measures **2.7 cm or 27 mm**.

6. A number contains 4 units, 4 tenths and 5 hundredths. Write it as a decimal and as hundredths.

Answer:
1. The number is $4 + \frac{4}{10} + \frac{5}{100} = 4.45$.
2. Four units equal 400 hundredths and 4 tenths equal 40 hundredths.
3. Therefore, **4.45 = 445 hundredths**.

7. A ribbon is 3.75 m long and another ribbon is 2.6 m long. Find their total length.

Answer:
1. Write 2.6 as **2.60** so that corresponding decimal places are aligned.
2. Add the lengths: $\mathbf{3.75 + 2.60 = 6.35}$.
3. Therefore, the total length of the ribbons is **6.35 m**.

8. A rope is 8.5 m long and 3.75 m is cut from it. Find the remaining length.

Answer:
1. Write 8.5 as **8.50** to align the decimal places.
2. Subtract: $\mathbf{8.50 - 3.75 = 4.75}$.
3. Therefore, **4.75 m of rope remains**.

9. A student writes 0.8 < 0.75 because 8 is less than 75. Identify and correct the mistake.

Answer:
1. The student has incorrectly compared 8 and 75 without considering their **decimal place values**.
2. Writing 0.8 as **0.80** shows that 80 hundredths is greater than 75 hundredths.
3. Therefore, the correct comparison is $\mathbf{0.8 > 0.75}$.

10. Explain why 4.50, 4.500 and 4.5 represent the same quantity.

Answer:
1. The number 4.5 represents **4 units and 5 tenths**.
2. Writing 4.50 or 4.500 only adds zero hundredths or zero thousandths to the same value.
3. Therefore, **4.5 = 4.50 = 4.500**.

11. A person's weight decreases from 35.75 kg to 34.50 kg. Find the decrease and express it in grams.

Answer:
1. The decrease in weight is **35.75 − 34.50 = 1.25 kg**.
2. Since 1 kg = 1000 g, **1.25 kg = 1250 g**.
3. Therefore, the person's weight decreased by **1.25 kg or 1250 g**.

12. A shopkeeper has ₹10 and sells an item for ₹6.75. How much change should be returned?

Answer:

1. Write ₹10 as **₹10.00** to align the decimal places.
2. Subtract the cost from the amount paid: **10.00 − 6.75 = 3.25**.
3. Therefore, the shopkeeper should return **₹3.25**.

13. Find the next three terms of the sequence 4.4, 4.8, 5.2, 5.6 and explain the pattern.

Answer:

1. The difference between each pair of consecutive terms is **0.4**.
2. Adding 0.4 successively gives **6.0, 6.4 and 6.8**.
3. Therefore, the next three terms are **6.0, 6.4 and 6.8**.

14. A number lies exactly halfway between 4.18 and 4.20. Find the number.

Answer:

1. The difference between 4.18 and 4.20 is **0.02**.
2. Half of 0.02 is **0.01**, which is added to 4.18.
3. Therefore, the number exactly halfway between them is **4.19**.

15. A bag contains 0.25 kg of one item, 0.30 kg of another and 0.50 kg of a third. Find the total weight.

Answer:

1. Add the first two quantities: **0.25 + 0.30 = 0.55 kg**.
2. Add the third quantity: **0.55 + 0.50 = 1.05 kg**.
3. Therefore, the total weight of the three items is **1.05 kg**.

16. A student claims that 101.01 means 101 units and 1 tenth. Explain the error.

Answer:

1. In 101.01, the first digit after the decimal point is **0**, so there are zero tenths.
2. The digit 1 is in the **hundredths place**, so it represents one hundredth.
3. Therefore, **101.01 means 101 units and 1 hundredth**, not 1 tenth.

17. A length is 325 cm. Express it in metres and explain its decimal place values.

Answer:

1. Since 100 cm = 1 m, **325 cm = 3.25 m**.
2. In 3.25, 3 represents **3 metres**, 2 represents **2 tenths of a metre**, and 5 represents **5 hundredths of a metre**.
3. Therefore, the length can be represented as **3.25 m** using decimal place values.

18. How would you locate 4.185 accurately on a number line?

Answer:

1. First locate **4.1 and 4.2** and divide that interval into equal parts to identify the hundredths.
2. Locate **4.18 and 4.19** and divide this smaller interval into 10 equal parts representing thousandths.
3. The fifth such subdivision after 4.18 represents **4.185**.

19. A student adds 3.6 and 2.45 and gets 2.81 by placing the digits without aligning decimal points. Explain the correct method.

Answer:

1. The decimal points must be aligned so that **3.6 is written as 3.60** above 2.45.
2. Adding corresponding place values gives **3.60 + 2.45 = 6.05**.
3. Therefore, the correct answer is **6.05**, because units, tenths and hundredths must be added separately.

20. A number has 2 units, 3 tenths and 5 hundredths; another has 2 units, 2 tenths and 15 hundredths. Compare them.

Answer:

1. The first number is **2.35**.
2. In the second number, 15 hundredths = 1 tenth + 5 hundredths, so it is also **2.35**.
3. Therefore, the two numbers are **equal: 2.35 = 2.35**.

3.11 Five-mark questions with Answers of LOTS Type: (15 Questions)

Five-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain tenths, hundredths, and thousandths with their fractional and decimal forms.

Answer:

1. When one whole is divided into **10 equal parts**, each part is called a **tenth**, written as $\frac{1}{10} = 0.1$.
2. When each tenth is divided into 10 equal parts, each smaller part is called a **hundredth**, written as $\frac{1}{100} = 0.01$.
3. Thus, **10 hundredths make 1 tenth**, and 100 hundredths make one whole.
4. Dividing a hundredth into 10 equal parts gives **thousandths**, with one thousandth written as $\frac{1}{1000} = 0.001$.
5. Therefore, the decimal place values to the right of the decimal point progress as **tenths, hundredths, and thousandths**.

2. Explain the decimal place-value system and the role of the decimal point.

Answer:

1. The decimal number system is a **base-10 place-value system**.
2. Each place has **10 times the value** of the place immediately to its right.
3. To the left of the decimal point, we have places such as **ones, tens, hundreds, and thousands**.
4. To the right of the decimal point, we have **tenths, hundredths, thousandths, and further fractional places**.
5. The **decimal point** separates the whole-number part from the fractional part of a decimal number.

3. Explain the place values in the decimal number 0.274.

Answer:

1. In **0.274**, the zero indicates that there are **no whole units**.
2. The digit 2 is in the **tenths place** and represents $\frac{2}{10}$.
3. The digit 7 is in the **hundredths place** and represents $\frac{7}{100}$.
4. The digit 4 is in the **thousandths place** and represents $\frac{4}{1000}$.
5. Hence, $0.274 = \frac{2}{10} + \frac{7}{100} + \frac{4}{1000}$.

4. Explain how decimal numbers are compared.

Answer:

1. First compare the **whole-number parts** of the given decimal numbers.
2. If the whole-number parts are equal, compare their **tenths digits**.
3. If the tenths digits are also equal, compare their **hundredths digits**, followed by thousandths if necessary.
4. At the first place where the digits differ, the number having the **larger digit is the greater decimal**.
5. For example, in comparing 1.23 and 1.32, the tenths digits show that **1.32 > 1.23**.

5. Explain the procedure for adding decimal numbers.

Answer:

1. Write the decimal numbers one below the other with the **decimal points aligned**.

2. Ensure that digits having the same place value are placed in the **same column**.
3. Begin addition from the **rightmost place** and proceed towards the left.
4. Regroup when necessary, remembering that **10 hundredths make 1 tenth and 10 tenths make 1 unit**.
5. Write the decimal point in the answer directly in line with the decimal points of the given numbers.

6. Explain the procedure for subtracting decimal numbers.

Answer:

1. Arrange the decimal numbers vertically so that their **decimal points are aligned**.
2. Place digits of the same place value, such as units, tenths, and hundredths, in the **same columns**.
3. Begin subtraction from the **rightmost decimal place**.
4. If the upper digit is smaller, **regroup from the next higher place value**.
5. Continue the subtraction and place the decimal point correctly in the final answer.

7. Explain how decimals can be located on a number line.

Answer:

1. First identify the **two whole numbers** between which the given decimal lies.
2. Divide the interval between the whole numbers into **10 equal parts** to represent tenths.
3. To locate hundredths, divide the required tenth interval again into **10 equal parts**.
4. To locate thousandths, divide the required hundredth interval further into **10 equal parts**.
5. In this way, numbers such as **4.185 can be located precisely** by successively magnifying the required interval.

8. Explain how smaller units help in measuring lengths accurately.

Answer:

1. Whole units such as centimetres may not always give an **exact measurement** of an object.
2. A centimetre can be divided into **10 equal parts**, with each part representing one-tenth of a centimetre.
3. Such smaller divisions make it possible to express measurements like $2\frac{7}{10}$cm.
4. The same measurement can be conveniently written in decimal notation as **2.7 cm**.
5. Thus, tenths and still smaller subdivisions enable us to record **more precise measurements**.

9. Explain the relationship between different metric units of length using decimals.

Answer:

1. **1 centimetre = 10 millimetres**, so 1 millimetre is 0.1 centimetre.
2. Therefore, millimetres can be converted to centimetres by **dividing by 10**.
3. **1 metre = 100 centimetres**, so 1 centimetre is 0.01 metre.
4. Therefore, centimetres can be converted to metres by **dividing by 100**.
5. Decimal notation thus makes it convenient to express a measurement in **different related units**.

10. Explain how decimals are used to represent weight.

Answer:

1. The relationship between kilograms and grams is **1 kg = 1000 g**.
2. Therefore, one gram represents **0.001 kg**.
3. To convert grams into kilograms, the number of grams is **divided by 1000**.
4. For example, **750 g = 0.750 kg = 0.75 kg**.
5. Thus, decimals allow quantities smaller than one kilogram to be **expressed conveniently in kilograms**.

11. Explain how decimals are used in representing money.
Answer:
1. In Indian currency, **₹1 = 100 paise**.
2. Therefore, one paisa represents $\frac{1}{100}$ **of a rupee or ₹0.01**.
3. An amount of 50 paise can be expressed as **₹0.50**.
4. Similarly, 75 paise can be expressed as **₹0.75**.
5. Decimal notation therefore provides a convenient way of expressing **rupees and paise together**.

12. Explain equivalent decimals with suitable examples.
Answer:
1. **Equivalent decimals** are decimal numbers that have the same numerical value.
2. A zero can be added at the extreme right of a decimal number **without changing its value**.
3. Thus, **4.5 and 4.50** represent the same quantity.
4. Similarly, **4.50 and 4.500** also represent the same quantity.
5. Therefore, **4.5 = 4.50 = 4.500**, although they are written with different numbers of decimal places.

13. Explain the decimal number 4.45 using different place values.
Answer:
1. The digit 4 before the decimal point represents **4 whole units**.
2. The first digit 4 after the decimal point represents **4 tenths**.
3. The digit 5 represents **5 hundredths**.
4. Therefore, its expanded form is $4 + \frac{4}{10} + \frac{5}{100}$.
5. Hence, **4 units + 4 tenths + 5 hundredths = 4.45**.

14. Describe how the value of a digit changes when its position changes in the decimal system.
Answer:
1. The value of a digit depends on its **position or place** in the number.
2. Moving a digit one place to the **left multiplies its place value by 10**.
3. Moving a digit one place to the **right divides its place value by 10**.
4. Thus, a digit 5 may represent **5 units, 5 tenths, or 5 hundredths**, depending on its position.
5. This place-value relationship is the basis for correctly **reading and interpreting decimal numbers**.

15. Explain how decimal sequences can be completed.
Answer:
1. First observe the **difference between consecutive terms** of the decimal sequence.
2. Identify whether the same decimal number is being **added or subtracted repeatedly**.
3. For example, in **4.4, 4.8, 5.2, 5.6**, the common increase is 0.4.
4. Adding 0.4 to 5.6 gives the next term **6.0**.
5. Continuing the same rule gives **6.4, 6.8, and so on**.

3.12 Five-mark questions with Answers of HOTS Type: (15 Questions)

Five-Mark Descriptive Questions with Answers – HOTS Type:
1. A student says that 5.8 is smaller than 5.65 because 8 is smaller than 65. Analyse the statement and find the correct relation.
Answer:

1. Decimal numbers must be compared according to their **place values**, not by comparing 8 and 65 as whole numbers.
2. Write **5.8 as 5.80** so that both numbers have the same number of decimal places.
3. Both numbers have 5 units, but 5.80 has **8 tenths**, whereas 5.65 has 6 tenths.
4. Since 8 tenths are greater than 6 tenths, **5.80 > 5.65**.
5. Therefore, the student's statement is incorrect and the correct relation is **5.8 > 5.65**.

2. A ribbon of length 8.50 m is cut into two pieces, one measuring 3.75 m. Find the length of the other piece and explain the calculation.

Answer:

1. The total length of the ribbon is **8.50 m**, and the first piece measures 3.75 m.
2. The length of the second piece is found by subtracting **3.75 from 8.50**.
3. Aligning the decimal points gives $8.50 - 3.75$.
4. Performing the subtraction gives **4.75 m**.
5. Therefore, the length of the remaining piece is **4.75 m**.

3. Arrange 4.5, 4.05, 4.505 and 4.005 in ascending order and explain your reasoning.

Answer:

1. Write the numbers with equal decimal places as **4.500, 4.050, 4.505 and 4.005**.
2. All four numbers have the same units digit, so their decimal places must be compared.
3. Among them, **4.005** has the smallest fractional part, followed by 4.050.
4. Comparing 4.500 and 4.505 shows that **4.500 < 4.505** at the thousandths place.
5. Therefore, the ascending order is **4.005 < 4.05 < 4.5 < 4.505**.

4. A person's weight changes from 35.75 kg to 34.50 kg. Find the decrease in kilograms and grams.

Answer:

1. The original weight is **35.75 kg**, while the new weight is 34.50 kg.
2. The decrease is $35.75 - 34.50 = 1.25$kg.
3. Since **1 kg = 1000 g**, 1.25 kg can be converted into grams.
4. Multiplying 1.25 by 1000 gives **1250 g**.
5. Therefore, the decrease in weight is **1.25 kg or 1250 g**.

5. A number contains 4 units, 4 tenths and 5 hundredths. Express it as a decimal, as hundredths, and in expanded form.

Answer:

1. Four units, four tenths and five hundredths can be written as $4 + \frac{4}{10} + \frac{5}{100}$.
2. Therefore, its decimal representation is **4.45**.
3. Four units are equal to **400 hundredths**.
4. Four tenths are 40 hundredths, so $400 + 40 + 5 = 445$hundredths.
5. Hence, $4.45 = 4 + \frac{4}{10} + \frac{5}{100} = 445$**hundredths**.

6. A student adds 3.6 and 2.45 and gets 2.81 because the digits were written without aligning decimal points. Identify the mistake and solve correctly.

Answer:

1. The student's mistake is that digits with **different place values were placed in the same columns**.
2. The number 3.6 should be written as **3.60** before adding it to 2.45.
3. The hundredths are $0 + 5 = 5$, while the tenths are $6 + 4 = 10$, requiring regrouping.
4. Adding correctly gives $3.60 + 2.45 = 6.05$.
5. Therefore, the correct answer is **6.05**, and decimal points must be aligned during addition.

7. Find the next four terms in the sequence 4.4, 4.8, 5.2, 5.6 and explain how you identified them.

Answer:
1. The difference between 4.4 and 4.8 is **0.4**.
2. The same increase of 0.4 occurs from 4.8 to 5.2 and from 5.2 to 5.6.
3. Therefore, the rule of the sequence is to **add 0.4 to each preceding term**.
4. Continuing the pattern gives **6.0, 6.4, 6.8 and 7.2**.
5. Hence, the next four terms are **6.0, 6.4, 6.8 and 7.2**.

8. Explain how you would locate 4.185 accurately on a number line.
Answer:
1. First identify that **4.185 lies between 4 and 5**, and then focus on the interval between 4.1 and 4.2.
2. Divide the interval from 4.1 to 4.2 into **10 equal parts** to identify hundredths.
3. The number 4.185 lies between **4.18 and 4.19**.
4. Divide the interval from 4.18 to 4.19 into 10 equal parts, each representing **0.001**.
5. The fifth subdivision after 4.18 represents **4.185**, locating the number precisely.

9. A shopkeeper receives ₹10.00 for an item costing ₹6.75. Find the change and express it in both rupees and paise.
Answer:
1. The amount received is **₹10.00**, and the cost of the item is ₹6.75.
2. The change is calculated as **₹10.00 − ₹6.75**.
3. Subtracting the decimal amounts gives **₹3.25**.
4. Since ₹1 equals 100 paise, **₹3.25 = 325 paise**.
5. Therefore, the shopkeeper should return **₹3.25 or 325 paise**.

10. A student says that 7.05, 7.5 and 7.50 are all equal because they contain the same non-zero digits. Evaluate the statement.
Answer:
1. The value of a digit in a decimal number depends on its **place**, not merely on the digit itself.
2. In 7.05, the digit 5 represents **5 hundredths**, whereas in 7.5 it represents 5 tenths.
3. Therefore, **7.05 is smaller than 7.5**.
4. However, 7.5 and 7.50 are equivalent because the final zero does not change the value.
5. Hence, the correct relationship is **7.05 < 7.5 = 7.50**.

11. A bag contains 0.25 kg of beans, 0.30 kg of carrots and 0.50 kg of potatoes. Find the total weight in kilograms and grams.
Answer:
1. Add the first two weights: **0.25 + 0.30 = 0.55 kg**.
2. Add the third weight to obtain **0.55 + 0.50 = 1.05 kg**.
3. Therefore, the total weight is **1.05 kg**.
4. Since 1 kg equals 1000 g, $1.05 \times 1000 = 1050\text{g}$.
5. Hence, the total weight is **1.05 kg or 1050 g**.

12. A number lies exactly halfway between 4.18 and 4.20. Find the number and justify your answer.
Answer:
1. The difference between the two numbers is **4.20 − 4.18 = 0.02**.
2. Half of this difference is **0.02 ÷ 2 = 0.01**.
3. Add this half-difference to the smaller number: **4.18 + 0.01 = 4.19**.
4. The distances from 4.19 to both 4.18 and 4.20 are **0.01**.
5. Therefore, the decimal exactly halfway between **4.18 and 4.20 is 4.19**.

13. A measurement is $2\frac{7}{10}$cm. Express it as a decimal, convert it into millimetres, and explain why smaller units are useful.

Answer:

1. The mixed measurement $2\frac{7}{10}$cm means **2 centimetres and 7 tenths of a centimetre**.
2. Its decimal representation is **2.7 cm**.
3. Since 1 cm equals 10 mm, **2.7 cm = 27 mm**.
4. Millimetres provide smaller divisions than whole centimetres and therefore allow **more precise measurement**.
5. Hence, the same measurement can be expressed as $2\frac{7}{10}$**cm = 2.7 cm = 27 mm**.

14. A decimal number has 2 units, 3 tenths and 15 hundredths. Regroup the number and write it in standard decimal form.

Answer:

1. The given quantity can be written as **2 + 0.3 + 0.15**.
2. Since 10 hundredths make one tenth, **15 hundredths = 1 tenth + 5 hundredths**.
3. The original 3 tenths and the regrouped 1 tenth together make **4 tenths**.
4. Thus, the number consists of **2 units, 4 tenths and 5 hundredths**.
5. Therefore, its standard decimal form is **2.45**.

15. A student claims that 0.1 and 0.01 differ only in the number of zeros and therefore have almost the same place value. Explain why this is incorrect.

Answer:

1. The decimal **0.1 represents one tenth**, while 0.01 represents one hundredth.
2. One tenth is equivalent to **10 hundredths**, so $0.1 = 0.10$.
3. Therefore, **0.10 is ten times 0.01**.
4. The position of the digit 1 determines whether it represents a tenth or a hundredth.
5. Hence, **0.1 > 0.01**, and their place values are different because each successive place to the right is ten times smaller.

3.13 Five-mark questions with Answers of Applied Type: (12 Questions)

Five-Mark Descriptive Questions with Answers – Applied Type:

1. Measuring a Ribbon

A tailor has a ribbon **8.50 m** long. He uses **3.75 m** for decorating a dress. How much ribbon is left? Explain the steps.

Answer:

1. The original length of the ribbon is **8.50 m**.
2. The length used for decoration is **3.75 m**.
3. The remaining length is found by subtraction: **8.50 − 3.75**.
4. On subtracting, we get **4.75 m**.
5. Therefore, the tailor has **4.75 m of ribbon left**.

2. Buying Vegetables

A family buys **0.25 kg of beans, 0.30 kg of carrots, and 0.50 kg of potatoes**. Find the total weight of the vegetables in kilograms and grams.

Answer:

1. The three weights are **0.25 kg, 0.30 kg, and 0.50 kg**.
2. Adding the first two gives **0.25 + 0.30 = 0.55 kg**.
3. Adding the third gives **0.55 + 0.50 = 1.05 kg**.
4. Since 1 kg = 1000 g, **1.05 kg = 1050 g**.
5. Therefore, the total weight is **1.05 kg or 1050 g**.

3. Shopping and Finding Change

Meera buys a notebook costing **₹6.75** and gives the shopkeeper **₹10.00**. Find the amount of change she should receive in rupees and paise.

Answer:

1. The amount paid by Meera is **₹10.00**.
2. The cost of the notebook is **₹6.75**.
3. The change is **₹10.00 − ₹6.75 = ₹3.25**.
4. Since ₹1 = 100 paise, **₹3.25 = 325 paise**.
5. Therefore, Meera should receive **₹3.25 or 325 paise** as change.

4. Measuring a Screw

A screw measures $2\frac{7}{10}$cm. Express its length in decimal form and then convert it into millimetres.

Answer:

1. The screw measures **2 whole centimetres and 7 tenths of a centimetre**.
2. Seven-tenths is written as the decimal **0.7**.
3. Therefore, $2\frac{7}{10}$cm = **2.7 cm**.
4. Since 1 cm = 10 mm, **2.7 × 10 = 27 mm**.
5. Hence, the screw measures **2.7 cm or 27 mm**.

5. Change in Body Weight

A person's weight was **35.75 kg** in one month and **34.50 kg** in the next month. Calculate the decrease in weight and express it in grams.

Answer:

1. The earlier weight was **35.75 kg**, and the later weight was 34.50 kg.
2. The decrease is **35.75 − 34.50 = 1.25 kg**.
3. Thus, the person's weight decreased by **1.25 kg**.
4. Since 1 kg = 1000 g, **1.25 kg = 1250 g**.
5. Therefore, the decrease in weight is **1.25 kg or 1250 g**.

6. Joining Two Pieces of Rope

A worker joins two ropes measuring **3.75 m** and **2.60 m**. Find the total length of the joined rope.

Answer:

1. The first rope measures **3.75 m**, and the second measures 2.60 m.
2. The decimal points are aligned before adding the lengths.
3. Adding gives **3.75 + 2.60 = 6.35 m**.
4. Thus, the combined length of the two ropes is **6.35 m**.
5. Therefore, the worker gets a rope of **6.35 m** after joining them.

7. Converting a Student's Height

A student's height is measured as **145 cm**. Express the height in metres and explain the conversion.

Answer:

1. The student's height is **145 cm**.
2. We know that **100 cm = 1 m**.
3. Therefore, centimetres are converted to metres by dividing by 100.
4. Thus, **145 ÷ 100 = 1.45 m**.
5. Hence, the student's height is **1.45 m**.

8. Comparing Running Distances

During a sports activity, Anu runs **2.75 km** and Ravi runs **2.8 km**. Who runs farther and by how much?

Answer:

1. Anu runs **2.75 km**, while Ravi runs 2.8 km.
2. Write 2.8 as **2.80** to compare the decimal places.
3. Since **2.80 > 2.75**, Ravi runs farther.

4. The difference is **2.80 − 2.75 = 0.05 km**.
5. Therefore, **Ravi runs 0.05 km farther than Anu**.

9. Packing Food Items

A shopkeeper packs **0.75 kg of rice** and **0.50 kg of pulses** in one bag. Find the total weight in kilograms and grams.

Answer:

1. The rice weighs **0.75 kg**, and the pulses weigh 0.50 kg.
2. Their combined weight is **0.75 + 0.50 = 1.25 kg**.
3. Therefore, the bag weighs **1.25 kg**.
4. Since 1 kg = 1000 g, **1.25 kg = 1250 g**.
5. Hence, the total weight of the packed items is **1.25 kg or 1250 g**.

10. Locating a Measurement on a Number Line

A science experiment gives a reading of **4.185 units**. Explain how a student can locate this value accurately on a number line.

Answer:

1. First locate the interval from **4.1 to 4.2** on the number line.
2. Divide this interval into 10 equal parts and locate **4.18 and 4.19**.
3. Divide the interval between 4.18 and 4.19 into **10 equal parts**.
4. Each small division represents **0.001**, and the fifth division after 4.18 gives 4.185.
5. Therefore, **4.185 can be located precisely by successive subdivision of the number line**.

11. Using Decimal Place Value in a Measurement

A container holds **4 units, 4 tenths, and 5 hundredths** of a liquid. Express the quantity as a decimal and as hundredths.

Answer:

1. The quantity consists of **4 units + 4 tenths + 5 hundredths**.
2. Its decimal representation is **4.45 units**.
3. Four whole units are equivalent to **400 hundredths**.
4. Four tenths are 40 hundredths, so the total is **400 + 40 + 5 = 445 hundredths**.
5. Therefore, the quantity can be expressed as **4.45 units or 445 hundredths**.

12. Planning a Walking Distance

A child walks **1.25 km** in the morning and **2.35 km** in the evening. If the daily target is **4 km**, find how much farther the child needs to walk.

Answer:

1. The morning distance is **1.25 km**, and the evening distance is 2.35 km.
2. The total distance walked is **1.25 + 2.35 = 3.60 km**.
3. The target distance is **4.00 km**.
4. The remaining distance is **4.00 − 3.60 = 0.40 km**.
5. Therefore, the child needs to walk **0.40 km more** to reach the target.

These applied questions assess the chapter concepts through **measurement, money, weight, comparison, decimal operations, unit conversion, place value, and number-line applications**, while keeping each answer suitable for a **five-mark, five-step response**.

3.14 Multiple Choice Questions with answers for Olympiad type Competitive Exams:

Olympiad-Type Multiple Choice Questions with Answers:

These questions focus on **decimal place value, comparison, equivalence, number lines, measurement, conversions, patterns, addition and subtraction**, as developed in the uploaded chapter.

1. Which of the following represents 4 units, 7 tenths and 3 hundredths?
A) 4.703
B) 4.73
C) 47.3
D) 4.073
Answer: B) 4.73
2. Which digit has the greatest place value in 5.274?
A) 2
B) 7
C) 4
D) 5
Answer: D) 5
3. Which of the following is the greatest number?
A) 4.5
B) 4.05
C) 4.505
D) 4.055
Answer: C) 4.505
4. Which is the correct ascending order?
A) 3.5, 3.05, 3.005
B) 3.005, 3.05, 3.5
C) 3.05, 3.005, 3.5
D) 3.5, 3.005, 3.05
Answer: B) 3.005, 3.05, 3.5
5. Which number is closest to 4?
A) 3.56
B) 3.65
C) 4.5
D) 4.45
Answer: B) 3.65
Explanation: Its distance from 4 is 0.35, which is the least among the options. The chapter includes this type of closest-decimal comparison.
6. Which statement is correct?
A) $5.4 > 5.40$
B) $5.4 < 5.40$
C) $5.4 = 5.40$
D) $5.40 = 54$
Answer: C) 5.4 = 5.40
7. The number 0.274 can be written as:
A) $\frac{2}{10} + \frac{7}{100} + \frac{4}{1000}$
B) $\frac{2}{100} + \frac{7}{10} + \frac{4}{1000}$
C) $\frac{2}{10} + \frac{7}{1000} + \frac{4}{100}$
D) $\frac{274}{100}$
Answer: A) $\frac{2}{10} + \frac{7}{100} + \frac{4}{1000}$
8. How many hundredths are equal to 3.5?
A) 35
B) 350
C) 305

D) 3500
Answer: B) 350
9. Which of the following is equal to 45 hundredths?
A) 4.5
B) 0.45
C) 0.045
D) 45.0
Answer: B) 0.45
10. Which number lies exactly halfway between 2.4 and 2.6?
A) 2.45
B) 2.50
C) 2.55
D) 2.65
Answer: B) 2.50
11. What should be added to 4.75 to obtain 5?
A) 0.15
B) 0.20
C) 0.25
D) 0.35
Answer: C) 0.25
12. Find the missing number: $3.45 + \square = 5.00$.
A) 1.45
B) 1.55
C) 1.65
D) 2.55
Answer: B) 1.55
13. Which is the smallest number?
A) 0.9
B) 0.09
C) 0.909
D) 0.99
Answer: B) 0.09
14. If $A = 2.05$, $B = 2.5$, **and** $C = 2.005$, **which relation is correct?**
A) A > B > C
B) C > A > B
C) B > A > C
D) A > C > B
Answer: C) B > A > C
Explanation: Writing them as 2.050, 2.500 and 2.005 makes the comparison clear.
15. A screw measures 2.7 cm. What is its length in millimetres?
A) 0.27 mm
B) 2.7 mm
C) 27 mm
D) 270 mm
Answer: C) 27 mm
16. 65 mm is equal to:
A) 0.65 cm
B) 6.5 cm
C) 65 cm

D) 650 cm
Answer: B) 6.5 cm
17. 275 cm is equal to:
A) 0.275 m
B) 2.075 m
C) 2.75 m
D) 27.5 m
Answer: C) 2.75 m
18. 1.25 kg is equal to:
A) 125 g
B) 1025 g
C) 1250 g
D) 12,500 g
Answer: C) 1250 g
19. Which is equal to 750 g?
A) 7.5 kg
B) 0.75 kg
C) 0.075 kg
D) 75 kg
Answer: B) 0.75 kg
20. ₹3.75 is equal to:
A) 37.5 paise
B) 75 paise
C) 300 paise
D) 375 paise
Answer: D) 375 paise
21. A student buys an item for ₹6.75 and pays ₹10. What change should the student receive?
A) ₹2.25
B) ₹3.15
C) ₹3.25
D) ₹3.75
Answer: C) ₹3.25
22. What is $4.75 + 2.6$**?**
A) 6.35
B) 7.25
C) 7.35
D) 7.45
Answer: C) 7.35
Decimal addition requires corresponding place values to be aligned.
23. Find $8.5 - 3.75$**.**
A) 4.25
B) 4.75
C) 5.25
D) 5.75
Answer: B) 4.75
24. A bag contains 0.25 kg, 0.30 kg and 0.50 kg of three items. What is their total weight?
A) 0.95 kg
B) 1.00 kg

C) 1.05 kg
D) 1.50 kg
Answer: C) 1.05 kg
25. A person's weight decreases from 35.75 kg to 34.50 kg. What is the decrease?
A) 0.75 kg
B) 1.15 kg
C) 1.25 kg
D) 1.75 kg
Answer: C) 1.25 kg
26. Find the next term: 4.4, 4.8, 5.2, 5.6, _____.
A) 5.8
B) 5.9
C) 6.0
D) 6.2
Answer: C) 6.0
Explanation: Each term increases by 0.4.
27. Which number comes next in the pattern 2.05, 2.15, 2.25, 2.35, _____?
A) 2.40
B) 2.45
C) 2.55
D) 3.35
Answer: B) 2.45
28. If 10 hundredths are removed from 3.45, what remains?
A) 2.45
B) 3.35
C) 3.44
D) 3.55
Answer: B) 3.35
29. Which decimal has 6 in the hundredths place?
A) 3. sixty?
B) 3.06
C) 3.60
D) 3.006
Answer: B) 3.06
30. Which statement about 4.185 is correct?
A) 1 represents one hundredth.
B) 8 represents eight tenths.
C) 5 represents five thousandths.
D) 4 represents four tenths.
Answer: C) 5 represents five thousandths.
31. If 0.1 = **□hundredths, what is the value of □?**
A) 1
B) 10
C) 100
D) 1000
Answer: B) 10
32. Which pair represents equivalent decimals?
A) 3.5 and 3.05
B) 3.5 and 3.50
C) 3.5 and 35.0

D) 3.5 and 0.35
Answer: B) 3.5 and 3.50
33. A number is greater than 5.25 but less than 5.30. Which could be the number?
A) 5.20
B) 5.24
C) 5.27
D) 5.31
Answer: C) 5.27
34. Which number is exactly 0.01 greater than 7.99?
A) 7.90
B) 7.991
C) 8.00
D) 8.09
Answer: C) 8.00
35. Which number is exactly 0.1 less than 10.05?
A) 9.05
B) 9.95
C) 10.04
D) 10.15
Answer: B) 9.95
36. If 4.185 is located on a number line, between which two hundredths does it lie?
A) 4.17 and 4.18
B) 4.18 and 4.19
C) 4.19 and 4.20
D) 4.10 and 4.11
Answer: B) 4.18 and 4.19
37. Which expression has the greatest value?
A) $4 + 0.5$
B) $4 + 0.05$
C) $4 + 0.005$
D) $4 + 0.0005$
Answer: A) $4 + 0.5$
38. If 25 hundredths are added to 75 hundredths, the result is:
A) 0.10
B) 0.90
C) 1.00
D) 10.00
Answer: C) 1.00
39. Which number has 3 units, 0 tenths and 7 hundredths?
A) 3.7
B) 3.07
C) 3.007
D) 30.7
Answer: B) 3.07
40. A decimal number has 2 units, 3 tenths and 15 hundredths. What is its standard decimal form?
A) 2.315
B) 2.35
C) 2.45
D) 3.45

Answer: C) 2.45
Explanation: 15 hundredths = 1 tenth + 5 hundredths, so $2 + 0.3 + 0.15 = 2.45$.

Answer Key:
1-B, 2-D, 3-C, 4-B, 5-B, 6-C, 7-A, 8-B, 9-B, 10-B, 11-C, 12-B, 13-B, 14-C, 15-C, 16-B, 17-C, 18-C, 19-B, 20-D, 21-C, 22-C, 23-B, 24-C, 25-C, 26-C, 27-B, 28-B, 29-B, 30-C, 31-B, 32-B, 33-C, 34-C, 35-B, 36-B, 37-A, 38-C, 39-B, 40-C.

3.15 Best Practices Opportunity List from the Chapter: (15 Ideas)

"Best Practices" Opportunities for Teaching:
The following practices are closely aligned with the chapter's focus on **tenths, hundredths, decimal place value, measurement, number lines, comparison, and decimal operations**.

(1) **Begin with Real Measurement Activities:** Let students measure pencils, screws, notebooks, ribbons, and other classroom objects using rulers marked in centimetres and millimetres. Ask them to express measurements such as $2\frac{7}{10}$cm as **2.7 cm**, helping them understand why fractional decimal units are needed for precise measurement.

(2) **Use a Place-Value Chart:** Display a chart showing **Hundreds–Tens–Ones–Tenths–Hundredths–Thousandths** and regularly ask students to place decimal numbers such as 70.5, 7.05, and 0.274 in it. This reinforces the chapter's extension of the base-10 place-value system to the right of the decimal point.

(3) **Teach Decimals through Concrete Fraction Models:** Use grids, strips, or paper squares divided into **10 and 100 equal parts** to demonstrate tenths and hundredths. Students should physically see that **10 hundredths = 1 tenth** and **100 hundredths = 1 whole** before moving to symbolic decimal notation.

(4) **Use Number-Line Exploration:** Draw large number lines and have students locate decimals by successively dividing intervals into tenths, hundredths, and thousandths. Challenging examples such as **4.185** can demonstrate how "zooming in" on a number line improves precision.

(5) **Practise Comparison through "Decimal Challenges":** Give pairs or groups of decimals such as **4.5, 4.05, 4.005** and ask students to justify the order using place value rather than the number of digits. Encourage the rule of comparing numbers from the **most significant place** until the first difference appears.

(6) **Connect Decimals with Everyday Units:** Regularly use practical conversions involving **millimetres and centimetres, centimetres and metres, grams and kilograms, and rupees and paise**. This makes decimals meaningful rather than treating them only as abstract numbers.

(7) **Insist on Decimal-Point Alignment:** While teaching addition and subtraction, train students to arrange numbers according to their **place values and align decimal points vertically**. Use place-value language during regrouping so students understand why 10 hundredths can be exchanged for 1 tenth.

(8) **Use Error-Analysis Questions:** Present deliberately incorrect statements such as **"4.50 > 4.5 because 4.50 has more digits"** or **"0.75 > 0.8 because 75 > 8."** Ask students to identify the misconception, correct it, and justify the correction using place value.

(9) **Include Decimal Pattern Activities:** Give sequences such as **4.4, 4.8, 5.2, 5.6, …** and ask students to identify the change and predict subsequent terms. This develops observation and numerical reasoning alongside decimal computation.

(10) **Use Think–Pair–Share:** Pose questions such as, "Which is closer to 4: 3.56 or 3.65?" Students first solve individually, then discuss with a partner, and finally explain their

reasoning to the class. This encourages mathematical communication rather than answer-only learning.

(11) **Follow Concrete → Pictorial → Abstract Progression:** Introduce a concept using measurable objects or divided strips, represent it through grids/place-value charts/number lines, and only then move to numerical notation and calculations. This progression is particularly useful for understanding **tenths and hundredths**.

(12) **Use Short Daily Mental-Maths Drills:** Begin or end lessons with quick questions such as **"10 hundredths = ?," "0.5 = how many hundredths?," "75 paise = ₹?,"** and **"Which is greater: 3.09 or 3.9?"** This builds fluency in decimal place value and conversions.

(13) **Encourage Multiple Representations:** Ask students to represent the same quantity in different ways, for example: **4.45 = 4 units + 4 tenths + 5 hundredths** = $4 + \frac{4}{10} + \frac{5}{100}$= **445 hundredths.** This strengthens conceptual understanding of equivalence.

(14) **Balance LOTS and HOTS Practice:** Begin with recall and routine conversion questions, then progress to **comparison, error analysis, missing-value problems, closest-number questions, and real-life applications**. This supports both school examinations and higher-order/competitive problem solving.

(15) **Use Exit Tickets for Continuous Assessment:** At the end of each lesson, give three short tasks—for example, one **place-value question, one comparison or operation, and one application problem**. The responses can quickly identify misconceptions that need reinforcement before proceeding to the next decimal concept.

3.16 Innovations Opportunity List from the Chapter: (15 Ideas)

"Innovations" Opportunities in Teaching–Learning for 7th Standard:

The following innovative activities can make the chapter more **interactive, experiential, visual, collaborative, and application-oriented**, while reinforcing tenths, hundredths, place value, comparison, measurement, decimal operations, and number lines.

(1) **Human Decimal Number Line:** Create a large number line on the classroom floor and give students decimal-number cards. Students physically position themselves at locations such as **4.1, 4.18, 4.185, and 4.19**, progressively "zooming in" from tenths to hundredths and thousandths. This converts the chapter's number-line exploration into a kinesthetic learning experience.

(2) **Decimal Measurement Lab:** Convert the classroom into a mini measurement laboratory where groups measure pencils, screws, books, desks, ribbons, and other objects. Students record measurements in different forms, such as $2\frac{7}{10}$**cm, 2.7 cm, and 27 mm**, connecting decimal notation directly with precision in measurement.

(3) **Build-a-Decimal with Grid Models:** Give students 10×10 grids, paper strips, or reusable transparent sheets and challenge them to construct decimals visually. For example, students can represent **4 units, 4 tenths and 5 hundredths** and discover why the number is **4.45**.

(4) **Decimal Shopping Mart:** Set up a mock classroom shop with products carrying decimal prices. Give students play money and ask them to **purchase items, calculate totals, compare prices, and determine change**, providing an engaging context for decimal addition and subtraction.

(5) **Decimal Detective – Find the Mistake:** Present intentionally incorrect solutions such as **0.75 > 0.8**, **5.4 < 5.40**, or incorrectly aligned decimal additions. Students act as "Decimal Detectives" to identify, correct, and explain each error using place-value

reasoning. The chapter emphasizes comparison from the most significant place and correct decimal operations.

(6) **Place-Value Flip Cards:** Create movable digit cards for **ones, tenths, hundredths, and thousandths**. Students move the same digit from one position to another and explain how its value changes—for example, comparing **5, 0.5, 0.05, and 0.005**—making the base-10 structure visually apparent.

(7) **Decimal Escape-Room Challenge:** Organize teams that solve a chain of decimal puzzles involving **place value, comparison, equivalent decimals, measurement, number lines, and operations**. Each correct solution provides a clue or code needed to unlock the next challenge, turning revision into collaborative problem solving.

(8) **Digital Decimal Zoom:** Use an interactive whiteboard or presentation to visually magnify a number line—first from **4 to 5**, then 4.1 to 4.2, and finally 4.18 to 4.19. Students can predict where **4.185** will appear before the final magnification, closely reflecting the chapter's successive subdivision approach.

(9) **Decimal Conversion Relay:** Divide students into teams and give each team conversion cards. One student may convert **27 mm → 2.7 cm**, another convert a fractional quantity to decimal notation, and another represent a decimal using place values. The relay format encourages speed while retaining conceptual reasoning.

(10) **Create-a-Pattern Challenge:** Instead of only completing decimal sequences, ask students to **design their own decimal patterns** and exchange them with classmates. For example, a learner may create **4.4, 4.8, 5.2, 5.6, …**, while another identifies the rule and predicts the next terms.

(11) **Decimal Card Battle:** Give pairs of students randomly selected decimal cards such as **4.5, 4.05, 4.505, and 4.055**. Each pair compares the cards, and the student who correctly identifies the larger number must also **justify the answer using place value** to earn the point.

(12) **Student-Created Decimal Story Problems:** Ask learners to create their own short problems involving **length, weight, money, or other decimal quantities** based on the chapter exercises. Students exchange problems, solve them, and evaluate whether their classmates' answers and methods are correct.

(13) **"I Am a Decimal" Role Play:** Assign students roles such as **Unit, Tenth, Hundredth, Thousandth, and Decimal Point**. Give a number such as **7.05 or 0.274**, and students arrange themselves physically to form it and explain the value represented by each position.

(14) **Decimal Concept Map Wall:** Students collaboratively develop a classroom wall map connecting **fractions → tenths → hundredths → decimal notation → place value → comparison → number line → measurement → addition/subtraction**. New examples can be added as each part of the chapter is completed.

(15) **Student-Designed Mini Decimal Game:** As a culminating innovation, small groups can design a board game, card game, quiz, or puzzle using concepts from the chapter. Require each game to include at least one task on **place value, comparison, number-line location, measurement, and decimal operations**, turning students from problem-solvers into **creators of mathematical learning experiences**.

3.17: Practicing Questions/Question Bank :

A. Fill-in-the-Blank Questions:

1. One-tenth is written in decimal form as ________.
   Answer: 0.1

2. One-hundredth is written as ________.
Answer: 0.01

3. Ten hundredths are equal to ________ tenth.
Answer: one

4. In 5.47, the digit 4 is in the ________ place.
Answer: tenths

5. In 8.305, the digit 5 is in the ________ place.
Answer: thousandths

6. $4 + \frac{5}{10} + \frac{7}{100} =$________.
Answer: 4.57

7. 6.5 = 6.50 = ________.
Answer: 6.500

8. 1 cm = ________ mm.
Answer: 10

9. 325 cm = ________ m.
Answer: 3.25

10. 750 g = ________ kg.
Answer: 0.75

11. ₹1 = ________ paise.
Answer: 100

12. ₹4.75 = ________ paise.
Answer: 475

13. $5.75 + 2.25 =$________.
Answer: 8.00

14. $8.50 - 3.75 =$________.
Answer: 4.75

15. The number exactly halfway between 4.18 and 4.20 is ________.
Answer: 4.19

16. 4.185 lies between ________ and ________ to the nearest hundredths.
Answer: 4.18 and 4.19

17. 25 hundredths = ________.
Answer: 0.25

18. 4 units, 4 tenths and 5 hundredths = ________.
Answer: 4.45

19. 0.8________ 0.75.
Answer: >

20. The next term in 4.4, 4.8, 5.2, 5.6, ________ is **6.0**.

B. One-Mark Descriptive Questions:

1. **What is a tenth?**
   Answer: A tenth is one of ten equal parts of a whole and is written as 0.1.

2. **What is a hundredth?**
   Answer: A hundredth is one of one hundred equal parts of a whole and is written as 0.01.

3. **What is the role of the decimal point?**
   Answer: The decimal point separates the whole-number part from the fractional part.

4. **What is the place value of 7 in 4.73?**
   Answer: The place value of 7 is seven-tenths or 0.7.

5. **Write 45 hundredths as a decimal.**
   Answer: 0.45.

6. **Write 3.5 as an equivalent decimal with two decimal places.**
   Answer: 3.50.

7. **Which is greater: 4.05 or 4.5?**
   Answer: 4.5 is greater.

8. **Convert 27 mm into centimetres.**
   Answer: 27 mm = 2.7 cm.

9. **Convert 1.25 kg into grams.**
   Answer: 1.25 kg = 1250 g.

10. **What decimal lies midway between 5.2 and 5.4?**
    Answer: 5.3.

11. **Write** $2\frac{7}{10}$ **as a decimal.**
    Answer: 2.7.

12. **What is** $3.60 + 2.45$**?**
    Answer: 6.05.

13. **What is** $10.00 - 6.75$**?**
    Answer: 3.25.

14. **Which is smaller: 0.09 or 0.9?**
    Answer: 0.09.

15. **Between which two hundredths does 4.185 lie?**
    Answer: It lies between 4.18 and 4.19.

C. Two-Mark Descriptive Questions:

1. Explain why 4.5 and 4.50 are equivalent decimals.
Answer:

1. Adding a zero at the extreme right of a decimal does not change its value.
2. Therefore, **4.5 = 4.50**.

2. Compare 5.08 and 5.8 using place value.
Answer:

1. Write 5.8 as 5.80 and compare the tenths digits.
2. Since 8 tenths > 0 tenths, **5.80 > 5.08**.

3. Express 3 units, 4 tenths and 7 hundredths as a decimal.
Answer:

1. The expanded form is $3 + \frac{4}{10} + \frac{7}{100}$.
2. Therefore, the decimal is **3.47**.

4. Convert 375 cm into metres.
Answer:

1. Since 100 cm = 1 m, divide 375 by 100.
2. Therefore, **375 cm = 3.75 m**.

5. Find $6.75 + 2.50$**.**
Answer:

1. Align the decimal points and add corresponding place values.
2. $6.75 + 2.50 = 9.25$.

6. Find the difference between 8.5 and 3.75.
Answer:

1. Write 8.5 as 8.50 and subtract 3.75.
2. $8.50 - 3.75 = 4.75$.

7. Why is 0.8 greater than 0.75?
Answer:

1. Write 0.8 as 0.80.
2. Since 80 hundredths > 75 hundredths, **0.8 > 0.75**.

8. Convert ₹7.25 into paise.
Answer:

1. Since ₹1 = 100 paise, multiply 7.25 by 100.
2. Therefore, **₹7.25 = 725 paise**.

9. Find the next two terms: 4.4, 4.8, 5.2, 5.6, …
Answer:

1. Each term increases by 0.4.
2. Therefore, the next two terms are **6.0 and 6.4**.

10. Explain why smaller units are useful in measurement.
Answer:

1. Smaller units allow us to measure quantities that are not exact whole units.

2. For example, $2\frac{7}{10}$cm can be represented precisely as **2.7 cm**.

D. Three-Mark Descriptive Questions:

1. Explain the place values in 5.274.
Answer:

1. The digit 2 represents **2 tenths or 0.2**.
2. The digit 7 represents **7 hundredths or 0.07**.
3. The digit 4 represents **4 thousandths or 0.004**.

2. Arrange 4.5, 4.05 and 4.005 in ascending order.
Answer:

1. Write them as 4.500, 4.050 and 4.005.
2. Comparing the decimal places gives $4.005 < 4.050 < 4.500$.
3. Therefore, the order is **4.005, 4.05, 4.5**.

3. Explain how to add 3.6 and 2.45.
Answer:

1. Write 3.6 as **3.60** and align the decimal points.
2. Add corresponding place values: $3.60 + 2.45$.
3. Therefore, the answer is **6.05**.

4. Convert 2.75 m into centimetres and millimetres.
Answer:

1. Since 1 m = 100 cm, **2.75 m = 275 cm**.
2. Since 1 cm = 10 mm, 275 cm = **2750 mm**.
3. Hence, **2.75 m = 275 cm = 2750 mm**.

5. Explain how 4.185 can be located on a number line.
Answer:

1. First locate the interval between **4.1 and 4.2**.
2. Then locate the interval between **4.18 and 4.19**.
3. Divide this interval into ten equal parts and mark the fifth division after 4.18 as **4.185**.

6. A person's weight decreases from 35.75 kg to 34.50 kg. Find the decrease.
Answer:

1. Subtract the new weight from the earlier weight.
2. $35.75 - 34.50 = 1.25$kg.
3. Therefore, the weight decreased by **1.25 kg or 1250 g**.

7. Explain the relationship among tenths, hundredths and a whole.
Answer:

1. **10 tenths make one whole**.
2. **10 hundredths make one tenth**.
3. Therefore, **100 hundredths make one whole**.

8. A student says 7.05 = 7.5. Explain the error.
Answer:

1. In 7.05, the digit 5 is in the **hundredths place**.
2. In 7.5, the digit 5 is in the **tenths place**.
3. Therefore, **7.05 < 7.5**, and the two numbers are not equal.

E. Five-Mark Descriptive Questions:

1. Explain the decimal place-value system with a suitable example.
Answer:

1. The decimal number system is based on **powers of 10**.
2. Places to the left include ones, tens, hundreds, and so on.
3. Places to the right include tenths, hundredths, thousandths, and so on.
4. Each place is ten times the value of the place immediately to its right.
5. For example, in **4.275**, 2 represents tenths, 7 represents hundredths, and 5 represents thousandths.

2. Describe how decimal numbers are compared, using 5.8 and 5.65 as an example.
Answer:

1. First compare the whole-number parts of the two decimals.
2. Since both have 5 units, compare their fractional parts.
3. Write 5.8 as **5.80** to make comparison easier.
4. Since 8 tenths are greater than 6 tenths, **5.80 > 5.65**.
5. Therefore, **5.8 is greater than 5.65**.

3. A ribbon is 8.50 m long and 3.75 m is used. Find the remaining length and explain the procedure.
Answer:

1. The original ribbon length is **8.50 m**.
2. The length used is **3.75 m**.
3. Align the decimal points and calculate $8.50 - 3.75$.
4. The difference is **4.75 m**.
5. Therefore, **4.75 m of ribbon remains**.

4. Explain how decimals are useful in everyday measurements.
Answer:

1. Decimals allow quantities smaller than a whole unit to be represented accurately.
2. Lengths can be expressed using centimetres, millimetres, and decimal centimetres.
3. Weights can be represented conveniently in kilograms and grams.
4. Money can be represented using rupees and paise in decimal form.
5. Thus, decimals make **measurement, comparison and calculation of everyday quantities easier and more precise**.

5. A family buys 0.25 kg of beans, 0.30 kg of carrots and 0.50 kg of potatoes. Find the total weight and express it in grams.
Answer:

1. The weights are **0.25 kg, 0.30 kg and 0.50 kg**.
2. Adding the first two quantities gives $0.25 + 0.30 = 0.55$kg.
3. Adding the potatoes gives $0.55 + 0.50 = 1.05$kg.
4. Since 1 kg = 1000 g, **1.05 kg = 1050 g**.
5. Therefore, the total weight of the vegetables is **1.05 kg or 1050 g**.

6. Explain equivalent decimals and their importance in calculations and comparison.
Answer:

1. Equivalent decimals are different decimal representations having the **same numerical value**.
2. Adding zeros to the extreme right of the fractional part does not change the value.
3. Therefore, **4.5 = 4.50 = 4.500**.
4. Equivalent decimals help align place values when comparing, adding, or subtracting decimals.
5. For example, writing **3.6 as 3.60** makes addition with 2.45 easier and clearer.

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7th Standard Maths Book Chapter 4

Chapter 4: EXPRESSIONS USING LETTER-NUMBERS

4.1 Summary of the Chapter:

Summary – Key Points:

(1) **Letter-numbers:** Letters such as $a, n, x,$and $y$can be used to represent numbers whose values may vary or may not yet be known. These are called **letter-numbers**.

(2) **Algebraic expressions:** Mathematical expressions containing letter-numbers are called **algebraic expressions**. For example, if Shabnam is 3 years older than Aftab, their ages can be related by $s = a + 3$.

(3) **Expressing real-life relationships:** Algebraic expressions provide a short and convenient way of representing everyday mathematical relationships involving ages, costs, quantities, lengths, perimeters, and other measurements.

(4) **Finding the value of an expression:** The value of an algebraic expression can be found by **replacing the letter-number with a given numerical value** and carrying out the required operations. For example, $7k = 28$when $k = 4$.

(5) **Omission of the multiplication symbol:** In algebra, the multiplication sign is generally omitted when multiplying a number by a letter. Thus, $4 \times n$is written simply as $4n$, with the number written before the letter.

(6) **Arithmetic rules apply to algebra:** The familiar rules used for arithmetic expressions—such as **swapping, grouping, brackets, negative signs, and the distributive property**—also help in working with algebraic expressions.

(7) **Simplification of expressions:** Algebraic expressions can often be reduced to a simpler form without changing their value. For example, repeated occurrences of the same letter-number can be combined using the distributive property: $5c + 3c + 10c = 18c$.

(8) **Like and unlike terms:** Terms containing the same letter-number can be combined and simplified; terms involving different letter-numbers generally cannot be combined into one term. Thus, an expression such as $18c + 11d$is already in its simplest form.

(9) **Removing brackets:** Expressions involving brackets can be simplified carefully by applying the correct signs and then **grouping like terms**. For example, $(40x + 75y) - (6x + 10y)$simplifies to $34x + 65y$.

(10) **Expressions and formulas:** Algebraic expressions can be used as **formulas** to describe general relationships between quantities. A number machine, for example, can be represented by a formula such as $2a - b$.

(11) **Describing patterns:** Algebra makes it possible to express repeating patterns using a general rule. For example, the nth term of the sequence 4,8,12,16, ...is represented by $4n$.

(12) **Power of algebraic modelling:** Algebraic expressions help us **identify patterns, establish relationships, make predictions, and explain why a mathematical pattern always works**. For example, algebra can prove that the two diagonal sums in any 2×2calendar block are equal.

In Short:

The chapter introduces students to the language of **algebra** by moving from ordinary numerical calculations to **letter-numbers and algebraic expressions**. It develops skills in forming, evaluating, interpreting, and simplifying expressions and shows how algebra can efficiently describe **real-life situations, formulas, sequences, and mathematical patterns**.

4.2 Important Formulas:

Important Formulas / Algebraic Rules for Quantitative Problems:

1. **Age relationship**
   - If one person is $k$years older than another:
     $$\boxed{y = x + k}$$
   - If one person is $k$years younger:
     $$\boxed{x = y - k}$$
2. Example from the chapter: $s = a + 3$.
3. **Repeated quantity / unit relationship**
   - If each item requires $k$units and there are $n$items:
     $$\boxed{\text{Total} = kn}$$
4. Example: If each L-shape needs 2 matchsticks:
5. $\boxed{M = 2n}$
6. **Total cost formula**
   - For two items with quantities $x, y$and unit prices p, q:
     $$\boxed{\text{Total Cost} = px + qy}$$
7. Example from the chapter:
8. $\boxed{35c + 60j}$
9. where *c*= number of coconuts and *j*= kg of jaggery.
10. **Perimeter of a square**
    $$\boxed{P = 4s}$$

where $s$is the side length.

11. **Perimeter of a rectangle**
    $$P = l + b + l + b$$

Simplified:

$$\boxed{P = 2l + 2b = 2(l + b)}$$

12. **Perimeter of an equilateral triangle**
    $$\boxed{P = 3s}$$
13. **Perimeter of a regular pentagon**
    $$\boxed{P = 5s}$$
14. **Perimeter of a regular hexagon**
    $$\boxed{P = 6s}$$
15. **General perimeter of a regular polygon**
    If a regular polygon has $n$equal sides of length s:
    $$\boxed{P = ns}$$
16. **Omission of multiplication symbol**
    $$\boxed{a \times b = ab}$$

In particular:

$$4 \times n = 4n,\ 7 \times k = 7k$$

17. **Substitution rule**
    If an expression is $ax + b$, substitute the given value of x:
    $$\boxed{ax + b = a(\text{given value}) + b}$$

Example:

$$5m + 3,\ m = 2$$

gives

$$5(2) + 3 = 13$$

18. **Addition of like terms**

$$\boxed{ax + bx = (a + b)x}$$

Example:

$$5c + 3c + 10c = (5 + 3 + 10)c = 18c$$

19. **Subtraction of like terms**

$$\boxed{ax - bx = (a - b)x}$$

Example:

$$12n - 4n = 8n$$

20. **Unlike terms cannot normally be combined**

$$\boxed{ax + by}$$

cannot be simplified further when $x$and $y$are different letter-numbers.
Example:

$$\boxed{18c + 11d}$$

21. **Distributive property**

$$\boxed{a(b + c) = ab + ac}$$

and

$$\boxed{a(b - c) = ab - ac}$$

Example:

$$4(x + y) = 4x + 4y$$

22. **Taking common factor**
    Reverse of distributive property:

$$\boxed{ab + ac = a(b + c)}$$

23. **Removing brackets preceded by $+$**

$$\boxed{a + (b + c) = a + b + c}$$

24. **Removing brackets preceded by $-$**

$$\boxed{a - (b + c) = a - b - c}$$

and

$$\boxed{a - (b - c) = a - b + c}$$

25. **Difference between two algebraic quantities**
    If two totals are $A$and B:

$$\boxed{\text{Difference} = A - B}$$

Example:

$$(40x + 75y) - (6x + 10y)$$
$$= \boxed{34x + 65y}$$

26. **Sum of several algebraic expressions**
    Add corresponding like terms:

$$(ap - bq) + (cp - dq) + (ep - fq)$$
$$= \boxed{(a + c + e)p - (b + d + f)q}$$

Example from the chapter:

$$(7p - 3q) + (8p - 4q) + (6p - 2q)$$
$$= \boxed{21p - 9q}$$

27. **General term of multiples**
    For the sequence

$$k, 2k, 3k, 4k, \ldots$$

the n^{th}term is:

$$\boxed{T_n = kn}$$

Example:

$$4,8,12,16,\ldots \Rightarrow \boxed{T_n = 4n}$$

28. **Repeating pattern of three designs**
    For the chapter's repeating pattern:

$$\boxed{\text{Design C position} = 3n}$$
$$\boxed{\text{Design B position} = 3n - 1}$$
$$\boxed{\text{Design A position} = 3n - 2}$$

29. **Calendar 2×2pattern**
    If the top-left entry is a, the four numbers are:

$$\boxed{\begin{matrix} a & a+1 \\ a+7 & a+8 \end{matrix}}$$

The two diagonal sums are:

$$a + (a + 8) = \boxed{2a + 8}$$
$$(a + 1) + (a + 7) = \boxed{2a + 8}$$

Hence the diagonal sums are always equal.

30. **Arithmetic progression-type matchstick pattern**
    When a pattern begins with $a$objects and increases by $d$objects at every step:

$$\boxed{T_n = a + (n - 1)d}$$

For the chapter's triangle matchstick pattern:

$$3,5,7,9,\ldots$$

so:

$$\boxed{T_n = 3 + 2(n - 1) = 2n + 1}$$

31. **General number-machine form**
    A mathematical rule involving two inputs can be represented algebraically. For example:

$$\boxed{2a - b}$$

means **twice the first number minus the second number**.

Most Important Rules to Remember

$$\boxed{ax + bx = (a + b)x}$$
$$\boxed{ax - bx = (a - b)x}$$
$$\boxed{a(b + c) = ab + ac}$$
$$\boxed{a(b - c) = ab - ac}$$
$$\boxed{a - (b + c) = a - b - c}$$
$$\boxed{T_n = a + (n - 1)d}$$

These are the **core formulas and algebraic rules most frequently required for solving the quantitative problems in Chapter 4**.

4.3 Fill-Up the Blank LOTS type questions with Answers: (35 Questions)

Fill in the Blanks – LOTS Type:

1. Letters used to represent numbers are called ___________.
   Answer: Letter-numbers
2. A mathematical expression containing letter-numbers is called an ___________ **expression**.
   Answer: Algebraic

3. If Shabnam is 3 years older than Aftab and Aftab's age is represented by a, Shabnam's age is __________.
   Answer: $a + 3$
4. If Shabnam's age is represented by s, Aftab's age is __________.
   Answer: $s - 3$
5. If each L-shaped pattern requires 2 matchsticks, $n$such Ls require __________ matchsticks.
   Answer: $2n$
6. If $n = 8$, the value of $2n$is __________.
   Answer: 16
7. The expression $4 \times n$is conventionally written as __________.
   Answer: $4n$
8. In algebraic expressions, the __________ symbol between a number and a letter is usually omitted.
   Answer: Multiplication
9. If $k = 4$, the value of $7k$is __________.
   Answer: 28
10. If $m = 2$, the value of $5m + 3$is __________.
    Answer: 13
11. The perimeter of a square with side $q$can be represented by the expression __________.
    Answer: $4q$
12. If $l$is the length and $b$is the breadth of a rectangle, its perimeter is __________.
    Answer: $2l + 2b$
13. The simplified form of $l + b + l + b$is __________.
    Answer: $2l + 2b$
14. Terms containing the same letter-numbers are called __________ **terms**.
    Answer: Like
15. Terms containing different letter-numbers are called __________ **terms**.
    Answer: Unlike
16. The simplified form of $5c + 3c + 10c$is __________.
    Answer: $18c$
17. The expression $18c + 11d$cannot be simplified further because $18c$and $11d$are __________ **terms**.
    Answer: Unlike
18. The simplified form of $4v + 3v$is __________.
    Answer: $7v$
19. The simplified form of $12n - 4n$is __________.
    Answer: $8n$
20. The simplified form of $(40x + 75y) - (6x + 10y)$is __________.
    Answer: $34x + 65y$
21. The simplified form of $(7p - 3q) + (8p - 4q) + (6p - 2q)$is __________.
    Answer: $21p - 9q$
22. In the sequence 4,8,12,16, ..., the n^{th}term is __________.
    Answer: $4n$
23. In the repeating design pattern discussed in the chapter, Design C occurs at positions that are multiples of __________.
    Answer: 3

24. The n^{th}occurrence of Design C is at position __________.
    Answer: $3n$
25. The n^{th}occurrence of Design B is at position __________.
    Answer: $3n - 1$
26. The n^{th}occurrence of Design A is at position __________.
    Answer: $3n - 2$
27. In a 2×2calendar block with $a$at the top-left, the number immediately to its right is __________.
    Answer: $a + 1$
28. In the same calendar block, the number directly below $a$is __________.
    Answer: $a + 7$
29. The number diagonally opposite $a$in the 2×2calendar block is __________.
    Answer: $a + 8$
30. The sum of either diagonal in this 2×2calendar block simplifies to __________.
    Answer: $2a + 8$
31. The expression $2a - b$means two times the first number __________ the second number.
    Answer: Minus
32. Algebraic expressions are useful for representing mathematical __________ and patterns concisely.
    Answer: Relationships
33. Algebraic expressions can be used in formulas to model patterns and make __________.
    Answer: Predictions
34. The rules used for manipulating __________ **expressions** also apply to algebraic expressions.
    Answer: Arithmetic
35. Algebraic expressions can often express patterns more __________ than ordinary language.
    Answer: Concisely

4.4 Fill-Up the Blank HOTS type questions with Answers: (35 Questions)

Fill in the Blanks with Answers – HOTS Type:

1. If $a + 3 = 18$, then the value of $a$is __________.
   Answer: 15
2. Shabnam is 3 years older than Aftab. If Shabnam is 27 years old, Aftab is __________ years old.
   Answer: 24
3. If nL-shaped figures require $2n$matchsticks, then 17 L-shaped figures require __________ matchsticks.
   Answer: 34
4. The value of $5m + 3$is 28. Therefore, the value of $m$is __________.
   Answer: 5
5. If $7k = 56$, then $k =$__________.
   Answer: 8
6. If a coconut costs ₹35 and 1 kg of jaggery costs ₹60, the total cost of 4 coconuts and 3 kg of jaggery is ₹__________.
   Answer: 320
   (₹35 × 4 + ₹60 × 3 = ₹320)

7. The perimeter of a square is represented by $4q$. If its perimeter is 52 cm, its side length is __________ **cm**.
   Answer: 13
8. A rectangle has $l = 8$cm and $b = 5$cm. Using $2l + 2b$, its perimeter is __________ **cm**.
   Answer: 26
9. If $l + b + l + b = 36$and $l = 10$, then $b =$__________.
   Answer: 8
10. The expression $6x + 9x - 4x$simplifies to __________.
   Answer: $11x$
11. If $5c + 3c + 10c =$ ₹900, then the value of $c$is ₹__________.
   Answer: 50
   Since $18c = 900,\ c = 50.$
12. If $4v + 3v = 63$, then $v =$__________.
   Answer: 9
13. If $12n - 4n = 72$, then $n =$__________.
   Answer: 9
14. The expression $4(x + y) - y$simplifies to __________.
   Answer: $4x + 3y$
15. If $x = 3$and $y = 2$, the value of $4(x + y) - y$is __________.
   Answer: 18
16. If $40x + 75y$is the initial payment and $6x + 10y$is returned, the actual amount paid simplifies to __________.
   Answer: $34x + 65y$
17. If $x = 2$and $y = 3$, the value of $34x + 65y$is ₹__________.
   Answer: 263
18. Charu's total quiz score is $21p - 9q$. If $p = 4$and $q = 1$, her total score is __________.
   Answer: 75
19. If the n^{th}term of the sequence 4,8,12,16, ...is $4n$, its 25th term is __________.
   Answer: 100
20. In the repeating pattern A, B, C, A, B, C, …, the 30th position contains Design __________.
   Answer: C
21. In the same repeating pattern, the 32nd position contains Design __________.
   Answer: B
22. If the n^{th}occurrence of Design A is at $3n - 2$, its 20th occurrence is at position __________.
   Answer: 58
23. If the n^{th}occurrence of Design B is at $3n - 1$, its 15th occurrence is at position __________.
   Answer: 44
24. If the n^{th}occurrence of Design C is at $3n$, Design C appears for the 40th time at position __________.
   Answer: 120
25. In a 2×2calendar block, if the top-left number is $a = 12$, the diagonally opposite number $a + 8$is __________.
   Answer: 20

26. In the same calendar block, if $a = 12$, the common sum of the two diagonals is __________.
    Answer: 32
    $12 + 20 = 13 + 19 = 32$.
27. If the common diagonal sum of a 2×2calendar block is $2a + 8 = 48$, then its top-left number $a$is __________.
    Answer: 20
28. A number machine follows the rule $2a - b$. If $a = 9$and $b = 5$, its output is __________.
    Answer: 13
29. A number machine following $2a - b$produces 16 when $a = 10$. Therefore, $b =$__________.
    Answer: 4
30. In the matchstick pattern 3,5,7,9,11, ..., the number of matchsticks increases by __________ at each successive step.
    Answer: 2
31. The rule for the matchstick pattern 3,5,7,9, ...can be written as $2n +$__________.
    Answer: 1
32. Using the rule $2n + 1$, the number of matchsticks required at Step 33 is __________.
    Answer: 67
33. If a pattern follows $2n + 1$and contains 101 matchsticks, then the corresponding step number is __________.
    Answer: 50
34. If $3a + 2b$is given, $3a$and $2b$cannot be combined because they are __________ **terms**.
    Answer: Unlike
35. If two different-looking algebraic expressions give the same value for every permissible value of their letter-numbers, the expressions are considered __________.
    Answer: Equal

These HOTS fill-ups emphasize **application, reverse reasoning, pattern recognition, substitution, simplification, and algebraic generalisation**, rather than simple recall.

4.5 One-mark questions with Answers of LOTS Type: (32 Questions)

One-Mark Descriptive Questions with Answers – LOTS Type:

1. **What are letter-numbers?**
   Answer: Letters used to represent numbers in mathematical expressions are called **letter-numbers**.
2. **What is an algebraic expression?**
   Answer: A mathematical expression containing one or more letter-numbers is called an **algebraic expression**.
3. **Write the expression for Shabnam's age if Aftab's age is $a$and Shabnam is 3 years older.**
   Answer: Shabnam's age is represented by $a + 3$.
4. **Write the expression for Aftab's age if Shabnam's age is s.**
   Answer: Aftab's age is represented by $s - 3$.
5. **How many matchsticks are required to make nL-shaped figures if each L requires two matchsticks?**
   Answer: The number of matchsticks required is $2n$.
6. **How is $4 \times n$written using the standard algebraic convention?**
   Answer: $4 \times n$is written as $4n$.

7. **Why is the multiplication sign generally omitted in $4n$?**
   Answer: In algebra, multiplication of a number and a letter is conventionally written by placing the number directly before the letter.
8. **Find the value of $7k$ when $k = 4$.**
   Answer: The value of $7k$ when $k = 4$ is **28**.
9. **Find the value of $5m + 3$ when $m = 2$.**
   Answer: The value of $5m + 3$ when $m = 2$ is **13**.
10. **Write an expression for the perimeter of a square with side q.**
    Answer: The perimeter of the square is $4q$.
11. **Write the simplified expression for the perimeter of a rectangle with length l and breadth b.**
    Answer: The perimeter of the rectangle is $2l + 2b$.
12. **What are like terms?**
    Answer: Terms involving the **same letter-numbers** are called like terms.
13. **What are unlike terms?**
    Answer: Terms involving **different letter-numbers** are called unlike terms.
14. **Can like terms be combined into a single term?**
    Answer: Yes, like terms can be added or subtracted and simplified into a single term.
15. **Simplify $5c + 3c + 10c$.**
    Answer: The simplified form of $5c + 3c + 10c$ is $18c$.
16. **Why can $18c + 11d$ not be simplified further?**
    Answer: It cannot be simplified further because $18c$ and $11d$ contain different letter-numbers and are **unlike terms**.
17. **Simplify $4v + 3v$.**
    Answer: The simplified form of $4v + 3v$ is $7v$.
18. **Simplify $12n - 4n$.**
    Answer: The simplified form of $12n - 4n$ is $8n$.
19. **What property is used to simplify $5c + 3c + 10c$ to $18c$?**
    Answer: The **distributive property** is used to simplify the expression.
20. **What happens to the signs of terms when a bracket preceded by a negative sign is removed?**
    Answer: The signs of the terms inside the bracket are **changed appropriately** when the bracket is removed.
21. **Simplify $(40x + 75y) - (6x + 10y)$.**
    Answer: The simplified expression is $34x + 65y$.
22. **What is Charu's total score expression after three quiz rounds?**
    Answer: Charu's total score after three rounds is $21p - 9q$.
23. **Write the n^{th} term of the sequence 4,8,12,16, ….**
    Answer: The n^{th} term of the sequence is $4n$.
24. **What formula represents the number machine described as "two times the first number minus the second number"?**
    Answer: The number-machine formula is $2a - b$.
25. **At what position does Design C occur for the n^{th} time in the repeating pattern?**
    Answer: Design C occurs for the n^{th} time at position $3n$.
26. **At what position does Design B occur for the n^{th} time?**
    Answer: Design B occurs for the n^{th} time at position $3n - 1$.
27. **At what position does Design A occur for the n^{th} time?**
    Answer: Design A occurs for the n^{th} time at position $3n - 2$.

28. **In a 2×2calendar block, what number lies immediately to the right of a?**
    Answer: The number immediately to the right of $a$is $a + 1$.
29. **In a 2×2calendar block, what number lies directly below a?**
    Answer: The number directly below $a$is $a + 7$.
30. **What is the sum of either diagonal of the 2×2calendar block starting with a?**
    Answer: The sum of either diagonal simplifies to $2a + 8$.
31. **What is the main advantage of using algebraic expressions to describe patterns?**
    Answer: Algebraic expressions describe mathematical patterns and relationships **concisely**.
32. **How are algebraic expressions useful in mathematical modelling?**
    Answer: Algebraic expressions are used to **model patterns and relationships between quantities and make predictions**.

4.6 One-mark questions with Answers of HOTS Type: (32 Questions)

One-Mark Descriptive Questions with Answers – HOTS Type:

1. **If $a + 3 = 21$, what is the value of a?**
   Answer: The value of $a$is **18**.
2. **If Shabnam is 3 years older than Aftab and Shabnam is 25 years old, how old is Aftab?**
   Answer: Aftab is **22 years old** because $25 - 3 = 22$.
3. **If nL-shaped figures require $2n$matchsticks, how many matchsticks are required for 18 Ls?**
   Answer: 36 matchsticks are required because $2 \times 18 = 36$.
4. **If $7k = 42$, what is the value of k?**
   Answer: The value of $k$is **6** because $42 \div 7 = 6$.
5. **If $5m + 3 = 23$, what is the value of m?**
   Answer: The value of $m$is **4** because $5(4) + 3 = 23$.
6. **A square has a perimeter of 36 cm; what is its side length?**
   Answer: Its side length is **9 cm** because $4q = 36$.
7. **If $l = 7$cm and $b = 5$cm, what is the value of $2l + 2b$?**
   Answer: The value of $2l + 2b$is **24 cm**.
8. **Can $8x + 5y$be simplified to $13xy$? Give a reason.**
   Answer: No, because $8x$and $5y$are **unlike terms** containing different letter-numbers.
9. **Simplify $8p + 5p - 4p$.**
   Answer: The expression simplifies to $9p$by combining the like terms.
10. **If $5c + 3c + 10c = 360$, what is the value of c?**
    Answer: The value of $c$is **20** because $18c = 360$.
11. **If $4v + 3v = 56$, what is the value of v?**
    Answer: The value of $v$is **8** because $7v = 56$.
12. **If $12n - 4n = 64$, find n.**
    Answer: The value of $n$is **8** because $8n = 64$.
13. **Simplify $4(x + y) - y$.**
    Answer: The expression simplifies to $4x + 3y$by using the distributive property and combining like terms.
14. **Are $5u$and $5 + u$equal for all values of u?**
    Answer: No, because $5u$means **five times** $u$whereas $5 + u$means **five more than** u.
15. **Are $10y - 3$and $10(y - 3)$equivalent expressions?**
    Answer: No, because $10(y - 3) = 10y - 30$, which is generally different from $10y - 3$.

16. **If $x = 2$and $y = 1$, what is the value of $34x + 65y$?**
    Answer: The value is **133** because $34(2) + 65(1) = 133$.
17. **If $p = 4$and $q = 1$, what is the value of Charu's total score $21p - 9q$?**
    Answer: Charu's total score is **75** because $21(4) - 9(1) = 75$.
18. **What is the 15th term of the sequence** $4,8,12,16, \ldots$**?**
    Answer: The 15th term is **60** because the general expression is $4n$.
19. **If the n^{th}occurrence of Design C is at position $3n$, where does its 12th occurrence appear?**
    Answer: The 12th occurrence of Design C appears at position **36**.
20. **If Design B occurs at positions $3n - 1$, where does its 10th occurrence appear?**
    Answer: The 10th occurrence of Design B appears at position **29**.
21. **Which design—A, B, or C—appears at position 122 in the repeating pattern?**
    Answer: Design A appears at position 122 because 122 leaves remainder 2 when divided by 3.
22. **Which design appears at position 99 in the repeating pattern?**
    Answer: Design C appears at position 99 because 99 is a multiple of 3.
23. **In a 2×2calendar block with top-left number 10, what is the diagonally opposite number?**
    Answer: The diagonally opposite number is **18** because it is represented by $a + 8$.
24. **If the top-left number of a 2×2calendar block is 15, what is the sum of either diagonal?**
    Answer: Each diagonal has a sum of **38** because $2a + 8 = 2(15) + 8$.
25. **Why are the two diagonal sums of every 2×2calendar block equal?**
    Answer: They are equal because both diagonal sums simplify to the same expression, $2a + 8$.
26. **A number machine follows the rule $2a - b$; what is its output when $a = 8$and $b = 5$?**
    Answer: The output is **11** because $2(8) - 5 = 11$.
27. **A number machine uses $2a - b$and gives an output of 14 when $a = 9$; what is b?**
    Answer: The value of $b$is **4** because $18 - b = 14$.
28. **The matchstick pattern has** $3,5,7,9, \ldots$**matchsticks; how many will Step 10 have?**
    Answer: Step 10 will have **21 matchsticks**, following the pattern of adding 2 matchsticks at every step.
29. **Why can $5c + 3c + 10c$be simplified but $18c + 11d$cannot be combined into one term?**
    Answer: The first expression contains **like terms**, whereas $18c$and $11d$are **unlike terms**.
30. **How can you check whether two different algebraic expressions are equivalent?**
    Answer: We can simplify them using valid algebraic rules or verify that they produce the **same value for the same letter-number values**.
31. **If two expressions simplify to $7x + 3y$, what can you conclude about them?**
    Answer: The two expressions are **equivalent** because they have the same simplified form.
32. **Why is algebra useful for studying patterns that continue indefinitely?**
    Answer: Algebra provides a **general expression** that represents all cases of a pattern without checking each case individually.

4.7 Two-mark questions with Answers of LOTS Type: (22 Questions)

Two-Mark Descriptive Questions with Answers – LOTS Type:

1. **What are letter-numbers? Give one example.**
   Answer:
   1. Letters used to represent numbers are called **letter-numbers**.
   2. For example, a can represent Aftab's age in the expression $a + 3$.
2. **What is an algebraic expression? Give one example.**
   Answer:
   1. An expression containing one or more letter-numbers is called an **algebraic expression**.
   2. For example, $a + 3$ and $s - 3$ are algebraic expressions.
3. **How can Shabnam's and Aftab's ages be represented using letter-numbers if Shabnam is 3 years older?**
   Answer:
   1. If Aftab's age is a, Shabnam's age can be written as $a + 3$.
   2. If Shabnam's age is s, Aftab's age can be written as $s - 3$.
4. **How many matchsticks are needed to make n L-shaped figures? Find the number needed when $n = 10$.**
   Answer:
   1. Since each L-shaped figure requires 2 matchsticks, n figures require $2n$ matchsticks.
   2. When $n = 10$, the number required is $2 \times 10 = 20$ matchsticks.
5. **How is multiplication represented in algebraic expressions? Give an example.**
   Answer:
   1. The multiplication sign between a number and a letter is generally **omitted** in algebra.
   2. Thus, $4 \times n$ is written as $4n$.
6. **Find the value of $7k$ when $k = 4$. Explain the substitution.**
   Answer:
   1. Substitute $k = 4$ in $7k$ to obtain 7×4.
   2. Therefore, the value of $7k$ is **28**.
7. **Find the value of $5m + 3$ when $m = 2$.**
   Answer:
   1. Substituting $m = 2$ gives $5(2) + 3$.
   2. Therefore, $5m + 3 = 10 + 3 = 13$.
8. **Write an algebraic expression for the perimeter of a square and find it when the side is 6 cm.**
   Answer:
   1. If the side of a square is q, its perimeter is $4q$.
   2. When $q = 6$cm, its perimeter is $4 \times 6 = 24$cm.
9. **Write the expression for the cost of c coconuts and j kg of jaggery using the prices given in the chapter.**
   Answer:
   1. At ₹35 per coconut, the cost of c coconuts is ₹$35c$.
   2. At ₹60 per kg of jaggery, the total cost is ₹$(35c + 60j)$.
10. **What arithmetic rules can also be applied to algebraic expressions?**
    Answer:
    1. Rules involving **swapping, grouping and brackets** can be applied to algebraic expressions.
    2. The rules for a **negative sign outside brackets and the distributive property** can also be used.

11. **Simplify $5c + 3c + 10c$. State the idea used.**
    Answer:
    1. The terms contain the same letter-number c, so their numerical parts can be added: $(5 + 3 + 10)c$.
    2. Therefore, $5c + 3c + 10c = 18c$, using the **distributive property**.
12. **Why can $18c + 11d$not be simplified further?**
    Answer:
    1. The two terms involve different letter-numbers, $c$and d.
    2. Therefore, they cannot be combined into a single term, and $18c + 11d$remains as it is.
13. **Simplify $(40x + 75y) - (6x + 10y)$.**
    Answer:
    1. Remove the brackets and group the corresponding terms: $40x - 6x + 75y - 10y$.
    2. Therefore, the simplified expression is $34x + 65y$.
14. **How is Charu's total quiz score represented after combining her scores?**
    Answer:
    1. Her scores are combined by adding the corresponding p-terms and q-terms.
    2. The resulting total score is $21p - 9q$.
15. **What is the rule for the sequence 4,8,12,16, ...? Find its 6th term.**
    Answer:
    1. The n^{th}term of the sequence is represented by $4n$.
    2. For $n = 6$, the term is $4 \times 6 = 24$.
16. **What does the expression $2a - b$mean in a number machine?**
    Answer:
    1. The expression instructs us to multiply the first input $a$by **2**.
    2. Then the second input $b$is subtracted, giving $2a - b$.
17. **Describe a 2×2calendar block using $a$as the top-left number.**
    Answer:
    1. The top row is represented by a, $a + 1$.
    2. The bottom row is represented by $a + 7$, $a + 8$.
18. **Show that the diagonal sums of a 2×2calendar block are equal.**
    Answer:
    1. One diagonal gives $a + (a + 8) = 2a + 8$.
    2. The other gives $(a + 1) + (a + 7) = 2a + 8$, so the two sums are equal.
19. **How are algebraic expressions useful for describing patterns?**
    Answer:
    1. Algebraic expressions represent **patterns and relationships** using numbers and letter-numbers.
    2. They provide concise rules that can also be used to **make predictions**.
20. **How can an algebraic expression be translated into ordinary language? Give an example.**
    Answer:
    1. The mathematical operations in an expression can be described using words.
    2. For example, $2a - b$can be stated as "twice $a$minus b."
21. **What is meant by simplifying an algebraic expression? Give an example from the chapter.**
    Answer:

1. Simplifying means writing an expression in a **shorter equivalent form without changing its value**.
2. For example, $5c + 3c + 10c$ simplifies to $18c$.

22. **Why are algebraic expressions more convenient than lengthy verbal descriptions?**
Answer:
1. Algebraic expressions represent mathematical relationships in a **short and precise form**.
2. They make it easier to describe patterns, perform calculations and express general relationships.

4.8. Two-mark questions with Answers of HOTS Type: (22 Questions)

Two-Mark Descriptive Questions with Answers – HOTS Type:

1. **Shabnam is 3 years older than Aftab. If Shabnam is 23 years old, find Aftab's age and explain the relationship.**
Answer:
   1. Since $s = a + 3$, we get $a = 23 - 3 = 20$.
   2. Therefore, **Aftab is 20 years old**, which is 3 years less than Shabnam.
2. **If n L-shaped figures require $2n$ matchsticks, how many L-shaped figures can be made using 50 matchsticks?**
Answer:
   1. We use $2n = 50$, which gives $n = 50 \div 2 = 25$.
   2. Therefore, **25 L-shaped figures** can be made.
3. **The value of $7k$ is 63. Find k and verify your answer.**
Answer:
   1. From $7k = 63$, we obtain $k = 63 \div 7 = 9$.
   2. Substituting $k = 9$ gives $7(9) = 63$, so the answer is correct.
4. **If $5m + 3 = 38$, find the value of m.**
Answer:
   1. Subtracting 3 gives $5m = 35$, so $m = 35 \div 5 = 7$.
   2. Substitution verifies the answer because $5(7) + 3 = 38$.
5. **A square has a perimeter of 68 cm. Use an algebraic expression to find its side.**
Answer:
   1. Since the perimeter of a square is $4q$, we have $4q = 68$.
   2. Therefore, $q = 68 \div 4 = 17$ cm.
6. **Using the chapter's cost expression $35c + 60j$, find the total cost when $c = 4$ and $j = 2$.**
Answer:
   1. Substituting the values gives $35(4) + 60(2) = 140 + 120$.
   2. Therefore, the **total cost is ₹260**.
7. **A student says that $6x + 4x = 10x^2$. Is the student correct? Explain.**
Answer:
   1. No, $6x$ and $4x$ are like terms, so their coefficients should be added.
   2. Hence, $6x + 4x = (6 + 4)x = 10x$, not $10x^2$.
8. **Why can $7c + 5c$ be simplified but $7c + 5d$ cannot be combined into one term?**
Answer:
   1. $7c$ and $5c$ contain the same letter-number, so $7c + 5c = 12c$.
   2. $7c$ and $5d$ contain different letter-numbers, so they cannot be combined into one term.

9. **Simplify** $12x + 8y - 5x - 3y$**by grouping appropriate terms.**
   Answer:
   1. Grouping like terms gives $(12x - 5x) + (8y - 3y)$.
   2. Therefore, the simplified expression is $7x + 5y$.
10. **A student simplifies** $(20x + 15y) - (5x + 4y)$**as** $15x + 19y$**. Identify and correct the error.**
    Answer:
    1. The negative sign must apply to both terms in the second bracket, giving $20x + 15y - 5x - 4y$.
    2. Hence, the correct simplified expression is $15x + 11y$.
11. **If** $x = 2$**and** $y = 3$**, find the value of the chapter expression** $34x + 65y$**.**
    Answer:
    1. Substituting gives $34(2) + 65(3) = 68 + 195$.
    2. Therefore, the value of the expression is **263**.
12. **Charu's total quiz score is** $21p - 9q$**. Find her score when** $p = 5$**and** $q = 2$**.**
    Answer:
    1. Substituting gives $21(5) - 9(2) = 105 - 18$.
    2. Therefore, Charu's total score is **87**.
13. **The** n^{th}**term of the pattern** $4,8,12,16, \ldots$**is** $4n$**. Find the position of the term 72.**
    Answer:
    1. Set $4n = 72$, which gives $n = 72 \div 4 = 18$.
    2. Therefore, **72 is the 18th term** of the pattern.
14. **How can you determine whether 100 belongs to the pattern** $4,8,12,16, \ldots$**?**
    Answer:
    1. Using $4n = 100$, we obtain $n = 25$, which is a whole-number position.
    2. Therefore, **100 belongs to the pattern and is its 25th term**.
15. **A number machine follows the rule** $2a - b$**. Find its output when** $a = 12$**and** $b = 7$**.**
    Answer:
    1. Substituting gives $2(12) - 7 = 24 - 7$.
    2. Therefore, the output of the number machine is 17**.**
16. **A number machine follows** $2a - b$**and produces 20 when** $a = 13$**. Find** b**.**
    Answer:
    1. Substituting gives $2(13) - b = 20$, so $26 - b = 20$.
    2. Therefore, $b = 6$**.**
17. **In a** 2×2**calendar block, the top-left number is 9. Find the four numbers using the algebraic pattern.**
    Answer:
    1. The numbers are represented by $a, a + 1, a + 7, a + 8$.
    2. For $a = 9$, the four numbers are **9, 10, 16 and 17**.
18. **For a** 2×2**calendar block beginning with** $a = 11$**, compare the two diagonal sums.**
    Answer:
    1. The diagonal sums are $11 + 19 = 30$and $12 + 18 = 30$.
    2. Thus, **both diagonal sums are equal**, as predicted by the expression $2a + 8$.
19. **If the common diagonal sum of a** 2×2**calendar block is 48, find its top-left number.**
    Answer:

1. Since each diagonal sum is $2a + 8$, we have $2a + 8 = 48$, giving $2a = 40$.
2. Therefore, the top-left number is $a = 20$.

20. **Two students obtain $5x + 2x$and $7x$as answers to the same calculation. Are their expressions equivalent? Explain.**
Answer:
    1. Using the distributive property, $5x + 2x = (5 + 2)x = 7x$.
    2. Therefore, **the two expressions are equivalent** because they have the same value for every value of x.
21. **Why is an algebraic rule more useful than listing many terms of a pattern?**
Answer:
    1. An algebraic rule describes the **general relationship** for all terms of the pattern in a concise form.
    2. It can be used to **predict terms at distant positions** without listing every preceding term.
22. **How does the calendar example demonstrate the power of algebraic modelling?**
Answer:
    1. Representing the four calendar entries as a, $a + 1$, $a + 7$, $a + 8$converts the observed pattern into algebraic expressions.
    2. Since both diagonals simplify to $2a + 8$, algebra shows that the equality holds **for every such** 2×2**calendar block**.

4.9. Three-mark questions with Answers of LOTS Type: (16 Questions)

Three-Mark Descriptive Questions with Answers – LOTS Type:
1. What are letter-numbers and algebraic expressions? Give an example.
Answer:
1. Letters used to represent numbers are called **letter-numbers**.
2. An expression containing one or more letter-numbers is called an **algebraic expression**.
3. For example, if Aftab's age is a, Shabnam's age can be represented by $a + 3$.

2. Explain how the ages of Aftab and Shabnam can be represented algebraically.
Answer:
1. Let Aftab's age be represented by the letter-number a.
2. Since Shabnam is 3 years older than Aftab, her age is $a + 3$.
3. Conversely, if Shabnam's age is s, Aftab's age can be represented as $s - 3$.

3. Explain the matchstick rule for making L-shaped figures and find the number needed for 12 Ls.
Answer:
1. Each L-shaped figure requires **2 matchsticks**.
2. Therefore, nL-shaped figures require $2n$matchsticks.
3. For $n = 12$, the number required is $2 \times 12 = 24$matchsticks.

4. Explain how multiplication is written in algebra and evaluate $7k$when $k = 4$.
Answer:
1. In algebra, the multiplication sign between a number and a letter is usually **omitted**.
2. Thus, $7 \times k$is written simply as $7k$.
3. When $k = 4$, $7k = 7 \times 4 = 28$.

5. Explain how to evaluate $5m + 3$when $m = 2$.
Answer:
1. Substitute the given value $m = 2$into the expression $5m + 3$.
2. This gives $5(2) + 3 = 10 + 3$.
3. Therefore, the value of the expression is **13**.

6. Write the algebraic expression for the cost of coconuts and jaggery and explain its terms.

Answer:

1. If one coconut costs ₹35, then the cost of $c$coconuts is **₹**$35c$.
2. If jaggery costs ₹60 per kg, then the cost of $j$kg of jaggery is **₹**$60j$.
3. Hence, the total cost is represented by **₹**$(35c + 60j)$.

7. Write an expression for the perimeter of a square and find the perimeter when its side is 8 units.

Answer:

1. If the side of a square is q, its perimeter is $q + q + q + q$.
2. This can be simplified to $4q$.
3. When $q = 8$, the perimeter is $4 \times 8 = 32$units.

8. Simplify $\mathbf{5c + 3c + 10c}$and explain the process.

Answer:

1. All the terms contain the same letter-number c, so they can be grouped together.
2. Using the distributive property, $5c + 3c + 10c = (5 + 3 + 10)c$.
3. Therefore, the simplified expression is $18c$.

9. Why can $\mathbf{18c + 11d}$not be simplified into a single term?

Answer:

1. The term $18c$contains the letter-number c, while $11d$contains d.
2. Since the letter-numbers are different, the two terms cannot be combined into one term.
3. Hence, $18c + 11d$is already in its simplified form.

10. Simplify $\mathbf{(40x + 75y) - (6x + 10y)}$.

Answer:

1. Remove the second bracket carefully to get $40x + 75y - 6x - 10y$.
2. Group corresponding terms to obtain $(40x - 6x) + (75y - 10y)$.
3. Therefore, the simplified expression is $34x + 65y$.

11. Explain how Charu's total quiz score is simplified to $\mathbf{21p - 9q}$.

Answer:

1. Charu's scores are represented by $(7p - 3q) + (8p - 4q) + (6p - 2q)$.
2. Combining the p-terms gives $21p$, while combining the q-terms gives $-9q$.
3. Therefore, her total score is $21p - 9q$.

12. Explain the general rule for the sequence $\mathbf{4, 8, 12, 16}$, ...

Answer:

1. Each term of the sequence is a multiple of **4**.
2. If the position of a term is n, the term can be represented by $4n$.
3. Thus, the general expression for the n^{th}term is $4n$.

13. Explain the number-machine rule represented by $\mathbf{2a - b}$.

Answer:

1. First, the input represented by $a$is multiplied by **2**.
2. Then the second input represented by $b$is subtracted from the result.
3. Hence, the number-machine rule is expressed algebraically as $2a - b$.

14. Represent a $\mathbf{2 \times 2}$calendar block algebraically when the top-left number is $\mathbf{a}$.

Answer:

1. The two numbers in the first row are $a$and $a + 1$.
2. The two numbers directly below them are $a + 7$and $a + 8$.
3. Thus, the block is represented as $\begin{matrix} a & a+1 \\ a+7 & a+8 \end{matrix}$.

15. Show that the diagonal sums of a $\mathbf{2 \times 2}$calendar block are equal.

Answer:

1. The first diagonal sum is $a + (a + 8) = 2a + 8$.
2. The second diagonal sum is $(a + 1) + (a + 7) = 2a + 8$.
3. Since both expressions are equal to $2a + 8$, the **two diagonal sums are always equal**.

16. State three ways in which algebraic expressions are useful.

Answer:

1. Algebraic expressions help to represent **mathematical patterns and relationships** concisely.
2. They can be simplified using the arithmetic rules that also apply to numerical expressions.
3. They help describe general relationships and can be used to **make predictions**.

4.10. Three-mark questions with Answers of HOTS Type: (18 Questions)

Three-Mark Descriptive Questions with Answers – HOTS Type:

1. Shabnam is 3 years older than Aftab. If the sum of their ages is 33 years, find their ages.

Answer:

1. If Aftab's age is a, Shabnam's age is $a + 3$, so $a + (a + 3) = 33$.
2. This gives $2a + 3 = 33$, hence $a = 15$.
3. Therefore, **Aftab is 15 years old and Shabnam is 18 years old**.

2. If nL-shaped figures require $2n$matchsticks, how many L-shaped figures can be made with 84 matchsticks?

Answer:

1. The number of matchsticks required is represented by $2n$, so $2n = 84$.
2. Dividing both sides by 2 gives $n = 42$.
3. Therefore, **42 L-shaped figures** can be made using 84 matchsticks.

3. The value of $5m + 3$is 48. Find $m$and verify your answer.

Answer:

1. From $5m + 3 = 48$, subtracting 3 gives $5m = 45$.
2. Dividing by 5 gives $m = 9$.
3. Verification: $5(9) + 3 = 45 + 3 = 48$, so the answer is correct.

4. A family buys 6 coconuts and 4 kg of jaggery at the prices given in the chapter. Find the total cost using an algebraic expression.

Answer:

1. The chapter represents the total cost as $35c + 60j$, where $c$is the number of coconuts and $j$is the kilograms of jaggery.
2. Substituting $c = 6$and $j = 4$gives $35(6) + 60(4) = 210 + 240$.
3. Therefore, the **total cost is ₹450**.

5. A square has a perimeter of 100 cm. Find its side using the algebraic expression for perimeter.

Answer:

1. If the side is q, the perimeter of the square is represented by $4q$.
2. Since $4q = 100$, dividing by 4 gives $q = 25$.
3. Therefore, the **side of the square is 25 cm**.

6. A student claims that $8x + 5x = 13x^2$. Analyse the claim and give the correct result.

Answer:

1. The terms $8x$and $5x$contain the same letter-number x, so they can be combined.
2. Their coefficients are added: $8x + 5x = (8 + 5)x$.
3. Therefore, the correct result is $13x$, not $13x^2$.

7. Why can $12c + 8c$be simplified to $20c$, while $12c + 8d$cannot be combined into a single term?

Answer:

1. $12c$ and $8c$ contain the same letter-number, so $12c + 8c = (12 + 8)c = 20c$.
2. In $12c + 8d$, the letter-numbers c and d are different.
3. Therefore, $12c + 8d$ **cannot be combined into one term**, unlike $12c + 8c$.

8. A student simplifies $(40x + 75y) - (6x + 10y)$ as $34x + 85y$. Identify the error and obtain the correct answer.

Answer:

1. The negative sign before the second bracket changes both terms, giving $40x + 75y - 6x - 10y$.
2. Combining corresponding terms gives $40x - 6x = 34x$ and $75y - 10y = 65y$.
3. Therefore, the correct simplified expression is $34x + 65y$.

9. Charu's total quiz score is $21p - 9q$. Find her score when $p = 6$ and $q = 3$.

Answer:

1. Substitute $p = 6$ and $q = 3$ into $21p - 9q$.
2. This gives $21(6) - 9(3) = 126 - 27$.
3. Therefore, **Charu's total score is 99**.

10. The rule for the sequence $4, 8, 12, 16, \ldots$ is $4n$. Determine whether 124 occurs in the sequence and state its position.

Answer:

1. To find the position, set $4n = 124$.
2. Dividing by 4 gives $n = 31$, which is a whole-number position.
3. Therefore, **124 occurs in the sequence as its 31st term**.

11. Can 102 occur in the sequence $4, 8, 12, 16, \ldots$? Justify your answer algebraically.

Answer:

1. If 102 were a term, then $4n = 102$, giving $n = 25.5$.
2. A term position n must be a positive whole number.
3. Therefore, **102 cannot occur in this sequence**.

12. A number machine follows the rule $2a - b$. If its output is 18 when $a = 12$, find b.

Answer:

1. Substituting $a = 12$ and output 18 gives $2(12) - b = 18$.
2. Thus, $24 - b = 18$, which gives $b = 6$.
3. Therefore, the **second input is** $b = 6$.

13. A 2×2 calendar block begins with 14 in its top-left corner. Find all four entries and compare its diagonal sums.

Answer:

1. Using $a, a + 1, a + 7, a + 8$, the four entries are **14, 15, 21 and 22**.
2. The diagonal sums are $14 + 22 = 36$ and $15 + 21 = 36$.
3. Therefore, **both diagonal sums are equal to 36**, illustrating the chapter's calendar pattern.

14. The common diagonal sum of a 2×2 calendar block is 58. Find its top-left number and the remaining three numbers.

Answer:

1. Since the common diagonal sum is $2a + 8$, $2a + 8 = 58$ gives $a = 25$.
2. The remaining numbers are $a + 1 = 26$, $a + 7 = 32$, and $a + 8 = 33$.
3. Therefore, the calendar block contains **25, 26, 32 and 33**.

15. Explain algebraically why the diagonal sums of any 2×2 calendar block are always equal.

Answer:

1. Represent the four entries as $a, a + 1, a + 7, a + 8$.

2. The first diagonal sum is $a + (a + 8) = 2a + 8$, while the second is $(a + 1) + (a + 7) = 2a + 8$.
3. Since both simplify to $2a + 8$, the diagonal sums are equal for every such block.

16. Two expressions are $5x + 3x + 2y$ and $8x + 2y$. Determine whether they are equivalent.

Answer:

1. Combining the like terms in the first expression gives $5x + 3x + 2y = 8x + 2y$.
2. This is exactly the same as the second expression.
3. Therefore, **the two algebraic expressions are equivalent** by simplification.

17. A student says $5(x + 3) = 5x + 3$. Examine the statement using the distributive property.

Answer:

1. The multiplier 5 must be applied to **each term** inside the bracket.
2. Thus, $5(x + 3) = 5x + 15$.
3. Therefore, the student's statement is **incorrect**, and the correct expression is $5x + 15$.

18. Why is an algebraic expression more useful than listing many individual cases of a pattern?

Answer:

1. An algebraic expression gives a **general rule** that represents all cases of the pattern.
2. The rule can be used to calculate or predict values at positions that have not been individually listed.
3. Therefore, algebra provides a **concise and powerful way to describe patterns and relationships**.

4.11 Five-mark questions with Answers of LOTS Type: (12 Questions)

Five-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain the concept of letter-numbers and algebraic expressions using the age example from the chapter.

Answer:

1. Letters used to represent numbers are called **letter-numbers**.
2. Mathematical expressions containing letter-numbers are called **algebraic expressions**.
3. If Aftab's age is represented by a, Shabnam's age, being 3 years older, is represented by $a + 3$.
4. If Shabnam's age is represented by s, Aftab's age can be represented by $s - 3$.
5. Thus, letter-numbers allow relationships between quantities to be expressed **concisely in algebraic form**.

2. Explain how the matchstick pattern in the chapter can be represented using a letter-number.

Answer:

1. Each L-shaped figure in the pattern requires **2 matchsticks**.
2. If the number of L-shaped figures is represented by n, the required number of matchsticks is $2 \times n$.
3. Following algebraic convention, $2 \times n$is written simply as $2n$.
4. For example, if $n = 10$, the number of matchsticks required is $2(10) = 20$.
5. Thus, $2n$provides a general algebraic rule for finding the number of matchsticks for any number of L-shaped figures.

3. Explain how to find the value of an algebraic expression by substitution, using $5m + 3$as an example.

Answer:

1. To evaluate an algebraic expression, replace the letter-number with its **given numerical value**.
2. Consider the expression $5m + 3$when $m = 2$.
3. Substituting $m = 2$gives $5(2) + 3$.
4. Performing the operations gives $10 + 3 = 13$.
5. Therefore, the value of $5m + 3$**is 13 when** $m = 2$.

4. Explain how algebraic expressions can be used to represent the cost of coconuts and jaggery.

Answer:

1. The chapter considers coconuts costing **₹35 each** and jaggery costing **₹60 per kg**.
2. If $c$represents the number of coconuts, their total cost is ₹$35c$.
3. If $j$represents the kilograms of jaggery, its total cost is ₹$60j$.
4. Adding the two costs gives the algebraic expression ₹$(35c + 60j)$.
5. Hence, the expression $35c + 60j$can be used to calculate the total cost for different values of $c$and j.

5. Explain how to form and use an algebraic expression for the perimeter of a square.

Answer:

1. Let the side length of a square be represented by the letter-number q.
2. Since all four sides of a square are equal, its perimeter is $q + q + q + q$.
3. This expression can be simplified to $4q$.
4. For example, if $q = 7$, the perimeter is $4(7) = 28$.
5. Therefore, $P = 4q$represents the perimeter of a square for any value of q.

6. Explain how $5c + 3c + 10c$is simplified using the distributive property.

Answer:

1. The terms $5c$, $3c$, and $10c$all contain the **same letter-number** c.
2. Therefore, the numerical coefficients 5, 3, and 10 can be grouped together.
3. The expression becomes $(5 + 3 + 10)c$.
4. Adding the coefficients gives $18c$.
5. Hence, using the distributive property, $5c + 3c + 10c = 18c$.

7. Explain why some terms can be combined while others cannot, using $5c + 3c + 10c$and $18c + 11d$.

Answer:

1. Terms containing the same letter-number can be grouped and simplified together.
2. Thus, $5c + 3c + 10c$can be simplified because all three terms contain c.
3. Their coefficients add to give $18c$.
4. In $18c + 11d$, the terms contain different letter-numbers, namely $c$and d.
5. Therefore, $18c + 11d$**cannot be simplified further into a single term**.

8. Simplify $(40x + 75y) - (6x + 10y)$and explain each step.

Answer:

1. Begin with the expression $(40x + 75y) - (6x + 10y)$.
2. Removing the brackets gives $40x + 75y - 6x - 10y$.
3. Group the corresponding terms as $(40x - 6x) + (75y - 10y)$.
4. Simplifying these groups gives $34x + 65y$.
5. Therefore, $(40x + 75y) - (6x + 10y) = 34x + 65y$.

9. Explain how Charu's total quiz score is represented and simplified algebraically.

Answer:

1. Charu's scores are represented by the expressions $(7p - 3q)$, $(8p - 4q)$, and $(6p - 2q)$.
2. Adding them gives $(7p - 3q) + (8p - 4q) + (6p - 2q)$.

3. Combining the p-terms gives $(7+8+6)p = 21p$.
4. Combining the q-terms gives $-(3+4+2)q = -9q$.
5. Therefore, Charu's total quiz score is represented by $21p - 9q$.

10. Explain how the sequence $4, 8, 12, 16, \ldots$can be represented by an algebraic expression.

Answer:

1. The terms 4,8,12,16, ...are successive **multiples of 4**.
2. The first term is 4×1, the second is 4×2, and the third is 4×3.
3. If the position of a term is represented by n, its value is $4 \times n$.
4. Using algebraic notation, $4 \times n$is written as $4n$.
5. Hence, $4n$gives a concise general expression for the terms of this pattern.

11. Explain the 2×2calendar pattern and show why its diagonal sums are equal.

Answer:

1. If the top-left number is a, the four calendar entries are a, $a + 1$, $a + 7$,and $a + 8$.
2. The first diagonal sum is $a + (a + 8)$.
3. Simplifying it gives $2a + 8$.
4. The other diagonal sum is $(a + 1) + (a + 7) = 2a + 8$.
5. Therefore, **the two diagonal sums are always equal because both simplify to** $2a + 8$.

12. Describe the importance of algebraic expressions in representing mathematical relationships and patterns.

Answer:

1. Algebraic expressions use **numbers and letter-numbers** to represent quantities and their relationships.
2. They can describe mathematical patterns in a short and systematic form.
3. Arithmetic rules can also be applied to algebraic expressions to **simplify** them.
4. Algebraic expressions can be translated between **ordinary language and mathematical language**.
5. They help us model relationships, describe patterns concisely, and **make predictions**.

4.12 Five-mark questions with Answers of HOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – HOTS Type:

1. Shabnam is 3 years older than Aftab. If the sum of their ages is 47 years, find their ages and verify the relationship.

Answer:

1. Let Aftab's age be a; then Shabnam's age is $a + 3$.
2. Their total age gives $a + (a + 3) = 47$, so $2a + 3 = 47$.
3. Therefore, $2a = 44$and $a = 22$.
4. Shabnam's age is $22 + 3 = 25$years.
5. Hence, **Aftab is 22 years and Shabnam is 25 years old**, and their age difference is 3 years.

2. The chapter gives the total cost expression $35c + 60j$for coconuts and jaggery. Find the total cost of 8 coconuts and 5 kg of jaggery, and explain the calculation.

Answer:

1. The total cost is represented by $35c + 60j$.
2. For 8 coconuts and 5 kg of jaggery, substitute $c = 8$and $j = 5$.
3. This gives $35(8) + 60(5) = 280 + 300$.
4. Therefore, the total amount is **₹580**.

5. Thus, the algebraic expression enables us to calculate the cost quickly for any given values of $c$and j.

3. A student says that $7x + 5x + 3y$can be simplified to $15xy$. Analyse the statement and give the correct simplification.

Answer:

1. The terms $7x$and $5x$contain the same letter-number x, so they can be combined.
2. Therefore, $7x + 5x = (7 + 5)x = 12x$.
3. The term $3y$contains a different letter-number and cannot be combined with $12x$.
4. Hence, the expression simplifies to $12x + 3y$, not $15xy$.
5. The student's error is combining **unlike terms** as though they were like terms.

4. A student simplifies $(40x + 75y) - (6x + 10y)$as $34x + 85y$. Identify the error and obtain the correct expression.

Answer:

1. The negative sign before the second bracket must be applied to **both terms** inside that bracket.
2. Therefore, the expression becomes $40x + 75y - 6x - 10y$.
3. Grouping like terms gives $(40x - 6x) + (75y - 10y)$.
4. Simplifying gives $34x + 65y$.
5. Hence, the student's answer is incorrect because $10y$should be **subtracted**, not added.

5. Charu's total quiz score is represented by $21p - 9q$. If $p = 7$and $q = 4$, calculate her total score and explain the steps.

Answer:

1. Charu's simplified total score is $21p - 9q$.
2. Substituting $p = 7$and $q = 4$gives $21(7) - 9(4)$.
3. This becomes $147 - 36$.
4. Therefore, Charu's total score is **111**.
5. This demonstrates how a general algebraic expression can be evaluated by substituting particular values for its letter-numbers.

6. The sequence $4, 8, 12, 16, \ldots$is represented by $4n$. Determine whether 156 belongs to this sequence and find its position.

Answer:

1. A term at position $n$in the sequence is represented by $4n$.
2. To check 156, form the equation $4n = 156$.
3. Dividing by 4 gives $n = 39$.
4. Since 39 is a positive whole-number position, **156 belongs to the sequence**.
5. Therefore, **156 is the 39th term** of the sequence.

7. Explain why 150 cannot be a term of the sequence $4, 8, 12, 16, \ldots$.

Answer:

1. The general expression for the sequence is $4n$.
2. If 150 were a term, then $4n = 150$.
3. Solving gives $n = 150 \div 4 = 37.5$.
4. A position in a sequence must be a positive whole number, but 37.5 is not a whole number.
5. Therefore, **150 cannot be a term of the given sequence**.

8. A number machine follows the rule $2a - b$. Its output is 23 when $a = 15$. Find $b$and verify your answer.

Answer:

1. The number-machine rule is $2a - b$.
2. Substituting $a = 15$and the output 23 gives $2(15) - b = 23$.

3. Therefore, $30 - b = 23$, giving $b = 7$.
4. Substituting $b = 7$back gives $2(15) - 7 = 30 - 7 = 23$.
5. Hence, $b = 7$is the correct second input.

9. A 2×2calendar block has 18 as its top-left number. Find the remaining entries and prove that its diagonal sums are equal.

Answer:

1. The entries of such a block are represented by $a, a + 1, a + 7, a + 8$.
2. For $a = 18$, the four entries are **18, 19, 25 and 26**.
3. One diagonal sum is $18 + 26 = 44$.
4. The other diagonal sum is $19 + 25 = 44$.
5. Hence, **both diagonal sums are equal to 44**, confirming the algebraic calendar pattern.

10. The diagonal sum of a 2×2calendar block is 52. Find all four numbers in the block.

Answer:

1. The common diagonal sum of the calendar block is represented by $2a + 8$.
2. Therefore, $2a + 8 = 52$, giving $2a = 44$and $a = 22$.
3. The number to the right is $a + 1 = 23$, and the number below $a$is $a + 7 = 29$.
4. The diagonally opposite number is $a + 8 = 30$.
5. Hence, the four numbers are **22, 23, 29 and 30**, with both diagonals summing to 52.

11. Two students represent the same quantity as $5x + 7x + 3y$and $12x + 3y$. Determine whether both expressions are equivalent and justify your answer.

Answer:

1. In the first expression, $5x$and $7x$contain the same letter-number and can be combined.
2. Thus, $5x + 7x + 3y = (5 + 7)x + 3y$.
3. This simplifies to $12x + 3y$.
4. The simplified form is exactly the same as the second student's expression.
5. Therefore, **both expressions are equivalent** because valid simplification produces the same algebraic expression.

12. Use algebra to explain why the two diagonal sums of every 2×2calendar block are equal, rather than checking only one example.

Answer:

1. Let the top-left number be a; then the block contains $a, a + 1, a + 7$,and $a + 8$.
2. The first diagonal sum is $a + (a + 8) = 2a + 8$.
3. The second diagonal sum is $(a + 1) + (a + 7) = 2a + 8$.
4. Since both expressions simplify to the same result, the equality does not depend on any particular value of a.
5. Therefore, algebra proves that **the diagonal sums are equal for every valid 2×2calendar block**, illustrating the power of algebraic modelling.

4.13 Five-mark questions with Answers of Applied Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – Applied Type:

1. A shop sells coconuts at ₹35 each and jaggery at ₹60 per kg. Meera buys 8 coconuts and 4 kg of jaggery. Form an algebraic expression and calculate her total expenditure.

Answer:

1. Let $c$represent the number of coconuts and $j$represent the kilograms of jaggery; the total cost is $35c + 60j$.
2. For Meera's purchase, substitute $c = 8$and $j = 4$.
3. The total cost is $35(8) + 60(4)$.
4. This gives $280 + 240 = ₹520$.

5. Therefore, **Meera spends ₹520**, showing how an algebraic expression can be applied to a shopping situation.

2. A school wants to place a decorative ribbon around a square notice board whose side is 18 cm. Form an algebraic expression for the perimeter and find the length of ribbon required.

Answer:

1. Let the side of the square be represented by q; its perimeter is $4q$.
2. For the notice board, $q = 18$cm.
3. Substituting gives $4q = 4(18)$.
4. Therefore, the perimeter is **72 cm**.
5. Hence, the school requires **72 cm of ribbon** to go once around the notice board.

3. A craft teacher uses 2 matchsticks to make each L-shaped figure. If 64 matchsticks are available, find how many complete L-shaped figures can be made using an algebraic expression.

Answer:

1. If $n$represents the number of L-shaped figures, the number of matchsticks required is $2n$.
2. Since 64 matchsticks are available, write $2n = 64$.
3. Dividing both sides by 2 gives $n = 32$.
4. Therefore, **32 complete L-shaped figures** can be made.
5. This application shows how the general expression $2n$can be used to determine an unknown quantity.

4. A game awards points according to the expression $21p - 9q$. If a player has $p = 8$and $q = 5$, calculate the final score.

Answer:

1. The total score is represented by the expression $21p - 9q$.
2. Substituting $p = 8$and $q = 5$gives $21(8) - 9(5)$.
3. This becomes $168 - 45$.
4. Therefore, the final score is **123 points**.
5. Thus, an algebraic score formula can be evaluated by substituting the given values of its letter-numbers.

5. A machine follows the rule $2a - b$. If the first input is 16 and the second input is 9, find the output and explain the procedure.

Answer:

1. The rule of the number machine is $2a - b$.
2. Substitute $a = 16$and $b = 9$into the expression.
3. This gives $2(16) - 9 = 32 - 9$.
4. Therefore, the machine produces an output of **23**.
5. The example shows how an algebraic rule can be applied to different numerical inputs.

6. A student observes the number pattern $4, 8, 12, 16, \ldots$and wants to find the 50th term without writing all the preceding terms. Use algebra to solve the problem.

Answer:

1. The general rule for the pattern is $4n$, where $n$represents the position of a term.
2. For the 50th term, substitute $n = 50$.
3. This gives $4n = 4(50)$.
4. Therefore, the 50th term is **200**.
5. Algebra makes it possible to find a distant term directly without listing all the earlier terms.

7. A student wants to know whether 172 appears in the pattern $4, 8, 12, 16, \ldots$. Use the algebraic rule to determine the answer and its position.

Answer:

1. Since the general term is $4n$, set $4n = 172$.
2. Dividing both sides by 4 gives $n = 43$.
3. Since 43 is a positive whole number, 172 occurs in the pattern.
4. Its position in the sequence is the **43rd position**.
5. Therefore, **172 is the 43rd term** of the given pattern.

8. While checking a calendar, Riya selects a 2×2block whose top-left number is 12. Find the four numbers and verify whether the diagonal sums are equal.

Answer:

1. A 2×2calendar block is represented by a, $a + 1$, $a + 7$,and $a + 8$.
2. For $a = 12$, the four numbers are **12, 13, 19 and 20**.
3. The first diagonal sum is $12 + 20 = 32$.
4. The second diagonal sum is $13 + 19 = 32$.
5. Therefore, **both diagonal sums are equal to 32**, confirming the calendar relationship.

9. A 2×2calendar block has a common diagonal sum of 42. Determine the four numbers in the block using algebra.

Answer:

1. The common diagonal sum of such a calendar block is $2a + 8$.
2. Therefore, $2a + 8 = 42$, which gives $2a = 34$and $a = 17$.
3. The four entries are $a = 17$, $a + 1 = 18$, $a + 7 = 24$,and $a + 8 = 25$.
4. Their diagonal sums are $17 + 25 = 42$and $18 + 24 = 42$.
5. Hence, the required calendar block contains **17, 18, 24 and 25**.

10. A student calculates the difference between two quantities as $(40x + 75y) - (6x + 10y)$. Simplify the expression and find its value when $x = 3$and $y = 2$.

Answer:

1. Removing the brackets gives $40x + 75y - 6x - 10y$.
2. Combining like terms gives $34x + 65y$.
3. Substituting $x = 3$and $y = 2$gives $34(3) + 65(2)$.
4. This equals $102 + 130 = 232$.
5. Therefore, the simplified expression is $34x + 65y$and its value for the given quantities is **232**.

4.14 Multiple Choice Questions with answers for Olympiad type Competitive Exams:

Olympiad-Type Multiple Choice Questions:

1. If $a$represents Aftab's age and Shabnam is 3 years older than Aftab, which expression represents Shabnam's age?

A) $a - 3$
B) $3a$
C) $a + 3$
D) $a \div 3$

Answer: C) $a + 3$

2. If Shabnam's age is $s$and she is 3 years older than Aftab, which expression represents Aftab's age?

A) $s + 3$
B) $s - 3$
C) $3s$
D) $s \div 3$

Answer: B) $s - 3$

3. Each L-shaped figure requires 2 matchsticks. Which expression gives the number of matchsticks required for $n$such figures?
A) $n + 2$
B) $2n$
C) $n - 2$
D) $n \div 2$
Answer: B) $2n$
4. If 46 matchsticks are used to make L-shaped figures according to the rule $2n$, how many figures can be made?
A) 21
B) 22
C) 23
D) 24
Answer: C) 23
5. Which is the standard algebraic way of writing $7 \times k$?
A) $7 + k$
B) $k7$
C) $7k$
D) $7 - k$
Answer: C) $7k$
6. If $k = 6$, what is the value of $7k$?
A) 13
B) 36
C) 42
D) 49
Answer: C) 42
7. If $m = 5$, what is the value of $5m + 3$?
A) 25
B) 28
C) 30
D) 40
Answer: B) 28
8. If $5m + 3 = 43$, what is the value of m?
A) 6
B) 7
C) 8
D) 9
Answer: C) 8
9. Which expression represents the perimeter of a square whose side is q?
A) $q + 4$
B) q^2
C) $2q$
D) $4q$
Answer: D) $4q$
10. A square has perimeter 76 cm. What is its side length?
A) 17 cm
B) 18 cm
C) 19 cm
D) 20 cm
Answer: C) 19 cm

11. Coconuts cost ₹35 each and jaggery costs ₹60 per kg. Which expression represents the cost of $c$coconuts and $j$kg of jaggery?
A) $35c + 60j$
B) $60c + 35j$
C) $95cj$
D) $35c - 60j$
Answer: A) $35c + 60j$
12. Using $35c + 60j$, what is the total cost of 4 coconuts and 3 kg of jaggery?
A) ₹280
B) ₹300
C) ₹320
D) ₹340
Answer: C) ₹320
13. Which of the following is equivalent to $5c + 3c + 10c$?
A) $18c$
B) $18c^3$
C) $15c$
D) $8c + 10$
Answer: A) $18c$
14. Which expression cannot be simplified into a single term?
A) $7x + 5x$
B) $8a - 3a$
C) $18c + 11d$
D) $12m + 6m$
Answer: C) $18c + 11d$
15. What is the simplified form of $13x + 8x - 6x$?
A) $15x$
B) $21x$
C) $27x$
D) $15x^2$
Answer: A) $15x$
16. Which of the following is equivalent to $6(x + 4)$?
A) $6x + 4$
B) $6x + 10$
C) $6x + 24$
D) $24x$
Answer: C) $6x + 24$
17. Which is the correct simplification of $8(a + b) - 3b$?
A) $8a + 5b$
B) $8a + 11b$
C) $5a + 8b$
D) $8a + 8b - 3$
Answer: A) $8a + 5b$
18. Simplify $(40x + 75y) - (6x + 10y)$.
A) $34x + 65y$
B) $46x + 85y$
C) $34x + 85y$
D) $46x + 65y$
Answer: A) $34x + 65y$

19. Charu's total quiz score is $21p - 9q$. What is her score when $p = 5$and $q = 3$?
A) 68
B) 72
C) 78
D) 82
Answer: C) 78

$$21(5) - 9(3) = 105 - 27 = 78$$

20. What is the n^{th}term of the sequence $4, 8, 12, 16, \ldots$?
A) $n + 4$
B) $4n$
C) $4 + n$
D) n^4
Answer: B) $4n$
21. What is the 37th term of the sequence $4, 8, 12, 16, \ldots$?
A) 144
B) 146
C) 148
D) 152
Answer: C) 148
22. Which number does not belong to the sequence $4, 8, 12, 16, \ldots$?
A) 72
B) 84
C) 94
D) 100
Answer: C) 94, because it cannot be written as $4n$for a whole-number value of n.
23. If $4n = 196$, what is the value of n?
A) 47
B) 48
C) 49
D) 50
Answer: C) 49
24. A number machine uses the rule $2a - b$. What is its output when $a = 12$and $b = 7$?
A) 5
B) 17
C) 19
D) 31
Answer: B) 17
25. A number machine follows $2a - b$. If the output is 22 and $a = 15$, what is b?
A) 6
B) 7
C) 8
D) 9
Answer: C) 8
26. A 2×2calendar block has $a$as its top-left number. Which arrangement is correct?
A) $\begin{matrix} a & a+1 \\ a+7 & a+8 \end{matrix}$
B) $\begin{matrix} a & a+2 \\ a+7 & a+9 \end{matrix}$
C) $\begin{matrix} a & a+1 \\ a+6 & a+7 \end{matrix}$

D) $\begin{matrix} a & a+7 \\ a+1 & a+8 \end{matrix}$
Answer: A) $\begin{matrix} a & a+1 \\ a+7 & a+8 \end{matrix}$
27. What is the sum of either diagonal of the calendar block $\begin{matrix} a & a+1 \\ a+7 & a+8 \end{matrix}$?
A) $2a+7$
B) $2a+8$
C) $2a+9$
D) $a+8$
Answer: B) $2a+8$
28. If the top-left number of a 2×2calendar block is 16, what is the sum of either diagonal?
A) 32
B) 36
C) 40
D) 48
Answer: C) 40, because $2(16)+8=40$.
29. If the common diagonal sum of a 2×2calendar block is 54, what is its top-left number?
A) 21
B) 22
C) 23
D) 24
Answer: C) 23, because $2a+8=54 \Rightarrow a=23$.
30. Why are the two diagonal sums in every 2×2calendar block equal?
A) Both contain the same numbers.
B) Both simplify to $2a+8$.
C) Every calendar number is even.
D) Each row has the same sum.
Answer: B) Both simplify to $2a+8$.
31. Which pair of expressions is equivalent?
A) $5x+3x$and $8x$
B) $5x+3y$and $8xy$
C) $4x+2$and $6x$
D) $3(x+2)$and $3x+2$
Answer: A) $5x+3x$**and** $8x$
32. A student writes $7(x+2)=7x+2$. What should the correct expression be?
A) $7x+7$
B) $7x+9$
C) $7x+14$
D) $14x+2$
Answer: C) $7x+14$
33. Which statement about $9x+6y$is correct?
A) It simplifies to $15xy$.
B) It simplifies to $15x$.
C) It simplifies to $15y$.
D) It cannot be combined into a single term.
Answer: D) It cannot be combined into a single term.
34. If $x=3$and $y=2$, what is the value of $34x+65y$?

A) 212
B) 222
C) 232
D) 242
Answer: C) 232
35. Which statement best describes the usefulness of algebraic expressions?
A) They can only represent fixed numbers.
B) They are useful only for addition and subtraction.
C) They describe patterns and relationships concisely and help make predictions.
D) They cannot represent real-life situations.
Answer: C) They describe patterns and relationships concisely and help make predictions.

Olympiad focus: These questions test **pattern recognition, substitution, simplification, reverse reasoning, distributive property, algebraic modelling, equivalence of expressions, and logical application of letter-numbers** based on Chapter 4.

4.15 Best Practices Opportunity List from the Chapter: (10 Ideas) :

Suggested "Best Practices" Opportunities While Teaching:

(1) Begin with real-life relationships: Introduce letter-numbers through familiar situations from the chapter, such as **ages, shopping costs, matchstick arrangements, and the perimeter of a square**. Students should first describe the relationship verbally and then convert it into an algebraic expression such as $a + 3$, $35c + 60j$, or $4q$.

(2) Follow Concrete → Pictorial → Algebraic learning: Use actual **matchsticks** to construct patterns, draw the arrangements, record the numerical pattern, and finally introduce the corresponding letter-number expression. This helps students see algebra as a way of generalising an observed relationship rather than merely manipulating symbols.

(3) Practise substitution systematically: Give students expressions such as $7k$and $5m + 3$and ask them to evaluate these for different values of the letter-number. Encourage the sequence **write the expression → substitute the value → perform operations → state the answer**.

(4) Strengthen simplification through grouping: Ask students to identify terms containing the same letter-number before performing any calculation. Examples such as $5c + 3c + 10c = 18c$and $18c + 11d$help them recognise which terms can and cannot be combined.

(5) Reinforce arithmetic properties in algebra: Connect students' previous knowledge of **swapping, grouping, brackets, signs, and the distributive property** with algebraic expressions. This helps them understand that many familiar arithmetic rules continue to operate when numbers are represented by letters.

(6) Use error-detection exercises: Give deliberately incorrect simplifications and ask students to identify, explain, and correct the mistake. For example, subtraction involving $(40x + 75y) - (6x + 10y)$can be used to reinforce correct handling of the negative sign and brackets.

(7) Conduct a "Formula Detective" activity: Provide students with input-output situations and let them discover the algebraic rule, similar to the chapter's $2a - b$number-machine activity. Students can then test their proposed rule using several input values.

(8) **Use calendar-based discovery learning:** Let groups choose different 2×2blocks from a calendar and calculate both diagonal sums. They can then represent the entries as a, $a + 1$, $a + 7$, $a + 8$and discover algebraically that both diagonal sums equal $2a + 8$.

(9) **Encourage verbal-to-symbolic and symbolic-to-verbal translation:** Regularly ask students to convert statements into algebraic expressions and explain expressions in ordinary language. This develops mathematical communication and reinforces the chapter's emphasis on using algebra as a **concise language for relationships**.

(10) **Promote Think–Pair–Share:** Give a pattern or expression first to individual students, then ask them to compare their reasoning with a partner before presenting it to the class. Emphasise **why an expression works**, rather than accepting only the final answer.

(11) **Use multiple representations:** Whenever possible, represent the same relationship through **words, objects/pictures, numerical examples, and algebraic expressions**. Students should be encouraged to move confidently from one representation to another.

(12) **Include short formative assessments:** End the lesson with 3–5 quick questions covering **substitution, simplification, pattern recognition, brackets, and application**. Include both straightforward and reasoning-based questions so misconceptions can be identified immediately.

Recommended Best-Practice Learning Cycle:
For this chapter, an effective classroom sequence is:
Observe a situation → Identify quantities → Represent with letter-numbers → Form an expression → Substitute values → Simplify → Generalise → Explain why the relationship works.
This approach aligns particularly well with the chapter's emphasis on using algebraic expressions to **represent patterns and relationships concisely, make predictions, and explain mathematical relationships**.

4.16 Innovations Opportunity List from the Chapter: (12 Ideas)

"Innovations" Opportunities for Teaching–Learning – 7th Standard:

(1) **Algebra Machine Challenge:** Create a classroom "number machine" where students enter values for letter-numbers and calculate outputs using rules such as $2a - b$. Later, reverse the activity by giving the output and one input and asking students to discover the missing value. This turns substitution into an interactive reasoning game.

(2) **Matchstick-to-Algebra Laboratory:** Give groups matchsticks to construct and extend patterns. Students record the number of figures and matchsticks, predict larger cases, and finally create a **general expression using a letter-number**. This converts a hands-on activity into algebraic generalisation.

(3) **Calendar Algebra Investigation:** Display a large calendar or give each group a calendar sheet. Students select different 2×2blocks, investigate diagonal sums, and then use $a, a + 1, a + 7, a + 8$to prove that both diagonal sums are $2a + 8$. The activity introduces students to the idea of using algebra to prove an observed pattern.

(4) **Virtual Algebra Shopping Mart:** Convert the chapter's coconut-and-jaggery situation into a mock shopping activity. Students choose different quantities and use $35c + 60j$to prepare bills, while classmates verify the calculations through substitution.

(5) **Expression Card-Matching Game:** Prepare three sets of cards containing **verbal statements, algebraic expressions, and numerical examples**. Students compete to match related cards—for example, "perimeter of a square of side q" with $4q$and then

with the appropriate value for a given q. This strengthens movement between words, symbols, and numbers.

(6) **Algebra Error Detective:** Display intentionally incorrect solutions such as combining terms containing different letter-numbers or incorrectly removing brackets. Teams identify the error, correct it, and explain the mathematical rule involved; examples such as $18c + 11d$and subtraction of bracketed expressions provide suitable chapter-based contexts.

(7) **Human Algebra Activity:** Assign students roles as **coefficients, letter-numbers, operation signs, and brackets**. Students physically rearrange themselves to represent and simplify expressions such as $5c + 3c + 10c$, making the process of grouping terms more visual and memorable.

(8) **Create-Your-Own Pattern Challenge:** Ask students to invent a simple numerical or visual pattern, prepare its first few cases, and develop an algebraic expression representing the general relationship. Classmates then test the expression by substituting different values. This extends the chapter's focus on using algebra to describe **patterns and relationships concisely**.

(9) **Digital Algebra Quiz/Game:** Use an interactive classroom quiz in which questions gradually progress from identifying letter-numbers to **substitution, simplification, brackets, pattern recognition, and reverse reasoning**. Immediate feedback can turn routine practice into a collaborative challenge while allowing the teacher to identify misconceptions quickly.

(10) **Student-Created Algebra Story Problems:** Let students create their own short situations involving **age, cost, scores, or measurements**, represent them using letter-numbers, and exchange them with classmates for solving. This encourages students to become problem creators rather than only problem solvers.

(11) **Algebra Escape-Room Activity:** Organise a sequence of clues where solving one expression reveals the next clue. Tasks can involve evaluating $5m + 3$, simplifying like terms, solving a number-machine puzzle, and discovering a calendar relationship, integrating several chapter concepts into one gamified activity.

(12) **"From Example to Proof" Mini-Project:** Students first test a mathematical pattern with several numerical examples and then attempt to explain it using letter-numbers. The calendar investigation is especially suitable because students can move from **observation → conjecture → algebraic representation → simplification → proof**.

These innovations can make the chapter more **activity-based, exploratory, collaborative, and reasoning-oriented**, while retaining its central objective of helping students use algebraic expressions to represent relationships, simplify them, recognise patterns, and explain why those patterns work.

4.17: Practicing Questions/Question Bank:

A. Fill-in-the-Blank Questions:

1. Letters used to represent numbers are called ________.
   Answer: Letter-numbers

2. An expression containing letter-numbers is called an ________ **expression**.
   Answer: Algebraic

3. If Aftab's age is a, then Shabnam's age, who is 3 years older, is ________.
   Answer: $a + 3$

4. The algebraic form of $7 \times k$is ________.
   Answer: $7k$

5. If $m = 4$, the value of $5m + 3$is ________.
   Answer: 23

6. $5c + 3c + 10c =$________.
   Answer: $18c$

7. The expression $18c + 11d$cannot be reduced to a single term because $c$and $d$are ________ letter-numbers.
   Answer: Different

8. If the side of a square is q, its perimeter is ________.
   Answer: $4q$

9. The cost of $c$coconuts at ₹35 each is ________.
   Answer: ₹$35c$

10. The cost of $j$kg of jaggery at ₹60 per kg is ________.
    Answer: ₹$60j$

11. The total cost of $c$coconuts and $j$kg of jaggery is ________.
    Answer: ₹$(35c + 60j)$

12. The simplified form of $(40x + 75y) - (6x + 10y)$is ________.
    Answer: $34x + 65y$

13. If the top-left number of a 2×2calendar block is a, the bottom-right number is ________.
    Answer: $a + 8$

14. The sum of either diagonal in the calendar pattern is ________.
    Answer: $2a + 8$

15. Algebraic expressions help us represent mathematical patterns and ________ concisely.
    Answer: Relationships

B. One-Mark Descriptive Questions:

1. **What is a letter-number?**
   Answer: A letter used to represent a number is called a **letter-number**.

2. **What is an algebraic expression?**
   Answer: An expression containing letter-numbers is called an **algebraic expression**.

3. **Write $4 \times n$in algebraic notation.**
   Answer: $4n$.

4. **If $k = 6$, find the value of $7k$.**
   Answer: $7(6) = 42$.

5. **Find the value of $5m + 3$when $m = 3$.**
   Answer: $5(3) + 3 = 18$.

6. **Simplify $8x + 5x$.**
   Answer: $13x$.

7. **Simplify $7c + 3c + 2c$.**
   Answer: $12c$.
8. **Can $8x + 5y$ be combined into a single term? Give a reason.**
   Answer: No, because x and y are different letter-numbers.
9. **Write the expression for the perimeter of a square of side q.**
   Answer: $4q$.
10. **What does $35c$ represent in the coconut-cost example?**
    Answer: It represents the cost of c coconuts at ₹35 each.
11. **What is the output of $2a - b$ when $a = 6$ and $b = 4$?**
    Answer: $2(6) - 4 = 8$.
12. **What is the simplified form of $5c + 3c + 10c$?**
    Answer: $18c$.
13. **If the top-left calendar number is a, what is the number immediately to its right?**
    Answer: $a + 1$.
14. **What is the number directly below a in the calendar pattern?**
    Answer: $a + 7$.
15. **Why are algebraic expressions useful?**
    Answer: They represent patterns and mathematical relationships in a concise form.

C. Two-Mark Descriptive Questions:

1. If Aftab's age is a, represent Shabnam's age if she is 3 years older.

Answer:

1. Aftab's age is represented by a.
2. Therefore, Shabnam's age is $a + 3$.

2. Evaluate $5m + 3$ when $m = 7$.

Answer:

1. Substitute $m = 7$: $5(7) + 3$.
2. Therefore, the value is **38**.

3. Simplify $6x + 9x$.

Answer:

1. Both terms contain the same letter-number x, so $6x + 9x = (6 + 9)x$.
2. Therefore, the simplified expression is $15x$.

4. Why can $12c + 8c$ be simplified but $12c + 8d$ cannot?

Answer:

1. $12c$ and $8c$ contain the same letter-number and combine to give $20c$.

2. $12c$ and $8d$ contain different letter-numbers, so they cannot be combined into one term.

5. Find the perimeter of a square whose side $q = 15$cm.

Answer:

1. Perimeter $= 4q = 4(15)$.
2. Therefore, the perimeter is **60 cm**.

6. Find the cost of 5 coconuts at ₹35 each.

Answer:

1. The cost of c coconuts is $35c$.
2. For $c = 5$, the cost is $35(5) = ₹175$.

7. A number machine uses $2a - b$. Find its output when $a = 10$ and $b = 6$.

Answer:

1. Substitute the values: $2(10) - 6$.
2. Therefore, the output is **14**.

8. Write the four entries of a 2×2 calendar block when its top-left entry is a.

Answer:

1. The top row contains a and $a + 1$.
2. The bottom row contains $a + 7$ and $a + 8$.

D. Three-Mark Descriptive Questions:

1. Find the total cost of 6 coconuts and 3 kg of jaggery if they cost ₹35 each and ₹60 per kg respectively.

Answer:

1. Total cost $= 35c + 60j$.
2. Substituting $c = 6$ and $j = 3$: $35(6) + 60(3) = 210 + 180$.
3. Therefore, the total cost is **₹390**.

2. Simplify $5c + 3c + 10c$ and explain the method.

Answer:

1. All the terms contain the same letter-number c.
2. Therefore, $5c + 3c + 10c = (5 + 3 + 10)c$.
3. Hence, the simplified expression is $18c$.

3. Simplify $(40x + 75y) - (6x + 10y)$.

Answer:

1. Remove the brackets: $40x + 75y - 6x - 10y$.
2. Group corresponding terms: $(40x - 6x) + (75y - 10y)$.
3. Therefore, the simplified expression is $34x + 65y$.

4. A number machine follows the rule $2a - b$. Find the output when $a = 14$and $b = 9$.

Answer:

1. Substitute $a = 14$and $b = 9$: $2(14) - 9$.
2. Simplify: $28 - 9$.
3. Therefore, the output is **19**.

5. A 2×2calendar block has 11 as its top-left number. Write all four numbers and find one diagonal sum.

Answer:

1. The four numbers are $11,12,18,19$.
2. One diagonal contains 11 and 19.
3. Therefore, its sum is $11 + 19 = 30$.

6. Explain why $18c + 11d$cannot be simplified into a single term.

Answer:

1. The first term contains the letter-number c.
2. The second term contains the different letter-number d.
3. Therefore, the two unlike terms **cannot be combined into a single term**.

E. Five-Mark Descriptive Questions:

1. Explain how letter-numbers and algebraic expressions are useful in representing mathematical relationships.

Answer:

1. A letter-number is a letter used to represent a number.
2. Expressions containing letter-numbers are called algebraic expressions.
3. For example, if Aftab's age is a, Shabnam's age can be represented as $a + 3$.
4. Algebraic expressions can also represent patterns, costs, measurements, and other relationships.
5. Thus, algebra allows mathematical relationships to be represented **concisely and generally**.

2. Explain how algebra can be used in a shopping situation involving coconuts and jaggery.

Answer:

1. Suppose a coconut costs ₹35 and jaggery costs ₹60 per kg.

2. If $c$coconuts are purchased, their cost is $35c$.
3. If $j$kg of jaggery is purchased, its cost is $60j$.
4. Therefore, the combined cost is $35c + 60j$.
5. By substituting values for $c$and j, we can calculate the total cost for different purchases.

3. Explain the process of simplifying algebraic expressions containing the same and different letter-numbers.

Answer:

1. Terms containing the same letter-number can be grouped together.
2. For example, $5c + 3c + 10c = (5 + 3 + 10)c$.
3. Therefore, the expression simplifies to $18c$.
4. However, $18c + 11d$contains two different letter-numbers, $c$and d.
5. Hence, $18c + 11d$**cannot be simplified into a single term**.

4. Prove algebraically that the diagonal sums of a 2×2calendar block are equal.

Answer:

1. Let the four numbers be a, $a + 1$, $a + 7$,and $a + 8$.
2. The first diagonal sum is $a + (a + 8) = 2a + 8$.
3. The second diagonal sum is $(a + 1) + (a + 7)$.
4. Simplifying the second sum also gives $2a + 8$.
5. Therefore, **the two diagonal sums are always equal**, irrespective of the value of a.

5. Explain how arithmetic rules help in simplifying algebraic expressions.

Answer:

1. Many rules used with numerical arithmetic also apply to algebraic expressions.
2. Terms containing the same letter-number can be grouped using arithmetic properties.
3. The distributive property helps us combine expressions such as $5c + 3c + 10c$.
4. Brackets and signs must be handled carefully when adding or subtracting algebraic expressions.
5. Using these rules correctly makes algebraic expressions **shorter, simpler, and easier to interpret**.

6. Explain how algebraic expressions help in discovering and proving patterns.

Answer:

1. A numerical or visual pattern can often be represented using a letter-number.
2. The letter-number allows one expression to represent many different cases.
3. Substitution can be used to test the expression for particular values.

4. Simplification can reveal why a mathematical relationship remains true for different values.
5. Thus, algebraic expressions help students move from **observing individual examples to establishing general mathematical relationships**.

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7th Standard Maths Book Chapter 5

Chapter 5: PARALLEL AND INTERSECTING LINES

5.1 Summary of the Chapter:

Chapter 5: Parallel and Intersecting Lines — Summary:

(1) **Intersecting lines** are two lines that meet at a common point on the same plane. When two lines intersect, they form **four angles**.

(2) **Linear pairs** are adjacent angles formed by two intersecting lines. The sum of the angles in every linear pair is always **180°**.

(3) **Vertically opposite angles** are the opposite angles formed when two lines intersect. Such angles are always **equal in measure**.

(4) **Perpendicular lines** are lines that intersect each other at **right angles (90°)**. When two lines are perpendicular, all four angles formed at their intersection measure 90°.

(5) **Parallel lines** are two lines lying on the **same plane** that never meet, however far they are extended in either direction.

(6) Parallel and perpendicular lines can be explored practically through **paper folding, dot-paper activities, rulers, set squares, and protractors**. These activities help students recognise their properties and relationships.

(7) A **transversal** is a line that intersects two other lines at different points. When a transversal crosses two lines, it forms **eight angles**, with a maximum of four distinct angle measures.

(8) **Corresponding angles** occupy matching positions at the two intersections created by a transversal. When a transversal intersects two **parallel lines**, the corresponding angles are always **equal**.

(9) Conversely, if a transversal intersects two lines and a pair of **corresponding angles is equal**, the two lines are **parallel**. This property can be used to test whether two given lines are parallel.

(10) **Alternate angles** formed when a transversal intersects a pair of parallel lines are always **equal**. This result follows from the properties of corresponding and vertically opposite angles.

(11) The **interior angles on the same side of a transversal** intersecting two parallel lines are supplementary; that is, their measures always add up to **180°**.

(12) The chapter develops the ability to **identify, draw, and reason about parallel, perpendicular, and intersecting lines**, and to calculate unknown angles using **linear pairs, vertically opposite angles, corresponding angles, alternate angles, and interior-angle relationships**. It also introduces **parallel illusions**, showing that visual appearance alone may sometimes be misleading when judging whether lines are parallel.

5.2 Important Formulas:

Important Formulas / Angle Relationships for Quantitative Problems:

The following are the key formulas and mathematical relationships required to solve numerical problems from this chapter.

1. **Angles on a Straight Line / Linear Pair**

$$\boxed{\angle 1 + \angle 2 = 180^\circ}$$

Therefore,

$$\boxed{\angle 2 = 180^\circ - \angle 1}$$

Two adjacent angles forming a linear pair are always supplementary.

2. **Vertically Opposite Angles**

When two straight lines intersect:

$$\boxed{\angle 1 = \angle 3}$$
$$\boxed{\angle 2 = \angle 4}$$

Thus, vertically opposite angles are always **equal**.

3. **Angles Around the Point of Intersection**

Four angles are formed when two lines intersect. Their total is:

$$\boxed{\angle 1 + \angle 2 + \angle 3 + \angle 4 = 360^\circ}$$

Since opposite angles are equal, knowing **one angle** is sufficient to determine the remaining three.

4. **Perpendicular Lines**

If two lines are perpendicular:

$$\boxed{\angle = 90^\circ}$$

Hence, all four angles at their intersection are:

$$\boxed{90^\circ + 90^\circ + 90^\circ + 90^\circ = 360^\circ}$$

Perpendicular lines intersect at right angles.

5. **Corresponding Angles of Parallel Lines**

If two parallel lines are cut by a transversal:

$$\boxed{\text{Corresponding angles are equal}}$$

For example,

$$\boxed{\angle 1 = \angle 5,\ \angle 2 = \angle 6,\ \angle 3 = \angle 7,\ \angle 4 = \angle 8}$$

6. **Test for Parallel Lines Using Corresponding Angles**

If corresponding angles formed by a transversal are equal:

$$\boxed{\text{Corresponding angles equal} \Rightarrow \text{lines are parallel}}$$

This relationship is particularly useful in problems asking whether two given lines are parallel.

7. **Alternate Angles of Parallel Lines**

When a transversal cuts two parallel lines:

$$\boxed{\text{Alternate angles are equal}}$$

For example:

$$\boxed{\angle f = \angle d}$$

8. **Interior Angles on the Same Side of a Transversal**

When a transversal cuts two parallel lines:

$$\boxed{\angle 1 + \angle 2 = 180^\circ}$$

Therefore:

$$\boxed{\angle 2 = 180^\circ - \angle 1}$$

The interior angles on the same side of the transversal are **supplementary**.

9. **Finding the Supplementary Angle**

If one angle is x°, its supplementary angle is:

$$\boxed{180^\circ - x^\circ}$$

Example: if one angle is 135°,

$$180^\circ - 135^\circ = \boxed{45^\circ}$$

This method is demonstrated in the chapter's worked examples.

10. **Useful Combined Rule for Two Parallel Lines and a Transversal**

If one angle is x°, all angles in the same corresponding/alternate/vertically-opposite group are:

$$\boxed{x^\circ}$$

while their adjacent supplementary angles are:

$$\boxed{180^\circ - x^\circ}$$

Thus, once **one angle is known**, all the other angles formed by a transversal across two parallel lines can generally be calculated using these relationships.

Quick Formula Revision

$$\boxed{\text{Linear Pair: } A + B = 180^\circ}$$

$$\boxed{\text{Vertically Opposite Angles: } A = C, B = D}$$

$$\boxed{\text{Perpendicular Lines: } A = 90^\circ}$$

$$\boxed{\text{Corresponding Angles (parallel lines): } A = B}$$

$$\boxed{\text{Alternate Angles (parallel lines): } A = B}$$

$$\boxed{\text{Same-side Interior Angles: } A + B = 180^\circ}$$

These are the **core angle relationships required for solving the quantitative problems in Chapter 5 – Parallel and Intersecting Lines**.

5.3 Fill-Up the Blank LOTS type questions with Answers: (30 Questions)

Fill-in-the-Blank Questions with Answers — LOTS Type:

1. When two lines meet each other at a point, the lines are said to ________ each other.
   Answer: intersect
2. When two lines intersect, they form ________ angles.
   Answer: four
3. Two adjacent angles formed by intersecting lines are called a ________ pair.
   Answer: linear
4. The sum of the angles in a linear pair is ________.
   Answer: 180°
5. Opposite angles formed by two intersecting lines are called ________ opposite angles.
   Answer: vertically
6. Vertically opposite angles are always ________ to each other.
   Answer: equal
7. If one angle of a linear pair measures 120°, the other angle measures ________.
   Answer: 60°
8. If two lines intersect and all four angles are equal, each angle measures ________.
   Answer: 90°
9. A pair of lines that intersect each other at right angles are called ________ lines.
   Answer: perpendicular
10. Parallel lines lie on the same ________.
    Answer: plane
11. Parallel lines never ________ each other, however far they are extended.
    Answer: meet
12. The opposite edges of a square sheet of paper are ________ to each other.
    Answer: parallel
13. The adjacent edges of a square sheet are ________ to each other.
    Answer: perpendicular
14. A line that intersects two different lines is called a ________.
    Answer: transversal
15. A transversal intersecting two lines forms a total of ________ angles.
    Answer: eight
16. When a transversal intersects two lines, there can be a maximum of ________ distinct angle measures.
    Answer: four

17. Angles occupying matching positions at the two intersections of a transversal are called ________ angles.
    Answer: corresponding
18. When a transversal intersects two parallel lines, the corresponding angles are always ________.
    Answer: equal
19. If corresponding angles formed by a transversal are equal, the two lines are ________.
    Answer: parallel
20. When a transversal intersects a pair of parallel lines, the ________ angles are always equal.
    Answer: alternate
21. The alternate angle of ∠f shown in Fig. 5.25 is ________.
    Answer: ∠d
22. The alternate angle of ∠e shown in Fig. 5.25 is ________.
    Answer: ∠c
23. If an alternate angle measures 120°, its corresponding alternate angle measures ________.
    Answer: 120°
24. Interior angles on the same side of a transversal cutting two parallel lines add up to ________.
    Answer: 180°
25. If one of the same-side interior angles is 50°, the other angle is ________.
    Answer: 130°
26. If one angle of a linear pair is 135°, the other angle measures ________.
    Answer: 45°
27. If one of two vertically opposite angles is 75°, the other angle measures ________.
    Answer: 75°
28. Perpendicular lines form an angle of ________ degrees at their point of intersection.
    Answer: 90
29. In mathematical diagrams, perpendicular lines can be indicated using a small ________ angle symbol.
    Answer: square
30. Parallel and perpendicular lines can be constructed and explored using tools such as a ruler, protractor and ________.
    Answer: set square

Key LOTS Concepts Covered :
These questions test students' **remembering and basic understanding** of intersecting lines, linear pairs, vertically opposite angles, perpendicular lines, parallel lines, transversals, corresponding angles, alternate angles, and same-side interior angles—the principal concepts of **Chapter 5: Parallel and Intersecting Lines**.

5.4 Fill-Up the Blank HOTS type questions with Answers: (30 Questions)

Fill-in-the-Blank Questions with Answers — HOTS Type:

1. Two lines intersect, and one of the angles formed is **68°**. The vertically opposite angle measures ________.
   Answer: 68°
2. If one angle formed by two intersecting lines is **115°**, its adjacent angle measures ________.
   Answer: 65°

3. Two angles form a linear pair. If one angle is **three times** the other, the smaller angle is ________.
   Answer: 45°
4. Two vertically opposite angles are represented by $3x + 10°$ and $5x - 30°$. The value of x is ________.
   Answer: 20
5. If two intersecting lines form four equal angles, each angle is ________ and the lines are ________.
   Answer: 90°; perpendicular
6. A transversal intersects two parallel lines. If one corresponding angle measures **72°**, its corresponding angle measures ________.
   Answer: 72°
7. A transversal intersects two lines and a pair of corresponding angles measures **85° and 85°**. The two lines must be ________.
   Answer: parallel
8. A transversal cuts two lines, and a pair of corresponding angles measures **75° and 105°**. Therefore, the two lines are ________.
   Answer: not parallel
9. Two parallel lines are cut by a transversal. If one angle measures **125°**, its alternate angle measures ________.
   Answer: 125°
10. If an alternate angle formed by a transversal across two parallel lines is $3x + 15°$ and the other alternate angle is $5x - 25°$, then $x =$________.
    Answer: 20
11. Two same-side interior angles formed by a transversal across parallel lines are **68°** and $x°$. The value of x is ________.
    Answer: 112°
12. If one same-side interior angle formed by a transversal cutting parallel lines is **145°**, the other interior angle is ________.
    Answer: 35°
13. Two same-side interior angles are represented by $2x°$ and $4x°$. Since the lines are parallel, $x =$________.
    Answer: 30°
14. Two angles of a linear pair are represented by $x + 30°$ and $2x°$. The value of x is ________.
    Answer: 50°
15. Two vertically opposite angles are represented by $4x - 15°$ and $3x + 20°$. The value of x is ________.
    Answer: 35°
16. A transversal cuts two parallel lines. If one of the eight angles is **40°**, every angle supplementary to it measures ________.
    Answer: 140°
17. In a pair of parallel lines cut by a transversal, if one angle is **135°**, the angles in its corresponding, alternate, and vertically opposite positions are each ________.
    Answer: 135°
18. If one angle formed by a transversal cutting two parallel lines is **47°**, its adjacent linear-pair angle measures ________.
    Answer: 133°

19. A transversal forms corresponding angles $2x + 20°$ and $4x - 40°$ on two parallel lines. The value of x is ________.
Answer: 30
20. If two corresponding angles formed by a transversal are equal and one of them is $6x - 15°$ while the other is $4x + 25°$, then $x =$________.
Answer: 20
21. Two parallel lines are cut by a transversal. One angle is $3x°$, while its same-side interior angle is $2x°$. The value of x is ________.
Answer: 36°
22. If a line is perpendicular to another line and one of the angles at their intersection is represented by $3x°$, then $x =$________.
Answer: 30°
23. If two different lines are each perpendicular to the same transversal, the corresponding angles formed are both ________; hence, the two lines are parallel.
Answer: 90°
24. A pair of parallel lines is crossed by a transversal. If one angle measures $x°$ and its linear-pair angle measures $x + 40°$, then $x =$________.
Answer: 70°
25. If two vertically opposite angles are $7x - 10°$ and $5x + 30°$, each of these angles measures ________.
Answer: 130°
26. Two same-side interior angles are $3x + 10°$ and $2x + 20°$. If the lines are parallel, $x =$________.
Answer: 30°
27. If one of the angles formed when a transversal crosses two parallel lines is **56°**, an adjacent angle at the same intersection is ________.
Answer: 124°
28. If one angle formed by two intersecting lines is $x°$, the angle vertically opposite to it is ________, while either adjacent angle is ________.
Answer: $x°$; $180° - x°$
29. When a transversal intersects two parallel lines, an alternate angle is **98°**. The same-side interior angle supplementary to it measures ________.
Answer: 82°
30. A transversal intersects two lines. If corresponding angles are both **110°**, the alternate angles corresponding through vertically opposite relationships will also measure ________.
Answer: 110°

These HOTS fill-ups require students to **analyse angle relationships, apply properties, form simple equations, calculate unknown angles, and determine whether lines are parallel or perpendicular**, rather than merely recall definitions.

5.5 One-mark questions with Answers of LOTS Type: (30 Questions)

One-Mark Descriptive Questions with Answers — LOTS Type:

1. **What are intersecting lines?**
Answer: Two lines that meet each other at a point on a plane are called **intersecting lines**.
2. **How many angles are formed when two lines intersect?**
Answer: Two intersecting lines form **four angles**.

3. **What is a linear pair?**
   Answer: Two adjacent angles formed by intersecting lines that together make a straight angle are called a **linear pair**.
4. **What is the sum of the angles in a linear pair?**
   Answer: The sum of the angles in a linear pair is **180°**.
5. **What are vertically opposite angles?**
   Answer: Opposite angles formed when two lines intersect are called **vertically opposite angles**.
6. **State the property of vertically opposite angles.**
   Answer: Vertically opposite angles are always **equal to each other**.
7. **What is meant by a proof in mathematics?**
   Answer: A **proof** is a mathematical justification established through logical reasoning.
8. **Why may measured angles sometimes differ slightly from their expected values?**
   Answer: Measured angles may differ slightly because of **measurement errors or variations in the thickness of drawn lines**.
9. **What are perpendicular lines?**
   Answer: Two lines that intersect each other at **right angles** are called perpendicular lines.
10. **What angle is formed by two perpendicular lines?**
    Answer: Perpendicular lines form an angle of **90°** at their intersection.
11. **What are parallel lines?**
    Answer: Parallel lines are lines on the same plane that **never meet however far they are extended**.
12. **How are the opposite edges of a square sheet related?**
    Answer: The opposite edges of a square sheet are **parallel to each other**.
13. **How are the adjacent edges of a square sheet related?**
    Answer: The adjacent edges of a square sheet are **perpendicular to each other**.
14. **How are parallel lines indicated in a geometrical diagram?**
    Answer: Parallel lines are indicated using matching **arrow marks** on the lines.
15. **How are perpendicular lines indicated in a geometrical diagram?**
    Answer: Perpendicular lines are indicated by a **small square marking the 90° angle**.
16. **What is a transversal?**
    Answer: A line that intersects two different lines is called a **transversal**.
17. **How many angles are formed when a transversal intersects two lines?**
    Answer: A transversal intersecting two lines forms **eight angles**.
18. **What are corresponding angles?**
    Answer: Angles occupying corresponding positions at the two intersections made by a transversal are called **corresponding angles**.
19. **State the relationship between corresponding angles when a transversal intersects parallel lines.**
    Answer: Corresponding angles formed by a transversal intersecting parallel lines are **equal**.
20. **What can be concluded if corresponding angles formed by a transversal are equal?**
    Answer: If the corresponding angles are equal, the two lines are **parallel**.
21. **What are alternate angles?**
    Answer: Alternate angles are angles lying on **opposite sides of a transversal** in the alternate positions between the two lines.

22. **State the property of alternate angles formed by parallel lines.**
    Answer: Alternate angles formed by a transversal intersecting two parallel lines are **equal**.
23. **What is the alternate angle of ∠f in Fig. 5.25?**
    Answer: The alternate angle of **∠f is ∠d**.
24. **What is the alternate angle of ∠e in Fig. 5.25?**
    Answer: The alternate angle of **∠e is ∠c**.
25. **What is the relationship between interior angles on the same side of a transversal cutting parallel lines?**
    Answer: Interior angles on the same side of the transversal always **add up to 180°**.
26. **If one angle of a linear pair is 120°, what is the other angle?**
    Answer: The other angle is **60°** because a linear pair adds up to 180°.
27. **If one of two vertically opposite angles is 75°, what is the other angle?**
    Answer: The other vertically opposite angle is **75°** because vertically opposite angles are equal.
28. **If one corresponding angle is 65° when a transversal cuts two parallel lines, what is the corresponding angle?**
    Answer: The corresponding angle is **65°** because corresponding angles between parallel lines are equal.
29. **If one of the same-side interior angles is 70°, what is the other angle?**
    Answer: The other interior angle is **110°** because the two angles add up to 180°.
30. **Name two instruments that can be used to draw or check parallel lines in this chapter.**
    Answer: A **ruler and set square** can be used to draw or check parallel lines.

5.6 One-mark questions with Answers of HOTS Type: (30 Questions)

One-Mark Descriptive Questions with Answers — HOTS Type:

1. **Two intersecting lines form an angle of 125°. What is the measure of its vertically opposite angle?**
   Answer: The vertically opposite angle is **125°** because vertically opposite angles are equal.
2. **If one angle of a linear pair is 68°, find the other angle.**
   Answer: The other angle is **112°**, since $180^\circ - 68^\circ = 112^\circ$.
3. **Two intersecting lines form an angle of 47°. What is the measure of its adjacent angle?**
   Answer: The adjacent angle is **133°**, because adjacent angles forming a linear pair add up to 180°.
4. **If two intersecting lines form four equal angles, what can you conclude about the lines?**
   Answer: The lines are **perpendicular** because each of the four equal angles must measure 90°.
5. **Can two straight lines intersect at two different points? Give a reason.**
   Answer: No, two distinct straight lines can intersect at only **one point**.
6. **If one angle formed by two intersecting lines is 90°, what will be the measure of its vertically opposite angle?**
   Answer: Its vertically opposite angle will also be **90°**.
7. **A transversal intersects two parallel lines, and one corresponding angle is 72°; what is the other corresponding angle?**

Answer: The other corresponding angle is **72°** because corresponding angles of parallel lines are equal.

8. **A transversal forms corresponding angles of 65° and 65° with two lines; what can you conclude about the lines?**
   Answer: The two lines are **parallel** because equal corresponding angles imply that the lines are parallel.
9. **A transversal forms corresponding angles of 70° and 110° with two lines; can the lines be parallel?**
   Answer: No, the lines cannot be parallel because their corresponding angles are **not equal**.
10. **If an alternate angle formed by two parallel lines and a transversal is 105°, find the other alternate angle.**
    Answer: The other alternate angle is **105°** because alternate angles between parallel lines are equal.
11. **If one same-side interior angle is 75°, find the other interior angle when the lines are parallel.**
    Answer: The other interior angle is **105°**, since same-side interior angles add up to 180°.
12. **If one angle formed by a transversal cutting two parallel lines is 135°, what is its adjacent angle?**
    Answer: Its adjacent angle is **45°**, because the two angles form a linear pair.
13. **Two vertically opposite angles are $3x°$and $75°$; find x.**
    Answer: $x = 25$, because $3x = 75°$.
14. **Two angles of a linear pair are $x°$and $120°$; find x.**
    Answer: $x = 60°$, because $x + 120° = 180°$.
15. **Corresponding angles formed by a transversal across parallel lines are $2x°$and $80°$; find x.**
    Answer: $x = 40°$, because corresponding angles are equal.
16. **Two alternate angles between parallel lines are $3x°$and $120°$; find x.**
    Answer: $x = 40°$, because alternate angles formed by parallel lines are equal.
17. **Two same-side interior angles are $x°$and $130°$; find x.**
    Answer: $x = 50°$, because the two interior angles have a sum of 180°.
18. **If a transversal cuts two parallel lines and one angle is 40°, what is the measure of an angle supplementary to it?**
    Answer: The supplementary angle measures **140°**, since $180° - 40° = 140°$.
19. **If two lines are both perpendicular to the same line, what relationship can be inferred between them?**
    Answer: The two lines are **parallel** because they form equal 90° corresponding angles with the same transversal.
20. **If one angle formed by two intersecting lines increases, what happens to its adjacent angle?**
    Answer: The adjacent angle **decreases by the same amount** so that their sum remains 180°.
21. **A transversal cuts two parallel lines and one angle is 55°; what are the two possible angle measures in the figure?**
    Answer: The two possible angle measures are **55° and 125°**.
22. **If one of the eight angles formed by a transversal cutting two parallel lines is 100°, what is the measure of its alternate angle?**
    Answer: Its alternate angle is **100°** because alternate angles are equal.

23. **If one of the eight angles formed by a transversal across parallel lines is 100°, what is the measure of its adjacent linear-pair angle?**
    Answer: Its adjacent linear-pair angle is **80°**, since $180° - 100° = 80°$.
24. **A transversal cuts two lines and a pair of corresponding angles are unequal; what can you conclude?**
    Answer: The two lines are **not parallel**, because corresponding angles must be equal for parallel lines.
25. **If ∠6 in Fig. 5.26 is 135°, what is the measure of ∠5?**
    Answer: ∠5 is **45°**, because ∠5 and ∠6 form a linear pair.
26. **If ∠3 is 50° in Fig. 5.28, what is the measure of ∠6?**
    Answer: ∠6 is **130°**, because ∠2 is 130° and ∠2 and ∠6 are corresponding angles.
27. **If a pair of same-side interior angles are equal when a transversal cuts parallel lines, what is the measure of each angle?**
    Answer: Each angle must be **90°**, because two equal angles with a sum of 180° are 90° each.
28. **If two vertically opposite angles are $x + 20°$ and $80°$, find x.**
    Answer: $x = 60°$, because vertically opposite angles are equal.
29. **If corresponding angles formed by a transversal are both 90°, what relationship exists between the two lines?**
    Answer: The two lines are **parallel** because their corresponding angles are equal.
30. **Why is measuring angles alone sometimes insufficient for an exact geometrical proof?**
    Answer: Measurements may contain small errors, whereas geometrical relationships are established exactly through **mathematical reasoning**.

5.7 Two-mark questions with Answers of LOTS Type: (22 Questions)

Two-Mark Descriptive Questions with Answers — LOTS Type:

1. What are intersecting lines? What happens when two lines intersect?

Answer:

1. Two lines that meet each other at a point on a plane are called **intersecting lines**.
2. When two lines intersect, they form **four angles** at the point of intersection.

2. What is a linear pair? State its angle property.

Answer:

1. Two adjacent angles formed by intersecting lines that together form a straight angle are called a **linear pair**.
2. The sum of the angles in a linear pair is always **180°**.

3. What are vertically opposite angles? State their property.

Answer:

1. Opposite angles formed when two lines intersect are called **vertically opposite angles**.
2. Vertically opposite angles are always **equal to each other**.

4. What are perpendicular lines? What angles do they form?

Answer:

1. Two lines that intersect each other at right angles are called **perpendicular lines**.
2. They form **four right angles of 90° each** at their point of intersection.

5. What are parallel lines? State an important condition for lines to be parallel.

Answer:

1. Parallel lines are a pair of lines that never meet, however far they are extended at both ends.
2. The two lines must lie on the **same plane** to be called parallel lines.

6. How are the opposite and adjacent edges of a square sheet related?
Answer:
1. The **opposite edges** of a square sheet are parallel to each other.
2. The **adjacent edges** are perpendicular to each other and meet at right angles.

7. How are parallel and perpendicular lines represented in geometrical figures?
Answer:
1. Sets of parallel lines are represented using matching **arrow marks**.
2. Perpendicular lines are represented by a **small square marking the 90° angle** between them.

8. What is a transversal? How many angles does it form when it intersects two lines?
Answer:
1. A line that intersects two different lines is called a **transversal**.
2. A transversal intersecting two lines forms a total of **eight angles**.

9. What are corresponding angles? Give one pair from Fig. 5.14.
Answer:
1. Angles occupying corresponding positions at the two intersections formed by a transversal are called **corresponding angles**.
2. In Fig. 5.14, **∠1 and ∠5** form one pair of corresponding angles.

10. List the four pairs of corresponding angles shown in Fig. 5.14.
Answer:
1. Two pairs are **∠1 and ∠5**, and **∠2 and ∠6**.
2. The other two pairs are **∠3 and ∠7**, and **∠4 and ∠8**.

11. State the relationship between corresponding angles and parallel lines.
Answer:
1. When a transversal intersects two parallel lines, their **corresponding angles are equal**.
2. Conversely, if corresponding angles formed by a transversal are equal, the two lines are **parallel**.

12. What are alternate angles? State their property for parallel lines.
Answer:
1. Alternate angles lie in alternate positions on opposite sides of a transversal between the two lines.
2. When a transversal intersects two parallel lines, the **alternate angles are equal**.

13. Name the alternate angles shown in Fig. 5.25.
Answer:
1. In Fig. 5.25, **∠d is the alternate angle of ∠f**.
2. Similarly, **∠c is the alternate angle of ∠e**.

14. State the property of same-side interior angles formed by parallel lines and a transversal.
Answer:
1. Same-side interior angles lie between the two parallel lines on the **same side of the transversal**.
2. Their measures always **add up to 180°**.

15. If one angle of a linear pair is 120°, find the other angle.
Answer:
1. The angles of a linear pair add up to **180°**.
2. Therefore, the other angle is $180^\circ - 120^\circ = 60^\circ$.

16. If one of two vertically opposite angles is 65°, find the other angle and give the reason.
Answer:
1. Vertically opposite angles are always **equal**.
2. Therefore, the other vertically opposite angle is also **65°**.

17. If one corresponding angle is 75° when a transversal cuts two parallel lines, find its corresponding angle.

Answer:

1. Corresponding angles formed by a transversal intersecting parallel lines are **equal**.
2. Therefore, the corresponding angle is also **75°**.

18. If one alternate angle is 110° when a transversal intersects two parallel lines, find the other alternate angle.

Answer:

1. Alternate angles formed by a transversal across parallel lines are **equal**.
2. Therefore, the other alternate angle is also **110°**.

19. If one same-side interior angle is 70°, find the other interior angle.

Answer:

1. Same-side interior angles between parallel lines have a sum of **180°**.
2. Therefore, the other angle is $180^\circ - 70^\circ = 110^\circ$.

20. How can a ruler and set square be used to construct parallel lines?

Answer:

1. Using a set square, two lines can be drawn **perpendicular to the same line** at different positions.
2. Since they form equal **90° corresponding angles** with that line, the two newly drawn lines are parallel.

21. Why may practical measurements of geometrical angles not be exactly equal to theoretical values?

Answer:

1. Small errors may occur because of the **improper use of measuring instruments** such as a protractor.
2. Variations may also arise because drawn lines have **thickness**, whereas an ideal geometrical line has no thickness.

22. What angle relationships are formed when a transversal intersects two parallel lines?

Answer:

1. The **corresponding angles and alternate angles are equal**.
2. The **interior angles on the same side** of the transversal add up to **180°**.

5.8. Two-mark questions with Answers of HOTS Type: (25 Questions)

Two-Mark Descriptive Questions with Answers — HOTS Type:

Each answer is given in ***two reasoning/calculation steps****. Simple figures are included wherever useful.*

1. Two lines intersect as shown. If ∠A = 125°, find ∠B.

```
  \ A /
   \ /
 B  X
   / \
  /   \
```

Answer:

Step 1: ∠A and ∠B form a linear pair, so $\angle A + \angle B = 180^\circ$.

Step 2: $\angle B = 180^\circ - 125^\circ = \boxed{55^\circ}$.

---

2. Two lines intersect and one angle measures 72°. Find the vertically opposite angle.

```
  \ 72° /
   \   /
```

```
  \ /
  / \
 /   \
/ x° \
```

Answer:
Step 1: Vertically opposite angles formed by intersecting lines are equal.
Step 2: Therefore, $x = 72°$, so the required angle is $\boxed{72°}$.

---

3. Two vertically opposite angles are $3x + 10°$ and $5x - 30°$. Find x.
Answer:
Step 1: Since vertically opposite angles are equal, $3x + 10 = 5x - 30$.
Step 2: $40 = 2x$, hence $\boxed{x = 20}$.

---

4. Two angles forming a linear pair are $2x°$ and $4x°$. Find x.
Answer:
Step 1: A linear pair has a sum of $180°$, so $2x + 4x = 180°$.
Step 2: $6x = 180°$, hence $\boxed{x = 30°}$.

---

5. Four equal angles are formed when two lines intersect. Find each angle and identify the lines.

```
     |
  x° | x°
-----+-----
  x° | x°
     |
```

Answer:
Step 1: Four equal angles around a point total $360°$, so each angle is $360° \div 4 = 90°$.
Step 2: Since the lines intersect at $90°$, they are **perpendicular lines**.

---

6. Two parallel lines are cut by a transversal. If ∠1 = 65°, find corresponding ∠2.

```
l ———————————————
      / 65°  ∠1
         /
         /
m ——/————————————
      / 65°  ∠2
```

Answer:
Step 1: Corresponding angles formed by a transversal cutting parallel lines are equal.
Step 2: Therefore, $\angle 2 = \angle 1 = \boxed{65°}$.

---

7. A transversal cuts two lines and forms corresponding angles of 80° and 80°. What can you conclude?
Answer:
Step 1: The two corresponding angles formed by the transversal are equal.
Step 2: Therefore, the two lines are $\boxed{\text{parallel}}$.

---

8. A transversal forms corresponding angles of 75° and 105°. Are the two lines parallel?

Answer:
Step 1: For two lines to be parallel, their corresponding angles must be equal, but $75^\circ \neq 105^\circ$.
Step 2: Therefore, the two lines are $\boxed{\text{not parallel}}$.

---

9. Two parallel lines are cut by a transversal. If one alternate angle is 118°, find the other alternate angle.

l ————————————
/ 118°
/
/
m ——/——————————
/ x°

Answer:
Step 1: Alternate angles formed by a transversal cutting parallel lines are equal.
Step 2: Therefore, $x = 118^\circ$, so the required angle is $\boxed{118^\circ}$.

---

10. Alternate angles formed by two parallel lines are $3x + 15^\circ$and $5x - 25^\circ$. Find x.
Answer:
Step 1: Alternate angles are equal, so $3x + 15 = 5x - 25$.
Step 2: $40 = 2x$, hence $\boxed{x = 20}$.

---

11. Two parallel lines are cut by a transversal. One same-side interior angle is 68°. Find the other.

l ————————————
/ 68°
/
/
m ———/——————————
/ x°

Answer:
Step 1: Same-side interior angles formed between parallel lines have a sum of 180°.
Step 2: $x = 180^\circ - 68^\circ = \boxed{112^\circ}$.

---

12. Same-side interior angles are $2x^\circ$and $4x^\circ$. Find $x$if the lines are parallel.
Answer:
Step 1: Same-side interior angles are supplementary, so $2x + 4x = 180^\circ$.
Step 2: $6x = 180^\circ$, therefore $\boxed{x = 30^\circ}$.

---

13. One of the eight angles formed by a transversal cutting two parallel lines is 135°. Find the measure of an adjacent angle.
Answer:
Step 1: The given angle and its adjacent angle form a linear pair whose sum is 180°.
Step 2: Required angle $= 180^\circ - 135^\circ = \boxed{45^\circ}$.

---

14. Corresponding angles of two parallel lines are $2x + 20^\circ$and $4x - 40^\circ$. Find x.
Answer:
Step 1: Corresponding angles are equal, so $2x + 20 = 4x - 40$.
Step 2: $60 = 2x$, hence $\boxed{x = 30}$.

---

15. If $\angle 3 = 50°$ in the arrangement of two parallel lines and a transversal, find $\angle 6$ as described in Fig. 5.28 of the chapter.
Answer:
Step 1: $\angle 2$ and $\angle 3$ form a linear pair, so $\angle 2 = 180° - 50° = 130°$.
Step 2: $\angle 2$ and $\angle 6$ are corresponding angles, so $\boxed{\angle 6 = 130°}$.

---

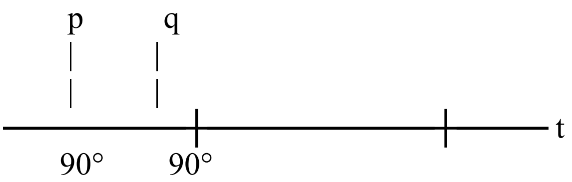
16. If $\angle 6 = 135°$ in Fig. 5.26, find $\angle 8$.
Answer:
Step 1: $\angle 6$ and $\angle 8$ are vertically opposite angles.
Step 2: Vertically opposite angles are equal; therefore, $\boxed{\angle 8 = 135°}$.

---

17. Two same-side interior angles are equal when a transversal cuts two parallel lines. Find each angle.
Answer:
Step 1: Let each angle be x; since same-side interior angles are supplementary, $x + x = 180°$.
Step 2: $2x = 180°$, hence each angle is $\boxed{90°}$.

---

18. Two different lines are perpendicular to the same line. Explain why the two lines are parallel.



Answer:
Step 1: Both lines form equal corresponding angles of **90°** with the common transversal.
Step 2: Since corresponding angles are equal, the two lines $p$and $q$are $\boxed{\text{parallel}}$.

---

19. A transversal cuts two parallel lines. One angle is $x°$and its adjacent angle is $x + 40°$. Find x.
Answer:
Step 1: The adjacent angles form a linear pair, so $x + (x + 40) = 180°$.
Step 2: $2x = 140°$, hence $\boxed{x = 70°}$.

---

20. Vertically opposite angles are $7x - 10°$and $5x + 30°$. Find the measure of each angle.
Answer:
Step 1: Since vertically opposite angles are equal, $7x - 10 = 5x + 30$, giving $x = 20$.
Step 2: Each angle $= 7(20) - 10 = \boxed{130°}$.

---

21. Two same-side interior angles are $3x + 10°$and $2x + 20°$. Find x.
Answer:
Step 1: Since the lines are parallel, $(3x + 10) + (2x + 20) = 180°$.
Step 2: $5x + 30 = 180$, so $5x = 150$and $\boxed{x = 30}$.

---

22. A transversal cuts two parallel lines. If one angle is 56°, determine the two different angle measures occurring in the figure.
Answer:
Step 1: Corresponding, alternate and vertically opposite angles equal to the given angle measure **56°**.

Step 2: Their adjacent supplementary angles measure $180^\circ - 56^\circ = \boxed{124^\circ}$, so the two measures are **56° and 124°**.

---

23. A transversal forms equal corresponding angles of 110° with two lines. Determine whether the lines are parallel and find the adjacent angle.

Answer:

Step 1: Since the corresponding angles are equal, the two lines are $\boxed{\text{parallel}}$.

Step 2: The adjacent angle is $180^\circ - 110^\circ = \boxed{70^\circ}$.

---

24. In Fig. 5.27 of the chapter, ∠a = 120° and ∠f = 70°. Explain why lines *l* and *m* are not parallel.

Answer:

Step 1: Since ∠a and ∠b form a linear pair, $\angle b = 180^\circ - 120^\circ = 60^\circ$.

Step 2: ∠b and ∠f are corresponding angles but $60^\circ \neq 70^\circ$; hence, *l* and *m* are $\boxed{\text{not parallel}}$.

---

25. Parallel lines *l* and *m* are cut by a transversal. If one angle is 40°, find its corresponding angle and its adjacent angle.

```
l ————————————————
    / 40°
   /
  /
m —/————————————————
  / 40°
```

Answer:

Step 1: The corresponding angle is equal to the given angle, so it is $\boxed{40^\circ}$.

Step 2: Its adjacent angle is supplementary, so $180^\circ - 40^\circ = \boxed{140^\circ}$.

These questions emphasize **HOTS skills** such as analysing diagrams, connecting multiple angle properties, forming equations, determining parallelism, and applying **linear-pair, vertically opposite, corresponding, alternate, and same-side interior angle relationships**.

5.9. Three-mark questions with Answers of LOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers — LOTS Type:

*Each answer is presented in **three clear steps/points**. Simple figures are included where useful.*

1. Two lines intersect as shown. If ∠a = 120°, find ∠b and ∠c.

```
 a = 120°
   \ /
 b  V
    Λ
   / \ c
```

Answer:

Step 1: ∠a and ∠b form a linear pair, so $\angle b = 180^\circ - 120^\circ = 60^\circ$.

Step 2: ∠a and ∠c are vertically opposite angles, so $\angle c = \angle a = 120^\circ$.

Step 3: Therefore, $\boxed{\angle b = 60^\circ, \angle c = 120^\circ}$.

2. Explain the properties of angles formed when two lines intersect.

```
     a
  \     /
d  \   /  b
    \ /
```

```
   / \
  /   \
    c
```

Answer:
Step 1: When two lines intersect, they form **four angles** at their point of intersection.
Step 2: Adjacent angles form **linear pairs**, and each linear pair adds up to **180°**.
Step 3: Opposite angles are **vertically opposite angles**, and they are always **equal**.

3. What are perpendicular lines? Explain their angle relationship.

```
        m
        |
   90° | 90°
 -------+------- l
   90° | 90°
        |
```

Answer:
Step 1: Perpendicular lines are two lines that intersect each other at **right angles**.
Step 2: Each angle formed at their point of intersection measures **90°**.
Step 3: Therefore, all four angles are equal and their total is $4 \times 90^\circ = 360^\circ$.

4. Explain parallel lines and give their important characteristics.

```
l ————————————————————————

m ————————————————————————
```

Answer:
Step 1: Parallel lines are a pair of lines that lie on the **same plane**.
Step 2: They do not meet each other however far they are extended at both ends.
Step 3: Thus, lines $l$and $m$remain separate and are represented as $l \parallel m$.

5. What is a transversal? Explain the angles formed by it.

```
l ——————————/——————————
          / t
         /
m ——————/——————————————
```

Answer:
Step 1: A line that intersects two different lines is called a **transversal**.
Step 2: The transversal creates **four angles at each point of intersection**.
Step 3: Therefore, a transversal intersecting two lines forms a total of **eight angles**.

6. What are corresponding angles? List the corresponding pairs shown in the chapter.

```
        t
       /
   1  / 2
l ————/——————
   4/ 3
   /
 5 / 6
m —/————————————
 8/ 7
```

Answer:
Step 1: Corresponding angles occupy the **same relative position** at the two intersections formed by a transversal.
Step 2: Two corresponding pairs are **∠1 and ∠5**, and **∠2 and ∠6**.
Step 3: The other corresponding pairs are **∠3 and ∠7**, and **∠4 and ∠8**.

7. State the relationship between corresponding angles and parallel lines.
Answer:
Step 1: When a transversal intersects a pair of **parallel lines**, corresponding angles are equal.
Step 2: For example, if one corresponding angle is 60°, the other corresponding angle is also **60°**.
Step 3: Conversely, if corresponding angles formed by a transversal are equal, the two lines are **parallel**.
8. A transversal cuts two parallel lines. If one corresponding angle is 70°, find its corresponding angle and an adjacent angle.

t
/
l ——————————/——————————
70°
/
m ————————/——————————————
70°

Answer:
Step 1: Corresponding angles between parallel lines are equal, so the corresponding angle is **70°**.
Step 2: The 70° angle and its adjacent angle form a linear pair, so the adjacent angle is $180° - 70° = 110°$.
Step 3: Therefore, the required angles are $\boxed{70° \text{ and } 110°}$.
9. Explain alternate angles and state their property for parallel lines.

t
/
l ——————————/——————————
/ d
/
f/
m ————————/——————————————

Answer:
Step 1: Alternate angles lie in alternate positions on **opposite sides of a transversal** between the two lines.
Step 2: In Fig. 5.25 of the chapter, **∠d and ∠f** form a pair of alternate angles.
Step 3: When the two lines are parallel, alternate angles are always **equal**, so $\boxed{\angle d = \angle f}$.
10. If ∠f = 120° in Fig. 5.25, find its alternate angle ∠d.
Answer:
Step 1: The corresponding angle ∠b of ∠f is 120°, because corresponding angles between parallel lines are equal.
Step 2: ∠b and ∠d are vertically opposite angles, so $\angle d = 120°$.
Step 3: Therefore, the alternate angle of ∠f is $\boxed{\angle d = 120°}$.
11. Explain the relationship between same-side interior angles when a transversal cuts parallel lines.

t
/
l ——————————/——————————
/ a
/
b /

m ————/——————————

Answer:

Step 1: The two angles lying between the parallel lines on the same side of the transversal are called **same-side interior angles**.

Step 2: Their sum is always **180°** when the two lines are parallel.

Step 3: Therefore, if one angle is $x°$, the other is $\boxed{180° - x°}$.

12. One same-side interior angle is 50°. Find the other interior angle.

Answer:

Step 1: Same-side interior angles formed by a transversal cutting parallel lines add up to **180°**.

Step 2: Required angle $= 180° - 50° = 130°$.

Step 3: Therefore, the other interior angle is $\boxed{130°}$.

13. In Fig. 5.26, ∠6 = 135°. Find ∠2 and ∠5.

Answer:

Step 1: $\angle 2$ and $\angle 6$ are corresponding angles, so $\angle 2 = \angle 6 = 135°$.

Step 2: $\angle 5$ and $\angle 6$ form a linear pair, so $\angle 5 = 180° - 135° = 45°$.

Step 3: Therefore, $\boxed{\angle 2 = 135°, \angle 5 = 45°}$.

14. In Fig. 5.28, ∠3 = 50°. Find ∠2 and ∠6.

l ————————————

2 / 3=50°

/

/ t

m ————————/————

5/ 6

Answer:

Step 1: $\angle 2$ and $\angle 3$ form a linear pair, so $\angle 2 = 180° - 50° = 130°$.

Step 2: $\angle 2$ and $\angle 6$ are corresponding angles because the lines are parallel, so $\angle 6 = 130°$.

Step 3: Therefore, $\boxed{\angle 2 = 130°, \angle 6 = 130°}$.

15. How can two parallel lines be drawn using a ruler and set square?

p q

| |

| |

————+——————————+———— l

90° 90°

Answer:

Step 1: Draw a line $l$with a ruler and use a set square to draw a line $p$perpendicular to l.

Step 2: At another point, use the set square to draw another line $q$perpendicular to l.

Step 3: Since $p$and $q$form equal **90° corresponding angles** with l, $\boxed{p \parallel q}$.

16. How can you decide whether two lines are parallel using corresponding angles?

Answer:

Step 1: Draw or identify a **transversal** intersecting the two given lines.

Step 2: Measure or determine a pair of **corresponding angles** formed by the transversal.

Step 3: If the corresponding angles are equal, the two lines are **parallel**.

17. Explain how parallel and perpendicular lines can be observed using a square sheet of paper.

Answer:

Step 1: The **opposite edges** of a square sheet are parallel to each other.

Step 2: The **adjacent edges** meet each other and form right angles.

Step 3: Therefore, opposite edges demonstrate **parallel lines**, while adjacent edges demonstrate **perpendicular lines**.

18. Why can actual angle measurements differ slightly from geometrically predicted values?
Answer:
Step 1: Small errors can occur because of **improper use of measuring instruments**, such as a protractor.
Step 2: Drawn lines have some **thickness**, whereas an ideal geometrical line has no thickness.
Step 3: Hence, practical measurements may differ slightly, while mathematical reasoning gives the **exact theoretical relationship**.
19. If two parallel lines are cut by a transversal and one angle is 45°, determine the measures of the remaining types of angles.

```
        t
       /
l ——————————/——————————
      / 45°
     /
m ———————/——————————————
```

Answer:
Step 1: Corresponding, alternate and vertically opposite angles equal to the given angle are **45°**.
Step 2: Every adjacent linear-pair angle is $180^\circ - 45^\circ = 135^\circ$.
Step 3: Hence, the eight angles formed have only two measures: $\boxed{45^\circ \text{ and } 135^\circ}$.
20. Summarise the three major angle relationships when a transversal intersects two parallel lines.
Answer:
Step 1: Corresponding angles are equal.
Step 2: Alternate angles are equal.
Step 3: Interior angles on the same side of the transversal add up to 180°.

5.10. Three-mark questions with Answers of HOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers — HOTS Type:
*Each answer contains **three reasoning/calculation steps**. Simple figures are included wherever they improve understanding.*
1. Two lines intersect at a point. One angle is 128°. Find the other three angles.

```
      128°
    \     /
     \   /
  x°  \ / y°
       \/
       /\
      /  \
     / z° \
```

Answer:
Step 1: The vertically opposite angle is equal to 128°, so $z = 128^\circ$.
Step 2: Each adjacent angle forms a linear pair with 128°, so $x = y = 180^\circ - 128^\circ = 52^\circ$.
Step 3: Therefore, the other three angles are $\boxed{52^\circ, 128^\circ, 52^\circ}$.
2. Two vertically opposite angles are $(3x + 15)^\circ$and $(5x - 25)^\circ$. Find $x$and the measure of each angle.
Answer:
Step 1: Vertically opposite angles are equal, so $3x + 15 = 5x - 25$.

Step 2: $40 = 2x$, hence $x = 20$.
Step 3: Each angle $= 3(20) + 15 = \boxed{75^\circ}$.

3. Two adjacent angles formed by intersecting lines are in the ratio 2:3. Find all four angles.

```
         /
    2x  / 3x
       /
——————————————X——————————————
     /
    /
```

Answer:
Step 1: Adjacent angles form a linear pair, so $2x + 3x = 180^\circ$, giving $x = 36^\circ$.
Step 2: The two adjacent angles are $2(36^\circ) = 72^\circ$and $3(36^\circ) = 108^\circ$.
Step 3: Vertically opposite angles are equal, so the four angles are $\boxed{72^\circ, 108^\circ, 72^\circ, 108^\circ}$.

4. A transversal cuts two parallel lines. If one angle is 65°, determine the measures of all eight angles.

```
          t
         /
l ——————————————————/——————————————
     65°/
       /
      /
m ——————————————/——————————————————
    /
```

Answer:
Step 1: Corresponding, alternate and vertically opposite angles equal to the given angle are all **65°**.
Step 2: Each adjacent angle is supplementary to 65°, so $180^\circ - 65^\circ = 115^\circ$.
Step 3: Therefore, four of the eight angles are $\boxed{65^\circ}$and the other four are $\boxed{115^\circ}$.

5. Corresponding angles formed by a transversal are $(4x + 10)^\circ$and $(6x - 30)^\circ$. If the lines are parallel, find $x$and the angles.

Answer:
Step 1: Corresponding angles between parallel lines are equal, so $4x + 10 = 6x - 30$.
Step 2: $40 = 2x$, hence $x = 20$.
Step 3: Each corresponding angle $= 4(20) + 10 = \boxed{90^\circ}$.

6. A transversal forms corresponding angles of 75° and 105° with two lines. Determine whether the lines are parallel and justify your answer.

```
        t
       /
l ——————————————/——————————————
    75°
     /
    /
m ——————————/——————————————————
  105°
```

Answer:
Step 1: If the two lines were parallel, their corresponding angles would be equal.
Step 2: Here, $75^\circ \neq 105^\circ$, so the corresponding angles are unequal.
Step 3: Therefore, the two lines are $\boxed{\text{not parallel}}$.

7. Alternate angles formed by a transversal cutting two parallel lines are $(5x - 20)^\circ$and $(3x + 30)^\circ$. Find $x$and the angle measures.
Answer:
Step 1: Alternate angles between parallel lines are equal, so $5x - 20 = 3x + 30$.
Step 2: $2x = 50$, hence $x = 25$.
Step 3: Each alternate angle $= 5(25) - 20 = \boxed{105^\circ}$.
8. Two same-side interior angles formed by parallel lines are in the ratio 4:5. Find both angles.

```
           t
          /
l ————————————————/————————————————
        / 4x
       /
     5x/
m ——————————/————————————————————
```

Answer:
Step 1: Same-side interior angles add up to 180°, so $4x + 5x = 180^\circ$.
Step 2: $9x = 180^\circ$, hence $x = 20^\circ$.
Step 3: The angles are $4(20^\circ) = \boxed{80^\circ}$and $5(20^\circ) = \boxed{100^\circ}$.
9. Two same-side interior angles are $(3x + 15)^\circ$and $(2x + 25)^\circ$. If the lines are parallel, find $x$and both angles.
Answer:
Step 1: Same-side interior angles are supplementary, so $(3x + 15) + (2x + 25) = 180$.
Step 2: $5x + 40 = 180$, giving $x = 28$.
Step 3: The angles are $\boxed{99^\circ}$and $\boxed{81^\circ}$, whose sum is 180°.
10. In Fig. 5.26 of the chapter, ∠6 = 135°. Find ∠2, ∠5 and ∠8.
Answer:
Step 1: $\angle 2$ corresponds to $\angle 6$, so $\angle 2 = \boxed{135^\circ}$.
Step 2: $\angle 8$ is vertically opposite to $\angle 6$, so $\angle 8 = \boxed{135^\circ}$.
Step 3: $\angle 5$ and $\angle 6$ form a linear pair, so $\angle 5 = 180^\circ - 135^\circ = \boxed{45^\circ}$.
11. In Fig. 5.28, ∠3 = 50°. Find ∠2, ∠6 and explain their relationship.

```
           t
          /
l ——————————————————/————————————————
       2 / 3 = 50°
        /
       /
m ————————————/————————————————————
     / 6
```

Answer:
Step 1: $\angle 2$ and $\angle 3$ form a linear pair, so $\angle 2 = 180^\circ - 50^\circ = 130^\circ$.
Step 2: $\angle 2$ and $\angle 6$ are corresponding angles, so $\angle 6 = 130^\circ$.
Step 3: Thus, $\boxed{\angle 2 = \angle 6 = 130^\circ}$, confirming the corresponding-angle property of parallel lines.
12. In Fig. 5.27, ∠a = 120° and ∠f = 70°. Determine whether lines $l$and $m$are parallel.
Answer:
Step 1: ∠a and ∠b form a linear pair, so $\angle b = 180^\circ - 120^\circ = 60^\circ$.

Step 2: ∠b and ∠f are corresponding angles, but $60^\circ \neq 70^\circ$.

Step 3: Since the corresponding angles are unequal, $\boxed{l \nparallel m}$.

13. Two lines p and q are each perpendicular to the same line t. Prove that $p \parallel q$.

Answer:

Step 1: Since $p \perp t$, the angle between p and t is **90°**.

Step 2: Since $q \perp t$, the corresponding angle between q and t is also **90°**.

Step 3: Equal corresponding angles imply parallel lines; therefore, $\boxed{p \parallel q}$.

14. One angle formed by a transversal cutting two parallel lines is twice its adjacent angle. Find both angles.

Answer:

Step 1: Let the smaller angle be x°; then the larger adjacent angle is $2x^\circ$.

Step 2: They form a linear pair, so $x + 2x = 180^\circ$, giving $x = 60^\circ$.

Step 3: Therefore, the two angle measures are $\boxed{60^\circ \text{ and } 120^\circ}$.

15. Two corresponding angles are $(3x + 20)^\circ$ and $(5x - 10)^\circ$. If the lines are parallel, find x, the corresponding angles and their supplementary angle.

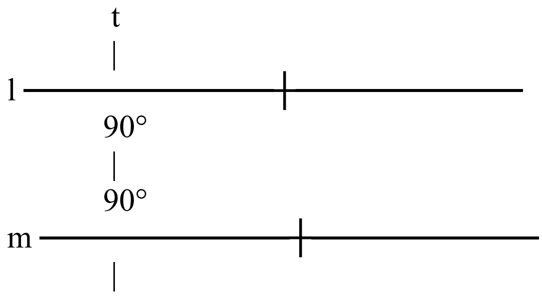
Answer:

Step 1: Equal corresponding angles give $3x + 20 = 5x - 10$, so $x = 15$.

Step 2: Each corresponding angle is $3(15) + 20 = \boxed{65^\circ}$.

Step 3: The supplementary angle is $180^\circ - 65^\circ = \boxed{115^\circ}$.

16. A pair of same-side interior angles are equal. If the lines are parallel, determine the nature of the transversal with respect to the parallel lines.



Answer:

Step 1: Same-side interior angles of parallel lines add up to 180°; if equal, let each be x, so $2x = 180^\circ$.

Step 2: Therefore, each angle is $\boxed{90^\circ}$.

Step 3: Since the transversal forms right angles with the parallel lines, it is **perpendicular to both lines**.

17. A student says that two lines are parallel because they do not meet on the page. Is this conclusion always correct?

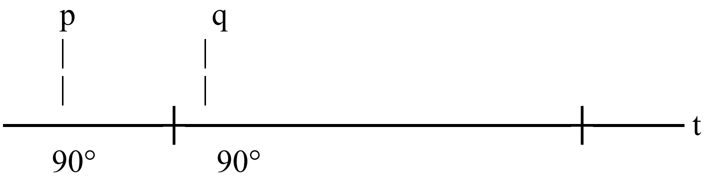
Answer:

Step 1: Two lines may fail to meet within the visible portion of a page but could meet when **extended further**.

Step 2: Parallel lines must lie on the **same plane** and never meet however far they are extended.

Step 3: Therefore, the student's conclusion is **not necessarily correct** without checking the complete relationship of the lines.

18. A student measures a pair of vertically opposite angles as 79° and 81°. Should the student conclude that vertically opposite angles are unequal? Explain.
Answer:
Step 1: Geometrically, vertically opposite angles are **always equal**.
Step 2: The small difference may result from improper use of the protractor or the thickness of the drawn lines.
Step 3: Therefore, the measurements indicate a **measurement error**, not a failure of the vertically opposite angle property.
19. A transversal cuts two parallel lines. One angle is $x°$, while its supplementary angle is $3x°$. Find all possible angle measures in the figure.
Answer:
Step 1: The two angles form a linear pair, so $x + 3x = 180°$, giving $x = 45°$.
Step 2: The supplementary angle is $3x = 3(45°) = 135°$.
Step 3: Therefore, all eight angles formed have only the two measures $\boxed{45° \text{ and } 135°}$.
20. A transversal intersects two lines. One pair of corresponding angles is 90° each. What can you conclude about the two lines and the transversal?



Answer:
Step 1: The corresponding angles formed by the transversal are equal because both measure **90°**.
Step 2: Equal corresponding angles imply that the two lines are **parallel**.
Step 3: Since each intersection forms a 90° angle, the transversal is also **perpendicular to both parallel lines**.

5.11 Five-mark questions with Answers of LOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers — LOTS Type:
1. Explain the important properties of angles formed when two straight lines intersect.

```
      a
   \     /
 d  \   /  b
     \ /
      X
     / \
    /   \
      c
```

Answer:
1. When two straight lines intersect at a point, they form **four angles**.
2. Adjacent angles such as ∠a and ∠b form a **linear pair**.
3. The sum of the angles in every linear pair is **180°**.
4. Opposite angles such as ∠a and ∠c are called **vertically opposite angles**.
5. Vertically opposite angles are always **equal**, so $\angle a = \angle c$ and $\angle b = \angle d$.

2. Define perpendicular lines and explain their important properties.

```
       m
       |
  90°  |  90°
```

```
 -------+------- l
  90°  |  90°
       |
```

Answer:

1. **Perpendicular lines** are a pair of lines that intersect each other at right angles.
2. The angle formed between two perpendicular lines is **90°**.
3. When two perpendicular lines intersect, they form **four equal angles**.
4. Each of these four angles is a **right angle** measuring 90°.
5. Therefore, if l and m meet at right angles, we can say that l and m are **perpendicular to each other**.

3. What are parallel lines? Explain their properties and representation.

```
 l ——————————————————————————→

 m ——————————————————————————→
```

Answer:

1. **Parallel lines** are a pair of lines that lie on the **same plane**.
2. They do not meet each other, however far they are extended at both ends.
3. Opposite edges of a square sheet provide a simple example of parallel line segments.
4. In geometrical figures, matching **arrow marks** are used to indicate sets of parallel lines.
5. It is important that the lines lie on the **same plane**; merely not meeting does not make two lines parallel.

4. Explain what a transversal is and describe the angles formed by it.

```
             t
            /
    1   2  /
l ——————————————/——————————
    4   3/
        /
   5   /6
m ———————————/——————————————
   8 / 7
```

Answer:

1. A line that intersects two different lines is called a **transversal**.
2. In the figure, line t acts as a transversal to lines l and m.
3. Four angles are formed where the transversal intersects line l, and another four are formed where it intersects line m.
4. Thus, a transversal intersecting two lines forms a total of **eight angles**.
5. Because vertically opposite angles are equal, these eight angles can have a maximum of **four distinct angle measures**.

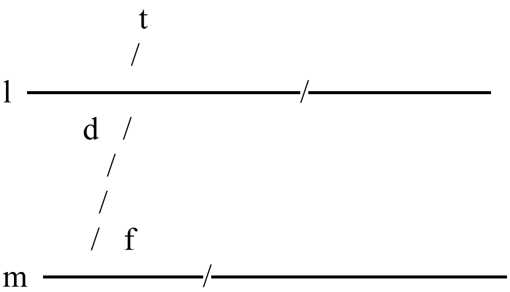
5. Explain corresponding angles and their relationship with parallel lines.

```
             t
            /
    1   2  /
l ——————————————/——————————
    4   3/
        /
   5   /6
m ———————————/——————————————
   8 / 7
```

Answer:

1. **Corresponding angles** occupy matching positions at the two intersections formed by a transversal.
2. In the figure, $\angle 1$ and $\angle 5$, $\angle 2$ and $\angle 6$, $\angle 3$ and $\angle 7$, and $\angle 4$ and $\angle 8$ are corresponding-angle pairs.
3. When a transversal intersects a pair of **parallel lines**, corresponding angles are always equal.
4. For example, if $\angle 1 = 60^\circ$, then its corresponding angle $\angle 5 = 60^\circ$.
5. Conversely, when corresponding angles formed by a transversal are equal, the two lines are **parallel**.

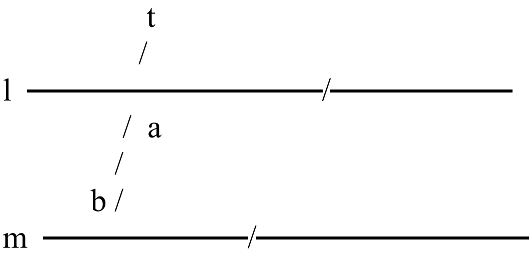
6. Explain alternate angles and their relationship when a transversal intersects parallel lines.



Answer:

1. **Alternate angles** are formed on opposite sides of a transversal in alternate positions.
2. In Fig. 5.25 of the chapter, ∠d is the alternate angle of ∠f.
3. Similarly, ∠c is the alternate angle of ∠e.
4. When a transversal intersects two **parallel lines**, alternate angles are always equal.
5. Hence, in Fig. 5.25, $\angle d = \angle f$ and $\angle c = \angle e$.

7. Explain the relationship between interior angles on the same side of a transversal.



Answer:

1. When a transversal intersects two parallel lines, some angles lie **between the two parallel lines**.
2. Angles lying between the parallel lines on the **same side of the transversal** are same-side interior angles.
3. These two interior angles are **supplementary**.
4. Therefore, their measures always add up to **180°**.
5. Hence, if one interior angle is 50°, the other is $180^\circ - 50^\circ = \boxed{130^\circ}$.

8. In Fig. 5.26, parallel lines l and m are intersected by transversal t. If ∠6 = 135°, explain how the other angles can be determined.

Answer:

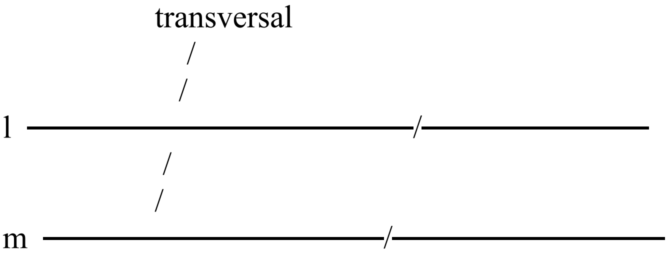
1. Since $\angle 2$ corresponds to $\angle 6$, $\angle 2 = \angle 6 = \boxed{135^\circ}$.
2. Since $\angle 8$ is vertically opposite to $\angle 6$, $\angle 8 = \boxed{135^\circ}$.
3. $\angle 4$ corresponds to $\angle 8$, so $\angle 4 = \boxed{135^\circ}$.
4. $\angle 5$ and $\angle 6$ form a linear pair, so $\angle 5 = 180^\circ - 135^\circ = \boxed{45^\circ}$.
5. Similarly, $\angle 1$, $\angle 3$ and $\angle 7$ are also **45°**, so the eight angles have measures **135° or 45°**.

9. Explain how parallel lines can be drawn using a ruler and set square.

Answer:

1. First, draw a straight line l using a **ruler**.
2. Use a **set square** to draw a line p perpendicular to l.
3. At another position, draw another line q perpendicular to l using the set square.
4. Both p and q make equal **90° corresponding angles** with line l.
5. Since the corresponding angles are equal, the two newly drawn lines are parallel; therefore, $\boxed{p \parallel q}$.

10. Summarise the major angle relationships studied in the chapter when a transversal intersects parallel lines.



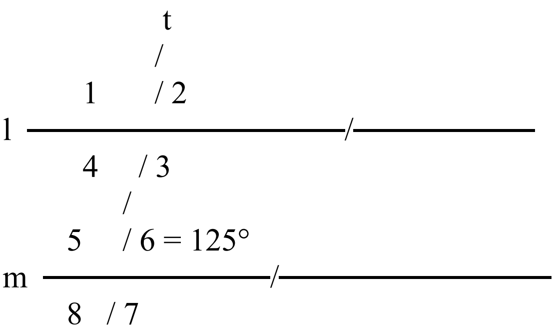
Answer:

1. A transversal intersecting two lines forms **eight angles**.
2. When the two lines are parallel, **corresponding angles are equal**.
3. **Alternate angles are also equal** when the transversal intersects parallel lines.
4. **Interior angles on the same side** of the transversal add up to **180°**.
5. These angle relationships help us **find unknown angles and determine whether two given lines are parallel**.

5.12 Five-mark questions with Answers of HOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers — HOTS Type:

1. Two parallel lines are cut by a transversal. If one of the angles is $125°$, determine the measures of all the remaining angles and justify your answer.



Answer:

1. Since $\angle 2$ and $\angle 6$ are corresponding angles, $\angle 2 = \angle 6 = 125°$.
2. Since $\angle 4$ is vertically opposite to $\angle 2$, $\angle 4 = 125°$, and $\angle 8$ corresponds to $\angle 4$, so $\angle 8 = 125°$.
3. $\angle 5$ and $\angle 6$ form a linear pair, so $\angle 5 = 180° - 125° = 55°$.
4. By vertically opposite and corresponding angle properties, $\angle 1 = \angle 3 = \angle 7 = 55°$.

5. Hence, $\boxed{\angle 2 = \angle 4 = \angle 6 = \angle 8 = 125^\circ}$ and $\boxed{\angle 1 = \angle 3 = \angle 5 = \angle 7 = 55^\circ}$.

2. Two parallel lines are cut by a transversal. Two alternate angles are $(5x - 15)^\circ$ and $(3x + 25)^\circ$. Find x, the alternate angles, and their supplementary angles.

t
/
l ——————————————/——————
(5x−15)°/
/
/
/ (3x+25)°
m ——————————/————————————

Answer:

1. Alternate angles formed by a transversal cutting parallel lines are equal, so $5x - 15 = 3x + 25$.
2. Solving, $2x = 40$, and therefore $\boxed{x = 20}$.
3. The first alternate angle is $5(20) - 15 = 85^\circ$.
4. The second alternate angle is $3(20) + 25 = 85^\circ$, confirming that the alternate angles are equal.
5. Their supplementary angles are $180^\circ - 85^\circ = \boxed{95^\circ}$; hence the angles in the figure are either **85° or 95°**.

3. Two same-side interior angles formed by a transversal cutting parallel lines are in the ratio $4:5$. Find both angles and explain their relationship.

t
/
l ——————————————/——————
/ 4x
/
5x/
m ———————————/——————————

Answer:

1. Same-side interior angles between parallel lines have a sum of 180°, so $4x + 5x = 180^\circ$.
2. Therefore, $9x = 180^\circ$, giving $\boxed{x = 20^\circ}$.
3. The first angle is $4x = 4(20^\circ) = \boxed{80^\circ}$.
4. The second angle is $5x = 5(20^\circ) = \boxed{100^\circ}$.
5. Since $80^\circ + 100^\circ = 180^\circ$, the result satisfies the **same-side interior angle property**.

4. A transversal cuts two lines and forms corresponding angles $(3x + 15)^\circ$ and $(5x - 25)^\circ$. If the lines are parallel, find x, the corresponding angles, and their adjacent angles.

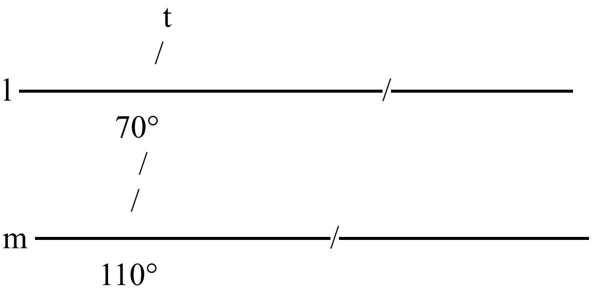
t
/
l ————————————————/——————
(3x+15)°
/
/
m ——————————————/——————————
(5x−25)°

Answer:

1. Since the lines are parallel, corresponding angles are equal; hence $3x + 15 = 5x - 25$.

2. Solving gives $40 = 2x$, so $\boxed{x = 20}$.
3. Each corresponding angle is $3(20) + 15 = \boxed{75°}$.
4. An adjacent angle forms a linear pair with 75°, so its measure is $180° - 75° = \boxed{105°}$.
5. Thus, the angle measures produced are **75° and 105°**, consistent with the corresponding-angle and linear-pair properties.

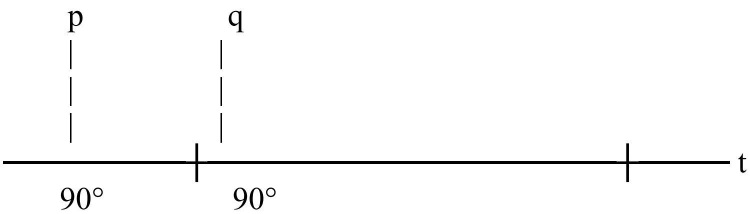
5. A student observes corresponding angles of 70° and 110° when a transversal intersects two lines. Analyse whether the two lines can be parallel.



Answer:

1. If two lines are parallel, corresponding angles formed by a transversal must be **equal**.
2. The measured corresponding angles here are 70°and 110°.
3. Since $70° \neq 110°$, the corresponding angles are not equal.
4. Therefore, the condition required for the two lines to be parallel is not satisfied.
5. Hence, based on the given angle measures, the two lines are $\boxed{\text{not parallel}}$.

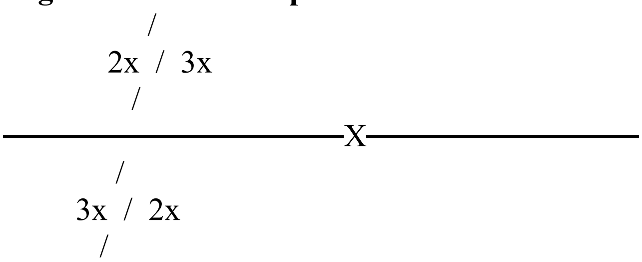
6. Two different lines $p$and $q$are perpendicular to the same line t. Use angle properties to show that $p$and $q$are parallel.



Answer:

1. Since $p \perp t$, the angle formed between $p$and $t$is 90°.
2. Since $q \perp t$, the corresponding angle formed between $q$and $t$is also 90°.
3. Thus, the two corresponding angles formed by transversal $t$are **equal**.
4. Equal corresponding angles imply that the two lines cut by the transversal are **parallel**.
5. Therefore, $\boxed{p \parallel q}$; this principle is also used in constructing parallel lines with a ruler and set square.

7. Two adjacent angles formed by intersecting lines are in the ratio 2: 3. Find all four angles formed at the point of intersection.



Answer:

1. The adjacent angles form a linear pair, so $2x + 3x = 180°$.
2. Thus, $5x = 180°$, giving $\boxed{x = 36°}$.
3. The two adjacent angles are $2x = 72°$and $3x = 108°$.

4. Vertically opposite angles are equal, so their opposite angles are also $72°$and $108°$.
5. Therefore, the four angles are $\boxed{72°, 108°, 72°, 108°}$.

8. A student measures a pair of vertically opposite angles as 78° and 82°. Analyse the result and explain what the student should conclude.

Answer:

1. Vertically opposite angles formed by two intersecting lines are **theoretically equal**.
2. Therefore, angles of 78° and 82° cannot represent the exact mathematical values of a vertically opposite pair.
3. The difference may have occurred because of inaccurate positioning or reading of the **protractor**.
4. The thickness of the drawn lines may also introduce a small measurement error.
5. Hence, the student should rely on the geometrical property that vertically opposite angles are equal rather than conclude that the property has failed.

9. A transversal cuts two parallel lines. One angle is three times its adjacent angle. Determine all possible angle measures in the figure.

t
/
l ——————————/——————
3x / x
/
/
m ——————————/——————

Answer:

1. The adjacent angles form a linear pair, so $3x + x = 180°$.
2. Therefore, $4x = 180°$, giving $\boxed{x = 45°}$.
3. The larger angle is $3x = 3(45°) = \boxed{135°}$.
4. Corresponding, alternate and vertically opposite angle relationships reproduce these two measures at the other intersection.
5. Hence, among the eight angles, four measure $\boxed{45°}$and four measure $\boxed{135°}$.

10. A student says, "These two lines look parallel because they do not meet anywhere on my notebook page." Evaluate the statement and suggest a mathematical way to check it.

l ————————————————————

m ————————————————————

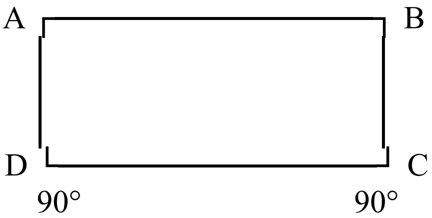
Answer:

1. The fact that two lines do not meet within the visible portion of a page is **not sufficient** to conclude that they are parallel.
2. Parallel lines must lie in the same plane and must never meet, however far they are extended.
3. A transversal can be drawn across the two lines to create pairs of **corresponding angles**.
4. If a pair of corresponding angles is equal, the corresponding-angle criterion establishes that the lines are parallel.
5. Therefore, mathematical angle relationships provide a more reliable test than judging parallelism merely by visual appearance.

5.13 Five-mark questions with Answers of Applied Type: (10 Questions)

Five-Mark Descriptive Questions with Answers — Applied Type:

1. A carpenter is making a rectangular window frame. The two vertical sides are each perpendicular to the bottom horizontal side. Explain why the two vertical sides are parallel.



Answer:

1. The vertical sides AD and BC each make an angle of **90°** with the horizontal side DC.
2. Thus, DC acts like a transversal forming equal corresponding angles with AD and BC.
3. Both corresponding angles are 90°, so they are equal.
4. When corresponding angles are equal, the two lines are **parallel**.
5. Therefore, $\boxed{AD \parallel BC}$, which helps the carpenter maintain a properly aligned rectangular frame.

2. Two straight railway tracks are represented by parallel lines. A road crosses both tracks as a transversal. If the road makes an angle of 65° with the first track, find the corresponding angle and the adjacent angle at the second track.

Railway track 1 ————————/————————
65°/
/ Road
/
Railway track 2 ————/————————
65°/ 115°

Answer:

1. The two railway tracks are parallel, and the crossing road acts as a **transversal**.
2. Corresponding angles formed by a transversal cutting parallel lines are equal.
3. Therefore, the corresponding angle at the second track is $\boxed{65°}$.
4. Its adjacent angle forms a linear pair with 65°, so it is $180° - 65° = 115°$.
5. Hence, the required angles at the second intersection are $\boxed{65°}$ and $\boxed{115°}$.

3. A designer draws two horizontal lines on a poster. A slanting line crosses them, producing corresponding angles of 75° and 75°. How can the designer confirm that the horizontal lines are parallel?

Line l ————————————/————————
75°/
/
/ Transversal
Line m ——————————/——————————
75°

Answer:

1. The slanting line acts as a **transversal** intersecting the two horizontal lines.
2. The corresponding angles formed at the two intersections are both **75°**.
3. Therefore, the pair of corresponding angles is equal.
4. If corresponding angles formed by a transversal are equal, the two lines are **parallel**.
5. Hence, the designer can conclude that $\boxed{l \parallel m}$.

4. Two parallel roads are crossed by another road. The two same-side interior angles are $(2x + 20)°$ and $(3x + 10)°$. Find x and the two angles.

Road 1 ——————————/——————————

/ (2x+20)°
/
/
(3x+10)°/
Road 2 ——————/——————

Answer:

1. The two given angles are same-side interior angles between parallel lines, so their sum is **180°**.
2. Therefore, $(2x + 20) + (3x + 10) = 180$, giving $5x + 30 = 180$.
3. Solving gives $5x = 150$, so $\boxed{x = 30}$.
4. The angles are $2(30) + 20 = \boxed{80^\circ}$ and $3(30) + 10 = \boxed{100^\circ}$.
5. Since $80^\circ + 100^\circ = 180^\circ$, the calculated angles satisfy the same-side interior angle property.

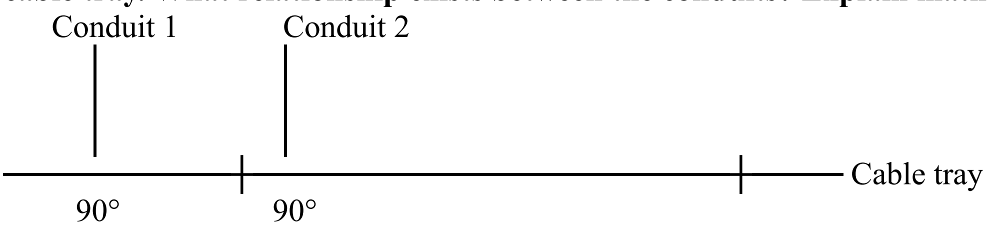
5. A school gardener wants to make two straight flower-bed boundaries parallel. He draws a third line across them and measures corresponding angles as 110° and 110°. Explain how he can verify that the boundaries are parallel.

Flower bed 1 ——————/——————
110°
/
/ Measuring line
/
Flower bed 2 ——————/——————
110°

Answer:

1. The measuring line crossing the two boundaries acts as a **transversal**.
2. The corresponding angle at the first boundary measures **110°**.
3. The corresponding angle at the second boundary also measures **110°**.
4. Since the corresponding angles are equal, the two boundaries satisfy the criterion for parallel lines.
5. Therefore, the gardener can conclude that the two flower-bed boundaries are $\boxed{\text{parallel}}$.

6. An electrician fixes two vertical conduits, each perpendicular to the same horizontal cable tray. What relationship exists between the conduits? Explain mathematically.



Answer:

1. Each vertical conduit forms a **90° angle** with the horizontal cable tray.
2. The cable tray can be treated as a transversal crossing the two conduit lines.
3. The corresponding angles formed at the two intersections are both 90°.
4. Equal corresponding angles imply that the two conduit lines are **parallel**.
5. Therefore, the electrician's two vertical conduits satisfy $\boxed{\text{Conduit 1} \parallel \text{Conduit 2}}$.

7. A road crosses two parallel boundary walls. One of the alternate angles is 115°. Find the alternate angle and the adjacent angle, explaining each step.

Wall 1 ——————/——————
115°/
/

/ Road

/

Wall 2 ——————————/——————————

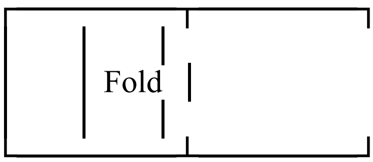
/115°

Answer:

1. The road acts as a transversal across the two **parallel boundary lines**.
2. Alternate angles formed by a transversal cutting parallel lines are equal.
3. Therefore, the alternate angle is also $\boxed{115^\circ}$.
4. The adjacent angle forms a linear pair with 115°, so it is $180^\circ - 115^\circ = \boxed{65^\circ}$.
5. Thus, the relevant angle measures in this arrangement are **115° and 65°**.

8. A student folds a square sheet vertically so that the fold is perpendicular to its top edge. Explain the relationship between the fold and the top and bottom edges of the sheet.

Top edge



Bottom edge

Answer:

1. The opposite top and bottom edges of the square sheet are **parallel**.
2. The vertical fold is made perpendicular to the top edge and therefore forms a **90° angle** with it.
3. Since the top and bottom edges are parallel, the corresponding angle made by the fold with the bottom edge is also 90°.
4. Thus, the fold is **perpendicular to both** the top and bottom edges.
5. This paper-folding activity provides a practical demonstration of **parallel and perpendicular lines**.

9. Two lines painted on a playground appear parallel. A third line crosses them, and the corresponding angles are measured as 60° and 65°. Should the lines be treated as parallel? Justify.

Line l ——————————/——————————

60°

/

/ Transversal

/

Line m ——————————/——————————

65°

Answer:

1. To test the lines, the crossing line can be considered a **transversal**.
2. If the painted lines are parallel, their corresponding angles should be equal.
3. Here, the corresponding angles are $60^\circ$and 65°, which are **not equal**.
4. Therefore, based on the given measurements, the corresponding-angle condition for parallel lines is not satisfied.
5. Hence, the two painted lines should $\boxed{\text{not be treated as parallel}}$ from these given angle measures.

10. A technician draws two parallel guide lines and a transversal. One of the eight angles formed is 140°. Determine the measures of all eight angles.

Guide 1 ——————————/——————————

/140°
/
/ Transversal
/
Guide 2 ——————/——————————————

Answer:

1. Vertically opposite, corresponding and alternate angles equal to the given angle will each measure **140°**.
2. An angle adjacent to 140° forms a linear pair with it.
3. Therefore, the adjacent angle is $180^\circ - 140^\circ = \boxed{40^\circ}$.
4. The angle relationships repeat at the two intersections, giving **four angles of 140° and four angles of 40°**.
5. Hence, the eight angles consist of $\boxed{140^\circ, 140^\circ, 140^\circ, 140^\circ}$ and $\boxed{40^\circ, 40^\circ, 40^\circ, 40^\circ}$.

5.14 Multiple Choice Questions with answers for Olympiad type Competitive Exams:

Olympiad-Type Multiple Choice Questions with Answers:
The following questions test **conceptual understanding, logical reasoning, angle calculation, parallel-line properties, transversals, corresponding angles, alternate angles, and same-side interior angles** from the uploaded chapter.

1. Two straight lines intersect. If one angle is 68°, what is the measure of its vertically opposite angle?
A) 22°
B) 68°
C) 112°
D) 292°
Answer: B) 68°

---

2. Two adjacent angles formed by intersecting lines are in the ratio $2:3$. What is the smaller angle?
A) 36°
B) 60°
C) 72°
D) 108°
Answer: C) 72°
Since $2x + 3x = 180^\circ$, $x = 36^\circ$, and $2x = 72^\circ$.

---

3. Observe the figure.
125°
\
\
————————————X——————————
/
/ x°
What is x?
A) 45°
B) 55°
C) 125°
D) 235°
Answer: C) 125°— Vertically opposite angles are equal.

4. If two intersecting lines form four equal angles, each angle must measure:
A) 45°
B) 60°
C) 90°
D) 180°
Answer: C) 90°

5. Which statement correctly describes two parallel lines?
A) They intersect at exactly one point.
B) They always form right angles.
C) They lie on the same plane and never meet however far extended.
D) They must have equal lengths.
Answer: C) They lie on the same plane and never meet however far extended.

6. A transversal intersects two lines as shown.
t
/
l ————————/————————
70°/
/
/
m ————————/————————
70°
If the marked angles are corresponding angles, what can be concluded?
A) $l \perp m$
B) $l \parallel m$
C) l and m must intersect
D) No conclusion can be made
Answer: B) $l \parallel m$— Equal corresponding angles imply parallel lines.

7. If corresponding angles formed by a transversal are 85° and 95°, which statement is correct?
A) The two lines are parallel.
B) The two lines are perpendicular.
C) The corresponding-angle condition for parallel lines is not satisfied.
D) The transversal is parallel to both lines.
Answer: C) The corresponding-angle condition for parallel lines is not satisfied.

8. Two parallel lines are cut by a transversal. If one corresponding angle is 117°, the other corresponding angle is:
A) 63°
B) 73°
C) 117°
D) 243°
Answer: C) 117°

9. Two parallel lines are cut by a transversal. One alternate angle is 105°. What is the other alternate angle?

A) 75°
B) 85°
C) 105°
D) 180°
Answer: C) 105°— Alternate angles are equal.

---

10. Two same-side interior angles between parallel lines are $x^\circ$and 120°. Find x.
A) 30°
B) 60°
C) 90°
D) 120°
Answer: B) 60°
Because $x + 120^\circ = 180^\circ$.

---

11. Two vertically opposite angles are $(3x + 10)^\circ$and $(5x - 30)^\circ$. What is x?
A) 10
B) 15
C) 20
D) 25
Answer: C) 20
Because $3x + 10 = 5x - 30$.

---

12. Corresponding angles between two parallel lines are $(4x + 5)^\circ$and $(3x + 25)^\circ$. Find x.
A) 10
B) 15
C) 20
D) 25
Answer: C) 20
Since $4x + 5 = 3x + 25$.

---

13. Alternate angles between two parallel lines are $(5x - 10)^\circ$and $(3x + 30)^\circ$. Find the measure of each alternate angle.
A) 70°
B) 80°
C) 90°
D) 100°
Answer: C) 90°
$5x - 10 = 3x + 30 \Rightarrow x = 20$, so each angle is 90°.

---

14. Same-side interior angles are in the ratio $4:5$. What are their measures?
A) $40^\circ, 50^\circ$
B) $60^\circ, 120^\circ$
C) $72^\circ, 108^\circ$
D) $80^\circ, 100^\circ$
Answer: D) $80^\circ, 100^\circ$
Their sum is 180°, so $9x = 180^\circ$and $x = 20^\circ$.

---

15. In the figure, $p \perp t$and $q \perp t$. Which conclusion is correct?

p q
| |
| |
————+————————————+———— t
90° 90°

A) $p \perp q$
B) $p \parallel q$
C) $p$and $q$intersect
D) $p = q = t$
Answer: B) $p \parallel q$— They form equal 90° corresponding angles with the same transversal.

---

16. A transversal intersects two lines. How many angles are formed altogether at the two points of intersection?
A) 4
B) 6
C) 8
D) 12
Answer: C) 8

---

17. Consider the standard labelling shown below.

t
/
1 / 2
l ————————/————————
4 / 3
/
5 / 6
m ————————/————————
8 / 7

Which is a pair of corresponding angles?
A) ∠1 and ∠3
B) ∠1 and ∠5
C) ∠2 and ∠4
D) ∠5 and ∠7
Answer: B) ∠1 and ∠5

---

18. In the same figure, if $l \parallel m$and $\angle 6 = 135^\circ$, what is ∠5?
A) 35°
B) 45°
C) 135°
D) 225°
Answer: B) 45°
Because ∠5 and ∠6 form a linear pair: $180^\circ - 135^\circ = 45^\circ$.

---

19. If $\angle 6 = 135^\circ$in the same parallel-line arrangement, which set contains only angles measuring 135°?
A) ∠1, ∠3, ∠5, ∠7
B) ∠2, ∠4, ∠6, ∠8

C) $\angle 1, \angle 2, \angle 3, \angle 4$
D) $\angle 5, \angle 6, \angle 7, \angle 8$
Answer: B) $\angle 2, \angle 4, \angle 6, \angle 8$

---

20. If one angle formed by a transversal across two parallel lines is 40°, how many of the eight angles measure 140°?
A) 2
B) 3
C) 4
D) 6
Answer: C) 4
The supplementary angle is $180^\circ - 40^\circ = 140^\circ$, and four angles have each measure.

---

21. One angle formed by a transversal across parallel lines is three times its adjacent angle. What is the smaller angle?
A) 30°
B) 45°
C) 60°
D) 90°
Answer: B) 45°
If the smaller angle is x, then $x + 3x = 180^\circ$, giving $x = 45^\circ$.

---

22. Two same-side interior angles formed between parallel lines are equal. What is the measure of each?
A) 45°
B) 60°
C) 90°
D) 180°
Answer: C) 90°
Equal same-side interior angles satisfy $x + x = 180^\circ$, so $x = 90^\circ$.

---

23. A pair of corresponding angles is $2x + 30^\circ$ and $4x - 20^\circ$. If the two lines are parallel, what is x?
A) 20
B) 25
C) 30
D) 35
Answer: B) 25
$2x + 30 = 4x - 20 \Rightarrow 50 = 2x \Rightarrow x = 25$.

---

24. Two intersecting lines form an angle of 35°. Which set correctly gives the measures of all four angles?
A) $35^\circ, 35^\circ, 35^\circ, 35^\circ$
B) $35^\circ, 145^\circ, 35^\circ, 145^\circ$
C) $35^\circ, 55^\circ, 35^\circ, 55^\circ$
D) $35^\circ, 145^\circ, 145^\circ, 35^\circ$
Answer: B) $35^\circ, 145^\circ, 35^\circ, 145^\circ$
Vertically opposite angles are equal and adjacent angles are supplementary.

---

25. A student says, "Two lines that do not meet on my notebook page must be parallel." Which is the best response?
A) Always true
B) True only if the lines are horizontal
C) Not necessarily; the lines may meet when extended
D) True if both lines have the same length
Answer: C) Not necessarily; the lines may meet when extended.

---

26. Which condition is sufficient to conclude that two lines cut by a transversal are parallel?
A) One angle is acute.
B) One angle is obtuse.
C) A pair of corresponding angles is equal.
D) Two angles at one intersection are supplementary.
Answer: C) A pair of corresponding angles is equal.

---

27. A student measures vertically opposite angles as $79^\circ$and 81°. Which explanation is most appropriate?
A) Vertically opposite angles are sometimes unequal.
B) The two lines must be parallel.
C) There is probably a drawing or measurement error.
D) Their sum must always be 160°.
Answer: C) There is probably a drawing or measurement error.
The chapter notes that line thickness and measuring-instrument errors can cause small discrepancies.

---

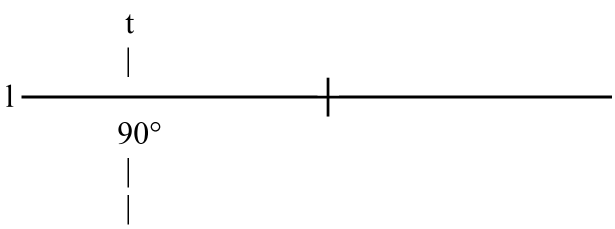
28. A transversal intersects two parallel lines. If an acute angle is $x^\circ$and an obtuse adjacent angle is $x + 60^\circ$, what is x?
A) 40°
B) 50°
C) 60°
D) 70°
Answer: C) 60°
$x + (x + 60) = 180 \Rightarrow 2x = 120 \Rightarrow x = 60^\circ$.

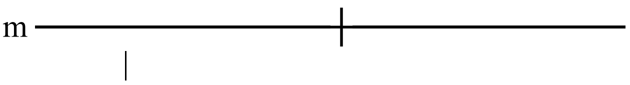
---

29. Which combination is always true when a transversal intersects two parallel lines?
A) Corresponding angles are supplementary; alternate angles are unequal.
B) Corresponding angles are equal; alternate angles are equal.
C) All eight angles are equal.
D) Same-side interior angles are equal.
Answer: B) Corresponding angles are equal; alternate angles are equal.

---

30. Two parallel lines are cut by a transversal. One of the eight angles is 90°. Which statement must be true?





A) Only two angles are 90°.
B) Four angles are 90°.
C) All eight angles are 90°.
D) The two original lines are not parallel.
Answer: C) All eight angles are 90°.
A 90° angle makes its vertical and adjacent angles 90°, and corresponding-angle equality carries the same measure to the second intersection.

---

31. Two same-side interior angles are $(4x - 10)^\circ$and $(2x + 40)^\circ$. If the lines are parallel, what is x?
A) 20
B) 25
C) 30
D) 35
Answer: B) 25
$(4x - 10) + (2x + 40) = 180 \Rightarrow 6x = 150 \Rightarrow x = 25$.

---

32. A transversal crosses two lines. A pair of corresponding angles measures 100°each. Which conclusion follows from the chapter's corresponding-angle criterion?
A) The lines are perpendicular.
B) The lines are parallel.
C) The transversal is parallel to both lines.
D) The lines form an angle of $100^\circ$with each other.
Answer: B) The lines are parallel.

---

33. Which statement is incorrect?
A) Vertically opposite angles are equal.
B) A linear pair adds up to 180°.
C) Alternate angles are equal when the lines are parallel.
D) Same-side interior angles of parallel lines are always equal.
Answer: D) Same-side interior angles of parallel lines are always equal.
They are **supplementary**, so their sum is 180°.

---

34. If two adjacent angles formed by intersecting lines are equal, what can be concluded?
A) Each is 45°.
B) Each is 60°.
C) Each is 90°, and the lines are perpendicular.
D) Each is 180°.
Answer: C) Each is 90°, and the lines are perpendicular.
Equal adjacent angles form a linear pair, so $2x = 180^\circ \Rightarrow x = 90^\circ$.

---

35. Which option correctly summarises the key relationships for parallel lines cut by a transversal?
A) Corresponding angles equal; alternate angles equal; same-side interior angles sum to 180°.
B) Corresponding angles sum to 180°; alternate angles are unequal; interior angles are equal.
C) All eight angles must be 90°.
D) Only vertically opposite angles have a predictable relationship.

Answer: A) Corresponding angles equal; alternate angles equal; same-side interior angles sum to 180°.

5.15 Best Practices Opportunity List from the Chapter: (10 Ideas)

"Best Practices" Opportunities While Teaching Chapter 5 – Parallel and Intersecting Lines:

(1) Begin with Real-Life Observation:
Introduce **parallel, intersecting, and perpendicular lines** through familiar objects such as railway tracks, road crossings, window frames, notebook edges, floor tiles, and classroom furniture. Ask students to identify and classify the different pairs of lines before introducing formal definitions. This connects the chapter with everyday experience.

(2) Use Paper-Folding Activities:
Provide square or rectangular sheets and ask students to create folds representing **parallel and perpendicular lines**. Students can compare opposite edges, adjacent edges, and fold lines and verify their relationships. This follows the chapter's hands-on approach and makes abstract line relationships visible.

(3) Promote "Measure–Observe–Conclude" Learning:
Draw two parallel lines with a transversal and ask students to measure **corresponding, alternate, and same-side interior angles** using a protractor. They should record their observations and independently arrive at the relationships: corresponding angles are equal, alternate angles are equal, and same-side interior angles total 180°.

(4) Use Colour Coding for Angle Relationships:
While teaching the eight angles created by a transversal, let students mark each pair of **corresponding angles** with the same colour or symbol. Different markings can similarly distinguish alternate and same-side interior angles. This reduces confusion when students work with complex diagrams.

(5) Encourage Reasoning Before Measurement:
Give students one known angle and ask them to calculate the remaining angles using **linear pairs, vertically opposite angles, corresponding angles, and alternate angles** before checking with a protractor. This develops mathematical reasoning rather than dependence on measurement alone. The chapter itself highlights possible practical measurement errors.

(6) Teach Through Construction Activities:
Let students use a **ruler and set square** to construct two lines perpendicular to the same line and observe that the constructed lines are parallel. Ask them to justify the result using equal 90° corresponding angles. This integrates geometrical construction with conceptual reasoning.

(7) Use Think–Pair–Share for "Are These Lines Parallel?" Problems:
Present diagrams in which students must decide whether two lines are parallel from the given angle measures. Students first solve individually, compare reasoning with a partner, and finally explain the conclusion to the class using the **corresponding-angle criterion**.

(8) Include Error-Analysis Questions:
Show an intentionally incorrect solution such as, "Corresponding angles are 60° and 120°, therefore the lines are parallel." Ask students to identify the mistake, correct it, and state the appropriate rule. Such activities strengthen conceptual understanding and mathematical communication.

(9) Connect Multiple Concepts in One Diagram:

Instead of teaching every angle relationship separately, use one transversal diagram and ask students to identify **vertical opposite angles, linear pairs, corresponding angles, alternate angles, and same-side interior angles**. This helps students understand how the chapter's concepts are interconnected.

(10) **End with a Student-Created Geometry Challenge:**
Ask each student or group to draw parallel lines with a transversal, assign the measure of one angle, and prepare a problem asking classmates to determine the remaining angles. Students should also prepare an answer key explaining each result using the correct geometrical property. This combines **creation, calculation, peer learning, and mathematical justification**.

5.16 Innovations Opportunity List from the Chapter: (10 Ideas)

"Innovations" Opportunities While Teaching-Learning Chapter 5 – Parallel and Intersecting Lines:

(1) **Geometry Detective – Classroom Line Hunt:**
Turn the classroom into a "Geometry Detective Zone." Students photograph or sketch examples of **parallel, intersecting, and perpendicular lines** found in windows, doors, desks, floor tiles, blackboards, and books, then classify them with reasons. This extends the chapter's use of real-world line relationships.

(2) **Interactive Transversal Angle Lab:**
Create two parallel strips and a movable transversal using cardboard, transparent sheets, or sticks. Students rotate the transversal and observe how the eight angles change while discovering that **corresponding and alternate angles remain equal** and **same-side interior angles remain supplementary**.

(3) **Human Geometry Activity:**
Students themselves can represent lines by holding ropes or standing in straight rows. Some groups form **parallel lines**, others form intersecting or perpendicular lines, while another student acts as a **transversal**. Classmates identify corresponding, alternate, and same-side interior angle positions.

(4) **Fold-and-Discover Geometry Lab:**
Give students square sheets and challenge them to create **parallel and perpendicular folds** without first providing the procedure. Students then explain why their folds satisfy the required properties. This creatively extends the paper-folding activities already included in the chapter.

(5) **Angle Coding with Symbols and Colours:**
Students can develop their own visual code for the eight angles formed by two parallel lines and a transversal—for example, matching symbols for equal corresponding or alternate angles and another marking for supplementary pairs. This creates a student-generated visual learning system for remembering angle relationships.

(6) **"Find the Missing Angle" Puzzle Wall:**
Create a classroom puzzle wall containing progressively challenging diagrams with one or two given angles. Students solve for unknown angles using **linear pairs, vertically opposite angles, corresponding angles, alternate angles, and same-side interior angles**, and attach a short reason beside each answer.

(7) **Parallel-Line Construction Challenge:**
Give students a ruler and set square and ask them to invent different ways of producing parallel lines. They can then test their constructions using the chapter's principle that **equal corresponding angles imply parallel lines**.

(8) Geometry Error-Detection Game:
Display intentionally incorrect statements such as "Vertically opposite angles add to 180°" or "Corresponding angles of parallel lines are supplementary." Teams earn points by identifying the error, correcting it, and stating the appropriate geometrical property. This encourages reasoning instead of memorisation.

(9) Student-Made Geometry Board Game:
Students can design a board game in which advancement depends on solving angle challenges. Cards may ask players to identify a transversal, calculate a supplementary angle, determine an alternate angle, or decide whether two lines are parallel from corresponding angles.

(10) Digital Dynamic-Geometry Exploration:
Where digital facilities are available, students can create two lines and a movable transversal in a dynamic geometry application. By dragging the transversal and observing angle measurements, they can experimentally investigate the chapter's relationships before expressing them as mathematical rules.

(11) "Design a City" Geometry Project:
Groups can prepare a miniature city map using **parallel roads, perpendicular streets, intersections, and transversal roads**. They label selected angles and create questions for other groups to solve. This connects the chapter's geometrical concepts with a meaningful design task.

(12) Student-Created Olympiad Challenge:
After learning the chapter, each group creates one difficult multiple-choice problem involving two or more properties—for example, a **linear pair followed by corresponding-angle reasoning**. Groups exchange questions, solve them, and evaluate whether the explanations are mathematically valid, promoting **problem creation, peer assessment, and higher-order thinking**.

5.17: Practicing Questions/Question Bank

A. Fill-in-the-Blank Questions:

1. Two lines that meet at a point are called __________ lines.
   Answer: Intersecting

2. Vertically opposite angles are always __________.
   Answer: Equal

3. The sum of two angles forming a linear pair is __________.
   Answer: 180°

4. Two lines intersecting at right angles are called __________ lines.
   Answer: Perpendicular

5. Each angle formed by two perpendicular lines measures __________.
   Answer: 90°

6. Lines lying in the same plane that never meet are called __________ lines.
   Answer: Parallel

7. A line intersecting two different lines is called a __________.
   Answer: Transversal

8. A transversal intersecting two lines forms a total of __________ angles.
   Answer: Eight

9. Corresponding angles formed by a transversal cutting parallel lines are __________.
   Answer: Equal

10. Alternate angles formed between parallel lines are __________.
    Answer: Equal

11. Same-side interior angles between parallel lines add up to __________.
    Answer: 180°

12. If one angle of a linear pair is 65°, the other is __________.
    Answer: 115°

13. If one vertically opposite angle is 105°, the other is __________.
    Answer: 105°

14. If corresponding angles are equal, the two lines are __________.
    Answer: Parallel

15. If one same-side interior angle is 80°, the other is __________.
    Answer: 100°

These concepts form the core relationships summarized in the chapter.

B. Suggested 1-Mark Descriptive Questions:

1. **What are intersecting lines?**
   Answer: Lines that meet each other at a point are called intersecting lines.

2. **What are vertically opposite angles?**
   Answer: Opposite angles formed when two straight lines intersect are called vertically opposite angles.

3. **State the property of vertically opposite angles.**
   Answer: Vertically opposite angles are always equal.

4. **What is a linear pair?**
   Answer: A pair of adjacent angles forming a straight angle is called a linear pair.

5. **What is the sum of the angles in a linear pair?**
   Answer: Their sum is 180°.

6. **Define perpendicular lines.**
   Answer: Two lines intersecting each other at right angles are called perpendicular lines.

7. **Define parallel lines.**
   Answer: Lines in the same plane that never meet however far extended are called parallel lines.

8. **What is a transversal?**
   Answer: A line intersecting two different lines is called a transversal.

9. **How many angles are formed when a transversal intersects two lines?**
   Answer: Eight angles are formed.

10. **State the property of corresponding angles between parallel lines.**
    Answer: Corresponding angles are equal.

11. **State the property of alternate angles between parallel lines.**
    Answer: Alternate angles are equal.
12. **What is the sum of same-side interior angles between parallel lines?**
    Answer: Their sum is 180°.
13. **Find the vertically opposite angle of 72°.**
    Answer: 72°.
14. **Find the supplementary angle of 125°.**
    Answer: 55°.
15. **What can be concluded if corresponding angles are equal?**
    Answer: The two lines are parallel.

C. Suggested 2-Mark Descriptive Questions:

1. Find $x$in the figure.

```
      120°
       \
        \
─────────────────X─────────────────
        /
       / x°
```

Answer:

1. $x$and $120^\circ$are vertically opposite angles.
2. Therefore, $\boxed{x = 120^\circ}$.

2. One angle of a linear pair is 48°. Find the other angle.

Answer:

1. The sum of a linear pair is 180°.
2. Required angle $= 180^\circ - 48^\circ = \boxed{132^\circ}$.

3. A transversal cuts two parallel lines. One corresponding angle is 75°. Find the other.

Answer:

1. Corresponding angles between parallel lines are equal.
2. Therefore, the required angle is $\boxed{75^\circ}$.

4. One alternate angle is 115°. Find the other alternate angle if the lines are parallel.

Answer:

1. Alternate angles between parallel lines are equal.
2. Therefore, the required angle is $\boxed{115^\circ}$.

5. One same-side interior angle is 68°. Find the other.

Answer:

1. Same-side interior angles add up to $180°$.
2. Required angle $= 180° - 68° = \boxed{112°}$.

6. Corresponding angles formed by a transversal are $80°$each. What can you conclude?

Answer:

1. The corresponding angles are equal.
2. Therefore, the two lines are **parallel**.

7. Corresponding angles are $70°$and $110°$. Are the lines parallel?

Answer:

1. The corresponding angles are unequal because $70° \neq 110°$.
2. Therefore, the lines are **not parallel**.

D. Suggested 3-Mark Descriptive Questions:

1. Two intersecting lines form an angle of $65°$. Find the remaining three angles.

```
  65°
\    /
 \  /
  \/
  /\
 /  \
```

Answer:

1. The vertically opposite angle is also $65°$.
2. Each adjacent angle is $180° - 65° = 115°$.
3. Hence, the remaining angles are $\boxed{65°, 115°, 115°}$.

2. Two adjacent angles are in the ratio $2:3$. Find both angles.

Answer:

1. Let the angles be $2x$and $3x$; then $2x + 3x = 180°$.
2. Thus, $5x = 180°$, giving $x = 36°$.
3. Therefore, the angles are $\boxed{72°}$and $\boxed{108°}$.

3. Corresponding angles are $(3x + 10)°$and $(2x + 30)°$. If the lines are parallel, find x.

Answer:

1. Corresponding angles are equal, so $3x + 10 = 2x + 30$.
2. Therefore, $x = 20$.
3. Each corresponding angle is $\boxed{70°}$.

4. Same-side interior angles are $2x°$and $4x°$. Find both angles.

Answer:

1. $2x + 4x = 180°$.
2. Therefore, $6x = 180°$, giving $x = 30°$.
3. Hence, the angles are $\boxed{60°}$ and $\boxed{120°}$.

5. Explain why two lines perpendicular to the same line are parallel.

```
    p          q
    |          |
    |          |
────────┼─────────────────────────┼──────── t
   90°        90°
```

Answer:

1. Lines p and q each form a $90°$ angle with line t.
2. These are equal corresponding angles.
3. Therefore, $\boxed{p \parallel q}$.

6. A transversal cuts two parallel lines, and one angle is $130°$. Find the two possible angle measures in the complete figure.

Answer:

1. Corresponding, alternate and vertically opposite angles equal to the given angle measure $130°$.
2. Adjacent angles measure $180° - 130° = 50°$.
3. Therefore, all eight angles have only the measures $\boxed{130°}$ and $\boxed{50°}$.

E. Suggested 5-Mark Descriptive Questions:

1. A transversal cuts two parallel lines. If one angle is $110°$, find all eight angles.

```
        t
       /
   1  / 2
l ──────────────/──────────
   4  / 3
     /
  5  / 6 = 110°
m ──────────/──────────────
  8 / 7
```

Answer:

1. Since $\angle 2$ corresponds to $\angle 6$, $\angle 2 = 110°$.
2. Vertically opposite angles give $\angle 4 = \angle 8 = 110°$.
3. $\angle 5$ forms a linear pair with $\angle 6$, so $\angle 5 = 180° - 110° = 70°$.
4. Corresponding and vertically opposite angle properties give $\angle 1 = \angle 3 = \angle 7 = 70°$.

5. Therefore, $\boxed{\angle 2 = \angle 4 = \angle 6 = \angle 8 = 110^\circ}$ and $\boxed{\angle 1 = \angle 3 = \angle 5 = \angle 7 = 70^\circ}$. The chapter uses the same reasoning pattern in its worked example.

2. Explain the three major angle relationships when a transversal intersects two parallel lines.

Answer:

1. A transversal intersecting two lines produces eight angles at two intersection points.
2. When the lines are parallel, **corresponding angles are equal**.
3. **Alternate angles are equal**.
4. **Same-side interior angles are supplementary**, adding up to 180°.
5. These properties can be used to calculate unknown angles and establish relationships between lines.

3. Two alternate angles are $(5x - 20)^\circ$ and $(3x + 30)^\circ$. Find x, the angles and their supplementary angles.

Answer:

1. Alternate angles between parallel lines are equal, so $5x - 20 = 3x + 30$.
2. Therefore, $2x = 50$, giving $\boxed{x = 25}$.
3. Each alternate angle is $5(25) - 20 = \boxed{105^\circ}$.
4. Its supplementary angle is $180^\circ - 105^\circ = \boxed{75^\circ}$.
5. Hence, the eight-angle arrangement contains angles measuring **105° and 75°**.

4. Explain how a ruler and set square can be used to construct parallel lines.

Answer:

1. Draw a straight line t using a ruler.
2. Draw line p perpendicular to t using a set square.
3. At another point on t, draw line q perpendicular to t.
4. Both p and q form equal 90° corresponding angles with t.
5. Hence, by the corresponding-angle criterion, $\boxed{p \parallel q}$.

5. A student claims two lines are parallel merely because they appear not to meet in a diagram. Explain how the claim can be tested mathematically.

Answer:

1. Visual appearance alone is not sufficient because apparently separate lines may meet when extended.

2. A transversal can be drawn across the two lines.
3. A pair of corresponding angles formed by the transversal can then be determined.
4. If the corresponding angles are equal, the two lines are parallel.
5. Thus, **angle relationships provide mathematical evidence for parallelism rather than relying only on appearance**.

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7th Standard Maths Book Chapter 6

Chapter 6: NUMBER PLAY

6.1 Summary of the Chapter:

Chapter 6 – Number Play: Summary:

(1) **Numbers can represent information:** A sequence of numbers can describe how objects or people are arranged without giving their actual measurements. For example, the chapter uses the relative heights of children to encode information about their arrangement.

(2) **Parity of numbers:** The property of a number being **even or odd** is called **parity**. Even numbers can be arranged completely in pairs, whereas odd numbers leave one unpaired.

(3) **Parity rules for addition:** The chapter establishes important patterns: **even + even = even**, **odd + odd = even**, and **even + odd = odd**. These rules help solve problems without performing lengthy calculations.

(4) **Parity in sums and products:** By studying combinations of odd and even numbers, we can predict whether the result of a sum or product will be odd or even. This idea is also applied to determine the parity of the number of small squares in rectangular grids.

(5) **Parity of algebraic expressions:** Expressions can be studied to determine whether they always produce even numbers, always produce odd numbers, or can produce either. The formulas $\mathbf{2n}$ and $\mathbf{2n-1}$ represent the *nth* even and *nth* odd numbers respectively.

(6) **Explorations with number grids:** In a **3 × 3 grid** containing the numbers 1 to 9 without repetition, the row and column sums provide useful clues for filling missing entries and deciding whether a proposed grid is possible.

(7) **Magic squares:** A square grid is called a **magic square** when every row, column and diagonal has the same sum, called the **magic sum**. For a 3 × 3 magic square using the numbers 1–9, the magic sum is **15** and the centre number must be **5**.

(8) **Magic squares in history and culture:** Magic squares have a rich mathematical history. The chapter discusses the **Chautīsā Yantra** from Khajuraho, whose rows, columns and diagonals add to **34**, as well as the ancient **Lo Shu Square** and Indian examples such as the **Navagraha Yantra**.

(9) **Virahāṅka–Fibonacci sequence:** The sequence **1, 2, 3, 5, 8, 13, 21, 34, 55, …** is formed by adding the previous two terms to obtain the next term. The chapter connects this sequence with **art, poetry, science and mathematics**.

(10) **Origin in Indian poetry:** The Virahāṅka numbers arose from studying combinations of **short syllables of one beat** and **long syllables of two beats** in Indian poetic traditions. The chapter explains how the sequence can count the different rhythms possible for a given number of beats.

(11) **Patterns in nature:** Virahāṅka–Fibonacci numbers occur in several mathematical and natural patterns. The chapter illustrates this using flowers with **13, 21 and 34 petals**, highlighting connections between **Art, Science and Mathematics**.

(12) **Cryptarithms or alphametics:** The chapter concludes with number puzzles in which **digits are replaced by letters**. Solving these puzzles requires logical reasoning, knowledge of place value and arithmetic operations, encouraging students to work like **"math-detectives."**

6.2 Important Formulas:

Important Formulas / Rules for Solving Quantitative Problems:

The following formulas and mathematical rules are useful for solving the quantitative and reasoning problems in the uploaded chapter.

1. **General form of an even number**

$$\boxed{2n}$$

where $n = 1,2,3, \ldots$. Therefore, the n^{th}**even number** = $2n$.

2. **General form of an odd number**

$$\boxed{2n - 1}$$

Therefore, the n^{th}**odd number** = $2n - 1$. For example, the 100th odd number is $2(100) - 1 = 199$.

3. **Parity rules for addition**

$$\boxed{\text{Even} + \text{Even} = \text{Even}}$$
$$\boxed{\text{Odd} + \text{Odd} = \text{Even}}$$
$$\boxed{\text{Even} + \text{Odd} = \text{Odd}}$$

These rules allow the parity of a sum to be determined without actually calculating the sum.

4. **Parity rules for subtraction**

$$\boxed{\text{Even} - \text{Even} = \text{Even}}$$
$$\boxed{\text{Odd} - \text{Odd} = \text{Even}}$$
$$\boxed{\text{Even} - \text{Odd} = \text{Odd}}$$
$$\boxed{\text{Odd} - \text{Even} = \text{Odd}}$$

These are the subtraction patterns explored in the chapter.

5. **Parity rules for multiplication**

$$\boxed{\text{Even} \times \text{Even} = \text{Even}}$$
$$\boxed{\text{Even} \times \text{Odd} = \text{Even}}$$
$$\boxed{\text{Odd} \times \text{Odd} = \text{Odd}}$$

Hence, a product is **odd only when all the factors are odd**.

6. **Number of small squares in a rectangular grid**

$$\boxed{\text{Number of small squares} = \text{Number of rows} \times \text{Number of columns}}$$

For an $m \times n$grid:

$$\boxed{N = mn}$$

Thus, if either $m$or $n$is even, the number of small squares is even; if both are odd, it is odd.

7. **Sum of the numbers 1 to 9**

$$\boxed{1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 = 45}$$

This result is particularly important when solving the chapter's **3 × 3 grid and magic-square problems**.

8. **Magic-sum condition**
   For a magic square,

$$\boxed{\text{Row Sum} = \text{Column Sum} = \text{Diagonal Sum}}$$

The common value is called the **magic sum**.

9. **Magic sum of a 3 × 3 square using 1–9**
   Since

$$1 + 2 + \cdots + 9 = 45,$$

and there are three equal row sums,

$$\boxed{\text{Magic Sum} = \frac{45}{3} = 15}$$

Thus, every row, column and diagonal must total **15**.

10. **Centre number of the 1–9 magic square**
    For the standard 3 × 3 magic square,

$$\boxed{\text{Centre number} = 5}$$

The chapter establishes that 5 must occupy the centre when the numbers 1–9 are used.

11. **Generalised 3 × 3 magic square**
If the centre number is m, the magic sum is
$$\boxed{3m}$$
Hence,
$$\boxed{m = \frac{\text{Magic Sum}}{3}}$$
This is useful for constructing magic squares with a specified centre or magic sum.
12. **Effect of adding a constant to a 3 × 3 magic square**
If $k$is added to every entry,
$$\boxed{\text{New Magic Sum} = \text{Old Magic Sum} + 3k}$$
because every row, column and diagonal contains three entries. The chapter specifically asks students to explore adding 1 to every number.
13. **Effect of multiplying every entry of a magic square**
If every entry is multiplied by k,
$$\boxed{\text{New Magic Sum} = k \times \text{Old Magic Sum}}$$
For example, doubling every number doubles the magic sum.
14. **Virahāṅka–Fibonacci recurrence rule**
Each term after the first two is obtained by adding the previous two:
$$\boxed{V_n = V_{n-1} + V_{n-2}}$$
with the sequence
$$\boxed{1, 2, 3, 5, 8, 13, 21, 34, 55, 89, \ldots}$$
15. **Number of ways to form $n$beats using 1-beat and 2-beat syllables**
If $R_n$represents the number of rhythms,
$$\boxed{R_n = R_{n-1} + R_{n-2}}$$
For example,
$$R_5 = R_4 + R_3 = 5 + 3 = 8$$
and
$$R_6 = R_5 + R_4 = 8 + 5 = 13.$$
16. **Staircase problems with 1-step or 2-step moves**
The same Virahāṅka rule applies:
$$\boxed{W_n = W_{n-1} + W_{n-2}}$$
because the final move to step $n$must be either a **1-step move from** $n - 1$or a **2-step move from** $n - 2$. The chapter applies this idea to an 8-step staircase.
17. **Useful parity rule for several odd numbers**
$$\boxed{\text{Even number of odd numbers} \rightarrow \text{Even sum}}$$
$$\boxed{\text{Odd number of odd numbers} \rightarrow \text{Odd sum}}$$
For example, five odd numbers cannot add up to 30 because an odd number of odd numbers always gives an odd sum.
18. **Useful parity rule for several even numbers**
$$\boxed{\text{Sum of any number of even numbers} = \text{Even}}$$
This follows because even numbers can always be arranged completely in pairs.

Key Formulas to Remember
$$\boxed{n^{th} \text{ even number} = 2n}$$
$$\boxed{n^{th} \text{ odd number} = 2n - 1}$$
$$\boxed{\text{Grid cells} = \text{Rows} \times \text{Columns}}$$
$$\boxed{3\times3 \text{ magic sum using 1–9} = 15}$$

$\boxed{\text{Generalised } 3\times3 \text{ magic sum } = 3m}$

$\boxed{V_n = V_{n-1} + V_{n-2}}$

These are the **most important formulas and rules for numerical, reasoning, HOTS, Olympiad-type, grid, parity, magic-square, and Virahāṅka–Fibonacci problems** from Chapter 6, *Number Play*.

6.3 Fill-Up the Blank LOTS type questions with Answers: (35 Questions)

LOTS Type – Fill in the Blanks with Answers:

1. A number that can be arranged completely in pairs is called an __________ number.
   Answer: Even
2. A number that cannot be arranged completely in pairs is called an __________ number.
   Answer: Odd
3. The property of a number being even or odd is called __________.
   Answer: Parity
4. The sum of any number of even numbers is always __________.
   Answer: Even
5. The sum of two odd numbers is always __________.
   Answer: Even
6. The sum of an even number and an odd number is always __________.
   Answer: Odd
7. In any two consecutive counting numbers, one number is even and the other is __________.
   Answer: Odd
8. The formula for the n^{th} even number is __________.
   Answer: $2n$
9. The formula for the n^{th} odd number is __________.
   Answer: $2n - 1$
10. The 100th even number is __________.
    Answer: 200
11. The 100th odd number is __________.
    Answer: 199
12. The total of the numbers from 1 to 9 is __________.
    Answer: 45
13. A square grid in which every row, column and diagonal adds up to the same number is called a __________.
    Answer: Magic square
14. The common sum of every row, column and diagonal of a magic square is called the __________.
    Answer: Magic sum
15. The magic sum of a 3 × 3 magic square made using the numbers 1 to 9 is __________.
    Answer: 15
16. The number that must occur at the centre of a 3 × 3 magic square using the numbers 1 to 9 is __________.
    Answer: 5
17. The numbers 1 and 9 cannot occur in any __________ position of the 3 × 3 magic square using 1 to 9.
    Answer: Corner

18. The first recorded 4 × 4 magic square discussed in the chapter is known as the __________ **Yantra**.
    Answer: Chautīsā
19. The magic sum of the Chautīsā Yantra is __________.
    Answer: 34
20. The first magic square ever recorded is known as the __________ **Square**.
    Answer: Lo Shu
21. The Lo Shu Square dates back over __________ years to ancient China.
    Answer: 2000
22. The sequence 1,2,3,5,8,13,21,34, ...is called the __________–**Fibonacci sequence**.
    Answer: Virahāṅka
23. In the Virahāṅka–Fibonacci sequence, each new term is obtained by adding the __________ previous terms.
    Answer: Two
24. The term that comes immediately after 55 in the Virahāṅka–Fibonacci sequence is __________.
    Answer: 89
25. In Indian poetry discussed in the chapter, a short syllable lasts __________ beat of time.
    Answer: One
26. A long syllable lasts __________ beats of time.
    Answer: Two
27. There are __________ different rhythms having 5 beats using short and long syllables.
    Answer: 8
28. There are __________ different rhythms having 6 beats.
    Answer: 13
29. There are __________ rhythms of short and long syllables having 8 beats.
    Answer: 34
30. Virahāṅka gave his method for counting rhythms around the year __________ **CE**.
    Answer: 700
31. The Italian mathematician Fibonacci wrote about these numbers in the year __________ **CE**.
    Answer: 1202
32. In a cryptarithm, digits are replaced by __________.
    Answer: Letters
33. Each letter in a cryptarithm represents a particular digit from __________ **to** __________.
    Answer: 0 to 9
34. Cryptarithms are also known as __________.
    Answer: Alphametics
35. In the chapter's first arrangement activity, each child calls out the number of children in front who are __________ than them.
    Answer: Taller
36. In a group of 8 people, the largest possible number a person can call out under the height-arrangement rule is __________.
    Answer: 7
37. The sum of an **odd number of odd numbers** is always __________.
    Answer: Odd

38. The sum of an **even number of odd numbers** is always __________.
    Answer: Even
39. The sum of an odd number of even numbers is always __________.
    Answer: Even
40. The sum of an even number of even numbers is always __________.
    Answer: Even

6.4 Fill-Up the Blank HOTS type questions with Answers: (40 Questions)

HOTS Type – Fill in the Blanks with Answers:

1. If five odd numbers are added together, their sum will always be __________.
   Answer: Odd
2. Kishor has five cards, each containing an odd number. Therefore, it is __________ for their sum to be 30.
   Answer: Impossible
3. Two consecutive numbers cannot have an even sum because one is even and the other is odd; therefore, their sum is always __________.
   Answer: Odd
4. If $n = 17$, the value of $2n$is __________.
   Answer: 34
5. If $n = 17$, the value of $2n - 1$is __________.
   Answer: 33
6. If the 50th even number is 100, the 50th odd number is __________.
   Answer: 99
7. Without multiplying completely, the number of small squares in a 27×13grid must be __________, because both factors are odd.
   Answer: Odd
8. Without calculating 42×78, we can conclude that the product is __________, because both factors are even.
   Answer: Even
9. Without calculating 135×654, its parity can be identified as __________ because one factor is even.
   Answer: Even
10. If $n$is even, the expression $3n + 4$will have __________ parity.
    Answer: Even
11. If $n$is odd, the expression $3n + 4$will have __________ parity.
    Answer: Odd
12. The expression $4m - 1$always gives an __________ number because $4m$is always even.
    Answer: Odd
13. In a 3 × 3 grid using the numbers 1–9 exactly once, a row sum of 5 is __________, because the smallest possible sum of three different entries is $1 + 2 + 3 = 6$.
    Answer: Impossible
14. In the same grid, a row sum of 26 is __________, because the largest possible sum is $9 + 8 + 7 = 24$.
    Answer: Impossible
15. In any 3 × 3 arrangement using the numbers 1–9 once each, the sum of all three row sums is __________.
    Answer: 45

16. If the three row sums of a 3 × 3 magic square using 1–9 are equal, each row must sum to __________.
    Answer: 15
17. In a 3 × 3 magic square using the numbers 1–9, if two entries in a row are 1 and 5, the third entry must be __________.
    Answer: 9
18. In a 3 × 3 magic square using 1–9, the centre cannot be 9 because a line containing 9 and 8 would require the third number to be __________ to make the magic sum 15.
    Answer: −2
19. If the centre of a generalised 3 × 3 magic square is 25, its magic sum will be __________.
    Answer: 75
20. If a 3 × 3 magic square has a magic sum of 60, its centre number is __________.
    Answer: 20
21. If 1 is added to every number of a 3 × 3 magic square whose magic sum is 15, the new magic sum becomes __________.
    Answer: 18
22. If every number of a 3 × 3 magic square with magic sum 15 is doubled, the new magic sum becomes __________.
    Answer: 30
23. In the Virahāṅka sequence 1,2,3,5,8,13,21,34,55,89, ..., the term immediately after 89 is __________.
    Answer: 144
24. The next term after 144 in the same sequence is __________.
    Answer: 233
25. If two consecutive Virahāṅka numbers are 987 and 1597, the next number is __________.
    Answer: 2584
26. If two consecutive Virahāṅka numbers are 987 and 1597, the number immediately before 987 is $1597 - 987 =$__________.
    Answer: 610
27. Since the number of 5-beat rhythms is 8 and the number of 6-beat rhythms is 13, the number of 7-beat rhythms is __________.
    Answer: 21
28. Using the same pattern, the number of different 8-beat rhythms is __________.
    Answer: 34
29. If a person can climb a staircase by taking either 1 or 2 steps at a time, the number of ways to climb 8 steps is __________.
    Answer: 34
30. A light bulb is initially ON. If its switch is toggled 77 times, the bulb will finally be __________ because 77 is odd.
    Answer: OFF
31. If the same ON bulb were toggled 100 times, it would finally be __________ because an even number of toggles returns it to its original state.
    Answer: ON
32. In the cryptarithm $T + T + T = UT$, the value of T is __________.
    Answer: 5
33. Therefore, in $T + T + T = UT$, the two-digit number UT is __________.
    Answer: 15

34. If an odd number of ₹1 coins and an odd number of ₹5 coins are combined with an even number of ₹10 coins, the total amount must have __________ parity.
    Answer: Even
35. Therefore, if the above collection of coins is claimed to total ₹205, the calculation must be __________.
    Answer: Incorrect
36. If a person in the height-arrangement activity calls out 0, it means there are __________ taller people standing in front of that person.
    Answer: No / zero
37. In a group of 8 people, if the last person is shorter than every person standing before them, the number they call out will be __________.
    Answer: 7
38. If eight odd numbers are added, the result must be __________, since odd numbers are being added an even number of times.
    Answer: Even
39. The parity pattern of the Virahāṅka sequence begins **odd, even, odd, odd, even, odd, odd, even, ...**; therefore, every third term is __________.
    Answer: Even
40. If the magic sum of a 3 × 3 magic square is $3m$, then a magic sum of 90 requires the centre number $m$to be __________.
    Answer: 30

6.5 One-mark questions with Answers of LOTS Type: (35 Questions)

One-Mark Descriptive Questions with Answers – LOTS Type:

1. **What is meant by parity of a number?**
   Answer: Parity is the property of a number being either **even or odd**.
2. **What is an even number?**
   Answer: An even number is a number that can be arranged completely in pairs without any leftovers.
3. **What is an odd number?**
   Answer: An odd number is a number that cannot be arranged completely in pairs and has one left over.
4. **What is the result of adding two even numbers?**
   Answer: The sum of two even numbers is always an **even number**.
5. **What is the result of adding two odd numbers?**
   Answer: The sum of two odd numbers is always an **even number**.
6. **What is the result of adding an even number and an odd number?**
   Answer: The sum of an even number and an odd number is always an **odd number**.
7. **What can you say about the parity of two consecutive numbers?**
   Answer: Of any two consecutive numbers, one is **even** and the other is **odd**.
8. **Write the formula for the n^{th}even number.**
   Answer: The formula for the n^{th}even number is $2n$.
9. **Write the formula for the n^{th}odd number.**
   Answer: The formula for the n^{th}odd number is $2n - 1$.
10. **What is the 100th even number?**
    Answer: The 100th even number is **200**.
11. **What is the 100th odd number?**
    Answer: The 100th odd number is **199**.
12. **What is the sum of the numbers from 1 to 9?**
    Answer: The sum of the numbers from 1 to 9 is **45**.

13. **What is a magic square?**
    Answer: A magic square is a square grid in which every row, column and diagonal adds up to the same number.
14. **What is meant by the magic sum?**
    Answer: The common sum of every row, column and diagonal of a magic square is called the **magic sum**.
15. **What is the magic sum of a 3 × 3 magic square using the numbers 1–9?**
    Answer: The magic sum is **15**.
16. **Which number must occupy the centre of a 3 × 3 magic square using 1–9?**
    Answer: The number **5** must occupy the centre.
17. **Where should the numbers 1 and 9 occur in a 3 × 3 magic square using 1–9?**
    Answer: The numbers 1 and 9 should occur in the **middle positions on the boundary and not at the corners**.
18. **What is the Chautīsā Yantra?**
    Answer: The Chautīsā Yantra is the first recorded **4 × 4 magic square** discussed in the chapter.
19. **What is the magic sum of the Chautīsā Yantra?**
    Answer: The magic sum of the Chautīsā Yantra is **34**.
20. **What is the Lo Shu Square?**
    Answer: The Lo Shu Square is the **first magic square ever recorded**, dating back over 2000 years to ancient China.
21. **Write the first eight Virahāṅka–Fibonacci numbers.**
    Answer: The first eight numbers are **1, 2, 3, 5, 8, 13, 21 and 34**.
22. **What is the rule for obtaining the next Virahāṅka–Fibonacci number?**
    Answer: Each new number is obtained by **adding the previous two numbers**.
23. **What number comes after 55 in the Virahāṅka–Fibonacci sequence?**
    Answer: The number after 55 is **89**.
24. **In what context were the Virahāṅka numbers first discovered?**
    Answer: The Virahāṅka numbers were first discovered through the study of **poetry**.
25. **How many beats does a short syllable take?**
    Answer: A short syllable takes **one beat** of time.
26. **How many beats does a long syllable take?**
    Answer: A long syllable takes **two beats** of time.
27. **How many different rhythms are possible with five beats?**
    Answer: There are **8 different rhythms** with five beats.
28. **How many different rhythms are possible with six beats?**
    Answer: There are **13 different rhythms** with six beats.
29. **How many rhythms of short and long syllables are possible with eight beats?**
    Answer: There are **34 rhythms** possible with eight beats.
30. **Who first explicitly described the rule for forming the Virahāṅka numbers?**
    Answer: Virahāṅka was the first known person to explicitly describe the rule for forming these numbers.
31. **Around which year did Virahāṅka give his method for counting rhythms?**
    Answer: Virahāṅka gave his method around **700 CE**.
32. **Name two later Indian scholars who wrote about the Virahāṅka numbers.**
    Answer: Gopala and Hemachandra later wrote about these numbers.
33. **What are cryptarithms?**
    Answer: Cryptarithms are arithmetic puzzles in which **digits are replaced by letters**.
34. **What is another name for cryptarithms?**
    Answer: Cryptarithms are also called **alphametics**.

35. **What digits can a letter represent in a cryptarithm?**
    Answer: Each letter can represent a particular digit from **0 to 9**.
36. **In the cryptarithm $T + T + T = UT$, what is the value of T?**
    Answer: The value of $T$is **5**.
37. **What does each child call out in the height-arrangement activity?**
    Answer: Each child calls out the number of children **in front of them who are taller than them**.
38. **What does it mean when the first person in the height arrangement calls out 0?**
    Answer: It means that there is **no person standing in front** of the first person.
39. **What is the largest possible number a person can call out in a group of eight people?**
    Answer: The largest possible number is **7**.
40. **What mathematical ideas are connected through the Virahāṅka–Fibonacci numbers in the chapter?**
    Answer: The Virahāṅka–Fibonacci numbers illustrate connections among **Art, Science and Mathematics**.

6.6 One-mark questions with Answers of HOTS Type: (30 Questions)

One-Mark Descriptive Questions with Answers – HOTS Type:

1. **Can five odd numbers have an even sum? Give a reason.**
   Answer: No, because the sum of an odd number of odd numbers is always **odd**.
2. **Can the ages of two people who are exactly one year apart add up to 112? Why?**
   Answer: No, because their ages are consecutive numbers whose sum is always **odd**, whereas 112 is even.
3. **Without calculating 27×13, determine whether the product is odd or even.**
   Answer: The product is **odd** because both 27 and 13 are odd.
4. **Without calculating 135×654, determine its parity.**
   Answer: The product is **even** because one of its factors, 654, is even.
5. **If $n$is odd, what is the parity of $3n + 4$?**
   Answer: $3n + 4$is **odd** because $3n$is odd and adding 4 does not change its parity.
6. **If $n$is even, what is the parity of $3n + 4$?**
   Answer: $3n + 4$is **even** because both $3n$and 4 are even.
7. **Find the 75th even number using the general formula.**
   Answer: The 75th even number is $2 \times 75 = 150$.
8. **Find the 75th odd number using the general formula.**
   Answer: The 75th odd number is $2(75) - 1 = 149$.
9. **Can a row in a 3 × 3 grid using 1–9 without repetition have a sum of 5? Why?**
   Answer: No, because the smallest possible sum of three different numbers is $1 + 2 + 3 = 6$.
10. **Can a row in the same grid have a sum of 26? Give a reason.**
    Answer: No, because the greatest possible sum of three different numbers is $9 + 8 + 7 = 24$.
11. **Why must the magic sum of a 3 × 3 magic square using 1–9 be 15?**
    Answer: Since the numbers total 45 and the three equal row sums together make 45, each row must sum to $45 \div 3 = 15$.
12. **If 1 and 5 occur in the same line of a 1–9 magic square, what must the third number be?**
    Answer: The third number must be **9**, because $1 + 5 + 9 = 15$.

13. **Why cannot 9 occupy the centre of a 3 × 3 magic square using 1–9?**
    Answer: If 9 were at the centre, placing 8 in any line through it would require a number outside 1–9 to make the magic sum 15.
14. **If the centre of a generalised 3 × 3 magic square is 25, what will its magic sum be?**
    Answer: The magic sum will be $3 \times 25 = 75$.
15. **What should be the centre number of a 3 × 3 magic square having magic sum 60?**
    Answer: The centre number should be $60 \div 3 = 20$.
16. **If 1 is added to every entry of a magic square having magic sum 15, what is the new magic sum?**
    Answer: The new magic sum is **18**, because each line contains three numbers and hence increases by 3.
17. **If every entry of a magic square with magic sum 15 is doubled, what will its new magic sum be?**
    Answer: The new magic sum will be **30** because doubling every entry doubles every row, column and diagonal sum.
18. **Find the next number after 89 in the Virahāṅka–Fibonacci sequence.**
    Answer: The next number is $55 + 89 = 144$.
19. **If 8 and 13 are consecutive Virahāṅka numbers, what is the next number?**
    Answer: The next number is $8 + 13 = 21$.
20. **If 987 and 1597 are consecutive Virahāṅka numbers, what is the next number?**
    Answer: The next number is $987 + 1597 = 2584$.
21. **If 987 and 1597 are consecutive Virahāṅka numbers, what is the number immediately before 987?**
    Answer: The previous number is $1597 - 987 = 610$.
22. **If there are 8 five-beat rhythms and 5 four-beat rhythms, how many six-beat rhythms are possible?**
    Answer: There are $8 + 5 = 13$six-beat rhythms.
23. **How many ways can a person climb an 8-step staircase by taking only one or two steps at a time?**
    Answer: The person can climb the staircase in **34 different ways**, following the Virahāṅka sequence.
24. **A bulb is initially ON and its switch is toggled 77 times; what will its final state be?**
    Answer: The bulb will be **OFF** because an odd number of toggles reverses its initial state.
25. **If the same bulb is toggled 78 times, what will its final state be?**
    Answer: The bulb will remain **ON** because an even number of toggles returns it to its original state.
26. **Can an odd number of ₹1 coins, an odd number of ₹5 coins and an even number of ₹10 coins total ₹205?**
    Answer: No, because the first two amounts are odd and the third is even, making the total even rather than 205.
27. **Is the expression $4m - 1$always odd? Give a reason.**
    Answer: Yes, because $4m$is always even and subtracting 1 from an even number gives an odd number.
28. **Can $2p + 1$represent every odd number? Give a reason.**
    Answer: Yes, because adding 1 to the even number $2p$produces an odd number.

29. **In the height-arrangement activity, what number will the last person say if all seven people in front are taller?**
    Answer: The last person will say **7** because seven taller people are standing in front.
30. **If a person says 0 in the height-arrangement activity, must that person be the tallest in the whole group?**
    Answer: No, because saying 0 only means that **no taller person is standing in front** of that person.
31. **If the first person in the height arrangement is not the tallest, what number will that person still say?**
    Answer: The first person will still say **0** because nobody is standing in front.
32. **What is the parity of the sum of eight odd numbers?**
    Answer: The sum is **even** because an even number of odd numbers has an even sum.
33. **What is the parity of the sum of five even numbers?**
    Answer: The sum is **even** because adding any number of even numbers always gives an even number.
34. **If three consecutive Virahāṅka numbers have parities odd, odd and even, what will be the parity of the next term?**
    Answer: The next term will be **odd** because odd plus even gives odd.
35. **In the cryptarithm $T + T + T = UT$, why can T not be 2?**
    Answer: T cannot be 2 because $2 + 2 + 2 = 6$, which is not a two-digit number ending in 2.
36. **What are T and UT in the cryptarithm $T + T + T = UT$?**
    Answer: $T = 5$ and $UT = 15$ because $5 + 5 + 5 = 15$.
37. **If a 3 × 3 magic square has centre number 30, what should its magic sum be?**
    Answer: Its magic sum should be $3 \times 30 = 90$.
38. **Can 1 be placed at a corner in a 3 × 3 magic square using 1–9?**
    Answer: No, because there are not enough distinct pairs with 1 that can produce the required magic sum of 15 along all three lines through a corner.
39. **If the parity pattern of the Virahāṅka sequence repeats as odd, even, odd, what is the parity of every third term?**
    Answer: Every third term is **odd** under the chapter's sequence starting 1,2,3, ...
40. **Why are parity rules useful in number puzzles?**
    Answer: Parity rules help determine whether a numerical result is **possible or impossible without carrying out the complete calculation**.

6.7 Two-mark questions with Answers of LOTS Type: (25 Questions)

Two-Mark Descriptive Questions with Answers – LOTS Type:

1. What is parity? Explain even and odd parity.

Answer:

1. The property of a number being **even or odd** is called **parity**.
2. Numbers that can be arranged completely in pairs are even, while numbers that leave one unpaired are odd.

2. State the parity rules for the sum of two numbers.

Answer:

1. **Even + Even = Even** and **Odd + Odd = Even**.
2. **Even + Odd = Odd** (and similarly, Odd + Even = Odd).

3. Why is the sum of two odd numbers always even?

Answer:

1. Each odd number consists of some pairs with **one element left unpaired**.

2. When two odd numbers are added, the two unpaired elements form another pair, making the total **even**.

4. Why is the sum of an even number and an odd number always odd?

Answer:

1. An even number can be completely arranged in pairs, while an odd number has **one element left over**.
2. After combining them, one element still remains unpaired, so the resulting sum is **odd**.

5. What can you say about the parity of two consecutive counting numbers?

Answer:

1. Counting numbers alternate as **odd, even, odd, even, ...**
2. Hence, among any two consecutive numbers, **one is odd and the other is even**.

6. Write the formulas for the n^{th}even and n^{th}odd numbers.

Answer:

1. The n^{th}even number is given by $2n$.
2. The n^{th}odd number is given by $2n - 1$.

7. Find the 100th even number and the 100th odd number.

Answer:

1. The 100th even number is $2 \times 100 = 200$.
2. The 100th odd number is $2 \times 100 - 1 = 199$.

8. How can you determine the parity of the number of small squares in a rectangular grid?

Answer:

1. The number of small squares is obtained by multiplying the **number of rows by the number of columns**.
2. If both dimensions are odd, the product is odd; if at least one dimension is even, the product is **even**.

9. What do the numbers outside the 3 × 3 grids in the chapter represent?

Answer:

1. The circled numbers outside the grid represent the **sums of the corresponding rows and columns**.
2. These sums can be used as clues to determine the numbers that should be placed inside the grid.

10. Why can a row sum in a 3 × 3 grid using 1–9 not be less than 6 or greater than 24?

Answer:

1. The smallest possible sum of three different numbers is $1 + 2 + 3 = 6$.
2. The largest possible sum is $9 + 8 + 7 = 24$; hence a row sum outside 6–24 is impossible.

11. What is a magic square? What is a magic sum?

Answer:

1. A **magic square** is a square grid in which every row, column and diagonal has the same sum.
2. This common value is known as the **magic sum**.

12. Why is the magic sum of a 3 × 3 magic square using 1–9 equal to 15?

Answer:

1. The sum of the numbers from 1 to 9 is $1 + 2 + \cdots + 9 = 45$.
2. Since the three row sums are equal, each row must have a sum of $45 \div 3 = 15$.

13. What two important observations are made about the centre of a 3 × 3 magic square using 1–9?

Answer:

1. Extreme numbers such as **1 and 9 cannot occupy the centre**, as they cannot satisfy the required sum of 15 in every direction.
2. The number at the centre of a 3 × 3 magic square using 1–9 **must be 5**.

14. What does the chapter state about the positions of 1 and 9 in a 3 × 3 magic square?
Answer:
1. The numbers **1 and 9 cannot occur in any corner position**.
2. Therefore, they must occupy one of the **middle positions along the boundary** of the square.

15. What happens when 1 is added to every number of a magic square?
Answer:
1. Each row, column and diagonal still contains three numbers increased by the same amount, so the grid **remains a magic square**.
2. Its magic sum increases by **3**, because 1 is added to each of the three entries in every line.

16. What happens when every number of a magic square is doubled?
Answer:
1. Every row, column and diagonal sum becomes **twice its original value**.
2. Therefore, the resulting grid remains a magic square and its **magic sum is doubled**.

17. What is the Chautīsā Yantra? State its magic sum.
Answer:
1. The **Chautīsā Yantra** is the first recorded 4 × 4 magic square discussed in the chapter, found in a 10th-century inscription at Khajuraho.
2. Every row, column and diagonal of this magic square adds up to **34**.

18. What is the Virahāṅka–Fibonacci sequence? State its formation rule.
Answer:
1. The sequence begins **1, 2, 3, 5, 8, 13, 21, 34, 55, ...**.
2. Each new term is obtained by **adding the two immediately preceding terms**.

19. How are short and long syllables represented while studying rhythms?
Answer:
1. A **short syllable** lasts for **one beat** of time.
2. A **long syllable** lasts for **two beats** of time.

20. How does the Virahāṅka rule help in finding the number of 6-beat rhythms?
Answer:
1. The number of 6-beat rhythms equals the number of **5-beat rhythms plus 4-beat rhythms**.
2. Hence, the number of 6-beat rhythms is $8 + 5 = 13$.

21. Mention two historical facts about the Virahāṅka numbers.
Answer:
1. Virahāṅka described the method for forming these numbers around **700 CE** in the context of poetic rhythms.
2. Later Indian scholars such as **Gopala and Hemachandra** also wrote about these numbers.

22. Give two examples showing the occurrence of Virahāṅka–Fibonacci numbers beyond arithmetic.
Answer:
1. The sequence is connected with fields such as **poetry, drumming, visual arts and architecture**.
2. It also occurs in nature; for example, the chapter illustrates daisies having **13, 21 and 34 petals**.

23. What are cryptarithms or alphametics?

Answer:

1. Cryptarithms are arithmetic puzzles in which **digits are replaced by letters**.
2. Each letter represents a particular digit from **0 to 9**, which has to be determined using arithmetic reasoning.

24. Solve the simple cryptarithm $T + T + T = UT$.

Answer:

1. The digit satisfying the condition is $T = 5$.
2. Therefore, $5 + 5 + 5 = 15$, giving $UT = 15$.

25. Explain the rule used in the chapter's height-arrangement activity.

Answer:

1. Each child counts the number of children **standing in front who are taller** than them.
2. The number obtained from this count is the number that the child **calls out**.

26. Why does the first person in the height-arrangement activity always call out 0?

Answer:

1. There is **no person standing in front** of the first person.
2. Therefore, the number of taller people in front is **zero**, irrespective of the first person's height.

27. Explain why five odd-numbered cards cannot have a sum of 30.

Answer:

1. Adding an **odd number of odd numbers** always produces an odd sum.
2. Since five is odd but **30 is even**, five odd-numbered cards cannot add up to 30.

28. How many rhythms are possible for 5 beats and 8 beats?

Answer:

1. There are **8 different rhythms** possible for 5 beats.
2. There are **34 different rhythms** possible for 8 beats.

These **28 two-mark LOTS questions** cover the major learning areas of the chapter—**number arrangements, parity, even and odd numbers, algebraic forms, grids, magic squares, historical magic squares, Virahāṅka–Fibonacci numbers, poetic rhythms, and cryptarithms**—with each answer presented in **exactly two key steps/points** suitable for Grade 7 assessment.

6.8. Two-mark questions with Answers of HOTS Type: (25 Questions)

Two-Mark Descriptive Questions with Answers (HOTS Type):

1. Kishor has five cards, and every card contains an odd number. Can their sum be 30? Explain.

Answer:

1. The sum of an odd number of odd numbers is always odd.
2. Therefore, five odd numbers cannot have the even sum 30.

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2. Martin and Maria are one year apart in age. Can the sum of their ages be 112? Why?

Answer:

1. Their ages are consecutive numbers, so one is even and the other is odd.
2. Their sum is always odd; hence it cannot be 112.

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3. Without multiplying, determine the parity of 27 × 13.

Answer:

1. Both 27 and 13 are odd numbers.
2. The product of two odd numbers is always odd.

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4. Without calculating, identify the parity of 42 × 78.
Answer:
1. Both factors are even numbers.
2. Therefore, the product is always even.

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5. If n is odd, determine the parity of 3n + 4.
Answer:
1. Multiplying an odd number by 3 gives an odd number.
2. Adding the even number 4 makes the expression odd.

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6. A 3 × 3 grid uses the numbers 1–9 without repetition. Can one row have a sum of 5?
Answer:
1. The smallest possible sum of three different numbers is 1 + 2 + 3 = 6.
2. Therefore, a row sum of 5 is impossible.

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7. Can a row in the same 3 × 3 grid have a sum of 26? Give a reason.
Answer:
1. The largest possible sum of three different numbers is 9 + 8 + 7 = 24.
2. Hence, a row sum of 26 cannot occur.

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8. Why must the magic sum of a 3 × 3 magic square using 1–9 be 15?
Answer:
1. The sum of all numbers from 1 to 9 is 45.
2. Since the three equal row sums total 45, each row must equal 15.

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9. Why must the centre of a 3 × 3 magic square contain 5?
Answer:
1. The chapter shows that numbers such as 1 and 9 cannot satisfy the required line sums when placed at the centre.
2. Therefore, the only possible centre number is 5.

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10. If the centre number of a generalised magic square is 25, find its magic sum.
Answer:
1. In a generalised 3 × 3 magic square, the magic sum equals 3 × centre number.
2. Therefore, the magic sum is 3 × 25 = 75.

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11. A magic square has magic sum 60. Find its centre number.
Answer:
1. The magic sum of a 3 × 3 square is 3m, where m is the centre number.
2. Hence, m = 60 ÷ 3 = 20.

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12. What happens to the magic sum when 1 is added to every entry of a magic square?
Answer:
1. Each row, column and diagonal receives an increase of 3 because each contains three numbers.
2. Thus, a magic sum of 15 becomes 18, and the grid remains a magic square.

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13. What happens when every number in a magic square is doubled?
Answer:

1. Every row, column and diagonal sum becomes twice its original value.
2. Therefore, the magic square remains valid and 15 becomes 30.

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14. Two consecutive Virahāṅka numbers are 987 and 1597. Find the next number.

Answer:

1. Each Virahāṅka number is obtained by adding the previous two numbers.
2. Therefore, the next number is 987 + 1597 = 2584.

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15. Two consecutive Virahāṅka numbers are 987 and 1597. Find the previous number.

Answer:

1. The previous term is found by subtracting the earlier number from the later number.
2. Therefore, the previous number is 1597 − 987 = 610.

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16. If there are 8 rhythms with 5 beats and 5 rhythms with 4 beats, how many rhythms are possible with 6 beats?

Answer:

1. The Virahāṅka rule states that the next value equals the sum of the previous two values.
2. Hence, 8 + 5 = 13 rhythms are possible with 6 beats.

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17. A person climbs an 8-step staircase by taking either 1 or 2 steps. How many different ways can they reach the top?

Answer:

1. The staircase follows the same recurrence as the Virahāṅka sequence.
2. Therefore, the number of different ways is 34.

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18. A light bulb is ON and its switch is toggled 77 times. What will be its final state?

Answer:

1. Every toggle changes the bulb from ON to OFF or OFF to ON.
2. Since 77 is odd, the bulb will finally be OFF.

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19. Lakpa has an odd number of ₹1 coins, an odd number of ₹5 coins and an even number of ₹10 coins. Can the total amount be ₹205?

Answer:

1. Odd + Odd + Even always gives an even total amount.
2. Therefore, the total ₹205 is impossible.

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20. In the height-arrangement activity, does a child saying 0 always mean that the child is the tallest?

Answer:

1. Saying 0 only means there is no taller child standing in front.
2. Therefore, it is only sometimes true that the child is the tallest.

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21. The first person in a height arrangement is shorter than everyone else. What number will the first person call out?

Answer:

1. The first person has nobody standing in front.
2. Therefore, the number called out is always 0.

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22. If 8 odd numbers are added together, what will be the parity of the result?

Answer:
1. An even number of odd numbers always produces an even sum.
2. Therefore, the result will be even.

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23. The Virahāṅka sequence begins 1, 2, 3, 5, 8, 13. Find the next two terms.

Answer:
1. Add 8 + 13 to obtain the next term 21.
2. Then add 13 + 21 to obtain 34.

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24. In the cryptarithm T + T + T = UT, determine T and UT.

Answer:
1. The digit satisfying the condition is T = 5.
2. Hence, 5 + 5 + 5 = 15, so UT = 15.

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25. Why are parity rules useful while solving number puzzles?

Answer:
1. Parity helps predict whether a result will be odd or even without complete calculation.
2. It is therefore useful for deciding whether many numerical situations are possible or impossible.

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6.9. Three-mark questions with Answers of LOTS Type: (24 Questions)

Three-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain the concept of parity and state the basic addition rules for odd and even numbers.

Answer:
1. **Parity** is the property of a number being either odd or even.
2. **Even + Even = Even** and **Odd + Odd = Even**.
3. **Even + Odd = Odd**.

2. Explain why the sum of two odd numbers is always even.

Answer:
1. An odd number can be viewed as a collection of pairs with **one element left over**.
2. When two odd numbers are added, their two leftover elements form **one additional pair**.
3. Hence, the complete collection can be arranged in pairs, so the sum is **even**.

3. Explain the parity of two consecutive counting numbers and their sum.

Answer:
1. Counting numbers alternate between **odd and even** numbers.
2. Therefore, among any two consecutive numbers, one is odd and the other is even.
3. Since **odd + even = odd**, the sum of two consecutive numbers is always odd.

4. Explain how to find the n^{th}even number and the n^{th}odd number.

Answer:
1. Multiply the position $n$by 2 to obtain the n^{th}even number: $2n$.
2. Subtract 1 from $2n$to obtain the corresponding odd number.
3. Therefore, the n^{th}odd number is $2n - 1$.

5. Find the 100th even number and the 100th odd number.

Answer:
1. The 100th even number is $2 \times 100 = 200$.
2. The 100th odd number is one less than the 100th even number.

3. Therefore, the 100th odd number is $200 - 1 = 199$.

6. Explain how parity can be determined for the number of small squares in a rectangular grid.

Answer:

1. The number of small squares is obtained from the product of the **number of rows and columns**.
2. If both dimensions are odd, the number of small squares is **odd**.
3. If at least one dimension is even, the number of small squares is **even**.

7. Explain the row and column sums in a 3 × 3 grid filled with the numbers 1–9.

Answer:

1. The numbers 1–9 are placed in the grid **without repetition**.
2. The circled numbers outside the grid represent the sums of the corresponding **rows and columns**.
3. These sums provide clues for determining the numbers to be placed in the grid.

8. Explain why a row or column sum in a 3 × 3 grid using 1–9 cannot be less than 6 or greater than 24.

Answer:

1. The smallest possible sum of three different numbers is $1 + 2 + 3 = 6$.
2. The largest possible sum of three different numbers is $9 + 8 + 7 = 24$.
3. Therefore, any row or column sum below 6 or above 24 is **impossible**.

9. Define a magic square and explain the meaning of magic sum.

Answer:

1. A **magic square** is a square grid of numbers arranged according to a special sum condition.
2. Every row, every column and every diagonal must have the **same sum**.
3. This common value is called the **magic sum**.

10. Show why the magic sum of a 3 × 3 magic square using 1–9 is 15.

Answer:

1. The total of the numbers is $1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 = 45$.
2. A magic square has three rows with equal sums.
3. Therefore, each row must have the sum $45 \div 3 = 15$, which is the magic sum.

11. State three observations about a 3 × 3 magic square made using the numbers 1–9.

Answer:

1. The **magic sum must be 15**.
2. The number at the **centre must be 5**.
3. The numbers **1 and 9 cannot occupy corner positions** and should occur in middle boundary positions.

12. Draw an example of a 3 × 3 magic square using the numbers 1–9 and verify one row, column and diagonal.

Answer:

2	7	6
9	5	1
4	3	8

1. First row: $2 + 7 + 6 = 15$.
2. First column: $2 + 9 + 4 = 15$.
3. Diagonal: $2 + 5 + 8 = 15$; hence the grid has magic sum **15**.

13. Describe the Chautīsā Yantra mentioned in the chapter.

Answer:

1. The **Chautīsā Yantra** is the first recorded 4 × 4 magic square discussed in the chapter.

2. It is found in a **10th-century inscription at the Pārśhvanath Jain temple in Khajuraho, India**.
3. Every row, column and diagonal in this magic square adds up to **34**.

14. Explain the formation of the Virahāṅka–Fibonacci sequence.

Answer:

1. The sequence begins as **1, 2, 3, 5, 8, 13, 21, 34, 55, ...**.
2. Each new term is obtained by adding the **two immediately preceding terms**.
3. For example, $8 + 13 = 21$, $13 + 21 = 34$, and $21 + 34 = 55$.

15. Explain how short and long syllables are related to the Virahāṅka numbers.

Answer:

1. In the poetry discussed in the chapter, a **short syllable takes one beat** and a **long syllable takes two beats**.
2. Different arrangements of short and long syllables produce different rhythms for a fixed number of beats.
3. The number of such rhythms follows the **Virahāṅka sequence**.

16. Explain how the number of 6-beat rhythms is obtained.

Answer:

1. There are **8** possible rhythms for 5 beats.
2. There are **5** possible rhythms for 4 beats.
3. Therefore, the number of 6-beat rhythms is $8 + 5 = 13$.

17. Give three historical facts about the Virahāṅka–Fibonacci numbers.

Answer:

1. **Virahāṅka** described the method for counting these poetic rhythms around **700 CE**.
2. Later Indian scholars such as **Gopala and Hemachandra** also wrote about these numbers.
3. Fibonacci wrote about the sequence in **1202 CE**, about 500 years after Virahāṅka.

18. Explain how Virahāṅka–Fibonacci numbers connect Art, Science and Mathematics.

Answer:

1. The numbers originated from mathematical questions related to **poetic rhythms**.
2. They are also connected with drumming, visual arts, architecture and several mathematical ideas.
3. They occur in nature too, and the chapter illustrates daisies having **13, 21 and 34 petals**.

19. What are cryptarithms? Explain using the example $T + T + T = UT$.

Answer:

1. **Cryptarithms or alphametics** are arithmetic puzzles in which digits are replaced by letters.
2. In $T + T + T = UT$, the value of $T = 5$.
3. Thus, $5 + 5 + 5 = 15$, so $UT = 15$.

20. Explain the rule followed in the height-arrangement activity.

Answer:

1. Children stand in a line in a particular **height arrangement**.
2. Each child counts how many children standing **in front are taller** than them.
3. The child calls out that count as their number; therefore, the first child always calls out **0**.

21. Explain why adding five odd numbers cannot give 30.

Answer:

1. Adding two odd numbers gives an **even number**.
2. Adding four odd numbers therefore gives an even number, and adding one more odd number makes the total **odd**.
3. Since **30 is even**, five odd numbers cannot add up to 30.

22. Explain what happens when every number in a 3 × 3 magic square is increased by 1.
Answer:
1. Each entry of every row, column and diagonal increases by **1**.
2. Since each line contains three entries, its sum increases by **3**.
3. Therefore, the grid remains a magic square, with its magic sum increased by **3**.

23. Explain what happens when every number in a magic square is doubled.
Answer:
1. Every entry in the magic square becomes **twice its original value**.
2. Consequently, every row, column and diagonal sum is also doubled.
3. Thus, the new grid remains a **magic square with twice the original magic sum**.

24. Explain the connection between an 8-step staircase problem and the Virahāṅka sequence.
Answer:
1. A person can reach each step by taking either a **1-step or a 2-step move**.
2. Hence, the number of ways to reach a step equals the sum of the ways of reaching the previous two steps.
3. This follows the Virahāṅka sequence, giving **34 different ways** to climb 8 steps.

6.10. Three-mark questions with Answers of HOTS Type: (24 Questions)

Three-Mark Descriptive Questions with Answers – HOTS Type:
1. Five odd-numbered cards are selected. Can their total be 30? Justify using parity.
Answer:
1. The sum of two odd numbers is **even**, so the sum of four odd numbers is also even.
2. Adding the fifth odd number to this even sum makes the final sum **odd**.
3. Since **30 is even**, five odd-numbered cards cannot have a total of 30.

2. Two people have consecutive ages. Can the sum of their ages be 112? Explain without trying different ages.
Answer:
1. Among two consecutive numbers, one is **even** and the other is **odd**.
2. The sum of an even number and an odd number is always **odd**.
3. Since **112 is even**, two consecutive ages cannot add up to 112.

3. Without performing complete multiplication, determine whether $135 \times 654$is odd or even.
Answer:
1. The number **135 is odd**, while **654 is even**.
2. A product containing an even factor is **even**.
3. Therefore, 135×654must be **even** without calculating its actual value.

4. If $n$is odd, determine the parity of $3n + 4$and justify your answer.
Answer:
1. Since $n$is odd and 3 is odd, $3n$is **odd**.
2. The number 4 is **even**.
3. Since odd + even = odd, $3n + 4$is **odd**.

5. A student claims that $4m - 1$can sometimes be even. Analyse the claim.
Answer:
1. For every whole number m, $4m$is **even** because it is divisible by 2.
2. Subtracting 1 from an even number produces an **odd number**.
3. Therefore, $4m - 1$is always odd, so the student's claim is **incorrect**.

6. A 3 × 3 grid is to be filled with the numbers 1–9 without repetition. Explain why a row sum of 5 is impossible.

Answer:

1. Every row must contain **three different numbers** from 1 to 9.
2. The three smallest available numbers give $1 + 2 + 3 = 6$.
3. Therefore, **6 is already the smallest possible row sum**, so a sum of 5 is impossible.

7. A student says that a row sum of 25 is possible in a 3 × 3 grid using 1–9 without repetition. Is the student correct?

Answer:

1. The three largest distinct numbers available are **9, 8 and 7**.
2. Their sum is $9 + 8 + 7 = 24$, which is the greatest possible sum of any row.
3. Therefore, a row sum of **25 is impossible**, and the student's claim is incorrect.

8. Prove that the magic sum of a 3 × 3 magic square containing 1–9 must be 15.

Answer:

1. The sum of all nine numbers is $1 + 2 + 3 + \cdots + 9 = 45$.
2. The three rows of a magic square have the **same sum** and together contain all nine numbers.
3. Therefore, each row must total $45 \div 3 = 15$, so the magic sum is 15.

9. In a 3 × 3 magic square using 1–9, a line contains 1 and 5. Find the third number and justify your answer.

Answer:

1. Every row, column and diagonal must have the magic sum **15**.
2. The known numbers give $1 + 5 = 6$.
3. Therefore, the missing number is $15 - 6 = 9$.

10. Why cannot 9 occupy the centre of a 3 × 3 magic square using 1–9?

Answer:

1. Every line through the centre must add up to the magic sum **15**.
2. If 9 is at the centre and 8 lies on a line through it, the third number would have to be $15 - 9 - 8 = -2$.
3. Since $-2$is not among the numbers 1–9, **9 cannot be the centre**.

11. The centre of a generalised 3 × 3 magic square is $\mathbf{25}$. Determine its magic sum.

Answer:

1. In the generalised pattern explored in the chapter, the magic sum is **three times the centre value**.
2. Thus, magic sum $= 3 \times 25$.
3. Therefore, the required magic sum is **75**.

12. A 3 × 3 magic square has a magic sum of 60. Determine its centre number.

Answer:

1. For the generalised 3 × 3 magic-square pattern, the magic sum is $3m$, where $m$is the centre.
2. Hence, $3m = 60$, giving $m = 60 \div 3$.
3. Therefore, the centre number is **20**.

13. A 3 × 3 magic square has magic sum 15. If 1 is added to every entry, will it remain a magic square? Find its new magic sum.

Answer:

1. Every row, column and diagonal contains **three entries**, each increased by 1.
2. Therefore, each common sum increases by $1 + 1 + 1 = 3$.
3. Hence, it remains a magic square and its new magic sum is $15 + 3 = 18$.

14. Every entry of a magic square with magic sum 15 is doubled. Analyse the resulting square.

Answer:

1. Doubling every entry doubles the sum of every row, column and diagonal.

2. Since all these sums were equal originally, they **remain equal after doubling**.
3. Therefore, the new grid is also a magic square with magic sum $2 \times 15 = 30$.

15. The consecutive Virahāṅka numbers 987 and 1597 are given. Find both the preceding and succeeding terms.

Answer:

1. The preceding term is $1597 - 987 = 610$.
2. The succeeding term is $987 + 1597 = 2584$.
3. Thus, the four consecutive terms are **610, 987, 1597, 2584**.

16. Use the Virahāṅka rule to determine the number of possible 7-beat rhythms.

Answer:

1. The numbers of 5-beat and 6-beat rhythms are **8 and 13**, respectively.
2. The next number is obtained by adding the previous two: $8 + 13 = 21$.
3. Therefore, there are **21 possible 7-beat rhythms**.

17. A child can climb a staircase by taking either one or two steps at a time. Explain why the number of ways follows the Virahāṅka sequence.

Answer:

1. To reach a particular step, the child's final move must come from either **one step below or two steps below**.
2. Therefore, the number of ways to reach that step equals the **sum of the numbers of ways to reach the previous two steps**.
3. This is exactly the recurrence rule of the **Virahāṅka sequence**, giving 34 ways for an 8-step staircase.

18. A bulb is initially ON and is toggled 77 times. Determine its final state using parity.

Answer:

1. Each toggle reverses the state of the bulb: **ON** → **OFF** or **OFF** → **ON**.
2. An even number of toggles restores the original state, while an odd number reverses it.
3. Since 77 is odd, the bulb that started ON will finally be **OFF**.

19. A child in the height-arrangement activity calls out 0. Can you conclude that the child is the tallest in the group?

Answer:

1. Calling out 0 means that **no child standing in front is taller** than that child.
2. A taller child may still be standing **behind** the child.
3. Therefore, calling out 0 does **not necessarily mean** that the child is the tallest in the whole group.

20. In a group of eight children, what is the greatest number that any child can call out in the height-arrangement activity? Explain.

Answer:

1. A child can count only the children who are **standing in front** and are taller.
2. At most, the last child can have all the other **seven children** standing in front.
3. Therefore, the greatest possible number that can be called out is **7**.

21. In the cryptarithm $T + T + T = UT$, determine the value of $T$and explain your reasoning.

Answer:

1. The result $UT$is a two-digit number whose units digit is the same digit **T**.
2. Testing the required digit condition gives $5 + 5 + 5 = 15$, whose units digit is again 5.
3. Therefore, $T = 5$, $U = 1$, **and** $UT = 15$.

22. The Virahāṅka sequence begins $1, 2, 3, 5, 8, 13, \ldots.$ Analyse the parity pattern and predict the parity of the next three terms.

Answer:

1. The parity pattern begins **odd, even, odd, odd, even, odd**, showing a repeating cycle of odd-even-odd.
2. The next three terms are 21,34,55.
3. Hence, their parities are **odd, even and odd**, respectively.

23. Eight odd numbers are added together. Determine the parity of the sum without adding the actual numbers.

Answer:

1. Two odd numbers added together produce an **even** number.
2. Eight odd numbers can be grouped into **four pairs**, each having an even sum.
3. The sum of four even numbers is even; therefore, the final result is **even**.

24. A student claims that every number appearing in the Virahāṅka sequence is odd. Evaluate the claim.

Answer:

1. The sequence begins **1, 2, 3, 5, 8, 13, 21, 34, ...**.
2. It contains even numbers such as **2, 8 and 34**, along with odd numbers.
3. Therefore, the claim is **false** because the sequence contains both odd and even numbers.

6.11 Five-mark questions with Answers of LOTS Type: (12 Questions)

Five-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain parity and the basic rules for addition of even and odd numbers.

Answer:

1. **Parity** tells whether a number is **even or odd**.
2. An even number can be arranged completely in pairs, whereas an odd number leaves one element unpaired.
3. The sum of two even numbers is always even: **Even + Even = Even**.
4. The sum of two odd numbers is always even: **Odd + Odd = Even**.
5. The sum of an even and an odd number is always odd: **Even + Odd = Odd**.

2. Explain how the n^{th}even and n^{th}odd numbers can be represented algebraically.

Answer:

1. The sequence of even numbers is **2, 4, 6, 8, 10, ...**.
2. Every even number is twice a counting number, so the n^{th}even number is $2n$.
3. The sequence of odd numbers is **1, 3, 5, 7, 9, ...**.
4. Every odd number is one less than the corresponding even number, so the n^{th}odd number is $2n - 1$.
5. For example, the 100th even number is **200**, while the 100th odd number is **199**.

3. Explain the important features of a 3 × 3 magic square formed using the numbers 1–9.

Answer:

1. A magic square has the same sum along every **row, column and diagonal**.
2. The numbers from 1 to 9 have a total sum of **45**.
3. Since there are three equal row sums, the magic sum is $45 \div 3 = 15$.
4. The number at the centre of such a magic square must be **5**.
5. The numbers **1 and 9 cannot occupy the corners** and must occur at middle positions on the boundary.

4. Explain why the possible row or column sums of a 3 × 3 grid containing 1–9 without repetition are restricted.

Answer:

1. Each row or column contains **three different numbers** selected from 1 to 9.
2. The three smallest numbers are 1, 2 and 3, whose sum is $1 + 2 + 3 = 6$.
3. Therefore, a row or column sum **smaller than 6 is impossible**.

4. The three largest numbers are 9, 8 and 7, whose sum is $9 + 8 + 7 = 24$.
5. Therefore, a row or column sum **greater than 24 is impossible**.

5. Describe the Chautīsā Yantra and the historical development of magic squares mentioned in the chapter.

Answer:

1. The **Chautīsā Yantra** is a famous 4 × 4 magic square discussed in the chapter.
2. It appears in a **10th-century inscription at the Pārśhvanath Jain temple in Khajuraho**.
3. Every row, column and diagonal of the Chautīsā Yantra has the magic sum **34**.
4. The chapter also discusses the ancient Chinese **Lo Shu** magic square, recorded more than 2000 years ago.
5. Magic squares were subsequently studied in places such as **India, Japan, Central Asia and Europe**, with several larger magic-square traditions developing in India.

6. Explain the Virahāṅka–Fibonacci sequence and its rule of formation.

Answer:

1. The sequence begins **1, 2, 3, 5, 8, 13, 21, 34, 55, ...**.
2. Each term after the first two is obtained by **adding the previous two terms**.
3. Thus, $1 + 2 = 3$, $2 + 3 = 5$, and $3 + 5 = 8$.
4. Similarly, $8 + 13 = 21$, $13 + 21 = 34$, and $21 + 34 = 55$.
5. Continuing the same rule, the term after 55 is $34 + 55 = 89$.

7. Explain how the Virahāṅka numbers originated from the study of poetic rhythms.

Answer:

1. In the poetic traditions described in the chapter, syllables can be **short or long**.
2. A short syllable takes **one beat**, while a long syllable takes **two beats**.
3. Different combinations of one-beat and two-beat syllables produce different rhythms of a given length.
4. The numbers of possible rhythms for successive beat lengths are **1, 2, 3, 5, 8, 13, ...**.
5. Thus, counting poetic rhythms leads naturally to the **Virahāṅka sequence**.

8. Describe the historical development of the Virahāṅka numbers as presented in the chapter.

Answer:

1. The sequence arose from the study of combinations of short and long syllables in **Indian poetry**.
2. **Virahāṅka**, around 700 CE, explicitly described the rule for obtaining these numbers, building on earlier work associated with **Piṅgala**.
3. **Gopala**, around 1135 CE, later discussed these numbers and their formation.
4. **Hemachandra**, around 1150 CE, also described this sequence in connection with poetic metres.
5. **Fibonacci** wrote about the same sequence in 1202 CE, about 500 years after Virahāṅka.

9. Explain how the Virahāṅka–Fibonacci numbers connect Mathematics, Art, Science and Nature.

Answer:

1. The sequence has its origins in the mathematical study of **poetic rhythms**.
2. Its patterns are also connected with **drumming and other rhythmic arrangements**.
3. The chapter mentions connections with **visual arts and architecture**.
4. Similar number patterns can also be observed in **nature**.
5. For example, the chapter illustrates flowers with **13, 21 and 34 petals**, which are Virahāṅka–Fibonacci numbers.

10. Explain cryptarithms (alphametics) using the example $\boldsymbol{T + T + T = UT}$.

Answer:

1. A **cryptarithm or alphametic** is an arithmetic puzzle in which digits are represented by letters.
2. Each letter represents a particular digit from **0 to 9**.
3. In $T + T + T = UT$, the same digit $T$is added three times.
4. The value satisfying the puzzle is $T = 5$because $5 + 5 + 5 = 15$.
5. Therefore, $T = 5$**,** $U = 1$**, and** $UT = 15$.

11. Explain the height-arrangement number activity described in the chapter.
Answer:

1. A group of children stands in a line, with children of different heights occupying different positions.
2. Each child observes only the children **standing in front** of them.
3. The child counts how many of those children are **taller than them**.
4. The number obtained is the number that the child **calls out**.
5. Since nobody stands in front of the first child, the first child always calls out **0**.

12. Explain how the number of possible poetic rhythms follows the Virahāṅka rule.
Answer:

1. A rhythm of $n$beats can end either with a **one-beat short syllable** or a **two-beat long syllable**.
2. If it ends with a one-beat syllable, the preceding part has $n - 1$beats.
3. If it ends with a two-beat syllable, the preceding part has $n - 2$beats.
4. Therefore, the number of n-beat rhythms equals the number of $(n - 1)$-beat rhythms plus the number of $(n - 2)$-beat rhythms.
5. For example, the number of 6-beat rhythms is $8 + 5 = 13$, following the Virahāṅka rule.

6.12 Five-mark questions with Answers of HOTS Type: (15 Questions)

Five-Mark Descriptive Questions with Answers – HOTS Type:
1. Five boxes are to be filled with odd-numbered cards. Analyse whether the five numbers can have a total of 30.
Answer:

1. The sum of **two odd numbers is even**.
2. Therefore, the sum of the first four odd numbers, grouped into two pairs, is even.
3. Adding the fifth odd number to this even sum produces an **odd number**.
4. Hence, the sum of any five odd numbers must always be **odd**.
5. Since **30 is even**, it is impossible to fill all five boxes with odd-numbered cards whose total is 30.

2. Two people are exactly one year apart in age. A student claims that the sum of their ages can be 112. Analyse the claim using parity.
Answer:

1. Two people who are one year apart have **consecutive whole-number ages**.
2. Among two consecutive numbers, one number is even and the other is odd.
3. The sum of an **even number and an odd number is always odd**.
4. Therefore, the sum of the two ages must be an odd number.
5. Since **112 is even**, the student's claim is impossible.

3. A student says that the sum of a row in a 3 × 3 grid containing the numbers 1–9 without repetition can be 25. Evaluate the claim.
Answer:

1. Each row contains **three different numbers** chosen from 1 to 9.
2. To obtain the greatest possible sum, we must choose the three largest numbers.

3. These numbers are **9, 8 and 7**.
4. Their sum is $9 + 8 + 7 = 24$, which is the maximum possible row sum.
5. Therefore, a row sum of **25 is impossible**, and the student's claim is incorrect.

4. Prove that the magic sum of a 3 × 3 magic square using the numbers 1–9 must be 15.

Answer:

1. The sum of all the numbers from 1 to 9 is **45**.
2. The three rows together contain all nine numbers exactly once.
3. In a magic square, the sums of all three rows must be **equal**.
4. Therefore, each row must have the sum $45 \div 3 = 15$.
5. Hence, every row, column and diagonal must have the common **magic sum 15**.

5. Explain through reasoning why 5 must occupy the centre of a 3 × 3 magic square using 1–9.

Answer:

1. The magic sum of the square is **15**, and the centre number belongs to a row, a column and both diagonals.
2. Therefore, the centre must work with several different pairs of numbers whose three-number totals are 15.
3. Extreme numbers such as **1 and 9 cannot satisfy all these required combinations** when placed at the centre.
4. By examining the possible centre values, the chapter shows that **5 is the value that satisfies all the required line sums**.
5. Hence, **5 must occupy the centre** of a 3 × 3 magic square formed using 1–9.

6. A 3 × 3 magic square has magic sum 15. If 1 is added to every number, analyse whether it remains a magic square.

Answer:

1. Each row, column and diagonal contains **three numbers**.
2. Adding 1 to every entry increases each line sum by $1 + 1 + 1 = 3$.
3. Therefore, every row sum changes from 15 to $15 + 3 = 18$.
4. Every column and diagonal also changes to **18**, so all the required sums remain equal.
5. Hence, the transformed grid **remains a magic square**, with new magic sum 18.

7. Every entry of a 3 × 3 magic square with magic sum 15 is doubled. Predict and justify the result.

Answer:

1. Doubling every entry means multiplying every number in the square by **2**.
2. Therefore, the sum of every row is also multiplied by 2.
3. The same happens to every column and diagonal because each of their entries is doubled.
4. The new common sum becomes $15 \times 2 = 30$.
5. Hence, the resulting arrangement is still a **magic square**, now having magic sum 30.

8. A generalised 3 × 3 magic square has 25 at its centre. Determine its magic sum using the pattern explored in the chapter.

Answer:

1. Let the centre number of the generalised magic square be represented by m.
2. The pattern explored in the chapter leads to a common line sum of $3m$.
3. Here, the centre number is $m = 25$.
4. Therefore, the magic sum is $3 \times 25 = 75$.
5. Hence, every row, column and diagonal of such a square must have the common sum **75**.

9. A generalised 3 × 3 magic square has a magic sum of 60. Determine its centre number and justify your answer.

Answer:

1. In the generalised pattern, the magic sum is **three times the centre number**.
2. Let the centre number be m; then $3m = 60$.
3. Dividing both sides by 3 gives $m = 60 \div 3$.
4. Therefore, $m = 20$.
5. Hence, a 3 × 3 magic square with magic sum 60 has **20 at its centre**.

10. Two consecutive Virahāṅka numbers are 987 and 1597. Determine the number immediately before 987 and the number immediately after 1597.

Answer:

1. In the Virahāṅka sequence, every term is the **sum of the previous two terms**.
2. Therefore, the term before 987 is found from $1597 - 987$.
3. This gives the previous term as **610**.
4. The term after 1597 is $987 + 1597 = 2584$.
5. Hence, the four consecutive terms are **610, 987, 1597 and 2584**.

11. Explain why the number of ways of climbing a staircase using only 1-step and 2-step moves follows the Virahāṅka sequence.

Answer:

1. To reach any particular step, the final move must be either a **1-step move or a 2-step move**.
2. A 1-step final move comes from the immediately preceding step.
3. A 2-step final move comes from the step two positions below.
4. Hence, the number of ways to reach a step equals the **sum of the numbers of ways to reach the previous two steps**.
5. This is the Virahāṅka recurrence rule, and therefore an **8-step staircase has 34 possible ways**.

12. A bulb is initially ON and its switch is toggled 77 times. Analyse its final state using parity.

Answer:

1. One toggle changes the bulb from **ON to OFF**.
2. A second toggle changes it back from **OFF to ON**.
3. Thus, every pair of toggles returns the bulb to its original state.
4. Since 77 is odd, it consists of **38 pairs of toggles and one extra toggle**.
5. Therefore, the extra toggle changes the initially ON bulb to **OFF**.

13. A child calls out 0 in the height-arrangement activity. Analyse whether this proves that the child is the tallest in the group.

Answer:

1. A child calls out the number of **taller children standing in front** of them.
2. Calling out 0 means that no child standing in front is taller.
3. However, the rule gives no information about the heights of children **standing behind** that child.
4. A taller child may therefore still be present later in the line.
5. Hence, calling out **0 does not necessarily prove that the child is the tallest in the entire group**.

14. Analyse the parity pattern in the Virahāṅka sequence $1, 2, 3, 5, 8, 13, 21, 34, \ldots$.

Answer:

1. The parities of the first terms are **odd, even, odd, odd, even, odd, odd, even, ...**
2. Adding odd + even produces odd, while adding odd + odd produces even.
3. Therefore, the recurrence naturally creates the repeating parity pattern **odd, even, odd**.
4. Consequently, the even terms occur at every **third position beginning with the second term**.

5. Thus, the parity pattern can be predicted without calculating every Virahāṅka number.

15. Solve the cryptarithm $T + T + T = UT$ and explain why the solution works.

Answer:

1. The same digit T is added three times, so the left side equals $3T$.
2. The result UT is a two-digit number whose units digit is also **T**.
3. The digit 5 satisfies this condition because $3 \times 5 = 15$.
4. Therefore, the units digit is $T = 5$ and the tens digit is $U = 1$.
5. Hence, the solution is $T = 5, U = 1$ because $5 + 5 + 5 = 15$.

6.13 Five-mark questions with Answers of Applied Type: (12 Questions)

Five-Mark Descriptive Questions with Answers – Applied Type:

1. During a school activity, five students each pick a card containing an odd number. Their teacher asks them to make a total of 50. Determine whether this is possible using parity.

Answer:

1. Each of the five selected numbers is **odd**.
2. The sum of two odd numbers is **even**.
3. Therefore, four odd numbers can be grouped into two pairs, giving an even total.
4. Adding the fifth odd number to this even total makes the final sum **odd**.
5. Since **50 is even**, five odd-numbered cards cannot have a total of 50.

2. A school garden has 27 rows with 15 plants in each row. Without calculating the exact number of plants, determine whether the total number of plants is odd or even.

Answer:

1. The number of rows, **27, is odd**.
2. The number of plants in each row, **15, is also odd**.
3. The total number of plants is represented by 27×15.
4. The product of two odd numbers is always **odd**.
5. Therefore, the school garden contains an **odd number of plants**.

3. A classroom floor is arranged in 18 rows and 25 columns of square tiles. Determine the parity of the total number of tiles without finding the exact product.

Answer:

1. The total number of tiles is represented by 18×25.
2. The number **18 is even**, while 25 is odd.
3. A product having at least one even factor is **even**.
4. Therefore, 18×25 must be an even number.
5. Hence, the classroom floor contains an **even number of tiles**.

4. A decorative 3 × 3 number board is to be made using the numbers 1–9 exactly once, with every row, column and diagonal having the same sum. Find the required common sum.

Answer:

1. The sum of the numbers from 1 to 9 is **45**.
2. The board contains three rows, and each number occurs exactly once.
3. Since it is a magic square, all three rows must have the **same sum**.
4. Therefore, the common sum is $45 \div 3 = 15$.
5. Hence, every row, column and diagonal of the number board must have the **magic sum 15**.

5. A student designs a 3 × 3 magic-square poster using the numbers 1–9 and places 5 at the centre. If one line contains 1 and 5, find the third number needed to complete that line.

Answer:

1. A 3×3 magic square using 1–9 has a magic sum of **15**.
2. The two known numbers in the line are **1 and 5**.
3. Their sum is $1 + 5 = 6$.
4. The missing number is $15 - 6 = 9$.
5. Therefore, the completed line is **1, 5, 9**, whose sum is 15.

6. An artist uses a 3 × 3 magic square having magic sum 15 and adds 4 to every number to create a new design. Find the new magic sum and explain whether the design remains a magic square.

Answer:

1. Each row, column and diagonal contains **three numbers**.
2. Adding 4 to every number increases each line sum by $4 + 4 + 4 = 12$.
3. Therefore, the new magic sum is $15 + 12 = 27$.
4. Every row, column and diagonal increases by exactly the same amount.
5. Hence, the new design **remains a magic square**, with magic sum **27**.

7. A game designer creates a generalised 3 × 3 magic square with 40 at the centre. Using the pattern studied in the chapter, determine its magic sum.

Answer:

1. Let the centre number of the generalised magic square be m.
2. The pattern explored in the chapter gives the magic sum as $3m$.
3. Here, $m = 40$.
4. Therefore, the magic sum is $3 \times 40 = 120$.
5. Hence, every row, column and diagonal of the designed magic square must total **120**.

8. A drummer is creating rhythmic patterns using short sounds of 1 beat and long sounds of 2 beats. If there are 8 patterns for 5 beats and 13 patterns for 6 beats, how many patterns are possible for 7 beats?

Answer:

1. The number of rhythmic patterns follows the **Virahāṅka sequence**.
2. Each new number is obtained by adding the previous two numbers.
3. The numbers of patterns for 5 and 6 beats are **8 and 13**, respectively.
4. Therefore, the number of 7-beat patterns is $8 + 13 = 21$.
5. Hence, the drummer can create **21 different 7-beat rhythmic patterns**.

9. A staircase has 8 steps. A child can climb either 1 step or 2 steps at a time. Determine the number of different ways the child can reach the top.

Answer:

1. To reach any step, the child's last move can be either a **1-step move or a 2-step move**.
2. Therefore, the number of ways to reach a step equals the sum of the ways of reaching the previous two steps.
3. This produces the Virahāṅka pattern **1, 2, 3, 5, 8, 13, 21, 34**.
4. The value corresponding to 8 steps is **34**.
5. Hence, the child can climb the 8-step staircase in **34 different ways**.

10. A decorative lamp is initially ON. During a programme, its switch is toggled 77 times. Determine whether the lamp will finally be ON or OFF.

Answer:

1. Every toggle changes the lamp from **ON to OFF or OFF to ON**.
2. Two toggles together return the lamp to its original state.
3. The first 76 toggles form **38 pairs**, so the lamp is ON after them.
4. The 77th toggle changes the lamp once more from ON to OFF.
5. Therefore, after 77 toggles, the lamp will finally be **OFF**.

11. Eight students stand in a queue for a height-based game. The last student is shorter than all seven students standing in front. What number will the last student call out? Explain.

Answer:

1. In the activity, each student counts the number of **taller students standing in front**.
2. The last student has seven students standing in front.
3. According to the situation, all seven are taller than the last student.
4. Therefore, the number of taller students in front is **7**.
5. Hence, the last student will call out **7**, which is also the largest possible call-out in a group of eight.

12. A puzzle uses the cryptarithm $T + T + T = UT$. Find the digits represented by $T$and U.

Answer:

1. Since the same digit $T$is added three times, the left side is $3T$.
2. The answer UTmust be a two-digit number ending with the same digit T.
3. Taking $T = 5$gives $5 + 5 + 5 = 15$.
4. Thus, the units digit is **5** and the tens digit is **1**.
5. Therefore, $T = 5$**,** $U = 1$**, and** $UT = 15$.

6.14 Multiple Choice Questions with answers for Olympiad type Competitive Exams: (20 MCQs of LOTS & 20 MCQs of HOTS Type)

Olympiad-Type Multiple Choice Questions:

Below are **30 MCQs** based on the concepts of parity, number patterns, grids, magic squares, Virahāṅka–Fibonacci numbers, and cryptarithms from the uploaded chapter.

1. Which of the following sums must always be odd?

A. Even + Even

B. Odd + Odd

C. Even + Odd

D. Even + Even + Even

Answer: C. Even + Odd

2. Five odd numbers are added together. Their sum must be:

A. Even

B. Odd

C. Zero

D. A multiple of 10

Answer: B. Odd

3. Which of the following cannot be the sum of five odd numbers?

A. 25

B. 35

C. 47

D. 50

Answer: D. 50

4. If $n$is a counting number, which expression always represents an even number?

A. $2n$

B. $2n - 1$

C. $2n + 1$

D. $3n + 1$

Answer: A. $2n$

5. Which expression represents the n^{th}odd number?

A. $n+1$
B. $2n$
C. $2n-1$
D. $3n-1$
Answer: C. $2n-1$
6. The 125th odd number is:
A. 249
B. 250
C. 251
D. 247
Answer: A. 249
Reason: $2(125)-1=249$.
7. Two consecutive counting numbers are added. Their sum is always:
A. Even
B. Odd
C. Prime
D. Divisible by 4
Answer: B. Odd
8. Without multiplying, determine the parity of $\mathbf{157 \times 243}$.
A. Even
B. Odd
C. Zero
D. Cannot be determined
Answer: B. Odd
Reason: Both factors are odd.
9. Without calculating the product, which of the following is certainly even?
A. 31×17
B. 43×55
C. 27×62
D. 19×71
Answer: C. 27×62
10. If $\boldsymbol{n}$is odd, which of the following is necessarily odd?
A. $2n$
B. $4n$
C. $3n+4$
D. $n+1$
Answer: C. $3n+4$
11. In a 3 × 3 grid containing the numbers 1–9 without repetition, what is the smallest possible sum of three numbers in a row?
A. 3
B. 5
C. 6
D. 9
Answer: C. 6
Reason: $1+2+3=6$.
12. What is the largest possible sum of three different numbers chosen from 1–9?
A. 21
B. 23
C. 24
D. 27

Answer: C. 24
Reason: $9 + 8 + 7 = 24.$
13. Which of the following cannot be a row sum in a 3 × 3 grid using 1–9 without repetition?
A. 10
B. 15
C. 22
D. 25
Answer: D. 25
14. The sum of all the numbers from 1 to 9 is:
A. 36
B. 40
C. 45
D. 54
Answer: C. 45
15. A 3 × 3 magic square is formed using the numbers 1–9 exactly once. Its magic sum must be:
A. 9
B. 12
C. 15
D. 18
Answer: C. 15
16. Which number must occupy the centre of a 3 × 3 magic square using 1–9?
A. 1
B. 3
C. 5
D. 9
Answer: C. 5
17. In a 3 × 3 magic square using 1–9, a line contains 2 and 5. What must be the third number?
A. 6
B. 7
C. 8
D. 9
Answer: C. 8
Reason: $15 - (2 + 5) = 8.$
18. In a 3 × 3 magic square using 1–9, which pair cannot occupy corner positions?
A. 2 and 4
B. 4 and 6
C. 6 and 8
D. 1 and 9
Answer: D. 1 and 9
19. A 3 × 3 magic square has magic sum 15. If 2 is added to every entry, its new magic sum is:
A. 17
B. 19
C. 21
D. 30
Answer: C. 21

Reason: Each line contains three entries, so the sum increases by $3 \times 2 = 6$; hence $15 + 6 = 21$.
20. Every entry of a magic square with magic sum 15 is tripled. What is the new magic sum?
A. 18
B. 30
C. 45
D. 60
Answer: C. 45
21. A generalised 3 × 3 magic square has 30 at its centre. What is its magic sum?
A. 30
B. 60
C. 90
D. 120
Answer: C. 90
Reason: Magic sum $= 3 \times 30 = 90$.
22. The Chautīsā Yantra discussed in the chapter has a magic sum of:
A. 15
B. 21
C. 34
D. 45
Answer: C. 34
23. Consider the Virahāṅka sequence:

$$1, 2, 3, 5, 8, 13, 21, \square$$

What number replaces the square?
A. 29
B. 32
C. 34
D. 35
Answer: C. 34
24. Which number comes immediately after 89 in the Virahāṅka sequence?
A. 123
B. 134
C. 144
D. 155
Answer: C. 144
Reason: $55 + 89 = 144$.
25. If 987 and 1597 are consecutive Virahāṅka numbers, what is the next number?
A. 1974
B. 2484
C. 2584
D. 2684
Answer: C. 2584
Reason: $987 + 1597 = 2584$.
26. If 987 and 1597 are consecutive Virahāṅka numbers, what is the number immediately before 987?
A. 510
B. 600
C. 610
D. 620

Answer: C. 610
Reason: $1597 - 987 = 610$.
27. A child can climb an 8-step staircase by taking either one step or two steps at a time. How many different ways are possible?
A. 21
B. 28
C. 34
D. 55
Answer: C. 34
28. A bulb is initially ON. Its switch is toggled 77 times. What is its final state?
A. ON
B. OFF
C. It flashes continuously
D. Cannot be determined
Answer: B. OFF
Reason: An odd number of toggles reverses the initial state.
29. In the cryptarithm

$$T + T + T = UT$$

what is the value of T?
A. 3
B. 4
C. 5
D. 6
Answer: C. 5
Reason: $5 + 5 + 5 = 15$, so $T = 5$and $U = 1$.
30. Eight children stand in a line. Each child calls out the number of taller children standing in front. What is the greatest possible number any child can call out?
A. 6
B. 7
C. 8
D. 9
Answer: B. 7
Reason: The last child can have at most seven taller children standing in front.

6.15 Best Practices Opportunity List from the Chapter: (10 Ideas)

"Best Practices" Opportunities While Teaching Chapter 6 – Number Play:
The following practices align with the chapter's emphasis on **number arrangements, parity, grids and magic squares, Virahāṅka–Fibonacci numbers, and cryptarithms**.

(1) **Activity-Based Learning for Parity:** Use counters, buttons, cards, or students themselves to form pairs and visually demonstrate **odd and even numbers** before introducing parity rules such as Even + Even = Even and Odd + Odd = Even.

(2) **Human Height-Arrangement Activity:** Recreate the chapter's activity by arranging students in a line and asking each student to count the number of **taller students standing in front**; then record the resulting number sequence and discuss what information it conveys.

(3) **Predict–Test–Explain Strategy:** Before calculating, ask students to predict whether a sum, difference, or product will be **odd or even**, test their prediction with examples, and finally explain the general parity rule. This encourages reasoning rather than mechanical calculation.

(4) **Hands-on Number-Card Challenges:** Give groups number cards and challenges such as selecting odd numbers to obtain a particular target sum; students should first use **parity reasoning** to decide whether the task is possible.
(5) **Grid Puzzle Learning:** Provide partially completed 3 × 3 grids and ask students to use the given **row and column sums** to determine missing entries. Encourage students to explain the reasoning behind each placement.
(6) **Magic-Square Exploration:** Let students construct 3 × 3 magic squares using the numbers **1–9**, discover that the magic sum is 15, and investigate why **5 occupies the centre**.
(7) **"Possible or Impossible?" Classroom Discussion:** Present statements such as "A row using three different numbers from 1–9 can have sum 25" and ask students to justify whether they are possible; this develops logical reasoning using minimum and maximum values.
(8) **Explore Transformations of Magic Squares:** Ask students what happens when the same number is added to every entry or every entry is multiplied by the same number; let them verify whether the resulting arrangement remains a magic square.
(9) **Connect Mathematics with Indian Knowledge Traditions:** Introduce the **Chautīsā Yantra** and the historical discussion of magic squares to show students how mathematical recreation and number patterns have been explored across cultures and historical periods.
(10) **Discover the Virahāṅka Sequence Through Rhythm:** Instead of giving the sequence directly, use combinations of **one-beat short syllables and two-beat long syllables** and allow students to count possible rhythms for successive numbers of beats.
(11) **Pattern Discovery Before Formula:** Display **1, 2, 3, 5, 8, 13, 21, 34, ...** and ask students to discover the rule themselves before stating that each term is the sum of the preceding two terms.
(12) **Cross-Curricular Connections:** Use the Virahāṅka numbers to connect mathematics with **poetry, rhythm, drumming, visual arts, architecture, science and patterns in nature**, helping students see mathematics beyond textbook calculations.
(13) **Cryptarithm Puzzle Sessions:** Use puzzles such as $T + T + T = UT$as short classroom challenges where students test possibilities systematically and justify why a particular digit works.
(14) **Think–Pair–Share for Number Puzzles:** First allow each student to attempt a parity, grid, magic-square, or cryptarithm problem independently; then let pairs compare strategies before discussing solutions with the whole class.
(15) **Maintain a "Number Play Journal":** Ask students to record newly discovered **patterns, parity rules, magic-square observations, Virahāṅka sequences, and puzzle-solving strategies** in their own words, ending each lesson with one observation and one self-created puzzle.

6.16 Innovations Opportunity List from the Chapter: (10 Ideas)

"Innovations" Opportunities While Teaching Chapter 6 – Number Play to Grade 7 Students:
The chapter offers strong opportunities for innovative learning through **parity, number sequences, grids, magic squares, Virahāṅka–Fibonacci numbers, rhythms, and cryptarithms**.
(1) **Parity Detective Game:** Create a classroom "Number Detective" challenge where students receive mystery situations and must identify whether the answer is **odd or**

even without actually calculating it. Students earn points not just for the correct answer but for explaining the parity rule used.

(2) **Human Number-Sequence Simulation:** Turn the height-arrangement problem into a live simulation by arranging students in different height orders and recording the numbers they call out. Groups can then challenge one another to reconstruct or interpret arrangements from the resulting sequences.

(3) **Digital Magic-Square Laboratory:** Let students use a spreadsheet or simple interactive grid to experiment with 3 × 3 magic squares. They can test different arrangements of 1–9, investigate why the magic sum is **15**, and explore what happens when every entry is increased or multiplied by the same value.

(4) **Design-Your-Own Magic Square Art:** Combine **Mathematics and Art** by asking students to create colourful magic-square posters, rangoli-style patterns, or geometric artwork based on number grids. They should label the magic sum and demonstrate that rows, columns and diagonals satisfy the required condition.

(5) **Virahāṅka Rhythm Lab:** Convert the Virahāṅka sequence into a **clapping, drumming or percussion activity**, representing short syllables by one beat and long syllables by two beats. Students can create all possible rhythms for a selected number of beats and discover how the sequence emerges naturally.

(6) **Mathematics–History Digital Story:** Ask student teams to prepare a short digital story or timeline featuring **Piṅgala, Virahāṅka, Gopala, Hemachandra and Fibonacci**, highlighting the development of the number sequence discussed in the chapter.

(7) **Nature Pattern Investigation:** Students can photograph or sketch flowers, leaves and other natural objects and compare observed counts or arrangements with the **Virahāṅka–Fibonacci sequence**. The chapter's examples of flowers with 13, 21 and 34 petals can serve as the starting point for the investigation.

(8) **Cryptarithm Escape Room:** Create an age-appropriate classroom "Math Escape Room" where solving cryptarithms unlocks successive clues. Begin with puzzles similar to $T + T + T = UT$ and gradually introduce more challenging letter-digit puzzles from the chapter.

(9) **Student-Created Number Puzzle Studio:** After solving parity, grid, magic-square and cryptarithm problems, ask groups to **design their own puzzles**, exchange them with other groups, solve them, and provide peer feedback on whether each puzzle has sufficient clues.

(10) **Staircase Simulation of Virahāṅka Numbers:** Construct a paper or floor model of a staircase and ask students to investigate how many ways a person can reach the top by taking **one or two steps at a time**. Students can compare the resulting numbers with the Virahāṅka sequence and explain the connection.

(11) **"Impossible or Possible?" QR Challenge:** Place QR-coded or station-based challenges around the classroom containing statements such as possible grid sums, parity claims, or number arrangements. Students rotate in teams, classify each as **possible or impossible**, and record mathematical justification. The chapter explicitly develops this type of reasoning with grid sums and parity.

(12) **Number Play Learning Stations:** Organise the classroom into rotating stations—**Parity Station, Grid Station, Magic Square Station, Virahāṅka Rhythm Station, and Cryptarithm Station**. Each station can contain a hands-on task, a reasoning challenge and a short reflection question, enabling differentiated and collaborative learning.

(13) **AI-Assisted Puzzle Creation:** Under teacher supervision, students can use an age-appropriate AI tool to generate parity or number-pattern puzzles, then act as **"mathematical validators"** by checking whether the generated puzzles and solutions

are actually correct. This shifts AI use from simply obtaining answers to **verification and critical thinking**.

(14) Number Play Mini-Hackathon: Divide students into teams and give them a fixed period to solve a sequence of interconnected challenges involving **odd-even reasoning, magic squares, Virahāṅka patterns and cryptarithms**. Teams can receive additional points for finding more than one solution strategy.

(15) Student Digital Portfolio – "My Number Play Lab": Each student can maintain a small digital or physical portfolio containing a parity discovery, a completed magic square, a Virahāṅka pattern, a self-designed cryptarithm, and a reflection titled **"The most surprising number pattern I discovered."** This provides evidence of both conceptual understanding and creative application.

6.17: Practicing Questions/Question Bank

A. Suggested Fill-in-the-Blank Questions:

1. The property of a number being odd or even is called ________.
   Answer: parity

2. The sum of two consecutive numbers is always ________.
   Answer: odd

3. The n^{th}even number can be represented as ________.
   Answer: $2n$

4. The n^{th}odd number can be represented as ________.
   Answer: $2n - 1$

5. The smallest possible sum of three different numbers chosen from 1–9 is ________.
   Answer: 6

6. The largest possible sum of three different numbers chosen from 1–9 is ________.
   Answer: 24

7. The magic sum of a 3 × 3 magic square using 1–9 is ________.
   Answer: 15

8. The centre number of a 3 × 3 magic square using 1–9 is ________.
   Answer: 5

9. The Virahāṅka sequence continues 1,2,3,5,8,13,________.
   Answer: 21

10. In $T + T + T = UT$, the value of $T$is ________.
    Answer: 5

B. Suggested 1-Mark Descriptive Questions:

1. **What is parity?**
   Answer: Parity is the property of a number being **even or odd**.

2. **What is the parity of the sum of two odd numbers?**
   Answer: The sum of two odd numbers is **even**.

3. **What is the 50th even number?**
   Answer: The 50th even number is **100**.

4. **What is a magic square?**
   Answer: A magic square is a square arrangement in which every row, column and diagonal has the same sum.

5. **What is the magic sum of a 3 × 3 magic square using 1–9?**
   Answer: The magic sum is **15**.

6. **What number occupies the centre of a 3 × 3 magic square using 1–9?**
   Answer: The centre number is **5**.

7. **Write the next term of** $13, 21, 34, 55, \ldots$**.**
   Answer: The next term is **89**.

8. **How many beats does a long syllable take in the rhythm activity?**
   Answer: A long syllable takes **two beats**.

9. **What are cryptarithms?**
   Answer: Cryptarithms are arithmetic puzzles in which digits are represented by letters.

10. **What is the greatest number that can be called out in the height activity involving eight children?**
    Answer: The greatest possible number is **7**.

C. Suggested 2-Mark Descriptive Questions:

1. Why is the sum of two consecutive numbers always odd?

Answer:

1. One of two consecutive numbers is even and the other is odd.
2. Since even + odd = odd, their sum is always **odd**.

2. Find the 75th even and 75th odd numbers.

Answer:

1. The 75th even number is $2 \times 75 = 150$.
2. The 75th odd number is $2 \times 75 - 1 = 149$.

3. Why can the sum of three different numbers selected from 1–9 not be 5?

Answer:

1. The three smallest distinct numbers are 1, 2 and 3.
2. Their sum is 6, so a sum of **5 is impossible**.

4. What happens if 2 is added to every entry of a 3 × 3 magic square?

Answer:

1. Each row, column and diagonal sum increases by $2 + 2 + 2 = 6$.
2. The resulting arrangement remains a **magic square**.

5. Find the next two terms of $\mathbf{21, 34, 55, \ldots}$**.**

Answer:

1. $21 + 34 = 55$, so the next term is $34 + 55 = 89$.
2. The following term is $55 + 89 = 144$.

6. Why does a bulb initially ON become OFF after 77 toggles?

Answer:

1. Every pair of toggles returns the bulb to its original state.
2. Since 77 is odd, one unpaired toggle remains and changes the bulb to **OFF**.

D. Suggested 3-Mark Descriptive Questions:

1. Explain why five odd numbers cannot have a sum of 30.

Answer:

1. Two odd numbers added together give an even number.
2. Four odd numbers therefore give an even sum, and adding another odd number gives an odd sum.
3. Since 30 is even, **five odd numbers cannot add up to 30**.

2. Explain why the magic sum of a 3 × 3 magic square using 1–9 is 15.

Answer:

1. The sum $1 + 2 + \cdots + 9$is **45**.
2. The three rows of the magic square must have equal sums.
3. Therefore, each row sums to $45 \div 3 = 15$.

3. Explain the rule of the Virahāṅka sequence with an example.

Answer:

1. The sequence begins 1,2,3,5,8,13, ...
2. Each term is obtained by adding the previous two terms.
3. For example, $8 + 13 = 21$and $13 + 21 = 34$.

4. Explain how short and long syllables lead to the Virahāṅka sequence.

Answer:

1. A short syllable takes one beat and a long syllable takes two beats.
2. Different combinations of these syllables produce different rhythms for a fixed number of beats.
3. The numbers of possible rhythms form the **Virahāṅka sequence**.

5. Explain the cryptarithm $\boldsymbol{T + T + T = UT}$.

Answer:

1. The same digit Toccurs three times on the left.
2. Taking $T = 5$gives $5 + 5 + 5 = 15$.

3. Hence, $T = 5$, $U = 1$, **and** $UT = 15$.

6. Explain why a child calling out 0 in the height activity need not be the tallest child.

Answer:

1. A child counts only taller children **standing in front**.
2. Calling 0 means there is no taller child in front.
3. A taller child may still stand behind, so the child need not be the tallest overall.

E. Suggested 5-Mark Descriptive Questions:

1. Analyse the main parity rules and explain how they help solve number puzzles.

Answer:

1. **Even + Even = Even**.
2. **Odd + Odd = Even**.
3. **Even + Odd = Odd**.
4. An even factor makes a product even, while a product of odd factors remains odd.
5. These rules allow us to decide whether many numerical situations are possible **without performing complete calculations**.

2. Explain the important properties of a 3 × 3 magic square using the numbers 1–9.

Answer:

1. The numbers 1–9 have a total sum of **45**.
2. Therefore, the common magic sum must be **15**.
3. Every row, column and diagonal must add up to 15.
4. The centre number must be **5**.
5. The numbers **1 and 9 cannot occupy corner positions**.

3. Explain how a magic square changes when the same operation is performed on every entry.

Answer:

1. Begin with a 3 × 3 magic square having magic sum 15.
2. Adding 1 to every entry increases every line sum by 3.
3. Therefore, its new magic sum becomes **18**.
4. Doubling every entry doubles every row, column and diagonal sum.
5. Hence, the doubled square remains magic and has magic sum **30**.

4. Explain the Virahāṅka sequence and its connection with poetic rhythms.

Answer:

1. The sequence begins **1, 2, 3, 5, 8, 13, 21, 34, ...**.

2. Every new term is the sum of the preceding two terms.
3. In the poetic-rhythm context, a short syllable takes one beat and a long syllable takes two beats.
4. Counting the different combinations of short and long syllables produces the same number pattern.
5. Thus, the Virahāṅka sequence connects **number patterns with poetry and rhythm**.

5. A child climbs an 8-step staircase by taking either one or two steps at a time. Explain how the problem is connected with the Virahāṅka sequence.

Answer:

1. A child reaching a step must come from either the immediately previous step or the step two places below.
2. Hence, the number of ways to reach a step is the sum of the ways to reach the previous two steps.
3. This produces the pattern **1, 2, 3, 5, 8, 13, 21, 34**.
4. This is exactly the recurrence pattern of the Virahāṅka sequence.
5. Therefore, an 8-step staircase can be climbed in **34 different ways**.

6. Explain how the chapter connects number play with Indian mathematical heritage and other areas of knowledge.

Answer:

1. The chapter discusses the **Chautīsā Yantra**, a historical 4×4 magic square with magic sum 34.
2. It traces the Virahāṅka sequence to the study of **Indian poetic rhythms**.
3. It mentions contributions associated with **Piṅgala, Virahāṅka, Gopala and Hemachandra**.
4. The sequence is connected with poetry, drumming, visual arts, architecture, science and patterns in nature.
5. Thus, the chapter presents number play as a connection between **mathematics, culture, art, history and nature**.

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7th Standard Maths Book Chapter 7

Chapter 7: A TALE OF THREE INTERSECTING LINES

7.1 Summary of the Chapter:

Summary of Chapter 7 – A Tale of Three Intersecting Lines:

(1) A **triangle** is a closed geometrical shape formed by **three vertices, three sides, and three angles**. Triangles can have different shapes depending on the lengths of their sides and measures of their angles.

(2) An **equilateral triangle** has all three sides equal. A compass and ruler can be used to construct it accurately by drawing intersecting arcs of equal radius.

(3) A triangle with **three given side lengths** can be constructed by taking one side as the base and drawing arcs from its endpoints with radii equal to the other two side lengths. The intersection of the arcs determines the third vertex.

(4) Three given lengths can form a triangle only when they satisfy the **triangle inequality**: the length of **each side must be less than the sum of the other two sides**.

(5) An efficient way to check the triangle inequality is to compare the **longest side with the sum of the other two sides**. If the sum of the two smaller sides is greater than the longest side, a triangle can be formed.

(6) A triangle can also be constructed when **two sides and their included angle** are given. First one side is drawn, the given angle is constructed at its endpoint, and the second given side is marked along the appropriate arm.

(7) When **two angles and their included side** are given, the included side is drawn first and the two given angles are constructed at its endpoints. Their arms intersect to determine the third vertex.

(8) For two given angles to belong to a triangle, their **sum must be less than 180°**. The third angle is determined by the remaining amount needed to make the total 180°.

(9) The **Angle Sum Property** states that the sum of the three interior angles of every triangle is always **180°**. This property can be demonstrated using parallel lines and corresponding/alternate angles.

(10) An **exterior angle** of a triangle is formed when one side of the triangle is extended. Using the angle-sum and straight-angle properties, its measure can be related to the two interior opposite angles.

(11) An **altitude of a triangle** is a perpendicular line segment drawn from a vertex to its opposite side (or its extension). Its length represents the height of the triangle corresponding to that side as the base.

(12) Triangles are classified **by sides** as **equilateral, isosceles, and scalene**, and **by angles** as **acute-angled, right-angled, and obtuse-angled triangles**.

7.2 Important Formulas:

Important Formulas / Rules for Chapter 7 – A Tale of Three Intersecting Lines:

The following formulas and mathematical rules are especially useful for solving **quantitative and reasoning-based problems** from this chapter.

1. Triangle Inequality:

For a triangle having side lengths a, b, and c:

$$\boxed{a < b + c}$$
$$\boxed{b < a + c}$$
$$\boxed{c < a + b}$$

A triangle can be formed **only when each side is smaller than the sum of the other two sides**.

For example, for sides 3,4,5:

$$3 < 4 + 5,\ 4 < 3 + 5,\ 5 < 3 + 4$$

Hence, a triangle is possible.

---

2. Quick Triangle-Existence Test

If the sides are arranged as

$$a \leq b \leq c$$

where $c$is the longest side, it is sufficient to check:

$$\boxed{a + b > c}$$

That is,

$$\boxed{\text{Sum of the two smaller sides} > \text{longest side}}$$

When this condition is satisfied, a triangle exists.
Example:
Sides 4,5,8

$$4 + 5 = 9 > 8$$

Therefore, the triangle can be formed.

---

3. When a Triangle Cannot Be Formed

If

$$\boxed{a + b < c}$$

where $c$is the longest side, a triangle **cannot** be formed.
Example:

$$10 + 15 < 30$$
$$25 < 30$$

Therefore, sides 10,15,30cannot form a triangle.
If

$$\boxed{a + b = c}$$

the two smaller sides only meet in a straight line, so a proper triangle is **not formed**.

---

4. Range of the Third Side of a Triangle

If two sides of a triangle are $a$and b, and the third side is x, triangle inequality gives:

$$x < a + b$$

and

$$x > \mid a - b \mid$$

Therefore,

$$\boxed{\mid a - b \mid < x < a + b}$$

This is very useful for finding the **possible values of an unknown third side**.
Example: if two sides are 3cm and 7cm:

$$\mid 7 - 3 \mid < x < 7 + 3$$
$$\boxed{4 < x < 10}$$

Thus, the third side must be **greater than 4 cm and less than 10 cm**. The chapter explicitly asks students to determine possible third-side values using triangle inequality.

---

5. Angle Sum Property of a Triangle

For any triangle ABC:

$$\boxed{\angle A + \angle B + \angle C = 180^\circ}$$

This is one of the most important formulas in the chapter.
To find an unknown angle:

$$\boxed{\angle C = 180^\circ - (\angle A + \angle B)}$$

Similarly,

$$\angle A = 180^\circ - (\angle B + \angle C)$$
$$\angle B = 180^\circ - (\angle A + \angle C)$$

Example:

$$\angle B = 50^\circ,\ \angle C = 70^\circ$$

Then,

$$\angle A = 180^\circ - (50^\circ + 70^\circ)$$
$$\boxed{\angle A = 60^\circ}$$

---

6. Condition for Two Given Angles to Form a Triangle

If two angles are $A$and B, then:

$$\boxed{A + B < 180^\circ}$$

for a triangle to exist.

If

$$\boxed{A + B \geq 180^\circ}$$

a triangle cannot be formed.

---

7. Third Angle from Two Given Angles

If two angles are $A$and B, the third angle $C$is:

$$\boxed{C = 180^\circ - (A + B)}$$

Example:

$$A = 36^\circ,\ B = 72^\circ$$
$$C = 180^\circ - (36^\circ + 72^\circ)$$
$$C = 180^\circ - 108^\circ$$
$$\boxed{C = 72^\circ}$$

---

8. Exterior Angle and Interior Angle on a Straight Line

An exterior angle and its adjacent interior angle form a straight angle.

Therefore,

$$\boxed{\text{Exterior angle} + \text{Adjacent interior angle} = 180^\circ}$$

or

$$\boxed{\text{Exterior angle} = 180^\circ - \text{Adjacent interior angle}}$$

For example:

```
     A
    / \
   /   \
  B-----C---------D
         \
     Exterior angle ∠ACD
```

If

$$\angle ACB = 70^\circ$$

then

$$\angle ACD = 180^\circ - 70^\circ$$
$$\boxed{\angle ACD = 110^\circ}$$

This relation is demonstrated directly in the chapter.

---

9. Exterior Angle Property

Combining the angle-sum property and straight-angle property gives:

$$\boxed{\text{Exterior angle} = \text{sum of the two interior opposite angles}}$$

For the figure above:

$$\boxed{\angle ACD = \angle A + \angle B}$$

Example:

$$\angle A = 50^\circ,\ \angle B = 60^\circ$$

Therefore,

$$\angle ACD = 50^\circ + 60^\circ$$
$$\boxed{\angle ACD = 110^\circ}$$

The chapter develops this relationship through the angle-sum and straight-angle properties.

---

10. Equilateral Triangle Angle Formula

An equilateral triangle has three equal angles.
If each angle is x,

$$x + x + x = 180^\circ$$
$$3x = 180^\circ$$

Therefore,

$$\boxed{x = 60^\circ}$$

Hence, every angle of an equilateral triangle is:

$$\boxed{60^\circ}$$

The chapter asks students to determine the angle measure when all three angles are equal.

---

11. Isosceles Triangle with One Known Vertex Angle

If an isosceles triangle has two equal base angles $x$and vertex angle A:

$$A + x + x = 180^\circ$$

Therefore,

$$A + 2x = 180^\circ$$

and

$$\boxed{x = \frac{180^\circ - A}{2}}$$

Example: if the vertex angle is 50°,

$$x = \frac{180^\circ - 50^\circ}{2}$$
$$x = \frac{130^\circ}{2}$$
$$\boxed{x = 65^\circ}$$

The chapter includes this type of problem with $\angle B = \angle C$and $\angle A = 50^\circ$.

---

12. Right-Angled Triangle Angle Relation

For a right triangle:

$$\boxed{\text{One angle} = 90^\circ}$$

Since the angle sum is 180°,

$$90^\circ + A + B = 180^\circ$$

Therefore,

$$\boxed{A + B = 90^\circ}$$

Thus, the two non-right angles of a right triangle are **complementary**.
Example:
If

$$A = 35^\circ$$

then

$$B = 90^\circ - 35^\circ$$

$$\boxed{B = 55^\circ}$$

The chapter explicitly includes right-angled triangles in its classification and construction problems.

---

13. Equal Angles in an Equilateral Triangle

Since all three angles are equal:

$$\boxed{\angle A = \angle B = \angle C = 60^\circ}$$

Also, by definition:

$$\boxed{AB = BC = CA}$$

This combines the chapter's side-based definition of an equilateral triangle with the angle-sum property.

---

14. Isosceles Triangle Side Condition

For an isosceles triangle:

$$\boxed{\text{Two sides are equal}}$$

For example:

$$\boxed{AB = AC}$$

The chapter classifies an isosceles triangle as one having two equal sides.

For numerical angle problems, the corresponding base angles will also be equal:

$$\boxed{\angle B = \angle C}$$

and therefore

$$\boxed{\angle B = \angle C = \frac{180^\circ - \angle A}{2}}$$

---

15. Scalene Triangle Side Condition

For a scalene triangle:

$$\boxed{a \neq b,\ b \neq c,\ c \neq a}$$

That is, all three sides have different lengths.

---

16. Classification of Triangles According to Angles

For numerical identification:

Acute-angled triangle

$$\boxed{\text{All three angles} < 90^\circ}$$

Right-angled triangle

$$\boxed{\text{One angle} = 90^\circ}$$

Obtuse-angled triangle

$$\boxed{\text{One angle} > 90^\circ}$$

The chapter uses these three angle-based classifications.

Quick Formula Sheet:

For revision, the most important formulas are:

1. **Triangle inequality**

$$\boxed{a + b > c,\ b + c > a,\ c + a > b}$$

2. **Quick existence test**

$$\boxed{\text{Two smaller sides' sum} > \text{longest side}}$$

3. **Range of third side**

$$\boxed{|a - b| < x < a + b}$$

4. **Angle sum property**

$$\boxed{A + B + C = 180^\circ}$$

5. **Third angle**

$$\boxed{C = 180^\circ - (A + B)}$$

6. **Condition for two given angles**

$$\boxed{A + B < 180^\circ}$$

7. **Linear pair**

$$\boxed{\text{Interior angle} + \text{exterior angle} = 180^\circ}$$

8. **Exterior angle property**

$$\boxed{\text{Exterior angle} = \text{sum of two opposite interior angles}}$$

9. **Equilateral triangle**

$$\boxed{A = B = C = 60^\circ}$$

10. **Isosceles triangle base angle**

$$\boxed{\text{Base angle} = \frac{180^\circ - \text{vertex angle}}{2}}$$

11. **Right triangle**

$$\boxed{\text{Sum of the two acute angles} = 90^\circ}$$

These are the principal relationships needed for **school-exam numerical questions, construction reasoning, HOTS problems, and Olympiad-type questions** based on the uploaded Chapter 7.

7.3 Fill-Up the Blank LOTS type questions with Answers: (30 Questions)

Fill in the Blanks – LOTS Type:

1. A triangle has _____ **vertices**.
   Answer: three
2. A triangle has _____ **sides**.
   Answer: three
3. The sides of a triangle meet to form _____ **angles**.
   Answer: three
4. A triangle in which all three sides are equal is called an _____ **triangle**.
   Answer: equilateral
5. A triangle having two equal sides is called an _____ **triangle**.
   Answer: isosceles
6. A triangle having all three sides of different lengths is called a _____ **triangle**.
   Answer: scalene
7. A _____ is used along with a ruler to construct arcs of fixed radius.
   Answer: compass
8. In constructing a triangle with three given sides, the point of intersection of two arcs gives the _____ **vertex**.
   Answer: third
9. According to the triangle inequality, each side of a triangle must be _____ **than the sum of the other two sides**.
   Answer: smaller

10. If the sum of the two smaller sides is greater than the longest side, a triangle _____.
    Answer: exists
11. If the sum of the two smaller sides is equal to the longest side, a proper triangle _____ be formed.
    Answer: cannot
12. If the sum of the two smaller sides is less than the longest side, the two arcs will _____ **intersect** to form a triangle.
    Answer: not
13. The sum of the three interior angles of a triangle is _____.
    Answer: 180°
14. If two angles of a triangle are 50°and 70°, the third angle is _____.
    Answer: 60°
15. Two given angles can be part of a triangle only if their sum is _____ **than** 180°.
    Answer: less
16. An angle formed by extending one side of a triangle is called an _____ **angle**.
    Answer: exterior
17. An exterior angle and its adjacent interior angle together form _____ **degrees**.
    Answer: 180°
18. An exterior angle of a triangle is equal to the sum of the two _____ **interior angles**.
    Answer: opposite
19. A perpendicular line segment drawn from a vertex to the opposite side of a triangle is called an _____.
    Answer: altitude
20. The length of an altitude represents the _____ of the triangle corresponding to a chosen base.
    Answer: height
21. A triangle having one angle equal to 90°is called a _____ **triangle**.
    Answer: right-angled
22. A triangle in which all the angles are less than 90°is called an _____ **triangle**.
    Answer: acute-angled
23. A triangle having one angle greater than 90°is called an _____ **triangle**.
    Answer: obtuse-angled
24. Each angle of an equilateral triangle measures _____.
    Answer: 60°
25. In a right-angled triangle, the sum of the other two angles is _____.
    Answer: 90°
26. In an isosceles triangle, the angles opposite the equal sides are _____.
    Answer: equal
27. When two sides and the angle between them are given, the angle is called the _____ **angle**.
    Answer: included
28. When two angles and the side common to both are given, the side is called the _____ **side**.
    Answer: included
29. The third angle of a triangle can be found by subtracting the sum of the other two angles from _____.
    Answer: 180°
30. Triangles may be classified on the basis of their _____ **lengths** and _____ **measures**.
    Answer: side, angle

These questions are based on the key definitions, constructions, triangle inequality, angle properties, altitudes, and classifications covered in the uploaded chapter.

7.4 Fill-Up the Blank HOTS type questions with Answers: (30 Questions)

Fill in the Blanks – HOTS Type:

1. If the side lengths of a triangle are 6 cm, 8 cm, and 13 cm, the triangle is possible because $6 + 8$is _____ than 13.
   Answer: greater
2. If three lengths are 4 cm, 5 cm, and 10 cm, they cannot form a triangle because $4 + 5$is _____ than 10.
   Answer: less
3. If the side lengths are 7 cm, 9 cm, and $x$cm, then for a triangle to exist, $x$must be less than _____ **cm**.
   Answer: 16
4. If two sides of a triangle are 5 cm and 9 cm, the third side must be greater than _____ **cm**.
   Answer: 4
5. If two sides are 5 cm and 9 cm, the possible third side $x$must satisfy

$$\boxed{\_\_\_\_ < x < \_\_\_\_}$$

Answer: $4 < x < 14$

6. A triangle with sides 3 cm, 6 cm, and 9 cm cannot be formed because the sum of the two smaller sides is _____ the longest side.
   Answer: equal to
7. During construction, if two arcs drawn from the endpoints of the base intersect at two points, either intersection point can be chosen as the _____ **vertex** of the triangle.
   Answer: third
8. If the sum of the two smaller side lengths is greater than the longest side, the two construction circles will _____ each other.
   Answer: intersect
9. If the angles of a triangle are $x°$, $60°$, and $70°$, then $x =$_____.
   Answer: $50°$
10. If two angles of a triangle are $35°$and $95°$, the third angle is _____.
    Answer: $50°$
11. If two given angles are $100°$and $85°$, a triangle _____ be formed because their sum exceeds $180°$.
    Answer: cannot
12. If two angles of a triangle are equal and the third angle is $40°$, each of the equal angles measures _____.
    Answer: $70°$
13. In an isosceles triangle, if the vertex angle is $80°$, each base angle is _____.
    Answer: $50°$
14. If one angle of a right-angled triangle is $90°$and another angle is $38°$, the third angle is _____.
    Answer: $52°$
15. If one angle of a triangle is $120°$, the sum of the other two angles must be _____.
    Answer: $60°$
16. If all three angles of a triangle are equal, each angle must be _____.
    Answer: $60°$

17. If an exterior angle of a triangle is 125°and one of the opposite interior angles is 55°, the other opposite interior angle is _____.
    Answer: 70°
18. If an interior angle adjacent to an exterior angle measures 68°, the exterior angle measures _____.
    Answer: 112°
19. If the two opposite interior angles of a triangle are 45°and 65°, the corresponding exterior angle is _____.
    Answer: 110°
20. If an exterior angle of a triangle is 140°, its adjacent interior angle is _____.
    Answer: 40°
21. If a triangle has angles 45°, 45°, and 90°, it is both an _____ triangle and a _____ triangle.
    Answer: isosceles, right-angled
22. If a triangle has angles 30°, 60°, and 90°, it is classified by angles as a _____ **triangle**.
    Answer: right-angled
23. A triangle having angles 100°, 40°, and 40°is both _____ and _____.
    Answer: isosceles, obtuse-angled
24. A triangle having angles 70°, 60°, and 50°is an _____ **triangle** because every angle is less than 90°.
    Answer: acute-angled
25. If all three sides of a triangle are equal, the triangle cannot be right-angled because each of its angles is _____.
    Answer: 60°
26. In a right-angled triangle, if one acute angle increases by 10°, the other acute angle must _____ **by** 10°so that their sum remains 90°.
    Answer: decrease
27. If two angles of a triangle have a total of 145°, the remaining angle is _____.
    Answer: 35°
28. If the longest side of three given lengths is 20 cm and the other two are 8 cm and 12 cm, a proper triangle _____ be formed.
    Answer: cannot
29. If the longest side is 20 cm and the other two sides are 9 cm and 12 cm, a triangle _____ be formed because $9 + 12 > 20$.
    Answer: can
30. An altitude drawn from a vertex of a triangle must meet the opposite side, or its extension, at an angle of _____.
    Answer: 90°

These HOTS fill-ups require students to **apply the triangle inequality, angle-sum property, exterior-angle relationship, classification of triangles, and properties of altitudes**, rather than merely recalling definitions.

7.5 One-mark questions with Answers of LOTS Type: (35 Questions)

One-Mark Descriptive Questions with Answers – LOTS Type:

1. **What is a triangle?**
   Answer: A triangle is a closed shape consisting of three vertices joined by three line segments called sides.
2. **How many vertices does a triangle have?**
   Answer: A triangle has three vertices.

3. **How many angles does a triangle have?**
   Answer: A triangle has three angles formed by its three sides.
4. **What is an equilateral triangle?**
   Answer: An equilateral triangle is a triangle in which all three sides are equal in length.
5. **What is an isosceles triangle?**
   Answer: An isosceles triangle is a triangle having two sides of equal length.
6. **What is a scalene triangle?**
   Answer: A scalene triangle is a triangle whose three sides have different lengths.
7. **What is the triangle inequality?**
   Answer: The triangle inequality states that each side of a triangle must be smaller than the sum of the other two sides.
8. **When can three given lengths form a triangle?**
   Answer: Three given lengths can form a triangle when they satisfy the triangle inequality.
9. **What happens if the sum of the two smaller lengths is greater than the longest length?**
   Answer: A triangle can be formed when the sum of the two smaller lengths is greater than the longest length.
10. **What is an included angle?**
    Answer: An included angle is the angle lying between two given sides of a triangle.
11. **What is an included side?**
    Answer: An included side is the side that is common to two given angles of a triangle.
12. **What is the angle sum property of a triangle?**
    Answer: The angle sum property states that the sum of the three interior angles of a triangle is 180°.
13. **What is the sum of the angles of an equilateral triangle?**
    Answer: The sum of the angles of an equilateral triangle is 180°.
14. **What is the measure of each angle of an equilateral triangle?**
    Answer: Each angle of an equilateral triangle measures 60°.
15. **How can the third angle of a triangle be found when two angles are known?**
    Answer: The third angle is found by subtracting the sum of the two known angles from 180°.
16. **What condition must two given angles satisfy to form a triangle?**
    Answer: The sum of the two given angles must be less than 180°.
17. **What is an exterior angle of a triangle?**
    Answer: An exterior angle is the angle formed between an extended side of a triangle and its adjacent side.
18. **What is the sum of an exterior angle and its adjacent interior angle?**
    Answer: The sum of an exterior angle and its adjacent interior angle is 180°.
19. **What is an altitude of a triangle?**
    Answer: An altitude is a perpendicular line segment drawn from a vertex of a triangle to its opposite side.
20. **What does the length of an altitude represent?**
    Answer: The length of an altitude represents the height of a vertex from its opposite side.
21. **What is an acute-angled triangle?**
    Answer: An acute-angled triangle is a triangle whose three angles are acute.

22. **What is a right-angled triangle?**
    Answer: A right-angled triangle is a triangle having one right angle.
23. **What is an obtuse-angled triangle?**
    Answer: An obtuse-angled triangle is a triangle having one obtuse angle.
24. **Which instrument simplifies the construction of a triangle when its side lengths are given?**
    Answer: A compass simplifies the construction of a triangle when its side lengths are given.
25. **How is the third vertex located when constructing a triangle from three given side lengths?**
    Answer: The third vertex is located at the intersection of the arcs drawn from the endpoints of the base.
26. **What happens to the construction circles when a triangle can be formed?**
    Answer: The two construction circles intersect each other when a triangle can be formed.
27. **What happens when the sum of the two smaller side lengths equals the longest side?**
    Answer: The construction circles touch at one point and a proper triangle is not formed.
28. **Which side is usually taken as the base while checking triangle existence using circles?**
    Answer: The longest of the three given lengths is taken as the base.
29. **Name the three types of triangles classified according to their side lengths.**
    Answer: The three types are equilateral, isosceles, and scalene triangles.
30. **Name the three types of triangles classified according to their angle measures.**
    Answer: The three types are acute-angled, right-angled, and obtuse-angled triangles.

7.6 One-mark questions with Answers of HOTS Type: (30 Questions)

One-Mark Descriptive Questions with Answers – HOTS Type:

1. **Can sides 5 cm, 7 cm, and 10 cm form a triangle? Give a reason.**
   Answer: Yes, they can form a triangle because $5 + 7 > 10$.
2. **Can sides 3 cm, 4 cm, and 8 cm form a triangle? Why?**
   Answer: No, because $3 + 4 < 8$, so the triangle inequality is not satisfied.
3. **Can sides 3 cm, 6 cm, and 9 cm form a triangle? Justify.**
   Answer: No, because $3 + 6 = 9$, whereas the sum of the two smaller sides must be greater than the longest side.
4. **Can 1 cm, 100 cm, and 100 cm be the sides of a triangle?**
   Answer: Yes, because the two smaller sides satisfy $1 + 100 > 100$.
5. **Can 1 cm, 1 cm, and 5 cm be the sides of a triangle?**
   Answer: No, because $1 + 1 < 5$, so the triangle inequality fails.
6. **If two sides of a triangle are 5 cm and 5 cm, can the third side be 9 cm?**
   Answer: Yes, because $5 + 5 > 9$, so the three lengths satisfy the triangle inequality.
7. **If two sides are 3 cm and 7 cm, can the third side be 10 cm? Why?**
   Answer: No, because $3 + 7 = 10$, so a proper triangle cannot be formed.
8. **If the longest side is 12 cm and the other sides are 5 cm and 10 cm, can a triangle be formed?**
   Answer: Yes, because $5 + 10 > 12$.
9. **Two construction circles touch each other at exactly one point; can they produce a proper triangle?**

Answer: No, because touching at one point means the sum of the two smaller lengths equals the longest length.

10. **Why do intersecting construction circles indicate that a triangle can be formed?**
Answer: Their intersection provides a third vertex that can be joined to the endpoints of the base.
11. **Two angles of a triangle are $75°$and $45°$; what is the third angle?**
Answer: The third angle is $180° - (75° + 45°) = 60°$.
12. **Can $35°$and $150°$be two angles of a triangle? Give a reason.**
Answer: No, because their sum is $185°$, which is greater than $180°$.
13. **Can $70°$and $30°$be two angles of a triangle? Give a reason.**
Answer: Yes, because their sum is $100°$, which is less than $180°$.
14. **If two angles of a triangle are $90°$and $30°$, find the third angle.**
Answer: The third angle is $180° - (90° + 30°) = 60°$.
15. **Can a triangle have three angles of $70°$each? Why?**
Answer: No, because $70° + 70° + 70° = 210°$, which exceeds $180°$.
16. **If all three angles of a triangle are equal, what is each angle?**
Answer: Each angle is $60°$because $180° \div 3 = 60°$.
17. **If $\angle B = \angle C$and $\angle A = 50°$, find $\angle B$.**
Answer: $\angle B = 65°$, because the remaining $130°$is equally divided between $\angle B$and $\angle C$.
18. **Can a triangle have two right angles? Give a reason.**
Answer: No, because two right angles already total $180°$, leaving no positive angle for the third vertex.
19. **Can a triangle have two obtuse angles? Give a reason.**
Answer: No, because two angles greater than $90°$would have a sum greater than $180°$.
20. **If one angle of a triangle is $120°$, what must be the sum of the other two angles?**
Answer: The other two angles must add up to $60°$because the total angle sum is $180°$.
21. **An exterior angle is $110°$and one opposite interior angle is $50°$; find the other opposite interior angle.**
Answer: The other opposite interior angle is $60°$.
22. **If an interior angle adjacent to an exterior angle is $70°$, what is the exterior angle?**
Answer: The exterior angle is $110°$because the two angles together form $180°$.
23. **If the two opposite interior angles are $45°$and $65°$, what is the corresponding exterior angle?**
Answer: The exterior angle is $110°$, equal to $45° + 65°$.
24. **A triangle has angles $50°$, $60°$, and $70°$; how is it classified according to angles?**
Answer: It is an acute-angled triangle because all three angles are less than $90°$.
25. **A triangle has angles $90°$, $45°$, and $45°$; how is it classified according to angles?**
Answer: It is a right-angled triangle because one of its angles measures $90°$.
26. **A triangle has angles $110°$, $40°$, and $30°$; how is it classified?**
Answer: It is an obtuse-angled triangle because one angle is greater than $90°$.
27. **Can an equilateral triangle also be right-angled? Give a reason.**
Answer: No, because each angle of an equilateral triangle is $60°$, so none can be $90°$.
28. **Can an equilateral triangle be obtuse-angled? Give a reason.**
Answer: No, because all its angles are $60°$, which are acute angles.
29. **If an altitude is drawn from vertex $A$to the opposite side BC, what angle does it make with BC?**

Answer: The altitude makes a $90°$angle with BCbecause it is perpendicular to the opposite side.

30. **If one acute angle of a right-angled triangle is $35°$, what is the other acute angle?**
Answer: The other acute angle is $55°$because the two acute angles together must total $90°$.

7.7 Two-mark questions with Answers of LOTS Type: (24 Questions)

Two-Mark Descriptive Questions with Answers – LOTS Type:

1. What is a triangle? State its basic components.

Answer:

1. A triangle is a **closed shape formed by three line segments**.
2. It has **three sides, three vertices, and three angles**.

2. What is an equilateral triangle? State one angle property of it.

Answer:

1. An equilateral triangle has **all three sides equal in length**.
2. Each of its three angles measures $60°$.

3. What is an isosceles triangle? How does it differ from a scalene triangle?

Answer:

1. An **isosceles triangle** has two sides of equal length.
2. A **scalene triangle** has all three sides of different lengths.

4. State the triangle inequality.

Answer:

1. In a triangle, the length of **each side must be smaller than the sum of the other two sides**.
2. Therefore, if $a, b, c$are its sides, $a < b + c$, $b < a + c$,and $c < a + b$.

5. Check whether sides 4 cm, 5 cm, and 8 cm can form a triangle.

Answer:

1. The longest side is 8 cm, and $4 + 5 = 9$cm.
2. Since $9 > 8$, the lengths satisfy the triangle inequality and **a triangle can be formed**.

6. Check whether sides 3 cm, 4 cm, and 8 cm can form a triangle.

Answer:

1. The sum of the two smaller sides is $3 + 4 = 7$cm.
2. Since $7 < 8$, the triangle inequality is not satisfied, so **a triangle cannot be formed**.

7. How can a compass help in constructing a triangle when its three side lengths are given?

Answer:

1. Draw one given side as the base and use the compass to draw **arcs of radii equal to the other two sides** from its endpoints.
2. The intersection of the arcs determines the **third vertex**, which is joined to the endpoints of the base.

8. What happens when the sum of the two smaller side lengths is greater than the longest side?

Answer:

1. The circles or arcs drawn using the two smaller lengths **intersect**.
2. Their intersection provides the third vertex, so **a triangle exists**.

9. State the angle sum property of a triangle and use it to find the third angle when two angles are $50°$and $70°$.

Answer:

1. The sum of the three angles of any triangle is $180°$.
2. The third angle is $180° - (50° + 70°) = \boxed{60°}$.

10. Can $70^\circ$and 30°be two angles of a triangle? Give reasons.
Answer:
1. Their sum is $70^\circ + 30^\circ = 100^\circ$, which is less than 180°.
2. Therefore, **a triangle can be formed** with these two angles.

11. What condition must two given angles satisfy for a triangle to exist?
Answer:
1. The **sum of the two given angles must be less than** 180°.
2. If their sum is greater than or equal to 180°, **no triangle can be formed**.

12. What is an exterior angle of a triangle? How is it formed?
Answer:
1. An exterior angle is an angle formed **outside a triangle when one of its sides is extended**.
2. It is formed between the **extended side and the adjacent side** of the triangle.

13. Find the exterior angle at Cif its adjacent interior angle is 70°.
Answer:
1. The interior and adjacent exterior angles form a straight angle, so their sum is 180°.
2. Therefore, the exterior angle is $180^\circ - 70^\circ = \boxed{110^\circ}$.

14. What is an altitude of a triangle? What does its length represent?
Answer:
1. An altitude is a **perpendicular line segment drawn from a vertex to its opposite side**.
2. Its length represents the **height of that vertex from the opposite side**.

15. Draw and identify an altitude $AD$of triangle ABC.
Answer:
1. Draw $AD$from vertex Aperpendicular to the opposite side BC.
2. Thus, $AD$is an **altitude** and $\angle ADB = 90^\circ$.

```
    A
   /|\
  / | \
 /  |  \
B---D---C
    ⊥
 AD ⊥ BC
```

16. Name the three types of triangles based on their side lengths and describe any one.
Answer:
1. Based on sides, triangles are **equilateral, isosceles, and scalene**.
2. An equilateral triangle has **all three sides equal in length**.

17. Name the three types of triangles based on their angle measures.
Answer:
1. Triangles are classified as **acute-angled, right-angled, and obtuse-angled** triangles.
2. These classifications depend on whether their angles are **acute, right, or obtuse**.

18. What is a right-angled triangle? What can be said about its other two angles?
Answer:
1. A right-angled triangle contains **one angle equal to** 90°.
2. The other two angles together measure $180^\circ - 90^\circ = \boxed{90^\circ}$.

19. What measurements are sufficient for constructing a triangle using two sides?
Answer:
1. The lengths of **two sides** of the triangle must be given.
2. The **included angle between those two sides** must also be given.

20. What measurements are sufficient for constructing a triangle using two angles?

Answer:

1. The measures of **two angles** of the triangle must be given.
2. The length of the **included side between the two angles** must also be given.

21. Why can a triangle not have two right angles?

Answer:

1. Two right angles have a total measure of $90^\circ + 90^\circ = 180^\circ$.
2. Since all three angles of a triangle total 180°, **no positive angle would remain for the third angle**.

22. If two angles of a triangle are $36^\circ$and 72°, find the third angle.

Answer:

1. By the angle sum property, the third angle is $180^\circ - (36^\circ + 72^\circ)$.
2. Hence, the third angle is $\boxed{72^\circ}$.

23. If $\angle B = \angle C$and $\angle A = 50^\circ$, find $\angle B$and $\angle C$.

Answer:

1. $\angle B + \angle C = 180^\circ - 50^\circ = 130^\circ$.
2. Since $\angle B = \angle C$, each angle is $130^\circ \div 2 = \boxed{65^\circ}$.

24. Why can an equilateral triangle not be right-angled?

Answer:

1. All three angles of an equilateral triangle are equal, so each measures $180^\circ \div 3 = 60^\circ$.
2. Therefore, it cannot be right-angled because **none of its angles measures** 90°.

7.8. Two-mark questions with Answers of HOTS Type: (24 Questions)

Two-Mark Descriptive Questions with Answers – HOTS Type:

1. Can sides 5 cm, 7 cm, and 13 cm form a triangle? Justify.

Answer:

1. The sum of the two smaller sides is $5 + 7 = 12$cm, which is less than 13 cm.
2. Therefore, the triangle inequality is not satisfied and **a triangle cannot be formed**.

2. A student says that sides 6 cm, 8 cm, and 14 cm can form a triangle because $6 + 8 = 14$. Is the student correct?

Answer:

1. No, because the sum of the two smaller sides must be **greater than**, not equal to, the longest side.
2. Since $6 + 8 = 14$, the sides lie along a straight line and **do not form a triangle**.

3. Two sides of a triangle are 4 cm and 7 cm. Can 2 cm be the third side? Explain.

Answer:

1. If the third side is 2 cm, then the two smaller sides give $2 + 4 = 6 < 7$.
2. Hence, the triangle inequality fails and **2 cm cannot be the third side**.

4. Why is it sufficient to compare the longest side with the sum of the other two sides while checking whether a triangle exists?

Answer:

1. The two shorter sides are automatically smaller than a sum containing the longest side.
2. Therefore, the crucial test is whether the **sum of the two smaller sides is greater than the longest side**.

5. During construction, two circles drawn from the endpoints of a base do not intersect. What can you conclude?

Answer:

1. The two radii together are not sufficiently long to produce an intersection that forms a triangle.

2. Hence, the given side lengths **do not satisfy the required triangle inequality and no triangle can be constructed**.

6. Two circles used for triangle construction touch at exactly one point. Why does this not produce a proper triangle?

Answer:

1. In this case, the sum of the two smaller lengths equals the longest side.
2. The three vertices become collinear, so **a proper triangle is not formed**.

7. Two angles of a triangle are $85°$and $70°$. Find the third angle and classify the triangle by angles.

Answer:

1. The third angle is $180° - (85° + 70°) = 25°$.
2. Since all three angles are less than $90°$, it is an **acute-angled triangle**.

8. Can $95°$and $90°$be two angles of the same triangle? Explain.

Answer:

1. Their sum is $95° + 90° = 185°$, which is greater than $180°$.
2. Therefore, **no triangle can have these two angles**.

9. If two angles of a triangle are equal and the third angle is $40°$, find the equal angles.

Answer:

1. The sum of the two equal angles is $180° - 40° = 140°$.
2. Therefore, each equal angle is $140° \div 2 = \boxed{70°}$.

10. A student claims that a triangle can have angles $70°$, $70°$,and $70°$. Explain the error.

Answer:

1. The sum of the proposed angles is $70° + 70° + 70° = 210°$.
2. Since the angles of a triangle must total $180°$, **such a triangle cannot exist**.

11. If one angle of a triangle is $120°$, what can you conclude about the other two angles?

Answer:

1. The other two angles together must measure $180° - 120° = 60°$.
2. Therefore, both remaining angles must be **acute angles**.

12. Can a triangle have two obtuse angles? Give a mathematical reason.

Answer:

1. Each obtuse angle is greater than $90°$, so two obtuse angles together would exceed $180°$.
2. Hence, a triangle **cannot contain two obtuse angles** because its total angle sum is $180°$.

13. Can a triangle have two right angles? Justify your answer.

Answer:

1. Two right angles already have a sum of $90° + 90° = 180°$.
2. This leaves $0°$for the third angle, so **such a triangle cannot exist**.

14. An exterior angle of a triangle is $125°$and one of its opposite interior angles is $55°$. Find the other opposite interior angle.

Answer:

1. An exterior angle equals the sum of the two opposite interior angles, so $125° = 55° + x$.
2. Therefore, $x = 125° - 55° = \boxed{70°}$.

15. An interior angle of a triangle is $65°$. Find its adjacent exterior angle and explain.

Answer:

1. The interior angle and its adjacent exterior angle together form a straight angle of $180°$.
2. Hence, the exterior angle is $180° - 65° = \boxed{115°}$.

16. An exterior angle is $100°$, and its two opposite interior angles are equal. Find each opposite angle.
Answer:
1. Since the exterior angle equals the sum of the two opposite interior angles, their total is $100°$.
2. As they are equal, each angle measures $100° \div 2 = \boxed{50°}$.

17. A triangle has angles $45°, 45°$, and $90°$. Classify it both by sides and by angles.
Answer:
1. Since two angles are equal, the triangle is **isosceles**.
2. Since one angle is 90°, it is also a **right-angled triangle**.

18. Can an equilateral triangle also be an obtuse-angled triangle? Explain.
Answer:
1. In an equilateral triangle, all three angles are equal and hence each measures $180° \div 3 = 60°$.
2. Since $60° < 90°$, an equilateral triangle is **acute-angled and cannot be obtuse-angled**.

19. If one acute angle of a right-angled triangle is 38°, find the other acute angle.
Answer:
1. The two acute angles of a right triangle together measure $180° - 90° = 90°$.
2. Therefore, the other acute angle is $90° - 38° = \boxed{52°}$.

20. In a right triangle, one acute angle increases from $35°$ to $45°$. What happens to the other acute angle?
Answer:
1. Initially the other angle is $90° - 35° = 55°$, while afterward it becomes $90° - 45° = 45°$.
2. Therefore, the other acute angle **decreases by** $10°$.

21. Why does changing the length of the included side not change the third angle when two angles are fixed?
Answer:
1. The third angle is determined by $180° -$ (sum of the two given angles).
2. Therefore, changing the included side length **does not affect the measure of the third angle**.

22. A student draws AD from vertex A to side BC, but $\angle ADB = 70°$. Can AD be called an altitude? Explain.
Answer:
1. An altitude must be **perpendicular** to the opposite side and therefore must form a $90°$ angle with it.
2. Since $\angle ADB = 70°$, AD **cannot be an altitude**.

23. Study the figure. Which segment is the altitude, and why?

```
    A
   /|\
  / | \
 /  |  \
B---D---C
    ⊥
```

Answer:
1. AD is the altitude because it is drawn from vertex A to the opposite side BC.
2. Since $AD \perp BC$, it forms a $90°$ **angle at** D.

24. If the two smaller sides of a triangle are increased while the longest side remains unchanged, how can this affect triangle formation?

Answer:

1. Increasing the two smaller sides increases their sum relative to the longest side.
2. Once their sum becomes **greater than the longest side**, the triangle inequality is satisfied and a triangle can be constructed.

7.9. Three-mark questions with Answers of LOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain the basic features of a triangle.

Answer:

1. A triangle is a **closed figure formed by three line segments**.
2. It has **three sides and three vertices**.
3. The three sides meet to form **three interior angles**.

2. Explain how a triangle can be constructed when its three side lengths are given.

Answer:

1. Draw one of the given sides as the **base** AB.
2. With A and B as centres, draw arcs having radii equal to the other two given sides so that they intersect at C.
3. Join AC and BC to obtain the required $\triangle ABC$.

```
   C
  / \
 /   \
/     \
A-------B
   Base
```

The chapter notes that a compass simplifies triangle construction when the side lengths are given.

3. State and explain the triangle inequality.

Answer:

1. The length of each side of a triangle must be **less than the sum of the other two sides**.
2. For sides a, b, c, the conditions are $a < b + c$, $b < a + c$, $c < a + b$.
3. If the given lengths satisfy these conditions, **a triangle can be constructed** with those side lengths.

4. Check whether sides 5 cm, 10 cm, and 12 cm can form a triangle.

Answer:

1. Arrange the sides and identify the longest side as **12 cm**.
2. Add the two smaller sides: $5 + 10 = 15$cm.
3. Since $15 > 12$, the triangle inequality is satisfied and **a triangle can be formed**.

5. Check whether sides 3 cm, 6 cm, and 9 cm can form a triangle.

Answer:

1. The longest side is **9 cm**.
2. The sum of the two smaller sides is $3 + 6 = 9$cm.
3. Since the sum is not greater than the longest side, **a proper triangle cannot be formed**.

6. Explain how a triangle is constructed when two sides and their included angle are given.

Answer:

1. Draw one of the given sides, say AB, of the required length.
2. At A, construct the **given included angle** and mark C on its ray so that AC equals the second given side.
3. Join B to C to obtain the required $\triangle ABC$.

C

```
      /
     /  Given side
    /
   A-------------B
    \)
  Given angle
```

7. Explain how a triangle is constructed when two angles and their included side are given.
Answer:
1. Draw the given included side AB of the required length.
2. Construct the two given angles at A and B, producing two rays.
3. Let the rays intersect at C; joining them with AB gives the required $\triangle ABC$.

8. State the condition under which two given angles can belong to a triangle.
Answer:
1. Add the measures of the **two given angles**.
2. If their sum is **less than** 180°, a triangle can exist with those angles.
3. If their sum is **greater than or equal to** 180°, no such triangle exists.

9. Explain the angle sum property of a triangle.
Answer:
1. Consider the three interior angles $\angle A, \angle B, \angle C$ of $\triangle ABC$.
2. The sum of these three angles is always a **straight angle**.
3. Therefore, $\boxed{\angle A + \angle B + \angle C = 180^\circ}$.

10. Find the third angle of a triangle if the other two angles are 36° and 72°.
Answer:
1. By the angle sum property, $\angle A + \angle B + \angle C = 180^\circ$.
2. The third angle is $180^\circ - (36^\circ + 72^\circ) = 180^\circ - 108^\circ$.
3. Therefore, the third angle is $\boxed{72^\circ}$.

11. If $\angle B = \angle C$ and $\angle A = 50^\circ$, find $\angle B$ and $\angle C$.
Answer:
1. The sum of $\angle B$ and $\angle C$ is $180^\circ - 50^\circ = 130^\circ$.
2. Since $\angle B = \angle C$, divide 130° equally: $130^\circ \div 2 = 65^\circ$.
3. Therefore, $\boxed{\angle B = \angle C = 65^\circ}$.

12. Define an exterior angle and explain how to find it from its adjacent interior angle.
Answer:
1. An exterior angle is formed between the **extension of one side of a triangle and its adjacent side**.
2. The exterior angle and its adjacent interior angle together form a straight angle of 180°.
3. Hence, $\boxed{\text{Exterior angle} = 180^\circ - \text{adjacent interior angle}}$.

```
     A
    / \
   /   \
  B-----C----------D
         \
 ∠ACD = Exterior angle
```

13. Find the exterior angle at C if $\angle A = 50^\circ$ and $\angle B = 60^\circ$.
Answer:
1. First find the interior angle: $\angle ACB = 180^\circ - (50^\circ + 60^\circ) = 70^\circ$.
2. $\angle ACB$ and exterior angle $\angle ACD$ together equal 180°.
3. Therefore, $\angle ACD = 180^\circ - 70^\circ = \boxed{110^\circ}$.

14. What is an altitude of a triangle? Explain with a figure.

Answer:

1. An altitude is a **perpendicular line segment drawn from a vertex to its opposite side**.
2. In $\triangle ABC$, if $AD \perp BC$, then $AD$is an altitude.
3. The length ADrepresents the **height of vertex $A$from side BC**.

```
   A
  /|\
 / | \
/  |  \
B---D---C
   ⊥
```

AD ⊥ BC

15. Explain the classification of triangles according to their side lengths.

Answer:

1. An **equilateral triangle** has all three sides equal.
2. An **isosceles triangle** has two sides equal.
3. A **scalene triangle** has all three sides of different lengths.

16. Explain the classification of triangles according to their angles.

Answer:

1. An **acute-angled triangle** has all its angles acute.
2. A **right-angled triangle** has one right angle.
3. An **obtuse-angled triangle** has one obtuse angle.

17. Explain why each angle of an equilateral triangle is 60°.

Answer:

1. All three angles of an equilateral triangle are equal.
2. The sum of the three angles of any triangle is 180°.
3. Therefore, each angle measures $180^\circ \div 3 = \boxed{60^\circ}$.

18. Find the third angle and classify a triangle whose two angles are $90^\circ$and 30°.

Answer:

1. The third angle is $180^\circ - (90^\circ + 30^\circ)$.
2. Thus, the third angle is $\boxed{60^\circ}$.
3. Since one angle is 90°, it is a **right-angled triangle**.

19. Explain what happens to construction circles when three given side lengths satisfy the triangle inequality.

Answer:

1. Take the longest given side as the base and the other two lengths as radii of circles centred at its endpoints.
2. When the triangle inequality is satisfied, the sum of the two smaller lengths is greater than the longest length.
3. The circles therefore **intersect**, providing the third vertex of the required triangle.

20. Explain why a compass is useful in constructing triangles with given side lengths.

Answer:

1. A compass can be set to a **given side length** and used to draw an accurate arc.
2. Arcs drawn from the two endpoints of the base locate the possible **third vertex**.
3. Thus, the compass makes triangle construction **simpler and more systematic** when side lengths are given.

7.10. Three-mark questions with Answers of HOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers – HOTS Type:

1. A student wants to construct a triangle with sides 6 cm, 8 cm, and 15 cm. Determine whether the construction is possible and justify your answer.

Answer:

1. The longest side is **15 cm**, while the sum of the other two sides is $6 + 8 = 14$cm.
2. Since $14 < 15$, the given lengths **do not satisfy the triangle inequality**.
3. Therefore, the construction is **not possible**, as the required arcs will not intersect to form the third vertex.

2. Two sides of a triangle are 5 cm and 9 cm. Can its third side be 3 cm, 6 cm, or 15 cm? Analyse each case.

Answer:

1. For 3 cm, $3 + 5 = 8 < 9$, so **3 cm is not possible**.
2. For 6 cm, $5 + 6 = 11 > 9$, so **6 cm is possible**.
3. For 15 cm, $5 + 9 = 14 < 15$, so **15 cm is not possible**.

3. A student says that 7 cm, 9 cm, and 16 cm can form a triangle because all three lengths are positive. Analyse the statement.

Answer:

1. The sum of the two smaller sides is $7 + 9 = 16$cm.
2. For a triangle, this sum must be **greater than** the longest side, whereas here it is equal to it.
3. Therefore, the three lengths **cannot form a proper triangle**, and the student's reasoning is incorrect.

4. Three sticks have lengths 4 cm, 7 cm, and 9 cm. Explain how you would decide whether they can form a triangle before actually joining them.

Answer:

1. Identify the longest stick, which is **9 cm**, and add the other two lengths: $4 + 7 = 11$cm.
2. Since $11 > 9$, the lengths satisfy the required **triangle inequality**.
3. Hence, the three sticks **can be joined to form a triangle**.

5. During a construction, two arcs drawn from the endpoints of a base do not intersect. Explain what this indicates about the given side lengths.

```
( arc )        ( arc )
  )              (
 )                (
A------------------------B
     Base
 No intersection
```

Answer:

1. The endpoints $A$and $B$are separated by the length of the chosen base, while the two arc radii represent the other two sides.
2. If the arcs do not meet, the two side lengths are **not sufficient to reach a common third vertex**.
3. Hence, the given lengths do not satisfy the condition needed to construct the required triangle.

6. Two angles of a triangle are $65°$and $75°$. Find the third angle and classify the triangle according to its angles.

Answer:

1. Using the angle sum property, the third angle is $180° - (65° + 75°)$.
2. Therefore, the third angle is $180° - 140° = \boxed{40°}$.
3. Since all three angles are less than $90°$, the triangle is an **acute-angled triangle**.

7. A student proposes $95°$, $45°$, and $40°$as the angles of a triangle. Verify the proposal and classify the triangle.

Answer:
1. Their sum is $95^\circ + 45^\circ + 40^\circ = 180^\circ$.
2. Therefore, the three angles satisfy the **angle sum property of a triangle**.
3. Since one angle is greater than 90°, it is an **obtuse-angled triangle**.

8. Can $100^\circ$and 85°be two angles of the same triangle? Explain using the angle sum property.

Answer:
1. The sum of the two given angles is $100^\circ + 85^\circ = 185^\circ$.
2. This sum is already greater than the total 180°available for all three angles of a triangle.
3. Therefore, **no triangle can be constructed** with $100^\circ$and 85°as two of its angles.

9. One angle of a triangle is 120°. What can you infer about the other two angles and the type of triangle?

Answer:
1. The sum of the remaining two angles is $180^\circ - 120^\circ = \boxed{60^\circ}$.
2. Since both remaining angles must be positive and together total 60°, **each must be acute**.
3. Since the triangle contains a 120°angle, it is an **obtuse-angled triangle**.

10. In an isosceles triangle, two equal angles are 55°each. Find the third angle and classify the triangle by angles.

Answer:
1. The sum of the two equal angles is $55^\circ + 55^\circ = 110^\circ$.
2. The third angle is $180^\circ - 110^\circ = \boxed{70^\circ}$.
3. Since $55^\circ, 55^\circ$,and $70^\circ$are all less than 90°, it is an **acute-angled triangle**.

11. An exterior angle of a triangle is 130°, and one opposite interior angle is 55°. Find the other opposite interior angle.

```
        A
       / \
  55° /   \
     /     \
   B-------C----------D
           130°
```

Answer:
1. An exterior angle equals the **sum of the two opposite interior angles**.
2. Therefore, $130^\circ = 55^\circ + \angle A$(the other opposite interior angle).
3. Hence, the other opposite interior angle is $130^\circ - 55^\circ = \boxed{75^\circ}$.

12. An exterior angle of a triangle measures 125°. Find its adjacent interior angle and explain the relationship.

Answer:
1. An exterior angle and its adjacent interior angle form a **straight angle of** 180°.
2. Hence, the adjacent interior angle is $180^\circ - 125^\circ$.
3. Therefore, the adjacent interior angle is $\boxed{55^\circ}$.

13. The two opposite interior angles corresponding to an exterior angle are $48^\circ$and 67°. Find both the exterior angle and its adjacent interior angle.

Answer:
1. The exterior angle is $48^\circ + 67^\circ = \boxed{115^\circ}$.
2. The adjacent interior angle is $180^\circ - 115^\circ = \boxed{65^\circ}$.
3. Thus, $48^\circ + 67^\circ + 65^\circ = 180^\circ$, confirming the triangle angle relationship.

14. A triangle has angles 45°, 45°, and 90°. Classify it by both sides and angles, giving reasons.

Answer:

1. Since two angles are equal, the sides opposite those equal angles are equal, so the triangle is **isosceles**.
2. Since one angle measures $90°$, it is also a **right-angled triangle**.
3. Therefore, it is an **isosceles right-angled triangle**.

15. Explain why an equilateral triangle cannot be a right-angled or an obtuse-angled triangle.

Answer:

1. In an equilateral triangle, all three angles are equal, so each measures $180° \div 3 = 60°$.
2. A right triangle requires a $90°$angle, while an obtuse triangle requires an angle greater than $90°$.
3. Since all its angles are $60°$, an equilateral triangle is **always acute-angled**.

16. A student draws $AD$from vertex $A$to side BC, but $\angle ADB = 75°$. Can ADbe an altitude? Explain.

```
   A
  /|
 / |
/  |
B---D------C
 75°
```

Answer:

1. An altitude must be drawn from a vertex **perpendicular to the opposite side**.
2. Therefore, an altitude from $A$to BCmust make an angle of $90°$at D.
3. Since $\angle ADB = 75°$, $AD$is **not an altitude** of the triangle.

17. Two triangles have the same two angles, $50°$and $60°$, but different included side lengths. Will their third angles be different? Explain.

Answer:

1. In each triangle, the third angle is $180° - (50° + 60°) = 70°$.
2. The third angle depends on the **two given angles**, not on the length of the included side.
3. Therefore, both triangles have the **same third angle of** $70°$even though their included sides differ.

18. A right-angled triangle has one acute angle of $32°$. Find the other acute angle and explain why both cannot be greater than $45°$.

Answer:

1. The other acute angle is $180° - (90° + 32°) = \boxed{58°}$.
2. The two acute angles of a right triangle must always add up to $90°$.
3. Therefore, both cannot be greater than $45°$, because their sum would then be greater than $90°$.

19. The angles of a triangle are in such a way that two are equal and the third is $80°$. Find all three angles and classify the triangle.

Answer:

1. The two equal angles together measure $180° - 80° = 100°$.
2. Each equal angle is $100° \div 2 = \boxed{50°}$, so the angles are $50°, 50°, 80°$.
3. Since all angles are below $90°$, it is an **acute-angled triangle**.

20. Three lengths are 10 cm, 15 cm, and 30 cm. A student checks only $10 < 15 + 30$and concludes that a triangle exists. Identify the mistake.

Answer:

1. Although $10 < 15 + 30$and $15 < 10 + 30$, the longest side must also satisfy the triangle inequality.

2. For the longest side, $30 > 10 + 15 = 25$, so the required condition fails.
3. Therefore, **10 cm, 15 cm, and 30 cm cannot form a triangle**, and checking only one inequality is insufficient.

7.11 Five-mark questions with Answers of LOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain how to construct a triangle when the lengths of all three sides are given.

Answer:

1. Draw one of the given sides, preferably the **longest side** AB, as the base.
2. Set the compass to the length of the second side and, with A **as centre**, draw an arc.
3. Set the compass to the length of the third side and, with B **as centre**, draw another arc intersecting the first at C.
4. Join A to C and B to C using a ruler.
5. Thus, $\triangle ABC$ having the **three given side lengths** is constructed.

```
      C
     / \
    /   \
   /     \
  /       \
A---------B
   Base
```

---

2. Explain the triangle inequality and how it is used to determine whether three given lengths can form a triangle.

Answer:

1. The **triangle inequality** states that each side of a triangle must be smaller than the sum of the other two sides.
2. For three lengths a, b, c, we check $a < b + c$, $b < a + c$, and $c < a + b$.
3. If all three inequalities are satisfied, the three lengths **can form a triangle**.
4. For example, 3 cm, 4 cm, and 5 cm satisfy the triangle inequality because each length is smaller than the sum of the other two.
5. If even one required inequality fails, as with 10 cm, 15 cm, and 30 cm, **a triangle cannot be formed**.

---

3. Describe the construction of a triangle when two sides and the included angle are given.

Answer:

1. Suppose AB, AC, and the included angle $\angle BAC$ are given.
2. Draw the given side AB accurately using a ruler.
3. At A, construct a ray making the **given included angle** with AB.
4. On this ray, mark C such that AC is equal to the given length of the second side.
5. Join B to C to obtain the required $\triangle ABC$.

```
    C
   /
  /  AC
 /
/ θ
A-----------B
    AB
```

---

4. Describe the construction of a triangle when two angles and the included side are given.
Answer:

1. Suppose the included side AB and angles $\angle A$ and $\angle B$ are given.
2. Draw AB equal to the **given length**.
3. At A, construct a ray making the given angle $\angle A$ with AB.
4. At B, construct another ray making the given angle $\angle B$ with BA; let the two rays intersect at C.
5. The figure formed is the required $\triangle ABC$ with the **given two angles and included side**.

```
      C
     / \
    /   \
   /     \
∠A/       \∠B
 A---------B
Included side
```

---

5. Explain the angle sum property of a triangle and use it to find the third angle when two angles are $50°$ and $70°$.
Answer:

1. The **angle sum property** states that the sum of the three interior angles of a triangle is $180°$.
2. Therefore, $\angle A + \angle B + \angle C = 180°$.
3. Here, the two given angles are $50°$ and $70°$, whose sum is $120°$.
4. The third angle is $180° - 120° = 60°$.
5. Hence, the measure of the **third angle is** $\boxed{60°}$.

---

6. Explain the exterior angle of a triangle and its relationship with the interior angles.
Answer:

1. An **exterior angle** is formed when one side of a triangle is extended beyond a vertex.
2. In the figure, extending BC to D forms exterior angle $\angle ACD$.
3. The exterior angle and its adjacent interior angle form a straight angle, so $\angle ACD + \angle ACB = 180°$.
4. The three interior angles also satisfy $\angle A + \angle B + \angle ACB = 180°$.
5. Hence, the exterior angle equals the **sum of the two opposite interior angles**, i.e., $\boxed{\angle ACD = \angle A + \angle B}$.

```
    A
   / \
  /   \
 /     \
B-------C----------D
         \
      Exterior
       angle
```

---

7. What is an altitude of a triangle? Explain how to draw the altitude from a vertex.
Answer:

1. An **altitude** is a perpendicular line segment drawn from a vertex to the opposite side of a triangle.
2. Consider $\triangle ABC$ and choose vertex A.

3. Draw a perpendicular from $A$to the opposite side BC, meeting it at D.
4. Since $AD \perp BC$, $\angle ADB = 90°$, and $AD$is an altitude of the triangle.
5. The length ADrepresents the **height of vertex** A**from side** BC.

```
     A
    /|\
   / | \
  /  |  \
 /   |   \
B----D---C
     ⊥
   AD ⊥ BC
```

---

8. Explain the classification of triangles based on their sides and angles.
Answer:

1. An **equilateral triangle** has all three sides equal in length.
2. An **isosceles triangle** has two equal sides, while a **scalene triangle** has three different side lengths.
3. An **acute-angled triangle** has all its angles acute.
4. A **right-angled triangle** has one right angle.
5. An **obtuse-angled triangle** has one obtuse angle.

---

9. Explain what happens when construction circles are used to test whether three given side lengths can form a triangle.
Answer:

1. Take the **longest given length as the base** and draw it as a line segment.
2. Draw circles or arcs from the two endpoints using the other two side lengths as radii.
3. If the sum of the two smaller lengths is **greater than the base**, the circles intersect and a triangle can be formed.
4. If their sum is **equal to the base**, the circles touch and a proper triangle is not formed.
5. If their sum is **less than the base**, the circles do not meet and no triangle can be formed.

---

10. Explain how to determine whether two given angles can be part of a triangle.
Answer:

1. Let the two given angles be $\angle A$and $\angle B$.
2. Add their measures to obtain $\angle A + \angle B$.
3. If their sum is **less than** $180°$, a positive third angle remains and a triangle can be formed.
4. The third angle is calculated as $\angle C = 180° - (\angle A + \angle B)$.
5. If the sum of the two given angles is $180°$**or more**, a triangle cannot be formed.

7.12 Five-mark questions with Answers of HOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – HOTS Type:
1. A student wants to construct a triangle using sticks of lengths 7 cm, 10 cm, and 18 cm. Analyse whether the construction is possible and explain what would happen during compass construction.
Answer:

1. The longest side is **18 cm**, so compare it with the sum of the other two sides.
2. The sum of the two smaller sides is $7 + 10 = 17$cm.
3. Since $17 < 18$, the given lengths **do not satisfy the triangle inequality**.

4. If 18 cm is drawn as the base and arcs of radii 7 cm and 10 cm are drawn from its endpoints, the arcs **will not intersect**.
5. Therefore, no common third vertex is obtained and **a triangle with these side lengths cannot be constructed**.

---

2. Two sides of a triangle are 5 cm and 8 cm. Analyse whether 2 cm, 6 cm, and 13 cm can separately be used as the third side.
Answer:
1. If the third side is 2 cm, $2 + 5 = 7 < 8$, so **2 cm cannot be the third side**.
2. If the third side is 6 cm, the longest side is 8 cm and $5 + 6 = 11 > 8$, so **6 cm can be the third side**.
3. If the third side is 13 cm, $5 + 8 = 13$, which gives equality rather than the required greater-than condition.
4. Hence, **13 cm cannot form a proper triangle**, because the three vertices would lie along a straight line.
5. Therefore, among the three proposed values, **only 6 cm can be the third side**.

---

3. A student claims that sides 10 cm, 15 cm, and 30 cm form a triangle because $10 < 15 + 30$and $15 < 10 + 30$. Examine the claim.
Answer:
1. The student has correctly checked that $10 < 15 + 30$.
2. The student has also correctly checked that $15 < 10 + 30$.
3. However, the third condition gives $30 < 10 + 15$, or $30 < 25$, which is **false**.
4. The triangle inequality requires **each side to be smaller than the sum of the other two sides**.
5. Therefore, the student's conclusion is incorrect and **10 cm, 15 cm, and 30 cm cannot form a triangle**.

---

4. Two angles of a triangle are $75^\circ$and 45°. Find the third angle, classify the triangle by angles, and explain whether changing the included side changes the third angle.
Answer:
1. By the angle sum property, the third angle is $180^\circ - (75^\circ + 45^\circ)$.
2. Therefore, the third angle is $\boxed{60^\circ}$.
3. All three angles—$75^\circ, 45^\circ$, and 60°—are less than 90°, so it is an **acute-angled triangle**.
4. Changing the length of the included side does not change the sum of the two given angles.
5. Hence, the third angle **remains** 60°irrespective of the length of the included side.

---

5. A student tries to construct a triangle with two angles $110^\circ$and $75^\circ$and an included side of 6 cm. Analyse why the construction fails.
Answer:
1. Add the two given angles: $110^\circ + 75^\circ = 185^\circ$.
2. The sum of the two given angles is already **greater than** 180°.
3. Using the angle sum property would give the third angle as $180^\circ - 185^\circ = -5^\circ$, which is impossible for a triangle.
4. Therefore, the rays constructed at the ends of the included side cannot meet in the required way to produce a triangle.
5. Hence, **no triangle can be constructed** with $110^\circ$and 75°as two of its angles.

6. In $\triangle ABC$, side BC is extended to D. If $\angle A = 55°$ and $\angle B = 65°$, find $\angle ACB$ and exterior angle $\angle ACD$, and verify the exterior-angle relationship.

```
        A
       / \
  55° /   \
     /     \
    B-------C----------D
  65°       ∠ACD
```

Answer:

1. Using the angle sum property, $\angle ACB = 180° - (55° + 65°)$.
2. Thus, $\angle ACB = \boxed{60°}$.
3. Since $\angle ACB$ and $\angle ACD$ form a straight angle, $\angle ACD = 180° - 60° = \boxed{120°}$.
4. The two opposite interior angles have sum $55° + 65° = 120°$.
5. Hence, $\boxed{\angle ACD = \angle A + \angle B = 120°}$, verifying the exterior-angle relationship.

7. An exterior angle of a triangle is $140°$, and the two opposite interior angles are equal. Determine all three interior angles and classify the triangle.

Answer:

1. The exterior angle equals the sum of the two opposite interior angles, so their total is $140°$.
2. Since the two opposite angles are equal, each measures $140° \div 2 = \boxed{70°}$.
3. The interior angle adjacent to the exterior angle is $180° - 140° = \boxed{40°}$.
4. Thus, the three interior angles are $70°, 70°$, and $40°$, all of which are less than $90°$.
5. Therefore, the triangle is **acute-angled**; it also has two equal angles.

8. A triangle has one angle of $120°$, and the other two angles are equal. Find the equal angles and analyse the type of triangle.

Answer:

1. The sum of the other two angles is $180° - 120° = \boxed{60°}$.
2. Since the remaining angles are equal, each measures $60° \div 2 = \boxed{30°}$.
3. Therefore, the three angles are $120°, 30°$, and $30°$.
4. Since one angle is greater than $90°$, the triangle is **obtuse-angled**.
5. The two equal angles also show that the triangle has **two equal corresponding sides**, so it is isosceles.

9. A student draws AD from vertex A to side BC and calls it an altitude, but $\angle ADB = 65°$. Analyse the student's claim and explain how it should be corrected.

```
       A
      /|
     / |
    /  |
   /   |
  B----D------C
      65°
```

Answer:

1. An altitude must be a line segment drawn from a **vertex to the opposite side**.
2. It must be **perpendicular** to the opposite side.
3. Therefore, an altitude from A to BC must make a $90°$ angle at its foot.

4. Since $\angle ADB = 65°$, the segment ADshown is **not an altitude**.
5. The student should redraw ADso that $\boxed{AD \perp BC}$and $\angle ADB = 90°$.

---

10. Explain why an equilateral triangle can neither be right-angled nor obtuse-angled.
Answer:

1. In an equilateral triangle, **all three sides are equal**, and its three angles are equal.
2. By the angle sum property, the sum of its three angles is $180°$.
3. Therefore, each angle measures $180° \div 3 = \boxed{60°}$.
4. A right-angled triangle requires one angle of $90°$, while an obtuse-angled triangle requires one angle greater than $90°$.
5. Since all three angles of an equilateral triangle are $60°$, it is **always acute-angled and can be neither right-angled nor obtuse-angled**.

7.13 Five-mark questions with Answers of Applied Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – Applied Type:
1. A carpenter has three wooden strips of lengths 6 cm, 8 cm, and 12 cm. He wants to join them to make a triangular frame. Determine whether this is possible and explain how he can verify it.
Answer:

1. The longest wooden strip is **12 cm**, so the sum of the other two strips must be compared with it.
2. The sum of the two smaller strips is $6 + 8 = 14$cm.
3. Since $14 > 12$, the three lengths satisfy the **triangle inequality**.
4. The carpenter can place the 12 cm strip as the base and bring the ends of the 6 cm and 8 cm strips together above the base.
5. Therefore, the three strips **can form a triangular frame** because their lengths satisfy the condition required for a triangle.

---

2. Riya has three sticks measuring 5 cm, 7 cm, and 13 cm for making a triangular decoration. Will she succeed? Suggest what must change for a triangle to become possible.
Answer:

1. The longest stick is **13 cm**, while the other two sticks measure 5 cm and 7 cm.
2. Their sum is $5 + 7 = 12$cm, which is **less than 13 cm**.
3. Hence, the sticks do not satisfy the triangle inequality, so **a triangle cannot be formed**.
4. Keeping the 5 cm and 7 cm sticks unchanged, the longest stick must be **shorter than 12 cm** for a triangle to be possible.
5. For example, replacing the 13 cm stick with a **10 cm stick** gives $5 + 7 > 10$, allowing a triangular decoration to be made.

---

3. A triangular road sign has two interior angles measuring 50°and 60°. Find the third interior angle and the exterior angle formed by extending the side at the third vertex.

```
          A
         / \
    50° /   \ 70°
       /     \
      B-------C----------D
     60°       Exterior
```

Answer:

1. The sum of the interior angles of a triangle is $180°$.

2. Therefore, the third angle is $180^\circ - (50^\circ + 60^\circ) = \boxed{70^\circ}$.
3. The 70°interior angle and its adjacent exterior angle form a straight angle of 180°.
4. Hence, the exterior angle is $180^\circ - 70^\circ = \boxed{110^\circ}$.
5. This can also be verified because the exterior angle equals the sum of the two opposite interior angles: $50^\circ + 60^\circ = \boxed{110^\circ}$.

---

4. An architect wants a triangular design with two angles of $65^\circ$and 75°. Find the third angle, decide whether the design is possible, and classify the triangle according to its angles.

Answer:

1. The sum of the two specified angles is $65^\circ + 75^\circ = 140^\circ$.
2. Since $140^\circ < 180^\circ$, the two angles **can belong to a triangle**.
3. The third angle is $180^\circ - 140^\circ = \boxed{40^\circ}$.
4. The three angles are therefore $65^\circ, 75^\circ$,and 40°.
5. Since all three angles are less than 90°, the design forms an **acute-angled triangle**.

---

5. A triangular flag has an exterior angle of 130°. One of the two opposite interior angles is 55°. Find the other opposite interior angle and the interior angle adjacent to the exterior angle.

```
        A
       / \
  55° /   \
     /     \
    B-------C----------D
            130°
```

Answer:

1. An exterior angle of a triangle equals the **sum of its two opposite interior angles**.
2. Therefore, the other opposite interior angle is $130^\circ - 55^\circ = \boxed{75^\circ}$.
3. The interior angle adjacent to the 130°exterior angle is $180^\circ - 130^\circ = \boxed{50^\circ}$.
4. The three interior angles are therefore $55^\circ, 75^\circ$,and 50°.
5. Their sum is $55^\circ + 75^\circ + 50^\circ = 180^\circ$, confirming the **angle sum property**.

---

6. A student wants to make a triangular model using two rods of 4 cm and 5 cm and another rod of variable length. Explain how the student can choose a suitable third rod.

Answer:

1. The three rod lengths must satisfy the **triangle inequality** for a triangular model to be formed.
2. The third rod must be short enough so that its length is less than $4 + 5 = 9$cm.
3. It must also be long enough so that, together with the 4 cm rod, its length exceeds 5 cm.
4. For example, a **6 cm rod** works because $4 + 5 > 6$, $4 + 6 > 5$,and $5 + 6 > 4$.
5. Therefore, rods of **4 cm, 5 cm, and 6 cm** can successfully be used to construct the triangular model.

---

7. A designer wants to make an equilateral triangular tile. If one angle is accidentally made 70°, can the tile still be equilateral? Explain.

Answer:

1. In an equilateral triangle, **all three sides are equal**.
2. Its three angles are also equal, and their total must be 180°.
3. Therefore, each angle of an equilateral triangle must measure $180^\circ \div 3 = \boxed{60^\circ}$.

4. An angle of $70°$ does not satisfy this requirement.
5. Hence, a triangular tile containing a $70°$ angle **cannot be an equilateral triangle**.

---

8. A surveyor wants to measure the height of vertex A of a triangular plot from boundary BC. Explain how the altitude helps in obtaining the required measurement.

```
          A
         /|\
        / | \
       /  |  \
      /   |   \
     B----D---C
          ⊥
      AD ⊥ BC
```

Answer:

1. The boundary BC is considered the **opposite side** to vertex A.
2. A perpendicular segment AD is drawn from A to BC, meeting it at D.
3. Since $AD \perp BC$, the angle at D is $90°$.
4. The segment AD is therefore an **altitude of** $\triangle ABC$.
5. The length of AD gives the **height of vertex A from the boundary** BC.

---

9. A craft student has to construct a triangular card with $AB = 5\text{cm}$, $AC = 4\text{cm}$, and $\angle BAC = 45°$. Describe how the card can be constructed.

Answer:

1. Draw the line segment $AB = 5\text{cm}$ using a ruler.
2. At A, construct an angle of $45°$ with AB.
3. Along the new ray, mark point C so that $AC = 4\text{cm}$.
4. Join points B and C using a ruler.
5. The resulting $\triangle ABC$ is the required triangular card with **two given sides and their included angle**.

```
       C
      /
  4 cm/
    /
 45° /
   A-----------B
       5 cm
```

---

10. A triangular support has one right angle and another angle of $35°$. Find its third angle and classify the triangle according to its angles.

Answer:

1. Since it is a right-angled triangle, one angle measures $90°$.
2. The second angle is given as $35°$.
3. By the angle sum property, the third angle is $180° - (90° + 35°)$.
4. Therefore, the third angle is $\boxed{55°}$.
5. The angles are $90°, 35°$, and $55°$, so the support forms a **right-angled triangle**.

7.14 Multiple Choice Questions with answers for Olympiad type Competitive Exams: (20 MCQs of LOTS & 20 MCQs of HOTS Type)

Olympiad-Type Multiple Choice Questions with Answers:

The following questions emphasize **logical reasoning, numerical application, triangle construction, triangle inequality, angle relationships, exterior angles, altitudes, and classification of triangles**, based on the uploaded chapter.

1. Which of the following sets of lengths can form a triangle?
A) 2 cm, 3 cm, 6 cm
B) 4 cm, 5 cm, 8 cm
C) 3 cm, 5 cm, 9 cm
D) 5 cm, 5 cm, 10 cm
Answer: B) 4 cm, 5 cm, 8 cm
Explanation: $4 + 5 = 9 > 8$, so the triangle inequality is satisfied.

2. Which set of lengths cannot form a proper triangle?
A) 5 cm, 6 cm, 8 cm
B) 7 cm, 8 cm, 10 cm
C) 4 cm, 7 cm, 11 cm
D) 6 cm, 7 cm, 9 cm
Answer: C) 4 cm, 7 cm, 11 cm
Explanation: $4 + 7 = 11$; the sum must be greater than the longest side, not equal to it.

3. Two sides of a triangle are 5 cm and 8 cm. Which of the following can be its third side?
A) 2 cm
B) 3 cm
C) 7 cm
D) 14 cm
Answer: C) 7 cm
Explanation: $5 + 7 > 8, 5 + 8 > 7,$and $7 + 8 > 5$.

4. Three sticks have lengths 8 cm, 12 cm, and $x$cm. Which value of $x$cannot form a triangle?
A) 5 cm
B) 8 cm
C) 15 cm
D) 20 cm
Answer: D) 20 cm
Explanation: $8 + 12 = 20$, so a proper triangle cannot be formed.

5. A triangle has angles $35°$and $75°$. What is its third angle?
A) $60°$
B) $70°$
C) $80°$
D) $90°$
Answer: B) $70°$
Explanation: $180° - (35° + 75°) = 70°$.

6. Which pair of angles cannot be two angles of the same triangle?
A) $80°, 70°$
B) $90°, 45°$
C) $100°, 85°$
D) $120°, 30°$
Answer: C) $100°, 85°$
Explanation: Their sum is $185° > 180°$, so no positive third angle is possible.

7. Two angles of a triangle are equal, and the third angle is $40°$. What is each equal angle?

A) 60°
B) 65°
C) 70°
D) 80°
Answer: C) 70°
Explanation: $(180^\circ - 40^\circ) \div 2 = 70^\circ$.
8. If all three angles of a triangle are equal, each angle measures:
A) 45°
B) 50°
C) 60°
D) 90°
Answer: C) 60°
Explanation: $180^\circ \div 3 = 60^\circ$.
9. A triangle has angles $45^\circ, 45^\circ$,and 90°. Which description is correct?
A) Scalene acute triangle
B) Isosceles right triangle
C) Equilateral triangle
D) Isosceles obtuse triangle
Answer: B) Isosceles right triangle
10. A triangle has angles $30^\circ, 60^\circ$,and 90°. It is:
A) Acute-angled
B) Obtuse-angled
C) Right-angled
D) Equilateral
Answer: C) Right-angled
Explanation: One of its angles measures 90°.
11. One angle of a triangle is 110°. Which statement must be true?
A) The other two angles total 110°
B) The other two angles total 90°
C) The other two angles total 70°
D) One other angle must be 90°
Answer: C) The other two angles total 70°
Explanation: $180^\circ - 110^\circ = 70^\circ$.
12. Which of the following angle sets represents an acute-angled triangle?
A) $90^\circ, 50^\circ, 40^\circ$
B) $100^\circ, 40^\circ, 40^\circ$
C) $80^\circ, 60^\circ, 40^\circ$
D) $120^\circ, 30^\circ, 30^\circ$
Answer: C) $80^\circ, 60^\circ, 40^\circ$
Explanation: All three angles are less than 90°.
13. Which of the following is impossible for a triangle?
A) One right angle
B) One obtuse angle
C) Three acute angles
D) Two obtuse angles
Answer: D) Two obtuse angles
Explanation: Two angles greater than 90°would already have a sum greater than 180°.
14. In the figure, $BC$is extended to D. If $\angle A = 50^\circ$and $\angle B = 60^\circ$, find exterior angle $\angle ACD$.

```
        A
       / \
  50° /   \
     /     \
    B-------C----------D
  60°       ?
```

A) $70°$
B) $100°$
C) $110°$
D) $120°$
Answer: C) $110°$
Explanation: The exterior angle equals the sum of the two opposite interior angles: $50° + 60° = 110°$.
15. An exterior angle of a triangle is $125°$. Its adjacent interior angle is:
A) $45°$
B) $55°$
C) $65°$
D) $75°$
Answer: B) $55°$
Explanation: $180° - 125° = 55°$.
16. An exterior angle is $135°$. One of its opposite interior angles is $60°$. What is the other opposite interior angle?
A) $65°$
B) $70°$
C) $75°$
D) $85°$
Answer: C) $75°$
Explanation: $135° - 60° = 75°$.
17. An exterior angle is $120°$, and its two opposite interior angles are equal. Each opposite interior angle is:
A) $40°$
B) $50°$
C) $60°$
D) $70°$
Answer: C) $60°$
Explanation: $120° \div 2 = 60°$.
18. Study the figure.

```
      A
     /|\
    / | \
   /  |  \
  B---D---C
      ⊥
```

If $AD \perp BC$, then $AD$is called:
A) Exterior angle
B) Altitude
C) Base
D) Vertex

Answer: B) Altitude
Explanation: An altitude is a perpendicular segment from a vertex to the opposite side.
19. A student draws a segment from vertex $A$to side BCmaking an angle of $80°$with BC. Which statement is correct?
A) It must be an altitude
B) It cannot be an altitude
C) It must divide BCequally
D) It must divide $\angle A$equally
Answer: B) It cannot be an altitude
Explanation: An altitude must be perpendicular to the opposite side and therefore form a $90°$angle.
20. Which information is sufficient for constructing a triangle as described in the chapter?
A) One side only
B) One angle only
C) Two sides and their included angle
D) Two sides without any angle information
Answer: C) Two sides and their included angle
21. A triangle is constructed using two fixed angles $50°$and $80°$. If the included side length is changed, what happens to the third angle?
A) It increases
B) It decreases
C) It remains $50°$
D) It becomes $80°$
Answer: C) It remains $50°$
Explanation: $180° - (50° + 80°) = 50°$, and the included side length does not determine the third angle.
22. In a right-angled triangle, one acute angle is $37°$. What is the other acute angle?
A) $43°$
B) $53°$
C) $63°$
D) $143°$
Answer: B) $53°$
Explanation: $90° - 37° = 53°$.
23. Which statement about an equilateral triangle is correct?
A) It can be right-angled.
B) It can be obtuse-angled.
C) Each angle is $60°$.
D) One angle must be $90°$.
Answer: C) Each angle is $60°$**.**
24. During the construction of a triangle from three side lengths, two construction circles intersect at two points. What do the intersection points represent?
A) Possible positions of the third vertex
B) Midpoints of the base
C) Centres of the triangle
D) Exterior vertices
Answer: A) Possible positions of the third vertex
Explanation: Either intersection can be joined to the endpoints of the base to obtain a triangle.

25. During triangle construction, two circles touch at exactly one point because the sum of their radii equals the base length. What is the result?
A) An equilateral triangle
B) A right triangle
C) A proper triangle is not formed
D) Two different triangles are formed
Answer: C) A proper triangle is not formed
Explanation: The three points lie on a straight line when the two smaller lengths add exactly to the longest length.
26. The longest side of a proposed triangle is 20 cm. Which pair of remaining sides allows a triangle to be formed?
A) 5 cm and 15 cm
B) 7 cm and 12 cm
C) 9 cm and 12 cm
D) 8 cm and 10 cm
Answer: C) 9 cm and 12 cm
Explanation: $9 + 12 = 21 > 20$, whereas the other pairs have sums less than or equal to 20.
27. If $\angle B = \angle C$and $\angle A = 50°$, then $\angle B$is:
A) 50°
B) 60°
C) 65°
D) 70°
Answer: C) 65°
Explanation: $(180° - 50°) \div 2 = 65°$.
28. A triangle has one exterior angle of 140°. What is the sum of the two opposite interior angles?
A) 40°
B) 90°
C) 140°
D) 180°
Answer: C) 140°
Explanation: An exterior angle equals the sum of its two opposite interior angles.
29. Which statement is always true for the three interior angles $A, B, C$of a triangle?
A) $A + B + C = 90°$
B) $A + B + C = 180°$
C) $A + B = C$
D) $A + B + C = 360°$
Answer: B) $A + B + C = 180°$
30. A student constructs a triangle having angles 40°, 60°, and x°. If an exterior angle adjacent to x°is 100°, what is x?
A) 60°
B) 70°
C) 80°
D) 100°
Answer: C) 80°
Explanation: The adjacent interior and exterior angles total 180°, so $x = 180° - 100° = 80°$; also $40° + 60° + 80° = 180°$.
31. A triangle has angles x°, $2x$°, and $3x$°. What is x?

A) 20°
B) 30°
C) 40°
D) 60°
Answer: B) 30°
Explanation: $x + 2x + 3x = 180^\circ \Rightarrow 6x = 180^\circ \Rightarrow x = 30^\circ$.
32. If the three angles of a triangle are 30°, 60°, and 90°, which angle is the largest?
A) 30°
B) 60°
C) 90°
D) All are equal
Answer: C) 90°
33. Which statement correctly compares an exterior angle with its adjacent interior angle?
A) Their sum is 90°.
B) Their sum is 180°.
C) They are always equal.
D) Their difference is always 90°.
Answer: B) Their sum is 180°**.**
34. Which triangle is classified by its side lengths rather than its angles?
A) Acute triangle
B) Obtuse triangle
C) Isosceles triangle
D) Right triangle
Answer: C) Isosceles triangle
Explanation: Equilateral, isosceles, and scalene are classifications based on side lengths.
35. A student is given three lengths and wants the quickest first check for triangle formation. Which approach is most useful?
A) Add the longest side to the shortest side.
B) Compare the sum of the two smaller lengths with the longest length.
C) Multiply all three lengths.
D) Find the difference between the two longest lengths.
Answer: B) Compare the sum of the two smaller lengths with the longest length.
Explanation: A triangle can be formed when the sum of the two smaller lengths is greater than the longest length.

7.15 Best Practices Opportunity List from the Chapter: (12 Ideas)

Best Practices Opportunities While Teaching:
The following best practices align with the chapter's focus on **triangle construction, triangle inequality, angle-sum property, exterior angles, altitudes, and classification of triangles**.

(1) **Hands-on Triangle Construction:** Give students rulers, compasses, protractors, and pencils and let them construct triangles using **three given sides, two sides with the included angle, and two angles with the included side**. This connects geometrical concepts with actual construction skills.
(2) **Triangle-Inequality Experiment:** Provide groups with sticks, straws, or paper strips of different lengths and ask them to predict and test which sets can form triangles. Students can then formulate the rule that the **sum of the two smaller sides must be greater than the longest side**.

(3) **Discover the Angle-Sum Property:** Ask students to draw different triangles, measure all three angles, and add them; alternatively, they can tear or fold the three corners and arrange them along a straight line. Use the activity to reinforce that $\angle A + \angle B + \angle C = 180°$.

(4) **Explore Exterior Angles Visually:** Let students extend one side of a drawn triangle and measure the resulting exterior angle and the two opposite interior angles. They can verify that the **exterior angle equals the sum of the two opposite interior angles**.

(5) **Altitude Drawing Practice:** Give students triangles of different shapes and ask them to draw a perpendicular from a selected vertex to the opposite side. Emphasize that the resulting perpendicular segment is the **altitude** and its length represents the corresponding height.

(6) **Classification Card Activity:** Prepare triangle cards with different side lengths and angle measures and ask students to sort them as **equilateral, isosceles, scalene, acute, right, or obtuse**. Encourage students to justify every classification using the defining property.

(7) **Predict–Construct–Verify Method:** Before students construct a triangle, ask them to **predict** whether it is possible, **construct** it using appropriate instruments, and finally **verify** their prediction mathematically. This is especially effective for developing understanding of triangle inequality and angle conditions.

(8) **Error-Analysis Questions:** Present deliberately incorrect examples such as sides **3 cm, 6 cm, 9 cm** forming a triangle or angles $100°, 85°, 20°$belonging to one triangle. Ask students to identify the error, state the relevant property, and correct the reasoning.

(9) **Think–Pair–Share for Reasoning:** Pose questions such as, “Can an equilateral triangle be right-angled?” or “Can a triangle have two obtuse angles?” Students should first think individually, discuss their reasoning with a partner, and then explain it to the class using the $180°$**angle-sum property**.

(10) **Use Real-Life Triangular Objects:** Connect the chapter with triangular frames, road signs, roof supports, flags, bridges, and decorative designs. Ask students to identify the type of triangle, estimate or measure its angles, locate possible altitudes, and relate these observations to the chapter concepts.

(11) **Peer Construction and Verification:** One student can give a set of side lengths or angle measurements, while another decides whether a triangle is possible and constructs it. Partners then exchange work and verify each other's **measurements, construction steps, and mathematical reasoning**.

(12) **Maintain a Geometry Learning Portfolio:** Encourage students to preserve their best constructions, solved problems, diagrams, observations, and short explanations from the chapter. The portfolio can include separate sections for **triangle inequality, constructions, angle sum, exterior angles, altitudes, and triangle classification**, helping students revise the chapter systematically.

7.16 Innovations Opportunity List from the Chapter: (12 Ideas)

Innovations Opportunities in Teaching–Learning:

The chapter offers good opportunities for innovative learning around **triangle construction, triangle inequality, angle relationships, exterior angles, altitudes, and classification of triangles**.

(1) **Digital Dynamic-Geometry Exploration:** Use an interactive geometry application to let students drag triangle vertices and observe how side lengths and angles change dynamically. Students can investigate which combinations still form a triangle and verify the **triangle inequality** through experimentation.

(2) **"Can You Build It?" Triangle Challenge:** Give teams sets of virtual or physical sticks with different lengths and ask them to predict whether each set will make a triangle before testing it. Award points not merely for correct answers but for explaining the decision using the **triangle inequality**.

(3) **Triangle Construction Design Lab:** Turn compass-and-ruler construction into a mini design studio where students create geometric logos, patterns, or artwork using triangles constructed from **three sides, two sides and the included angle, or two angles and the included side**.

(4) **AR/Camera-Based Triangle Hunt:** Students can use a tablet or phone camera, where permitted, to photograph triangular shapes around the school—such as roof structures, signboards, frames, and supports—and classify them as **equilateral, isosceles, scalene, acute, right, or obtuse**.

(5) **Angle-Sum Investigation Station:** Create a learning station where students draw different triangles, cut out their three corners, and rearrange them along a straight line. Students then explain visually why the three interior angles together make 180°.

(6) **Exterior-Angle Puzzle Game:** Display partially labelled triangle diagrams in which students must determine missing interior and exterior angles. The puzzles can progress through levels, culminating in problems requiring students to recognize that an **exterior angle equals the sum of the two opposite interior angles**.

(7) **Human Triangle Activity:** Three students can represent the vertices of a large triangle using ropes as sides, while another student demonstrates an altitude using a rope placed perpendicular to the opposite side. This creates a memorable physical representation of the chapter's definition of **altitude and height**.

(8) **Geometry Escape-Room Challenge:** Organize a sequence of clue cards where solving one triangle problem reveals the next clue. Challenges can include deciding whether three lengths form a triangle, finding a missing angle, identifying an exterior angle, locating an altitude, and classifying a triangle.

(9) **Student-Created Geometry Quiz:** Ask groups to create their own **LOTS, HOTS, MCQ, and construction-based questions** from the chapter and exchange them with another group. Students become question designers as well as problem solvers, encouraging deeper engagement with the chapter concepts.

(10) **Predict–Simulate–Explain Learning Cycle:** Present a situation such as three proposed side lengths or two given angles; students first **predict** whether a triangle is possible, then **simulate or construct** it, and finally **explain** the result using the appropriate property. This converts construction activities into inquiry-based learning.

(11) **QR-Based Self-Learning Stations:** Place QR codes at classroom learning stations linking to teacher-prepared hints, construction demonstrations, short quizzes, or challenge problems on different chapter concepts. Students can rotate through stations on **triangle inequality, angle sum, exterior angles, altitude, and classification** at their own pace.

(12) **"Geometry Engineer" Mini-Project:** Ask students to design a small triangular structure such as a **bridge frame, roof frame, kite pattern, or display stand**. They should label its sides and angles, classify the triangles used, identify an altitude, and explain which chapter concepts guided their design, thereby integrating mathematical understanding with creativity and application.

7.17: Practicing Questions/Question Bank:

A. Fill-in-the-Blank Questions:

1. A triangle has ______ vertices, ______ sides, and ______ angles.
   Answer: 3, 3, 3
2. A triangle having all three sides equal is called an ______ triangle.
   Answer: equilateral
3. A triangle having two equal sides is called an ______ triangle.
   Answer: isosceles
4. A triangle having all three sides of different lengths is called a ______ triangle.
   Answer: scalene
5. The sum of the three interior angles of a triangle is ______.
   Answer: 180°
6. Each angle of an equilateral triangle measures ______.
   Answer: 60°
7. The sum of the two smaller sides of a triangle must be ______ than the longest side.
   Answer: greater
8. An angle formed by extending one side of a triangle is called an ______ angle.
   Answer: exterior
9. An exterior angle equals the sum of the two ______ interior angles.
   Answer: opposite
10. A perpendicular segment drawn from a vertex to the opposite side is called an ______.
    Answer: altitude
11. The length of an altitude represents the ______ of a triangle from the corresponding vertex.
    Answer: height
12. A triangle containing one 90°angle is called a ______ triangle.
    Answer: right-angled
13. A triangle containing one angle greater than 90°is called an ______ triangle.
    Answer: obtuse-angled
14. A triangle whose three angles are less than 90°is called an ______ triangle.
    Answer: acute-angled
15. If two angles of a triangle are 50°and 60°, the third angle is ______.
    Answer: 70°

B. One-Mark Descriptive Questions:

1. **What is a triangle?**
   Answer: A triangle is a closed figure formed by three line segments.
2. **State the triangle inequality.**
   Answer: Each side of a triangle must be smaller than the sum of the other two sides.
3. **What is an equilateral triangle?**
   Answer: An equilateral triangle has all three sides equal.
4. **What is a scalene triangle?**
   Answer: A scalene triangle has all three sides of different lengths.

5. **State the angle-sum property of a triangle.**
   Answer: The sum of the three interior angles of a triangle is $180°$.

6. **What is an exterior angle of a triangle?**
   Answer: An exterior angle is formed between an extended side of a triangle and its adjacent side.

7. **What is an altitude of a triangle?**
   Answer: An altitude is a perpendicular segment drawn from a vertex to its opposite side.

8. **Can 4 cm, 5 cm, and 10 cm form a triangle?**
   Answer: No, because $4 + 5 < 10$.

9. **Find the third angle if two angles are $70°$and $60°$.**
   Answer: The third angle is $50°$.

10. **Can a triangle have two right angles?**
    Answer: No, because two right angles already total $180°$.

C. Two-Mark Descriptive Questions:

1. **Check whether 5 cm, 7 cm, and 10 cm can form a triangle.**
   Answer: $5 + 7 = 12 > 10$; therefore, the three lengths can form a triangle.

2. **Why can 4 cm, 6 cm, and 10 cm not form a proper triangle?**
   Answer: $4 + 6 = 10$, which equals the longest side; the sum must be greater than the longest side.

3. **Find the third angle if two angles are $45°$and $75°$.**
   Answer: $45° + 75° = 120°$; therefore, the third angle is $180° - 120° = 60°$.

4. **What happens when construction circles intersect while constructing a triangle from three sides?**
   Answer: Their intersection gives the third vertex; joining it to the base endpoints forms the triangle.

5. **Differentiate between an equilateral and a scalene triangle.**
   Answer: An equilateral triangle has three equal sides, whereas a scalene triangle has three unequal sides.

6. **Find an exterior angle if its adjacent interior angle is $65°$.**
   Answer: The two angles total $180°$; therefore, the exterior angle is $115°$.

7. **Why is an altitude perpendicular to the opposite side?**
   Answer: An altitude represents the perpendicular height from a vertex; hence, it forms a $90°$angle with the opposite side.

8. **Can $100°$and $85°$be two angles of a triangle?**
   Answer: No, because $100° + 85° = 185° > 180°$.

D. Three-Mark Descriptive Questions:

1. **Explain how to construct a triangle when its three side lengths are given.**
   Answer:

   1. Draw one given side as the base.

   2. Draw arcs from its endpoints using the other two side lengths as radii.

3. Join the intersection of the arcs to the endpoints of the base.

2. **Explain the triangle inequality using sides 4 cm, 5 cm, and 8 cm.**
Answer:
   1. The longest side is 8 cm.
   2. $4 + 5 = 9 > 8$.
   3. Therefore, the lengths satisfy the triangle inequality and can form a triangle.

3. **Find the third angle and classify a triangle having angles $50°$and $80°$.**
Answer:
   1. $50° + 80° = 130°$.
   2. The third angle is $180° - 130° = 50°$.
   3. Since all three angles are acute, it is an acute-angled triangle.

4. **Explain the exterior-angle relationship of a triangle.**
Answer:
   1. Extending one side produces an exterior angle.
   2. The exterior angle and adjacent interior angle total $180°$.
   3. The exterior angle equals the sum of the two opposite interior angles.

5. **Explain how an altitude is drawn from vertex $A$of $\triangle ABC$.**
Answer:
   1. Select the opposite side BC.
   2. Draw $AD$from Aperpendicular to BC.
   3. Then $AD$is the altitude and represents the height from A.

6. **Explain the classification of triangles according to sides.**
Answer:
   1. Equilateral triangles have three equal sides.
   2. Isosceles triangles have two equal sides.
   3. Scalene triangles have three different side lengths.

E. Five-Mark Descriptive Questions:

1. **Explain how the triangle inequality determines whether three given lengths can form a triangle. Use 6 cm, 8 cm, and 13 cm as an example.**
Answer:
   1. Identify the longest side, which is 13 cm.
   2. Add the other two sides: $6 + 8 = 14$cm.
   3. Since $14 > 13$, the essential triangle inequality is satisfied.
   4. The other inequalities are also satisfied because each shorter side is less than the sum containing the longest side.

5. Therefore, 6 cm, 8 cm, and 13 cm **can form a triangle**.

2. **Describe the construction of a triangle when two sides and their included angle are given.**
Answer:
    1. Draw one given side AB.
    2. At A, construct the given included angle.
    3. On the new ray, mark C so that AC equals the second given side.
    4. Join B to C.
    5. $\triangle ABC$ is the required triangle.

3. **In a triangle, two angles are 55° and 65°. Find the third angle and the exterior angle adjacent to it, and verify the exterior-angle property.**
Answer:
    1. The sum of the given angles is $55^\circ + 65^\circ = 120^\circ$.
    2. The third angle is $180^\circ - 120^\circ = 60^\circ$.
    3. Its adjacent exterior angle is $180^\circ - 60^\circ = 120^\circ$.
    4. The two opposite interior angles also total $55^\circ + 65^\circ = 120^\circ$.
    5. Thus, the exterior angle equals the sum of the two opposite interior angles.

4. **Explain the classification of triangles based on both sides and angles.**
Answer:
    1. An equilateral triangle has three equal sides.
    2. An isosceles triangle has two equal sides, while a scalene triangle has three different sides.
    3. An acute-angled triangle has three acute angles.
    4. A right-angled triangle has one 90° angle.
    5. An obtuse-angled triangle has one angle greater than 90°.

5. **A student claims that 7 cm, 9 cm, and 16 cm can form a triangle. Examine the claim using construction ideas and triangle inequality.**
Answer:
    1. The longest side is 16 cm.
    2. The other two sides have sum $7 + 9 = 16$cm.
    3. The sum equals, rather than exceeds, the longest side.
    4. The construction does not produce a proper triangular region because the three points become collinear.
    5. Therefore, **7 cm, 9 cm, and 16 cm cannot form a proper triangle**.

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7th Standard Maths Book Chapter 8

Chapter 8: WORKING WITH FRACTIONS

8.1 Summary of the Chapter:

Chapter 8: Working with Fractions — Summary:

(1) **Fractions in daily life:** Fractions are used in practical situations involving **distance, time, sharing, measurement, area, quantities, and rates**. The chapter develops multiplication and division of fractions through such real-life examples.

(2) **Multiplying a fraction by a whole number:** A fraction can be multiplied by a whole number in the same way as repeated addition. A whole number may also be written as a fraction with denominator **1** before multiplication.

(3) **Multiplication of two fractions:** To multiply two fractions, multiply their **numerators together** and their **denominators together**:

$$\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$$

(4) **Geometrical meaning of fraction multiplication:** Multiplication of fractions can be understood visually using a **unit square divided into rows and columns**. This helps students see why the denominators are multiplied when finding a fraction of another fraction.

(5) **Simplifying products:** While multiplying fractions, common factors in the numerators and denominators can be **cancelled before multiplication**. This makes calculations easier and gives the answer in its **lowest form**.

(6) **Size of the product:** Multiplication does not always make a number larger. When multiplying by a number **between 0 and 1**, the product becomes smaller than the other number; multiplying by a number **greater than 1** makes the product greater than the other number.

(7) **Order of multiplication:** The order in which two fractions are multiplied does not change the product. Thus,

$$\frac{a}{b} \times \frac{c}{d} = \frac{c}{d} \times \frac{a}{b}.$$

This can also be understood through the area of a rectangle.

(8) **Reciprocal of a fraction:** The reciprocal of $\frac{a}{b}$ is $\frac{b}{a}$. A fraction multiplied by its reciprocal gives **1**. For example,

$$\frac{3}{5} \times \frac{5}{3} = 1.$$

(9) **Division of fractions:** To divide one fraction by another, find the **reciprocal of the divisor** and multiply it by the dividend:

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{a \times d}{b \times c}.$$

(10) **Size of the quotient:** When the divisor is **between 0 and 1**, the quotient is greater than the dividend. When the divisor is **greater than 1**, the quotient is less than the dividend.

(11) **Applications of fractions:** Multiplication and division of fractions are applied to problems involving **distance travelled, sharing quantities, area of rectangles, filling tanks, rates, land distribution, and other everyday situations**, strengthening students' problem-solving skills.

(12) **Indian mathematical heritage:** The chapter highlights India's contribution to fraction arithmetic. **Brahmagupta** gave general rules for multiplication and division of fractions in the *Brāhmasphuṭasiddhānta* in **628 CE**, while later mathematicians such as **Bhāskara I and Bhāskara II** further explained and developed these ideas.

8.2 Important Formulas:

Important Formulas — Chapter 8: Working with Fractions:

1. **Fraction × Whole Number**

$$\frac{a}{b} \times n = \frac{a \times n}{b}$$

Example:

$$\frac{3}{5} \times 7 = \frac{21}{5}$$

2. **Whole Number × Fraction**

$$n \times \frac{a}{b} = \frac{n \times a}{b}$$

A whole number can also be written as:

$$n = \frac{n}{1}$$

3. **Multiplication of Two Fractions**

$$\boxed{\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}}$$

This is the main formula for multiplying fractions.

4. **Multiplication of Unit Fractions**

$$\frac{1}{b} \times \frac{1}{d} = \frac{1}{bd}$$

Example:

$$\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$$

5. **Fraction of a Quantity**

To find $\frac{a}{b}$of a quantity Q:

$$\boxed{\frac{a}{b} \times Q}$$

Example:

$$\frac{3}{4} \text{ of } 20 = \frac{3}{4} \times 20 = 15$$

6. **Area of a Rectangle with Fractional Sides**

$$\boxed{\text{Area} = \text{Length} \times \text{Breadth}}$$

If

$$l = \frac{a}{b},\ b = \frac{c}{d},$$

then

$$\text{Area} = \frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$

7. **Conversion of a Mixed Fraction into an Improper Fraction**

$$\boxed{p\frac{a}{b} = \frac{pb + a}{b}}$$

Example:

$$1\frac{1}{4} = \frac{1 \times 4 + 1}{4} = \frac{5}{4}$$

8. **Conversion of an Improper Fraction into a Mixed Fraction**

For

$$\frac{a}{b},$$

divide $a$by b:

$$\boxed{\frac{a}{b} = \text{Quotient} + \frac{\text{Remainder}}{b}}$$

Example:

$$\frac{21}{5} = 4\frac{1}{5}$$

9. **Cancellation of Common Factors before Multiplication**

If a numerator and denominator have a common factor, divide both by that common factor before multiplying.
For example:

$$\frac{12}{7} \times \frac{5}{24} = \frac{1}{7} \times \frac{5}{2} = \frac{5}{14}$$

This process is called **cancelling common factors**.

10. **Reciprocal of a Fraction**

The reciprocal of

$$\frac{a}{b}$$

is

$$\boxed{\frac{b}{a}}$$

Also,

$$\boxed{\frac{a}{b} \times \frac{b}{a} = 1}$$

11. **Division of Two Fractions**

To divide by a fraction, multiply by its reciprocal:

$$\boxed{\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}}$$

Therefore,

$$\boxed{\frac{a}{b} \div \frac{c}{d} = \frac{a \times d}{b \times c}}$$

12. **Fraction ÷ Whole Number**

Since

$$n = \frac{n}{1},$$

$$\frac{a}{b} \div n = \frac{a}{b} \times \frac{1}{n}$$

Hence,

$$\boxed{\frac{a}{b} \div n = \frac{a}{bn}}$$

13. **Whole Number ÷ Fraction**

$$n \div \frac{a}{b} = n \times \frac{b}{a}$$

Hence,

$$\boxed{n \div \frac{a}{b} = \frac{nb}{a}}$$

14. **Quantity per Unit**

When a total quantity $Q$is divided equally among $n$units:

$$\boxed{\text{Quantity per unit} = \frac{Q}{n}}$$

Example from the chapter context:

$$\frac{1}{4} \div 5 = \frac{1}{4} \times \frac{1}{5} = \frac{1}{20}$$

15. **Number of Equal Parts Required**

If each part has size $p$and the total quantity is Q:

$$\boxed{\text{Number of parts} = Q \div p}$$

For fractional p:

$$Q \div \frac{a}{b} = Q \times \frac{b}{a}$$

16. **Distance Formula Used in Fraction Problems**

$$\boxed{\text{Distance} = \text{Speed} \times \text{Time}}$$

When speed or time is fractional, use fraction multiplication.

17. **Rate–Time–Quantity Relationship**

$$\boxed{\text{Quantity produced} = \text{Rate} \times \text{Time}}$$

and

$$\boxed{\text{Time} = \frac{\text{Quantity}}{\text{Rate}}}$$

These are useful for canal-work, filling-tank, travel, and similar problems in the chapter.

18. **Combined Rate**

If several persons, taps, fountains, or machines work together:

$$\boxed{\text{Combined Rate} = R_1 + R_2 + R_3 + \cdots}$$

Then,

$$\boxed{\text{Time required} = \frac{\text{Total Work}}{\text{Combined Rate}}}$$

19. **Fractional Part of a Fraction**

If $\frac{a}{b}$of $\frac{c}{d}$of a quantity is required:

$$\boxed{\frac{a}{b} \text{ of } \frac{c}{d} = \frac{a}{b} \times \frac{c}{d}}$$

For several successive fractions:

$$\boxed{\frac{a}{b} \times \frac{c}{d} \times \frac{e}{f} \times \cdots}$$

20. **Commutative Property of Multiplication**

$$\boxed{\frac{a}{b} \times \frac{c}{d} = \frac{c}{d} \times \frac{a}{b}}$$

So, the **order of multiplication does not affect the product**.

Key Rules for Checking Answers

When multiplying:

- If one factor is **between 0 and 1**, the product is smaller than the other factor.
- If one factor is **greater than 1**, the product is greater than the other factor.

When dividing:

- If the divisor is **between 0 and 1**, the quotient is greater than the dividend.
- If the divisor is **greater than 1**, the quotient is smaller than the dividend.

8.3 Fill-Up the Blank LOTS type questions with Answers: (35 Questions)

Fill in the Blanks – LOTS Type:

1. To multiply two fractions, we multiply their ________ and their denominators separately.
   Answer: Numerators
2. The product of $\frac{1}{2} \times \frac{1}{4}$ is ________.
   Answer: $\frac{1}{8}$
3. The product of $\frac{3}{4} \times \frac{2}{5}$ is ________.
   Answer: $\frac{3}{10}$
4. The product of $\frac{1}{b} \times \frac{1}{d}$ is ________.
   Answer: $\frac{1}{bd}$
5. The general formula for multiplication is $\frac{a}{b} \times \frac{c}{d} =$ ________.
   Answer: $\frac{ac}{bd}$
6. A whole number n can be written as a fraction with denominator ________.
   Answer: 1
7. Before multiplying fractions, common factors in the numerator and denominator can be ________.
   Answer: Cancelled
8. The process of removing common factors before multiplication is called ________ the common factors.
   Answer: Cancelling
9. The reciprocal of $\frac{3}{5}$ is ________.
   Answer: $\frac{5}{3}$
10. The reciprocal of $\frac{a}{b}$ is ________.
    Answer: $\frac{b}{a}$
11. The product of a non-zero fraction and its reciprocal is always ________.
    Answer: 1
12. To divide two fractions, first find the ________ of the divisor.
    Answer: Reciprocal
13. To divide by a fraction, we multiply the dividend by the ________ of the divisor.
    Answer: Reciprocal
14. $\frac{2}{3} \div \frac{3}{5} =$ ________.
    Answer: $\frac{10}{9}$
15. $1 \div \frac{2}{3} =$ ________.
    Answer: $\frac{3}{2}$
16. $3 \div \frac{2}{3} =$ ________.
    Answer: $\frac{9}{2}$
17. $\frac{1}{5} \div \frac{1}{2} =$ ________.
    Answer: $\frac{2}{5}$
18. In a division problem, the number being divided is called the ________.
    Answer: Dividend

19. In a division problem, the number by which we divide is called the ________.
Answer: Divisor
20. The result obtained after division is called the ________.
Answer: Quotient
21. When the divisor is between 0 and 1, the quotient is ________ than the dividend.
Answer: Greater
22. When the divisor is greater than 1, the quotient is ________ than the dividend.
Answer: Less
23. When one of the numbers being multiplied is between 0 and 1, the product is ________ than the other number.
Answer: Less
24. When one of the numbers being multiplied is greater than 1, the product is ________ than the other number.
Answer: Greater
25. The order of multiplication of two fractions does ________ affect their product.
Answer: Not
26. The area of a rectangle is obtained by multiplying its ________ and breadth.
Answer: Length
27. The product $\frac{1}{18} \times \frac{1}{12}$is ________.
Answer: $\frac{1}{216}$
28. The product $3 \times \frac{3}{4}$is ________.
Answer: $\frac{9}{4}$
29. The product $\frac{3}{5} \times 4$is ________.
Answer: $\frac{12}{5}$
30. The general division formula is

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \_.$$

Answer: $\frac{d}{c}$
31. Brahmagupta stated the general rules for multiplication and division of fractions in the ________.
Answer: *Brāhmasphuṭasiddhānta*
32. Brahmagupta's *Brāhmasphuṭasiddhānta* was written in ________ CE.
Answer: 628 CE
33. The area of a square brick having side $\frac{1}{5}$unit is ________ square unit.
Answer: $\frac{1}{25}$
34. If $\frac{1}{4}$litre of milk is equally divided among 5 cups, each cup contains ________ litre of milk.
Answer: $\frac{1}{20}$
35. Fractions are useful in everyday situations involving sharing and ________ quantities equally.
Answer: Dividing

8.4 Fill-Up the Blank HOTS type questions with Answers: (35 Questions)

Fill in the Blanks – HOTS Type:

1. A tortoise travels $\frac{2}{5}$km in 1 hour. In $\frac{3}{4}$hour, it travels ________ km.
   Answer: $\frac{3}{10}$km
2. If a number is multiplied by a fraction between 0 and 1, the product will be ________ than the original number.
   Answer: Less
3. If both fractions being multiplied are between 0 and 1, their product will be ________ than both fractions.
   Answer: Less
4. If both numbers being multiplied are greater than 1, their product will be ________ than both numbers.
   Answer: Greater
5. If one factor is between 0 and 1 and the other is greater than 1, the product is ________ than the factor greater than 1.
   Answer: Less
6. Without performing detailed multiplication, $\frac{7}{8} \times \frac{5}{6}$must be ________ than $\frac{7}{8}$.
   Answer: Less
7. Without calculating the exact value, $4 \times \frac{7}{5}$must be ________ than 4.
   Answer: Greater
8. A rectangle has length $\frac{3}{4}$m and breadth $\frac{2}{5}$m. Its area is ________ m^2.
   Answer: $\frac{3}{10}m^2$
9. If $\frac{12}{7} \times \frac{5}{24}$is simplified by cancelling common factors before multiplication, the product is ________.
   Answer: $\frac{5}{14}$
10. A student changes $\frac{2}{3} \div \frac{4}{5}$into multiplication. The correct expression is $\frac{2}{3} \times$________.
    Answer: $\frac{5}{4}$
11. If $\frac{a}{b} \times \frac{b}{a} = 1$, then $\frac{b}{a}$is called the ________ of $\frac{a}{b}$.
    Answer: Reciprocal
12. A number divided by $\frac{1}{4}$is equivalent to multiplying that number by ________.
    Answer: 4
13. Without doing complete division, $6 \div \frac{1}{4}$must be ________ than 6.
    Answer: Greater
14. Since $\frac{1}{8} \div \frac{1}{4} = \frac{1}{2}$, the quotient is ________ than the dividend $\frac{1}{8}$.
    Answer: Greater
15. If the divisor is a fraction between 0 and 1, the quotient is ________ than the dividend.
    Answer: Greater
16. If the divisor is greater than 1, the quotient is ________ than the dividend.
    Answer: Less
17. A tap fills $\frac{7}{10}$of a tank in one hour. In $\frac{1}{3}$hour, it will fill ________ of the tank.
    Answer: $\frac{7}{30}$

18. A tap fills $\frac{7}{10}$ of a tank in one hour. In $\frac{2}{3}$ hour, it will fill ________ of the tank.
    Answer: $\frac{7}{15}$
19. If $\frac{1}{6}$ of Somu's land is taken for a road, the fraction of the original land remaining is ________.
    Answer: $\frac{5}{6}$
20. If Somu gives half of the remaining $\frac{5}{6}$ of her land to Krishna, Krishna receives ________ of the original land.
    Answer: $\frac{5}{12}$
21. Four saplings are planted in a straight row with $\frac{3}{4}$ m between consecutive saplings. The distance between the first and fourth saplings is ________ m.
    Answer: $\frac{9}{4}$ m or $2\frac{1}{4}$ m
22. $\frac{12}{15}$ of 500 g is ________ grams.
    Answer: 400 g
23. $\frac{3}{20}$ of 4 kg is ________ grams.
    Answer: 600 g
24. Comparing $\frac{12}{15}$ of 500 g and $\frac{3}{20}$ of 4 kg, the second quantity is heavier by ________ grams.
    Answer: 200 g
25. If $\frac{1}{4}$ litre of milk is shared equally among 5 cups of tea, each cup contains ________ litre of milk.
    Answer: $\frac{1}{20}$ litre
26. A square brick has side $\frac{1}{5}$ unit. Its area is ________ square unit.
    Answer: $\frac{1}{25}$ square unit
27. If a shaded region occupies $\frac{3}{4}$ of a triangle whose area is $\frac{1}{8}$ square unit, the shaded area is ________ square unit.
    Answer: $\frac{3}{32}$ square unit
28. If $\frac{1}{18} \times \frac{1}{12} = \frac{1}{216}$, multiplying the denominators 18 and 12 gives ________.
    Answer: 216
29. If $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$, the fraction $\frac{d}{c}$ is the ________ of the divisor.
    Answer: Reciprocal
30. If $\frac{2}{3} \div \frac{3}{5} = \frac{10}{9}$, the answer can also be expressed as the mixed fraction ________.
    Answer: $1\frac{1}{9}$
31. If the length and breadth of a rectangle are interchanged, its area remains ________. Therefore, the order of multiplying two fractions does not affect their product.
    Answer: Unchanged
32. A fraction is multiplied by its reciprocal and the result is then multiplied by 7. The final result is ________.
    Answer: 7
33. If $x \div \frac{2}{5} = 10$, then $x =$ ________.
    Answer: 4

34. If $\frac{3}{4} \times x = \frac{3}{8}$, then $x =$________.
    Answer: $\frac{1}{2}$
35. If a quantity becomes twice as large while the number of equal shares remains unchanged, the quantity received by each person becomes ________ as large.
    Answer: Twice

8.5 One-mark questions with Answers of LOTS Type: (35 Questions)

One-Mark Descriptive Questions with Answers – LOTS Type:

1. **What is meant by multiplication of two fractions?**
   Answer: Multiplication of two fractions means multiplying their numerators together and their denominators together.
2. **Write the general formula for multiplying two fractions.**
   Answer: The formula is $\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$.
3. **How can a whole number be written as a fraction?**
   Answer: A whole number can be written as a fraction by taking its denominator as 1.
4. **What is the product of $\frac{1}{2}$ and $\frac{1}{4}$?**
   Answer: The product of $\frac{1}{2}$ and $\frac{1}{4}$ is $\frac{1}{8}$.
5. **What is the product of $\frac{3}{4}$ and $\frac{2}{5}$?**
   Answer: The product of $\frac{3}{4}$ and $\frac{2}{5}$ is $\frac{3}{10}$.
6. **What is meant by cancelling common factors?**
   Answer: Cancelling common factors means dividing a numerator and a denominator by their common factors before multiplying.
7. **Why are common factors cancelled before multiplying fractions?**
   Answer: Common factors are cancelled to simplify the multiplication and obtain the product in its lowest form.
8. **What is a reciprocal of a fraction?**
   Answer: The reciprocal of a fraction is obtained by interchanging its numerator and denominator.
9. **What is the reciprocal of $\frac{3}{5}$?**
   Answer: The reciprocal of $\frac{3}{5}$ is $\frac{5}{3}$.
10. **What is the product of a non-zero fraction and its reciprocal?**
    Answer: The product of a non-zero fraction and its reciprocal is 1.
11. **What is meant by division of fractions?**
    Answer: Division of fractions is performed by multiplying the dividend by the reciprocal of the divisor.
12. **Write the general formula for division of two fractions.**
    Answer: The formula is $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$.
13. **What is a dividend?**
    Answer: The dividend is the number or quantity that is being divided.
14. **What is a divisor?**
    Answer: The divisor is the number or quantity by which the dividend is divided.
15. **What is a quotient?**
    Answer: The quotient is the result obtained after division.

16. **What is $1 \div \frac{2}{3}$?**
    Answer: $1 \div \frac{2}{3} = \frac{3}{2}$.
17. **What is $3 \div \frac{2}{3}$?**
    Answer: $3 \div \frac{2}{3} = \frac{9}{2}$.
18. **Find $\frac{1}{5} \div \frac{1}{2}$.**
    Answer: $\frac{1}{5} \div \frac{1}{2} = \frac{2}{5}$.
19. **Find $\frac{2}{3} \div \frac{3}{5}$.**
    Answer: $\frac{2}{3} \div \frac{3}{5} = \frac{10}{9}$.
20. **What happens to the quotient when the divisor is between 0 and 1?**
    Answer: When the divisor is between 0 and 1, the quotient is greater than the dividend.
21. **What happens to the quotient when the divisor is greater than 1?**
    Answer: When the divisor is greater than 1, the quotient is less than the dividend.
22. **What happens to the product when one factor is between 0 and 1?**
    Answer: When one factor is between 0 and 1, the product is less than the other factor.
23. **What happens to the product when one factor is greater than 1?**
    Answer: When one factor is greater than 1, the product is greater than the other factor.
24. **Does the order of multiplication of two fractions affect their product?**
    Answer: No, changing the order of multiplication of two fractions does not change their product.
25. **How is multiplication of fractions related to the area of a rectangle?**
    Answer: The product of two fractions can be represented as the area of a rectangle having the fractions as its side lengths.
26. **What is the area of a square whose side is $\frac{1}{5}$unit?**
    Answer: The area of the square is $\frac{1}{25}$square unit.
27. **How much milk is in each cup if $\frac{1}{4}$litre is equally shared among 5 cups?**
    Answer: Each cup contains $\frac{1}{20}$litre of milk.
28. **What is the product of 3and $\frac{3}{4}$?**
    Answer: The product of 3and $\frac{3}{4}$is $\frac{9}{4}$.
29. **What is the product of $\frac{3}{5}$and 4?**
    Answer: The product of $\frac{3}{5}$and 4is $\frac{12}{5}$.
30. **Which Indian mathematician stated the general formula for multiplication of fractions?**
    Answer: Brahmagupta stated the general formula for multiplication of fractions.
31. **In which work did Brahmagupta state the rules for arithmetic operations on fractions?**
    Answer: Brahmagupta stated these rules in the *Brāhmasphuṭasiddhānta*.
32. **In which year was Brahmagupta's *Brāhmasphuṭasiddhānta* written?**
    Answer: The *Brāhmasphuṭasiddhānta* was written in 628 CE.
33. **What is meant by a unit fraction?**
    Answer: A unit fraction is a fraction whose numerator is 1.

34. **Find the product of $\frac{1}{18}$ and $\frac{1}{12}$.**

Answer: The product of $\frac{1}{18}$ and $\frac{1}{12}$ is $\frac{1}{216}$.

35. **What mathematical operation is represented by the word "of" in fractional calculations?**

Answer: The word "of" generally represents multiplication when finding a fractional part of a quantity.

8.6 One-mark questions with Answers of HOTS Type: (30 Questions)

One-Mark Descriptive Questions with Answers – HOTS Type:

1. **Without multiplying completely, state whether $\frac{3}{4} \times \frac{2}{5}$ is greater or less than $\frac{3}{4}$. Why?**

   Answer: It is less than $\frac{3}{4}$ because multiplying by $\frac{2}{5}$, a number between 0 and 1, decreases the other number.
2. **Without calculation, predict whether $5 \times \frac{4}{3}$ is greater or less than 5.**

   Answer: The product is greater than 5 because $\frac{4}{3}$ is greater than 1.
3. **If two proper fractions are multiplied, how does their product compare with the two fractions?**

   Answer: The product is less than both fractions because both factors lie between 0 and 1.
4. **A student says that multiplication always makes numbers larger; is the statement correct for fractions?**

   Answer: No, multiplying a number by a fraction between 0 and 1 makes the product smaller than that number.
5. **Why is $\frac{1}{2} \times \frac{1}{4}$ equal to $\frac{1}{4} \times \frac{1}{2}$?**

   Answer: They are equal because changing the order of the factors does not change the product.
6. **If $\frac{3}{5} \times x = 1$, what must x be?**

   Answer: $x = \frac{5}{3}$, because $\frac{5}{3}$ is the reciprocal of $\frac{3}{5}$.
7. **Why does multiplying a fraction by its reciprocal give 1?**

   Answer: The numerator and denominator become equal after multiplication, so the resulting fraction simplifies to 1.
8. **A student writes $\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{3}{5}$; what correction is required?**

   Answer: The divisor must be replaced by its reciprocal, giving $\frac{2}{3} \times \frac{5}{3}$.
9. **Why does $6 \div \frac{1}{4}$ give a number greater than 6?**

   Answer: Dividing by $\frac{1}{4}$ asks how many one-fourths are contained in 6, so the quotient becomes greater than 6.
10. **Without performing the division, predict whether $8 \div \frac{2}{3}$ is greater or less than 8.**

    Answer: The quotient is greater than 8 because the divisor $\frac{2}{3}$ lies between 0 and 1.
11. **Without calculating, predict whether $8 \div \frac{3}{2}$ is greater or less than 8.**

    Answer: The quotient is less than 8 because the divisor $\frac{3}{2}$ is greater than 1.

12. **If $\frac{1}{5} \div \frac{1}{2} = \frac{2}{5}$, why is the quotient greater than the dividend?**
    Answer: The quotient is greater because the divisor $\frac{1}{2}$ is between 0 and 1.
13. **A tortoise travels $\frac{2}{5}$ km in an hour; how far will it travel in $\frac{3}{4}$ hour?**
    Answer: It will travel $\frac{3}{4} \times \frac{2}{5} = \frac{3}{10}$ km.
14. **If the length and breadth of a rectangle are $\frac{1}{2}$ unit and $\frac{1}{4}$ unit, what is its area?**
    Answer: Its area is $\frac{1}{2} \times \frac{1}{4} = \frac{1}{8}$ square unit.
15. **Why can a unit square help us understand multiplication of fractions?**
    Answer: A unit square visually shows the fractional product as the overlapping part obtained by dividing the whole into equal rows and columns.
16. **If the side of a square is $\frac{1}{5}$ unit, why is its area $\frac{1}{25}$ square unit?**
    Answer: Its area is $\frac{1}{5} \times \frac{1}{5} = \frac{1}{25}$ square unit.
17. **A tap fills $\frac{7}{10}$ of a tank in one hour; what fraction will it fill in $\frac{1}{3}$ hour?**
    Answer: It will fill $\frac{1}{3} \times \frac{7}{10} = \frac{7}{30}$ of the tank.
18. **Four saplings are planted in a row with $\frac{3}{4}$ m between consecutive saplings; what is the distance from the first to the fourth?**
    Answer: The distance is $3 \times \frac{3}{4} = \frac{9}{4} = 2\frac{1}{4}$ m.
19. **Which is heavier, $\frac{12}{15}$ of 500 g or $\frac{3}{20}$ of 4 kg?**
    Answer: $\frac{3}{20}$ of 4 kg is heavier because it equals 600 g, whereas $\frac{12}{15}$ of 500 g equals 400 g.
20. **If $\frac{1}{4}$ litre of milk is shared equally among 5 cups, how much milk is present in each cup?**
    Answer: Each cup contains $\frac{1}{4} \div 5 = \frac{1}{20}$ litre of milk.
21. **Why is cancelling common factors before multiplying fractions useful?**
    Answer: Cancelling common factors simplifies the numbers and makes the multiplication easier while keeping the value unchanged.
22. **If $\frac{12}{7} \times \frac{5}{24}$ is simplified before multiplication, which common factor can be cancelled first?**
    Answer: The common factor 12 can be cancelled from 12 and 24.
23. **If $x \div \frac{2}{5} = 10$, what is the value of x?**
    Answer: $x = 4$, because $4 \div \frac{2}{5} = 10$.
24. **If $\frac{3}{4} \times x = \frac{3}{8}$, what is the value of x?**
    Answer: $x = \frac{1}{2}$, because $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$.
25. **If a shaded region is $\frac{3}{4}$ of a triangle whose area is $\frac{1}{8}$ square unit, what is the shaded area?**
    Answer: The shaded area is $\frac{3}{4} \times \frac{1}{8} = \frac{3}{32}$ square unit.
26. **Why does $\frac{1}{18} \times \frac{1}{12}$ have 216 as its denominator?**
    Answer: Its denominator is 216 because $18 \times 12 = 216$.

27. **If a quantity is multiplied successively by $\frac{1}{2}$and $\frac{1}{3}$, what fraction of the original quantity remains?**
    Answer: $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$of the original quantity remains.
28. **Can the product of two fractions greater than 1 be smaller than either factor? Explain.**
    Answer: No, the product is greater than both factors when both fractions are greater than 1.
29. **If a number is divided by its reciprocal, how would you express the operation as multiplication?**
    Answer: Dividing $\frac{a}{b}$by $\frac{b}{a}$becomes $\frac{a}{b} \times \frac{a}{b}$.
30. **A student obtains $\frac{10}{9}$as an answer to $\frac{2}{3} \div \frac{3}{5}$; is it reasonable that the answer exceeds 1?**
    Answer: Yes, because dividing $\frac{2}{3}$by the smaller fraction $\frac{3}{5}$gives the quotient $\frac{10}{9} > 1$.

8.7 Two-mark questions with Answers of LOTS Type: (25 Questions)

Two-Mark Descriptive Questions with Answers – LOTS Type:

1. **How do you multiply two fractions?**
   Answer:
   1. Multiply the numerators of the two fractions to obtain the numerator of the product.
   2. Multiply the denominators to obtain the denominator, i.e., $\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$.
2. **How do you multiply a fraction by a whole number?**
   Answer:
   1. Write the whole number as a fraction with denominator 1.
   2. Multiply the numerators and denominators in the usual way.
3. **Find $\frac{3}{5} \times 4$.**
   Answer:
   1. $\frac{3}{5} \times 4 = \frac{3}{5} \times \frac{4}{1}$.
   2. Therefore, $\frac{3\times4}{5\times1} = \frac{12}{5} = 2\frac{2}{5}$.
4. **Find $\frac{2}{3} \times \frac{3}{5}$.**
   Answer:
   1. $\frac{2}{3} \times \frac{3}{5} = \frac{2\times3}{3\times5} = \frac{6}{15}$.
   2. Simplifying, $\frac{6}{15} = \frac{2}{5}$.
5. **What is meant by cancelling common factors while multiplying fractions?**
   Answer:
   1. Common factors occurring in a numerator and a denominator can be divided out before multiplication.
   2. This makes the multiplication simpler without changing the value of the product.
6. **Simplify $\frac{12}{7} \times \frac{5}{24}$by cancelling common factors.**
   Answer:
   1. Cancel the common factor 12 from 12 and 24 to get $\frac{1}{7} \times \frac{5}{2}$.

   2. Therefore, the product is $\frac{5}{14}$.

7. **What happens when a number is multiplied by a fraction between 0 and 1?**
   Answer:
   1. The resulting product is smaller than the other number.
   2. For example, $\frac{1}{2} \times 6 = 3$, and $3 < 6$.
8. **What happens when a number is multiplied by a number greater than 1?**
   Answer:
   1. The resulting product is greater than the other number.
   2. For example, $\frac{3}{2} \times 4 = 6$, and $6 > 4$.
9. **What is the reciprocal of a fraction? Give an example.**
   Answer:
   1. The reciprocal of $\frac{a}{b}$ is obtained by interchanging its numerator and denominator, giving $\frac{b}{a}$.
   2. For example, the reciprocal of $\frac{3}{5}$ is $\frac{5}{3}$.
10. **What is the relationship between a fraction and its reciprocal?**
    Answer:
    1. A non-zero fraction multiplied by its reciprocal gives 1.
    2. Thus, $\frac{a}{b} \times \frac{b}{a} = 1$.
11. **How do you divide one fraction by another fraction?**
    Answer:
    1. Replace the divisor by its reciprocal and change division into multiplication.
    2. Thus, $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$.
12. **Find $\frac{2}{3} \div \frac{3}{5}$.**
    Answer:
    1. $\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{5}{3}$.
    2. Therefore, the quotient is $\frac{10}{9} = 1\frac{1}{9}$.
13. **Find $3 \div \frac{2}{3}$.**
    Answer:
    1. $3 \div \frac{2}{3} = \frac{3}{1} \times \frac{3}{2}$.
    2. Therefore, the quotient is $\frac{9}{2} = 4\frac{1}{2}$.
14. **Find $\frac{1}{5} \div \frac{1}{2}$.**
    Answer:
    1. $\frac{1}{5} \div \frac{1}{2} = \frac{1}{5} \times \frac{2}{1}$.
    2. Therefore, the quotient is $\frac{2}{5}$.
15. **What happens when a number is divided by a fraction between 0 and 1?**
    Answer:
    1. The quotient becomes greater than the dividend.
    2. For example, $3 \div \frac{1}{2} = 6$, which is greater than 3.
16. **What happens when a number is divided by a number greater than 1?**
    Answer:
    1. The quotient becomes smaller than the dividend.

2. For example, $6 \div 2 = 3$, which is smaller than 6.

17. **Explain how the multiplication of two fractions can be represented geometrically.**
Answer:
    1. A unit square can be divided into equal rows and columns according to the denominators of the fractions.
    2. The overlapping shaded portion represents the product of the two fractions.

18. **Find the area of a square whose side is $\frac{1}{5}$unit.**
Answer:
    1. Area $= \frac{1}{5} \times \frac{1}{5}$square unit.
    2. Therefore, the area is $\frac{1}{25}$square unit.

19. **A tortoise travels $\frac{2}{5}$km in one hour. How far does it travel in $\frac{3}{4}$hour?**
Answer:
    1. Distance travelled $= \frac{3}{4} \times \frac{2}{5}$km.
    2. Therefore, it travels $\frac{3}{10}$km.

20. **If $\frac{1}{4}$litre of milk is equally divided among 5 cups, how much milk does each cup contain?**
Answer:
    1. Milk in each cup $= \frac{1}{4} \div 5 = \frac{1}{4} \times \frac{1}{5}$.
    2. Therefore, each cup contains $\frac{1}{20}$litre of milk.

21. **Does changing the order of two fractions change their product? Explain with an example.**
Answer:
    1. No, changing the order of two fractions does not change their product.
    2. For example, $\frac{1}{2} \times \frac{3}{4} = \frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$.

22. **Find the product of $\frac{1}{18}$and $\frac{1}{12}$.**
Answer:
    1. $\frac{1}{18} \times \frac{1}{12} = \frac{1\times1}{18\times12}$.
    2. Therefore, the product is $\frac{1}{216}$.

23. **How can you find a fractional part of a given quantity?**
Answer:
    1. Multiply the given quantity by the required fraction.
    2. For example, $\frac{3}{4}$of 20 is $\frac{3}{4} \times 20 = 15$.

24. **Find $\frac{12}{15}$of 500 g.**
Answer:
    1. $\frac{12}{15} \times 500 = \frac{4}{5} \times 500$.
    2. Therefore, the required quantity is **400 g**.

25. **State two important contributions of Indian mathematicians to the study of fractions.**
Answer:
    1. Brahmagupta stated systematic rules for arithmetic with fractions in the *Brāhmasphuṭasiddhānta* (628 CE).
    2. Bhāskara II described division of fractions using the reciprocal in the *Līlāvatī*.

8.8. Two-mark questions with Answers of HOTS Type: (25 Questions)

Two-Mark Descriptive Questions with Answers – HOTS Type:

1. **Without calculating the exact product, determine whether $\frac{7}{8} \times \frac{3}{5}$ is greater or less than $\frac{7}{8}$. Give a reason.**
   Answer:
   1. The factor $\frac{3}{5}$ lies between 0 and 1.
   2. Therefore, $\frac{7}{8} \times \frac{3}{5}$ is **less than** $\frac{7}{8}$.
2. **A student says that multiplication always increases a number. Is the statement correct for fractions? Justify.**
   Answer:
   1. No, multiplication does not always increase a number.
   2. Multiplying by a fraction between 0 and 1 makes the product smaller than the other factor.
3. **Without calculating fully, compare $5 \times \frac{4}{3}$ with 5.**
   Answer:
   1. Since $\frac{4}{3} > 1$, multiplication by $\frac{4}{3}$ increases 5.
   2. Therefore, $5 \times \frac{4}{3} > 5$.
4. **Ravi claims that $\frac{3}{4} \times \frac{2}{5}$ must be greater than $\frac{3}{4}$ because multiplication makes numbers larger. Correct his reasoning.**
   Answer:
   1. Since $\frac{2}{5} < 1$, multiplying $\frac{3}{4}$ by $\frac{2}{5}$ reduces its value.
   2. Hence, $\frac{3}{4} \times \frac{2}{5} = \frac{3}{10} < \frac{3}{4}$.
5. **Without performing complete multiplication, decide which is greater: $\frac{5}{6}$ or $\frac{5}{6} \times \frac{7}{8}$.**
   Answer:
   1. Since $\frac{7}{8}$ is less than 1, multiplying $\frac{5}{6}$ by it decreases the value.
   2. Therefore, $\frac{5}{6} > \frac{5}{6} \times \frac{7}{8}$.
6. **A student calculates $\frac{12}{7} \times \frac{5}{24}$ directly; suggest a simpler method and find the answer.**
   Answer:
   1. Cancel the common factor 12 from 12 and 24 before multiplying.
   2. This gives $\frac{1}{7} \times \frac{5}{2} = \frac{5}{14}$.
7. **A student says that the reciprocal of $\frac{4}{7}$ is $\frac{4}{7}$. Identify and correct the mistake.**
   Answer:
   1. A reciprocal is obtained by interchanging the numerator and denominator.
   2. Therefore, the reciprocal of $\frac{4}{7}$ is $\frac{7}{4}$, not $\frac{4}{7}$.
8. **If $\frac{5}{8} \times x = 1$, find x and explain your reasoning.**
   Answer:
   1. A non-zero fraction multiplied by its reciprocal gives 1.
   2. Therefore, $x = \frac{8}{5}$, the reciprocal of $\frac{5}{8}$.

9. **A student writes $\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{3}{5}$. Explain and correct the error.**

Answer:

1. In fraction division, the divisor must be replaced by its reciprocal.
2. Hence, $\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{5}{3} = \frac{10}{9}$.

10. **Without calculating the exact answer, decide whether $6 \div \frac{3}{4}$ is greater or less than 6. Why?**

Answer:

1. The divisor $\frac{3}{4}$ lies between 0 and 1.
2. Therefore, the quotient is **greater than 6**.

11. **Without calculating the exact answer, decide whether $6 \div \frac{3}{2}$ is greater or less than 6. Why?**

Answer:

1. The divisor $\frac{3}{2}$ is greater than 1.
2. Therefore, the quotient is **less than 6**.

12. **Why is $\frac{1}{5} \div \frac{1}{2}$ greater than $\frac{1}{5}$? Find the quotient.**

Answer:

1. Dividing by $\frac{1}{2}$, which is less than 1, makes the quotient greater than the dividend.
2. $\frac{1}{5} \div \frac{1}{2} = \frac{1}{5} \times 2 = \frac{2}{5}$.

13. **A tortoise travels $\frac{2}{5}$ km in one hour. Find the distance travelled in $\frac{3}{4}$ hour and explain the operation used.**

Answer:

1. Since the time is $\frac{3}{4}$ of an hour, multiply $\frac{2}{5}$ by $\frac{3}{4}$.
2. Distance $= \frac{2}{5} \times \frac{3}{4} = \frac{3}{10}$ km.

14. **A rectangle is $\frac{3}{4}$ m long and $\frac{2}{5}$ m broad. Find its area.**

Answer:

1. Area = length × breadth $= \frac{3}{4} \times \frac{2}{5}$.
2. Therefore, the area is $\frac{3}{10}$ m^2.

15. **If the length and breadth of a rectangle are interchanged, will its area change? Explain using fractions.**

Answer:

1. No, because $\frac{a}{b} \times \frac{c}{d} = \frac{c}{d} \times \frac{a}{b}$.
2. Hence, interchanging fractional length and breadth does not change the area.

16. **A square has side $\frac{1}{5}$ unit. Find its area and explain why the answer is smaller than $\frac{1}{5}$.**

Answer:

1. Area $= \frac{1}{5} \times \frac{1}{5} = \frac{1}{25}$ square unit.
2. The area is smaller than $\frac{1}{5}$ because it is multiplied by another fraction less than 1.

17. **If $\frac{1}{4}$litre of milk is shared equally among 5 cups, find the amount in each cup.**
Answer:
1. Milk in each cup $= \frac{1}{4} \div 5 = \frac{1}{4} \times \frac{1}{5}$.
2. Therefore, each cup receives $\frac{1}{20}$litre.

18. **Four saplings are planted in a straight line with $\frac{3}{4}$m between consecutive saplings. Find the distance between the first and fourth saplings.**
Answer:
1. Four saplings create **three equal gaps**, each measuring $\frac{3}{4}$m.
2. Distance $= 3 \times \frac{3}{4} = \frac{9}{4} = 2\frac{1}{4}$m.

19. **A tap fills $\frac{7}{10}$of a tank in one hour. How much of the tank will it fill in $\frac{2}{3}$hour?**
Answer:
1. Required part $= \frac{2}{3} \times \frac{7}{10}$.
2. Therefore, the tap fills $\frac{7}{15}$of the tank.

20. **Which is greater: $\frac{12}{15}$of 500 g or $\frac{3}{20}$of 4 kg? Show your reasoning.**
Answer:
1. $\frac{12}{15} \times 500 = 400$g, while $\frac{3}{20} \times 4000 = 600$g.
2. Therefore, $\frac{3}{20}$of 4 kg is greater by **200 g**.

21. **If $\frac{3}{4} \times x = \frac{3}{8}$, find x.**
Answer:
1. $x = \frac{3}{8} \div \frac{3}{4} = \frac{3}{8} \times \frac{4}{3}$.
2. Therefore, $x = \frac{1}{2}$.

22. **If $x \div \frac{2}{5} = 10$, find x.**
Answer:
1. Since $x \div \frac{2}{5} = 10$, we have $x = 10 \times \frac{2}{5}$.
2. Therefore, $x = 4$.

23. **A quantity is first reduced to $\frac{1}{2}$of itself and then to $\frac{1}{3}$of the new quantity. What fraction of the original quantity remains?**
Answer:
1. The remaining fraction is $\frac{1}{2} \times \frac{1}{3}$.
2. Therefore, $\frac{1}{6}$of the original quantity remains.

24. **A shaded portion is $\frac{3}{4}$of a region whose area is $\frac{1}{8}$square unit. Find the shaded area.**
Answer:
1. Shaded area $= \frac{3}{4} \times \frac{1}{8}$.
2. Therefore, the shaded area is $\frac{3}{32}$square unit.

25. **Explain why the product $\frac{1}{18} \times \frac{1}{12}$is $\frac{1}{216}$using the unit-square idea.**
Answer:

1. Dividing a unit square into 18 parts in one direction and 12 parts in the other produces $18 \times 12 = 216$equal small parts.
   2. The common selected part is one of these 216 parts, so its area is $\frac{1}{216}$.

8.9. Three-mark questions with Answers of LOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers – LOTS Type:
1. Explain the rule for multiplying two fractions with an example.
Answer:
1. Multiply the **numerators** of the two fractions to obtain the numerator of the product.
2. Multiply the **denominators** to obtain the denominator of the product.
3. For example, $\frac{2}{3} \times \frac{4}{5} = \frac{2\times4}{3\times5} = \frac{8}{15}$.

2. Find $\frac{3}{5} \times 4$and express the answer as a mixed fraction.
Answer:
1. Write 4as $\frac{4}{1}$: $\frac{3}{5} \times 4 = \frac{3}{5} \times \frac{4}{1}$.
2. Multiply: $\frac{3\times4}{5\times1} = \frac{12}{5}$.
3. Therefore, $\frac{12}{5} = 2\frac{2}{5}$.

3. Find the product $\frac{12}{7} \times \frac{5}{24}$by cancelling common factors.
Answer:
1. In $\frac{12}{7} \times \frac{5}{24}$, 12 and 24 have the common factor 12.
2. Cancelling gives $\frac{1}{7} \times \frac{5}{2}$.
3. Therefore, the product is $\frac{5}{14}$.

4. Explain what happens when a number is multiplied by a fraction between 0 and 1.
Answer:
1. A fraction between 0 and 1 represents a part of a whole.
2. Multiplying a number by such a fraction gives only a part of that number.
3. Therefore, the product is **less than the other number**; for example, $6 \times \frac{1}{2} = 3 < 6$.

5. Explain what happens when a number is multiplied by a number greater than 1.
Answer:
1. A number greater than 1 represents more than one whole.
2. Multiplying by such a number increases the value of the other factor.
3. For example, $4 \times \frac{3}{2} = 6$, so the product is greater than 4.

6. What is the reciprocal of a fraction? Explain with an example.
Answer:
1. The reciprocal of a non-zero fraction is obtained by **interchanging its numerator and denominator**.
2. Thus, the reciprocal of $\frac{3}{5}$is $\frac{5}{3}$.
3. A fraction multiplied by its reciprocal equals 1: $\frac{3}{5} \times \frac{5}{3} = 1$.

7. Explain the procedure for dividing one fraction by another.
Answer:
1. Keep the **dividend** unchanged and find the reciprocal of the divisor.
2. Replace division by multiplication and multiply the dividend by the reciprocal of the divisor.

3. Thus, $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$.

8. Find $\frac{2}{3} \div \frac{3}{5}$.

Answer:

1. The reciprocal of the divisor $\frac{3}{5}$is $\frac{5}{3}$.
2. Therefore, $\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{5}{3} = \frac{10}{9}$.
3. Hence, the quotient is $\frac{10}{9} = 1\frac{1}{9}$.

9. Find $3 \div \frac{2}{3}$.

Answer:

1. Write 3as $\frac{3}{1}$, and find the reciprocal of $\frac{2}{3}$, which is $\frac{3}{2}$.
2. Multiply: $\frac{3}{1} \times \frac{3}{2} = \frac{9}{2}$.
3. Therefore, $3 \div \frac{2}{3} = \frac{9}{2} = 4\frac{1}{2}$.

10. Find $\frac{1}{5} \div \frac{1}{2}$and state how the quotient compares with the dividend.

Answer:

1. Replace division by multiplication using the reciprocal: $\frac{1}{5} \div \frac{1}{2} = \frac{1}{5} \times \frac{2}{1}$.
2. Therefore, the quotient is $\frac{2}{5}$.
3. Since $\frac{1}{2} < 1$, the quotient $\frac{2}{5}$is greater than the dividend $\frac{1}{5}$.

11. Explain the effect of dividing a number by a fraction between 0 and 1.

Answer:

1. Consider a divisor such as $\frac{1}{2}$, which is between 0 and 1.
2. Dividing by $\frac{1}{2}$is equivalent to multiplying by its reciprocal 2.
3. Hence, the quotient becomes **greater than the dividend**.

12. Explain the effect of dividing a number by a number greater than 1.

Answer:

1. A divisor greater than 1 divides the dividend into comparatively larger groups.
2. Therefore, fewer such groups can be formed from the dividend.
3. Hence, the quotient is **less than the dividend**.

13. Explain the geometrical representation of multiplication of fractions using a unit square.

Answer:

1. Divide a unit square into equal parts in one direction according to the denominator of the first fraction.
2. Divide it in the other direction according to the denominator of the second fraction and identify the overlapping region.
3. The fraction represented by the overlapping region gives the **product of the two fractions**.

14. Find the area of a square whose side is $\frac{1}{5}$unit.

Answer:

1. The area of a square is side $\times$ side.
2. Therefore, area $= \frac{1}{5} \times \frac{1}{5} = \frac{1\times1}{5\times5}$.
3. Hence, the area is $\frac{1}{25}$**square unit**.

15. A tortoise travels $\frac{2}{5}$km in one hour. Find the distance it travels in $\frac{3}{4}$hour.

Answer:

1. Distance travelled in $\frac{3}{4}$hour $= \frac{3}{4}$of $\frac{2}{5}$km.
2. Therefore, distance $= \frac{3}{4} \times \frac{2}{5} = \frac{6}{20}$km.
3. Simplifying, the tortoise travels $\frac{3}{10}$km.

16. If $\frac{1}{4}$litre of milk is divided equally among 5 cups, find the amount of milk in each cup.

Answer:

1. Milk in each cup $= \frac{1}{4} \div 5$litre.
2. Therefore, $\frac{1}{4} \div 5 = \frac{1}{4} \times \frac{1}{5} = \frac{1}{20}$.
3. Hence, each cup contains $\frac{1}{20}$litre of milk.

17. Find $\frac{3}{4}$of 20 and explain the calculation.

Answer:

1. The word **"of"** indicates multiplication, so calculate $\frac{3}{4} \times 20$.
2. $\frac{3}{4} \times 20 = \frac{3\times20}{4} = \frac{60}{4}$.
3. Therefore, $\frac{3}{4}$of 20 is **15**.

18. Find $\frac{12}{15}$of 500 g.

Answer:

1. Required quantity $= \frac{12}{15} \times 500$g.
2. Simplify $\frac{12}{15} = \frac{4}{5}$, giving $\frac{4}{5} \times 500$.
3. Therefore, the required quantity is **400 g**.

19. Show that the order of multiplication does not affect the product of $\frac{1}{2}$and $\frac{3}{4}$.

Answer:

1. $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$.
2. Reversing the order, $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$.
3. Hence, $\frac{1}{2} \times \frac{3}{4} = \frac{3}{4} \times \frac{1}{2}$, showing that the order does not affect the product.

20. Describe Brahmagupta's contribution to arithmetic with fractions.

Answer:

1. **Brahmagupta** was an important Indian mathematician who systematically presented rules for arithmetic with fractions.
2. These rules appeared in his work *Brāhmasphuṭasiddhānta*, composed in **628 CE**.
3. His work included rules corresponding to the multiplication and division of fractions used today.

8.10. Three-mark questions with Answers of HOTS Type: (20 Questions)

Three-Mark Descriptive Questions with Answers – HOTS Type:

1. A student says that $\frac{3}{4} \times \frac{2}{5}$must be greater than $\frac{3}{4}$because multiplication increases numbers. Analyse the statement.

Answer:

1. The factor $\frac{2}{5}$lies between 0 and 1, so multiplication by it reduces the other factor.
2. $\frac{3}{4} \times \frac{2}{5} = \frac{6}{20} = \frac{3}{10}$.

3. Since $\frac{3}{10} < \frac{3}{4}$, the student's statement is **incorrect**.

2. Without calculating the exact products first, compare $\frac{5}{6} \times \frac{3}{4}$ and $\frac{5}{6} \times \frac{4}{3}$.

Answer:

1. Since $\frac{3}{4} < 1$, $\frac{5}{6} \times \frac{3}{4}$ is less than $\frac{5}{6}$.
2. Since $\frac{4}{3} > 1$, $\frac{5}{6} \times \frac{4}{3}$ is greater than $\frac{5}{6}$.
3. Therefore, $\frac{5}{6} \times \frac{4}{3} > \frac{5}{6} \times \frac{3}{4}$.

3. A student obtains $\frac{24}{35}$ for $\frac{4}{5} \times \frac{6}{7}$. How can you check whether the answer is reasonable without repeating the complete multiplication?

Answer:

1. Both $\frac{4}{5}$ and $\frac{6}{7}$ are fractions between 0 and 1.
2. Their product must therefore be smaller than both $\frac{4}{5}$ and $\frac{6}{7}$.
3. Since $\frac{24}{35} < \frac{4}{5}$ and $\frac{24}{35} < \frac{6}{7}$, the answer is reasonable.

4. A student calculates $\frac{18}{25} \times \frac{15}{24}$ by multiplying large numbers directly. Suggest a more efficient method and find the product.

Answer:

1. Cancel common factors before multiplication: 18 with 24 gives $\frac{3}{4}$, and 15 with 25 gives $\frac{3}{5}$.
2. The expression becomes $\frac{3}{4} \times \frac{3}{5}$.
3. Therefore, the product is $\frac{9}{20}$.

5. A student says that the reciprocal of $\frac{7}{9}$ is $-\frac{7}{9}$. Identify the error and justify the correct answer.

Answer:

1. A reciprocal is obtained by interchanging the numerator and denominator, not by changing the sign.
2. Hence, the reciprocal of $\frac{7}{9}$ is $\frac{9}{7}$.
3. This is verified because $\frac{7}{9} \times \frac{9}{7} = 1$.

6. If $\frac{5}{8} \times x = 1$, determine x and explain why.

Answer:

1. A non-zero fraction multiplied by its reciprocal gives 1.
2. The reciprocal of $\frac{5}{8}$ is $\frac{8}{5}$.
3. Therefore, $x = \frac{8}{5}$, since $\frac{5}{8} \times \frac{8}{5} = 1$.

7. A student writes $\frac{3}{5} \div \frac{2}{7} = \frac{3}{5} \times \frac{2}{7}$. Analyse and correct the solution.

Answer:

1. The student has not replaced the divisor by its reciprocal.
2. The reciprocal of $\frac{2}{7}$ is $\frac{7}{2}$, so $\frac{3}{5} \div \frac{2}{7} = \frac{3}{5} \times \frac{7}{2}$.
3. Therefore, the correct quotient is $\frac{21}{10} = 2\frac{1}{10}$.

8. Without calculating first, predict whether $4 \div \frac{2}{3}$ will be greater or less than 4, and then verify.

Answer:

1. Since the divisor $\frac{2}{3}$ lies between 0 and 1, the quotient must be greater than the dividend.
2. $4 \div \frac{2}{3} = 4 \times \frac{3}{2} = 6$.
3. Thus, $6 > 4$, confirming the prediction.

9. Without calculating first, predict whether $4 \div \frac{3}{2}$ will be greater or less than 4, and then verify.

Answer:

1. Since the divisor $\frac{3}{2} > 1$, the quotient must be smaller than the dividend.
2. $4 \div \frac{3}{2} = 4 \times \frac{2}{3} = \frac{8}{3} = 2\frac{2}{3}$.
3. Thus, $2\frac{2}{3} < 4$, confirming the prediction.

10. A tortoise travels $\frac{2}{5}$ km in one hour. Compare the distances it travels in $\frac{3}{4}$ hour and $\frac{1}{2}$ hour.

Answer:

1. In $\frac{3}{4}$ hour, it travels $\frac{2}{5} \times \frac{3}{4} = \frac{3}{10}$ km.
2. In $\frac{1}{2}$ hour, it travels $\frac{2}{5} \times \frac{1}{2} = \frac{1}{5}$ km.
3. Since $\frac{3}{10} > \frac{1}{5}$, it travels farther in $\frac{3}{4}$ hour.

11. A rectangle has length $\frac{3}{4}$ m and breadth $\frac{2}{5}$ m. If the dimensions are interchanged, will its area change? Justify.

Answer:

1. Original area $= \frac{3}{4} \times \frac{2}{5} = \frac{3}{10}$ m^2.
2. After interchanging, area $= \frac{2}{5} \times \frac{3}{4} = \frac{3}{10}$ m^2.
3. Hence, the area does not change because multiplication of fractions is **commutative**.

12. A square has side $\frac{2}{3}$ m. A student claims that its area must be greater than $\frac{2}{3}$ m^2. Is the claim correct?

Answer:

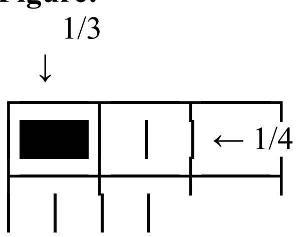
1. Area of the square $= \frac{2}{3} \times \frac{2}{3} = \frac{4}{9}$ m^2.
2. Since $\frac{2}{3} < 1$, multiplying it by another $\frac{2}{3}$ makes the result smaller.
3. Therefore, $\frac{4}{9} < \frac{2}{3}$, so the student's claim is **incorrect**.

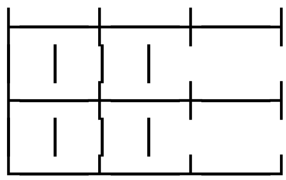
13. A unit square is divided into 4 equal rows and 3 equal columns. If one row-fraction and one column-fraction overlap, what fraction of the square is represented by the overlap?

Answer:

1. Four rows and three columns divide the square into $4 \times 3 = 12$ equal parts.
2. The overlap of $\frac{1}{4}$ and $\frac{1}{3}$ occupies one of these 12 parts.
3. Hence, $\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$.

Figure:





Shaded overlap = 1/12

14. Four saplings are planted in a straight row, with $\frac{3}{4}$m between consecutive saplings. A student calculates the total distance as $4 \times \frac{3}{4}$. Explain the mistake.

Answer:

1. Four saplings create only **three spaces** between consecutive saplings.
2. Therefore, the distance from the first to the fourth sapling is $3 \times \frac{3}{4}$.
3. Hence, the correct distance is $\frac{9}{4} = 2\frac{1}{4}$m, not 3 m.

15. If $\frac{1}{4}$litre of milk is shared equally among 5 cups, explain why each cup contains less than $\frac{1}{4}$litre.

Answer:

1. The amount in each cup is $\frac{1}{4} \div 5 = \frac{1}{4} \times \frac{1}{5}$.
2. This gives $\frac{1}{20}$litre per cup.
3. Since $\frac{1}{20} < \frac{1}{4}$, each cup necessarily contains less than the original quantity.

16. A tap fills $\frac{7}{10}$of a tank in one hour. Compare the amount filled in $\frac{1}{2}$hour and $\frac{3}{4}$hour.

Answer:

1. In $\frac{1}{2}$hour, it fills $\frac{1}{2} \times \frac{7}{10} = \frac{7}{20}$of the tank.
2. In $\frac{3}{4}$hour, it fills $\frac{3}{4} \times \frac{7}{10} = \frac{21}{40}$of the tank.
3. Since $\frac{21}{40} > \frac{14}{40} = \frac{7}{20}$, more of the tank is filled in $\frac{3}{4}$hour.

17. Which is greater: $\frac{12}{15}$of 500 g or $\frac{3}{20}$of 4 kg? By how much?

Answer:

1. $\frac{12}{15} \times 500 = 400$g.
2. $\frac{3}{20} \times 4$ kg $= \frac{3}{20} \times 4000 = 600$g.
3. Therefore, the second quantity is greater by $600 - 400 = 200$g.

18. If $\frac{3}{4} \times x = \frac{3}{8}$, determine $x$and verify your answer.

Answer:

1. $x = \frac{3}{8} \div \frac{3}{4} = \frac{3}{8} \times \frac{4}{3}$.
2. Thus, $x = \frac{1}{2}$.
3. Verification: $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$, so the answer is correct.

19. A number $x$satisfies $x \div \frac{2}{5} = 10$. Find $x$and verify it.

Answer:

1. From $x \div \frac{2}{5} = 10$, we get $x = 10 \times \frac{2}{5}$.
2. Hence, $x = 4$.
3. Verification: $4 \div \frac{2}{5} = 4 \times \frac{5}{2} = 10$.

20. A quantity is first reduced to $\frac{2}{3}$of itself and then to $\frac{3}{4}$of the new quantity. What fraction of the original quantity remains?

Answer:

1. The first operation leaves $\frac{2}{3}$of the original quantity.
2. Taking $\frac{3}{4}$of this gives $\frac{3}{4} \times \frac{2}{3} = \frac{6}{12}$.
3. Therefore, $\frac{1}{2}$of the original quantity remains.

8.11 Five-mark questions with Answers of LOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain the multiplication of two fractions and find $\frac{3}{4} \times \frac{2}{5}$.

Answer:

1. To multiply two fractions, multiply their **numerators** and **denominators** separately.
2. The general rule is $\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$.
3. Therefore, $\frac{3}{4} \times \frac{2}{5} = \frac{3 \times 2}{4 \times 5}$.
4. This gives $\frac{6}{20}$, which simplifies by dividing numerator and denominator by 2.
5. Hence, $\frac{3}{4} \times \frac{2}{5} = \boxed{\frac{3}{10}}$.

2. Explain how common factors can be cancelled before multiplying fractions. Find $\frac{12}{7} \times \frac{5}{24}$.

Answer:

1. Before multiplying fractions, we can look for **common factors** between numerators and denominators.
2. In $\frac{12}{7} \times \frac{5}{24}$, 12 and 24 have the common factor 12.
3. Cancelling 12 gives $\frac{1}{7} \times \frac{5}{2}$.
4. Multiplying the remaining numerators and denominators gives $\frac{1 \times 5}{7 \times 2}$.
5. Therefore, $\frac{12}{7} \times \frac{5}{24} = \boxed{\frac{5}{14}}$.

3. What is the reciprocal of a fraction? Explain its important properties with examples.

Answer:

1. The **reciprocal** of a non-zero fraction is obtained by interchanging its numerator and denominator.
2. Thus, the reciprocal of $\frac{3}{5}$is $\frac{5}{3}$.
3. Similarly, the reciprocal of $\frac{4}{7}$is $\frac{7}{4}$.
4. A non-zero fraction multiplied by its reciprocal gives 1; for example, $\frac{3}{5} \times \frac{5}{3} = 1$.
5. Thus, in general, the reciprocal of $\frac{a}{b}$is $\frac{b}{a}$, and $\frac{a}{b} \times \frac{b}{a} = 1$.

4. Explain the method of dividing one fraction by another and find $\frac{2}{3} \div \frac{3}{5}$.

Answer:

1. To divide two fractions, keep the **dividend** unchanged.
2. Find the reciprocal of the divisor; the reciprocal of $\frac{3}{5}$is $\frac{5}{3}$.
3. Change the division sign into multiplication: $\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{5}{3}$.

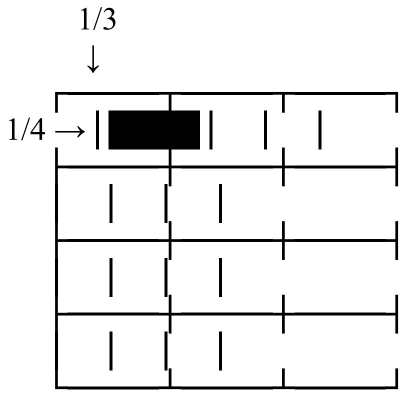
4. Multiply the numerators and denominators: $\frac{2\times5}{3\times3} = \frac{10}{9}$.
5. Therefore, $\frac{2}{3} \div \frac{3}{5} = \boxed{\frac{10}{9} = 1\frac{1}{9}}$.

5. Explain how the multiplication of fractions can be represented geometrically using a unit square.

Answer:

1. Consider a **unit square** representing one whole.
2. To represent $\frac{1}{4}$, divide the square into 4 equal horizontal parts and select one part.
3. To represent $\frac{1}{3}$, divide the same square into 3 equal vertical parts and select one part.
4. The two divisions produce $4 \times 3 = 12$equal small rectangles, and the overlapping region occupies one of them.
5. Hence, the overlapping region represents $\frac{1}{4} \times \frac{1}{3} = \boxed{\frac{1}{12}}$.

Figure:



Shaded part = 1/12

6. Explain how the size of a product changes when fractions are multiplied.

Answer:

1. When a number is multiplied by a fraction **between 0 and 1**, the product becomes smaller than the other number.
2. For example, $6 \times \frac{1}{2} = 3$, and $3 < 6$.
3. When a number is multiplied by a number **greater than 1**, the product becomes greater than the other number.
4. For example, $4 \times \frac{3}{2} = 6$, and $6 > 4$.
5. Thus, the size of the product depends on whether the multiplying factor is **less than 1 or greater than 1**.

7. Explain how the size of a quotient changes depending on the divisor.

Answer:

1. In fraction division, the dividend is multiplied by the **reciprocal of the divisor**.
2. When the divisor is between 0 and 1, the quotient is greater than the dividend.
3. For example, $3 \div \frac{1}{2} = 3 \times 2 = 6$, and $6 > 3$.
4. When the divisor is greater than 1, the quotient is smaller than the dividend.
5. For example, $3 \div \frac{3}{2} = 3 \times \frac{2}{3} = 2$, and $2 < 3$.

8. A tortoise travels $\frac{2}{5}$km in one hour. Find how far it travels in $\frac{3}{4}$hour and explain the calculation.

Answer:

1. Distance travelled in 1 hour is $\frac{2}{5}$km.
2. The required time is $\frac{3}{4}$of an hour.
3. Therefore, required distance $= \frac{3}{4} \times \frac{2}{5}$km.
4. Multiplying gives $\frac{3\times2}{4\times5} = \frac{6}{20} = \frac{3}{10}$.
5. Hence, the tortoise travels $\boxed{\frac{3}{10}\text{ km}}$ in $\frac{3}{4}$hour.

9. Explain the multiplication of a fraction by a whole number and find $\frac{3}{5} \times 4$.

Answer:

1. A whole number can be expressed as a fraction with denominator 1; thus, $4 = \frac{4}{1}$.
2. Therefore, $\frac{3}{5} \times 4 = \frac{3}{5} \times \frac{4}{1}$.
3. Multiply the numerators: $3 \times 4 = 12$.
4. Multiply the denominators: $5 \times 1 = 5$, giving $\frac{12}{5}$.
5. Hence, $\frac{3}{5} \times 4 = \boxed{\frac{12}{5} = 2\frac{2}{5}}$.

10. Explain the contributions of Indian mathematicians to the development of arithmetic with fractions.

Answer:

1. Indian mathematicians made important contributions to the systematic development of arithmetic involving fractions.
2. **Brahmagupta** presented rules for operations with fractions in his *Brāhmasphuṭasiddhānta* in **628 CE**.
3. His treatment included rules corresponding to multiplication and division of fractions used today.
4. **Bhāskara I** provided a geometrical interpretation related to multiplication of fractions.
5. **Bhāskara II**, in his *Līlāvatī* (around 1150 CE), described division of fractions through multiplication by the reciprocal.

8.12 Five-mark questions with Answers of HOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers – HOTS Type:

1. A student says, "Multiplication always makes a number larger." Analyse the statement using $\frac{4}{5} \times \frac{3}{4}$.

Answer:

1. The statement is **not always true**, especially when multiplying fractions.
2. Here, $\frac{3}{4}$lies between 0 and 1, so multiplying $\frac{4}{5}$by it should reduce the value.
3. $\frac{4}{5} \times \frac{3}{4} = \frac{4\times3}{5\times4}$.
4. Cancelling the common factor 4 gives $\frac{3}{5}$.
5. Since $\frac{3}{5} < \frac{4}{5}$, multiplication by a fraction between 0 and 1 makes the product smaller than the other factor.

2. Without initially calculating the exact answers, compare $6 \div \frac{3}{4}$and $6 \div \frac{3}{2}$, and justify your conclusion.

Answer:

1. Since $\frac{3}{4} < 1$, dividing 6 by $\frac{3}{4}$ should give a number **greater than 6**.
2. Since $\frac{3}{2} > 1$, dividing 6 by $\frac{3}{2}$ should give a number **less than 6**.
3. $6 \div \frac{3}{4} = 6 \times \frac{4}{3} = 8$.
4. $6 \div \frac{3}{2} = 6 \times \frac{2}{3} = 4$.
5. Therefore, $6 \div \frac{3}{4} > 6 > 6 \div \frac{3}{2}$, confirming the rule about the size of a quotient.

3. A student solves $\frac{4}{5} \div \frac{2}{3}$ as $\frac{4}{5} \times \frac{2}{3} = \frac{8}{15}$. Identify the error and obtain the correct answer.

Answer:

1. The student has incorrectly multiplied by the divisor itself instead of its **reciprocal**.
2. The reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$.
3. Hence, $\frac{4}{5} \div \frac{2}{3} = \frac{4}{5} \times \frac{3}{2}$.
4. Cancelling the common factor gives $\frac{2\times3}{5\times1} = \frac{6}{5}$.
5. Therefore, the correct answer is $\boxed{\frac{6}{5} = 1\frac{1}{5}}$, not $\frac{8}{15}$.

4. A rectangle has length $\frac{3}{4}$m and breadth $\frac{2}{3}$m. Find its area and explain why the area is smaller than either dimension numerically.

Answer:

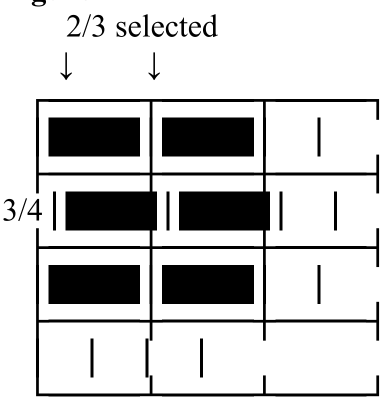
1. Area of a rectangle = length × breadth.
2. Therefore, area $= \frac{3}{4} \times \frac{2}{3}$.
3. Cancelling common factors gives $\frac{1}{2}$ m^2.
4. Both $\frac{3}{4}$ and $\frac{2}{3}$ lie between 0 and 1, so their product must be smaller than either factor.
5. Hence, the area is $\boxed{\frac{1}{2}\ \text{m}^2}$, and numerically $\frac{1}{2} < \frac{2}{3} < \frac{3}{4}$.

5. A unit square is used to represent $\frac{2}{3} \times \frac{3}{4}$. Explain the representation and determine the product.

Answer:

1. Take a unit square and divide it into **3 equal columns**; select 2 columns to represent $\frac{2}{3}$.
2. Divide the same square into **4 equal rows**; select 3 rows to represent $\frac{3}{4}$.
3. The two sets of divisions produce $3 \times 4 = 12$ equal small regions.
4. The overlapping region contains $2 \times 3 = 6$ of these 12 regions.
5. Therefore, $\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \boxed{\frac{1}{2}}$.

Figure:



Overlapping part = 6/12 = 1/2

6. A tortoise travels $\frac{2}{5}$km in one hour. Compare the distances travelled in $\frac{3}{4}$hour and $1\frac{1}{2}$hours.

Answer:

1. In $\frac{3}{4}$hour, distance $= \frac{2}{5} \times \frac{3}{4} = \frac{3}{10}$km.
2. Convert $1\frac{1}{2}$hours into the improper fraction $\frac{3}{2}$hours.
3. In $\frac{3}{2}$hours, distance $= \frac{2}{5} \times \frac{3}{2} = \frac{3}{5}$km.
4. Since $\frac{3}{5} = \frac{6}{10}$, the second distance is twice $\frac{3}{10}$.
5. Therefore, the tortoise travels $\boxed{\frac{3}{10}}$km in $\frac{3}{4}$hour and $\boxed{\frac{3}{5}}$km in $1\frac{1}{2}$hours.

7. Four saplings are planted in a straight row with $\frac{3}{4}$m between consecutive saplings. A student says the distance from the first to the fourth sapling is 3 m. Analyse the answer.

Answer:

1. Four saplings create only **three spaces** between consecutive saplings.
2. Each space measures $\frac{3}{4}$m.
3. Therefore, the distance from the first to the fourth sapling is $3 \times \frac{3}{4}$.
4. This equals $\frac{9}{4} = 2\frac{1}{4}$m.
5. Hence, the student's answer of 3 m is incorrect; the correct distance is $\boxed{2\frac{1}{4}\text{ m}}$.

8. A tap fills $\frac{7}{10}$of a tank in one hour. Determine how much it fills in $\frac{1}{2}$hour and $\frac{3}{4}$hour, and compare the results.

Answer:

1. In $\frac{1}{2}$hour, the tap fills $\frac{1}{2} \times \frac{7}{10} = \frac{7}{20}$of the tank.
2. In $\frac{3}{4}$hour, it fills $\frac{3}{4} \times \frac{7}{10} = \frac{21}{40}$of the tank.
3. Convert $\frac{7}{20}$to $\frac{14}{40}$.
4. Since $\frac{21}{40} > \frac{14}{40}$, more water is filled in $\frac{3}{4}$hour.
5. The difference is $\frac{21}{40} - \frac{14}{40} = \boxed{\frac{7}{40}}$of the tank.

9. Which is greater: $\frac{12}{15}$of 500 g or $\frac{3}{20}$of 4 kg? Find the difference.

Answer:

1. The first quantity is $\frac{12}{15} \times 500 = \frac{4}{5} \times 500 = 400$g.
2. Convert 4 kg into grams: 4 kg $= 4000$ g.
3. The second quantity is $\frac{3}{20} \times 4000 = 600$g.
4. Therefore, the second quantity is greater than the first.
5. The difference is $600 - 400 = \boxed{200\text{ g}}$.

10. A student says that the reciprocal of $\frac{5}{8}$is $-\frac{5}{8}$. Analyse the statement and explain the role of reciprocal in division.

Answer:

1. The statement is incorrect because finding a reciprocal does not mean changing the sign.

2. The reciprocal is obtained by interchanging the numerator and denominator, so the reciprocal of $\frac{5}{8}$ is $\frac{8}{5}$.
3. Verification gives $\frac{5}{8} \times \frac{8}{5} = 1$.
4. In division of fractions, the divisor is replaced by its reciprocal.
5. Thus, for example, $\frac{3}{4} \div \frac{5}{8} = \frac{3}{4} \times \frac{8}{5} = \boxed{\frac{6}{5}}$.

11. A quantity is first reduced to $\frac{2}{3}$ of its original value and then $\frac{3}{4}$ of the remaining quantity is taken. What fraction of the original quantity is finally taken?

Answer:

1. After the first operation, the quantity becomes $\frac{2}{3}$ of the original.
2. We then take $\frac{3}{4}$ of this new quantity.
3. Required fraction $= \frac{3}{4} \times \frac{2}{3}$.
4. Multiplying and simplifying gives $\frac{6}{12} = \frac{1}{2}$.
5. Therefore, the final quantity is $\boxed{\frac{1}{2}}$ of the original quantity.

12. If $\frac{3}{4} \times x = \frac{3}{8}$, determine x and verify the result.

Answer:

1. From $\frac{3}{4} \times x = \frac{3}{8}$, divide both sides by $\frac{3}{4}$.
2. Thus, $x = \frac{3}{8} \div \frac{3}{4}$.
3. Change division to multiplication by the reciprocal: $x = \frac{3}{8} \times \frac{4}{3}$.
4. Simplifying gives $x = \frac{1}{2}$.
5. Verification: $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$; hence, $\boxed{x = \frac{1}{2}}$.

13. A student says that $\frac{1}{2} \times \frac{1}{3}$ and $\frac{1}{2} \div \frac{1}{3}$ should give similar-sized answers. Compare the two operations.

Answer:

1. Multiplication gives $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$.
2. Since $\frac{1}{3} < 1$, multiplication makes $\frac{1}{2}$ smaller.
3. Division gives $\frac{1}{2} \div \frac{1}{3} = \frac{1}{2} \times 3 = \frac{3}{2}$.
4. Since the divisor $\frac{1}{3} < 1$, division makes the quotient greater than $\frac{1}{2}$.
5. Therefore, $\boxed{\frac{1}{6} < \frac{1}{2} < \frac{3}{2}}$, showing that multiplication and division by the same proper fraction have very different effects.

14. Two students calculate $\frac{18}{25} \times \frac{15}{24}$. One multiplies directly, while the other cancels common factors first. Show which method is more efficient.

Answer:

1. Direct multiplication gives $\frac{18 \times 15}{25 \times 24} = \frac{270}{600}$.
2. This fraction must then be simplified to $\frac{9}{20}$.
3. Alternatively, cancel 18 and 24 by 6 to obtain 3 and 4.
4. Cancel 15 and 25 by 5 to obtain 3 and 5, giving $\frac{3}{4} \times \frac{3}{5}$.

5. Thus, the product is immediately $\boxed{\frac{9}{20}}$, so cancelling first is more efficient.

15. Explain why dividing by a proper fraction can produce an answer larger than the original number, using $3 \div \frac{1}{4}$.

Answer:

1. The question $3 \div \frac{1}{4}$ asks how many groups of size $\frac{1}{4}$ can be formed from 3 wholes.
2. Each whole contains four one-fourths.
3. Therefore, 3 wholes contain $3 \times 4 = 12$ one-fourths.
4. Algebraically, $3 \div \frac{1}{4} = 3 \times \frac{4}{1} = 12$.
5. Hence, the quotient $\boxed{12}$ is greater than 3 because the divisor $\frac{1}{4}$ is smaller than 1.

8.13 Five-mark questions with Answers of Applied Type: (12 Questions)

Five-Mark Descriptive Questions with Answers – Applied Type:

1. A water tank is filled at the rate of $\frac{7}{10}$ of its capacity per hour. What fraction of the tank will be filled in $\frac{3}{4}$ hour? If the tank has a capacity of 800 litres, how many litres of water will be filled?

Answer:

1. Fraction filled in $\frac{3}{4}$ hour $= \frac{7}{10} \times \frac{3}{4}$.
2. $\frac{7}{10} \times \frac{3}{4} = \frac{21}{40}$ of the tank.
3. Capacity of the tank $= 800$ litres.
4. Water filled $= \frac{21}{40} \times 800 = 420$ litres.
5. Therefore, $\boxed{\frac{21}{40}}$ of the tank, or $\boxed{420 \text{ litres}}$, will be filled.

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2. A rectangular vegetable garden is $\frac{5}{6}$ km long and $\frac{3}{4}$ km wide. Find its area. If $\frac{2}{5}$ of the garden is used to grow vegetables, find the area used for vegetables.

Answer:

1. Area of garden $= \frac{5}{6} \times \frac{3}{4} = \frac{15}{24} = \frac{5}{8}\ \text{km}^2$.
2. Fraction used for vegetables $= \frac{2}{5}$ of the total area.
3. Vegetable area $= \frac{2}{5} \times \frac{5}{8}$.
4. Cancelling common factors gives $\frac{1}{4}\ \text{km}^2$.
5. Therefore, the total area is $\boxed{\frac{5}{8}\ \text{km}^2}$, of which $\boxed{\frac{1}{4}\ \text{km}^2}$ is used for vegetables.

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3. Meera has $\frac{3}{4}$ litre of fruit juice. She pours it equally into 6 glasses. How much juice will each glass contain? How many such glasses could be filled from $1\frac{1}{2}$ litres?

Answer:

1. Juice in each glass $= \frac{3}{4} \div 6$.
2. $\frac{3}{4} \div 6 = \frac{3}{4} \times \frac{1}{6} = \frac{1}{8}$ litre.
3. $1\frac{1}{2}$ litres $= \frac{3}{2}$ litres.

4. Number of glasses $= \frac{3}{2} \div \frac{1}{8} = \frac{3}{2} \times 8 = 12$.
5. Therefore, each glass contains $\boxed{\frac{1}{8} \text{ litre}}$, and $\boxed{12}$ such glasses can be filled.

---

4. A farmer owns a piece of land. $\frac{1}{6}$ of it is used for constructing a road. He gives $\frac{1}{2}$ of the remaining land to one of his children. What fraction of the original land does the child receive?

Answer:

1. Fraction of land used for the road $= \frac{1}{6}$.
2. Fraction remaining $= 1 - \frac{1}{6} = \frac{5}{6}$.
3. The child receives $\frac{1}{2}$ of the remaining land.
4. Child's share $= \frac{1}{2} \times \frac{5}{6} = \frac{5}{12}$.
5. Therefore, the child receives $\boxed{\frac{5}{12}}$ of the original land.

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5. A school plants 8 saplings in a straight line. The distance between every two consecutive saplings is $\frac{3}{4}$ m. Find the distance between the first and the last sapling.

Answer:

1. With 8 saplings, the number of spaces between consecutive saplings is $8 - 1 = 7$.
2. Distance of each space $= \frac{3}{4}$ m.
3. Total distance $= 7 \times \frac{3}{4}$.
4. $7 \times \frac{3}{4} = \frac{21}{4} = 5\frac{1}{4}$ m.
5. Therefore, the distance between the first and last sapling is $\boxed{5\frac{1}{4} \text{ m}}$.

Figure:

●———●———●———●———●———●———●———●

3/4 3/4 3/4 3/4 3/4 3/4 3/4 m

8 saplings → 7 equal spaces
Total distance = 7 × 3/4 = 5¼ m

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6. A tortoise travels $\frac{2}{5}$ km in one hour. How far will it travel in $2\frac{1}{2}$ hours? How much farther is this than the distance travelled in $\frac{3}{4}$ hour?

Answer:

1. Convert $2\frac{1}{2}$ hours to $\frac{5}{2}$ hours.
2. Distance in $\frac{5}{2}$ hours $= \frac{2}{5} \times \frac{5}{2} = 1$ km.
3. Distance in $\frac{3}{4}$ hour $= \frac{2}{5} \times \frac{3}{4} = \frac{3}{10}$ km.
4. Difference $= 1 - \frac{3}{10} = \frac{7}{10}$ km.
5. Therefore, it travels $\boxed{1 \text{ km}}$ in $2\frac{1}{2}$ hours, which is $\boxed{\frac{7}{10} \text{ km}}$ farther.

---

7. A ribbon $3\frac{1}{2}$m long is cut into pieces of length $\frac{1}{4}$m each. How many pieces can be obtained?

Answer:

1. Convert $3\frac{1}{2}$into an improper fraction: $3\frac{1}{2} = \frac{7}{2}$.
2. Number of pieces $= \frac{7}{2} \div \frac{1}{4}$.
3. Replace division by multiplication by the reciprocal: $\frac{7}{2} \times \frac{4}{1}$.
4. $\frac{7}{2} \times 4 = 14$.
5. Therefore, $\boxed{14}$ pieces of ribbon can be obtained.

---

8. A family uses $\frac{3}{5}$kg of rice for one meal. How much rice will be required for $2\frac{1}{2}$such meal quantities? If they have 2 kg of rice, how much will remain?

Answer:

1. Convert $2\frac{1}{2}$into $\frac{5}{2}$.
2. Rice required $= \frac{3}{5} \times \frac{5}{2}$.
3. Simplifying, $\frac{3}{5} \times \frac{5}{2} = \frac{3}{2} = 1\frac{1}{2}$kg.
4. Rice remaining $= 2 - 1\frac{1}{2} = \frac{1}{2}$kg.
5. Therefore, $\boxed{1\frac{1}{2}\text{ kg}}$ of rice is required and $\boxed{\frac{1}{2}\text{ kg}}$ remains.

---

9. A square floor tile has side $\frac{2}{5}$m. Find the area of one tile. If 10 such tiles are used, find the total area covered.

Answer:

1. Area of a square $=$ side $\times$ side.
2. Area of one tile $= \frac{2}{5} \times \frac{2}{5} = \frac{4}{25}\ \text{m}^2$.
3. Number of tiles $= 10$.
4. Total area $= 10 \times \frac{4}{25} = \frac{40}{25} = \frac{8}{5}\ \text{m}^2$.
5. Therefore, one tile has area $\boxed{\frac{4}{25}\ \text{m}^2}$, and 10 tiles cover $\boxed{\frac{8}{5} = 1\frac{3}{5}\ \text{m}^2}$.

---

10. Two packets contain different quantities of food grains. Packet A contains $\frac{12}{15}$of 500 g, while Packet B contains $\frac{3}{20}$of 4 kg. Which packet contains more and by how much?

Answer:

1. Packet A contains $\frac{12}{15} \times 500 = \frac{4}{5} \times 500 = 400$g.
2. Convert 4 kg into grams: 4 kg $=$ 4000 g.
3. Packet B contains $\frac{3}{20} \times 4000 = 600$g.
4. Difference $= 600 - 400 = 200$g.
5. Therefore, **Packet B** contains more, by $\boxed{200\text{ g}}$.

---

11. A student reads $\frac{2}{5}$of a book on Monday and then reads $\frac{1}{2}$of the remaining book on Tuesday. What fraction of the whole book is still unread?

Answer:

1. After Monday, the unread portion is $1 - \frac{2}{5} = \frac{3}{5}$.
2. On Tuesday, the student reads $\frac{1}{2}$ of the remaining $\frac{3}{5}$.
3. Tuesday's reading $= \frac{1}{2} \times \frac{3}{5} = \frac{3}{10}$.
4. Total read $= \frac{2}{5} + \frac{3}{10} = \frac{4}{10} + \frac{3}{10} = \frac{7}{10}$.
5. Therefore, the fraction still unread is $\boxed{\frac{3}{10}}$.

---

12. A rectangular sheet is $\frac{3}{4}$m long and $\frac{2}{3}$m wide. It is divided into two equal-area pieces. Find the area of each piece.

Answer:

1. Area of the whole sheet $= \frac{3}{4} \times \frac{2}{3}$.
2. Cancelling common factors gives an area of $\frac{1}{2}$ m^2.
3. The sheet is divided into 2 equal-area pieces.
4. Area of each piece $= \frac{1}{2} \div 2 = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ m^2.
5. Therefore, each piece has an area of $\boxed{\frac{1}{4}\ \text{m}^2}$.

These applied problems use the chapter's central ideas of **fraction multiplication, division by the reciprocal, fractional parts of quantities, area, sharing, distance, and fractional relationships**.

8.14 Multiple Choice Questions with answers for Olympiad type Competitive Exams: (20 MCQs of LOTS & 20 MCQs of HOTS Type)

Olympiad-Type Multiple Choice Questions:

1. What is the value of $\frac{3}{4} \times \frac{8}{9}$?

A) $\frac{2}{3}$
B) $\frac{3}{4}$
C) $\frac{8}{9}$
D) $\frac{3}{2}$

Answer: A) $\frac{2}{3}$

2. Which of the following is equal to $\frac{5}{6} \div \frac{10}{9}$?

A) $\frac{25}{27}$
B) $\frac{3}{4}$
C) $\frac{4}{3}$
D) $\frac{50}{54}$

Answer: B) $\frac{3}{4}$

3. The reciprocal of $2\frac{1}{3}$ is:

A) $\frac{7}{3}$
B) $\frac{3}{7}$

C) $\frac{2}{3}$
D) $\frac{3}{2}$
Answer: B) $\frac{3}{7}$
4. If $\frac{3}{5} \times x = 1$**, then** x**is:**
A) $\frac{3}{5}$
B) $\frac{2}{5}$
C) $\frac{5}{3}$
D) $\frac{5}{2}$
Answer: C) $\frac{5}{3}$
A fraction multiplied by its reciprocal gives 1.
5. Without calculating the exact product, which statement about $\frac{7}{8} \times \frac{5}{6}$**is correct?**
A) Product $> \frac{7}{8}$
B) Product $= \frac{7}{8}$
C) Product $< \frac{7}{8}$
D) Product > 1
Answer: C) Product $< \frac{7}{8}$
6. Which is the greatest?
A) $\frac{3}{4} \times \frac{1}{2}$
B) $\frac{3}{4} \times 1$
C) $\frac{3}{4} \times \frac{3}{2}$
D) $\frac{3}{4} \times \frac{2}{3}$
Answer: C) $\frac{3}{4} \times \frac{3}{2}$
Multiplication by a number greater than 1 increases the other factor.
7. The value of $\frac{12}{7} \times \frac{5}{24}$**, in simplest form, is:**
A) $\frac{5}{14}$
B) $\frac{10}{21}$
C) $\frac{5}{28}$
D) $\frac{60}{31}$
Answer: A) $\frac{5}{14}$
8. Which operation gives the greatest result?
A) $4 \times \frac{1}{2}$
B) $4 \div 2$
C) $4 \div \frac{1}{2}$
D) $4 \times \frac{1}{4}$
Answer: C) $4 \div \frac{1}{2}$

9. If $x \div \frac{2}{5} = 15$, what is x?
A) 6
B) 10
C) 15
D) $\frac{75}{2}$
Answer: A) 6
10. Which of the following is NOT equal to 1?
A) $\frac{3}{7} \times \frac{7}{3}$
B) $\frac{5}{9} \times \frac{9}{5}$
C) $\frac{4}{7} \div \frac{4}{7}$
D) $\frac{5}{8} \times \frac{5}{8}$
Answer: D) $\frac{5}{8} \times \frac{5}{8}$
11. A number is multiplied by $\frac{3}{4}$and the result is $\frac{3}{8}$. What is the number?
A) $\frac{1}{4}$
B) $\frac{1}{2}$
C) $\frac{2}{3}$
D) $\frac{3}{4}$
Answer: B) $\frac{1}{2}$
12. If $A = \frac{2}{3} \times \frac{3}{4}$and $B = \frac{2}{3} \div \frac{3}{4}$, then:
A) $A = B$
B) $A > B$
C) $A < B$
D) $A + B = 1$
Answer: C) $A < B$
Here, $A = \frac{1}{2}$while $B = \frac{8}{9}$.
13. A square has side $\frac{3}{5}$m. Its area is:
A) $\frac{6}{5}\ \mathrm{m}^2$
B) $\frac{9}{10}\ \mathrm{m}^2$
C) $\frac{9}{25}\ \mathrm{m}^2$
D) $\frac{6}{25}\ \mathrm{m}^2$
Answer: C) $\frac{9}{25}\ \mathrm{m}^2$
14. A rectangle is $\frac{3}{4}$m long and $\frac{2}{3}$m broad. Its area is:
A) $\frac{5}{6}\ \mathrm{m}^2$
B) $\frac{1}{2}\ \mathrm{m}^2$
C) $\frac{7}{12}\ \mathrm{m}^2$
D) $\frac{5}{12}\ \mathrm{m}^2$

Answer: B) $\frac{1}{2}$ m^2
The chapter uses area models to develop multiplication of fractions.
15. A tortoise travels $\frac{2}{5}$km in one hour. How far will it travel in $1\frac{1}{2}$hours?
A) $\frac{2}{5}$km
B) $\frac{3}{5}$km
C) $\frac{4}{5}$km
D) $1\frac{1}{5}$km
Answer: B) $\frac{3}{5}$km
16. A ribbon $2\frac{1}{4}$m long is cut into pieces of length $\frac{3}{8}$m each. How many complete pieces are obtained?
A) 4
B) 5
C) 6
D) 8
Answer: C) 6
17. If $\frac{3}{4}$litre of juice is equally divided among 6 children, each child receives:
A) $\frac{1}{8}$litre
B) $\frac{1}{6}$litre
C) $\frac{1}{4}$litre
D) $\frac{3}{8}$litre
Answer: A) $\frac{1}{8}$litre
18. Which expression correctly represents $\frac{4}{5} \div \frac{2}{3}$?
A) $\frac{4}{5} \times \frac{2}{3}$
B) $\frac{5}{4} \times \frac{3}{2}$
C) $\frac{4}{5} \times \frac{3}{2}$
D) $\frac{5}{4} \times \frac{2}{3}$
Answer: C) $\frac{4}{5} \times \frac{3}{2}$
19. If $P = \frac{5}{6} \div \frac{1}{2}$, then Pequals:
A) $\frac{5}{12}$
B) $\frac{5}{3}$
C) $\frac{5}{6}$
D) $\frac{6}{5}$
Answer: B) $\frac{5}{3}$
20. Which of the following statements is always true for a positive number x?
A) $x \times \frac{1}{2} > x$
B) $x \div \frac{1}{2} < x$

C) $x \times \frac{1}{2} < x$
D) $x \div 2 > x$
Answer: C) $x \times \frac{1}{2} < x$
21. A farmer uses $\frac{1}{6}$of his land for a road. He gives $\frac{1}{2}$of the remaining land to his son. What fraction of the original land does the son receive?
A) $\frac{1}{3}$
B) $\frac{5}{12}$
C) $\frac{1}{2}$
D) $\frac{5}{6}$
Answer: B) $\frac{5}{12}$
22. Eight saplings are planted in a straight line with $\frac{3}{4}$m between consecutive saplings. What is the distance between the first and eighth saplings?
A) 6m
B) $5\frac{1}{4}$m
C) $6\frac{3}{4}$m
D) $4\frac{1}{2}$m
Answer: B) $5\frac{1}{4}$**m**
23. A tap fills $\frac{7}{10}$of a tank in one hour. What fraction does it fill in $\frac{3}{4}$hour?
A) $\frac{7}{40}$
B) $\frac{21}{40}$
C) $\frac{21}{10}$
D) $\frac{14}{15}$
Answer: B) $\frac{21}{40}$
24. Which is greater?
A) $\frac{12}{15}$of 500 g
B) $\frac{3}{20}$of 4 kg
C) Both are equal
D) Cannot be determined
Answer: B) $\frac{3}{20}$**of 4 kg**
The quantities are 400 g and 600 g respectively.
25. If $\frac{2}{3}$of a quantity is taken and then $\frac{3}{4}$of that result is taken, what fraction of the original quantity is obtained?
A) $\frac{1}{6}$
B) $\frac{1}{2}$
C) $\frac{7}{12}$
D) $\frac{5}{6}$
Answer: B) $\frac{1}{2}$

26. Which number should replace ?in $\frac{5}{8} \times ? = \frac{15}{32}$?

A) $\frac{3}{4}$
B) $\frac{4}{5}$
C) $\frac{3}{8}$
D) $\frac{5}{4}$

Answer: A) $\frac{3}{4}$

27. If $A = \frac{4}{5} \div \frac{2}{5}$ and $B = \frac{4}{5} \times \frac{5}{2}$, which statement is correct?

A) $A > B$
B) $A < B$
C) $A = B$
D) $A + B = 2$

Answer: C) $A = B$

Division by a fraction is equivalent to multiplication by its reciprocal.

28. Which fraction, when multiplied by $\frac{7}{12}$, gives $\frac{7}{18}$?

A) $\frac{1}{2}$
B) $\frac{2}{3}$
C) $\frac{3}{4}$
D) $\frac{4}{3}$

Answer: B) $\frac{2}{3}$

29. A unit square is divided into 5 equal rows and 4 equal columns. One row and one column overlap in what fraction of the whole square?

A) $\frac{1}{9}$
B) $\frac{1}{10}$
C) $\frac{1}{20}$
D) $\frac{1}{4}$

Answer: C) $\frac{1}{20}$

30. Which sequence is in increasing order?

A) $\frac{3}{4} \times \frac{1}{2}, \frac{3}{4}, \frac{3}{4} \div \frac{1}{2}$
B) $\frac{3}{4}, \frac{3}{4} \times \frac{1}{2}, \frac{3}{4} \div \frac{1}{2}$
C) $\frac{3}{4} \div \frac{1}{2}, \frac{3}{4}, \frac{3}{4} \times \frac{1}{2}$
D) $\frac{3}{4} \times \frac{1}{2}, \frac{3}{4} \div \frac{1}{2}, \frac{3}{4}$

Answer: A)

Because $\frac{3}{8} < \frac{3}{4} < \frac{3}{2}$.

31. The value of $\frac{1}{2} \div \frac{1}{3}$ is how many times the value of $\frac{1}{2} \times \frac{1}{3}$?

A) 3 times
B) 6 times
C) 9 times
D) 12 times

Answer: C) 9 times
Since $\frac{1}{2} \div \frac{1}{3} = \frac{3}{2}$and $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$, and $\frac{3}{2} \div \frac{1}{6} = 9$.
32. If $x \times \frac{2}{3} = \frac{4}{5}$, then $x$equals:
A) $\frac{8}{15}$
B) $\frac{6}{5}$
C) $\frac{10}{12}$
D) $\frac{15}{8}$
Answer: B) $\frac{6}{5}$
33. Which pair consists of reciprocals?
A) $\frac{3}{5}, \frac{3}{5}$
B) $\frac{4}{7}, \frac{7}{4}$
C) $\frac{2}{3}, \frac{3}{2} + 1$
D) $\frac{5}{8}, \frac{3}{8}$
Answer: B) $\frac{4}{7}, \frac{7}{4}$
34. A quantity is multiplied by $\frac{3}{5}$and then by its reciprocal. The final quantity is:
A) $\frac{3}{5}$of the original
B) $\frac{5}{3}$of the original
C) Twice the original
D) Equal to the original
Answer: D) Equal to the original
35. Brahmagupta's rules for arithmetic with fractions appeared in which work?
A) *Līlāvatī*
B) *Āryabhaṭīya*
C) *Brāhmasphuṭasiddhānta*
D) *Sulba Sūtras*
Answer: C) *Brāhmasphuṭasiddhānta*

8.15 Best Practices Opportunity List from the Chapter: (10 Ideas)

"Best Practices" Opportunities While Teaching Chapter 8: Working with Fractions:

(1) Use Concrete-to-Pictorial-to-Abstract Learning
Begin with familiar objects such as paper strips, chocolates, measuring cups, or fraction tiles, then move to diagrams and finally to numerical expressions. This helps students understand fraction multiplication and division conceptually rather than memorising rules.

(2) Use Area Models for Multiplication of Fractions
Ask students to divide a unit square into rows and columns and shade overlapping portions to represent expressions such as $\frac{1}{2} \times \frac{1}{3}$. This directly reinforces the chapter's geometrical interpretation of fraction multiplication.

(3) Encourage Estimation Before Calculation
Before solving, ask students to predict whether the answer should be larger or smaller than the original number. For example, they should recognise that multiplication by a

fraction between 0 and 1 decreases a positive quantity, while multiplication by a number greater than 1 increases it.

(4) Teach Cancellation Before Multiplication
Encourage students to identify and cancel common factors before multiplying numerators and denominators. This reduces computational effort, keeps numbers manageable, and reinforces equivalent fractions.

(5) Develop the Reciprocal Concept Before Teaching Division
Establish clearly that the reciprocal of $\frac{a}{b}$ is $\frac{b}{a}$ and that their product is 1 before introducing division. Students can then understand why division by a fraction is performed by multiplying by its reciprocal.

(6) Use Real-Life Fraction Problems
Connect exercises to situations involving **distance, sharing, area, quantities, rates, land, tanks, and measurements**. Students should first identify whether the situation requires multiplication or division and only then perform the calculation.

(7) Promote Error Analysis
Give intentionally incorrect solutions such as

$$\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{3}{5}$$

and ask students to identify and correct the mistake. Such activities strengthen reasoning and reduce common misconceptions about fraction division.

(8) Use Think–Pair–Share for Multiple Strategies
Give a fraction problem individually, allow students to compare methods with a partner, and then discuss solutions with the class. Encourage strategies such as direct multiplication, cancellation, diagrams, and reciprocal-based reasoning.

(9) Connect Multiplication with Division
Present related calculations together, such as

$$\frac{1}{2} \times \frac{1}{3} = \frac{1}{6} \text{ and } \frac{1}{2} \div \frac{1}{3} = \frac{3}{2}.$$

Ask students to explain why multiplication by a proper fraction makes a quantity smaller whereas division by it can make the quotient larger.

(10) Include Indian Mathematical Heritage
Briefly discuss **Brahmagupta, Bhāskara I, and Bhāskara II** while teaching the relevant concepts. This connects present-day fraction algorithms with the chapter's account of India's mathematical heritage.

(11) Use Peer Explanation and Student Demonstration
Invite students to explain at the board why a fraction is inverted during division or how an area model represents a product. Explaining a method to classmates helps reveal whether the concept has actually been understood.

(12) Use Short Formative Assessments and Exit Questions
End the lesson with two or three quick questions—one calculation, one prediction, and one application. For example: *"Without calculating, is* $5 \div \frac{3}{4}$ *greater or smaller than 5? Why?"* This gives the teacher immediate evidence of conceptual understanding.

8.16 Innovations Opportunity List from the Chapter: (10 Ideas)

"Innovations" Opportunities While Teaching Chapter 8: Working with Fractions – Grade 7:

(1) Fraction Lab with Paper Folding:

Create a hands-on "Fraction Lab" where students fold transparent sheets or coloured paper horizontally and vertically to model products such as $\frac{1}{2} \times \frac{1}{3}$. The overlapping region allows students to *see* why the numerators and denominators are multiplied. This extends the chapter's area-model approach.

(2) Fraction Prediction Challenge:

Before students calculate, display expressions such as $\frac{4}{5} \times \frac{2}{3}$, $\frac{4}{5} \times \frac{3}{2}$, $\frac{4}{5} \div \frac{2}{3}$, and $\frac{4}{5} \div \frac{3}{2}$. Students classify the answer as **greater than, equal to, or less than** the starting number and then calculate to verify their prediction. This develops number sense around the chapter's product-and-quotient patterns.

(3) "Reciprocal Partner" Classroom Game:

Give each student a fraction card and ask them to locate the classmate holding its reciprocal—for example, $\frac{3}{7}$pairs with $\frac{7}{3}$. Each pair verifies that their fractions multiply to 1 and then creates a division problem using the pair.

(4) Fraction Café or Mini-Market Simulation:

Transform the classroom into a small café or market where students work with fractional quantities of juice, rice, fruits, cakes, or other imaginary goods. Tasks such as sharing $\frac{3}{4}$litre equally, finding $\frac{2}{5}$of a quantity, or doubling a fractional recipe turn multiplication and division into practical problem-solving.

(5) Digital Fraction Visualiser:

Use an interactive whiteboard or simple digital drawing tool to create rectangles divided into rows and columns. Students can shade different fractions and observe the overlapping region dynamically, linking visual representation with symbolic multiplication.

(6) "Find the Mathematical Error" Challenge:

Display deliberately incorrect solutions, such as

$$\frac{3}{5} \div \frac{2}{7} = \frac{3}{5} \times \frac{2}{7}.$$

Student teams act as "mathematical detectives" to locate the error, explain why it is wrong, and reconstruct the correct solution using the reciprocal rule.

(7) Fraction Journey/Race Game:

Create a number-line race in which students move according to fraction-operation cards. Correctly solving multiplication or division problems allows them to advance, while prediction cards ask whether an answer will be larger or smaller before calculation.

(8) Design-Your-Own Fraction Puzzle:

After learning multiplication and division, students create puzzles such as: "I multiplied a number by $\frac{3}{4}$and obtained $\frac{3}{8}$. What was my number?" Students exchange puzzles and solve one another's challenges, encouraging creativity alongside algebraic reasoning.

(9) Real-Life Fraction Investigation Project:

Small groups can investigate fractions in **recipes, travel distances, land measurements, sharing, area, or rates**. They prepare one real-life problem involving multiplication and another involving division, solve them, and explain why each operation is appropriate. The chapter itself develops fraction ideas through contextual problems such as distance travelled in fractional time.

(10) Fraction Art and Mosaic Activity:

Students design a square mosaic divided into rows and columns and use different patterns to represent products such as $\frac{2}{3} \times \frac{3}{4} = \frac{1}{2}$. Mathematics is thereby integrated with art while preserving the chapter's geometric interpretation of fraction multiplication.

(11) Brahmagupta–Bhāskara Mathematics Corner:
Create a classroom heritage corner or student-made digital timeline highlighting **Brahmagupta, Bhāskara I, and Bhāskara II** and the fraction ideas discussed in the chapter. Students can present a one-minute "mathematician spotlight" connecting historical rules with the methods they use today.

(12) Student-Created Fraction Video/Comic:
Groups can create a one-minute video, animation, or comic explaining concepts such as **"Why do we multiply by the reciprocal?"**, **"Why can multiplication make a number smaller?"**, or **"How does an area model show multiplication of fractions?"** The activity turns students from receivers of rules into explainers of mathematical ideas.

These innovations particularly support **visualisation, experiential learning, mathematical reasoning, collaboration, creativity, application, and Olympiad-oriented problem-solving** while remaining closely connected to the concepts developed in *Working with Fractions*.

8.17: Practicing Questions/Question Bank:

The uploaded chapter is **Mathematics – Chapter 8: "Working with Fractions," not Science**. Based strictly on that uploaded Grade 7 chapter, the following additional questions would strengthen the question bank.

A. Fill in the Blanks:

1. The reciprocal of $\frac{7}{9}$ is ________.
   Answer: $\frac{9}{7}$

2. $\frac{4}{5} \times \frac{2}{3} =$________.
   Answer: $\frac{8}{15}$

3. A fraction multiplied by its reciprocal gives ________.
   Answer: 1

4. $\frac{3}{5} \div \frac{2}{7} = \frac{3}{5} \times$________.
   Answer: $\frac{7}{2}$

5. $\frac{3}{4}$ of 20 is ________.
   Answer: 15

6. When a positive number is multiplied by a fraction between 0 and 1, the product is ________ than the original number.
   Answer: smaller

7. When a positive number is divided by a fraction between 0 and 1, the quotient is ________ than the dividend.
   Answer: greater

8. $\frac{1}{2} \times \frac{1}{3} =$________.
   Answer: $\frac{1}{6}$

9. The reciprocal of $2\frac{1}{2}$ is ________.

   Answer: $\frac{2}{5}$

10. $\frac{2}{3} \div \frac{3}{5} =$________.

    Answer: $\frac{10}{9}$

B. One-Mark Descriptive Questions:

1. What is meant by the reciprocal of a fraction?
Answer: The reciprocal of a non-zero fraction is obtained by interchanging its numerator and denominator.

2. Find the reciprocal of $\frac{11}{13}$.
Answer: The reciprocal is $\frac{13}{11}$.

3. Find $\frac{2}{3} \times \frac{3}{4}$.
Answer: $\frac{2}{3} \times \frac{3}{4} = \frac{1}{2}$.

4. Find $\frac{5}{6} \div \frac{1}{2}$.
Answer: $\frac{5}{6} \div \frac{1}{2} = \frac{5}{3}$.

5. What happens when a fraction is multiplied by its reciprocal?
Answer: The product is 1.

6. Write the general rule for multiplying two fractions.
Answer: $\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$.

7. How do we divide one fraction by another?
Answer: We multiply the first fraction by the reciprocal of the second fraction.

8. Find $\frac{3}{5}$ of 20.
Answer: $\frac{3}{5} \times 20 = 12$.

9. Is $\frac{3}{4} \times \frac{2}{3}$ greater or smaller than $\frac{3}{4}$?
Answer: It is smaller than $\frac{3}{4}$.

10. What is the reciprocal of 5?
Answer: The reciprocal of 5 is $\frac{1}{5}$.

C. Two-Mark Descriptive Questions:

1. Find $\frac{5}{8} \times \frac{4}{15}$ and simplify.
Answer:

1. $\frac{5}{8} \times \frac{4}{15} = \frac{20}{120}$.
2. Therefore, the simplified answer is $\boxed{\frac{1}{6}}$.

2. Find $\frac{3}{4} \div \frac{2}{5}$.
Answer:

1. $\frac{3}{4} \div \frac{2}{5} = \frac{3}{4} \times \frac{5}{2}$.
2. Therefore, the answer is $\boxed{\frac{15}{8}}$.

3. Explain why $\frac{3}{5} \times \frac{1}{2} < \frac{3}{5}$.
Answer:

1. The multiplier $\frac{1}{2}$ lies between 0 and 1.
2. Multiplication by such a fraction makes a positive quantity smaller.

4. Find the reciprocal of $1\frac{3}{4}$ and verify it.
Answer:

1. $1\frac{3}{4} = \frac{7}{4}$, so its reciprocal is $\frac{4}{7}$.
2. Verification: $\frac{7}{4} \times \frac{4}{7} = 1$.

5. A child drinks $\frac{2}{3}$ of a $\frac{3}{4}$-litre bottle of juice. How much juice does the child drink?
Answer:

1. Quantity consumed $= \frac{2}{3} \times \frac{3}{4}$.
2. Therefore, the child drinks $\boxed{\frac{1}{2}}$ litre.

6. Find $3 \div \frac{3}{4}$ and explain its meaning.
Answer:

1. $3 \div \frac{3}{4} = 3 \times \frac{4}{3} = 4$.
2. Thus, four groups of size $\frac{3}{4}$ can be made from 3 wholes.

D. Three-Mark Descriptive Questions:

1. Find $\frac{18}{25} \times \frac{15}{24}$ using cancellation.
Answer:

1. Cancel common factors: $\frac{18}{24} = \frac{3}{4}$ and $\frac{15}{25} = \frac{3}{5}$.
2. Thus, the product becomes $\frac{3}{4} \times \frac{3}{5}$.
3. Therefore, the answer is $\boxed{\frac{9}{20}}$.

2. A tortoise travels $\frac{2}{5}$ km in one hour. Find the distance travelled in $\frac{3}{4}$ hour.
Answer:

1. Distance $= \frac{2}{5} \times \frac{3}{4}$km.
2. $= \frac{6}{20}$km.
3. Therefore, it travels $\boxed{\frac{3}{10}}$km.

3. Explain why $5 \div \frac{1}{2}$is greater than 5.
Answer:

1. Dividing by $\frac{1}{2}$means finding how many halves are contained in 5.
2. $5 \div \frac{1}{2} = 5 \times 2 = 10$.
3. Therefore, $10 > 5$, illustrating that division by a proper fraction can increase a positive quantity.

4. Find $x$if $\frac{3}{4}x = \frac{3}{8}$.
Answer:

1. $x = \frac{3}{8} \div \frac{3}{4}$.
2. $x = \frac{3}{8} \times \frac{4}{3}$.
3. Therefore, $\boxed{x = \frac{1}{2}}$.

5. A rectangle has length $\frac{5}{6}$m and breadth $\frac{3}{5}$m. Find its area.
Answer:

1. Area $=$ length $\times$ breadth.
2. $= \frac{5}{6} \times \frac{3}{5} = \frac{15}{30}$.
3. Therefore, area $= \boxed{\frac{1}{2}\ \mathrm{m}^2}$.

6. Compare $\frac{3}{4} \times \frac{1}{2}$and $\frac{3}{4} \div \frac{1}{2}$.
Answer:

1. $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$.
2. $\frac{3}{4} \div \frac{1}{2} = \frac{3}{4} \times 2 = \frac{3}{2}$.
3. Therefore, $\boxed{\frac{3}{8} < \frac{3}{2}}$; multiplication and division by the same proper fraction have different effects.

E. Five-Mark Descriptive Questions:

1. Explain multiplication of fractions using an area model for $\frac{2}{3} \times \frac{3}{4}$.
Answer:

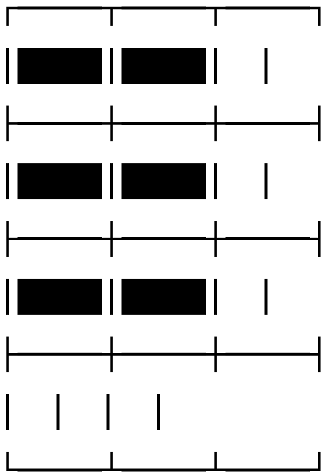
1. Draw a unit square and divide it into 3 equal columns.

2. Shade 2 columns to represent $\frac{2}{3}$.

3. Divide the same square into 4 equal rows and consider 3 rows to represent $\frac{3}{4}$.

4. The overlapping region consists of 6 out of 12 equal parts.

5. Hence, $\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \boxed{\frac{1}{2}}$.



Overlap = 6/12 = 1/2

2. A ribbon $4\frac{1}{2}$m long is cut into pieces of $\frac{3}{8}$m each. Find the number of pieces.
Answer:

1. Convert $4\frac{1}{2}$into an improper fraction: $\frac{9}{2}$.

2. Number of pieces $= \frac{9}{2} \div \frac{3}{8}$.

3. Replace division by multiplication by the reciprocal.

4. $\frac{9}{2} \times \frac{8}{3} = \frac{72}{6} = 12$.

5. Therefore, $\boxed{12}$pieces can be obtained.

3. A tank is filled at the rate of $\frac{3}{5}$of its capacity per hour. Find the fraction filled in $1\frac{1}{2}$hours. If its capacity is 600 litres, find the quantity of water filled.
Answer:

1. $1\frac{1}{2} = \frac{3}{2}$hours.

2. Fraction filled $= \frac{3}{5} \times \frac{3}{2}$.

3. This equals $\frac{9}{10}$of the tank.

4. Water filled $= \frac{9}{10} \times 600 = 540$litres.

5. Therefore, $\boxed{\frac{9}{10}}$ of the tank, or $\boxed{540 \text{ litres}}$, is filled.

4. A student claims that multiplication always increases a number. Examine the claim using $\frac{4}{5} \times \frac{1}{2}$ and $\frac{4}{5} \times \frac{3}{2}$.

Answer:

1. $\frac{4}{5} \times \frac{1}{2} = \frac{2}{5}$.
2. Here, $\frac{2}{5} < \frac{4}{5}$, because the multiplier $\frac{1}{2} < 1$.
3. $\frac{4}{5} \times \frac{3}{2} = \frac{6}{5}$.
4. Here, $\frac{6}{5} > \frac{4}{5}$, because the multiplier $\frac{3}{2} > 1$.
5. Therefore, multiplication does **not always increase** a number; the effect depends on the multiplying factor.

5. A family has $2\frac{1}{4}$ litres of juice. The juice is poured equally into glasses holding $\frac{3}{8}$ litre each. Find how many glasses can be completely filled and verify your answer.

Answer:

1. Convert $2\frac{1}{4}$ to $\frac{9}{4}$ litres.
2. Number of glasses $= \frac{9}{4} \div \frac{3}{8}$.
3. $= \frac{9}{4} \times \frac{8}{3}$.
4. Simplifying gives 6glasses.
5. Verification: $6 \times \frac{3}{8} = \frac{18}{8} = \frac{9}{4} = 2\frac{1}{4}$; therefore, $\boxed{6}$ glasses can be completely filled.

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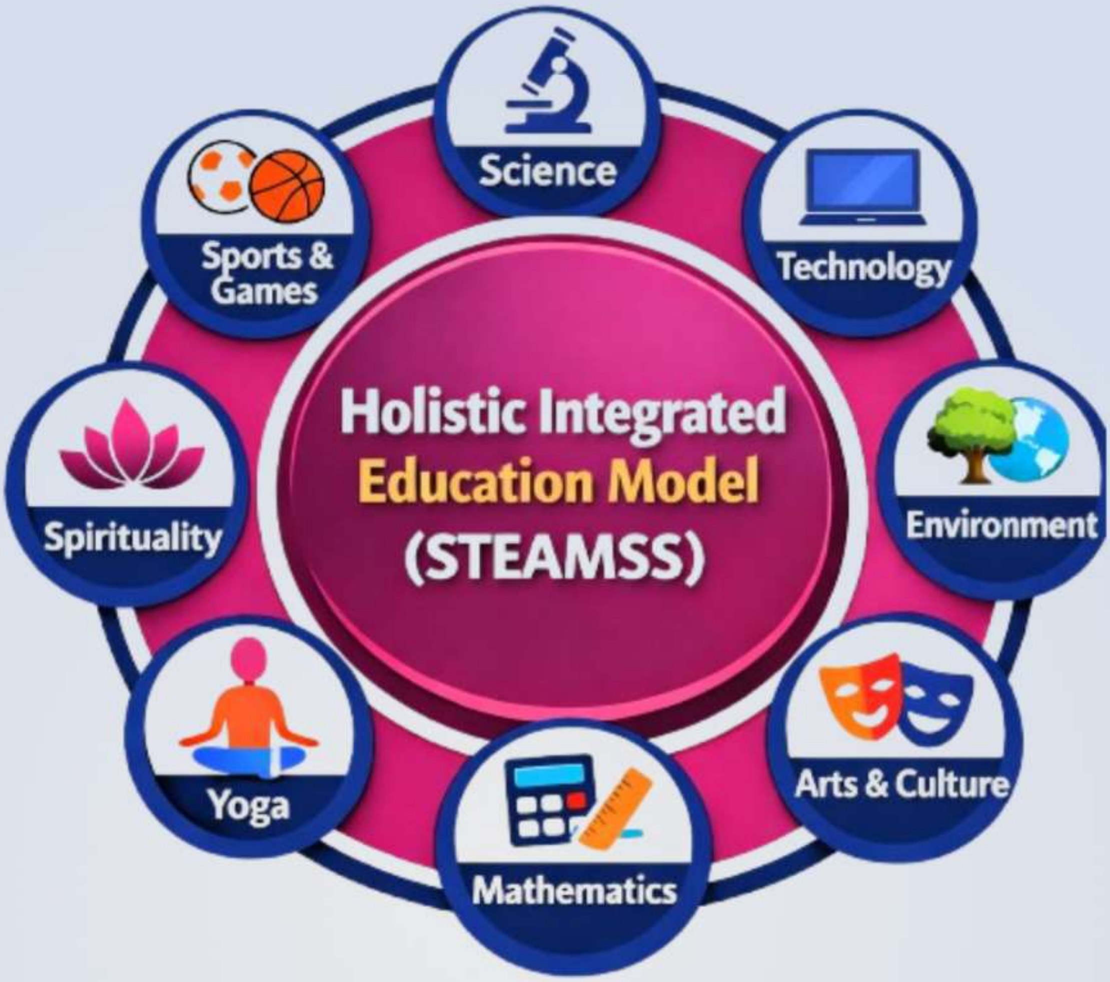

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