Super Power Series Book

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GANITA PRAKASH
FOR YOUNG LEARNERS

Mathematics
Builds
a Brighter
Tomorrow

Study Material BOOK for 6th Standard Mathematics Subject

Based on NCERT/CBSE Curriculum

Compiled By: Dr. P. S. Aithal
Alevoor Poornaprajna Public School, Udupi
www.alevoorpps.in

Better
Learners
Brighter
Futures

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Study Material BOOK for 6th Standard Mathematics Subject

(Prepared as per Poornaprajna Integrated Student Support Model)

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PREFACE

GANITA PRAKASH FOR YOUNG LEARNERS: Study Material Book for 6th Standard Mathematics Subject has been thoughtfully developed in accordance with the **Poornaprajna Integrated Student Support Model** and the **NCERT/CBSE Curriculum** with the help of AI-driven GPTs. The book aims to make Mathematics interesting, meaningful, and accessible by strengthening conceptual understanding, mathematical curiosity, logical reasoning, and problem-solving abilities among young learners.

The book provides systematic learning and practice across important Grade 6 topics such as **Patterns in Mathematics, Lines and Angles, Number Play, Data Handling and Presentation, Prime Time, Perimeter and Area, Fractions, Constructions, Symmetry, and Integers**. Through chapter summaries, important formulas, **LOTS and HOTS questions, application-oriented exercises, and Olympiad-type multiple-choice questions**, the material encourages students to progress from basic understanding to analysis, reasoning, and practical application of mathematical concepts.

This book is intended to serve as a comprehensive learning companion for **6th Grade CBSE students**, supporting their preparation for both **school examinations and competitive examinations such as Olympiads**. Its structured practice, problem-solving activities, best practices, and innovative learning opportunities are designed to build accuracy, confidence, creativity, and independent thinking. We hope *GANITA PRAKASH FOR YOUNG LEARNERS* inspires every student to explore Mathematics with curiosity, discover patterns with enthusiasm, and develop a lasting interest in mathematical learning.

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

6th Standard Mathematics Book Chapter 1

Chapter 1: PATTERNS IN MATHEMATICS

1.1 Summary of the Chapter:

Chapter 1: Patterns in Mathematics — Summary:

(1) Mathematics involves discovering patterns and explaining why those patterns occur.
(2) Mathematical patterns are found everywhere—in nature, daily activities, technology, weather, and the movement of celestial bodies.
(3) Mathematics is considered both an art and a science because identifying patterns requires creativity and logical thinking.
(4) Number theory is the branch of mathematics that studies patterns in whole numbers.
(5) Important number sequences include counting, odd, even, triangular, square, cube, Virahanka, and powers-of-2 and powers-of-3 sequences.
(6) Number sequences can be represented using dots, diagrams, and shapes, making their patterns easier to understand.
(7) A number may belong to more than one sequence; for example, 36 is both a triangular number and a square number.
(8) Adding consecutive odd numbers starting from 1 produces square numbers, such as $1 + 3 + 5 + 7 = 16$.
(9) Adding counting numbers in ascending and descending order also produces square numbers, such as $1 + 2 + 3 + 2 + 1 = 9$.
(10) Different number sequences are interconnected; for example, adding two consecutive triangular numbers gives a square number.
(11) Geometry studies patterns in shapes, including regular polygons, complete graphs, stacked squares, stacked triangles, and Koch snowflakes.
(12) Shape sequences are closely related to number sequences—for example, stacked squares represent square numbers, while the Koch snowflake produces three times the powers of 4.

1.2 Important Formulas:

Important Formulas — Chapter 1: Patterns in Mathematics:

1. **nth counting number**

$$a_n = n$$

2. **nth odd number**

$$a_n = 2n - 1$$

3. **nth even number**

$$a_n = 2n$$

4. **nth triangular number**

$$T_n = \frac{n(n+1)}{2}$$

5. **nth square number**

$$S_n = n^2$$

6. **nth cube number**

$$C_n = n^3$$

7. **Powers of 2**

$$a_n = 2^{n-1}$$

8. **Powers of 3**

$$a_n = 3^{n-1}$$

9. **Virahanka number rule**

$$V_n = V_{n-1} + V_{n-2}$$

Each term is the sum of the preceding two terms.

10. **Sum of the first $n$counting numbers**
$$1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$$
11. **Sum of the first $n$odd numbers**
$$1 + 3 + 5 + \cdots + (2n-1) = n^2$$
12. **Adding counting numbers up and down**
$$1 + 2 + \cdots + n + (n-1) + \cdots + 2 + 1 = n^2$$
13. **Sum of two consecutive triangular numbers**
$$T_n + T_{n+1} = (n+1)^2$$
14. **Sum of powers of 2**
$$1 + 2 + 4 + \cdots + 2^{n-1} = 2^n - 1$$
15. **Relationship between triangular and hexagonal numbers**
$$H_n = 6T_n + 1$$

This gives the sequence 7,19,37,61, ..., excluding the initial value 1.

16. **Sum of the first $n$hexagonal-pattern numbers**
$$1 + 7 + 19 + 37 + \cdots = n^3$$
17. **Number of sides or corners of consecutive regular polygons**
$$a_n = n + 2$$
18. **Number of lines in a complete graph with $n$points**
$$L = \frac{n(n-1)}{2}$$
19. **Number of small squares or triangles in the nth stacked arrangement**
$$n^2$$
20. **Number of line segments in the nth Koch snowflake stage**
$$L_n = 3 \times 4^{n-1}$$

1.3 Fill-Up the Blank LOTS type questions with Answers: (36 Questions)

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

1. Mathematics is largely the search for __________ and explanations for why they exist.
   Answer: patterns
2. Patterns can be observed in nature, homes, schools and the movement of the __________.
   Answer: sun, moon and stars
3. Mathematicians consider mathematics both an art and a __________.
   Answer: science
4. The branch of mathematics that studies patterns in whole numbers is called __________.
   Answer: number theory
5. The sequence 1,2,3,4,5, ...represents __________ numbers.
   Answer: counting
6. The sequence 1,3,5,7,9, ...represents __________ numbers.
   Answer: odd
7. The sequence 2,4,6,8,10, ...represents __________ numbers.
   Answer: even
8. The next number in the sequence 1,3,5,7,9, ...is __________.
   Answer: 11

9. The next number in the sequence 2,4,6,8,10, ...is __________.
Answer: 12
10. The sequence 1,3,6,10,15, ...represents __________ numbers.
Answer: triangular
11. The next triangular number after 15 is __________.
Answer: 21
12. The sequence 1,4,9,16,25, ...represents __________ numbers.
Answer: square
13. The next square number after 25 is __________.
Answer: 36
14. The sequence 1,8,27,64,125, ...represents __________ numbers.
Answer: cube
15. The next cube number after 125 is __________.
Answer: 216
16. In the Virahanka sequence, every new term is obtained by adding the previous __________ terms.
Answer: two
17. The next number in the sequence 1,2,3,5,8,13, ...is __________.
Answer: 21
18. The next number in the powers-of-2 sequence 1,2,4,8,16, ...is __________.
Answer: 32
19. The next number in the powers-of-3 sequence 1,3,9,27,81, ...is __________.
Answer: 243
20. Adding consecutive odd numbers beginning with 1 gives __________ numbers.
Answer: square
21. The sum $1 + 3 + 5 + 7$is __________.
Answer: 16
22. The sum of the first ten odd numbers is __________.
Answer: 100
23. Adding counting numbers from 1 upwards and then downwards gives __________ numbers.
Answer: square
24. Adding counting numbers successively, such as 1, $1 + 2$, $1 + 2 + 3$, ..., produces __________ numbers.
Answer: triangular
25. The sum of two consecutive triangular numbers produces a __________ number.
Answer: square
26. The number 36 is both a square number and a __________ number.
Answer: triangular
27. The sequence 1,7,19,37, ...represents __________ numbers.
Answer: hexagonal
28. The branch of mathematics that studies patterns in shapes is called __________.
Answer: geometry
29. Regular polygons have sides of equal length and equal __________.
Answer: angles
30. A polygon with five sides is called a __________.
Answer: pentagon
31. A polygon with six sides is called a __________.
Answer: hexagon

32. A polygon with eight sides is called an __________.
Answer: octagon
33. In any polygon, the number of sides is equal to the number of __________.
Answer: corners (vertices)
34. The numbers of lines in the complete graphs shown form the __________ number sequence.
Answer: triangular
35. The sequence of stacked squares represents __________ numbers.
Answer: square
36. The number of line segments in successive Koch snowflake patterns is 3,12,48, ..., which is three times the powers of __________.
Answer: 4

1.4 Fill-Up the Blank HOTS type questions with Answers: (35 Questions)

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

1. The 15th odd number is __________.
Answer: 29
2. The 20th even number is __________.
Answer: 40
3. The 8th triangular number is __________.
Answer: 36
4. The 12th square number is __________.
Answer: 144
5. The 7th cube number is __________.
Answer: 343
6. The next two terms in 1,2,3,5,8,13, __, __are __________ and __________.
Answer: 21 and 34
7. The missing term in 1,4,9, __,25,36is __________.
Answer: 16
8. The missing term in 1,3,6,10, __,21is __________.
Answer: 15
9. The sum of the first 12 odd numbers is __________.
Answer: 144
10. If $1 + 3 + 5 + \cdots + 19 = n^2$, then the value of $n$is __________.
Answer: 10
11. The sum $1 + 2 + 3 + 4 + 5 + 4 + 3 + 2 + 1$equals __________.
Answer: 25
12. The value of $1 + 2 + 3 + \cdots + 49 + 50 + 49 + \cdots + 3 + 2 + 1$is __________.
Answer: 2500
13. The sum of the consecutive triangular numbers 15 and 21 is the square number __________.
Answer: 36
14. The next term in 4,9,16,25, __obtained by adding consecutive triangular numbers is __________.
Answer: 36
15. Adding the first six counting numbers produces the triangular number __________.
Answer: 21
16. The value of $1 + 2 + 4 + 8 + 16$is one less than __________.
Answer: 32

17. When 1 is added to $1 + 2 + 4 + 8 + 16$, the result is __________.
    Answer: 32
18. If a power-of-2 sequence begins with 1, its eighth term is __________.
    Answer: 128
19. If a power-of-3 sequence begins with 1, its sixth term is __________.
    Answer: 243
20. Multiplying the triangular number 10 by 6 and adding 1 gives the hexagonal number __________.
    Answer: 61
21. The next term in the hexagonal-number sequence 1,7,19,37,61, ...is __________.
    Answer: 91
22. The sum $1 + 7 + 19 + 37$gives the cube number __________.
    Answer: 64
23. The sum of the first five hexagonal-pattern numbers $1 + 7 + 19 + 37 + 61$is __________.
    Answer: 125
24. A number that can be arranged as both a triangle and a 6×6square is __________.
    Answer: 36
25. A regular polygon with 12 equal sides and 12 equal angles is called a __________.
    Answer: dodecagon
26. A complete graph with six points contains __________ connecting lines.
    Answer: 15
27. The next complete graph after those with 1,3,6,10,15lines will contain __________ lines.
    Answer: 21
28. The seventh stacked-square pattern contains __________ small squares.
    Answer: 49
29. The fourth Koch snowflake pattern has $3 \times 4^3 =$__________ line segments.
    Answer: 192
30. If a Koch snowflake pattern has 192 segments, the next pattern will contain __________ segments.
    Answer: 768
31. The common multiplication factor in the sequence 3,12,48,192, ...is __________.
    Answer: 4
32. A student says that $1 + 3 + 5 + 7 + 9 = 20$. The correct sum, found using the square-number pattern, is __________.
    Answer: 25
33. If $T_n = \frac{n(n+1)}{2} = 28$, then $n =$__________.
    Answer: 7
34. The square number obtained by adding the triangular numbers 28 and 36 is __________.
    Answer: 64
35. If a stacked-triangle arrangement follows 1,4,9,16,25, ..., the number of small triangles in its tenth pattern is __________.
    Answer: 100

1.5 One-mark questions with Answers of LOTS Type: (32 Questions)

One-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is mathematics largely concerned with?**
   Mathematics is largely concerned with finding patterns and explaining why they exist.
2. **Where can mathematical patterns be observed?**
   Mathematical patterns can be observed in nature, daily life, technology and the movement of celestial bodies.
3. **Why is mathematics considered both an art and a science?**
   Mathematics combines creative pattern discovery with logical and scientific explanation.
4. **What is number theory?**
   Number theory is the branch of mathematics that studies patterns in whole numbers.
5. **What is a number sequence?**
   A number sequence is an ordered list of numbers formed according to a particular rule.
6. **What are counting numbers?**
   Counting numbers are 1,2,3,4,5, ...
7. **What are odd numbers?**
   Odd numbers are whole numbers that are not exactly divisible by 2.
8. **What are even numbers?**
   Even numbers are whole numbers that are exactly divisible by 2.
9. **What are triangular numbers?**
   Triangular numbers are numbers that can be represented by dots arranged in a triangular shape.
10. **Write the first five triangular numbers.**
    The first five triangular numbers are 1,3,6,10and 15.
11. **What are square numbers?**
    Square numbers are numbers obtained by multiplying a whole number by itself.
12. **Write the first five square numbers.**
    The first five square numbers are 1,4,9,16and 25.
13. **What are cube numbers?**
    Cube numbers are obtained by multiplying a whole number by itself three times.
14. **Write the first five cube numbers.**
    The first five cube numbers are 1,8,27,64and 125.
15. **State the rule for forming Virahanka numbers.**
    Each Virahanka number is obtained by adding the two immediately preceding numbers.
16. **Write the first seven Virahanka numbers.**
    The first seven Virahanka numbers are 1,2,3,5,8,13and 21.
17. **Write the first six powers of 2 given in the chapter.**
    The first six powers of 2 are 1,2,4,8,16and 32.
18. **Write the first six powers of 3 given in the chapter.**
    The first six powers of 3 are 1,3,9,27,81and 243.
19. **What type of numbers are obtained by adding consecutive odd numbers from 1?**
    Adding consecutive odd numbers from 1 produces square numbers.
20. **What sequence is obtained by successively adding counting numbers?**
    Successively adding counting numbers produces the triangular-number sequence.
21. **What is obtained by adding two consecutive triangular numbers?**
    Adding two consecutive triangular numbers produces a square number.
22. **Why is 36 special among the numbers discussed in the chapter?**
    The number 36 is both a triangular number and a square number.

23. **What are hexagonal numbers?**
    Hexagonal numbers are numbers that can be represented through dots arranged in a hexagonal pattern.
24. **What is geometry?**
    Geometry is the branch of mathematics that studies patterns in shapes.
25. **What is a regular polygon?**
    A regular polygon is a closed shape having equal sides and equal angles.
26. **What is a complete graph?**
    A complete graph is a figure in which every point is connected to every other point.
27. **What number sequence is represented by the lines in successive complete graphs?**
    The lines in successive complete graphs represent the triangular-number sequence.
28. **What number sequence is represented by stacked squares?**
    Stacked squares represent the square-number sequence.
29. **How is each successive Koch snowflake pattern formed?**
    Each successive Koch snowflake pattern is formed by replacing every line segment with a small speed-bump shape.
30. **What is the number pattern for the line segments in successive Koch snowflakes?**
    The number of line segments follows the pattern $3, 12, 48, 192, \ldots$.
31. **How do pictures help in understanding number sequences?**
    Pictures make number patterns and relationships easier to observe and understand.
32. **What is the relationship between the sides and corners of a polygon?**
    A polygon always has an equal number of sides and corners.

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

One-Mark Descriptive Questions with Answers — HOTS Type:

1. **What is the 12th odd number?**
   The 12th odd number is $2(12) - 1 = 23$.
2. **What is the 15th even number?**
   The 15th even number is $2(15) = 30$.
3. **What is the next term in** $1, 3, 6, 10, 15, \ldots$**?**
   The next term is 21, obtained by adding 6 to 15.
4. **What is the next term in** $1, 4, 9, 16, 25, \ldots$**?**
   The next term is 36, which is 6^2.
5. **What is the next term in** $1, 8, 27, 64, 125, \ldots$**?**
   The next term is 216, which is 6^3.
6. **What are the next two Virahanka numbers after 13?**
   The next two Virahanka numbers are 21 and 34.
7. **How can you determine the seventh power-of-2 term when the sequence begins with 1?**
   The seventh term is 64, obtained by repeatedly multiplying each term by 2.
8. **What is the sum of the first eight odd numbers?**
   The sum is $8^2 = 64$.
9. **Without direct addition, find** $1 + 3 + 5 + \cdots + 19$**.**
   The sum is $10^2 = 100$because 19 is the tenth odd number.
10. **What is the sum** $1 + 2 + 3 + 4 + 3 + 2 + 1$**?**
    The sum is $4^2 = 16$.
11. **What is the sum** $1 + 2 + \cdots + 25 + 24 + \cdots + 2 + 1$**?**
    The sum is $25^2 = 625$.

12. **Which square number is obtained by adding the consecutive triangular numbers 10 and 15?**
Adding 10 and 15 gives the square number 25.
13. **Which number is both the eighth triangular number and the sixth square number?**
The number 36 is both the eighth triangular number and the sixth square number.
14. **If a triangular arrangement has 21 dots, how many rows does it contain?**
It contains 6 rows because $1 + 2 + 3 + 4 + 5 + 6 = 21$.
15. **What is obtained when 1 is added to** $1 + 2 + 4 + 8 + 16$**?**
The result is 32, which is the next power of 2.
16. **What is the next term in the sequence** 1,7,19,37,61, ...**?**
The next term is 91 because the successive differences are 6,12,18,24,and 30.
17. **What cube number is obtained from** $1 + 7 + 19 + 37$**?**
The sum is $64 = 4^3$.
18. **How can the number 49 be represented using a square arrangement?**
The number 49 can be represented by arranging dots in 7 rows and 7 columns.
19. **Can 45 be a triangular number? Give a reason.**
Yes, 45 is the ninth triangular number because $1 + 2 + \cdots + 9 = 45$.
20. **Why does adding consecutive odd numbers form square numbers?**
Each new odd number adds an L-shaped border that changes one square arrangement into the next larger square.
21. **How many sides and corners does a regular decagon have?**
A regular decagon has 10 sides and 10 corners.
22. **Which number sequence is formed by the number of sides of a triangle, quadrilateral, pentagon and hexagon?**
These shapes form the counting-number sequence 3,4,5,6, ...
23. **How many lines are present in a complete graph containing five points?**
A complete graph with five points contains 10 lines.
24. **How many lines would a complete graph with seven points contain?**
A complete graph with seven points contains $\frac{7\times 6}{2} = 21$lines.
25. **How many small squares are present in the eighth stacked-square pattern?**
The eighth stacked-square pattern contains $8^2 = 64$small squares.
26. **What will be the number of line segments after 48 in the Koch snowflake sequence?**
The next Koch snowflake pattern has $48 \times 4 = 192$line segments.
27. **Why does the Koch snowflake sequence grow rapidly?**
It grows rapidly because every line segment is replaced by four smaller segments at each stage.
28. **If a Koch snowflake stage has 192 segments, how many will the next stage have?**
The next stage will have $192 \times 4 = 768$segments.
29. **What common relationship connects stacked squares and stacked triangles in the chapter?**
Both arrangements generate the square-number sequence 1,4,9,16,25, ...
30. **How does visualisation help explain a mathematical pattern?**
Visualisation shows how quantities are arranged and makes the reason behind the pattern easier to understand.

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

Two-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is mathematics? Why is the study of patterns important?**
    - Mathematics is the search for patterns and explanations for why they exist.
    - Studying patterns helps us understand ideas and apply them in different situations.
2. **Why is mathematics considered both an art and a science?**
    - Mathematics is an art because discovering patterns requires creativity.
    - It is a science because patterns are studied and explained through logical reasoning.
3. **Mention any two uses of mathematics in everyday life.**
    - Mathematics is used while shopping, cooking and managing money.
    - It is also used to understand time, weather, distance and technology.
4. **What is number theory? Give one example of a number pattern.**
    - Number theory is the branch of mathematics that studies patterns in whole numbers.
    - The odd-number sequence 1,3,5,7,9, ...is an example.
5. **Differentiate between odd numbers and even numbers.**
    - Odd numbers are not exactly divisible by 2, such as 1,3,5, ...
    - Even numbers are exactly divisible by 2, such as 2,4,6, ...
6. **What are triangular numbers? Write the first five terms.**
    - Triangular numbers can be represented by dots arranged in the form of a triangle.
    - Their first five terms are 1,3,6,10and 15.
7. **What are square numbers? Write the first five terms.**
    - Square numbers can be represented by dots arranged in equal rows and columns.
    - Their first five terms are 1,4,9,16and 25.
8. **What are cube numbers? Write the first five terms.**
    - Cube numbers are obtained by multiplying a number by itself three times.
    - Their first five terms are 1,8,27,64and 125.
9. **Explain the rule used to form Virahanka numbers.**
    - Each new Virahanka number is obtained by adding the two preceding terms.
    - Thus, the sequence begins 1,2,3,5,8,13,21, ...
10. **Describe the powers-of-2 number sequence.**
    - The powers-of-2 sequence begins with 1, and every term is twice the preceding term.
    - Its first few terms are 1,2,4,8,16,32, ...
11. **Describe the powers-of-3 number sequence.**
    - The powers-of-3 sequence begins with 1, and every term is three times the preceding term.
    - Its first few terms are 1,3,9,27,81,243, ...
12. **How are consecutive odd numbers related to square numbers?**
    - Adding consecutive odd numbers beginning with 1 produces square numbers.
    - For example, $1 + 3 + 5 + 7 = 16 = 4^2$.
13. **What happens when counting numbers are added upwards and then downwards?**
    - Adding counting numbers upwards and then downwards produces a square number.
    - For example, $1 + 2 + 3 + 2 + 1 = 9 = 3^2$.
14. **How are consecutive triangular numbers related to square numbers?**
    - The sum of two consecutive triangular numbers is a square number.
    - For example, $6 + 10 = 16 = 4^2$.
15. **How are powers of 2 related to their successive sums?**

- Successive sums of powers of 2 are $1,3,7,15,31, \ldots$.
- Adding 1 to each sum gives the next powers of 2: $2,4,8,16,32, \ldots$.

16. **What are hexagonal numbers? Write the first five terms shown in the chapter.**
    - Hexagonal numbers can be represented using dots arranged in a hexagonal pattern.
    - Their first five terms are $1,7,19,37$and 61.
17. **How are hexagonal numbers related to cube numbers?**
    - Successively adding hexagonal numbers produces cube numbers.
    - For example, $1 + 7 + 19 = 27 = 3^3$.
18. **What is geometry? Name any two shape sequences.**
    - Geometry is the branch of mathematics that studies patterns in shapes.
    - Regular polygons and complete graphs are examples of shape sequences.
19. **What are regular polygons? Give two examples.**
    - Regular polygons are closed shapes with equal sides and equal angles.
    - An equilateral triangle and a square are examples of regular polygons.
20. **State the relationship between the sides and corners of a polygon.**
    - The number of sides of a polygon is equal to its number of corners or vertices.
    - For example, a pentagon has five sides and five corners.
21. **What is a complete graph? Which number pattern does it produce?**
    - A complete graph connects every point to every other point.
    - The numbers of connecting lines form the triangular-number sequence $1,3,6,10,15, \ldots$.
22. **Which number pattern is represented by stacked squares and stacked triangles?**
    - Stacked squares represent the square-number sequence $1,4,9,16,25, \ldots$.
    - Stacked triangles also produce square numbers when their rows are counted.
23. **How is each new stage of the Koch snowflake formed?**
    - Each line segment is replaced by four smaller segments forming a speed-bump shape.
    - Therefore, the number of line segments becomes four times the previous number.
24. **Write the line-segment sequence of the Koch snowflake and state its rule.**
    - The number of line segments follows $3,12,48,192, \ldots$.
    - Each term is obtained by multiplying the preceding term by 4.
25. **How do pictures help us understand number sequences?**
    - Pictures show how numbers can be arranged as dots, rows or geometric shapes.
    - They make patterns and relationships between sequences easier to understand.

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

Two-Mark Descriptive Questions with Answers — HOTS Type:

1. **Find the next two terms of** $1,3,6,10,15, \ldots$**and explain the pattern.**
    - The next two terms are 21 and 28.
    - Consecutive counting numbers 6 and 7 are added to the previous terms.
2. **Find the next two terms of** $1,2,3,5,8,13, \ldots$**and justify your answer.**
    - The next two terms are 21 and 34.
    - Each term is obtained by adding the two immediately preceding terms.
3. **Find the sum of the first 15 odd numbers without adding them individually.**
    - The sum of the first $n$odd numbers is n^2.
    - Therefore, the required sum is $15^2 = 225$.
4. **Evaluate** $1 + 3 + 5 + \cdots + 39$**using a number pattern.**

- Since 39 is the 20th odd number, the expression contains 20 terms.
- Therefore, its value is $20^2 = 400$.

5. **Find the value of** $1 + 2 + 3 + \cdots + 20 + 19 + \cdots + 2 + 1$**.**
   - Counting numbers added upwards to 20 and then downwards form a square number.
   - Therefore, the value is $20^2 = 400$.
6. **Explain pictorially why adding consecutive odd numbers produces square numbers.**
   - Each successive odd number can be arranged as an L-shaped border around the preceding square.
   - Therefore, adding odd numbers enlarges one square arrangement into the next.
7. **Determine whether 28 is a triangular number and justify your answer.**
   - Yes, $28 = 1 + 2 + 3 + 4 + 5 + 6 + 7$.
   - Hence, 28 is the seventh triangular number.
8. **Show that 36 belongs to two different number sequences.**
   - The number 36 is a square number because $36 = 6^2$.
   - It is also a triangular number because $36 = 1 + 2 + \cdots + 8$.
9. **Find the square number obtained by adding the consecutive triangular numbers 21 and 28.**
   - Adding the two triangular numbers gives $21 + 28 = 49$.
   - Therefore, the resulting square number is $49 = 7^2$.
10. **Find the next term in** $1,7,19,37,61, \ldots$**and explain your reasoning.**
    - The successive differences are $6,12,18$and 24, so the next difference is 30.
    - Therefore, the next term is $61 + 30 = 91$.
11. **Find the value of** $1 + 7 + 19 + 37 + 61$**using the relation given in the chapter.**
    - Successive sums of hexagonal numbers produce cube numbers.
    - Therefore, the sum is $5^3 = 125$.
12. **What happens when 1 is added to** $1 + 2 + 4 + 8 + 16 + 32$**? Explain the pattern.**
    - The given sum is 63, and adding 1 gives 64.
    - The result is the next power of 2 because $64 = 2^6$.
13. **A student says that the seventh square number is 42; identify and correct the mistake.**
    - Square numbers are formed by multiplying a number by itself, not by multiplying it by the next number.
    - Therefore, the seventh square number is $7^2 = 49$, not 42.
14. **How many lines are present in a complete graph with eight points?**
    - The number of lines is $\frac{8\times7}{2}$.
    - Therefore, the complete graph contains 28 lines.
15. **Why do the numbers of sides and corners in a polygon form the same sequence?**
    - Two sides meet at each corner, and every side connects two neighbouring corners.
    - Therefore, every polygon has an equal number of sides and corners.
16. **Find the number of small squares in the ninth stacked-square pattern and explain.**
    - The nth stacked-square pattern contains n^2small squares.
    - Therefore, the ninth pattern contains $9^2 = 81$small squares.
17. **Predict the next two terms of the Koch snowflake sequence** $3,12,48,192, \ldots$**.**
    - Each term is four times the preceding term.
    - Therefore, the next two terms are 768 and 3072.
18. **Compare the growth of square numbers and powers of 2 using their sixth terms.**

- The sixth square number is $6^2 = 36$, while the sixth power-of-2 term beginning with 1 is 32.
- Thus, at the sixth term, the square-number sequence has the greater value.

19. **Can 64 belong to both the square-number and cube-number sequences? Explain.**
    - Yes, $64 = 8^2$, so it is a square number.
    - Also, $64 = 4^3$, so it is a cube number.
20. **A stacked-triangle pattern contains 100 small triangles; identify its position in the sequence.**
    - Stacked-triangle patterns follow the square-number sequence n^2.
    - Since $100 = 10^2$, it is the tenth pattern.
21. **How can visualisation prove that two consecutive triangular numbers form a square?**
    - Two consecutive triangular dot arrangements can be fitted together without gaps.
    - The combined arrangement forms a square whose area equals their sum.
22. **Find the number of line segments in the sixth Koch snowflake pattern if the first has 3 segments.**
    - The number of segments is $3 \times 4^{6-1}$.
    - Therefore, the sixth pattern has $3 \times 1024 = 3072$segments.
23. **Which is greater—the eighth triangular number or the eighth square number—and by how much?**
    - The eighth triangular number is 36, while the eighth square number is 64.
    - Hence, the eighth square number is greater by $64 - 36 = 28$.
24. **Why is finding the explanation behind a pattern as important as identifying it?**
    - An explanation shows whether the pattern will continue and why it works.
    - It also allows the pattern to be applied confidently in other situations.
25. **How does the chapter connect number theory with geometry?**
    - Number theory identifies sequences such as triangular and square numbers.
    - Geometry visually represents these sequences through dots, polygons and stacked shapes.

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

Three-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is mathematics? Explain its importance in everyday life.**
    - Mathematics involves discovering patterns and explaining why those patterns exist.
    - It is used in activities such as shopping, cooking, measuring, travelling and telling time.
    - It also supports the development of buildings, vehicles, computers, satellites and other technologies.
2. **Why is mathematics regarded as both an art and a science?**
    - Mathematics is an art because discovering and representing patterns involves creativity.
    - It is a science because patterns are studied through observation and logical reasoning.
    - Mathematicians also explain why patterns exist and how they can be applied.
3. **What is number theory? Give examples of number sequences.**
    - Number theory is the branch of mathematics that studies patterns in whole numbers.

- Odd numbers, even numbers, triangular numbers and square numbers are examples of number sequences.
- Cube numbers, Virahanka numbers and powers of 2 and 3 are other examples.

4. **Explain the odd-number and even-number sequences with examples.**
    - Odd numbers are not exactly divisible by 2 and form the sequence $1, 3, 5, 7, 9, \ldots$.
    - Even numbers are exactly divisible by 2 and form the sequence $2, 4, 6, 8, 10, \ldots$.
    - Consecutive terms in both sequences differ by 2.
5. **What are triangular numbers? Explain their formation.**
    - Triangular numbers are numbers that can be represented by dots arranged in a triangular shape.
    - They are formed by successively adding counting numbers: $1,\ 1+2,\ 1+2+3, \ldots$.
    - The sequence begins $1, 3, 6, 10, 15, 21, \ldots$.
6. **What are square numbers? Explain their pictorial representation.**
    - Square numbers are obtained by multiplying a whole number by itself.
    - They can be represented by arranging dots in an equal number of rows and columns.
    - The sequence begins $1, 4, 9, 16, 25, 36, \ldots$.
7. **What are cube numbers? Give their sequence and method of formation.**
    - Cube numbers are obtained by multiplying a number by itself three times.
    - They can be visualised as objects arranged in equal layers to form a cube.
    - The sequence begins $1, 8, 27, 64, 125, 216, \ldots$.
8. **Explain how Virahanka numbers are formed.**
    - The Virahanka sequence begins with 1 and 2.
    - Every subsequent term is obtained by adding the two immediately preceding terms.
    - Thus, the sequence is $1, 2, 3, 5, 8, 13, 21, \ldots$.
9. **Describe the powers-of-2 and powers-of-3 sequences.**
    - The powers-of-2 sequence is $1, 2, 4, 8, 16, 32, \ldots$, where every term is twice the preceding term.
    - The powers-of-3 sequence is $1, 3, 9, 27, 81, 243, \ldots$, where every term is three times the preceding term.
    - Both sequences begin with 1 and grow through repeated multiplication.
10. **Explain the relationship between odd numbers and square numbers.**
    - Adding consecutive odd numbers beginning with 1 produces square numbers.
    - For example, $1+3+5+7+9=25=5^2$.
    - A dot diagram shows each new odd number forming an L-shaped border around the previous square.
11. **Explain how adding counting numbers upwards and downwards gives square numbers.**
    - Counting numbers are first added in increasing order and then in decreasing order.
    - For example, $1+2+3+4+3+2+1=16$.
    - Therefore, the sum forms the square number 4^2.
12. **Describe the relationship between consecutive triangular numbers and square numbers.**
    - Adding two consecutive triangular numbers produces a square number.
    - For example, $6+10=16$.
    - The two triangular dot arrangements can be combined to form a square.
13. **Explain the relationship between powers of 2 and their successive sums.**

- Successively adding powers of 2 gives 1,3,7,15,31, ...
- Each of these sums is one less than the next power of 2.
- Therefore, adding 1 gives 2,4,8,16,32, ...

14. **What are hexagonal numbers? Explain their relationship with cube numbers.**
    - Hexagonal numbers in the chapter form the sequence 1,7,19,37,61, ...
    - Successively adding these numbers produces 1,8,27,64,125, ...
    - These sums are cube numbers.
15. **What is geometry? Name and describe two shape sequences.**
    - Geometry is the branch of mathematics that studies patterns in shapes.
    - Regular polygons form a sequence by increasing the number of equal sides and angles.
    - Complete graphs form a sequence by connecting every point to every other point.
16. **Describe regular polygons and their number pattern.**
    - Regular polygons have equal-length sides and equal angles.
    - A triangle, quadrilateral, pentagon and hexagon have 3, 4, 5 and 6 sides respectively.
    - Their numbers of sides and corners follow the counting-number sequence beginning with 3.
17. **Explain the number pattern found in complete graphs.**
    - In a complete graph, every point is joined to every other point.
    - The numbers of connecting lines are 1,3,6,10,15, ...
    - These numbers form the triangular-number sequence.
18. **Describe the pattern in stacked squares and stacked triangles.**
    - Stacked squares contain 1,4,9,16,25, ...small squares.
    - Stacked triangles also contain 1,4,9,16,25, ...small triangles.
    - Both arrangements represent the square-number sequence.
19. **Explain how the Koch snowflake pattern is formed.**
    - The Koch snowflake begins with a triangle containing three line segments.
    - At each stage, every line segment is replaced by four smaller segments forming a speed bump.
    - The numbers of line segments are 3,12,48,192, ...
20. **How does visualisation help in understanding mathematical patterns?**
    - Visualisation represents numbers through dots, diagrams and geometric shapes.
    - It makes relationships among different number sequences easier to recognise.
    - It can also explain why a particular mathematical pattern continues.

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

Three-Mark Descriptive Questions with Answers — HOTS Type:

1. **Find the next three terms in the triangular-number sequence** 1,3,6,10,15, ...**and explain your reasoning.**
    - The differences between consecutive terms are 2,3,4and 5.
    - Add 6,7and 8successively to the last term.
    - Therefore, the next three terms are 21,28and 36.
2. **Find the sum of the first 25 odd numbers without adding them individually.**
    - The sum of the first $n$odd numbers is n^2.
    - Substitute $n = 25$: $25^2 = 25 \times 25$.
    - Therefore, the required sum is 625.
3. **Evaluate** $1 + 3 + 5 + \cdots + 49$**using the square-number pattern.**

   - Since $49 = 2(25) - 1$, it is the 25th odd number.
   - The sum of the first 25 odd numbers is 25^2.
   - Therefore, the value of the expression is 625.
4. **Find the value of** $1 + 2 + 3 + \cdots + 30 + 29 + \cdots + 3 + 2 + 1$**.**
   - The expression contains counting numbers increasing to 30 and then decreasing to 1.
   - Such an up-and-down sum gives the square of the greatest number.
   - Therefore, the value is $30^2 = 900$.
5. **Show that 36 is both a triangular number and a square number.**
   - The sum $1 + 2 + 3 + 4 + 5 + 6 + 7 + 8$equals 36.
   - Also, $6 \times 6 = 36$.
   - Hence, 36 is both the eighth triangular number and the sixth square number.
6. **Find the square number obtained by adding the consecutive triangular numbers 36 and 45.**
   - The numbers 36 and 45 are the eighth and ninth triangular numbers.
   - Their sum is $36 + 45 = 81$.
   - Therefore, the resulting square number is $81 = 9^2$.
7. **The sum of consecutive odd numbers beginning with 1 is 196; determine how many odd numbers were added.**
   - The sum of the first $n$odd numbers equals n^2.
   - Since $196 = 14^2$, we get $n = 14$.
   - Therefore, the first 14 odd numbers were added.
8. **Find the next three terms of the Virahanka sequence** 1,2,3,5,8,13, ….
   - Add the last two terms: $8 + 13 = 21$.
   - Continue similarly: $13 + 21 = 34$and $21 + 34 = 55$.
   - Therefore, the next three terms are 21,34and 55.
9. **Find the next term in the sequence** 1,7,19,37,61, ….
   - The successive differences are 6,12,18and 24.
   - The differences increase by 6, so the next difference is 30.
   - Therefore, the next term is $61 + 30 = 91$.
10. **Find** $1 + 7 + 19 + 37 + 61 + 91$**using the pattern given in the chapter.**
    - Successive sums of these hexagonal numbers form cube numbers.
    - Since six terms are added, the sum equals 6^3.
    - Therefore, the value is 216.
11. **Find the result obtained by adding 1 to** $1 + 2 + 4 + 8 + 16 + 32 + 64$**.**
    - The given expression is the sum of consecutive powers of 2.
    - Its sum is one less than the next power of 2, so it equals $128 - 1 = 127$.
    - After adding 1, the result is 128.
12. **Determine the number of lines in a complete graph containing nine points.**
    - Each point can connect to the other eight points, giving $9 \times 8 = 72$counts.
    - Every line is counted twice, once from each endpoint, so divide by 2.
    - Therefore, the graph contains $\frac{72}{2} = 36$lines.
13. **A complete graph contains 15 lines; determine the number of points.**
    - Complete graphs with 2,3,4,5,6, …points contain 1,3,6,10,15, …lines.
    - The number 15 is the fifth triangular number in this sequence.
    - Therefore, the complete graph contains 6 points.
14. **Find the number of small squares in the twelfth stacked-square pattern.**
    - The number of small squares follows the sequence 1,4,9,16, ….
    - The nth stacked-square pattern contains n^2small squares.

- Therefore, the twelfth pattern contains $12^2 = 144$small squares.

15. **Find the next two terms of the Koch snowflake sequence** $3,12,48,192,$ **....**
    - Each stage has four times as many line segments as the preceding stage.
    - Thus, $192 \times 4 = 768$and $768 \times 4 = 3072$.
    - Therefore, the next two terms are 768 and 3072.
16. **At which Koch snowflake stage will there be 768 line segments if the first stage has 3?**
    - The sequence is $3,12,48,192,768,$ ....
    - Each term is obtained by multiplying the previous term by 4.
    - Therefore, 768 line segments occur at the fifth stage.
17. **Compare the tenth triangular number with the tenth square number.**
    - The tenth triangular number is $\frac{10\times11}{2} = 55$.
    - The tenth square number is $10^2 = 100$.
    - Therefore, the square number is greater than the triangular number by $100 - 55 = 45$.
18. **Determine whether 64 belongs to more than one number sequence discussed in the chapter.**
    - Since $64 = 8^2$, it belongs to the square-number sequence.
    - Since $64 = 4^3$, it also belongs to the cube-number sequence.
    - It is additionally a power of 2 because $64 = 2^6$.
19. **Explain how a picture can prove that two consecutive triangular numbers form a square.**
    - Draw two consecutive triangular dot arrangements.
    - Rotate one arrangement and fit it beside the other without gaps.
    - The combined dots form a square, showing that their sum is a square number.
20. **Identify and correct the error in the claim** $1 + 3 + 5 + 7 + 9 + 11 = 35$**.**
    - The expression is the sum of the first six odd numbers.
    - The sum of the first six odd numbers is 6^2.
    - Therefore, the correct sum is 36, not 35.

1.11 Five-mark questions with Answers of LOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers — LOTS Type:

1. What is mathematics? Explain the role of patterns in mathematics and everyday life.

1. Mathematics is largely the search for patterns and explanations of why they exist.
2. Mathematical patterns can be found in nature, homes, schools and daily activities.
3. They are used in shopping, cooking, measuring, travelling and playing games.
4. Mathematics helps us understand the movement of the Sun, Moon, planets and stars.
5. It also supports the development of buildings, vehicles, computers, satellites and medical technology.

2. Explain the main number sequences discussed in the chapter.

1. Counting numbers form the sequence $1,2,3,4,5,$ ....
2. Odd and even numbers form the sequences $1,3,5,7,$ ...and $2,4,6,8,$ ..., respectively.
3. Triangular numbers form the sequence $1,3,6,10,15,$ ....
4. Square and cube numbers form the sequences $1,4,9,16,$ ...and $1,8,27,64,$ ....
5. Other important sequences include Virahanka numbers and powers of 2 and 3.

3. Describe triangular, square and cube numbers with examples.

1. Triangular numbers can be represented by arranging dots in the shape of a triangle.
2. Their sequence begins $1,3,6,10,15,$ ....

3. Square numbers can be arranged in equal rows and columns and begin 1,4,9,16,25, ...
4. Cube numbers can be represented by equal layers forming cubes and begin 1,8,27,64,125, ...
5. These pictorial arrangements make the rules of the sequences easier to understand.

4. Explain the relationship between odd numbers and square numbers.

1. Consecutive odd numbers beginning with 1 produce square numbers when added.
2. For example, $1 = 1^2$and $1 + 3 = 4 = 2^2$.
3. Similarly, $1 + 3 + 5 = 9 = 3^2$.
4. In a dot diagram, each new odd number forms an L-shaped border around the previous square.
5. Therefore, the sum of the first $n$odd numbers is n^2.

5. Explain how counting numbers are related to triangular and square numbers.

1. Successive sums of counting numbers produce triangular numbers.
2. For example, $1 + 2 + 3 + 4 = 10$, which is the fourth triangular number.
3. Adding counting numbers upwards and then downwards produces square numbers.
4. For example, $1 + 2 + 3 + 4 + 3 + 2 + 1 = 16 = 4^2$.
5. Adding two consecutive triangular numbers also gives a square number, such as $6 + 10 = 16$.

6. Describe the Virahanka, powers-of-2 and powers-of-3 sequences.

1. The Virahanka sequence begins 1,2,3,5,8,13,21, ...
2. Each Virahanka number is obtained by adding the two immediately preceding numbers.
3. The powers-of-2 sequence is 1,2,4,8,16,32, ..., with each term twice the preceding term.
4. The powers-of-3 sequence is 1,3,9,27,81,243, ..., with each term three times the preceding term.
5. These sequences demonstrate how repeated addition or multiplication creates number patterns.

7. Explain the relationship between powers of 2 and their successive sums.

1. Begin with the powers-of-2 sequence 1,2,4,8,16, ...
2. Successively adding its terms gives 1,3,7,15,31, ...
3. Each sum is one less than the next power of 2.
4. Adding 1 to these sums gives 2,4,8,16,32, ...
5. Thus, $1 + 2 + 4 + \cdots + 2^{n-1} = 2^n - 1$.

8. Explain shape patterns and their connection with number sequences.

1. Geometry is the branch of mathematics that studies patterns in shapes.
2. Important shape sequences include regular polygons, complete graphs and stacked shapes.
3. The sides and corners of regular polygons follow the counting-number sequence beginning with 3.
4. The numbers of lines in complete graphs follow the triangular-number sequence.
5. Stacked squares and stacked triangles represent the square-number sequence.

9. Describe regular polygons and complete graphs.

1. A regular polygon has sides of equal length and angles of equal measure.
2. Triangles, quadrilaterals, pentagons and hexagons have 3, 4, 5 and 6 sides, respectively.
3. In every polygon, the number of sides equals the number of corners.
4. In a complete graph, every point is connected to every other point.
5. The numbers of lines in successive complete graphs are 1,3,6,10,15, ...

10. Explain the formation and number pattern of the Koch snowflake.

1. The Koch snowflake begins with a triangle having three line segments.
2. To form the next stage, each line segment is replaced by four smaller segments.
3. These segments create a small outward speed-bump shape.

4. The numbers of line segments form the sequence 3,12,48,192, ...
5. Thus, every new stage has four times the number of segments in the preceding stage.

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

Five-Mark Descriptive Questions with Answers — HOTS Type:

1. Prove that the sum of the first six odd numbers is a square number using a dot pattern.

1. The first six odd numbers are 1,3,5,7,9and 11.
2. Their sum is $1+3+5+7+9+11=36$.
3. Starting with one dot, each successive odd number can be added as an L-shaped border.
4. The resulting dots form a square with 6 rows and 6 columns.
5. Therefore, $1+3+5+7+9+11=6^2=36$.

Pattern:

● ● ● ● ● ●
● ● ● ● ● ●
● ● ● ● ● ●
● ● ● ● ● ●
● ● ● ● ● ●
● ● ● ● ● ●

2. Show that adding two consecutive triangular numbers produces a square number.

1. Consider the consecutive triangular numbers 15 and 21.
2. They can be written as $15=1+2+3+4+5$and $21=1+2+3+4+5+6$.
3. Their sum is $15+21=36$.
4. The two triangular dot arrangements can be fitted together to form a 6×6square.
5. Hence, the sum of two consecutive triangular numbers is a square number: $15+21=6^2$.

3. Find the sum $1+2+3+\cdots+50+49+\cdots+3+2+1$and explain the pattern.

1. The numbers increase from 1 to 50 and then decrease from 49 to 1.
2. Such an up-and-down arrangement produces a square number.
3. The greatest number in the arrangement is 50.
4. Therefore, the value of the sum is $50^2=2500$.
5. Thus, $1+2+\cdots+50+49+\cdots+2+1=2500$.

4. Investigate whether 64 belongs to more than one sequence discussed in the chapter.

1. The number 64 is a square number because $8^2=64$.
2. It is also a cube number because $4^3=64$.
3. It belongs to the powers-of-2 sequence because $2^6=64$.
4. However, it is not a triangular number because no whole number $n$satisfies $\frac{n(n+1)}{2}=64$.
5. Therefore, 64 belongs to the square, cube and powers-of-2 sequences.

5. Determine the next three hexagonal-pattern numbers after $1,7,19,37,61$.

1. The differences between consecutive terms are 6,12,18and 24.
2. These differences increase successively by 6.
3. The next three differences are therefore 30,36and 42.
4. The next terms are $61+30=91$, $91+36=127$and $127+42=169$.
5. Hence, the extended sequence is 1,7,19,37,61,91,127,169, ...

6. Explain the relationship between powers of 2 and their successive sums.

1. Consider the powers-of-2 sequence 1,2,4,8,16,32, ...
2. Its successive sums are 1,3,7,15,31,63, ...
3. Adding 1 to each sum gives 2,4,8,16,32,64, ...

4. Each result is the next term in the powers-of-2 sequence.
5. Therefore, $1 + 2 + 4 + \cdots + 2^{n-1} = 2^n - 1$.

7. Find the number of connecting lines in a complete graph with ten points and explain your method.

1. Each of the 10 points can be connected to the other 9 points.
2. This gives $10 \times 9 = 90$endpoint connections.
3. Every line is counted twice because it joins two points.
4. Therefore, the actual number of lines is $\frac{90}{2} = 45$.
5. Hence, a complete graph with ten points contains 45 connecting lines.

8. Analyse the number of line segments in the sixth stage of a Koch snowflake.

1. The Koch snowflake begins with 3 line segments.
2. At every new stage, each segment is replaced by 4 smaller segments.
3. Its number sequence is 3,12,48,192,768,3072, ...
4. The sixth-stage value can also be calculated as 3×4^5.
5. Therefore, the sixth stage contains $3 \times 1024 = 3072$line segments.

Replacement pattern:

One segment:

Next-stage idea: 

9. A student claims that 45 is a square number because it is a triangular number. Examine the claim.

1. The number 45 is triangular because $1 + 2 + 3 + \cdots + 9 = 45$.
2. A square number must be expressible as $n^2$for a whole number n.
3. Since $6^2 = 36$and $7^2 = 49$, 45 lies between two consecutive square numbers.
4. Therefore, 45 cannot be arranged as a perfect square.
5. The student's claim is incorrect because every triangular number is not necessarily a square number.

10. Compare the tenth triangular number, tenth square number and tenth cube number.

1. The tenth triangular number is $\frac{10\times11}{2} = 55$.
2. The tenth square number is $10^2 = 100$.
3. The tenth cube number is $10^3 = 1000$.
4. Their ascending order is $55 < 100 < 1000$.
5. Thus, for the tenth term, cube numbers grow faster than square numbers, while square numbers grow faster than triangular numbers.

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

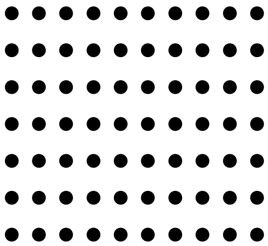
Five-Mark Descriptive Questions with Answers — Applied Type:

1. A school arranges students in successive square formations. If the tenth formation has 10 rows, find the total number of students and explain the pattern.

1. Square formations follow the sequence 1,4,9,16,25, ...
2. The number of students in the nth formation is n^2.
3. For the tenth formation, the number is 10^2.
4. Therefore, $10 \times 10 = 100$students are required.
5. The students will be arranged in 10 rows with 10 students in each row.

Formation:

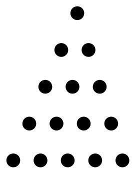
● ● ● ● ● ● ● ● ● ●
● ● ● ● ● ● ● ● ● ●
● ● ● ● ● ● ● ● ● ●



2. A gardener plants saplings in a triangular arrangement with 12 rows. How many saplings are required?

1. A triangular arrangement follows the pattern 1,3,6,10,15, ...
2. The number of saplings is $1 + 2 + 3 + \cdots + 12$.
3. The twelfth triangular number is $T_{12} = \frac{12\times13}{2}$.
4. Thus, $T_{12} = \frac{156}{2} = 78$.
5. Therefore, the gardener requires 78 saplings.

Beginning of the pattern:



3. An auditorium has 1 light in the first row, 3 in the second, 5 in the third, and so on. Find the total number of lights in the first 15 rows.

1. The numbers of lights follow the odd-number sequence 1,3,5,7, ...
2. The sum of the first $n$odd numbers is n^2.
3. For 15 rows, the total is 15^2.
4. Therefore, the total number of lights is 225.
5. The lights can collectively be viewed as forming a 15×15square arrangement.

4. During a tournament, every one of eight teams plays exactly one match against every other team. Find the total number of matches.

1. Represent each team as a point and each match as a line joining two points.
2. This situation forms a complete graph with eight points.
3. The total number of possible connections is $\frac{8\times7}{2}$.
4. Therefore, the total number of matches is $\frac{56}{2} = 28$.
5. Hence, 28 matches are required for every team to play every other team once.

5. A hall has chairs arranged as $\mathbf{1 + 2 + 3 + \cdots + 20 + 19 + \cdots + 2 + 1}$. Find the total number of chairs.

1. The arrangement increases from 1 chair to 20 chairs and then decreases to 1 chair.
2. Such an up-and-down arrangement forms a square-number pattern.
3. The greatest number in the arrangement is 20.
4. Hence, the total is $20^2 = 400$.
5. Therefore, the hall contains 400 chairs.

6. A digital message is forwarded so that the number of receivers doubles at each stage: $\mathbf{1, 2, 4, 8}$, ... Find the receivers at the eighth stage and the total receivers up to that stage.

1. The pattern follows powers of 2, with every term twice the preceding term.
2. The eighth-stage value is $2^7 = 128$.
3. The total up to the eighth stage is $1 + 2 + 4 + \cdots + 128$.
4. Using the pattern $1 + 2 + \cdots + 2^{n-1} = 2^n - 1$, the total is $2^8 - 1 = 255$.

5. Therefore, 128 people receive the message at the eighth stage, and 255 receive it altogether.

7. An artist makes a Koch snowflake design beginning with three line segments. How many segments are present at the fifth stage?

1. The design begins with 3 line segments in its first stage.
2. Every line segment is replaced by 4 smaller segments at each new stage.
3. The sequence is $3, 12, 48, 192, 768, \ldots$.
4. The fifth-stage value is $3 \times 4^4 = 3 \times 256$.
5. Therefore, the artist draws 768 line segments at the fifth stage.

Pattern rule:
Stage 1: 3
Stage 2: 3 × 4 = 12
Stage 3: 12 × 4 = 48
Stage 4: 48 × 4 = 192
Stage 5: 192 × 4 = 768

8. A designer places floor tiles in square patterns of sides 5, 6 and 7 tiles. Find the number of tiles in each pattern and the additional tiles required at every step.

1. A square of side 5 requires $5^2 = 25$tiles.
2. A square of side 6 requires $6^2 = 36$tiles.
3. A square of side 7 requires $7^2 = 49$tiles.
4. Increasing the side from 5 to 6 requires $36 - 25 = 11$additional tiles.
5. Increasing the side from 6 to 7 requires $49 - 36 = 13$additional tiles, showing the consecutive odd-number pattern.

9. A fruit seller stacks oranges in triangular layers containing 15 and 21 oranges. Show how they can be rearranged into a square.

1. The numbers 15 and 21 are consecutive triangular numbers.
2. Combining them gives $15 + 21 = 36$oranges.
3. Consecutive triangular numbers together form a square number.
4. Since $36 = 6^2$, the oranges can be arranged in 6 rows of 6.
5. Therefore, the two triangular stacks can be rearranged into a 6×6square.

10. A decorative display uses hexagonal-pattern groups containing $\mathbf{1, 7, 19, 37}$lamps. Find the total and identify the resulting pattern.

1. Add the numbers of lamps: $1 + 7 + 19 + 37$.
2. The successive sums of these hexagonal-pattern numbers produce cube numbers.
3. The sum is 64.
4. Since $64 = 4^3$, it is the fourth cube number.
5. Therefore, the display uses 64 lamps, corresponding to a $4 \times 4 \times 4$cube pattern.

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

Olympiad-Type Multiple-Choice Questions with Answers:

1. What is the next term in the sequence $\mathbf{1, 3, 6, 10, 15, \ldots}$?

A. 18
B. 20
C. 21
D. 25

Answer: C. 21

---

2. Which number is both triangular and square?

A. 25
B. 28
C. 36
D. 49
Answer: C. 36

---

3. What is the tenth triangular number?
A. 45
B. 50
C. 55
D. 60
Answer: C. 55

---

4. What is the sum of the first 20 odd numbers?
A. 200
B. 380
C. 400
D. 420
Answer: C. 400

---

5. Evaluate $1 + 3 + 5 + \cdots + 29$.
A. 196
B. 210
C. 225
D. 256
Answer: C. 225

---

6. Which number comes next in the Virahanka sequence $1, 2, 3, 5, 8, 13, 21, \ldots$?
A. 29
B. 32
C. 34
D. 36
Answer: C. 34

---

7. What is the next term in the sequence $1, 2, 4, 8, 16, 32, \ldots$?
A. 48
B. 54
C. 64
D. 72
Answer: C. 64

---

8. What is the seventh term of the sequence $1, 3, 9, 27, \ldots$?
A. 243
B. 486
C. 729
D. 2187
Answer: C. 729

---

9. What is the value of $1 + 2 + 3 + 4 + 5 + 4 + 3 + 2 + 1$?

A. 20
B. 25
C. 30
D. 36
Answer: B. 25

---

10. Which pair consists of consecutive triangular numbers whose sum is 64?
A. 15 and 21
B. 21 and 28
C. 28 and 36
D. 36 and 45
Answer: C. 28 and 36

---

11. What is the sum of the first seven counting numbers?
A. 21
B. 27
C. 28
D. 36
Answer: C. 28

---

12. If $\mathbf{1 + 3 + 5 + \cdots + (2n - 1) = 144}$, what is $\boldsymbol{n}$?
A. 10
B. 11
C. 12
D. 14
Answer: C. 12

---

13. Which of the following is a cube number but not a square number?
A. 1
B. 8
C. 64
D. 729
Answer: B. 8

---

14. Which number is a square number, a cube number and a power of 2?
A. 16
B. 36
C. 64
D. 81
Answer: C. 64

---

15. What is the next term in the sequence $\mathbf{1, 7, 19, 37, 61, \ldots}$?
A. 81
B. 89
C. 91
D. 97
Answer: C. 91

---

16. What is $\mathbf{1 + 7 + 19 + 37 + 61}$?

A. 100
B. 121
C. 125
D. 144
Answer: C. 125

---

17. The sum $1 + 2 + 4 + 8 + \cdots + 128$is:
A. 254
B. 255
C. 256
D. 257
Answer: B. 255

---

18. What number should be added to $1 + 2 + 4 + 8 + 16 + 32$to obtain the next power of 2?
A. 1
B. 2
C. 4
D. 8
Answer: A. 1

---

19. A complete graph with six points contains how many lines?
A. 12
B. 15
C. 18
D. 21
Answer: B. 15

---

20. How many lines are present in a complete graph with eight points?
A. 21
B. 24
C. 28
D. 32
Answer: C. 28

---

21. A complete graph has 45 connecting lines. How many points does it contain?
A. 9
B. 10
C. 11
D. 12
Answer: B. 10

---

22. Which sequence represents the number of lines in successive complete graphs?
A. Odd numbers
B. Even numbers
C. Triangular numbers
D. Cube numbers
Answer: C. Triangular numbers

---

23. How many small squares are present in the 15th stacked-square pattern?

A. 125
B. 200
C. 225
D. 250
Answer: C. 225

---

24. The first Koch snowflake stage has 3 segments. How many segments will the fourth stage have?
A. 48
B. 96
C. 192
D. 256
Answer: C. 192

---

25. Which rule generates the number of line segments in successive Koch snowflake stages?
A. Add 4 to each term
B. Multiply each term by 3
C. Multiply each term by 4
D. Square each term
Answer: C. Multiply each term by 4

---

26. What is the missing number in the pattern $3, 12, 48, \_\_\_, 768$?
A. 96
B. 144
C. 192
D. 256
Answer: C. 192

---

27. The numbers of sides of a triangle, quadrilateral, pentagon and hexagon form which sequence?
A. 1,2,3,4
B. 2,3,4,5
C. 3,4,5,6
D. 3,5,7,9
Answer: C. 3,4,5,6

---

28. A regular polygon has 12 corners. How many sides does it have?
A. 10
B. 11
C. 12
D. 24
Answer: C. 12

---

29. Which expression represents the eighth triangular number?
A. 8×8
B. $\frac{8\times9}{2}$
C. $2 \times 8 - 1$
D. 8^3

Answer: B. $\frac{8\times9}{2}$

---

30. Which of the following numbers is not triangular?
A. 21
B. 28
C. 36
D. 40
Answer: D. 40

---

31. What is the difference between the tenth square number and the tenth triangular number?
A. 40
B. 45
C. 50
D. 55
Answer: B. 45

---

32. Which statement is always true?
A. Every triangular number is a square number.
B. Every square number is a cube number.
C. The sum of consecutive triangular numbers is a square number.
D. Every odd number is a triangular number.
Answer: C. The sum of consecutive triangular numbers is a square number.

---

33. A square arrangement has 169 dots. How many dots are there in each row?
A. 11
B. 12
C. 13
D. 14
Answer: C. 13

---

34. What is the value of $1 + 2 + 3 + \cdots + 100 + 99 + \cdots + 2 + 1$?
A. 1,000
B. 5,050
C. 9,900
D. 10,000
Answer: D. 10,000

---

35. Which number completes the pattern $1, 4, 9, 16, 25, \_\_, 49$?
A. 30
B. 32
C. 36
D. 42
Answer: C. 36

---

36. If the differences between consecutive terms are $6, 12, 18, 24, \ldots$, what will the next difference be?
A. 26
B. 28

C. 30
D. 36
Answer: C. 30

---

37. Which mathematical branch primarily studies patterns in shapes?
A. Arithmetic
B. Geometry
C. Number theory
D. Algebra
Answer: B. Geometry

---

38. Which of the following correctly matches a shape pattern with its number sequence?
A. Complete graphs — even numbers
B. Stacked squares — square numbers
C. Regular polygons — cube numbers
D. Koch snowflake — odd numbers
Answer: B. Stacked squares — square numbers

---

39. The sum of the sixth and seventh triangular numbers is:
A. 42
B. 45
C. 49
D. 56
Answer: C. 49

---

40. If the fifth Koch snowflake stage has 768 segments, how many segments will the sixth stage have?
A. 1,536
B. 2,304
C. 3,072
D. 4,096
Answer: C. 3,072

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

Best Practices for Teaching "Patterns in Mathematics":

(1) **Begin with everyday patterns:**
Introduce the chapter using familiar patterns found in floor tiles, rangoli designs, calendars, music, plants and daily routines.

(2) **Use concrete learning materials:**
Let students form triangular, square, cube and hexagonal patterns using counters, buttons, seeds, matchsticks or coloured paper.

(3) **Follow the Concrete–Pictorial–Abstract approach:**
First construct patterns with objects, then draw them and finally express their rules using numbers and formulas.

(4) **Encourage observation and prediction:**
Display incomplete number and shape sequences and ask students to identify the rule, predict subsequent terms and justify their answers.

(5) **Use visual proofs:**

(6) Demonstrate relationships such as $1 + 3 + 5 + \cdots + (2n - 1) = n^2$ by arranging dots or tiles into growing squares.

(7) **Promote mathematical discussion:**
Conduct “Math Talk” sessions in which students explain how they discovered a pattern and compare different solution methods.

(8) **Connect number and shape patterns:**
Link triangular numbers with dot triangles, square numbers with square grids, complete graphs with triangular numbers and Koch snowflakes with powers of 4.

(9) **Use guided discovery:**
Allow students to discover rules through carefully arranged examples before presenting formulas or formal explanations.

(10) **Include collaborative activities:**
Organise students into groups to construct, extend and present number sequences or geometric patterns to the class.

(11) **Ask ‘why’ questions regularly:**
Move beyond identifying the next term by asking students why the rule works and whether it will continue for all terms.

(12) **Address multiple possible patterns:**
Explain that a short sequence may follow more than one possible rule, so students must clearly state and justify their chosen rule.

(13) **Use differentiated worksheets:**
Provide simple continuation tasks for learners needing support and reasoning, proof and pattern-creation tasks for advanced learners.

(14) **Integrate digital tools appropriately:**
Use spreadsheets, presentation animations or geometry software to generate long sequences and observe rapidly growing patterns.

(15) **Assess learning continuously:**
Use exit slips, oral questions, quick quizzes and pattern-completion exercises to identify misconceptions during the lesson.

(16) **Encourage students to create patterns:**
Ask students to design their own number or shape sequence, write its rule and challenge classmates to extend and explain it.

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

Innovations in Teaching–Learning “Patterns in Mathematics”:

(1) **Pattern Laboratory:**
Establish a classroom station where students use beads, buttons, sticks, blocks and tiles to construct triangular, square, cube and hexagonal patterns.

(2) **Human Number Patterns:**
Ask students to stand in different formations to represent odd, even, triangular and square numbers, helping them experience patterns physically.

(3) **Digital Sequence Generator:**
Let students use spreadsheets to enter pattern rules and automatically generate Virahanka numbers, powers of 2, powers of 3 and other sequences.

(4) **Mathematical Pattern Hunt:**
Students photograph or sketch patterns found in flowers, leaves, buildings, fabrics, rangoli, floor tiles and school surroundings and explain their mathematical features.

(5) **Animated Visual Proofs:**

Use slides or simple animations to show odd-number layers gradually forming squares and consecutive triangular arrangements combining into a square.

(6) **Koch Snowflake Art Project:**
Students construct successive Koch snowflake stages using paper strips, drawing software or craft materials and record the number of segments at each stage.

(7) **Pattern Detective Challenge:**
Present incomplete or misleading number sequences and ask teams to identify possible rules, find missing terms and defend their conclusions.

(8) **Student-Created Pattern Cards:**
Each student designs a card containing a number or shape pattern on the front and its rule and explanation on the back for peer-learning games.

(9) **Complete-Graph Friendship Activity:**
Represent students or teams as points and their pairwise connections as lines to explore triangular numbers through friendship networks or round-robin tournaments.

(10) **Mathematics Storytelling:**
Students create short stories involving growing plants, tiled floors, seating arrangements or spreading messages to explain different number patterns.

(11) **QR-Code Learning Stations:**
Place QR codes around the classroom linking to clues, animated patterns, puzzles and self-checking activities for station-based learning.

(12) **Pattern Escape Room:**
Organise puzzles based on odd numbers, square numbers, Virahanka numbers, polygon sequences and powers; each correct solution reveals the next clue.

(13) **Augmented Reality Shape Exploration:**
Use suitable AR applications to help students observe and manipulate two-dimensional and three-dimensional patterns, especially cubes and geometric constructions.

(14) **Pattern-to-Music Activity:**
Convert number sequences into rhythmic beats or claps—for example, 1, 2, 3, 5 and 8 beats—to connect mathematics with music.

(15) **Student Video Explanations:**
Ask students to record one-minute videos demonstrating a chosen pattern with household objects and explaining why the pattern works.

1.17: Practicing Questions/Question Bank

A. Fill-in-the-Blank Questions:

1. The branch of mathematics that studies patterns in whole numbers is called __________.
   Answer: Number theory

2. The sequence 1,3,6,10,15, ...represents __________ numbers.
   Answer: Triangular

3. The next number in 1,4,9,16,25, ...is __________.
   Answer: 36

4. Each term of the Virahanka sequence is obtained by adding the previous __________ terms.
   Answer: Two

5. The sum of the first ten odd numbers is __________.
   Answer: 100

6. Adding two consecutive triangular numbers produces a __________ number.
   Answer: Square

7. The branch of mathematics that studies patterns in shapes is called __________.
   Answer: Geometry

8. A regular polygon has equal sides and equal __________.
   Answer: Angles

9. The next term in $1,7,19,37,61,\ldots$is __________.
   Answer: 91

10. Successive Koch snowflake stages contain $3,12,48,$___, ...segments.
    Answer: 192

B. One-Mark Questions:

1. **What is a number sequence?**
   A number sequence is an ordered list of numbers formed according to a particular rule.

2. **Write the first five triangular numbers.**
   The first five triangular numbers are $1,3,6,10$and 15.

3. **What are square numbers?**
   Square numbers are numbers obtained by multiplying a whole number by itself.

4. **State the rule of the Virahanka sequence.**
   Each new term is obtained by adding the two immediately preceding terms.

5. **What is the sum of the first eight odd numbers?**
   The sum of the first eight odd numbers is $8^2 = 64$.

6. **Why is 36 special in this chapter?**
   The number 36 is both a triangular number and a square number.

7. **What is a regular polygon?**
   A regular polygon is a closed shape with equal sides and equal angles.

8. **What is the next term in** $3,12,48,192,\ldots$**?**
   The next term is $192 \times 4 = 768$.

C. Two-Mark Questions:

1. What is number theory? Give one example of a number sequence.

- Number theory is the branch of mathematics that studies patterns in whole numbers.
- The sequence $1,3,5,7,9,\ldots$is an example of an odd-number pattern.

2. Differentiate between triangular and square numbers.

- Triangular numbers can be arranged as triangular dot patterns, such as $1,3,6,10,\ldots$.
- Square numbers can be arranged in equal rows and columns, such as $1,4,9,16,\ldots$.

3. Explain the relationship between odd numbers and square numbers.

- Adding consecutive odd numbers beginning with 1 produces square numbers.
- For example, $1 + 3 + 5 + 7 = 16 = 4^2$.

4. How are consecutive triangular numbers related to square numbers?

- The sum of two consecutive triangular numbers is a square number.
- For example, $10 + 15 = 25 = 5^2$.

5. What pattern is followed by Koch snowflake segments?

- The segment numbers follow $3,12,48,192, \ldots$.
- Each new stage has four times as many segments as the previous stage.

6. Why do regular polygons have equal numbers of sides and corners?

- Every pair of neighbouring sides meets at one corner.
- Therefore, a polygon has the same number of sides and corners.

D. Three-Mark Questions:

1. Explain triangular numbers with an example.

- Triangular numbers can be represented by dots arranged in triangular shapes.
- They are obtained by successively adding counting numbers.
- For example, $1 + 2 + 3 + 4 = 10$, so 10 is the fourth triangular number.

2. Explain the Virahanka number sequence.

- The Virahanka sequence begins with 1 and 2.
- Each new term is the sum of the previous two terms.
- Hence, the sequence is $1,2,3,5,8,13,21, \ldots$.

3. Find the sum of the first 20 odd numbers.

- The sum of the first $n$odd numbers is n^2.
- Substituting $n = 20$, the sum is 20^2.
- Therefore, the required sum is 400.

4. Show that 36 belongs to two different number sequences.

- The number 36 is triangular because $1 + 2 + \cdots + 8 = 36$.
- It is square because $6 \times 6 = 36$.
- Therefore, 36 is both triangular and square.

5. Find the number of lines in a complete graph with seven points.

- Each of the seven points can be joined to six other points.
- Since every line is counted twice, the number is $\frac{7\times6}{2}$.
- Therefore, the complete graph has 21 lines.

6. Explain the relationship between shape and number patterns.

- Shape patterns can represent numerical relationships visually.

- Complete graphs represent triangular numbers, while stacked squares represent square numbers.
- Such visualisation helps students understand why number patterns occur.

E. Five-Mark Questions:

1. Explain how adding consecutive odd numbers produces square numbers.

1. Begin with the consecutive odd numbers 1,3,5,7,9, ...
2. Their successive sums are 1,4,9,16,25, ...
3. These are the square numbers $1^2, 2^2, 3^2, 4^2, 5^2$, ...
4. In a dot diagram, every new odd number forms an L-shaped border around the preceding square.
5. Therefore, the sum of the first $n$odd numbers is n^2.

2. Describe the important number sequences studied in the chapter.

1. Counting numbers form the sequence 1,2,3,4, ...
2. Odd and even numbers form 1,3,5,7, ...and 2,4,6,8, ...
3. Triangular and square numbers form 1,3,6,10, ...and 1,4,9,16, ...
4. Cube numbers form 1,8,27,64, ...
5. Virahanka numbers and powers of 2 and 3 are other important sequences.

3. Evaluate $\mathbf{1 + 2 + \cdots + 25 + 24 + \cdots + 2 + 1}$.

1. The numbers increase from 1 to 25 and then decrease to 1.
2. Such an up-and-down sum produces a square number.
3. The greatest number in the arrangement is 25.
4. Therefore, the value is 25^2.
5. Hence, the required sum is 625.

4. Explain how shape sequences are connected with number sequences.

1. Regular polygons produce the counting-number sequence through their numbers of sides.
2. Complete graphs produce triangular numbers through their numbers of connecting lines.
3. Stacked squares contain 1,4,9,16, ...small squares.
4. Stacked triangles also represent the square-number sequence.
5. Koch snowflake stages produce three times the powers-of-4 sequence.

5. A tournament has ten teams, and each team plays every other team once. Find the total number of matches.

1. Represent the ten teams as ten points of a complete graph.
2. Every point can be connected to the other nine points.

3. This gives $10 \times 9 = 90$endpoint connections.
4. Each match is counted twice, so the total is $\frac{90}{2} = 45$.
5. Therefore, the tournament requires 45 matches.

6. Explain the Koch snowflake pattern and calculate the number of segments in its fifth stage.

1. The first Koch snowflake stage contains three line segments.
2. Each segment is replaced by four smaller segments in the next stage.
3. The sequence is $3,12,48,192,768, \ldots$.
4. The fifth-stage value is 3×4^4.
5. Therefore, the fifth stage contains 768 line segments.

****

6th Standard Mathematics Book Chapter 2

Chapter 2: Lines and Angles

2.1 Summary of the Chapter:

Chapter 2: Lines and Angles — Summary:

(1) A **point** represents an exact location and has no length, breadth or height. It is named using a capital letter.
(2) A **line segment** is the shortest path between two points and has two fixed endpoints.
(3) A **line** extends endlessly in both directions, and exactly one line can be drawn through any two distinct points.
(4) A **ray** has one fixed starting point and extends endlessly in one direction.
(5) An **angle** is formed by two rays having a common starting point. The common point is called the **vertex**, and the rays are called its **arms**.
(6) An angle is named using three letters, with the letter representing the vertex written in the middle, such as $\angle ABC$.
(7) The size of an angle depends on the amount of **rotation or turn** between its arms, not on the lengths of the arms.
(8) Angles can be compared by observation, superimposition or by measuring them accurately.
(9) One complete turn is divided into **360 equal parts**, and each part is called one degree, written as 1°.
(10) A **protractor** is used to measure and draw angles accurately in degrees. Its centre must be placed on the vertex and its baseline aligned with one arm.
(11) Angles are classified as **acute** $(0^\circ < \theta < 90^\circ)$, **right** (90°), **obtuse** $(90^\circ < \theta < 180^\circ)$, **straight** (180°), and **reflex** $(180^\circ < \theta < 360^\circ)$.
(12) Lines and angles can be observed in everyday objects and situations such as clocks, doors, scissors, books, swings, slopes and the spokes of the Ashoka Chakra.

2.2 Important Formulas:

Important Formulas — Chapter 2: Lines and Angles:

The chapter contains no major algebraic formulas. However, the following angle relationships are useful for solving quantitative problems:

1. **Complete angle (one full turn)**
$$360^\circ$$
2. **Straight angle (half turn)**
$$180^\circ$$
3. **Right angle (quarter turn)**
$$90^\circ$$
4. **Angle formed by a fraction of a complete turn**
$$\text{Angle} = \text{Fraction of turn} \times 360^\circ$$
5. **Fraction of a complete turn represented by an angle**
$$\text{Fraction of turn} = \frac{\text{Angle}}{360^\circ}$$
6. **Sum of angles around a point**
$$\angle 1 + \angle 2 + \angle 3 + \cdots = 360^\circ$$
7. **Angles forming a straight angle**
$$\angle 1 + \angle 2 + \angle 3 + \cdots = 180^\circ$$
8. **Angles forming a right angle**
$$\angle 1 + \angle 2 + \angle 3 + \cdots = 90^\circ$$

9. **Finding a missing angle**

$$\text{Missing angle} = \text{Total angle} - \text{sum of known angles}$$

10. **Reflex angle**

$$\text{Reflex angle} = 360^\circ - \text{smaller angle}$$

11. **Angle between equally spaced rays or spokes**

$$\text{Angle between consecutive rays} = \frac{360^\circ}{n}$$

where $n$is the number of equally spaced rays or spokes.

12. **Angle between consecutive numbers on a clock**

$$\frac{360^\circ}{12} = 30^\circ$$

13. **Angle formed by the hour hand at an exact hour**

$$\text{Angle} = n \times 30^\circ$$

where $n$is the number of hour divisions between the hands.

14. **Angle between equal divisions of a straight angle**

$$\text{Each angle} = \frac{180^\circ}{n}$$

15. **Angle between equal divisions of a right angle**

$$\text{Each angle} = \frac{90^\circ}{n}$$

Classification of Angles:

- **Acute angle:**

$$0^\circ < \theta < 90^\circ$$

- **Right angle:**

$$\theta = 90^\circ$$

- **Obtuse angle:**

$$90^\circ < \theta < 180^\circ$$

- **Straight angle:**

$$\theta = 180^\circ$$

- **Reflex angle:**

$$180^\circ < \theta < 360^\circ$$

- **Complete angle:**

$$\theta = 360^\circ$$

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

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

1. A ______ determines an exact location.
   Answer: point
2. A point is generally named using a ______ letter.
   Answer: capital
3. A point has no length, breadth or ______.
   Answer: height
4. The shortest path between two points is called a ______.
   Answer: line segment
5. A line segment has ______ endpoints.
   Answer: two
6. A line extends endlessly in ______ directions.
   Answer: both
7. Exactly ______ line can be drawn through two distinct points.
   Answer: one

8. A part of a line that begins at a fixed point and extends endlessly in one direction is called a ______.
   Answer: ray
9. The fixed point of a ray is called its ______ point.
   Answer: starting
10. Two rays with a common starting point form an ______.
    Answer: angle
11. The common starting point of the two rays forming an angle is called its ______.
    Answer: vertex
12. The two rays forming an angle are called its ______.
    Answer: arms
13. While naming an angle using three letters, the vertex is written as the ______ letter.
    Answer: middle
14. The size of an angle depends on the amount of ______ between its arms.
    Answer: rotation
15. The standard unit used to measure an angle is the ______.
    Answer: degree
16. The symbol used to represent a degree is ______.
    Answer: $^\circ$
17. One complete turn measures ______ degrees.
    Answer: 360
18. A half turn forms a ______ angle.
    Answer: straight
19. A straight angle measures ______.
    Answer: 180°
20. A quarter turn forms a ______ angle.
    Answer: right
21. A right angle measures ______.
    Answer: 90°
22. An angle measuring less than $90^\circ$is called an ______ angle.
    Answer: acute
23. An angle measuring more than 90°but less than $180^\circ$is called an ______ angle.
    Answer: obtuse
24. An angle measuring more than 180°but less than $360^\circ$is called a ______ angle.
    Answer: reflex
25. The instrument used to measure an angle is called a ______.
    Answer: protractor
26. The centre point of a protractor must be placed exactly on the ______ of the angle.
    Answer: vertex
27. A semicircular protractor is divided into ______ equal parts.
    Answer: 180
28. The angle between two consecutive numbers on a clock is ______.
    Answer: 30°
29. The angle between two consecutive spokes of the 24-spoked Ashoka Chakra is ______.
    Answer: 15°
30. Angles can be compared by placing one angle over another, a method called ______.
    Answer: superimposition

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

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

1. A student marks one point on a sheet of paper. The number of lines that can pass through it is ______.
   Answer: infinitely many
2. If two distinct points are marked on a sheet, exactly ______ line can pass through both points.
   Answer: one
3. The shortest route connecting points $A$and $B$is the line segment ______.
   Answer: AB
4. A geometrical figure extending endlessly in both directions is a ______.
   Answer: line
5. A beam of light beginning at a lighthouse and travelling in one direction represents a ______.
   Answer: ray
6. Ray $\overrightarrow{AB}$cannot generally be written as ray $\overrightarrow{BA}$because their ______ points are different.
   Answer: starting
7. If rays $\overrightarrow{OA}$and $\overrightarrow{OB}$have the same starting point, they form the angle ______.
   Answer: $\angle AOB$
8. In $\angle PQR$, the common starting point of its arms is point ______.
   Answer: Q
9. Two angles with arms of different lengths can still be equal because the size of an angle depends on the amount of ______.
   Answer: rotation
10. When one arm makes half a complete turn towards the other arm, the angle formed measures ______.
    Answer: $180°$
11. If a complete turn is divided into four equal parts, each part measures ______.
    Answer: $90°$
12. An angle measuring $35°$is classified as an ______ angle.
    Answer: acute
13. An angle measuring $125°$is classified as an ______ angle.
    Answer: obtuse
14. An angle measuring $260°$is classified as a ______ angle.
    Answer: reflex
15. The smaller angle between the hands of a clock at 4 o'clock is ______.
    Answer: $120°$
16. The angle between the hands of a clock at 6 o'clock is a ______ angle.
    Answer: straight
17. If the smaller angle between two rays is $100°$, the corresponding reflex angle is ______.
    Answer: $260°$
18. Two adjacent angles form a straight angle. If one angle measures $65°$, the other measures ______.
    Answer: $115°$
19. Two angles together form a right angle. If one measures $28°$, the other measures ______.
    Answer: $62°$

20. Three angles around a point measure $90°$, $120°$and $x°$. Therefore, $x$equals ______.
    Answer: 150°
21. If a straight angle is divided into six equal parts, each angle measures ______.
    Answer: 30°
22. If eight equal angles together form a complete turn, each angle measures ______.
    Answer: 45°
23. The Ashoka Chakra has 24 equally spaced spokes. Therefore, the angle between two consecutive spokes is ______.
    Answer: 15°
24. The largest acute angle that can be formed between the spokes of a 24-spoked Ashoka Chakra is ______.
    Answer: 75°
25. If $\angle AOB = 80°$and $\angle BOC = 40°$, with ray OBlying inside $\angle AOC$, then $\angle AOC =$______.
    Answer: 120°
26. If $\angle AOC = 150°$and $\angle AOB = 65°$, with ray OBlying inside $\angle AOC$, then $\angle BOC =$______.
    Answer: 85°
27. An angle becomes a straight angle when its measure of $90°$is multiplied by ______.
    Answer: 2
28. If an acute angle is doubled and becomes a right angle, its original measure is ______.
    Answer: 45°
29. A door opened through one-fourth of a complete turn forms an angle of ______.
    Answer: 90°
30. If five equal angles together form a straight angle, the measure of each angle is ______.
    Answer: 36°

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

One-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is a point?**
   Answer: A point represents an exact location and has no length, breadth or height.
2. **How is a point usually named?**
   Answer: A point is usually named using a capital letter.
3. **What is a line segment?**
   Answer: A line segment is the shortest path joining two points.
4. **How many endpoints does a line segment have?**
   Answer: A line segment has two endpoints.
5. **What is a line?**
   Answer: A line is a straight path that extends endlessly in both directions.
6. **How many lines can be drawn through two distinct points?**
   Answer: Exactly one line can be drawn through two distinct points.
7. **What is a ray?**
   Answer: A ray is a part of a line that starts at one point and extends endlessly in one direction.
8. **How many starting points does a ray have?**
   Answer: A ray has one starting point.
9. **What is an angle?**
   Answer: An angle is formed by two rays having a common starting point.

10. **What is the vertex of an angle?**
    Answer: The common starting point of the two rays forming an angle is called its vertex.
11. **What are the arms of an angle?**
    Answer: The two rays forming an angle are called its arms.
12. **How is an angle named using three letters?**
    Answer: An angle is named with its vertex written as the middle letter.
13. **What determines the size of an angle?**
    Answer: The amount of rotation or turn between its arms determines the size of an angle.
14. **What is the standard unit used to measure angles?**
    Answer: The degree is the standard unit used to measure angles.
15. **What is the symbol used for a degree?**
    Answer: The symbol used for a degree is °.
16. **What is the measure of a complete angle?**
    Answer: A complete angle measures 360°.
17. **What is the measure of a straight angle?**
    Answer: A straight angle measures 180°.
18. **What is the measure of a right angle?**
    Answer: A right angle measures 90°.
19. **What is an acute angle?**
    Answer: An acute angle measures more than 0°but less than 90°.
20. **What is an obtuse angle?**
    Answer: An obtuse angle measures more than 90°but less than 180°.
21. **What is a reflex angle?**
    Answer: A reflex angle measures more than 180°but less than 360°.
22. **Which instrument is used to measure angles?**
    Answer: A protractor is used to measure angles.
23. **Where should the centre of a protractor be placed while measuring an angle?**
    Answer: The centre of the protractor should be placed exactly on the vertex of the angle.
24. **What is superimposition of angles?**
    Answer: Superimposition is the method of placing one angle over another to compare their sizes.
25. **What angle is formed by a quarter turn?**
    Answer: A quarter turn forms a right angle of 90°.
26. **What angle is formed by a half turn?**
    Answer: A half turn forms a straight angle of 180°.
27. **How many degrees are there between consecutive numbers on a clock?**
    Answer: There are 30°between consecutive numbers on a clock.
28. **What is the angle between consecutive spokes of the Ashoka Chakra?**
    Answer: The angle between consecutive spokes of the 24-spoked Ashoka Chakra is 15°.
29. **Give one real-life example of a ray.**
    Answer: A beam of light from a torch is a real-life example of a ray.
30. **Give one real-life example of an angle.**
    Answer: The opening between the blades of a pair of scissors is an example of an angle.

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

One-Mark Descriptive Questions with Answers — HOTS Type:

1. **How many lines can pass through a single point?**
   Answer: Infinitely many lines can pass through a single point.
2. **Why can only one line pass through two distinct points?**
   Answer: Two distinct points determine one unique straight line.
3. **Why is a line segment considered the shortest route between two points?**
   Answer: A straight path gives the minimum distance between two points.
4. **Can ray $\overrightarrow{AB}$ always be renamed as ray $\overrightarrow{BA}$? Give a reason.**
   Answer: No, because $\overrightarrow{AB}$ starts at A, whereas $\overrightarrow{BA}$ starts at B.
5. **If B lies between A and C on the same ray, can $\overrightarrow{AB}$ be named $\overrightarrow{AC}$?**
   Answer: Yes, because both rays start at A and extend in the same direction.
6. **Can two angles with arms of different lengths be equal? Give a reason.**
   Answer: Yes, because the size of an angle depends on the amount of rotation and not on the lengths of its arms.
7. **Why is $\angle ABC$ not generally named simply as $\angle B$?**
   Answer: It may cause confusion if more than one angle has B as its vertex.
8. **Which is greater: an angle of $89°$ or an angle of $91°$?**
   Answer: The $91°$ angle is greater because its degree measure is larger.
9. **Classify an angle measuring $89°$.**
   Answer: An angle measuring $89°$ is an acute angle because it is less than $90°$.
10. **Classify an angle measuring $91°$.**
    Answer: An angle measuring $91°$ is an obtuse angle because it lies between $90°$ and $180°$.
11. **What angle is formed when a ray completes three-fourths of a full turn?**
    Answer: Three-fourths of a full turn forms an angle of $270°$.
12. **If one angle on a straight line measures $70°$, what is the other angle?**
    Answer: The other angle measures $110°$ because angles on a straight line total $180°$.
13. **If two angles together form a right angle and one measures $35°$, find the other angle.**
    Answer: The other angle measures $55°$ because $90° - 35° = 55°$.
14. **Two adjacent angles measure $120°$ and $60°$; what type of angle do they form together?**
    Answer: They form a straight angle because their sum is $180°$.
15. **If three angles around a point measure $90°$, $110°$ and $x°$, find x.**
    Answer: The third angle is $160°$ because angles around a point total $360°$.
16. **Find the reflex angle corresponding to an angle of $80°$.**
    Answer: The reflex angle is $280°$ because $360° - 80° = 280°$.
17. **At 3 o'clock, what type of angle is formed between the clock hands?**
    Answer: The clock hands form a right angle of $90°$.
18. **At 5 o'clock, what is the smaller angle between the clock hands?**
    Answer: The smaller angle is $150°$ because five hour-divisions equal $5 \times 30°$.
19. **The Ashoka Chakra has 24 equally spaced spokes; what is the angle between two consecutive spokes?**
    Answer: The angle is $15°$ because $360° \div 24 = 15°$.
20. **If an angle is doubled to obtain a straight angle, what is its original measure?**
    Answer: Its original measure is $90°$ because $180° \div 2 = 90°$.
21. **If an acute angle is doubled to form a right angle, what is the angle?**
    Answer: The angle is $45°$ because $90° \div 2 = 45°$.

22. **A door turns through one-fourth of a complete rotation; through what angle has it opened?**
    Answer: The door has opened through $90°$because one-fourth of $360°$is $90°$.
23. **If a straight angle is divided into five equal angles, what is the measure of each angle?**
    Answer: Each angle measures $36°$because $180° \div 5 = 36°$.
24. **If nine equal angles meet at a point, what is the measure of each angle?**
    Answer: Each angle measures $40°$because $360° \div 9 = 40°$.
25. **Can an angle of $180°$be called an obtuse angle? Give a reason.**
    Answer: No, because $180°$is a straight angle and an obtuse angle must be less than $180°$.
26. **Can an angle of $360°$be called a reflex angle? Give a reason.**
    Answer: No, because $360°$is a complete angle while a reflex angle is less than $360°$.
27. **Why should the correct protractor scale be selected while measuring an angle?**
    Answer: The correct scale must begin from $0°$on the arm aligned with the protractor's baseline.
28. **If $\angle AOB = 45°$and $\angle BOC = 75°$, with OBinside $\angle AOC$, find $\angle AOC$.**
    Answer: $\angle AOC = 120°$because $45° + 75° = 120°$.
29. **If $\angle AOC = 140°$and $\angle AOB = 55°$, find $\angle BOC$when OBlies inside $\angle AOC$.**
    Answer: $\angle BOC = 85°$because $140° - 55° = 85°$.
30. **Why is measurement better than visual observation when comparing two nearly equal angles?**
    Answer: Measurement gives exact degree values and avoids errors caused by visual estimation.

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

Two-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is a point? How is it named?**
   Answer:
   1. A point represents an exact location and has no length, breadth or height.
   2. It is generally named using a capital letter such as A, Bor P.
2. **Define a line segment and state its main feature.**
   Answer:
   1. A line segment is the shortest straight path joining two points.
   2. It has two fixed endpoints.
3. **What is a line? How is it represented?**
   Answer:
   1. A line is a straight path that extends endlessly in both directions.
   2. A line through $A$and $B$is represented as $\overleftrightarrow{AB}$.
4. **Define a ray and give one example.**
   Answer:
   1. A ray starts at a fixed point and extends endlessly in one direction.
   2. A beam of light coming from a torch is an example of a ray.
5. **Distinguish between a line and a line segment.**
   Answer:
   1. A line extends endlessly in both directions and has no endpoints.
   2. A line segment has two fixed endpoints and a measurable length.
6. **Distinguish between a line segment and a ray.**
   Answer:

1. A line segment has two endpoints and does not extend endlessly.
2. A ray has one starting point and extends endlessly in one direction.

7. **What is an angle? Name its two main parts.**
   Answer:
   1. An angle is formed by two rays having a common starting point.
   2. Its two main parts are the vertex and the arms.
8. **What are the vertex and arms of $\angle ABC$?**
   Answer:
   1. Point B is the vertex of $\angle ABC$.
   2. Rays $\overrightarrow{BA}$ and $\overrightarrow{BC}$ are its arms.
9. **How is an angle named using three letters?**
   Answer:
   1. One point from each arm and the vertex are used to name an angle.
   2. The vertex is always written as the middle letter, as in $\angle ABC$.
10. **What determines the size of an angle? Does arm length affect it?**
    Answer:
    1. The size of an angle is determined by the amount of rotation between its arms.
    2. The lengths of the arms do not affect the size of the angle.
11. **What is superimposition? How does it help in comparing angles?**
    Answer:
    1. Superimposition means placing one angle exactly over another angle.
    2. The angle whose arm shows a greater turn is the larger angle.
12. **What is a degree? How many degrees are there in a complete turn?**
    Answer:
    1. A degree is the standard unit used to measure an angle.
    2. One complete turn contains 360°.
13. **What is a right angle? Give one real-life example.**
    Answer:
    1. A right angle is an angle measuring exactly 90°.
    2. The corner of a rectangular sheet is an example of a right angle.
14. **What is a straight angle? How is it related to a complete turn?**
    Answer:
    1. A straight angle measures exactly 180°.
    2. It represents half of a complete turn.
15. **Define acute and obtuse angles.**
    Answer:
    1. An acute angle measures more than 0° but less than 90°.
    2. An obtuse angle measures more than 90° but less than 180°.
16. **What is a reflex angle? State its range.**
    Answer:
    1. A reflex angle is larger than a straight angle but smaller than a complete angle.
    2. Its measure is more than 180° but less than 360°.
17. **What is a protractor? State its use.**
    Answer:
    1. A protractor is a geometrical instrument marked in degrees.
    2. It is used to measure and draw angles accurately.
18. **Mention two important steps for measuring an angle with a protractor.**
    Answer:
    1. Place the centre of the protractor exactly on the vertex of the angle.

2. Align its baseline with one arm and read where the other arm crosses the correct scale.

19. **What angles are formed by a quarter turn and a half turn?**
Answer:
    1. A quarter turn forms a right angle measuring 90°.
    2. A half turn forms a straight angle measuring 180°.
20. **How are angles seen in a clock? Give one example.**
Answer:
    1. The hour and minute hands of a clock act as the arms of an angle.
    2. At 3 o'clock, the two hands form a right angle of 90°.
21. **How many spokes are there in the Ashoka Chakra, and what is the angle between consecutive spokes?**
Answer:
    1. The Ashoka Chakra contains 24 equally spaced spokes.
    2. The angle between two consecutive spokes is $360^\circ \div 24 = 15^\circ$.
22. **State two ways of comparing angles.**
Answer:
    1. Angles can be compared by superimposing one angle over another.
    2. They can also be compared accurately by measuring them with a protractor.
23. **What is the difference between an acute angle and a right angle?**
Answer:
    1. An acute angle measures less than 90°.
    2. A right angle measures exactly 90°.
24. **What is the difference between an obtuse angle and a reflex angle?**
Answer:
    1. An obtuse angle lies between $90^\circ$and 180°.
    2. A reflex angle lies between $180^\circ$and 360°.
25. **Identify the vertex and arms of an angle formed by an open door and a wall.**
Answer:
    1. The hinge or joining point of the door and wall represents the vertex.
    2. The edges of the door and wall represent the two arms of the angle.

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

Two-Mark Descriptive Questions with Answers — HOTS Type:

1. **Why can infinitely many lines pass through one point, while only one line can pass through two distinct points?**
Answer:
    1. A line passing through one point can be turned in infinitely many directions.
    2. Two distinct points fix a unique direction and therefore determine only one line.
2. **Can ray $\overrightarrow{AB}$be named ray $\overrightarrow{BA}$? Justify your answer.**
Answer:
    1. No, ray $\overrightarrow{AB}$starts at A, whereas ray $\overrightarrow{BA}$starts at B.
    2. Reversing the letters changes the starting point and direction of the ray.
3. **Points A, $B$and Clie in that order on the same ray starting at A. Can it be named both $\overrightarrow{AB}$and $\overrightarrow{AC}$?**
Answer:
    1. Yes, both names represent a ray beginning at $A$and extending in the same direction.

2. Either B or C may be used as the second point to name the ray.

4. **Two angles have arms of different lengths but the same opening. Are they equal? Explain.**
   Answer:
   1. Yes, the two angles are equal because they represent the same amount of rotation.
   2. The lengths of the arms do not determine the size of an angle.
5. **Why is visual observation sometimes unreliable when comparing two angles? Suggest a better method.**
   Answer:
   1. Different orientations or arm lengths may make equal or nearly equal angles appear different.
   2. They should be compared by superimposition or measured with a protractor.
6. **An angle measures $88°$. What type of angle is it, and what type will it become if increased by $4°$?**
   Answer:
   1. The original angle is acute because $88° < 90°$.
   2. After increasing by $4°$, it becomes $92°$, which is obtuse.
7. **An angle measures $179°$. What happens to its classification when $1°$ is added?**
   Answer:
   1. The $179°$ angle is obtuse because it lies between $90°$ and $180°$.
   2. After adding $1°$, it becomes a straight angle of $180°$.
8. **Two adjacent angles form a straight angle, and one measures $68°$. Find and classify the other angle.**
   Answer:
   1. The other angle measures $180° - 68° = 112°$.
   2. It is an obtuse angle because it lies between $90°$ and $180°$.
9. **Two angles together form a right angle in the ratio $1:2$. Find their measures.**
   Answer:
   1. The three equal parts together measure $90°$, so each part measures $30°$.
   2. Therefore, the two angles measure $30°$ and $60°$.
10. **Three angles around a point measure $80°$, $125°$ and $x°$. Find x and classify it.**
    Answer:
    1. $x = 360° - (80° + 125°) = 155°$.
    2. The angle is obtuse because it lies between $90°$ and $180°$.
11. **The smaller angle between two rays is $110°$. Find and classify the corresponding larger angle.**
    Answer:
    1. The larger angle measures $360° - 110° = 250°$.
    2. It is a reflex angle because it lies between $180°$ and $360°$.
12. **What angle is formed between the hands of a clock at 4 o'clock? Classify it.**
    Answer:
    1. The smaller angle is $4 \times 30° = 120°$.
    2. It is an obtuse angle because it lies between $90°$ and $180°$.
13. **Find the smaller and reflex angles between the clock hands at 2 o'clock.**
    Answer:
    1. The smaller angle is $2 \times 30° = 60°$.
    2. The corresponding reflex angle is $360° - 60° = 300°$.

14. **The Ashoka Chakra has 24 equally spaced spokes. Find the angle between two consecutive spokes and between every third spoke.**
Answer:
    1. The angle between consecutive spokes is $360° \div 24 = 15°$.
    2. The angle covering three equal spaces is $3 \times 15° = 45°$.
15. **A straight angle is divided into six equal parts. Find and classify each part.**
Answer:
    1. Each part measures $180° \div 6 = 30°$.
    2. Each part is an acute angle because $30° < 90°$.
16. **A complete angle is divided into eight equal parts. Find the measure and type of each part.**
Answer:
    1. Each part measures $360° \div 8 = 45°$.
    2. Each part is an acute angle because its measure is less than $90°$.
17. **If $\angle AOB = 45°$and $\angle BOC = 85°$, with ray OBinside $\angle AOC$, find and classify $\angle AOC$.**
Answer:
    1. $\angle AOC = 45° + 85° = 130°$.
    2. It is an obtuse angle because it lies between $90°$and $180°$.
18. **If $\angle AOC = 145°$and $\angle AOB = 60°$, with ray OBinside $\angle AOC$, find and classify $\angle BOC$.**
Answer:
    1. $\angle BOC = 145° - 60° = 85°$.
    **2. It is an acute angle because its measure is less than $90°$.
19. **A student obtains $130°$while measuring an acute-looking angle using a protractor. What mistake might have occurred?**
Answer:
    1. The student may have read the wrong scale of the protractor.
    2. The reading should begin from the $0°$mark aligned with the initial arm.
20. **An acute angle becomes an obtuse angle when tripled but remains acute when doubled; give one possible measure.**
Answer:
    1. One possible measure is $40°$, because twice the angle is $80°$, which is acute.
    2. Three times the angle is $120°$, which is obtuse.
21. **A door is opened through one-third of a straight angle. Find and classify the opening.**
Answer:
    1. The opening measures $180° \div 3 = 60°$.
    2. It is an acute angle because it is less than $90°$.
22. **Can two acute angles combine to form an obtuse angle? Support your answer with an example.**
Answer:
    1. Yes, two acute angles can have a sum greater than $90°$but less than $180°$.
    2. For example, $50° + 60° = 110°$, which is obtuse.
23. **Can two obtuse angles combine to form a straight angle? Explain.**
Answer:
    1. No, each obtuse angle is greater than $90°$.
    2. Therefore, the sum of two obtuse angles must be greater than $180°$.

24. **Four equal angles are formed around a point. Find the measure and type of each angle.**
    Answer:
    1. Each angle measures $360^\circ \div 4 = 90^\circ$.
    2. Therefore, each of the four angles is a right angle.
25. **An angle is one-fifth of a complete turn. Find its measure and classify it.**
    Answer:
    1. The angle measures $360^\circ \div 5 = 72^\circ$.
       2. It is an acute angle because it lies between $0^\circ$and 90°.

2.9. Three-mark questions with Answers of LOTS Type: (18 Questions)

Three-Mark Descriptive Questions with Answers — LOTS Type:

1. Define a point and explain how it is represented and named.

Answer:
1. A point indicates an exact location and has no length, breadth or height.
2. It is represented by a small dot made with a sharp pencil.
3. It is named using a capital letter such as A, Por R.

2. Define a line segment and state its main characteristics.

Answer:
1. A line segment is the shortest straight path joining two points.
2. It has two fixed endpoints and a definite length.
3. The line segment joining $A$and $B$is denoted by $\bar{AB}$or $\bar{BA}$.

3. Define a line and explain how it is named.

Answer:
1. A line is a straight path that extends endlessly in both directions.
2. It has neither endpoints nor a fixed length.
3. A line through points $A$and $B$is denoted by $\overleftrightarrow{AB}$or by a small letter such as $l$or m.

4. Define a ray and explain how it is named.

Answer:
1. A ray is a part of a line that starts at one point and extends endlessly in one direction.
2. The fixed point is called its starting or initial point.
3. A ray starting at $A$and passing through $B$is denoted by $\overrightarrow{AB}$.

5. Differentiate among a line, a ray and a line segment.

Answer:
1. A line extends endlessly in both directions and has no endpoints.
2. A ray has one starting point and extends endlessly in one direction.
3. A line segment has two fixed endpoints and a definite length.

6. Define an angle and identify its parts.

Answer:
1. An angle is formed by two rays having a common starting point.
2. The common starting point is called the vertex of the angle.
3. The two rays forming the angle are called its arms.

7. Explain how an angle is named using three letters.

Answer:
1. An angle is named using a point on each arm and its vertex.
2. The letter representing the vertex is always written in the middle.
3. Therefore, an angle with vertex $O$and arms $OA$and $OB$is named $\angle AOB$or $\angle BOA$.

8. Explain what determines the size of an angle.

Answer:

1. The size of an angle depends on the amount of rotation or turn between its arms.
2. A greater amount of rotation produces a larger angle.
3. The lengths of the arms do not affect the size of the angle.

9. Explain how angles can be compared by superimposition.

Answer:

1. Place the vertex of one angle exactly over the vertex of the other angle.
2. Align one arm of the first angle with one arm of the second angle.
3. The angle whose other arm shows a greater turn is the larger angle.

10. What is a degree? Explain its connection with different turns.

Answer:

1. A degree is the standard unit used to measure angles and is represented by °.
2. One complete turn measures $360°$.
3. A half turn measures $180°$, while a quarter turn measures $90°$.

11. Describe the steps for measuring an angle using a protractor.

Answer:

1. Place the centre of the protractor exactly on the vertex of the angle.
2. Align its baseline with one arm of the angle.
3. Read the correct scale at the point where the other arm crosses the protractor.

12. Explain acute, right and obtuse angles.

Answer:

1. An acute angle measures more than $0°$but less than $90°$.
2. A right angle measures exactly $90°$.
3. An obtuse angle measures more than $90°$but less than $180°$.

13. Explain straight, reflex and complete angles.

Answer:

1. A straight angle measures exactly $180°$and represents a half turn.
2. A reflex angle measures more than $180°$but less than $360°$.
3. A complete angle measures exactly $360°$and represents one full turn.

14. Describe three real-life situations in which angles are formed.

Answer:

1. The blades of an open pair of scissors form an angle at their joining point.
2. A door and a wall form an angle at the hinges when the door is opened.
3. The hour and minute hands of a clock form angles at the centre of the clock.

15. Explain the angles formed by the hands of a clock at 2, 3 and 6 o'clock.

Answer:

1. At 2 o'clock, the hands form an angle of $60°$.
2. At 3 o'clock, the hands form a right angle of $90°$.
3. At 6 o'clock, the hands form a straight angle of $180°$.

16. Explain the angles formed by the spokes of the Ashoka Chakra.

Answer:

1. The Ashoka Chakra contains 24 equally spaced spokes.
2. A complete angle of $360°$is divided equally among these 24 spaces.
3. Therefore, the angle between two consecutive spokes is $360° \div 24 = 15°$.

17. State three important facts about drawing lines through points.

Answer:

1. Infinitely many lines can be drawn through a single point.
2. Exactly one line can be drawn through two distinct points.
3. Two points are sufficient to determine a unique line.

18. Explain how to draw an angle of a given measure using a protractor.

Answer:

1. Draw a ray and place the centre of the protractor at its starting point.
2. Mark the required degree on the correct scale of the protractor.
3. Draw another ray from the starting point through the marked position.

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

Three-Mark Descriptive Questions with Answers — HOTS Type:

1. Why can many lines pass through one point but only one line through two distinct points?

Answer:

1. A line passing through one point can be drawn in any direction.
2. Therefore, infinitely many lines can pass through a single point.
3. Two distinct points fix a unique direction, so only one line can pass through both.

2. Points A, B and C lie in that order on the same ray beginning at A. Explain why $\overrightarrow{AB}$ and $\overrightarrow{AC}$ represent the same ray.

Answer:

1. Both rays have A as their starting point.
2. Points B and C lie in the same direction from A.
3. Therefore, $\overrightarrow{AB}$ and $\overrightarrow{AC}$ represent the same ray.

3. Two angles have arms of different lengths but the same opening. Compare them and justify your answer.

Answer:

1. The size of an angle depends on the amount of rotation between its arms.
2. It does not depend on the lengths of the arms.
3. Therefore, the two angles are equal because their openings are the same.

4. An angle measures $65°$. Find the angle required to complete a straight angle and classify it.

Answer:

1. The angles forming a straight angle have a total measure of $180°$.
2. The required angle is $180° - 65° = 115°$.
3. It is an obtuse angle because it lies between $90°$ and $180°$.

5. Two angles form a right angle and are in the ratio $2:3$. Find their measures.

Answer:

1. The total number of ratio parts is $2 + 3 = 5$.
2. Each part measures $90° \div 5 = 18°$.
3. Therefore, the angles measure $36°$ and $54°$.

6. Three angles around a point measure $75°$, $110°$ and $x°$. Find and classify x.

Answer:

1. The sum of angles around a point is $360°$.
2. Therefore, $x = 360° - (75° + 110°) = 175°$.
3. The angle is obtuse because it is greater than $90°$ but less than $180°$.

7. The smaller angle between two rays is $125°$. Find and classify the corresponding larger angle.

Answer:

1. The angles around a point together measure $360°$.
2. The larger angle is $360° - 125° = 235°$.
3. It is a reflex angle because its measure lies between $180°$ and $360°$.

8. Find and classify the smaller angle between the hands of a clock at 5 o'clock.

Answer:

1. The angle between two consecutive hour marks is $360° \div 12 = 30°$.
2. At 5 o'clock, the smaller angle is $5 \times 30° = 150°$.
3. It is an obtuse angle because it lies between $90°$and $180°$.

9. The Ashoka Chakra has 24 equally spaced spokes. Find the angle formed between every fourth spoke and classify it.

Answer:

1. The angle between two consecutive spokes is $360° \div 24 = 15°$.
2. The angle covering four equal spaces is $4 \times 15° = 60°$.
3. It is an acute angle because it is less than $90°$.

10. A complete angle is divided into eight equal angles. Find and classify each angle.

Answer:

1. A complete angle measures $360°$.
2. Each angle measures $360° \div 8 = 45°$.
3. Each angle is acute because $45°$is less than $90°$.

11. An angle is doubled and becomes $160°$. Find the original angle and classify both angles.

Answer:

1. The original angle is $160° \div 2 = 80°$.
2. The original angle is acute because it measures less than $90°$.
3. The doubled angle is obtuse because $160°$lies between $90°$and $180°$.

12. If $\angle AOB = 48°$and $\angle BOC = 76°$, with OBlying inside $\angle AOC$, find and classify $\angle AOC$.

Answer:

1. The complete angle is the sum of the two adjacent angles.
2. Therefore, $\angle AOC = 48° + 76° = 124°$.
3. It is an obtuse angle because it lies between $90°$and $180°$.

13. If $\angle AOC = 155°$and $\angle AOB = 70°$, with OBlying inside $\angle AOC$, find and classify $\angle BOC$.

Answer:

1. The missing angle is found by subtracting $\angle AOB$from $\angle AOC$.
2. Therefore, $\angle BOC = 155° - 70° = 85°$.
3. It is an acute angle because it measures less than $90°$.

14. A student measures an acute-looking angle as $140°$. Identify the likely mistake and explain how to correct it.

Answer:

1. The student has probably read the wrong scale of the protractor.
2. The scale beginning with $0°$on the side of the initial arm must be used.
3. The correct measurement is likely $180° - 140° = 40°$.

15. Can two acute angles combine to form a straight angle? Justify your answer.

Answer:

1. Each acute angle measures less than $90°$.
2. Therefore, the sum of two acute angles must be less than $180°$.
3. Hence, two acute angles cannot combine to form a straight angle.

16. Can two obtuse angles combine to form a reflex angle? Explain with an example.

Answer:

1. Each obtuse angle measures more than $90°$but less than $180°$.
2. For example, $110° + 120° = 230°$.
3. Since $230°$lies between $180°$and $360°$, it is a reflex angle.

17. A door is opened through three-eighths of a complete turn. Find and classify the angle formed.

Answer:
1. A complete turn measures $360°$.
2. The angle formed is $\frac{3}{8} \times 360° = 135°$.
3. It is an obtuse angle because it lies between $90°$and $180°$.

18. An angle remains acute when doubled but becomes obtuse when tripled. Give one possible measure and verify it.
Answer:
1. Consider an angle measuring $40°$.
2. Its double is $80°$, which is still acute.
3. Its triple is $120°$, which is obtuse.

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

Five-Mark Descriptive Questions with Answers — LOTS Type:
1. Explain the basic geometrical concepts of a point, line segment, line and ray.
Answer:
1. A point represents an exact location and has no length, breadth or height.
2. A line segment is the shortest straight path joining two points and has two endpoints.
3. A line extends endlessly in both directions and has no endpoints.
4. A ray has one starting point and extends endlessly in one direction.
5. These concepts are the basic building blocks used to study lines, angles and geometrical shapes.

2. Define an angle and explain its parts and naming convention.
Answer:
1. An angle is formed by two rays having a common starting point.
2. The common starting point of the rays is called the vertex.
3. The two rays forming the angle are called its arms.
4. An angle is named using a point on each arm along with its vertex.
5. The vertex is always written as the middle letter, as in $\angle ABC$.

3. Explain how the size of an angle is understood and compared.
Answer:
1. The size of an angle represents the amount of rotation from one arm to the other.
2. A greater amount of rotation produces a larger angle.
3. The lengths of the arms do not affect the size of the angle.
4. Angles may be compared by superimposing one angle on another.
5. They can be compared more accurately by measuring them in degrees using a protractor.

4. Explain the different types of angles according to their measures.
Answer:
1. An acute angle measures more than $0°$but less than $90°$.
2. A right angle measures exactly $90°$.
3. An obtuse angle measures more than $90°$but less than $180°$.
4. A straight angle measures exactly $180°$.
5. A reflex angle measures more than $180°$but less than $360°$.

5. Describe the steps involved in measuring an angle using a protractor.
Answer:
1. Identify the vertex and the two arms of the angle.
2. Place the centre mark of the protractor exactly over the vertex.
3. Align the baseline of the protractor with one arm of the angle.
4. Select the scale that begins with $0°$on the aligned arm.

5. Read the degree mark where the other arm crosses the protractor.

6. Describe the steps for drawing an angle of a given measure using a protractor.

Answer:

1. Draw a ray with a fixed starting point as the vertex.
2. Place the centre of the protractor on the vertex.
3. Align the baseline of the protractor with the drawn ray.
4. Mark a point at the required degree measure on the correct scale.
5. Draw another ray from the vertex through the marked point to complete the angle.

7. Explain the relationship between turns and angle measures.

Answer:

1. One complete turn forms an angle of $360°$.
2. A half turn forms a straight angle of $180°$.
3. A quarter turn forms a right angle of $90°$.
4. Three-fourths of a turn forms a reflex angle of $270°$.
5. Thus, the degree measure of an angle indicates the fraction of a complete turn made.

8. Explain how different angles are formed by the hands of a clock.

Answer:

1. A clock face is divided into 12 equal sections around its centre.
2. Each section forms an angle of $360° \div 12 = 30°$.
3. At 2 o'clock, the clock hands form a smaller angle of $60°$.
4. At 3 o'clock, the clock hands form a right angle of $90°$.
5. At 6 o'clock, the clock hands form a straight angle of $180°$.

9. Explain how angles appear in daily-life objects.

Answer:

1. The blades of an open pair of scissors form an angle at their joining point.
2. The arms of a compass or divider form an angle at the hinge.
3. An open door forms an angle with the wall at its hinges.
4. The hands of a clock form different angles at its centre.
5. The edges of sloping surfaces form angles that indicate their steepness.

10. Explain the Ashoka Chakra using the concept of angles.

Answer:

1. The Ashoka Chakra contains 24 equally spaced spokes.
2. The spokes divide the complete angle at the centre into 24 equal parts.
3. The angle between two consecutive spokes is $360° \div 24 = 15°$.
4. The angle between every second spoke is $2 \times 15° = 30°$.
5. The largest acute angle obtainable between its spokes is $75°$.

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

Five-Mark Descriptive Questions with Answers — HOTS Type:

1. Two angles form a straight angle and are in the ratio $2:3$. Find their measures and classify them.

Answer:

1. A straight angle measures $180°$.
2. The total number of ratio parts is $2 + 3 = 5$.
3. One part measures $180° \div 5 = 36°$.
4. The angles are $2 \times 36° = 72°$and $3 \times 36° = 108°$.
5. Therefore, $72°$is acute and $108°$is obtuse.

2. Three angles around a point are in the ratio $2:3:5$. Find and classify each angle.

Answer:

1. Angles around a point have a total measure of $360°$.
2. The total number of ratio parts is $2 + 3 + 5 = 10$.
3. One part measures $360° \div 10 = 36°$.
4. The three angles are $72°$, $108°$and $180°$.
5. Therefore, they are acute, obtuse and straight angles respectively.

3. The smaller angle between two rays is $125°$. Find the corresponding larger angle and compare their classifications.

Answer:

1. The angles formed around a point together measure $360°$.
2. The corresponding larger angle is $360° - 125° = 235°$.
3. The smaller angle of $125°$is an obtuse angle.
4. The larger angle of $235°$is a reflex angle.
5. Thus, the same two rays can form both an obtuse angle and a reflex angle.

4. A student says that an angle with longer arms is always larger. Examine the statement and explain a correct method of comparison.

Answer:

1. The student's statement is incorrect because arm length does not determine angle size.
2. The size of an angle depends only on the amount of rotation between its arms.
3. Two angles with different arm lengths can therefore have equal measures.
4. They may be compared by placing their vertices and one pair of arms exactly over each other.
5. A protractor provides the most accurate comparison by measuring both angles in degrees.

5. The hands of a clock show 5 o'clock. Find and classify both angles formed between them.

Answer:

1. The angle between two consecutive hour marks is $360° \div 12 = 30°$.
2. The smaller angle at 5 o'clock is $5 \times 30° = 150°$.
3. The larger angle is $360° - 150° = 210°$.
4. The smaller angle of $150°$is obtuse.
5. The larger angle of $210°$is reflex.

6. The Ashoka Chakra has 24 equally spaced spokes. Find the angles covering one, four and eight spaces and classify them.

Answer:

1. The angle between two consecutive spokes is $360° \div 24 = 15°$.
2. The angle covering one space is $15°$, which is acute.
3. The angle covering four spaces is $4 \times 15° = 60°$, which is acute.
4. The angle covering eight spaces is $8 \times 15° = 120°$, which is obtuse.
5. Thus, increasing the number of spaces can change the classification of the angle.

7. Ray OBlies inside $\angle AOC$. If $\angle AOC = 160°$and $\angle AOB$is three times $\angle BOC$, find both angles.

Answer:

1. Let $\angle BOC = x°$, so $\angle AOB = 3x°$.
2. Since the two angles form $\angle AOC$, $3x + x = 160°$.
3. Therefore, $4x = 160°$and $x = 40°$.
4. Hence, $\angle BOC = 40°$and $\angle AOB = 120°$.
5. The two angles are acute and obtuse respectively.

8. An angle remains acute when doubled, tripled and quadrupled but becomes obtuse when multiplied by five. Find all possible whole-number measures.

Answer:

1. Since four times the angle is acute, its measure must satisfy $4x < 90°$, giving $x < 22.5°$.
2. Since five times the angle is obtuse, $5x > 90°$, giving $x > 18°$.
3. The whole-number values between $18°$and $22.5°$are $19°, 20°, 21°$and $22°$.
4. Their quadruples are all less than $90°$, so they remain acute.
5. Their fivefold values lie between $90°$and $180°$, so all four measures satisfy the conditions.

9. A student measures an acute-looking angle as $145°$. Analyse the error and explain the correct procedure.

Answer:

1. The student has probably read the wrong scale of the protractor.
2. The supplementary reading on the other scale is $180° - 145° = 35°$.
3. The protractor's centre must first be placed exactly on the vertex.
4. Its baseline must then be aligned with the initial arm of the angle.
5. The scale beginning at $0°$on that arm gives the correct measure of $35°$.

10. Four angles around a point are $45°$, $75°$, $x°$and $2x°$. Find the unknown angles and classify them.

Answer:

1. Angles around a point total $360°$, so $45° + 75° + x° + 2x° = 360°$.
2. This gives $120° + 3x° = 360°$.
3. Therefore, $3x° = 240°$and $x = 80°$.
4. The two unknown angles are $80°$and $160°$.
5. Hence, the first is acute and the second is obtuse.

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

Five-Mark Descriptive Questions with Answers — Applied Type:

1. Clock-Hand Angles:

At 4 o'clock, determine the smaller and larger angles formed between the hour and minute hands and classify them.

Answer:

1. A clock face is divided into 12 equal parts, so each part measures $360° \div 12 = 30°$.
2. At 4 o'clock, the hands are separated by four divisions.
3. The smaller angle is $4 \times 30° = 120°$.
4. The larger angle is $360° - 120° = 240°$.
5. Therefore, the smaller angle is obtuse and the larger angle is reflex.

2. Opening of a Door:

A door initially lies along a wall and is opened through one-third of a straight angle. Find the opening angle and identify its vertex and arms.

Answer:

1. A straight angle measures $180°$.
2. One-third of a straight angle is $180° \div 3 = 60°$.
3. Therefore, the door is opened through an angle of $60°$.
4. The hinge of the door represents the vertex of the angle.
5. The edge of the door and the wall represent the two arms of the angle.

3. Ashoka Chakra:

The Ashoka Chakra has 24 equally spaced spokes. Find the angles formed by gaps of one, five and eight spokes and classify them.

Answer:

1. The angle between consecutive spokes is $360^\circ \div 24 = 15^\circ$.
2. One spoke-gap forms an acute angle of 15°.
3. Five spoke-gaps form $5 \times 15^\circ = 75^\circ$, which is acute.
4. Eight spoke-gaps form $8 \times 15^\circ = 120^\circ$, which is obtuse.
5. Thus, equally spaced spokes can be used to construct and compare different angles.

4. Designing a Road Junction:

Three roads meet at a point and form angles of 90°, $125^\circ$and x°. Find and classify the third angle.

Answer:

1. The meeting point of the roads represents the vertex of the angles.
2. The angles around a point add up to 360°.
3. Therefore, $x = 360^\circ - (90^\circ + 125^\circ) = 145^\circ$.
4. The third angle measures 145°.
5. It is an obtuse angle because it is greater than 90°but less than 180°.

5. Making a Paper Fan:

A paper fan opens through three-eighths of a complete turn. Calculate and classify the angle formed by its outer edges.

Answer:

1. A complete turn measures 360°.
2. Three-eighths of a complete turn is $\frac{3}{8} \times 360^\circ$.
3. Therefore, the opening angle is 135°.
4. The joining point of the fan represents the vertex, and its outer edges represent the arms.
5. The angle is obtuse because 135°lies between $90^\circ$and 180°.

6. Designing a Circular Garden:

A circular garden is divided into eight equal sectors by paths from its centre. Find the angle of each sector and the angle occupied by three adjacent sectors.

Answer:

1. The angles around the centre of the garden total 360°.
2. Each sector measures $360^\circ \div 8 = 45^\circ$.
3. Each sector therefore forms an acute angle.
4. Three adjacent sectors occupy $3 \times 45^\circ = 135^\circ$.
5. The combined angle of the three sectors is obtuse.

7. Position of a Swing

A swing moves 35°backward from its vertical resting position and then 50°forward beyond that position. Find the total angle covered.

Answer:

1. The vertical resting position separates the backward and forward movements.
2. The backward movement covers an angle of 35°.
3. The forward movement covers another angle of 50°.
4. The total angle covered is $35^\circ + 50^\circ = 85^\circ$.
5. This total angle is acute because it is less than 90°.

8. Sloping Playground Ramp:

A ramp forms an angle of $40^\circ$with the ground. Find the angle between the ramp and a vertical support and classify both angles.

Answer:

1. The ground and the vertical support form a right angle of 90°.
2. The ramp makes an angle of $40^\circ$with the ground.
3. The angle between the ramp and the vertical support is $90^\circ - 40^\circ = 50^\circ$.
4. Both $40^\circ$and $50^\circ$are less than 90°.

5. Therefore, both angles are acute.

9. Turning of a Robot:
A robot turns $70°$to the right and then another $55°$in the same direction. Find and classify its total turn and the angle needed to complete a straight turn.
Answer:
1. The robot's total turn is $70° + 55° = 125°$.
2. A $125°$turn forms an obtuse angle.
3. A straight turn measures $180°$.
4. The additional turn needed is $180° - 125° = 55°$.
5. The additional angle of $55°$is acute.

10. Opening a Pair of Scissors:
The blades of a pair of scissors initially form an angle of $25°$and are opened by another $50°$. Find the final angle and describe its parts.
Answer:
1. The initial angle between the blades is $25°$.
2. The blades are opened through an additional $50°$.
3. The final angle is $25° + 50° = 75°$.
4. The joining screw is the vertex, and the two blades are the arms.
5. The final angle is acute because it measures less than $90°$.

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

Olympiad-Type Multiple-Choice Questions:
1. How many distinct lines can be drawn through one given point?
A. 0
B. 1
C. 2
D. Infinitely many
Answer: D. Infinitely many
2. How many distinct lines can pass through two given distinct points?
A. None
B. Exactly one
C. Exactly two
D. Infinitely many
Answer: B. Exactly one
3. Which geometrical figure has two endpoints?
A. Line
B. Ray
C. Line segment
D. Angle
Answer: C. Line segment
4. Which statement about ray $\overrightarrow{AB}$is correct?
A. It starts at $B$and passes through A.
B. It starts at $A$and passes through B.
C. It has two fixed endpoints.
D. It extends endlessly in both directions.
Answer: B. It starts at $A$and passes through B.
5. In $\angle PQR$, the vertex is:
A. P
B. Q

C. R
D. PR
Answer: B. Q
6. Which statement is correct?
A. A larger angle must have longer arms.
B. A smaller angle must have shorter arms.
C. The size of an angle depends on the amount of rotation between its arms.
D. The size of an angle depends on the thickness of its arms.
Answer: C. The size of an angle depends on the amount of rotation between its arms.
7. Which of the following represents three-fourths of a complete turn?
A. $90°$
B. $180°$
C. $270°$
D. $360°$
Answer: C. $270°$
8. Which of the following is an obtuse angle?
A. $89°$
B. $90°$
C. $145°$
D. $185°$
Answer: C. $145°$
9. Which of the following is a reflex angle?
A. $75°$
B. $150°$
C. $180°$
D. $225°$
Answer: D. $225°$
10. Two adjacent angles form a straight angle. If one angle is $47°$, the other angle is:
A. $43°$
B. $123°$
C. $133°$
D. $313°$
Answer: C. $133°$
11. Two angles together form a right angle and are in the ratio $1:2$. What is the larger angle?
A. $30°$
B. $45°$
C. $60°$
D. $90°$
Answer: C. $60°$
12. Three angles around a point measure $85°$, $115°$and $x°$. Find x.
A. $150°$
B. $160°$
C. $170°$
D. $180°$
Answer: B. $160°$
13. The reflex angle corresponding to $72°$is:
A. $108°$
B. $208°$

C. 288°
D. 298°
Answer: C. 288°
14. A complete angle is divided into ten equal parts. Each part measures:
A. 18°
B. 30°
C. 36°
D. 45°
Answer: C. 36°
15. The smaller angle between the hands of a clock at 4 o'clock is:
A. 90°
B. 120°
C. 150°
D. 240°
Answer: B. 120°
16. The larger angle between the hands of a clock at 5 o'clock is:
A. 150°
B. 180°
C. 210°
D. 250°
Answer: C. 210°
17. The Ashoka Chakra contains 24 equally spaced spokes. The angle between two consecutive spokes is:
A. 10°
B. 12°
C. 15°
D. 24°
Answer: C. 15°
18. What is the largest acute angle that can be formed between the spokes of the Ashoka Chakra?
A. 60°
B. 75°
C. 89°
D. 90°
Answer: B. 75°
19. If $\angle AOB = 38^\circ$ and $\angle BOC = 67^\circ$, with OB inside $\angle AOC$, then $\angle AOC$ equals:
A. 29°
B. 95°
C. 105°
D. 115°
Answer: C. 105°
20. If $\angle AOC = 155^\circ$ and $\angle AOB = 75^\circ$, with OB inside $\angle AOC$, then $\angle BOC$ equals:
A. 70°
B. 80°
C. 90°
D. 230°
Answer: B. 80°
21. An angle is doubled to obtain a straight angle. The original angle is:

A. 45°
B. 60°
C. 90°
D. 180°
Answer: C. 90°
22. An angle remains acute when doubled but becomes obtuse when tripled. Which could be its measure?
A. 20°
B. 35°
C. 50°
D. 70°
Answer: B. 35°
23. Four angles around a point are equal. What is the measure of each angle?
A. 45°
B. 60°
C. 90°
D. 120°
Answer: C. 90°
24. Five equal angles together form a straight angle. What is the measure of each angle?
A. 30°
B. 36°
C. 45°
D. 72°
Answer: B. 36°
25. A door is opened through $\frac{5}{12}$ of a complete turn. The angle formed is:
A. 120°
B. 135°
C. 150°
D. 210°
Answer: C. 150°
26. Two angles are in the ratio $3:7$ and together form a straight angle. The smaller angle is:
A. 36°
B. 54°
C. 72°
D. 126°
Answer: B. 54°
27. Which pair of angles together forms a right angle?
A. 35° and 45°
B. 40° and 50°
C. 60° and 40°
D. 75° and 25°
Answer: B. 40° and 50°
28. Which pair of angles can combine to form a reflex angle?
A. 40° and 50°
B. 70° and 80°
C. 100° and 110°
D. 85° and 90°
Answer: C. 100° and 110°

29. A student reads $135°$instead of the acute angle shown on the other scale of a protractor. What is the correct angle?
A. 35°
B. 45°
C. 55°
D. 65°
Answer: B. 45°
30. Angles $x°$, $2x°$and $3x°$together form a complete angle. What is x?
A. 30°
B. 45°
C. 60°
D. 90°
Answer: C. 60°

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

Best Practices for Teaching "Lines and Angles":

(1) **Begin with familiar objects:** Introduce points, lines, rays and angles using pencils, rulers, torchlight, clock hands, scissors, doors and road junctions.
(2) **Use hands-on activities:** Ask students to create lines and angles through paper folding, matchsticks, straws, ice-cream sticks and thread.
(3) **Teach correct mathematical notation:** Regularly practise naming line segments, rays and angles, emphasizing that the vertex must be the middle letter when naming an angle.
(4) **Develop estimation skills:** Let students estimate an angle before measuring it with a protractor and compare the estimated and actual values.
(5) **Demonstrate protractor use clearly:** Model the correct placement of the centre, baseline and $0°$scale, while highlighting common errors such as reading the wrong scale.
(6) **Use movement to explain rotation:** Ask students to demonstrate quarter, half, three-quarter and complete turns using their bodies, arms or classroom objects.
(7) **Compare angles practically:** Use tracing paper or cut-out angle models for superimposition so students understand that arm length does not determine angle size.
(8) **Encourage classification practice:** Provide angles in different sizes and orientations for students to classify as acute, right, obtuse, straight or reflex.
(9) **Connect concepts with daily life:** Ask students to identify and photograph angles seen in buildings, clocks, playground equipment, road signs and household objects.
(10) **Use peer learning:** Let students work in pairs to draw, measure, name and verify each other's angles.
(11) **Address misconceptions immediately:** Clarify that a line has no endpoints, a ray has one endpoint, a line segment has two endpoints, and longer arms do not create a larger angle.
(12) **Progress from concrete to abstract:** Begin with physical objects, move to drawings and finally introduce symbols, measurements and calculations.
(13) **Include frequent formative assessment:** Use oral questions, exit slips, quick drawings and short measurement tasks to check students' understanding.
(14) **Encourage mathematical reasoning:** Ask students to explain how they compared, classified or calculated an angle instead of providing only the final answer.
(15) **Promote accuracy and neatness:** Train students to use a sharp pencil, ruler and protractor carefully and to label all points, vertices and arms clearly.

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

Innovations in Teaching–Learning "Lines and Angles":

(1) **Digital Angle Laboratory:** Use interactive geometry applications such as GeoGebra to let students rotate rays, change angle sizes and observe degree measurements instantly.

(2) **Human Geometry Activity:** Students can use their arms and bodies to represent points, lines, rays, acute angles, right angles, obtuse angles and straight angles.

(3) **Angle Hunt Challenge:** Organize a classroom or campus hunt in which students photograph, identify, estimate and classify angles found in real-life objects.

(4) **Build a Working Angle Detector:** Students can make a simple angle-measuring device using cardboard, a straw, thread and a protractor template to measure slopes and openings.

(5) **Augmented-Reality Exploration:** Use suitable mobile applications to place virtual rays over classroom objects and measure the angles appearing on the screen.

(6) **Clock-Angle Simulator:** Let students construct movable clock models and investigate the smaller and reflex angles formed at different times.

(7) **Robot-Turn Coding Activity:** Use a programmable robot or block-based simulation in which students enter angle commands to make the robot draw geometrical patterns.

(8) **Angle Art and Rangoli:** Encourage students to create artwork, rangoli patterns or symmetrical designs using specified acute, right, obtuse and reflex angles.

(9) **Geometry Through Storytelling:** Present a story in which a robot, traveller or explorer follows directions involving rays and different degrees of turning.

(10) **Student-Created Video Lessons:** Ask groups to produce short videos demonstrating how to measure and construct angles correctly with a protractor.

(11) **Interactive Angle Stations:** Set up learning stations for paper folding, protractor measurement, angle classification, superimposition and real-life applications.

(12) **Error-Detection Challenge:** Display incorrectly named or measured angles and ask students to identify, explain and correct each error.

(13) **Ashoka Chakra Investigation:** Ask students to construct a 24-spoked circular model and calculate angles between consecutive and non-consecutive spokes.

(14) **Angle Board Game:** Create a game in which students advance by solving angle puzzles, identifying geometrical figures and completing turns accurately.

(15) **Digital Student Portfolio:** Let each student maintain a collection of photographs, drawings, measurements, reflections and solved angle problems to document learning progress.

2.17: Practicing Questions/Question Bank:

A. Fill-in-the-Blank Questions:

1. A ______ represents an exact location.
   Answer: Point

2. The shortest path joining two points is called a ______.
   Answer: Line segment

3. A line extends endlessly in ______ directions.
   Answer: Both

4. A ray has ______ fixed starting point.
   Answer: One
5. Two rays having a common starting point form an ______.
   Answer: Angle
6. The common starting point of the arms of an angle is called its ______.
   Answer: Vertex
7. One complete turn measures ______.
   Answer: 360°
8. An angle measuring exactly 90°is called a ______ angle.
   Answer: Right
9. An angle between 180°and 360°is called a ______ angle.
   Answer: Reflex
10. The instrument used to measure an angle is called a ______.
    Answer: Protractor

B. One-Mark Descriptive Questions:

1. What is a point?

Answer: A point represents an exact location and has no length, breadth or height.

2. What is a line segment?

Answer: A line segment is the shortest straight path joining two points.

3. What is a ray?

Answer: A ray starts at a fixed point and extends endlessly in one direction.

4. What is the vertex of an angle?

Answer: The common starting point of the two rays forming an angle is called its vertex.

5. What determines the size of an angle?

Answer: The amount of rotation or turn between its arms determines the size of an angle.

6. What is an acute angle?

Answer: An acute angle measures more than 0°but less than 90°.

7. What is a reflex angle?

Answer: A reflex angle measures more than 180°but less than 360°.

8. How many lines can pass through two distinct points?

Answer: Exactly one line can pass through two distinct points.

9. What is the angle between consecutive numbers on a clock?

Answer: The angle between consecutive numbers on a clock is 30°.

10. Which instrument is used to measure angles?

Answer: A protractor is used to measure angles.

C. Two-Mark Descriptive Questions:

1. Differentiate between a line and a line segment.

Answer:

1. A line extends endlessly in both directions and has no endpoints.
2. A line segment has two fixed endpoints and a definite length.

2. Distinguish between a ray and a line segment.

Answer:

1. A ray has one starting point and extends endlessly in one direction.
2. A line segment has two fixed endpoints and does not extend endlessly.

3. Identify the vertex and arms of $\angle ABC$.

Answer:

1. Point $B$is the vertex of $\angle ABC$.
2. Rays $\overrightarrow{BA}$and $\overrightarrow{BC}$are its arms.

4. What are acute and obtuse angles?

Answer:

1. An acute angle measures more than $0°$but less than $90°$.
2. An obtuse angle measures more than $90°$but less than $180°$.

5. Why can angles with arms of different lengths be equal?

Answer:

1. The size of an angle depends on the amount of rotation between its arms.
2. Therefore, changing the lengths of the arms does not change the angle.

6. One angle on a straight line measures $65°$. Find the other angle.

Answer:

1. Angles forming a straight angle have a sum of $180°$.
2. The other angle is $180° - 65° = 115°$.

D. Three-Mark Descriptive Questions:

1. Explain the differences among a line, ray and line segment.

Answer:

1. A line extends endlessly in both directions and has no endpoints.

2. A ray has one starting point and extends endlessly in one direction.
3. A line segment has two fixed endpoints and a measurable length.

2. Explain how an angle is formed and named.

Answer:

1. An angle is formed by two rays having a common starting point.
2. The common point is its vertex, and the rays are its arms.
3. While naming an angle, the vertex is written as the middle letter.

3. Explain the steps for measuring an angle with a protractor.

Answer:

1. Place the centre of the protractor exactly on the vertex.
2. Align its baseline with one arm of the angle.
3. Read the correct scale where the other arm crosses the protractor.

4. Three angles around a point measure $70°$, $120°$and $x°$. Find and classify x.

Answer:

1. Angles around a point have a total measure of $360°$.
2. Therefore, $x = 360° - (70° + 120°) = 170°$.
3. The angle is obtuse because it lies between $90°$and $180°$.

5. Find and classify both angles formed between the clock hands at 4 o'clock.

Answer:

1. Each hour division represents $360° \div 12 = 30°$.
2. The smaller angle is $4 \times 30° = 120°$, which is obtuse.
3. The larger angle is $360° - 120° = 240°$, which is reflex.

6. Explain the angles formed by the spokes of the Ashoka Chakra.

Answer:

1. The Ashoka Chakra contains 24 equally spaced spokes.
2. The angle between consecutive spokes is $360° \div 24 = 15°$.
3. For example, the angle covering five spoke-gaps is $5 \times 15° = 75°$.

E. Five-Mark Descriptive Questions:

1. Explain the classification of angles according to their measures.

Answer:

1. An acute angle measures more than $0°$but less than $90°$.

2. A right angle measures exactly $90°$.
3. An obtuse angle measures more than $90°$ but less than $180°$.
4. A straight angle measures exactly $180°$.
5. A reflex angle measures more than $180°$ but less than $360°$.

2. Describe how to draw an angle of $125°$ using a protractor.

Answer:

1. Draw a ray $\overrightarrow{OA}$ with O as its starting point.
2. Place the centre of the protractor on point O.
3. Align its baseline with ray $\overrightarrow{OA}$.
4. Mark point B at $125°$ on the correct scale.
5. Draw ray $\overrightarrow{OB}$ to obtain $\angle AOB = 125°$.

3. Two angles form a straight angle and are in the ratio $2:3$. Find and classify them.

Answer:

1. A straight angle measures $180°$.
2. The total number of ratio parts is $2 + 3 = 5$.
3. One part measures $180° \div 5 = 36°$.
4. The angles are $2 \times 36° = 72°$ and $3 \times 36° = 108°$.
5. Therefore, $72°$ is acute and $108°$ is obtuse.

4. Explain how angles occur in everyday situations.

Answer:

1. The hands of a clock form angles at the centre of the clock.
2. A door forms an angle with the wall when it is opened.
3. The blades of scissors form an angle at their joining point.
4. The arms of a compass or divider form an angle at the hinge.
5. Sloping ramps form angles with the horizontal ground.

5. Four angles around a point are $50°$, $70°$, $x°$ and $2x°$. Find and classify the unknown angles.

Answer:

1. Angles around a point have a total measure of $360°$.
2. Therefore, $50° + 70° + x° + 2x° = 360°$.
3. This gives $3x = 240°$, so $x = 80°$.
4. The two unknown angles are $80°$ and $160°$.
5. Therefore, $80°$ is acute and $160°$ is obtuse.

6. Explain the relationship between turns and angle measures.

Answer:

1. One complete turn forms an angle of $360°$.
2. A half turn forms a straight angle of $180°$.
3. A quarter turn forms a right angle of $90°$.
4. Three-fourths of a turn forms a reflex angle of $270°$.
5. Thus, an angle's degree measure indicates the fraction of a complete turn made.

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6th Standard Maths Book Chapter 3

Chapter 3: NUMBER PLAY

3.1 Summary of the Chapter:

Chapter 3: Number Play — Summary:

(1) Numbers are used in everyday life for counting, arranging, comparing, measuring and solving practical problems.

(2) Numbers can describe relationships and positions, such as the number of taller neighbours standing beside a child in a line.

(3) A **supercell** is a cell containing a number greater than all its adjacent cells. Supercell puzzles develop comparison, arrangement and logical-reasoning skills.

(4) Number lines help us locate, compare and arrange numbers accurately from the smallest to the largest.

(5) Numbers can be explored through their digits, including the number of one-digit, two-digit, three-digit and higher-digit numbers.

(6) The **digit sum** of a number is obtained by adding its digits. Different numbers may have the same digit sum and form interesting patterns.

(7) A **palindromic number** reads the same from left to right and right to left, such as 66, 121 and 1111. Palindromes can also be produced through the reverse-and-add process.

(8) **Kaprekar's process** involves arranging the digits of a number in descending and ascending order and subtracting the smaller number from the larger one. Most suitable four-digit numbers eventually reach the Kaprekar constant **6174**.

(9) Clocks and calendars contain interesting numerical patterns, including palindromic times such as 10:01 and special dates that read similarly forwards and backwards.

(10) Mental mathematics helps us judge whether particular sums or differences are possible and whether numerical statements are always, sometimes or never true.

(11) Number arrangements and repeated operations create fascinating patterns. The **Collatz conjecture** generates sequences by halving even numbers and calculating $3n + 1$for odd numbers, but its general proof remains unknown.

(12) Estimation and number games strengthen practical reasoning. Winning strategies can be developed by recognizing patterns, predicting an opponent's moves and controlling key totals.

3.2 Important Formulas:

Important Formulas and Rules — Chapter 3: Number Play:

This chapter has few conventional formulas. The following rules and relationships are useful for solving its quantitative problems:

1. **Digit Sum**

$$\text{Digit Sum} = \text{Sum of all digits of the number}$$

Example: Digit sum of $568 = 5 + 6 + 8 = 19$.

2. **Number of n-Digit Numbers**

$$\text{Number of } n\text{-digit numbers} = 9 \times 10^{n-1}$$

Examples: Two-digit numbers $= 9 \times 10 = 90$; three-digit numbers $= 9 \times 100 = 900$.

3. **Place-Value Expansion**

$$a\bar{b}c = 100a + 10b + c$$
$$a\bar{b}cd = 1000a + 100b + 10c + d$$

4. **Reverse of a Two-Digit Number**

If the number is $10a + b$, its reverse is:

$$10b + a$$

5. **Reverse-and-Add Rule**

$$\text{New number} = \text{Original number} + \text{Number with reversed digits}$$

Repeat the process until a palindrome is obtained.

6. **Three-Digit Palindrome**

$$a\bar{b}a = 100a + 10b + a = 101a + 10b$$

7. **Five-Digit Palindrome**

$$ab\bar{c}ba = 10001a + 1010b + 100c$$

8. **Kaprekar Operation**

$$C = A - B$$

Here, $A$is the largest number formed using the given digits and $B$is the smallest number formed using the same digits. Repeating this process for an eligible four-digit number generally leads to **6174**.

9. **Maximum Number of Supercells in a Row**

For $n$cells with distinct numbers:

$$\text{Maximum supercells} = \left\lceil \frac{n}{2} \right\rceil$$

Equivalently:

- If $n$is even: $\frac{n}{2}$
- If $n$is odd: $\frac{n+1}{2}$

10. **Sum and Difference of Numbers**

$$\text{Sum} = A + B$$

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

11. **Collatz Sequence Rule**

For a positive whole number n:

$$\text{Next term} = \begin{cases} \frac{n}{2}, & \text{if } n \text{ is even} \\ 3n + 1, & \text{if } n \text{ is odd} \end{cases}$$

12. **Estimation Using Average**

$$\text{Estimated total} = \text{Estimated average per group} \times \text{Number of groups}$$

13. **Estimated Time**

$$\text{Estimated time} = \text{Time per day} \times \text{Number of days}$$

14. **Elapsed Time**

$$\text{Elapsed time} = \text{Ending time} - \text{Starting time}$$

15. **Distance–Speed–Time Relationships**

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

16. **Winning-Strategy Complement Rule**

When players may add any number from 1to m, aim to make the two players' successive additions total:

$$m + 1$$

For additions from 1 to 3, the controlling total is:

$$4$$

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

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

1. A number in a cell that is greater than all the numbers in its neighbouring cells is called a __________.
   Answer: supercell
2. On a number line, numbers increase as we move towards the __________.
   Answer: right
3. There are __________ one-digit natural numbers.
   Answer: 9
4. There are __________ two-digit numbers.
   Answer: 90
5. There are __________ three-digit numbers.
   Answer: 900
6. There are __________ four-digit numbers.
   Answer: 9,000
7. There are __________ five-digit numbers.
   Answer: 90,000
8. The sum of the digits of 68 is __________.
   Answer: 14
9. The digit sum of 176 is __________.
   Answer: 14
10. The smallest number whose digit sum is 14 is __________.
    Answer: 59
11. A number that reads the same from left to right and right to left is called a __________ number.
    Answer: palindromic
12. The number 121 is a __________ number.
    Answer: palindromic
13. The reverse of 47 is __________.
    Answer: 74
14. When 47 is added to its reverse, the sum is __________.
    Answer: 121
15. The five-digit palindrome described in the chapter's puzzle is __________.
    Answer: 12,421
16. D. R. Kaprekar was a mathematics teacher from __________ in Maharashtra.
    Answer: Devlali
17. The Kaprekar constant for four-digit numbers is __________.
    Answer: 6174
18. In the Kaprekar process, the smaller number is __________ from the larger number.
    Answer: subtracted
19. For suitable three-digit numbers, the number that begins to repeat in Kaprekar's process is __________.
    Answer: 495
20. The time 10:01 is an example of a __________ time.
    Answer: palindromic
21. The smallest five-digit palindrome is __________.
    Answer: 10,001
22. The largest five-digit palindrome is __________.
    Answer: 99,999
23. The sum of the smallest and largest five-digit palindromes is __________.
    Answer: 1,10,000

24. The difference between the largest and smallest five-digit palindromes is __________.
    Answer: 89,998
25. In a Collatz sequence, an even number is divided by __________.
    Answer: 2
26. In a Collatz sequence, an odd number is multiplied by 3 and then __________ is added.
    Answer: 1
27. The Collatz sequence is expected to eventually reach the number __________.
    Answer: 1
28. The German mathematician associated with the Collatz conjecture was __________.
    Answer: Lothar Collatz
29. An approximate value calculated without finding the exact answer is called an __________.
    Answer: estimate
30. In a number game where players can add 1, 2 or 3, the complementary total used in the winning strategy is __________.
    Answer: 4

3.4 Fill-Up the Blank HOTS type questions with Answers: (35 Questions)

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

1. In the row 8,3,7,2,6, the supercells are __________.
   Answer: 8, 7 and 6
2. The maximum number of supercells possible in a row of seven cells containing distinct numbers is __________.
   Answer: 4
3. The maximum number of supercells possible in a row of ten cells containing distinct numbers is __________.
   Answer: 5
4. In a row of distinct numbers, the largest number will __________ be a supercell.
   Answer: always
5. In a row containing more than one distinct number, the smallest number can __________ be a supercell.
   Answer: never
6. The missing number in the number-line sequence 9,996,9,997,___,9,999is __________.
   Answer: 9,998
7. The number exactly halfway between 2,000 and 3,000 is __________.
   Answer: 2,500
8. The smallest three-digit number having a digit sum of 14 is __________.
   Answer: 149
9. The largest four-digit number having a digit sum of 14 is __________.
   Answer: 9,500
10. The digit sum of the consecutive-digit number 678 is __________.
    Answer: 21
11. The digit sums of the numbers 123, 234, 345 and 456 increase successively by __________.
    Answer: 3
12. The digit 7 appears __________ times while writing all the numbers from 1 to 100.
    Answer: 20

13. The number of three-digit palindromes that can be formed using only 1, 2 and 3, with repetition allowed, is __________.
    Answer: 9
14. Reversing 56 and adding it to the original number gives __________.
    Answer: 121
15. Starting with 29, the first reverse-and-add operation gives the palindrome __________.
    Answer: 121
16. In the five-digit palindrome $abcba$, if $a = 3$, $b = 6$and $c = 9$, the number is __________.
    Answer: 36,963
17. In the five-digit palindrome puzzle, if the units digit is 1, the tens digit is twice the units digit and the hundreds digit is twice the tens digit, the number formed is __________.
    Answer: 12,421
18. The largest number formed using the digits 6, 3, 8 and 2 exactly once is __________.
    Answer: 8,632
19. The smallest number formed using the digits 6, 3, 8 and 2 exactly once is __________.
    Answer: 2,368
20. The first result of the Kaprekar operation on 6,382 is $8{,}632 - 2{,}368 =$__________.
    Answer: 6,264
21. Applying the Kaprekar operation to 7,641 produces __________.
    Answer: 6,174
22. Once the four-digit Kaprekar process reaches 6,174, its next result is again __________.
    Answer: 6,174
23. The three-digit Kaprekar process applied to 321 first gives $321 - 123 =$__________.
    Answer: 198
24. The repeating constant generally reached in the three-digit Kaprekar process is __________.
    Answer: 495
25. Starting at 10:01, the next palindromic time appears after __________ minutes.
    Answer: 70
26. The sum of the smallest and largest five-digit palindromes is __________.
    Answer: 1,10,000
27. The maximum possible difference between two five-digit numbers is __________.
    Answer: 89,999
28. According to the Collatz rule, the number following 27 is __________.
    Answer: 82
29. The first five terms of the Collatz sequence beginning with 20 are 20,10,5,16,and __________.
    Answer: 8
30. Every power of 2 eventually reaches 1 in the Collatz sequence because it is repeatedly divided by __________.
    Answer: 2
31. If an estimated class size is 30 and a school has 20 classes, the estimated number of students is __________.
    Answer: 600

32. If a student spends 6 hours per day in school for 200 working days, the estimated school time in one year is __________ hours.
    Answer: 1,200
33. In a game where each player may add 1, 2 or 3, if one player adds 1, the other player should add __________ to make their combined addition 4.
    Answer: 3
34. In the same game, if an opponent adds 2, the next player should add __________ to maintain the complementary strategy.
    Answer: 2
35. A four-digit number added to another four-digit number can __________ produce a six-digit sum.
    Answer: never

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

One-Mark Descriptive Questions with Answers – LOTS Type:

1. **What is a supercell?**
   Answer: A supercell is a cell containing a number greater than all the numbers in its neighbouring cells.
2. **Which cells are considered neighbours in a single-row supercell table?**
   Answer: The cells immediately to the left and right are considered neighbouring cells.
3. **Which cells are considered neighbours in a multi-row supercell table?**
   Answer: The cells immediately to the left, right, top and bottom are considered neighbours.
4. **In which direction do numbers increase on a number line?**
   Answer: Numbers increase as we move from left to right on a number line.
5. **How many one-digit natural numbers are there?**
   Answer: There are nine one-digit natural numbers.
6. **How many two-digit numbers are there?**
   Answer: There are 90 two-digit numbers.
7. **How many three-digit numbers are there?**
   Answer: There are 900 three-digit numbers.
8. **What is the digit sum of a number?**
   Answer: The digit sum of a number is the sum of all its digits.
9. **What is the digit sum of 545?**
   Answer: The digit sum of 545 is $5 + 4 + 5 = 14$.
10. **How many times does the digit 7 occur from 1 to 100?**
    Answer: The digit 7 occurs 20 times from 1 to 100.
11. **What is a palindromic number?**
    Answer: A palindromic number reads the same from left to right and right to left.
12. **Give one example of a three-digit palindrome.**
    Answer: The number 121 is an example of a three-digit palindrome.
13. **What is the reverse of 47?**
    Answer: The reverse of 47 is 74.
14. **What is the result when 47 is added to its reverse?**
    Answer: Adding 47 and 74 gives the palindrome 121.
15. **Who discovered the special process associated with the number 6174?**
    Answer: Indian mathematician D. R. Kaprekar discovered the process associated with 6174.

16. **What is the Kaprekar constant for four-digit numbers?**
    Answer: The Kaprekar constant for four-digit numbers is 6174.
17. **What condition should a four-digit number satisfy for Kaprekar's process?**
    Answer: The four-digit number must contain at least two different digits.
18. **What number generally repeats in the three-digit Kaprekar process?**
    Answer: The number 495 generally repeats in the three-digit Kaprekar process.
19. **What is a palindromic time?**
    Answer: A palindromic time reads the same forwards and backwards when written in numerical form.
20. **Give one example of a palindromic time.**
    Answer: The time 10:01 is an example of a palindromic time.
21. **What is mental mathematics?**
    Answer: Mental mathematics is the process of performing calculations mentally without written work or calculating devices.
22. **State the rule used for an even number in a Collatz sequence.**
    Answer: An even number is divided by 2 to obtain the next term in a Collatz sequence.
23. **State the rule used for an odd number in a Collatz sequence.**
    Answer: An odd number is multiplied by 3 and increased by 1 to obtain the next term.
24. **Who proposed the Collatz conjecture?**
    Answer: German mathematician Lothar Collatz proposed the Collatz conjecture.
25. **What number is expected to be reached eventually in every Collatz sequence?**
    Answer: Every Collatz sequence is expected to eventually reach 1.
26. **What is estimation?**
    Answer: Estimation is the process of finding an approximate value instead of an exact value.
27. **Why is estimation useful?**
    Answer: Estimation helps us obtain a quick and reasonable answer when an exact value is unnecessary.
28. **What is the smallest five-digit palindrome?**
    Answer: The smallest five-digit palindrome is 10,001.
29. **What is the largest five-digit palindrome?**
    Answer: The largest five-digit palindrome is 99,999.
30. **What is a winning strategy in a number game?**
    Answer: A winning strategy is a planned method of making moves that guarantees victory when followed correctly.

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

One-Mark Descriptive Questions with Answers – HOTS Type:

1. **Can the first cell in a row be a supercell? Give a reason.**
   Answer: Yes, the first cell is a supercell if its number is greater than the number in the only adjacent cell.
2. **Will the cell containing the largest number always be a supercell? Why?**
   Answer: Yes, the largest number is always a supercell because it is greater than every adjacent number.
3. **Can the smallest number in a row of distinct numbers be a supercell? Why?**
   Answer: No, because at least one adjacent number will be greater than the smallest number.

4. **What is the maximum number of supercells possible in a row of nine cells?**
   Answer: A maximum of five supercells is possible by placing larger and smaller numbers alternately.
5. **Why can two adjacent cells containing distinct numbers not both be supercells?**
   Answer: Two adjacent cells cannot both be supercells because each would have to be greater than the other.
6. **Which number lies exactly halfway between 2,000 and 3,000?**
   Answer: The number 2,500 lies exactly halfway between 2,000 and 3,000.
7. **What is the smallest three-digit number whose digit sum is 14?**
   Answer: The smallest three-digit number with a digit sum of 14 is 149.
8. **What is the largest four-digit number whose digit sum is 14?**
   Answer: The largest four-digit number with a digit sum of 14 is 9,500.
9. **Why are the digit sums of 123, 234 and 345 multiples of 3?**
   Answer: Their digit sums are 6,9and 12, which are all divisible by 3.
10. **How many three-digit palindromes can be formed using 1, 2 and 3 with repetition allowed?**
    Answer: Nine palindromes can be formed because there are three choices each for the first and middle digits.
11. **What palindrome is obtained by adding 56 to its reverse?**
    Answer: Adding 56 and 65 produces the palindrome 121.
12. **Why is 12,421 a palindrome?**
    Answer: The number 12,421 is a palindrome because its digits read identically in both directions.
13. **What is the first result when Kaprekar's process is applied to 6,382?**
    Answer: The first result is $8{,}632 - 2{,}368 = 6{,}264$.
14. **Why cannot 4,444 be used effectively in the four-digit Kaprekar process?**
    Answer: It has no two different digits, so subtracting its smallest arrangement from its largest gives zero.
15. **What happens when Kaprekar's operation is applied to 6,174 again?**
    Answer: It produces $7{,}641 - 1{,}467 = 6{,}174$, so the number repeats.
16. **What repeating number is reached when the three-digit Kaprekar process begins with 321?**
    Answer: Repeated application of the process eventually reaches the constant 495.
17. **How many minutes pass from 10:01 to the next palindromic time, 11:11?**
    Answer: Seventy minutes pass from 10:01 to 11:11.
18. **What is the difference between the largest and smallest five-digit palindromes?**
    Answer: Their difference is $99{,}999 - 10{,}001 = 89{,}998$.
19. **Can two four-digit numbers have a six-digit sum? Give a reason.**
    Answer: No, because their greatest possible sum is $9{,}999 + 9{,}999 = 19{,}998$, which has only five digits.
20. **Can two five-digit numbers have a sum of 18,500? Give a reason.**
    Answer: No, because the smallest possible sum of two five-digit numbers is $10{,}000 + 10{,}000 = 20{,}000$.
21. **What is the next term after 27 in the Collatz sequence?**
    Answer: The next term is $3 \times 27 + 1 = 82$, because 27 is odd.
22. **What is the next term after 82 in the Collatz sequence?**
    Answer: The next term is $82 \div 2 = 41$, because 82 is even.
23. **Why does a Collatz sequence beginning with a power of 2 reach 1?**
    Answer: It reaches 1 because repeated division by 2 successively reduces every power of 2 to 1.

24. **Estimate the number of students in 18 classes if each class has approximately 30 students.**
    Answer: The estimated number of students is $18 \times 30 = 540$.
25. **A student attends school for 6 hours daily on 200 days; how many hours does the student spend in school annually?**
    Answer: The student spends approximately $6 \times 200 = 1{,}200$hours in school annually.
26. **In a game allowing additions of 1, 2 or 3, what should you add after your opponent adds 1?**
    Answer: You should add 3 so that the two additions together make the strategic total of 4.
27. **What should you add after your opponent adds 2 to maintain the same winning strategy?**
    Answer: You should add 2 so that the combined additions equal 4.
28. **Can the second-largest number fail to be a supercell? Explain.**
    Answer: Yes, it will fail to be a supercell when it is placed next to the largest number.
29. **How can the number of supercells in a row be maximised?**
    Answer: Supercells can be maximised by arranging relatively large and small numbers alternately.
30. **Why is the Collatz statement called a conjecture rather than a theorem?**
    Answer: It is called a conjecture because it has been tested for many numbers but has not been proved for every positive whole number.

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

Two-Mark Descriptive Questions with Answers – LOTS Type:
1. What is a supercell? How is it identified?
Answer:
1. A supercell is a cell containing a number greater than all the numbers in its neighbouring cells.
2. It is identified by comparing its number with the numbers immediately adjacent to it.

2. Which cells are considered neighbours in single-row and multi-row supercell tables?
Answer:
1. In a single-row table, the cells immediately to the left and right are neighbours.
2. In a multi-row table, the cells immediately to the left, right, top and bottom are neighbours.

3. How does a number line help us understand numbers?
Answer:
1. A number line shows the relative positions of numbers in an ordered manner.
2. It helps us compare, arrange and identify the numbers between two given values.

4. How many two-digit and three-digit numbers are there?
Answer:
1. There are 90 two-digit numbers, ranging from 10 to 99.
2. There are 900 three-digit numbers, ranging from 100 to 999.

5. What is a digit sum? Find the digit sum of 568.
Answer:
1. A digit sum is obtained by adding all the digits of a number.
2. The digit sum of 568 is $5 + 6 + 8 = 19$.

6. Find the digit sums of 176 and 545.
Answer:

1. The digit sum of 176 is $1 + 7 + 6 = 14$.
2. The digit sum of 545 is $5 + 4 + 5 = 14$.

7. What pattern is found in the digit sums of 123, 234 and 345?

Answer:

1. Their digit sums are 6,9and 12, respectively.
2. The sums increase by 3 and are multiples of 3.

8. What are palindromic numbers? Give two examples.

Answer:

1. Palindromic numbers read the same from left to right and from right to left.
2. The numbers 121 and 1,111 are examples of palindromic numbers.

9. Explain the reverse-and-add method.

Answer:

1. Reverse the digits of a number and add the reversed number to the original number.
2. Repeat the process until a palindromic number is obtained.

10. Use the reverse-and-add method for the number 47.

Answer:

1. The reverse of 47 is 74.
2. Adding them gives $47 + 74 = 121$, which is a palindrome.

11. Who was D. R. Kaprekar, and what did he discover?

Answer:

1. D. R. Kaprekar was a mathematics teacher from Devlali in Maharashtra.
2. He discovered a fascinating number process involving four-digit numbers in 1949.

12. State the first two steps of Kaprekar's process.

Answer:

1. Form the largest possible number by arranging the given digits in descending order.
2. Form the smallest possible number by arranging the same digits in ascending order.

13. What are the next steps in Kaprekar's process?

Answer:

1. Subtract the smallest number from the largest number.
2. Repeat the same procedure using the digits of the result.

14. What are the Kaprekar constants for four-digit and three-digit numbers?

Answer:

1. The Kaprekar constant generally reached by suitable four-digit numbers is 6,174.
2. The repeating number generally reached by suitable three-digit numbers is 495.

15. What are palindromic times? Give two examples.

Answer:

1. Palindromic times read the same forwards and backwards when written numerically.
2. The times 10:01 and 12:21 are examples of palindromic times.

16. Write two observations about the smallest and largest five-digit palindromes.

Answer:

1. The smallest five-digit palindrome is 10,001.
2. The largest five-digit palindrome is 99,999.

17. State the rules for generating a Collatz sequence.

Answer:

1. If a number is even, divide it by 2.
2. If a number is odd, multiply it by 3 and add 1.

18. Write the Collatz sequence beginning with 8 until it reaches 1.

Answer:

1. Since 8 is even, successive division gives 8,4,2.
2. Dividing 2 by 2 gives 1, so the sequence is 8,4,2,1.

19. What is the Collatz conjecture?
Answer:
1. It states that repeatedly applying the Collatz rules to any positive whole number will eventually lead to 1.
2. Although it has been verified for many numbers, it has not yet been proved for all positive whole numbers.

20. What is estimation, and why is it useful?
Answer:
1. Estimation is the process of finding a value reasonably close to the exact value.
2. It is useful when a quick approximate answer is sufficient for a practical purpose.

21. How can the approximate number of students in a school be estimated?
Answer:
1. Estimate the average number of students in each class.
2. Multiply this average by the total number of classes in the school.

22. What do “always true” and “sometimes true” mean in number statements?
Answer:
1. An always-true statement is correct for every possible case.
2. A sometimes-true statement is correct only for certain cases.

23. What does “never true” mean? Give an example from addition.
Answer:
1. A never-true statement is not correct in any possible case.
2. For example, the sum of two four-digit numbers can never be a six-digit number.

24. What is a winning strategy in a number game?
Answer:
1. A winning strategy is a planned sequence of moves that enables a player to control the game.
2. It is developed by observing patterns and choosing moves that force the desired final total.

25. Explain the complementary strategy when players can add 1, 2 or 3.
Answer:
1. A player chooses a number that makes the two players’ successive additions total 4.
2. Thus, the responses to 1, 2 and 3 are 3, 2 and 1, respectively.

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

Two-Mark Descriptive Questions with Answers – HOTS Type:

1. Can two adjacent cells containing different numbers both be supercells? Justify.
Answer:
1. No, two adjacent cells containing different numbers cannot both be supercells.
2. Each number would have to be greater than the other, which is impossible.

2. Why is the largest number in a table always a supercell?
Answer:
1. The largest number is greater than every other number in the table.
2. Therefore, it must also be greater than all the numbers in its neighbouring cells.

3. How can the maximum number of supercells be created in a single row?
Answer:
1. Arrange relatively large and small numbers alternately in the row.
2. Each larger number will then be greater than its adjacent smaller numbers.

4. Find the maximum number of supercells possible in a row of nine cells.
Answer:

1. For an odd number of cells, the maximum is $(n + 1) \div 2$.
2. Therefore, $(9 + 1) \div 2 = 5$supercells are possible.

5. Can the second-largest number in a row fail to be a supercell? Explain.

Answer:

1. Yes, place the second-largest number next to the largest number.
2. It will not be a supercell because its neighbour is greater than it.

6. Find the smallest and largest three-digit numbers having a digit sum of 14.

Answer:

1. The smallest such number is 149 because its digits add up to 14.
2. The largest such number is 950 because its digits also add up to 14.

7. Why do 68, 176 and 545 belong to the same digit-sum group?

Answer:

1. Their respective digit sums are $6 + 8$, $1 + 7 + 6$and $5 + 4 + 5$.
2. Each calculation gives 14, so all three numbers have the same digit sum.

8. How many three-digit palindromes can be formed using 1, 2 and 3 with repetition allowed?

Answer:

1. The first and last digits must be identical, giving three choices for them.
2. With three choices for the middle digit, $3 \times 3 = 9$palindromes can be formed.

9. Apply the reverse-and-add method to 68 and state the result.

Answer:

1. The reverse of 68 is 86.
2. Their sum is $68 + 86 = 154$, which is not yet a palindrome.

10. Continue the reverse-and-add process from 154 until a palindrome is obtained.

Answer:

1. The reverse of 154 is 451, and $154 + 451 = 605$.
2. Then $605 + 506 = 1{,}111$, which is a palindrome.

11. Why is 4,444 unsuitable as a starting number for the Kaprekar process?

Answer:

1. Its largest and smallest digit arrangements are both 4,444.
2. Their difference is zero, so the process cannot proceed towards 6,174.

12. Perform the first Kaprekar operation on 6,382.

Answer:

1. The largest and smallest arrangements are 8,632 and 2,368.
2. Their difference is $8{,}632 - 2{,}368 = 6{,}264$.

13. Show why 6,174 is called the Kaprekar constant.

Answer:

1. Arranging its digits gives 7,641 as the largest number and 1,467 as the smallest.
2. Their difference is again $7{,}641 - 1{,}467 = 6{,}174$.

14. Apply the three-digit Kaprekar process once to 321.

Answer:

1. The descending and ascending arrangements are 321 and 123.
2. Their difference is $321 - 123 = 198$.

15. Calculate the time from 10:01 to the next palindromic time.

Answer:

1. The next palindromic time after 10:01 is 11:11.
2. The interval between them is 1 hour 10 minutes, or 70 minutes.

16. Find the sum and difference of the smallest and largest five-digit palindromes.

Answer:

1. Their sum is $10{,}001 + 99{,}999 = 1{,}10{,}000$.

2. Their difference is $99{,}999 - 10{,}001 = 89{,}998$.

17. Can two four-digit numbers produce a six-digit sum? Justify.

Answer:

1. The greatest possible sum is $9{,}999 + 9{,}999 = 19{,}998$.
2. Since 19,998 has only five digits, a six-digit sum is impossible.

18. Can two five-digit numbers have a sum of 18,500? Explain.

Answer:

1. The smallest five-digit number is 10,000.
2. Hence, the smallest possible sum is 20,000, which is greater than 18,500.

19. Generate the next two terms of the Collatz sequence after 19.

Answer:

1. Since 19 is odd, the next term is $3 \times 19 + 1 = 58$.
2. Since 58 is even, the following term is $58 \div 2 = 29$.

20. Why does a Collatz sequence beginning with 32 quickly reach 1?

Answer:

1. The number 32 is a power of 2, so every term obtained by halving it remains even until 2.
2. Thus, the sequence is 32,16,8,4,2,1.

21. Estimate the number of students in a school containing 22 classes with about 35 students each.

Answer:

1. Multiply the estimated class strength by the number of classes.
2. The estimated number of students is $35 \times 22 = 770$.

22. A Grade 6 student claims to have spent 13,000 hours in school over eight years; is this reasonable?

Answer:

1. At six hours daily for 200 days annually, eight years amount to approximately $6 \times 200 \times 8 = 9{,}600$hours.
2. Therefore, the claim of 13,000 hours is an overestimate.

23. In an addition game allowing 1, 2 or 3, what should you add after your opponent adds 3?

Answer:

1. You should add 1 so that both moves together total 4.
2. Repeating this complementary strategy helps you control the important totals.

24. Classify the statement "A four-digit number plus a two-digit number gives a four-digit number."

Answer:

1. The statement is sometimes true because $2{,}000 + 50 = 2{,}050$remains a four-digit number.
2. It is not always true because $9{,}999 + 99 = 10{,}098$, which is a five-digit number.

25. Classify the statement "A five-digit number minus a two-digit number gives a three-digit number."

Answer:

1. The statement is never true because even $10{,}000 - 99 = 9{,}901$.
2. Since 9,901 is a four-digit number, no such subtraction can produce a three-digit positive difference.

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

Three-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain the concept of supercells.
Answer:
1. A supercell is a cell containing a number greater than all the numbers in its neighbouring cells.
2. In a single row, the cells immediately to its left and right are considered its neighbours.
3. In a multi-row table, the cells immediately to its left, right, top and bottom are its neighbours.

2. Explain how numbers are placed and compared on a number line.
Answer:
1. Numbers are placed at marked positions according to the interval shown on the number line.
2. Numbers increase as we move from left to right.
3. Therefore, the leftmost number is the smallest and the rightmost number is the largest.

3. State the numbers of two-digit, three-digit and four-digit numbers.
Answer:
1. There are 90 two-digit numbers, ranging from 10 to 99.
2. There are 900 three-digit numbers, ranging from 100 to 999.
3. There are 9,000 four-digit numbers, ranging from 1,000 to 9,999.

4. What is a digit sum? Illustrate it with two examples.
Answer:
1. The digit sum of a number is obtained by adding all its digits.
2. The digit sum of 68 is $6 + 8 = 14$.
3. The digit sum of 545 is $5 + 4 + 5 = 14$.

5. Describe the pattern in the digit sums of 123, 234 and 345.
Answer:
1. The digit sum of 123 is $1 + 2 + 3 = 6$.
2. The digit sums of 234 and 345 are 9 and 12, respectively.
3. These sums increase by 3 and are all multiples of 3.

6. Explain palindromic numbers with examples.
Answer:
1. A palindromic number reads the same from left to right and from right to left.
2. The numbers 66, 121 and 848 are palindromes.
3. In a palindrome, the first digit matches the last digit, the second matches the second-last digit and so on.

7. Describe the reverse-and-add method for obtaining a palindrome.
Answer:
1. Begin with a number and write the number formed by reversing its digits.
2. Add the reversed number to the original number.
3. If the result is not a palindrome, repeat the same process until a palindrome is obtained.

8. Apply the reverse-and-add method to the number 47.
Answer:
1. The reverse of 47 is 74.
2. Adding the two numbers gives $47 + 74 = 121$.
3. The result 121 is a palindrome because it reads the same in both directions.

9. Write a short note on D. R. Kaprekar.
Answer:
1. D. R. Kaprekar was a mathematics teacher in a government school at Devlali, Maharashtra.
2. He enjoyed exploring numbers and discovering interesting numerical patterns.
3. In 1949, he discovered a remarkable process involving four-digit numbers.

10. Explain the steps of Kaprekar's process for a four-digit number.
Answer:
1. Arrange the digits in descending order to form the largest number and in ascending order to form the smallest number.
2. Subtract the smallest number from the largest number.
3. Repeat the same steps with each result until the number 6,174 is reached.

11. Apply the first step of Kaprekar's process to 6,382.
Answer:
1. The largest number formed from its digits is 8,632.
2. The smallest number formed from its digits is 2,368.
3. Their difference is $8{,}632 - 2{,}368 = 6{,}264$.

12. Explain the importance of the number 6,174.
Answer:
1. The number 6,174 is known as the Kaprekar constant for four-digit numbers.
2. Suitable four-digit numbers generally reach 6,174 after repeatedly applying Kaprekar's process.
3. Reapplying the process gives $7{,}641 - 1{,}467 = 6{,}174$, so the number repeats.

13. What are palindromic times and dates?
Answer:
1. A palindromic time reads the same forwards and backwards when its digits are viewed in order.
2. Times such as 10:01, 11:11 and 12:21 are palindromic.
3. Certain dates also form similar symmetrical numerical patterns.

14. Explain the rules of the Collatz sequence.
Answer:
1. Begin with any positive whole number.
2. If it is even, divide it by 2; if it is odd, multiply it by 3 and add 1.
3. Continue applying the appropriate rule to each new number obtained.

15. Generate the Collatz sequence for 8 until it reaches 1.
Answer:
1. Starting with 8 and dividing by 2 gives 8,4,2.
2. Dividing 2 by 2 gives 1.
3. Therefore, the complete sequence is 8,4,2,1.

16. What is the Collatz conjecture?
Answer:
1. The Collatz conjecture is a statement about sequences formed using different rules for odd and even numbers.
2. It states that every positive whole number will eventually reach 1 when the rules are repeatedly applied.
3. Although tested for many starting numbers, the conjecture has not been mathematically proved for all positive whole numbers.

17. Explain estimation and its usefulness.
Answer:
1. Estimation means finding a value close to the exact value.
2. It is useful when complete information is unavailable or an exact calculation is unnecessary.
3. It helps us quickly judge whether an answer or claim is reasonable.

18. How can the number of students in a school be estimated?
Answer:
1. First, estimate the average number of students in one class.

2. Then, count or estimate the total number of classes in the school.
3. Multiply the average class strength by the number of classes to obtain the estimated total.

19. Explain the meanings of "always," "sometimes" and "never" in mathematical statements.

Answer:

1. An always-true statement is correct in every possible case.
2. A sometimes-true statement is correct in some cases but incorrect in others.
3. A never-true statement is not correct in any possible case.

20. Explain the complementary strategy in a game where players may add 1, 2 or 3.

Answer:

1. A player tries to make their move and the opponent's preceding move total 4.
2. The player responds to 1 with 3, to 2 with 2 and to 3 with 1.
3. Repeating these complementary moves helps the player control important totals and reach the target first.

3.10. Three-mark questions with Answers of HOTS Type: (18 Questions)

Three-Mark Descriptive Questions with Answers – HOTS Type:

1. Find the maximum number of supercells possible in a row of nine cells and explain the arrangement.

Answer:

1. The maximum number of supercells is $(9 + 1) \div 2 = 5$.
2. Arrange relatively large and small numbers alternately, beginning and ending with large numbers.
3. Each of the five large numbers will then be greater than its adjacent number or numbers.

2. Can the largest and second-largest numbers both be supercells? Explain with an arrangement.

Answer:

1. Yes, both can be supercells if they are not placed next to each other.
2. For example, in the row 9,2,8, both 9 and 8 are greater than their only adjacent number, 2.
3. Therefore, separating the two numbers with a smaller number makes both of them supercells.

3. Find the smallest and largest three-digit numbers whose digit sum is 14.

Answer:

1. For the smallest number, choose the smallest possible hundreds digit and place the remaining value towards the right, giving 149.
2. For the largest number, place the greatest possible digit in the hundreds place, giving 950.
3. Thus, the smallest and largest numbers are 149 and 950, and both have a digit sum of 14.

4. Determine the pattern in the digit sums of 123, 234, 345, 456 and 567.

Answer:

1. Their digit sums are 6, 9, 12, 15 and 18, respectively.
2. Each successive digit sum is 3 more than the preceding digit sum.
3. Hence, all these digit sums are consecutive multiples of 3.

5. Apply the reverse-and-add process to 68 until a palindrome is obtained.

Answer:

1. First, $68 + 86 = 154$, which is not a palindrome.

2. Next, $154 + 451 = 605$, which is also not a palindrome.
3. Finally, $605 + 506 = 1{,}111$, which is a palindrome.

6. How many three-digit palindromes can be formed using only the digits 1, 2 and 3 if repetition is allowed?

Answer:

1. In a three-digit palindrome, the first and last digits must be the same.
2. There are three choices for the outer digit and three choices for the middle digit.
3. Therefore, $3 \times 3 = 9$such palindromes can be formed.

7. Apply Kaprekar's process to 3,210 until the constant is reached.

Answer:

1. $3{,}210 - 1{,}023 = 2{,}187$, and then $8{,}721 - 1{,}278 = 7{,}443$.
2. Next, $7{,}443 - 3{,}447 = 3{,}996$, followed by $9{,}963 - 3{,}699 = 6{,}264$.
3. Continuing gives $6{,}642 - 2{,}466 = 4{,}176$and $7{,}641 - 1{,}467 = 6{,}174$.

8. Explain why 6,174 remains unchanged under Kaprekar's process.

Answer:

1. Arranging the digits of 6,174 in descending order gives 7,641.
2. Arranging them in ascending order gives 1,467.
3. Their difference is $7{,}641 - 1{,}467 = 6{,}174$, so the same number is obtained again.

9. Why cannot a four-digit number with all identical digits reach 6,174 through Kaprekar's process?

Answer:

1. Its ascending and descending arrangements are identical.
2. Subtracting these two arrangements gives zero.
3. Therefore, the process stops at zero and cannot proceed towards 6,174.

10. Find the next two palindromic times after 10:01 and calculate the intervals.

Answer:

1. The next two palindromic times are 11:11 and 12:21.
2. The interval from 10:01 to 11:11 is 70 minutes.
3. The interval from 10:01 to 12:21 is 140 minutes.

11. Show that two four-digit numbers cannot have a six-digit sum.

Answer:

1. The greatest four-digit number is 9,999.
2. The greatest possible sum is $9{,}999 + 9{,}999 = 19{,}998$.
3. Since 19,998 has five digits, a six-digit sum is impossible.

12. Examine whether two five-digit numbers can have a sum of 18,500.

Answer:

1. The smallest five-digit number is 10,000.
2. The smallest possible sum of two five-digit numbers is $10{,}000 + 10{,}000 = 20{,}000$.
3. Therefore, two five-digit numbers cannot have a sum of 18,500.

13. Generate the Collatz sequence from 13 until it reaches 1.

Answer:

1. Beginning with 13 gives $13{,}40{,}20{,}10{,}5$.
2. Continuing from 5 gives $16{,}8{,}4{,}2{,}1$.
3. Therefore, the sequence is $13{,}40{,}20{,}10{,}5{,}16{,}8{,}4{,}2{,}1$.

14. Explain why every Collatz sequence beginning with a power of 2 reaches 1.

Answer:

1. Every power of 2 is even and can therefore be divided by 2.
2. Repeated division produces successively smaller powers of 2.
3. The sequence eventually reaches 2, which gives $2 \div 2 = 1$.

15. Assess a Grade 6 student's claim that they have spent about 13,000 hours in school.

Answer:

1. Assuming 6 school hours per day and 200 working days per year, the annual total is approximately 1,200 hours.
2. Over eight school years, the estimated total is $1{,}200 \times 8 = 9{,}600$hours.
3. Therefore, 13,000 hours is an unreasonable overestimate under these assumptions.

16. Classify the statement "A four-digit number plus a two-digit number gives a four-digit number."

Answer:

1. The statement is true in some cases, such as $2{,}000 + 50 = 2{,}050$.
2. It is false in other cases, such as $9{,}999 + 99 = 10{,}098$.
3. Therefore, the statement is only sometimes true.

17. Classify the statement "A five-digit number minus a two-digit number gives a three-digit positive number."

Answer:

1. The smallest five-digit number is 10,000, while the largest two-digit number is 99.
2. Their difference is $10{,}000 - 99 = 9{,}901$, which is still a four-digit number.
3. Therefore, the statement is never true.

18. Explain the winning response strategy in a game where each player can add 1, 2 or 3.

Answer:

1. Make your number and the opponent's preceding number add up to 4.
2. Respond to 1 with 3, to 2 with 2 and to 3 with 1.
3. Repeating this pattern allows you to control a sequence of strategic totals leading to the target.

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

Five-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain the concept of supercells and their neighbouring cells.

Answer:

1. A supercell is a cell containing a number greater than all the numbers in its neighbouring cells.
2. In a single-row table, the cells immediately to the left and right are treated as neighbours.
3. A cell at either end of a row has only one neighbouring cell.
4. In a multi-row table, the cells immediately to the left, right, top and bottom are neighbours.
5. Supercell activities develop skills in comparing and logically arranging numbers.

2. Explain digit sums and the patterns formed by consecutive-digit numbers.

Answer:

1. The digit sum of a number is obtained by adding all its digits.
2. For example, the digit sum of 568 is $5 + 6 + 8 = 19$.
3. The digit sums of 123, 234 and 345 are 6, 9 and 12, respectively.
4. Each successive digit sum in this pattern increases by 3.
5. Therefore, the digit sums of such three-digit consecutive-digit numbers are multiples of 3.

3. Describe palindromic numbers and the reverse-and-add process.

Answer:

1. A palindromic number reads the same from left to right and right to left.
2. The numbers 66, 121, 848 and 1,111 are examples of palindromes.
3. In the reverse-and-add process, the digits of a number are reversed.

4. The reversed number is then added to the original number.
5. The process is repeated until a palindromic number is obtained.

4. Explain the reverse-and-add process beginning with 68.

Answer:

1. The reverse of 68 is 86, and $68 + 86 = 154$.
2. As 154 is not a palindrome, its digits are reversed to obtain 451.
3. Adding them gives $154 + 451 = 605$.
4. The reverse of 605 is 506, and $605 + 506 = 1{,}111$.
5. The result 1,111 is a palindrome, so the process stops.

5. Describe Kaprekar's process for four-digit numbers.

Answer:

1. Begin with a four-digit number having at least two different digits.
2. Arrange its digits in descending order to form the largest possible number.
3. Arrange the same digits in ascending order to form the smallest possible number.
4. Subtract the smaller number from the larger number.
5. Repeat these steps with each result until the Kaprekar constant 6,174 is reached.

6. Apply Kaprekar's process to 6,382 until 6,174 is obtained.

Answer:

1. $8{,}632 - 2{,}368 = 6{,}264$.
2. $6{,}642 - 2{,}466 = 4{,}176$.
3. $7{,}641 - 1{,}467 = 6{,}174$.
4. Applying the process again gives $7{,}641 - 1{,}467 = 6{,}174$.
5. Thus, the process reaches and continues to repeat the Kaprekar constant 6,174.

7. Explain palindromic patterns found in clocks and calendars.

Answer:

1. A palindromic time reads the same forwards and backwards when its digits are written in sequence.
2. The times 10:01, 11:11 and 12:21 are examples of palindromic times.
3. Similar patterns can also be observed in dates written numerically.
4. Calendar patterns may repeat after a certain number of years.
5. Studying clocks and calendars helps learners recognise number symmetry and repetition.

8. Explain mental mathematics using "always, sometimes and never" statements.

Answer:

1. Mental mathematics involves performing calculations and making numerical judgments without written procedures.
2. An always-true statement is correct for every possible example.
3. A sometimes-true statement is correct in certain cases but not in others.
4. A never-true statement is impossible in all cases.
5. Testing examples and counterexamples helps classify numerical statements correctly.

9. Explain the Collatz conjecture and its rules.

Answer:

1. The Collatz sequence begins with any positive whole number.
2. If the number is even, it is divided by 2.
3. If the number is odd, it is multiplied by 3 and then increased by 1.
4. The appropriate rule is repeatedly applied to every new term.
5. The Collatz conjecture states that the sequence will eventually reach 1, although this has not been proved for all starting numbers.

10. Generate and explain the Collatz sequence beginning with 13.

Answer:

1. Since 13 is odd, $3 \times 13 + 1 = 40$.
2. The even-number rule gives 40,20,10,5.
3. Applying the odd-number rule to 5 gives $3 \times 5 + 1 = 16$.
4. Repeatedly halving 16 gives 16,8,4,2,1.
5. Therefore, the complete sequence is 13,40,20,10,5,16,8,4,2,1.

11. Explain estimation and its use in daily life.

Answer:

1. Estimation means finding a value close to an exact quantity.
2. It is useful when exact information is unavailable or unnecessary.
3. The number of students in a school can be estimated using the average class strength.
4. Travel distance, expenses and time can also be estimated.
5. Estimation helps us make quick decisions and check whether an answer is reasonable.

12. Explain the complementary winning strategy in an addition game.

Answer:

1. Suppose each player is allowed to add 1, 2 or 3 during each turn.
2. A player should try to make their number and the opponent's preceding number total 4.
3. If the opponent adds 1, the player should add 3.
4. If the opponent adds 2 or 3, the player should add 2 or 1, respectively.
5. Repeating this complementary strategy helps the player control the required totals and reach the target first.

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

Five-Mark Descriptive Questions with Answers – HOTS Type:

1. Arrange the numbers 1 to 9 in a row to obtain the maximum possible number of supercells. Explain your answer.

Answer:

1. One suitable arrangement is 9,1,8,2,7,3,6,4,5.
2. The numbers 9, 8, 7, 6 and 5 are greater than their respective neighbouring numbers.
3. Therefore, these five numbers are supercells.
4. Two adjacent cells cannot both be supercells because each cannot be greater than the other.
5. Hence, five is the maximum possible number of supercells in a row of nine cells.

2. The second-largest number in a row should not be a supercell, but the second-smallest number should be one. Construct and justify an arrangement.

Answer:

1. Consider the arrangement 2,1,3,4,5,6,7,9,8.
2. The second-smallest number 2 is greater than its only neighbour, 1, so it is a supercell.
3. The second-largest number 8 is adjacent to 9.
4. Since 8 is smaller than 9, it is not a supercell.
5. Thus, the arrangement satisfies both the given conditions.

3. Find the smallest and largest five-digit numbers having a digit sum of 14, and explain your method.

Answer:

1. To form the smallest number, place the smallest possible non-zero digit in the ten-thousands place.
2. Place the remaining digit value as far to the right as possible, giving 10,049.
3. To form the largest number, place the greatest possible digit in the ten-thousands place.
4. Placing 9 first and the remaining 5 in the thousands place gives 95,000.
5. Therefore, the smallest and largest five-digit numbers are 10,049 and 95,000.

4. Apply the reverse-and-add process to 87 until a palindrome is obtained.
Answer:
1. Reverse 87 to obtain 78 and calculate $87 + 78 = 165$.
2. Reverse 165 to obtain 561 and calculate $165 + 561 = 726$.
3. Reverse 726 to obtain 627 and calculate $726 + 627 = 1{,}353$.
4. The number 1,353 reads the same from left to right and right to left.
5. Therefore, 87 reaches the palindrome 1,353 after three reverse-and-add rounds.

5. Apply Kaprekar's process to 5,683 until the constant 6,174 is reached.
Answer:
1. The first two rounds give $8{,}653 - 3{,}568 = 5{,}085$and $8{,}550 - 5{,}058 = 3{,}492$.
2. The next two rounds give $9{,}432 - 2{,}349 = 7{,}083$and $8{,}730 - 3{,}078 = 5{,}652$.
3. Continuing gives $6{,}552 - 2{,}556 = 3{,}996$and $9{,}963 - 3{,}699 = 6{,}264$.
4. The seventh round gives $6{,}642 - 2{,}466 = 4{,}176$.
5. The eighth round gives $7{,}641 - 1{,}467 = 6{,}174$, the Kaprekar constant.

6. Explain why the largest possible difference between two five-digit numbers is 89,999.
Answer:
1. The largest five-digit number is 99,999.
2. The smallest five-digit number is 10,000.
3. The greatest difference is obtained by subtracting the smallest possible number from the largest possible number.
4. Therefore, the difference is $99{,}999 - 10{,}000 = 89{,}999$.
5. Hence, a difference of 90,000 or more is impossible between two five-digit numbers.

7. Classify the statement "A five-digit number plus another five-digit number gives a five-digit number" as always, sometimes or never true.
Answer:
1. The statement is true for $10{,}000 + 20{,}000 = 30{,}000$, which is a five-digit number.
2. It is false for $60{,}000 + 50{,}000 = 1{,}10{,}000$, which is a six-digit number.
3. The result depends on the sizes of the two numbers being added.
4. Sums below 1,00,000 remain five-digit numbers, while larger sums become six-digit numbers.
5. Therefore, the statement is only sometimes true.

8. Generate the Collatz sequence beginning with 28 and explain how it reaches 1.
Answer:
1. The sequence begins $28, 14, 7, 22, 11, 34$.
2. It continues as $17, 52, 26, 13, 40, 20$.
3. The next terms are $10, 5, 16, 8, 4, 2, 1$.
4. Even terms are divided by 2, while odd terms are multiplied by 3 and increased by 1.
5. Following these rules, the starting number 28 eventually reaches 1.

9. A Grade 6 student says that they have spent approximately 13,000 hours in school. Evaluate the claim.
Answer:
1. Assume that the student attends school for 6 hours per day and 200 days per year.
2. The estimated school time per year is $6 \times 200 = 1{,}200$hours.
3. If the student has attended school for eight years, the total is $1{,}200 \times 8 = 9{,}600$hours.
4. The difference between the claim and the estimate is $13{,}000 - 9{,}600 = 3{,}400$hours.
5. Therefore, 13,000 hours appears to be an unreasonable overestimate under these assumptions.

10. Develop a winning strategy for a game in which players alternately add 1, 2 or 3, and the first to reach 22 wins.
Answer:

1. The first player should begin by adding 2 and reaching the strategic total 2.
2. After every opponent's move, the first player should choose a number that makes their two additions total 4.
3. Thus, the player should respond to 1 with 3, to 2 with 2 and to 3 with 1.
4. This strategy enables the first player to reach 2,6,10,14,18and finally 22.
5. Therefore, the first player can guarantee victory by starting with 2 and using complementary moves.

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

Five-Mark Descriptive Questions with Answers – Applied Type:

1. A teacher places the number cards 140, 560, 230, 780, 310, 690 and 200 in a row. Identify the supercells and explain your answer.

Answer:

1. The number 560 is greater than its neighbours 140 and 230, so it is a supercell.
2. The number 780 is greater than its neighbours 230 and 310, so it is a supercell.
3. The number 690 is greater than its neighbours 310 and 200, so it is a supercell.
4. The remaining numbers are smaller than at least one of their neighbours.
5. Therefore, the supercells are 560, 780 and 690.

2. A security code is the smallest five-digit number whose digits add up to 14. Find and verify the code.

Answer:

1. The ten-thousands digit must be at least 1 for the number to have five digits.
2. To obtain the smallest number, the higher place-value digits should be kept as small as possible.
3. After placing 1 first, the remaining digit sum required is $14 - 1 = 13$.
4. Placing 4 in the tens place and 9 in the units place gives 10,049.
5. Since $1 + 0 + 0 + 4 + 9 = 14$, the required security code is 10,049.

3. A digital clock shows 10:01 when a programme begins. Find the next two palindromic times and the waiting time for each.

Answer:

1. A palindromic time reads the same forwards and backwards.
2. The next palindromic time after 10:01 is 11:11.
3. The waiting time from 10:01 to 11:11 is 1 hour 10 minutes, or 70 minutes.
4. The following palindromic time is 12:21.
5. It occurs 2 hours 20 minutes, or 140 minutes, after 10:01.

4. A student enters 3,210 into a number-pattern application that follows Kaprekar's process. Show how the application reaches the Kaprekar constant.

Answer:

1. $3{,}210 - 1{,}023 = 2{,}187$, and $8{,}721 - 1{,}278 = 7{,}443$.
2. $7{,}443 - 3{,}447 = 3{,}996$.
3. $9{,}963 - 3{,}699 = 6{,}264$.
4. $6{,}642 - 2{,}466 = 4{,}176$.
5. Finally, $7{,}641 - 1{,}467 = 6{,}174$, which is the Kaprekar constant.

5. A school has 24 classes with approximately 32 students in each class. Estimate the total enrolment and comment on the reliability of the estimate.

Answer:

1. The estimated number of students per class is 32.
2. The school has 24 classes.
3. The estimated enrolment is $32 \times 24 = 768$students.

4. The actual total may differ because every class may not have exactly 32 students.
5. Therefore, 768 is a reasonable estimate but not necessarily the exact enrolment.

6. A student attends school for 6 hours a day, 200 days a year, for eight years. Estimate the total time spent in school and assess a claim of 13,000 hours.

Answer:

1. The estimated time spent in school each year is $6 \times 200 = 1{,}200$hours.
2. For eight years, the estimated total is $1{,}200 \times 8 = 9{,}600$hours.
3. The claimed total exceeds the estimate by $13{,}000 - 9{,}600 = 3{,}400$hours.
4. Minor differences in school days or daily hours cannot easily account for such a large gap.
5. Therefore, the claim of 13,000 hours is probably an overestimate.

7. A computer game applies the Collatz rules to the starting number 19. Generate the sequence until it reaches 1.

Answer:

1. The sequence begins $19, 58, 29, 88, 44, 22$.
2. It continues as $11, 34, 17, 52, 26, 13$.
3. The next terms are $40, 20, 10, 5, 16$.
4. Repeated halving then gives $8, 4, 2, 1$.
5. Thus, the starting number 19 reaches 1 after applying the odd and even rules repeatedly.

8. Two players begin at 0 and alternately add 1, 2 or 3; the first to reach 22 wins. Develop a strategy for the first player.

Answer:

1. The first player should begin by adding 2.
2. After that, the first player should make each pair of moves total 4.
3. Thus, the responses to the opponent's choices 1, 2 and 3 should be 3, 2 and 1, respectively.
4. This allows the first player to control the totals $2, 6, 10, 14, 18$and 22.
5. Therefore, beginning with 2 and using complementary moves guarantees the first player's victory.

9. A shopkeeper claims that two five-digit bills can have a total value of ₹18,500. Examine the claim.

Answer:

1. The smallest five-digit number is 10,000.
2. Therefore, each five-digit bill must have a value of at least ₹10,000.
3. The smallest possible sum of two such bills is $10{,}000 + 10{,}000 = ₹20{,}000$.
4. This minimum total is already ₹1,500 greater than ₹18,500.
5. Hence, the shopkeeper's claim is mathematically impossible.

10. A family chooses the digits 7, 4, 3 and 1 for a locker code. Find the largest and smallest codes and calculate their sum and difference.

Answer:

1. Arranging the digits in descending order gives the largest code, 7,431.
2. Arranging them in ascending order gives the smallest code, 1,347.
3. Their sum is $7{,}431 + 1{,}347 = 8{,}778$.
4. Their difference is $7{,}431 - 1{,}347 = 6{,}084$.
5. Thus, the codes have a sum of 8,778 and a difference of 6,084.

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

Olympiad-Type Multiple-Choice Questions:

1. In the row $36, 18, 42, 25, 51, 30$, which numbers are supercells?

A. 36, 42 and 51
B. 18, 25 and 30
C. 36 and 51 only
D. 42 and 51 only
Answer: A. 36, 42 and 51

---

2. What is the maximum number of supercells possible in a row of 11 distinct numbers?
A. 5
B. 6
C. 7
D. 10
Answer: B. 6

---

3. Which statement about a row of distinct numbers is always true?
A. The smallest number is a supercell.
B. Every alternate number is a supercell.
C. The largest number is a supercell.
D. The second-largest number is a supercell.
Answer: C. The largest number is a supercell.

---

4. In which arrangement is the second-largest number not a supercell?
A. 9,1,8
B. 8,1,9
C. 1,8,2,9
D. 1,9,8
Answer: D. 1,9,8

---

5. How many four-digit numbers are there?
A. 900
B. 8,999
C. 9,000
D. 9,999
Answer: C. 9,000

---

6. What is the smallest three-digit number whose digit sum is 14?
A. 149
B. 158
C. 239
D. 509
Answer: A. 149

---

7. What is the largest four-digit number whose digit sum is 14?
A. 9,401
B. 9,410
C. 9,500
D. 9,140
Answer: C. 9,500

---

8. What is the smallest five-digit number whose digit sum is 14?

A. 10,049
B. 10,139
C. 10,409
D. 14,000
Answer: A. 10,049

---

9. The digit sums of 234, 345, 456 and 567 form which sequence?
A. 9,11,13,15
B. 9,12,15,18
C. 6,9,12,15
D. 9,18,27,36
Answer: B. 9,12,15,18

---

10. How many times does the digit 7 occur while writing all the numbers from 1 to 100?
A. 10
B. 11
C. 19
D. 20
Answer: D. 20

---

11. Which of the following is not a palindrome?
A. 12,321
B. 45,654
C. 78,987
D. 56,765
Answer: D. 56,765

---

12. How many three-digit palindromes can be formed using only the digits 1, 2 and 3 if repetition is allowed?
A. 6
B. 9
C. 12
D. 27
Answer: B. 9

---

13. How many three-digit palindromes are there altogether?
A. 81
B. 90
C. 99
D. 100
Answer: B. 90

---

14. Which number is obtained after one reverse-and-add operation on 47?
A. 111
B. 112
C. 121
D. 131
Answer: C. 121

---

15. Starting with 68, which palindrome is eventually obtained by the reverse-and-add process shown below?
A. 1,001
B. 1,111
C. 1,221
D. 1,331
Answer: B. 1,111

---

16. Which condition is necessary for a four-digit number to be used meaningfully in Kaprekar's process?
A. All its digits must be even.
B. It must contain at least two different digits.
C. It must be a palindrome.
D. Its digit sum must be 18.
Answer: B. It must contain at least two different digits.

---

17. What is the first result when Kaprekar's process is applied to 3,524?
A. 2,087
B. 3,087
C. 3,078
D. 3,187
Answer: B. 3,087

---

18. What is the first result when Kaprekar's process is applied to 6,382?
A. 6,174
B. 6,246
C. 6,264
D. 6,624
Answer: C. 6,264

---

19. Why does Kaprekar's process leave 6,174 unchanged?
A. $6{,}174 - 0 = 6{,}174$
B. $7{,}641 - 1{,}467 = 6{,}174$
C. $7{,}614 - 1{,}440 = 6{,}174$
D. $6{,}741 - 567 = 6{,}174$
Answer: B. $7{,}641 - 1{,}467 = 6{,}174$

---

20. Which number generally repeats in the three-digit Kaprekar process?
A. 198
B. 297
C. 396
D. 495
Answer: D. 495

---

21. Which is the next palindromic time after 10:01?
A. 10:10
B. 10:11
C. 11:01
D. 11:11
Answer: D. 11:11

22. How many minutes pass from 10:01 to 11:11?
A. 60 minutes
B. 69 minutes
C. 70 minutes
D. 110 minutes
Answer: C. 70 minutes

23. What is the sum of the smallest and largest five-digit palindromes?
A. 1,00,000
B. 1,09,999
C. 1,10,000
D. 1,11,000
Answer: C. 1,10,000

24. What is the difference between the largest and smallest five-digit palindromes?
A. 89,898
B. 89,998
C. 90,000
D. 99,998
Answer: B. 89,998

25. Which of the following is impossible?
A. A five-digit number plus a five-digit number gives a six-digit number.
B. A five-digit number minus a five-digit number gives a three-digit number.
C. A four-digit number plus a four-digit number gives a six-digit number.
D. A five-digit number minus a four-digit number gives a four-digit number.
Answer: C. A four-digit number plus a four-digit number gives a six-digit number.

26. What is the greatest possible difference between two five-digit numbers?
A. 89,899
B. 89,999
C. 90,000
D. 99,999
Answer: B. 89,999

27. Which statement is sometimes true?
A. A four-digit number plus a two-digit number gives a six-digit number.
B. A four-digit number plus a two-digit number gives a four-digit number.
C. A five-digit number minus a two-digit number gives a three-digit number.
D. Two five-digit numbers have a sum smaller than 20,000.
Answer: B. A four-digit number plus a two-digit number gives a four-digit number.

28. According to the Collatz rule, which number comes immediately after 27?
A. 28
B. 54
C. 81
D. 82
Answer: D. 82

29. What are the next two terms after 19 in the Collatz sequence?
A. 38, 19
B. 56, 28
C. 58, 29
D. 60, 30
Answer: C. 58, 29

---

30. Which of the following is a complete Collatz sequence ending at 1?
A. 8,4,3,2,1
B. 8,4,2,1
C. 8,16,4,2,1
D. 8,7,6,5,1
Answer: B. 8,4,2,1

---

31. Why does every Collatz sequence starting with a power of 2 reach 1?
A. Powers of 2 are repeatedly divided by 2.
B. Powers of 2 are repeatedly multiplied by 3.
C. Every power of 2 is a palindrome.
D. Every power of 2 has a digit sum of 2.
Answer: A. Powers of 2 are repeatedly divided by 2.

---

32. A school has 18 classes with approximately 35 students in each class. What is its estimated enrolment?
A. 530
B. 600
C. 630
D. 650
Answer: C. 630

---

33. A student attends school for 6 hours per day on 200 days annually. Approximately how many hours does the student spend in school in eight years?
A. 8,600 hours
B. 9,600 hours
C. 10,600 hours
D. 12,000 hours
Answer: B. 9,600 hours

---

34. Players alternately add 1, 2 or 3, starting from 0, and the first to reach 22 wins. What should the first player add initially to follow the winning strategy?
A. 1
B. 2
C. 3
D. Any number
Answer: B. 2

---

35. In the same game, what should a player add if the opponent has added 3 and the complementary total must be 4?
A. 1
B. 2

C. 3
D. 4
Answer: A. 1

3.15 Best Practices Opportunity List from the Chapter: (15 Ideas)

Best Practices for Teaching Chapter 3: Number Play:

(1) **Use concrete number cards:** Ask students to arrange number cards physically to identify supercells, form the largest and smallest numbers, and discover patterns.
(2) **Encourage mathematical discussion:** Allow students to explain their strategies, compare solutions and justify why a particular number or arrangement satisfies a condition.
(3) **Follow the concrete–visual–abstract approach:** Begin with physical objects, progress to tables and number lines, and finally introduce numerical rules and symbolic representations.
(4) **Promote pattern discovery:** Let students examine digit sums, palindromes, Kaprekar operations and Collatz sequences before formally explaining the underlying rules.
(5) **Connect learning with daily life:** Use clocks, calendars, school enrolment, travel distance, shopping expenses and identification numbers to demonstrate practical applications.
(6) **Use guided questioning:** Ask questions such as "What do you notice?", "Will this always happen?" and "Can you find a counterexample?" to strengthen reasoning.
(7) **Encourage estimation before calculation:** Ask students to estimate quantities and results first, calculate afterwards, and compare the estimate with the exact answer.
(8) **Include collaborative learning:** Organise students into small groups for supercell puzzles, number-pattern investigations and winning-strategy games.
(9) **Require written justification:** Encourage students to support every answer with a rule, calculation, example or counterexample rather than giving only the final result.
(10) **Differentiate learning tasks:** Provide basic number patterns for learners needing support and open-ended investigations for advanced learners.
(11) **Use error analysis:** Present intentionally incorrect solutions and ask students to locate, explain and correct the mistakes.
(12) **Integrate mental mathematics:** Conduct short daily exercises involving digit sums, reversals, number formation, approximation and quick calculations.
(13) **Maintain a number-pattern journal:** Ask students to record palindromes, Kaprekar steps, Collatz sequences and patterns they discover during the chapter.
(14) **Assess learning continuously:** Use exit slips, oral questions, observation checklists, mini-quizzes and peer explanations to monitor understanding.
(15) **Conclude with student reflection:** Ask students to describe the most interesting pattern they discovered and explain how their problem-solving strategy improved.

3.16 Innovations Opportunity List from the Chapter: (15 Ideas)

Innovations in Teaching–Learning Chapter 3: Number Play:

(1) **Digital Supercell Challenge:** Create an interactive grid in which students enter numbers and receive instant feedback when a cell becomes a supercell.
(2) **Human Number-Line Activity:** Mark a large number line on the classroom floor and ask students holding number cards to stand at appropriate positions.
(3) **Palindrome Hunt:** Students can search vehicle numbers, digital-clock times, dates, receipts and page numbers for palindromes and prepare a classroom display.

(4) **Kaprekar Digital Laboratory:** Use a spreadsheet or simple program to arrange digits, subtract numbers and count how many rounds different four-digit numbers take to reach 6,174.
(5) **Collatz Sequence Race:** Groups can choose different starting numbers, generate their Collatz sequences and compare sequence lengths through colourful charts.
(6) **Number Detective QR Stations:** Place QR-coded puzzles around the classroom covering digit sums, supercells, palindromes, estimation and number patterns.
(7) **Design-a-Puzzle Project:** Ask students to create original supercell tables, digit-sum riddles, palindromic-number puzzles or Kaprekar challenges for classmates.
(8) **Clock and Calendar Pattern Studio:** Let students use paper clocks or digital simulations to locate palindromic times and investigate patterned dates.
(9) **Estimation Field Survey:** Students can estimate the number of books, plants, tiles or students in the school and then compare their estimates with actual counts.
(10) **Winning-Strategy Tournament:** Conduct number-game tournaments in which students record their moves, identify controlling totals and formulate winning rules.
(11) **Number-Pattern Art:** Students can transform repeated numbers, palindromes and numerical sequences into symmetrical artwork, rangoli designs or mosaics.
(12) **Student-Created Explainer Videos:** Small groups can create short videos explaining Kaprekar's process, the Collatz rules or supercell strategies with examples.
(13) **AI-Assisted Puzzle Generation:** Under teacher supervision, students can use an age-appropriate AI tool to generate number puzzles and then verify whether the answers are correct.
(14) **Interactive Number Escape Room:** Create sequential challenges in which solving a digit-sum, palindrome, supercell or estimation puzzle reveals the code for the next task.
(15) **Math Discovery Portfolio:** Each student can maintain a digital or paper portfolio containing observations, conjectures, calculations, counterexamples and reflections from the chapter.

3.17: Practicing Questions/Question Bank:

A. Fill-in-the-Blank Questions:

1. A cell containing a number greater than all its neighbouring cells is called a __________.
   Answer: supercell

2. Numbers increase towards the __________ on a number line.
   Answer: right

3. There are __________ three-digit numbers.
   Answer: 900

4. The digit sum of 545 is __________.
   Answer: 14

5. A number that reads identically in both directions is called a __________ number.
   Answer: palindromic

6. The reverse of 68 is __________.
   Answer: 86

7. The Kaprekar constant for four-digit numbers is __________.
   Answer: 6,174

8. The repeating number in the three-digit Kaprekar process is __________.
   Answer: 495

9. In a Collatz sequence, an even number is divided by __________.
   Answer: 2

10. The next Collatz term after 13 is __________.
    Answer: 40

11. The smallest five-digit palindrome is __________.
    Answer: 10,001

12. An approximate value of a quantity is called an __________.
    Answer: estimate

B. One-Mark Descriptive Questions:

1. **What is a supercell?**
   Answer: A supercell contains a number greater than all the numbers in its neighbouring cells.

2. **How many two-digit numbers are there?**
   Answer: There are 90 two-digit numbers.

3. **What is the digit sum of 568?**
   Answer: The digit sum of 568 is $5 + 6 + 8 = 19$.

4. **What is a palindromic number?**
   Answer: A palindromic number reads the same from left to right and right to left.

5. **Give one example of a palindromic time.**
   Answer: The time 10:01 is a palindromic time.

6. **Who discovered the four-digit process involving 6,174?**
   Answer: D. R. Kaprekar discovered the process involving 6,174.

7. **What condition must a starting number satisfy for the four-digit Kaprekar process?**
   Answer: It must have four digits with at least two different digits.

8. **State the Collatz rule for an odd number.**
   Answer: Multiply an odd number by 3 and add 1.

9. **What is estimation?**
   Answer: Estimation is the process of finding a value reasonably close to the exact value.

10. **Can two four-digit numbers have a six-digit sum?**
    Answer: No, because their greatest possible sum is only 19,998.

C. Two-Mark Descriptive Questions:

1. Explain how neighbouring cells are identified in a supercell table.

Answer:

1. In a single row, the immediately left and right cells are neighbours.
2. In a grid, the immediately left, right, top and bottom cells are neighbours.

2. What is a digit sum? Find the digit sum of 3,452.

Answer:

1. A digit sum is obtained by adding all the digits of a number.
2. The digit sum of 3,452 is $3 + 4 + 5 + 2 = 14$.

3. Explain the reverse-and-add process.

Answer:

1. Reverse the digits of the given number and add the reversed number to the original.
2. Repeat the procedure until a palindrome is obtained.

4. State the two Collatz rules.

Answer:

1. Divide an even number by 2.
2. Multiply an odd number by 3 and add 1.

5. Why can two adjacent cells not both be supercells?

Answer:

1. Each cell would need to contain a number greater than the other.
2. Since this is impossible, two adjacent cells cannot both be supercells.

6. Find the smallest and largest five-digit palindromes.

Answer:

1. The smallest five-digit palindrome is 10,001.
2. The largest five-digit palindrome is 99,999.

D. Three-Mark Descriptive Questions:

1. Explain how to maximise the number of supercells in a row.

Answer:

1. Place relatively large and small numbers alternately.
2. Begin and, where possible, end the row with larger numbers.
3. Each larger number will then be greater than its adjacent smaller numbers.

2. Apply the reverse-and-add process to 68 until a palindrome is obtained.

Answer:

1. $68 + 86 = 154$.
2. $154 + 451 = 605$.
3. $605 + 506 = 1{,}111$, which is a palindrome.

3. Describe Kaprekar's process.

Answer:

1. Arrange the given digits to form the largest and smallest possible numbers.

2. Subtract the smaller number from the larger number.
3. Repeat these steps with every result until 6,174 is reached.

4. Generate the Collatz sequence for 13.

Answer:

1. The sequence begins 13,40,20,10,5.
2. It then continues 16,8,4,2,1.
3. Thus, 13 reaches 1 after repeatedly applying the Collatz rules.

5. Classify the statement "A four-digit number plus a two-digit number gives a four-digit number."

Answer:

1. It is true for $2{,}000 + 50 = 2{,}050$.
2. It is false for $9{,}999 + 99 = 10{,}098$.
3. Therefore, the statement is only sometimes true.

6. Explain why estimation is useful.

Answer:

1. Estimation provides a quick approximate value.
2. It is helpful when exact information is unavailable or unnecessary.
3. It also allows us to check whether a calculated result is reasonable.

E. Five-Mark Descriptive Questions:

1. Apply Kaprekar's process to 3,210 until 6,174 is reached.

Answer:

1. $3{,}210 - 1{,}023 = 2{,}187$, followed by $8{,}721 - 1{,}278 = 7{,}443$.
2. $7{,}443 - 3{,}447 = 3{,}996$.
3. $9{,}963 - 3{,}699 = 6{,}264$.
4. $6{,}642 - 2{,}466 = 4{,}176$.
5. $7{,}641 - 1{,}467 = 6{,}174$.

2. Generate and explain the Collatz sequence beginning with 28.

Answer:

1. The sequence begins 28,14,7,22,11,34.
2. It continues 17,52,26,13,40,20.
3. The remaining terms are 10,5,16,8,4,2,1.
4. Every even term is divided by 2.

5. Every odd term is multiplied by 3 and increased by 1.

3. Estimate whether a Grade 6 student has spent 13,000 hours in school.

Answer:

1. Assume that the student attends school for 6 hours daily.
2. At 200 working days annually, the student spends about $6 \times 200 = 1{,}200$hours in school each year.
3. Over eight years, the estimated total is $1{,}200 \times 8 = 9{,}600$hours.
4. This is 3,400 hours less than the claimed 13,000 hours.
5. Therefore, 13,000 hours is probably an overestimate.

4. Explain why two five-digit numbers cannot have a sum of 18,500.

Answer:

1. The smallest five-digit number is 10,000.
2. Therefore, each of the two numbers must be at least 10,000.
3. Their smallest possible sum is $10{,}000 + 10{,}000 = 20{,}000$.
4. This minimum is greater than 18,500.
5. Hence, the required sum is impossible.

5. Explain the winning strategy for reaching 22 when players may add 1, 2 or 3.

Answer:

1. The first player should begin by adding 2.
2. Thereafter, the player should make each pair of successive moves total 4.
3. Respond to 1 with 3, to 2 with 2 and to 3 with 1.
4. This controls the totals $2, 6, 10, 14, 18$and 22.
5. Therefore, the first player can reach 22 and win by following this strategy.

6. Find and explain the smallest and largest five-digit numbers having a digit sum of 14.

Answer:

1. The smallest five-digit number must begin with the smallest non-zero digit, 1.
2. Placing the remaining value in the lowest possible places produces 10,049.
3. The largest number is obtained by placing the greatest possible digit, 9, first.
4. Placing the remaining 5 in the thousands place produces 95,000.
5. Hence, the required numbers are 10,049 and 95,000.

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6th Standard Maths Book Chapter 4

Chapter 4: DATA HANDLING AND PRESENTATION

4.1 Summary of the Chapter:

Chapter 4: Data Handling and Presentation — Summary:

(1) **Data** is a collection of facts, numbers, measurements, observations or descriptions that provide useful information.

(2) Data can be collected through surveys, interviews, observations, measurements and questionnaires.

(3) Raw data should be arranged systematically so that it becomes easier to understand, compare and interpret.

(4) A **frequency** shows how many times a particular value, item or observation occurs in a dataset.

(5) **Tally marks** provide a quick method of recording and counting observations, usually grouped in sets of five.

(6) A **frequency distribution table** organises data into categories and displays the frequency of each category clearly.

(7) A **pictograph** represents data using pictures or symbols. Each symbol may represent one or more items according to a specified key or scale.

(8) Partial symbols may be used in a pictograph to represent values such as one-half of the quantity indicated by a complete symbol.

(9) A **bar graph** represents data using rectangular bars of equal width, with equal gaps between consecutive bars.

(10) The height or length of each bar shows the frequency of a category. Bar graphs may be drawn vertically or horizontally.

(11) Selecting a suitable and uniform **scale** is essential for constructing accurate, readable and visually appealing pictographs and bar graphs.

(12) Graphs and infographics must be read carefully because exaggerated pictures, unequal scales or misleading designs can create an incorrect impression of the data.

4.2 Important Formulas:

The chapter has no complex formulas. The following basic formulas and rules are useful for solving problems involving frequency tables, pictographs and bar graphs.

1. **Frequency**

$$\text{Frequency} = \text{Number of times an observation occurs}$$

2. **Total number of observations**

$$N = \sum f$$

where f represents the frequency of each category.

3. **Value shown by a pictograph**

$$\text{Value represented} = \text{Number of symbols} \times \text{Value of one symbol}$$

4. **Number of pictograph symbols required**

$$\text{Number of symbols} = \frac{\text{Total quantity}}{\text{Value represented by one symbol}}$$

5. **Value of a partial symbol**

$$\text{Value of partial symbol} = \text{Fraction of symbol} \times \text{Value of one complete symbol}$$

For example:

$$\text{Half symbol} = \frac{1}{2} \times \text{Value of one symbol}$$

$$\text{Quarter symbol} = \frac{1}{4} \times \text{Value of one symbol}$$

6. **Value represented by a bar**

$$\text{Data value} = \text{Height or length of bar} \times \text{Value of one unit}$$

7. **Height or length of a bar**

$$\text{Bar height or length} = \frac{\text{Data value}}{\text{Value of one unit}}$$

8. **Scale of a bar graph**

$$\text{Scale} = \frac{\text{Data value}}{\text{Number of unit lengths}}$$

Example:

$$1 \text{ unit} = 5 \text{ students}$$

9. **Difference between two quantities**

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

10. **Combined frequency**

$$\text{Combined frequency} = f_1 + f_2 + f_3 + \cdots$$

11. **Total value from a frequency table**

$$\text{Total value} = \sum (\text{Observation} \times \text{Frequency})$$

For example:

$$\text{Total wickets} = \sum (\text{Wickets per match} \times \text{Number of matches})$$

12. **Average or mean, when required**

$$\text{Mean} = \frac{\text{Sum of all observations}}{\text{Total number of observations}}$$

13. **Twice a quantity**

$$\text{Twice a quantity} = 2 \times \text{Quantity}$$

14. **Half of a quantity**

$$\text{Half of a quantity} = \frac{\text{Quantity}}{2}$$

15. **Percentage of a category, when required**

$$\text{Percentage} = \frac{\text{Frequency of the category}}{\text{Total frequency}} \times 100$$

These formulas help students collect, organise, represent, compare and interpret numerical data accurately.

4.3 Fill-Up the Blank LOTS type questions with Answers: (30 Questions)

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

1. A collection of facts, numbers, measurements or observations is called __________.
   Answer: data
2. Data collected in its original form is known as __________ data.
   Answer: raw
3. The number of times a particular observation occurs is called its __________.
   Answer: frequency
4. Data can be organised systematically in a __________.
   Answer: table
5. __________ marks are used to record and count observations quickly.
   Answer: Tally
6. The fifth tally mark is drawn across the previous __________ tally marks.
   Answer: four

7. A table that shows different observations and their frequencies is called a __________ table.
   Answer: frequency distribution
8. Arranging numerical data from the smallest value to the largest value is called __________ order.
   Answer: ascending
9. A pictorial representation of data is called a __________.
   Answer: pictograph
10. A pictograph uses pictures or __________ to represent data.
    Answer: symbols
11. The value represented by each symbol in a pictograph is given by its __________.
    Answer: key
12. Another name for the key used in a pictograph or bar graph is __________.
    Answer: scale
13. If one symbol represents 10 students, five symbols represent __________ students.
    Answer: 50
14. If one complete symbol represents 10 children, half a symbol represents __________ children.
    Answer: 5
15. A graph that represents data using rectangular bars is called a __________ graph.
    Answer: bar
16. The bars in a bar graph must have __________ width.
    Answer: equal
17. The gaps between consecutive bars in a bar graph should be __________.
    Answer: equal
18. The height or length of a bar represents the __________ of the corresponding category.
    Answer: frequency
19. A bar graph can have either vertical or __________ bars.
    Answer: horizontal
20. The names of the categories are usually written along one of the __________ of a bar graph.
    Answer: axes
21. The numerical values or frequencies are marked along the other __________ of a bar graph.
    Answer: axis
22. The scale of a graph should be clearly __________.
    Answer: specified
23. The category with the tallest or longest bar has the __________ frequency.
    Answer: highest
24. The category with the shortest bar has the __________ frequency.
    Answer: lowest
25. The sum of the frequencies of all categories gives the total number of __________.
    Answer: observations
26. Colours can make a bar graph more attractive and easier to __________.
    Answer: understand
27. Pictographs and bar graphs help us make __________ from the given data.
    Answer: inferences

28. An attractive visual presentation combining data, pictures and text is called an __________.
    Answer: infographic
29. Incorrect scales and exaggerated pictures can make a graph __________.
    Answer: misleading
30. Data must be represented accurately to avoid drawing incorrect __________.
    Answer: conclusions

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

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

1. In a class survey, cricket received 8 votes, hockey received 12 votes and football received 7 votes. The most popular game is __________.
   Answer: hockey
2. A tally table shows three complete groups of five marks and two additional marks. The frequency is __________.
   Answer: 17
3. The frequencies of four categories are 6, 9, 13 and 7. The total frequency is __________.
   Answer: 35
4. The shoe sizes of five students are 6, 4, 7, 5 and 3. When arranged in ascending order, the last value will be __________.
   Answer: 7
5. If one symbol in a pictograph represents 10 children, $4\frac{1}{2}$symbols represent __________ children.
   Answer: 45
6. A pictograph uses one kite symbol to represent 100 kites. Seven symbols represent __________ kites.
   Answer: 700
7. If 350 objects must be shown using a symbol representing 100 objects, the pictograph will require three complete symbols and __________ of a symbol.
   Answer: one-half
8. A pictograph uses one symbol to represent 6 dogs. A village with 36 dogs must be represented by __________ symbols.
   Answer: 6
9. Two villages have 48 and 18 dogs respectively. The first village has __________ more dogs than the second village.
   Answer: 30
10. In a bar graph, one unit represents 5 students. A bar of 8 units represents __________ students.
    Answer: 40
11. A bar represents 24 tickets and has a height of 6 units. Therefore, one unit represents __________ tickets.
    Answer: 4
12. If the scale of a graph is 1 unit = 4 tickets, a bar representing 20 tickets should have a height of __________ units.
    Answer: 5
13. A bar graph shows 45 students choosing playing and 30 choosing reading. Playing was chosen by __________ more students.
    Answer: 15

14. The frequencies of cars, buses and bicycles are 12, 5 and 8 respectively. The combined frequency of buses and bicycles is __________.
Answer: 13
15. In a transport survey, 13 bikes, 9 scooters and 6 cars were observed. The mode of transport used most frequently was the __________.
Answer: bike
16. A student adds only the observation values in a frequency table to find the total. The correct method is to multiply each observation by its __________ before adding the products.
Answer: frequency
17. A bowler took 3 wickets in each of 8 matches. The total number of wickets taken in these matches was __________.
Answer: 24
18. A graph has bars of unequal widths even though they represent similar categories. To make the graph accurate, the bars should have __________ widths.
Answer: equal
19. Two categories have equal frequencies. Their bars in a correctly drawn bar graph must have __________ heights.
Answer: equal
20. If a graph begins its vertical scale at a high value instead of zero, small differences may appear __________.
Answer: exaggerated
21. A picture representing a mountain is doubled in both height and width. Its area becomes __________ times the original area.
Answer: four
22. Mount Everest is 8,849 metres high and Mount Elbrus is 5,642 metres high. Since $5{,}642 \times 2 = 11{,}284$, Everest is __________ twice as high as Elbrus.
Answer: not
23. In a pictograph, one symbol represents 10 students. A class strength of 33 cannot be represented exactly using only complete and half symbols because 33 is not a multiple of __________.
Answer: 5
24. A data table shows how many students selected each sweet but does not record their names. It is sufficient for purchasing sweets but not for __________ them to the correct students.
Answer: distributing
25. A bar graph shows 310 saplings planted during a week. If 70 were planted on Wednesday and Thursday together, the remaining days account for __________ saplings.
Answer: 240
26. A village has 12 tractors while another has 6 tractors. The first village has __________ the number of tractors in the second village.
Answer: twice
27. If one symbol represents 6 animals, half a symbol represents __________ animals.
Answer: 3
28. When category names are long, a __________ bar graph may make the labels easier to display.
Answer: horizontal
29. A graph without a specified scale cannot be interpreted __________.
Answer: accurately

30. Decorative pictures that are not proportional to the actual values may create a __________ impression of the data.
Answer: misleading

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

One-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is data?**
Answer: Data is a collection of facts, numbers, measurements, observations or descriptions that convey information.
2. **What is raw data?**
Answer: Raw data is data collected in its original and unorganised form.
3. **What is meant by data collection?**
Answer: Data collection is the process of gathering information for a particular purpose.
4. **What is frequency?**
Answer: Frequency is the number of times a particular observation or value occurs in a dataset.
5. **Why do we organise data?**
Answer: We organise data to make it easier to understand, compare and interpret.
6. **What are tally marks?**
Answer: Tally marks are short vertical lines used to record and count observations quickly.
7. **How is the fifth tally mark written?**
Answer: The fifth tally mark is drawn across the previous four tally marks.
8. **What is a frequency distribution table?**
Answer: A frequency distribution table displays observations or categories along with their frequencies.
9. **What is ascending order?**
Answer: Ascending order is the arrangement of values from the smallest to the largest.
10. **What is a pictograph?**
Answer: A pictograph is a visual representation of data using pictures or symbols.
11. **What does the key of a pictograph indicate?**
Answer: The key indicates the quantity represented by each symbol in a pictograph.
12. **Why is a key necessary in a pictograph?**
Answer: A key is necessary to determine the numerical value represented by each symbol.
13. **What is a partial symbol in a pictograph?**
Answer: A partial symbol represents a fraction of the value shown by one complete symbol.
14. **What is a bar graph?**
Answer: A bar graph represents data using rectangular bars of equal width.
15. **What does the height of a bar represent?**
Answer: The height of a bar represents the frequency or value of its category.
16. **What is the scale of a bar graph?**
Answer: The scale shows the quantity represented by one unit length of a bar.
17. **Why should the scale be written on a bar graph?**
Answer: The scale should be written so that the values represented by the bars can be interpreted accurately.

18. **Name the two types of bar graphs based on the direction of their bars.**
    Answer: The two types are vertical bar graphs and horizontal bar graphs.
19. **How should the widths of bars in a bar graph be drawn?**
    Answer: All the bars in a bar graph should be drawn with equal widths.
20. **How should the gaps between consecutive bars be maintained?**
    Answer: Equal gaps should be maintained between consecutive bars.
21. **What is shown on the horizontal axis of a vertical bar graph?**
    Answer: The horizontal axis generally shows the different categories of data.
22. **What is shown on the vertical axis of a vertical bar graph?**
    Answer: The vertical axis generally shows the frequencies or numerical values.
23. **What is an infographic?**
    Answer: An infographic is a visual presentation that combines data, pictures, symbols and text.
24. **State one advantage of a pictograph.**
    Answer: A pictograph helps readers understand and compare data quickly.
25. **State one advantage of a bar graph.**
    Answer: A bar graph makes it easy to compare the values of different categories.
26. **What does the tallest bar in a vertical bar graph indicate?**
    Answer: The tallest bar indicates the category with the highest frequency or value.
27. **What does the shortest bar in a vertical bar graph indicate?**
    Answer: The shortest bar indicates the category with the lowest frequency or value.
28. **How can the total number of observations be found from a frequency table?**
    Answer: The total number of observations is found by adding all the frequencies.
29. **Why should visual representations of data be accurate?**
    Answer: Visual representations should be accurate to prevent readers from drawing incorrect conclusions.
30. **How can a graph become misleading?**
    Answer: A graph can become misleading when it uses an unsuitable scale, unequal bars or exaggerated pictures.

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

One-Mark Descriptive Questions with Answers — HOTS Type:

1. **A list of students' favourite games is difficult to interpret; how can it be improved?**
   Answer: It can be organised into a frequency table showing each game and the number of students who prefer it.
2. **How would you identify the most popular game from a frequency table?**
   Answer: The game having the highest frequency is the most popular game.
3. **Why is arranging shoe sizes in ascending order useful?**
   Answer: It helps us quickly identify the smallest and largest sizes and count repeated sizes.
4. **A tally table has two groups of five marks and three additional marks; what is its frequency?**
   Answer: Its frequency is $5 + 5 + 3 = 13$.
5. **Why is a table showing only the number of students choosing each sweet insufficient for distributing the sweets?**
   Answer: It does not show the name of each student and the sweet chosen by that student.

6. **One pictograph symbol represents 10 children; what does half a symbol represent?**
   Answer: Half a symbol represents 5 children.
7. **A pictograph contains six symbols, with each symbol representing 100 kites; how many kites are shown?**
   Answer: The pictograph shows $6 \times 100 = 600$kites.
8. **Why is it difficult to represent 33 students when one pictograph symbol represents 10 students?**
   Answer: It is difficult because 33 cannot be represented exactly using only complete and half symbols of value 10.
9. **How many symbols are required to represent 36 dogs if one symbol represents 6 dogs?**
   Answer: Six symbols are required because $36 \div 6 = 6$.
10. **A bar is 7 units high and one unit represents 5 students; how many students does it represent?**
    Answer: The bar represents $7 \times 5 = 35$students.
11. **A bar of 6 units represents 24 tickets; what scale has been used?**
    Answer: The scale used is one unit representing $24 \div 6 = 4$tickets.
12. **How can you find the difference between the values represented by two bars?**
    Answer: Subtract the value of the shorter bar from the value of the taller bar.
13. **Two categories have the same frequency; how should their bars appear?**
    Answer: Their bars should have equal heights or lengths.
14. **Why must all bars in a bar graph have equal widths?**
    Answer: Equal widths ensure fair comparison and prevent the graph from giving a misleading impression.
15. **Why should equal gaps be maintained between the bars?**
    Answer: Equal gaps clearly separate the categories and make the graph easy to interpret.
16. **Which type of bar graph is more suitable when category names are long?**
    Answer: A horizontal bar graph is generally more suitable because it provides more space for long category names.
17. **Why should a bar graph usually begin its numerical axis at zero?**
    Answer: Beginning at zero prevents small differences between values from appearing exaggerated.
18. **Can a pictograph be interpreted correctly if its key is missing? Give a reason.**
    Answer: No, because the numerical value represented by each symbol would be unknown.
19. **A graph has an attractive design but an incorrect scale; can it be trusted?**
    Answer: No, because an incorrect scale presents the data inaccurately despite the graph's attractive appearance.
20. **How can you verify whether the tallest bar has been drawn correctly?**
    Answer: Multiply its height in units by the scale and compare the result with the original data.
21. **A bowler took three wickets in each of eight matches; how many wickets did he take in those matches?**
    Answer: He took $3 \times 8 = 24$wickets.
22. **Why is adding only the observation values in a frequency table an incorrect way to find the total?**
    Answer: Each observation must first be multiplied by its frequency because it may occur more than once.

23. **A picture is doubled in both height and width; how does its displayed area change?**
    Answer: Its displayed area becomes four times the original area.
24. **Why can enlarged pictures in an infographic mislead readers?**
    Answer: Their areas may increase disproportionately and make differences in the data appear greater than they really are.
25. **How would you determine whether one category has twice the frequency of another?**
    Answer: Check whether the larger frequency is equal to two times the smaller frequency.
26. **Why is a scale of one symbol representing 6 dogs suitable for the values 12, 18, 24, 36 and 48?**
    Answer: It is suitable because all the given values are exactly divisible by 6.
27. **If the tallest bar does not represent the greatest value in the table, what can you conclude?**
    Answer: The graph has been drawn incorrectly or an inconsistent scale has been used.
28. **How can a survey help verify which television programme is most popular in a class?**
    Answer: Each student’s choice can be collected and the programme with the highest frequency can be identified.
29. **Why is data collection unnecessary for finding the date of India’s independence?**
    Answer: It is an established historical fact that can be obtained from a reliable reference source.
30. **What should you examine before accepting the conclusion suggested by an infographic?**
    Answer: You should examine its data, scale, labels and proportional accuracy before accepting the conclusion.

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

Two-Mark Descriptive Questions with Answers — LOTS Type

1. **What is data? Give one example.**
   Answer:
   - Data is a collection of facts, numbers, measurements, observations or descriptions that provide information.
   - A list of the favourite games of students in a class is an example of data.
2. **What is meant by data collection? Mention one method of collecting data.**
   Answer:
   - Data collection is the process of gathering information for a specific purpose.
   - Data can be collected by conducting a survey or directly observing events.
3. **Why do we organise raw data?**
   Answer:
   - Raw data may be difficult to understand and interpret.
   - Organising it helps us compare values and draw conclusions easily.
4. **What is frequency? How is it determined?**
   Answer:
   - Frequency is the number of times a particular observation occurs in a dataset.
   - It is determined by counting the occurrences of that observation.
5. **What are tally marks? How are they grouped?**
   Answer:

- Tally marks are vertical strokes used to record observations quickly.
- They are grouped in sets of five, with the fifth mark crossing the first four.

6. **What is a frequency distribution table? State one advantage.**
   Answer:
   - A frequency distribution table lists different observations or categories along with their frequencies.
   - It makes data easier to read, compare and interpret.
7. **What is ascending order? How does it help in studying data?**
   Answer:
   - Ascending order arranges numerical values from the smallest to the largest.
   - It helps us identify the smallest value, largest value and repeated observations easily.
8. **What is a pictograph?**
   Answer:
   - A pictograph represents data through pictures or symbols.
   - Each picture represents a particular number of objects or observations.
9. **What is the key or scale of a pictograph? Why is it important?**
   Answer:
   - The key specifies the numerical value represented by one symbol.
   - It is important because it enables readers to calculate the quantity represented.
10. **How is a partial symbol used in a pictograph?**
    Answer:
    - A partial symbol represents a fraction of the value of a complete symbol.
    - For example, if one symbol represents 10 students, half a symbol represents 5 students.
11. **State two advantages of using a pictograph.**
    Answer:
    - A pictograph presents data in a simple and visually attractive form.
    - It helps readers compare different categories quickly.
12. **What is a bar graph?**
    Answer:
    - A bar graph represents data using rectangular bars of equal width.
    - The height or length of each bar shows the frequency or value of its category.
13. **Mention the two common types of bar graphs.**
    Answer:
    - A vertical bar graph uses bars extending upwards from the horizontal axis.
    - A horizontal bar graph uses bars extending sideways from the vertical axis.
14. **What information is displayed along the two axes of a vertical bar graph?**
    Answer:
    - The horizontal axis generally displays the categories being compared.
    - The vertical axis displays their frequencies or numerical values.
15. **Why is a scale used in a bar graph?**
    Answer:
    - A scale indicates the value represented by one unit length on an axis.
    - It allows large numerical values to be displayed conveniently and accurately.
16. **State two rules for drawing bars in a bar graph.**
    Answer:
    - All the bars must have equal widths.
    - Equal gaps should be maintained between consecutive bars.

17. **How can the category with the highest and lowest frequencies be identified from a vertical bar graph?**
    Answer:
    - The tallest bar represents the category with the highest frequency.
    - The shortest bar represents the category with the lowest frequency.
18. **How is the total number of observations found from a frequency table?**
    Answer:
    - Note the frequency given against each observation or category.
    - Add all the frequencies to obtain the total number of observations.
19. **What is an infographic? State one feature.**
    Answer:
    - An infographic communicates information by combining data, pictures, symbols and text.
    - It presents information in an attractive and easily understandable form.
20. **Why must an infographic represent data accurately?**
    Answer:
    - Inaccurate pictures or scales can exaggerate or reduce the actual differences between values.
    - Accurate representation helps readers draw correct conclusions from the data.
21. **How do colours and pictures improve the presentation of data?**
    Answer:
    - Colours help distinguish different categories and make a graph visually appealing.
    - Relevant pictures can make the displayed information easier to recognise and remember.
22. **Differentiate between a frequency table and a pictograph.**
    Answer:
    - A frequency table represents data using categories and numerical frequencies.
    - A pictograph represents the same data using pictures or symbols according to a key.
23. **Differentiate between a pictograph and a bar graph.**
    Answer:
    - A pictograph uses pictures or symbols to represent frequencies.
    - A bar graph uses rectangular bars whose heights or lengths represent frequencies.
24. **State two uses of data representation.**
    Answer:
    - Data representation helps us compare the values of different categories.
    - It helps us interpret information and draw meaningful conclusions.
25. **What precautions should be taken while reading a graph?**
    Answer:
    - The title, labels and scale of the graph should be examined carefully.
    - The lengths or heights of the bars should be interpreted according to the stated scale.

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

Two-Mark Descriptive Questions with Answers — HOTS Type:

1. **Navya has a list of the favourite games of her classmates. How can she identify the most popular game?**
   Answer:
   - She should organise the games in a frequency table using tally marks.
   - The game with the highest frequency will be the most popular.
2. **A tally table contains three complete groups of five marks and two additional marks. Find the frequency.**
   Answer:
   - Three complete groups represent $3 \times 5 = 15$observations.
   - Therefore, the total frequency is $15 + 2 = 17$.
3. **Why does arranging shoe sizes in ascending order make the data easier to analyse?**
   Answer:
   - It places the smallest and largest shoe sizes at the two ends of the list.
   - It also groups equal sizes together, making their frequencies easier to count.
4. **A sweets table shows only the number of students choosing each sweet. Why is it insufficient for distributing the sweets?**
   Answer:
   - The table gives the frequency of each choice but does not give the students' names.
   - A student-wise list of names and choices is needed for correct distribution.
5. **One symbol in a pictograph represents 10 children. What do $3\frac{1}{2}$symbols represent?**
   Answer:
   - Three complete symbols represent $3 \times 10 = 30$children.
   - Half a symbol represents 5 children, so the total is 35 children.
6. **Why is it difficult to represent 33 students when one symbol represents 10 students?**
   Answer:
   - Three complete symbols represent 30 students, leaving 3 students unrepresented.
   - Representing 3 accurately would require an inconvenient fraction of the symbol.
7. **A pictograph uses one symbol to represent 100 kites. How many symbols are needed to represent 650 kites?**
   Answer:
   - Six complete symbols represent $6 \times 100 = 600$kites.
   - One-half symbol represents the remaining 50 kites, so $6\frac{1}{2}$symbols are needed.
8. **One dog symbol represents six dogs. Represent 27 dogs using complete and partial symbols.**
   Answer:
   - Four complete symbols represent $4 \times 6 = 24$dogs.
   - One-half symbol represents 3 dogs, so $4\frac{1}{2}$symbols are required.
9. **A bar is six units high and represents 24 tickets. Determine the scale.**
   Answer:
   - Divide the represented value by the bar's height: $24 \div 6 = 4$.
   - Therefore, the scale is 1 unit = 4 tickets.

10. **Using the scale 1 unit = 5 students, determine the height of a bar representing 35 students.**
    Answer:
    - Divide the number of students by the value of one unit: $35 \div 5 = 7$.
    - Therefore, the bar should be 7 units high.
11. **Two bars represent 45 and 30 students. Find and interpret the difference.**
    Answer:
    - The difference is $45 - 30 = 15$students.
    - Thus, the first category was chosen by 15 more students than the second.
12. **Two categories have the same frequency, but their bars have different heights. What does this indicate?**
    Answer:
    - Equal frequencies must be represented by bars of equal height when the same scale is used.
    - Therefore, at least one of the bars has been drawn incorrectly.
13. **Why should the bars in a bar graph have equal widths and equal gaps?**
    Answer:
    - Equal widths prevent the size of a bar from giving a false impression of its value.
    - Equal gaps clearly separate the categories and make comparison easier.
14. **How would you check whether a bar representing 40 students is correct when the scale is 1 unit = 5 students?**
    Answer:
    - Calculate the required height as $40 \div 5 = 8$units.
    - The bar is correct only if its height is exactly 8 units.
15. **A student claims that the total number of wickets can be found by adding the values in the 'wickets per match' column. Explain the error.**
    Answer:
    - Each wickets-per-match value may occur in several matches and must be multiplied by its frequency.
    - The total is found by adding all the products of wickets and their corresponding frequencies.
16. **A bowler took 3 wickets in each of 8 matches and 4 wickets in each of 3 matches. Find the total wickets in these matches.**
    Answer:
    - The wickets taken are $3 \times 8 = 24$and $4 \times 3 = 12$.
    - Therefore, the bowler took $24 + 12 = 36$wickets in all.
17. **Would you choose a vertical or horizontal bar graph to represent the lengths of the longest rivers? Give reasons.**
    Answer:
    - A horizontal bar graph is convenient because river names can be written clearly beside the bars.
    - The lengths of rivers can also be compared naturally through horizontal bar lengths.
18. **Why can a graph whose numerical axis does not begin at zero be misleading?**
    Answer:
    - A shortened axis can make small differences between values appear unusually large.
    - Readers may therefore overestimate the actual difference between the categories.

19. **A mountain picture is doubled in both height and width to represent twice the value. Why is this misleading?**
   Answer:
   - Doubling both dimensions makes the picture's area four times as large.
   - The visual impression therefore exaggerates the actual twofold increase.
20. **Everest is 8,849 m high and Elbrus is 5,642 m high. Is Everest twice as high as Elbrus? Justify.**
   Answer:
   - Twice the height of Elbrus is $5{,}642 \times 2 = 11{,}284$m.
   - Since 8,849 m is less than 11,284 m, Everest is not twice as high.
21. **Village B has 36 dogs and Village D has 48 dogs. If one symbol represents 6 dogs, compare the required symbols.**
   Answer:
   - Village B requires $36 \div 6 = 6$symbols, while Village D requires $48 \div 6 = 8$symbols.
   - Therefore, Village D requires two more symbols than Village B.
22. **A survey shows 13 bikes, 9 scooters, 8 bicycles and 6 cars. What conclusions can be drawn?**
   Answer:
   - Bikes were observed most frequently because they have the highest frequency of 13.
   - Cars were observed least frequently because they have the lowest frequency of 6.
23. **A pictograph has no key or scale. Can its exact numerical values be determined? Explain.**
   Answer:
   - The number of symbols can be counted, but the value represented by each symbol is unknown.
   - Therefore, the exact numerical values cannot be determined.
24. **How can you determine whether one category has twice the frequency of another from a bar graph?**
   Answer:
   - Read the two values using the scale given on the graph.
   - Check whether the larger value is exactly two times the smaller value.
25. **An infographic looks attractive but uses pictures of unequal proportions. Should its conclusion be accepted immediately?**
   Answer:
   - No, because disproportionate pictures can exaggerate or reduce the differences between values.
   - The original data, scale and dimensions should be checked before accepting its conclusion.

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

Three-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is data? Mention two examples of data.**
   Answer:
   - Data is a collection of facts, numbers, measurements, observations or descriptions that convey information.
   - A list of students' favourite games is an example of data.

- The weights or shoe sizes of students are also examples of data.

2. **Explain the process of collecting and organising data.**
   Answer:
   - First, information is collected through observation, measurement, interviews or surveys.
   - The collected data is classified into suitable categories.
   - It is then arranged in a table using tally marks and frequencies.
3. **What are tally marks? Explain how they are used.**
   Answer:
   - Tally marks are short strokes used to record observations quickly.
   - One vertical mark is drawn for each observation.
   - Every fifth mark crosses the previous four marks to form a group of five.
4. **What is frequency? How is it represented in a table?**
   Answer:
   - Frequency is the number of times a particular observation or category occurs.
   - Tally marks can be used to count the occurrences of each observation.
   - The final count is written as a number in the frequency column.
5. **State three advantages of organising data in a table.**
   Answer:
   - A table presents data in a systematic and compact form.
   - It makes comparison between different categories easier.
   - It helps identify the highest, lowest and equal frequencies quickly.
6. **How does arranging numerical data in ascending order help us?**
   Answer:
   - It arranges the observations from the smallest to the largest value.
   - It helps us identify the smallest and largest observations easily.
   - It also makes repeated observations and their frequencies easier to count.
7. **What is a pictograph? Explain its main features.**
   Answer:
   - A pictograph represents data using pictures or symbols.
   - Each picture represents a fixed number of objects or observations.
   - A key or scale is provided to explain the value of each symbol.
8. **Explain the importance of the key in a pictograph.**
   Answer:
   - The key states the quantity represented by one complete symbol.
   - It helps calculate the value represented by several symbols.
   - It also helps interpret complete and partial symbols correctly.
9. **How are partial symbols used in a pictograph? Give an example.**
   Answer:
   - A partial symbol represents a fraction of the value of a complete symbol.
   - If one complete symbol represents 10 children, half a symbol represents 5 children.
   - Partial symbols are used when the frequency is not an exact multiple of the key value.
10. **State three advantages of using pictographs.**
    Answer:
    - Pictographs present data in an attractive visual form.
    - They allow quick comparison between different categories.
    - They help readers identify the highest and lowest frequencies easily.

11. **What is a bar graph? Describe its basic features.**
    Answer:
    - A bar graph represents data using rectangular bars of equal width.
    - The height or length of each bar represents the value or frequency of a category.
    - Equal gaps are maintained between consecutive bars.
12. **Explain the two axes of a vertical bar graph.**
    Answer:
    - The horizontal axis generally displays the categories being compared.
    - The vertical axis displays the frequencies or numerical values.
    - The values on the vertical axis are marked according to a suitable scale.
13. **Differentiate between vertical and horizontal bar graphs.**
    Answer:
    - In a vertical bar graph, the bars extend upwards from the horizontal axis.
    - In a horizontal bar graph, the bars extend sideways from the vertical axis.
    - Both types use the height or length of bars to represent data values.
14. **What is the scale of a bar graph? Why is it necessary?**
    Answer:
    - The scale states the value represented by one unit length on the graph.
    - It allows large values to be represented within the available space.
    - It helps readers calculate and interpret the values of the bars accurately.
15. **Mention three rules for drawing a bar graph.**
    Answer:
    - All bars must have equal widths.
    - Equal gaps must be maintained between consecutive bars.
    - A suitable scale, title and axis labels must be provided.
16. **How can information be interpreted from a bar graph?**
    Answer:
    - The scale is used to determine the value represented by each bar.
    - The tallest or longest bar represents the highest frequency.
    - The shortest bar represents the lowest frequency.
17. **Differentiate between a frequency table, pictograph and bar graph.**
    Answer:
    - A frequency table represents data using categories, tally marks and numerical frequencies.
    - A pictograph represents data using pictures or symbols according to a key.
    - A bar graph represents data using rectangular bars drawn according to a scale.
18. **What is an infographic? Mention two of its features.**
    Answer:
    - An infographic is a visual presentation of information or data.
    - It combines numbers with pictures, symbols, colours and brief text.
    - It presents information in an attractive and easily understandable form.
19. **How do colours and pictures improve data presentation?**
    Answer:
    - Colours help distinguish one category from another.
    - Pictures make data more attractive and easier to recognise.
    - They should be used proportionately so that the data is not misrepresented.
20. **Mention three precautions to follow while reading a graph or infographic.**
    Answer:
    - Read the title, labels, key and scale carefully.

- Check whether the bars or pictures are proportional to the given values.
- Avoid drawing conclusions from decorative elements that may exaggerate the data.

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

Three-Mark Descriptive Questions with Answers — HOTS Type:

1. **Navya collected a list of her classmates' favourite games. How should she organise and analyse the data to find the most popular game?**
   Answer:
   - She should list each game in a frequency table and use tally marks to record the students' choices.
   - She should count the tally marks and write the frequency of each game.
   - The game with the highest frequency will be the most popular game.
2. **A tally table contains four complete groups of five marks and three additional marks. Find the frequency and explain your method.**
   Answer:
   - Four complete groups represent $4 \times 5 = 20$observations.
   - The three additional tally marks represent 3 more observations.
   - Therefore, the total frequency is $20 + 3 = 23$.
3. **The shoe sizes of eight students are 6, 4, 5, 7, 4, 3, 5 and 4. Arrange and interpret the data.**
   Answer:
   - In ascending order, the data is 3, 4, 4, 4, 5, 5, 6, 7.
   - The smallest shoe size is 3 and the largest shoe size is 7.
   - Shoe size 4 occurs most frequently, appearing three times.
4. **A sweets table shows that 6 students chose jalebi, 9 chose gulab jamun and 13 chose gujiya. What can be inferred from the data?**
   Answer:
   - Gujiya is the most popular sweet because it has the highest frequency of 13.
   - Jalebi is the least popular among the three because it has the lowest frequency of 6.
   - Altogether, $6 + 9 + 13 = 28$students were surveyed.
5. **One pictograph symbol represents 10 children. How would you represent 35 children, and why?**
   Answer:
   - Three complete symbols represent $3 \times 10 = 30$children.
   - Half a symbol represents the remaining $10 \div 2 = 5$children.
   - Therefore, 35 children should be represented by $3\frac{1}{2}$symbols.
6. **A pictograph uses one symbol to represent 100 kites. Find the symbols required to show 450 kites.**
   Answer:
   - Four complete symbols represent $4 \times 100 = 400$kites.
   - Half a symbol represents the remaining 50 kites.
   - Therefore, $4\frac{1}{2}$symbols are required to represent 450 kites.
7. **Why may a scale of one symbol representing 10 students be unsuitable for frequencies such as 27 and 33?**
   Answer:

- Complete symbols represent multiples of 10, while half-symbols represent multiples of 5.
- The numbers 27 and 33 cannot be represented exactly using only complete and half-symbols.
- A smaller scale, such as one symbol representing one student, would show the data accurately.

8. **A bar is six units high and represents 24 railway tickets. Determine the scale and the height needed for 36 tickets.**
   Answer:
   - The scale is $24 \div 6 = 4$tickets for each unit.
   - The bar height required for 36 tickets is $36 \div 4 = 9$units.
   - Therefore, the scale is 1 unit = 4 tickets, and the second bar should be 9 units high.
9. **A bar graph uses the scale 1 unit = 5 students. Compare bars of 9 units and 6 units.**
   Answer:
   - The first bar represents $9 \times 5 = 45$students.
   - The second bar represents $6 \times 5 = 30$students.
   - Thus, the first category has $45 - 30 = 15$more students.
10. **Two categories have frequencies of 20 and 40, but their bars are drawn with heights of 5 units and 8 units. Is the graph correct?**
    Answer:
    - The first bar gives a scale of $20 \div 5 = 4$units of value per unit length.
    - With this scale, a frequency of 40 requires a bar of $40 \div 4 = 10$units.
    - Therefore, the second bar is incorrect because it should be 10 units high.
11. **A transport survey records 13 bikes, 9 scooters, 8 bicycles, 8 autorickshaws, 6 cars and 4 buses. Interpret the findings.**
    Answer:
    - Bikes were observed most frequently, with a frequency of 13.
    - Bicycles and autorickshaws were observed equally often, with 8 observations each.
    - Buses were observed least frequently, with a frequency of 4.
12. **A bowler took 2 wickets in 5 matches, 3 wickets in 8 matches and 4 wickets in 3 matches. Find the total wickets taken.**
    Answer:
    - The wickets in the three groups are $2 \times 5 = 10$, $3 \times 8 = 24$and $4 \times 3 = 12$.
    - The total number of wickets is $10 + 24 + 12 = 46$.
    - Simply adding 2, 3 and 4 would be incorrect because their frequencies must be considered.
13. **Why can a graph with an incorrect scale lead to a wrong conclusion? Give an example.**
    Answer:
    - An incorrect scale causes the length or height of a bar to represent the wrong value.
    - For example, with 1 unit = 5 students, a bar of 6 units represents 30 students, not 35.
    - Therefore, comparisons and conclusions based on such a graph will be inaccurate.

14. **Everest is 8,849 m high and Elbrus is 5,642 m high. Evaluate the statement, "Everest is twice as high as Elbrus."**
    Answer:
    - Twice the height of Elbrus is $5{,}642 \times 2 = 11{,}284$m.
    - Everest's height of 8,849 m is less than 11,284 m.
    - Therefore, the statement that Everest is twice as high as Elbrus is incorrect.
15. **A designer doubles both the height and width of a picture to represent twice the quantity. Explain why this is misleading.**
    Answer:
    - Doubling both dimensions makes the picture's area $2 \times 2 = 4$times the original area.
    - The viewer may wrongly believe that the quantity has increased fourfold.
    - Only one dimension should be changed proportionately, or equal-width bars should be used.
16. **When would a horizontal bar graph be preferable to a vertical bar graph? Explain with an example.**
    Answer:
    - A horizontal bar graph is useful when category names are long and need more writing space.
    - It is also suitable for comparing naturally horizontal measures such as river lengths.
    - For example, the longest rivers of different continents can be compared clearly with horizontal bars.
17. **A graph begins its vertical axis at 90 instead of zero and compares values 95 and 100. Why should it be examined carefully?**
    Answer:
    - The graph displays only the small interval between 90 and 100.
    - This can make the difference of 5 appear much larger than it actually is.
    - The scale and starting value must therefore be checked before interpreting the graph.
18. **A pictograph has attractive symbols but does not include a key. Analyse its usefulness.**
    Answer:
    - The symbols may show which category has more or fewer observations.
    - However, the exact quantity represented by each symbol cannot be determined.
    - Therefore, the pictograph is incomplete and cannot provide precise numerical information.
19. **Village B has 36 dogs and Village D has 48 dogs, with one symbol representing 6 dogs. Compare their pictograph representations.**
    Answer:
    - Village B requires $36 \div 6 = 6$symbols.
    - Village D requires $48 \div 6 = 8$symbols.
    - Thus, Village D requires two more symbols and has 12 more dogs than Village B.
20. **How would you verify whether an infographic presents data fairly and accurately?**
    Answer:
    - Check that its title, labels, key and scale are clearly stated and consistently used.

- Compare the sizes of its bars or pictures with the original numerical data.
- Ensure that decorative elements do not exaggerate or hide differences between the values.

4.11 Five-mark questions with Answers of LOTS Type: (10 Questions)

Five-Mark Descriptive Questions with Answers — LOTS Type:

1. Explain the meaning of data and the process of collecting and organising it.

Answer:

1. Data is a collection of facts, numbers, measurements, observations or descriptions that provide information.
2. Data can be collected through surveys, interviews, observations or measurements.
3. The collected raw data is classified into suitable categories.
4. Tally marks can be used to record the occurrence of each category.
5. The data is finally presented in a frequency table for easy comparison and interpretation.

2. Explain tally marks and frequency tables with their uses.

Answer:

1. Tally marks are short vertical strokes used to record observations quickly.
2. One tally mark is drawn for each occurrence of an observation.
3. Every fifth tally mark crosses the previous four to form a group of five.
4. The number of tally marks for a category gives its frequency.
5. A frequency table makes it easy to identify the highest, lowest and equal frequencies.

3. Explain how arranging data in ascending order helps in its interpretation.

Answer:

1. Ascending order means arranging numerical values from the smallest to the largest.
2. It helps us identify the smallest value immediately.
3. It also makes the largest value easy to locate.
4. Equal observations appear together and can be counted conveniently.
5. Therefore, the frequency of each observation can be determined easily.

4. What is a pictograph? Explain its important features.

Answer:

1. A pictograph is a visual representation of data using pictures or symbols.
2. Each picture represents a fixed number of objects or observations.
3. A key or scale specifies the value represented by one complete symbol.
4. Partial symbols may represent fractions of the value of a complete symbol.
5. A pictograph helps readers compare categories and interpret data quickly.

5. Describe the steps involved in constructing a pictograph.

Answer:

1. Collect and organise the data into appropriate categories.
2. Select a simple and suitable picture or symbol to represent the data.
3. Choose a convenient scale based on the given frequencies.
4. Draw the required number of complete or partial symbols for every category.
5. Provide a suitable title, category labels and a clearly written key.

6. What is a bar graph? Explain its main features.

Answer:

1. A bar graph represents data using rectangular bars.
2. All the bars should have equal widths.
3. Equal gaps should be maintained between consecutive bars.
4. The height or length of each bar represents the frequency or value of its category.

5. A suitable title, scale and labels must be included for correct interpretation.

7. Describe the steps involved in constructing a vertical bar graph.

Answer:

1. Draw a horizontal axis and a vertical axis perpendicular to each other.
2. Write the categories at equal intervals along the horizontal axis.
3. Choose a suitable scale and mark the numerical values on the vertical axis.
4. Draw bars of equal width and appropriate height with equal gaps between them.
5. Add a suitable title and label both axes clearly.

8. Differentiate among a frequency table, pictograph and bar graph.

Answer:

1. A frequency table presents categories and their numerical frequencies in rows and columns.
2. It may use tally marks to record and count observations.
3. A pictograph uses pictures or symbols to represent frequencies according to a key.
4. A bar graph uses equal-width rectangular bars drawn according to a scale.
5. All three forms help organise, compare and interpret data effectively.

9. Explain the role of scale in pictographs and bar graphs.

Answer:

1. A scale states the quantity represented by one symbol or one unit length.
2. In a pictograph, it determines the value of each complete or partial symbol.
3. In a bar graph, it determines the value represented by the height or length of a bar.
4. A suitable scale makes large data values easier to display.
5. The scale must be stated clearly and used consistently to avoid misinterpretation.

10. Explain how a bar graph is read and interpreted.

Answer:

1. First, read the title to understand what information the graph presents.
2. Study the labels on both axes to identify the categories and numerical values.
3. Note the scale used to calculate the value represented by each bar.
4. Compare the heights or lengths of the bars to identify the highest and lowest values.
5.

Five-Mark Descriptive Questions with Answers — LOTS Type

Chapter 4: Data Handling and Presentation

1. What is data? Explain the basic steps involved in collecting and organising data.

Answer:

1. Data is a collection of facts, numbers, measurements, observations or descriptions that convey information.
2. Data may be collected through surveys, interviews, observations or measurements.
3. The collected data is classified into suitable categories based on the purpose of the study.
4. Tally marks are used to record the number of observations in each category.
5. The tally marks are counted and their frequencies are entered in a table for easy interpretation.

2. Explain how a frequency distribution table is prepared.

Answer:

1. First, study the raw data and identify the different observations or categories.
2. Write each distinct observation or category in the first column of the table.
3. Record every occurrence using tally marks in the second column.
4. Count the tally marks and write the corresponding frequencies in the third column.
5. Add all the frequencies to check the total number of observations.

3. Explain tally marks and their use in organising data.

Answer:
1. Tally marks are short vertical strokes used for recording observations quickly.
2. One tally mark is drawn whenever a particular observation occurs.
3. The first four observations are shown using four separate vertical strokes.
4. The fifth tally mark is drawn across the previous four to form a group of five.
5. These groups make counting frequencies faster and reduce the chances of error.

4. What is a pictograph? Explain how it is constructed and interpreted.

Answer:
1. A pictograph is a visual representation of data using pictures or symbols.
2. The categories are written in one column, and the corresponding symbols are drawn beside them.
3. A suitable key is selected to show the value represented by one complete symbol.
4. Partial symbols may be used to represent fractions of the value of a complete symbol.
5. The data is interpreted by multiplying the number of symbols by the value stated in the key.

5. Explain the importance of the key or scale in a pictograph.

Answer:
1. The key indicates the quantity represented by one complete symbol.
2. It helps convert the symbols into their actual numerical values.
3. It enables readers to interpret partial symbols such as half or quarter symbols.
4. A suitable key reduces the number of symbols needed to represent large quantities.
5. Without a key, the exact values shown in a pictograph cannot be determined.

6. What is a bar graph? Explain its important features.

Answer:
1. A bar graph represents numerical data using rectangular bars.
2. All the bars must have equal widths and equal gaps between them.
3. The categories are shown along one axis and their frequencies along the other axis.
4. The height or length of each bar represents the value of its category according to a scale.
5. A bar graph should include a suitable title, labels and clearly stated scale.

7. Describe the steps involved in drawing a vertical bar graph.

Answer:
1. Draw two perpendicular lines to form the horizontal and vertical axes.
2. Write the categories at equal intervals along the horizontal axis.
3. Choose a suitable scale and mark the frequencies along the vertical axis.
4. Draw equal-width bars with equal gaps according to the given frequencies.
5. Add a suitable title and label both axes clearly.

8. Differentiate among a frequency table, pictograph and bar graph.

Answer:
1. A frequency table organises data using categories, tally marks and numerical frequencies.
2. A pictograph represents data using pictures or symbols according to a specified key.
3. A bar graph represents data using rectangular bars drawn according to a scale.
4. A table provides exact numerical information, while a pictograph gives an attractive visual display.
5. A bar graph makes comparison among several categories quick and convenient.

9. Explain how data can be interpreted from a bar graph.

Answer:
1. Begin by reading the title to understand what information the graph presents.
2. Observe the labels on both axes to identify the categories and quantities.
3. Read the scale carefully to find the value represented by one unit length.

4. Determine each value by comparing the height or length of its bar with the scale.
5. Compare the bars to identify the highest, lowest, equal and total frequencies.

10. What precautions should be followed while preparing and reading visual representations of data?

Answer:

1. A suitable and uniform scale should be selected and clearly stated.
2. Bars should have equal widths and equal gaps between them.
3. Pictures and symbols should be proportional to the numerical values they represent.
4. The title, axis labels and pictograph key should be displayed clearly.
5. Decorative features should not exaggerate differences or create a misleading impression.

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

Five-Mark Descriptive Questions with Answers — HOTS Type

1. The favourite games of 30 students are recorded as follows: Cricket–8, Hockey–10, Football–5, Kabaddi–4 and Badminton–3. Analyse the data.

Answer:

1. The total frequency is $8 + 10 + 5 + 4 + 3 = 30$, which agrees with the number of students surveyed.
2. Hockey is the most popular game because it has the highest frequency of 10.
3. Badminton is the least popular game because it has the lowest frequency of 3.
4. The difference between the frequencies of hockey and badminton is $10 - 3 = 7$.
5. Cricket and football together are preferred by $8 + 5 = 13$students.

2. A pictograph uses one symbol to represent 10 students. The categories contain $4\frac{1}{2}$, 3, $2\frac{1}{2}$and 5 symbols. Interpret the pictograph.

Answer:

1. The first category represents $4\frac{1}{2} \times 10 = 45$students.
2. The second category represents $3 \times 10 = 30$students.
3. The third category represents $2\frac{1}{2} \times 10 = 25$students.
4. The fourth category represents $5 \times 10 = 50$students.
5. The total number of students represented is $45 + 30 + 25 + 50 = 150$.

3. A pictograph must represent 300, 450, 600 and 750 kites. Suggest a suitable scale and explain the representation.

Answer:

1. A suitable scale is one symbol representing 100 kites.
2. The first value, 300 kites, requires $300 \div 100 = 3$complete symbols.
3. The second value, 450 kites, requires $4\frac{1}{2}$symbols.
4. The third and fourth values require 6 symbols and $7\frac{1}{2}$symbols respectively.
5. This scale is convenient because all the values can be represented using complete and half-symbols.

4. A bar graph uses the scale 1 unit = 5 students. Its bars have heights of 4, 7, 5, 9 and 3 units. Analyse the data.

Answer:

1. The bars represent $20, 35, 25, 45$and 15 students respectively.
2. The fourth category has the highest frequency of 45 students.
3. The fifth category has the lowest frequency of 15 students.

4. The difference between the highest and lowest frequencies is $45 - 15 = 30$.
5. The total number of students represented is $20 + 35 + 25 + 45 + 15 = 140$.

5. A railway-ticket graph shows that a bar of 6 units represents 24 tickets. Find the scale and determine the heights needed for 16, 28, 36 and 40 tickets.

Answer:

1. The scale is $24 \div 6 = 4$tickets for every unit length.
2. A value of 16 tickets requires a bar of $16 \div 4 = 4$units.
3. A value of 28 tickets requires a bar of $28 \div 4 = 7$units.
4. Values of 36 and 40 tickets require bars of 9 units and 10 units respectively.
5. Therefore, the bars should have heights of 4, 7, 9 and 10 units using the scale 1 unit = 4 tickets.

6. A bowler's performance is shown below: 0 wickets in 2 matches, 1 wicket in 5 matches, 2 wickets in 7 matches, 3 wickets in 8 matches and 4 wickets in 3 matches. Find the total wickets and analyse the data.

Answer:

1. The wickets contributed by the five groups are $0 \times 2 = 0$, $1 \times 5 = 5$, $2 \times 7 = 14$, $3 \times 8 = 24$and $4 \times 3 = 12$.
2. The bowler took $0 + 5 + 14 + 24 + 12 = 55$wickets in these matches.
3. He most frequently took 3 wickets in a match because this occurred in 8 matches.
4. He remained wicketless in 2 matches.
5. Adding only $0 + 1 + 2 + 3 + 4$would be incorrect because the frequency of each performance must be considered.

7. A graph represents the values 20 and 30 using bars of heights 4 cm and 10 cm respectively. Evaluate the graph.

Answer:

1. The first bar gives a scale of $20 \div 4 = 5$units of value per centimetre.
2. According to this scale, the bar for 30 should be $30 \div 5 = 6$cm high.
3. The second bar is therefore 4 cm taller than its correct height.
4. Its excessive height exaggerates the difference between the two values.
5. The graph should be corrected by using one uniform scale for both bars.

8. An infographic doubles both the height and width of a mountain image to represent twice the height. Explain why this is misleading and suggest a correction.

Answer:

1. Doubling the height and width makes the image four times as large in area.
2. Viewers may incorrectly assume that the represented quantity is four times greater.
3. The enlarged area therefore exaggerates the actual twofold difference.
4. The images should have equal widths, with only their heights changing according to the data.
5. A bar graph with a clearly stated scale would provide a more accurate comparison.

9. Everest is 8,849 m high and Elbrus is 5,642 m high. Analyse an infographic that shows Everest as twice as tall as Elbrus.

Answer:

1. Twice the height of Elbrus is $5{,}642 \times 2 = 11{,}284$m.
2. Everest, at 8,849 m, is less than 11,284 m.
3. The actual difference between the two mountains is $8{,}849 - 5{,}642 = 3{,}207$m.
4. Therefore, showing Everest as twice as tall exaggerates the difference.
5. Both mountain images should be drawn using the same proportional vertical scale.

10. A student wants to find the most common means of transport passing a road in one hour. Explain an appropriate data-handling process.

Answer:

1. The student should decide the exact location and one-hour observation period.
2. A table listing vehicles such as bikes, cars, buses, bicycles and autorickshaws should be prepared.
3. One tally mark should be recorded whenever a vehicle of a particular type passes.
4. The tallies should be counted and converted into numerical frequencies.
5. The vehicle type with the highest frequency will be the most commonly observed means of transport.

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

Five-Mark Descriptive Questions with Answers — Applied Type:

1. A class teacher surveyed the favourite fruits of 40 students and obtained the following data: mango–12, apple–8, banana–10, orange–6 and grapes–4. Analyse the data and explain how it can be presented.

Answer:

1. The data can be organised in a frequency table with fruits and the number of students as its columns.
2. The total frequency is $12 + 8 + 10 + 6 + 4 = 40$, which agrees with the number of students surveyed.
3. Mango is the most popular fruit because it is preferred by 12 students.
4. Grapes are the least popular fruit because they are preferred by only 4 students.
5. A bar graph using the scale 1 unit = 2 students can represent the data with bars of 6, 4, 5, 3 and 2 units respectively.

2. A librarian recorded the number of books borrowed from Monday to Saturday as 20, 35, 25, 40, 30 and 50. Prepare a plan for representing and interpreting the data.

Answer:

1. Write the days along the horizontal axis and the number of books along the vertical axis.
2. Choose the scale 1 unit = 5 books because all the given values are divisible by 5.
3. Draw bars of 4, 7, 5, 8, 6 and 10 units for Monday to Saturday respectively.
4. Saturday has the highest borrowing, with 50 books, while Monday has the lowest, with 20 books.
5. Altogether, $20 + 35 + 25 + 40 + 30 + 50 = 200$books were borrowed during the six days.

3. A school recorded the means of transport used by its students: bus–60, car–30, bicycle–20, walking–40 and autorickshaw–50. Represent the data using a pictograph.

Answer:

1. A suitable key is one symbol representing 10 students.
2. Bus requires $60 \div 10 = 6$symbols, while car requires $30 \div 10 = 3$symbols.
3. Bicycle requires 2 symbols, walking requires 4 symbols and autorickshaw requires 5 symbols.
4. Bus is the most commonly used mode of transport, while bicycle is the least used.
5. The pictograph represents a total of $60 + 30 + 20 + 40 + 50 = 200$students.

4. A fruit seller sold 45 kg of apples, 30 kg of oranges, 25 kg of bananas, 40 kg of mangoes and 20 kg of grapes. Explain how a bar graph can help the seller.

Answer:

1. The fruits can be written along the horizontal axis and their quantities along the vertical axis.
2. Using the scale 1 unit = 5 kg, bars of 9, 6, 5, 8 and 4 units should be drawn.
3. Apples were sold in the greatest quantity, while grapes were sold in the least quantity.

4. The difference between apple and grape sales is $45 - 20 = 25$kg.
5. The seller can use this information to stock more apples and fewer grapes in the future.

5. A doctor recorded the number of patients visiting a clinic from Monday to Friday as 24, 32, 20, 36 and 28. Analyse the data using a suitable graph.

Answer:

1. A vertical bar graph can be drawn with days on the horizontal axis and patients on the vertical axis.
2. A suitable scale is 1 unit = 4 patients, giving bar heights of 6, 8, 5, 9 and 7 units.
3. Thursday had the highest number of patients, with 36 visits.
4. Wednesday had the lowest number of patients, with 20 visits.
5. The doctor can arrange additional staff on busier days, particularly Thursday.

6. Students planted 18, 36, 12, 48, 18 and 24 saplings in six areas of their school. Prepare and interpret a pictograph.

Answer:

1. A convenient key is one tree symbol representing 6 saplings.
2. The six areas require 3, 6, 2, 8, 3 and 4 symbols respectively.
3. The fourth area has the highest number of saplings, while the third area has the lowest.
4. The first and fifth areas have an equal number of saplings because both have 18.
5. The total number of saplings planted is $18 + 36 + 12 + 48 + 18 + 24 = 156$.

7. A household spends ₹3,500 on food, ₹2,000 on rent, ₹1,000 on education, ₹500 on electricity and ₹1,500 on other needs. Analyse the expenditure.

Answer:

1. The total household expenditure is ₹$3{,}500 + 2{,}000 + 1{,}000 + 500 + 1{,}500 = 8{,}500$.
2. Food has the highest expenditure of ₹3,500.
3. Electricity has the lowest expenditure of ₹500.
4. Food expenditure is ₹$3{,}500 - 2{,}000 = 1{,}500$ more than rent expenditure.
5. A bar graph using the scale 1 unit = ₹500 can display and compare these expenses clearly.

8. A student observes traffic for one hour and records 15 bikes, 10 cars, 5 buses, 8 bicycles and 12 autorickshaws. Explain how the student should organise and use the data.

Answer:

1. The student should prepare a frequency table listing each vehicle type and its frequency.
2. The total number of vehicles observed is $15 + 10 + 5 + 8 + 12 = 50$.
3. Bikes are the most frequently observed vehicles, while buses are the least frequent.
4. The difference between the numbers of bikes and buses is $15 - 5 = 10$.
5. The information can help local authorities understand traffic patterns and plan road-safety measures.

9. A canteen sold 60 idlis, 45 dosas, 30 sandwiches, 20 fruit bowls and 25 plates of rice. How can the data help the canteen manager?

Answer:

1. The sales can be presented using a bar graph with the scale 1 unit = 5 plates.
2. The bars for idlis, dosas, sandwiches, fruit bowls and rice should measure 12, 9, 6, 4 and 5 units respectively.
3. Idli is the most popular item, whereas fruit bowl is the least popular item.
4. The difference between the highest and lowest sales is $60 - 20 = 40$plates.
5. The manager can prepare more idlis and review the quantity or promotion of fruit bowls.

10. A school infographic shows 100 students using one child-shaped picture and 200 students using a picture doubled in both height and width. Evaluate and improve the design.

Answer:

1. Doubling both the height and width makes the second picture four times larger in area.
2. The design therefore visually suggests 400 students instead of 200 students.
3. Such disproportionate enlargement can mislead readers about the actual difference.
4. The pictures should have equal widths, with the second picture only twice as tall, or two equal symbols should be used.
5. A bar graph with a uniform scale would provide an even clearer and more accurate comparison.

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

Olympiad-Type Multiple Choice Questions:

(1) Which of the following best describes *data*?
A. A single mathematical operation
B. A collection of facts, numbers or observations
C. A geometrical figure
D. A mathematical formula
Answer: B. A collection of facts, numbers or observations

(2) The marks scored by eight students are:
12, 15, 18, 12, 16, 12, 15, 14
What is the frequency of 12?
A. 2
B. 3
C. 4
D. 5
Answer: B. 3

(3) Which tally mark represents a frequency of 13?
A. Two groups of five and three additional marks
B. One group of five and three additional marks
C. Three groups of five
D. Two groups of five and two additional marks
Answer: A. Two groups of five and three additional marks

(4) The following table shows the number of books read by students:

Books read	**Number of students**
2	3
3	5
4	4
5	2

How many students were surveyed?
A. 12
B. 13
C. 14
D. 15
Answer: C. 14

5. Using the table in Question 4, how many students read more than three books?
A. 5
B. 6
C. 7
D. 9

Answer: B. 6

6. In a pictograph, one ★ represents 4 students. If a class is represented by 7 stars, how many students are in the class?

A. 11
B. 21
C. 28
D. 32

Answer: C. 28

7. In a pictograph, one symbol represents 6 mangoes. What does half a symbol represent?

A. 2 mangoes
B. 3 mangoes
C. 4 mangoes
D. 5 mangoes

Answer: B. 3 mangoes

8. A pictograph uses one ● to represent 5 bicycles. How many complete symbols are required to represent 40 bicycles?

A. 5
B. 6
C. 8
D. 10

Answer: C. 8

9. The number of visitors to a museum on four days was 120, 180, 240 and 300. Which scale is most convenient for constructing a bar graph?

A. 1 unit = 2 visitors
B. 1 unit = 3 visitors
C. 1 unit = 60 visitors
D. 1 unit = 100 visitors

Answer: C. 1 unit = 60 visitors

10. In a bar graph, the height of a bar is 8 cm and the scale is 1 cm = 25 students. How many students does the bar represent?

A. 100
B. 150
C. 200
D. 225

Answer: C. 200

11. The frequencies of four observations are 6, 8, $x$and 9. If their total frequency is 30, find x.

A. 5
B. 6
C. 7
D. 8

Answer: C. 7

12. Consider the following data:

5, 7, 6, 8, 7, 9, 7, 6, 5, 7
Which number occurs most frequently?

A. 5
B. 6
C. 7
D. 8

Answer: C. 7

13. A survey records the favourite fruits of students:

Fruit	**Number of students**
Apple	12
Mango	18
Orange	9
Banana	15

How many more students prefer mangoes than oranges?
A. 6
B. 7
C. 8
D. 9
Answer: D. 9

14. Using the table in Question 13, what fraction of the students prefer bananas?
A. $\frac{2}{9}$
B. $\frac{5}{18}$
C. $\frac{1}{3}$
D. $\frac{5}{9}$
Answer: B. $\frac{5}{18}$
Total students $= 12 + 18 + 9 + 15 = 54$; required fraction $= \frac{15}{54} = \frac{5}{18}$.

15. A bar representing 45 trees is 9 cm high. At the same scale, what should be the height of a bar representing 30 trees?
A. 5 cm
B. 6 cm
C. 7 cm
D. 8 cm
Answer: B. 6 cm

16. Which feature is essential for interpreting a pictograph correctly?
A. The colour of the page
B. The name of the artist
C. The key or scale of the symbols
D. The number of letters in the title
Answer: C. The key or scale of the symbols

17. A shop sold 24 pens on Monday. Sales increased by 6 pens each day for the next three days. How many pens were sold on Thursday?
A. 36
B. 40
C. 42
D. 48
Answer: C. 42

18. The frequencies of five categories are 12, 15, 8, 10 and 5. What percentage of the total frequency is represented by the category having frequency 15?
A. 15%
B. 20%
C. 25%
D. 30%

Answer: D. 30%

Total frequency $= 50$, and $\frac{15}{50} \times 100 = 30\%$.

19. In a pictograph, one tree symbol represents 8 trees. A village has 44 trees. How should 44 trees be represented?

A. 4 complete symbols and one-half symbol
B. 5 complete symbols and one-half symbol
C. 5 complete symbols and one-fourth symbol
D. 6 complete symbols

Answer: B. 5 complete symbols and one-half symbol

20. Two bars in a graph have heights of 6 cm and 9 cm. If 1 cm represents 12 units, what is the difference between the represented quantities?

A. 24 units
B. 30 units
C. 36 units
D. 48 units

Answer: C. 36 units

21. A survey of 40 students shows that 14 prefer cricket, 10 prefer football, 8 prefer badminton and the rest prefer basketball. How many students prefer basketball?

A. 6
B. 8
C. 10
D. 12

Answer: B. 8

22. Which of the following may make a bar graph misleading?

A. Giving the graph a suitable title
B. Labelling both axes clearly
C. Using unequal intervals on the same axis
D. Keeping equal spaces between the bars

Answer: C. Using unequal intervals on the same axis

23. Study the following frequency table:

Number	**Frequency**
1	4
2	6
3	5
4	3

What is the sum of all the observations represented by the table?

A. 18
B. 38
C. 42
D. 45

Answer: D. 45

Sum $= (1 \times 4) + (2 \times 6) + (3 \times 5) + (4 \times 3) = 45$.

24. A student recorded temperatures of 28°C, 30°C, 32°C, 31°C and 29°C. If a bar graph begins its vertical axis at 28°C instead of 0°C, what precaution is necessary?

A. The bars should have different widths.
B. A break in the axis should be clearly indicated.
C. The graph should not have a title.
D. The temperatures should be written in descending order.

Answer: B. A break in the axis should be clearly indicated.

25. The numbers of notebooks sold from Monday to Friday are 20, 25, 30, 35 and 40 respectively. Which statement is correct?

A. The number sold decreases by five daily.
B. The number sold increases by ten daily.
C. The number sold increases by five daily.
D. The same number is sold every day.

Answer: C. The number sold increases by five daily.

26. A survey contains the values 2, 3, 3, 4, 4, 4, 5 and 5. Which frequency table entry is incorrect?

A. Frequency of 2 = 1
B. Frequency of 3 = 2
C. Frequency of 4 = 3
D. Frequency of 5 = 3

Answer: D. Frequency of 5 = 3

The correct frequency of 5 is 2.

27. A graph uses the scale 1 division = 50 vehicles. A bar reaches halfway between the sixth and seventh divisions. How many vehicles does it represent?

A. 300
B. 325
C. 350
D. 375

Answer: B. 325

28. In a survey, the ratio of students who prefer mathematics to those who prefer science is 3: 2. If 18 students prefer mathematics, how many prefer science?

A. 10
B. 12
C. 15
D. 27

Answer: B. 12

29. A pictograph shows 6 complete symbols and one-half symbol. If one complete symbol represents 10 objects, how many objects are represented?

A. 60
B. 65
C. 70
D. 75

Answer: B. 65

30. The following data show the number of goals scored in six matches:

2, 3, 1, 4, 3, 5

If one more match with 6 goals is added, by how much does the total number of goals increase?

A. 1
B. 3
C. 5
D. 6

Answer: D. 6

4.15 Best Practices Opportunity List from the Chapter: (15 Ideas)

Best Practices for Teaching "Data Handling and Presentation":

(1) **Begin with real-life data collection**
Ask students to collect class data such as favourite games, modes of transport, daily temperatures or number of siblings. This makes data handling meaningful and relatable.

(2) **Follow the data-handling sequence**
Teach students to frame a question, collect data, organise it using tally marks and frequency tables, represent it visually, and finally interpret the results.

(3) **Use concrete materials**
Use buttons, counters, coloured blocks, seeds or bottle caps to demonstrate sorting, grouping, counting and frequency before introducing tables and graphs.

(4) **Emphasise titles, labels, scales and keys**
Encourage students to check that every graph has a suitable title, clearly labelled axes, equal intervals, an appropriate scale and a key wherever required.

(5) **Develop graph-reading skills through questions**
Ask questions involving the highest and lowest values, totals, differences, comparisons and conclusions instead of limiting instruction to drawing graphs.

(6) **Compare different representations**
Present the same data through a frequency table, pictograph and bar graph. Let students discuss which representation is clearer and more suitable.

(7) **Teach students to choose an appropriate scale**
Provide datasets of different sizes and ask students to select efficient scales. Discuss why an unsuitable scale may make a graph difficult to draw or interpret.

(8) **Include error-detection activities**
Display graphs containing errors such as missing titles, unequal intervals, incorrect keys or inconsistent bar widths. Ask students to identify and correct them.

(9) **Promote collaborative learning**
Organise students into groups to conduct surveys, prepare frequency tables, construct graphs and present their findings to the class.

(10) **Connect mathematics with other subjects**
Use rainfall data from Geography, plant-growth observations from Science or sports results from Physical Education to demonstrate the wider use of data.

(11) **Use graph paper and drawing instruments properly**
Train students to use rulers, pencils and graph paper accurately and to maintain equal widths and spaces between bars.

(12) **Encourage estimation before calculation**
Before finding exact answers, ask students to estimate which category has the greatest frequency or approximately how much two values differ.

(13) **Discuss misleading representations**
Show how unequal scales, omitted values or truncated axes can exaggerate differences. Encourage students to examine graphs critically.

(14) **Integrate simple digital tools**
After students understand manual construction, allow them to create tables and graphs using spreadsheet software and compare digital results with hand-drawn work.

(15) **Use continuous formative assessment**
Employ oral questions, exit slips, worksheets and short graph-interpretation tasks to identify misconceptions and provide immediate feedback.

4.16 Innovations Opportunity List from the Chapter: (15 Ideas)

Innovations in Teaching–Learning "Data Handling and Presentation":

(1) **Live Classroom Data Dashboard:**
Students collect information such as attendance, weather, reading time or classroom preferences and update a weekly data dashboard using tables, pictographs and bar graphs.

(2) **Human Bar Graph Activity:**
Students stand in rows according to choices such as favourite sport or fruit. Each row forms a "human bar," helping learners understand frequency and comparison physically.

(3) **Data Detective Challenge:**
Provide incomplete, incorrect or misleading graphs. Students act as detectives to identify errors involving scales, labels, keys, intervals and data values.

(4) **QR-Code Survey Project:**
Create a simple digital survey using QR codes. Students collect responses, organise the results in frequency tables and present them through suitable graphs.

(5) **Graph Gallery Walk:**
Groups represent the same dataset using pictographs and bar graphs. Their work is displayed around the classroom, and students evaluate each representation using a checklist.

(6) **Build-a-Graph Game:**
Give each group data cards, scale cards, title cards and graph labels. Students must select the correct components and construct an accurate graph within a fixed time.

(7) **Storytelling Through Data:**
Students study a graph and create a short story explaining what the data reveals—for example, changes in rainfall, book sales, attendance or sports performance.

(8) **Student Data Journal:**
Each learner maintains a weekly journal recording personal data such as study time, water consumption, steps walked or books read and represents it graphically.

(9) **Interdisciplinary Data Lab:**
Connect data handling with Science, Social Science and Physical Education by analysing plant growth, rainfall, population, temperature or sports scores.

(10) **Spreadsheet-Based Graph Exploration:**
Students enter a small dataset into spreadsheet software and observe how a graph changes when values, scales or categories are modified.

(11) **Data Treasure Hunt:**
Place data clues at different classroom stations. Students solve tally-table, pictograph and bar-graph questions to reach the final clue.

(12) **Design a Misleading Graph:**
Students intentionally create a misleading graph and then explain the error. This develops critical thinking and awareness of how data can be misrepresented.

(13) **Classroom Data Newsroom:**
Groups work as data reporters, prepare a graph from collected information and present a one-minute "data news bulletin" highlighting important findings.

(14) **Eco-Data Project:**
Students record water use, electricity consumption or classroom waste for a week and create graphs to suggest practical conservation measures.

(15) **Peer-Created Olympiad Quiz**
Students design challenging multiple-choice questions based on tables, pictographs and bar graphs. Groups exchange and solve one another's quizzes.

4.17: Practicing Questions/Question Bank :

A. Fill in the Blanks:

1. A collection of facts, numbers or observations is called __________.
   Answer: data

2. Marks used to record frequencies quickly are called __________ marks.
   Answer: tally

3. Tally marks are generally arranged in groups of __________.
   Answer: five

4. The number of times a particular observation occurs is called its __________.
   Answer: frequency

5. A table showing observations and their frequencies is called a __________ table.
   Answer: frequency distribution

6. A representation of data using pictures or symbols is called a __________.
   Answer: pictograph

7. The meaning assigned to each symbol in a pictograph is given by its __________.
   Answer: key

8. In a bar graph, all bars must have equal __________.
   Answer: width

9. The spaces between consecutive bars should be __________.
   Answer: equal

10. The numerical value represented by one unit on a graph is called its __________.
    Answer: scale

11. The horizontal line of a bar graph is called the __________ axis.
    Answer: horizontal

12. The vertical line of a bar graph is called the __________ axis.
    Answer: vertical

13. If one symbol represents 8 objects, half a symbol represents __________ objects.
    Answer: 4

14. If 1 cm represents 10 students, a 6 cm bar represents __________ students.
    Answer: 60

15. The category represented by the tallest bar has the __________ frequency.
    Answer: highest

B. One-Mark Questions:

1. **What is data?**
   Answer: Data is a collection of facts, numbers or observations gathered for a particular purpose.

2. **What is frequency?**
   Answer: Frequency is the number of times a particular observation occurs.

3. **Why are tally marks grouped in sets of five?**
   Answer: Grouping tally marks in sets of five makes counting quicker and easier.

4. **What is a pictograph?**
   Answer: A pictograph represents data using pictures or symbols.

5. **What is the purpose of a key in a pictograph?**
   Answer: A key tells us the numerical value represented by each symbol.

6. **What is a bar graph?**
   Answer: A bar graph represents data using rectangular bars of equal width.

7. **Name two essential components of a bar graph.**
   Answer: A suitable title and an appropriate scale.

8. **Which graph is more suitable for comparing quantities belonging to different categories?**
   Answer: A bar graph.

9. **The frequencies of four categories are 7, 9, 5 and 4. Find the total frequency.**
   Answer: $7 + 9 + 5 + 4 = 25$.

10. **One symbol represents 6 books. How many books do five symbols represent?**
    Answer: $5 \times 6 = 30$books.

11. **A bar is 7 cm high and 1 cm represents 5 children. What is its frequency?**
    Answer: $7 \times 5 = 35$children.

12. **Find the frequency of 4 in the data: 2, 4, 5, 4, 6, 4, 3.**
    Answer: 3.

13. **Which type of data is obtained directly by asking people questions?**
    Answer: Primary data.

14. **What should be written along the two axes of a bar graph?**
    Answer: The categories and the corresponding numerical values.

15. **What does the tallest bar in a bar graph indicate?**
    Answer: It indicates the category with the greatest frequency.

C. Two-Mark Questions:

1. **Prepare tally marks for the frequencies 7 and 12.**
   Answer:
   Frequency 7: one group of five and two additional tally marks.
   Frequency 12: two groups of five and two additional tally marks.

2. **Differentiate between data and frequency.**
   Answer:
   Data is a collection of observations or information. Frequency is the number of times a particular observation occurs in the data.

3. **The number of notebooks sold on four days was 20, 35, 25 and 40. Find:**
   a) the highest sale;
   b) the difference between the highest and lowest sales.
   Answer:

a) Highest sale = 40notebooks.
b) Difference = 40 − 20 = 20notebooks.

4. **In a pictograph, one represents 4 students. How many symbols are needed to represent 28 students?**
Answer:
Number of symbols = 28 ÷ 4 = 7.
Therefore, seven symbols are needed.

5. **The frequencies of four observations are 8, 12, $x$and 15. Their total is 45. Find x.**
Answer:
$$8 + 12 + x + 15 = 45$$
$x = 45 - 35 = 10.$

6. **A bar measuring 6 cm represents 42 students. What value does 1 cm represent?**
Answer:
Value of 1 cm = 42 ÷ 6 = 7.
Therefore, the scale is 1 cm = 7 students.

7. **Why should bars in a bar graph have equal widths and equal gaps?**
Answer:
Equal widths and gaps make the graph clear and uniform. They also prevent the visual presentation from becoming misleading.

8. **One picture represents 10 trees. How would you represent 35 trees?**
Answer:
Three complete pictures represent 30 trees. Half a picture represents 5 trees; therefore, 35 trees require $3\frac{1}{2}$pictures.

9. **Find the frequencies of 2 and 5 in the following data:**
2, 3, 5, 2, 4, 5, 5, 6, 2
Answer:
Frequency of 2 = 3.
Frequency of 5 = 3.

10. **State any two advantages of a frequency table.**
Answer:
It organises raw data systematically. It also makes comparison and interpretation easier.

D. Three-Mark Descriptive Questions:

1. **Organise the following data into a frequency table:**
1, 2, 3, 2, 4, 3, 2, 1, 4, 2

Answer:

- Frequency of 1 = 2
- Frequency of 2 = 4
- Frequency of 3 = 2
- Frequency of 4 = 2

- Total frequency = 10

2. **Explain three important rules for drawing a bar graph.**
   Answer:
   - Give the graph a suitable title and label both axes clearly.
   - Use an appropriate and uniform scale throughout the graph.
   - Draw bars of equal width with equal spaces between consecutive bars.
3. **A pictograph uses one symbol to represent 8 bicycles. Find the number of symbols required to represent 16, 28 and 40 bicycles.**
   Answer:
   - 16 bicycles: $16 \div 8 = 2$symbols
   - 28 bicycles: $3\frac{1}{2}$symbols
   - 40 bicycles: $40 \div 8 = 5$symbols
4. **The numbers of storybooks read by five students are 6, 8, 5, 10 and 7. Find the total, highest and lowest numbers.**
   Answer:
   - Total $= 6 + 8 + 5 + 10 + 7 = 36$books
   - Highest number $= 10$books
   - Lowest number $= 5$books
5. **A bar graph uses the scale 1 cm = 5 kg. Find the heights of the bars required to represent 20 kg, 35 kg and 45 kg.**
   Answer:
   - For 20 kg: $20 \div 5 = 4$cm
   - For 35 kg: $35 \div 5 = 7$cm
   - For 45 kg: $45 \div 5 = 9$cm
6. **Explain how raw data can be converted into a frequency table.**
   Answer:
   - List each distinct observation in the first column.
   - Record every occurrence using tally marks in the second column.
   - Count the tally marks and enter the corresponding frequencies in the final column.
7. **The numbers of students participating in four activities are: Music—18, Dance—24, Art—15 and Sports—30. Answer the following:**
   a) Which activity has the highest participation?
   b) How many more students selected sports than art?
   c) Find the total participation.

Answer:

- Sports has the highest participation.

- Difference $= 30 - 15 = 15$students.
- Total $= 18 + 24 + 15 + 30 = 87$.

8. **Why may a graph with unequal intervals be misleading? Give an example.**
   Answer:
   - Unequal intervals do not represent changes proportionately.
   - They may make small differences appear very large or large differences appear small.
   - For example, marking 0, 10, 20 and then 100 at equal distances gives a false visual impression.

E. Five-Mark Descriptive Questions:

1. **The favourite fruits of 30 students are given below:**
   Mango—10, Apple—8, Banana—6, Orange—4, Grapes—2.
   Draw a bar graph and answer the questions that follow.

a) Which fruit is the most popular?
b) Which fruit is the least popular?
c) How many more students prefer mangoes than grapes?

Answer:

- Draw the horizontal axis and write the names of the fruits.
- Draw the vertical axis and choose the scale 1 unit = 2 students.
- Draw bars of heights 5, 4, 3, 2 and 1 units respectively.
- Mango is the most popular fruit, while grapes are the least popular.
- Difference $= 10 - 2 = 8$students.

2. **The number of vehicles passing a checkpoint during five hours was 40, 60, 50, 80 and 70. Represent the data using a bar graph and interpret it.**

Answer:

- Mark the five hours on the horizontal axis.
- Mark the number of vehicles on the vertical axis.
- Use the scale 1 unit = 10 vehicles.
- Draw bars of heights 4, 6, 5, 8 and 7 units.
- The fourth hour had the highest traffic, while the first hour had the lowest.

3. **The pocket-money amounts received by 12 students are:**
   ₹20, ₹30, ₹20, ₹40, ₹30, ₹20, ₹50, ₹40, ₹30, ₹20, ₹50, ₹30.
   Prepare a frequency table and answer the questions.

Answer:

- ₹20 occurs 4 times.

- ₹30 occurs 4 times.
- ₹40 occurs 2 times.
- ₹50 occurs 2 times.
- The total frequency is 12, and ₹20 and ₹30 have the joint highest frequency.

4. **A pictograph represents the number of saplings planted by four houses. One 🌱 represents 5 saplings. House A planted 20, House B planted 35, House C planted 15 and House D planted 30 saplings. Construct the pictograph and interpret it.**

Answer:

- House A: 4 symbols
- House B: 7 symbols
- House C: 3 symbols
- House D: 6 symbols
- House B planted the most saplings, while House C planted the fewest. The total number planted was $20 + 35 + 15 + 30 = 100$.

5. **A school recorded the number of absentees during a week as follows:**
Monday—8, Tuesday—12, Wednesday—6, Thursday—10, Friday—4.
Construct a bar graph and write three conclusions.

Answer:

- Mark the weekdays on the horizontal axis and absentees on the vertical axis.
- Use the scale 1 unit = 2 absentees.
- Draw bars of heights 4, 6, 3, 5 and 2 units respectively.
- Tuesday had the highest absenteeism, while Friday had the lowest.
- Total absentees recorded $= 8 + 12 + 6 + 10 + 4 = 40$.

6. **A student claims that pictographs are always better than bar graphs. Do you agree? Give reasons and examples.**

Answer:

- Pictographs are attractive and easy to understand for small datasets.
- Their symbols help young learners compare quantities visually.
- However, partial symbols may be required when values are not exact multiples of the key.
- Bar graphs are more suitable for representing and comparing larger or more precise values.
- Therefore, the best representation depends on the nature and size of the data.

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6th Standard Maths Book Chapter 5

Chapter 5: PRIME TIME

5.1 Summary of the Chapter:

Chapter 5: Prime Time — Summary:

(1) A **multiple** of a number is obtained by multiplying it by whole numbers. Numbers that are multiples of two or more given numbers are called **common multiples**.
(2) A **factor** or **divisor** divides a number exactly, leaving no remainder. For example, 1, 2, 3, 4, 6 and 12 are factors of 12.
(3) **Common factors** are factors shared by two or more numbers. For example, the common factors of 14 and 36 are 1 and 2.
(4) A **prime number** has exactly two factors—1 and the number itself. Examples include 2, 3, 5, 7, 11 and 13.
(5) A **composite number** has more than two factors. Examples include 4, 6, 8, 9, 10 and 12.
(6) The number **1 is neither prime nor composite**, while 2 is the only even prime number.
(7) The **Sieve of Eratosthenes** is a systematic method of identifying prime numbers by crossing out the multiples of each prime number.
(8) Two numbers are called **co-prime** when their only common factor is 1. Co-prime numbers need not themselves be prime; for example, 8 and 15 are co-prime.
(9) Every number greater than 1 can be expressed as a product of prime numbers. This process is called **prime factorisation**; for example, $84 = 2 \times 2 \times 3 \times 7$.
(10) The prime factorisation of a number is unique, except for the order in which the prime factors are written.
(11) Prime factorisation can be used to check whether two numbers are co-prime and whether one number is divisible by another.
(12) Divisibility can be tested quickly: numbers ending in 0, 2, 4, 6 or 8 are divisible by 2; the last two digits determine divisibility by 4; numbers ending in 0 or 5 are divisible by 5; the last three digits determine divisibility by 8; and numbers ending in 0 are divisible by 10.

5.2 Important Formulas:

Important Formulas and Rules — Chapter 5: Prime Time:

1. **Multiple of a number**

$$\text{Multiple} = \text{Given number} \times \text{Whole number}$$

Example: Multiples of 6 are $6, 12, 18, 24, \ldots$

2. **Factor relationship**

If a divides b exactly, then:

$$b = a \times n$$

Therefore, a is a factor of b.

3. **Number of multiples up to a given number**

$$\text{Number of multiples of } a \text{ up to } N = \left\lfloor \frac{N}{a} \right\rfloor$$

4. **Common multiple**

A number M is a common multiple of a and b when:

$$M = a \times m = b \times n$$

5. **Prime number**

A prime number has exactly two factors:

$$1 \text{ and the number itself}$$

6. **Composite number**

A composite number has more than two factors and can be expressed as:

$$n = a \times b,\ a > 1, b > 1$$

7. **Prime factorisation**

Every whole number greater than 1 can be written as a product of prime numbers:

$$N = p_1 \times p_2 \times p_3 \times \cdots$$

Example:

$$84 = 2 \times 2 \times 3 \times 7 = 2^2 \times 3 \times 7$$

8. **Co-prime numbers**

Two numbers $a$and $b$are co-prime when their only common factor is 1:

$$\mathrm{HCF}(a, b) = 1$$

9. **LCM of co-prime numbers**

If $a$and $b$are co-prime, then:

$$\mathrm{LCM}(a, b) = a \times b$$

10. **Divisibility through prime factorisation**

A number $A$is divisible by Bif all the prime factors of B, with their required repetitions, are present in the prime factorisation of A.

11. **Divisibility tests**

- **By 2:** The units digit must be 0,2,4,6or 8.
- **By 4:** The number formed by the last two digits must be divisible by 4.
- **By 5:** The units digit must be 0 or 5.
- **By 8:** The number formed by the last three digits must be divisible by 8.
- **By 10:** The units digit must be 0.

12. **Remainder relationship**

$$\text{Dividend} = (\text{Divisor} \times \text{Quotient}) + \text{Remainder}$$

A number is exactly divisible by another number when:

$$\text{Remainder} = 0$$

13. **Perfect number condition**

A number is perfect when the sum of all its factors, including itself, equals twice the number:

$$\text{Sum of all factors} = 2N$$

Example:

$$1 + 2 + 3 + 6 = 12 = 2 \times 6$$

14. **Leap-year rule**

A year is a leap year if it is divisible by 4. However, a century year must also be divisible by 400:

$$\text{Leap year} \Rightarrow \begin{cases} \text{Divisible by 4,} & \text{ordinary year} \\ \text{Divisible by 400,} & \text{century year} \end{cases}$$

5.3 Fill-Up the Blank LOTS type questions with Answers: (30 Questions)

Fill in the Blanks with Answers – LOTS Type:

1. A number that divides another number exactly is called a __________ of that number.
   Answer: factor
2. The numbers obtained by multiplying a given number by whole numbers are called its __________.
   Answer: multiples
3. The first five multiples of 3 are 3, 6, 9, 12 and __________.
   Answer: 15
4. The common multiples of 3 and 5 are multiples of __________.
   Answer: 15

5. The factors of 12 are 1, 2, 3, 4, 6 and __________.
   Answer: 12
6. The common factors of 14 and 36 are 1 and __________.
   Answer: 2
7. A number having exactly two factors is called a __________ number.
   Answer: prime
8. A number having more than two factors is called a __________ number.
   Answer: composite
9. The smallest prime number is __________.
   Answer: 2
10. The only even prime number is __________.
    Answer: 2
11. The number 1 is neither prime nor __________.
    Answer: composite
12. The factors of a prime number are 1 and the number __________.
    Answer: itself
13. The method used to find prime numbers by crossing out multiples is called the __________ of Eratosthenes.
    Answer: Sieve
14. The number 9 is a composite number because it has the factors 1, 3 and __________.
    Answer: 9
15. Two numbers having no common factor other than 1 are called __________ numbers.
    Answer: co-prime
16. The numbers 8 and 15 are __________ because their only common factor is 1.
    Answer: co-prime
17. Writing a number as a product of prime numbers is called __________.
    Answer: prime factorisation
18. The prime factorisation of 12 is $2 \times 2 \times$__________.
    Answer: 3
19. The prime factorisation of 30 is $2 \times 3 \times$__________.
    Answer: 5
20. Every number greater than 1 can be written as a product of __________ numbers.
    Answer: prime
21. A number is divisible by 2 if its units digit is 0, 2, 4, 6 or __________.
    Answer: 8
22. A number is divisible by 5 if its units digit is 0 or __________.
    Answer: 5
23. A number is divisible by 10 if its units digit is __________.
    Answer: 0
24. To test divisibility by 4, we examine the number formed by the last __________ digits.
    Answer: two
25. To test divisibility by 8, we examine the number formed by the last __________ digits.
    Answer: three
26. The number 36 is divisible by 4 because its last two digits form the number __________.
    Answer: 36
27. The number 8560 is divisible by 10 because its units digit is __________.
    Answer: 0

28. When a number is divided exactly by another number, the remainder is __________.
    Answer: zero
29. A number whose factors add up to twice the number is called a __________ number.
    Answer: perfect
30. The smallest perfect number is __________.
    Answer: 6

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

Fill in the Blanks with Answers – HOTS Type:

1. The smallest number that is a multiple of both 6 and 8 is __________.
   Answer: 24
2. In the Idli-Vada game using 3 and 5, "Idli-Vada" is said for the tenth time at __________.
   Answer: 150
3. A number below 40 has 7 as a factor, and the sum of its digits is 8. The number is __________.
   Answer: 35
4. The smallest perfect number, whose factors add up to twice the number, is __________.
   Answer: 6
5. The smallest number that is a multiple of every number from 1 to 10 is __________.
   Answer: 2520
6. The smallest number that is a multiple of all numbers from 1 to 10 except 7 is __________.
   Answer: 360
7. The greatest common factor of 28 and 70 is __________.
   Answer: 14
8. The first common multiple of 8 and 9 is __________ because the two numbers are co-prime.
   Answer: 72
9. If two co-prime numbers have a product of 77, their first common multiple is __________.
   Answer: 77
10. The number 105 has exactly three distinct prime factors: 3, 5 and __________.
    Answer: 7
11. The smallest number having three different prime factors is __________.
    Answer: 30
12. The smallest number having four different prime factors is __________.
    Answer: 210
13. The number whose prime factorisation is $2 \times 3 \times 3 \times 11$is __________.
    Answer: 198
14. If $1955 = 5 \times 17 \times p$, then the prime number $p$is __________.
    Answer: 23
15. The prime factorisation of 64 contains the factor 2 repeated __________ times.
    Answer: 6
16. The prime factorisation of 729 is 3^n. The value of $n$is __________.
    Answer: 6
17. The numbers 121 and 1331 are not co-prime because their common prime factor is __________.
    Answer: 11

18. The numbers 343 and 216 are co-prime because their prime factorisations contain no ___________ prime factor.
    Answer: common
19. The number 8536 is divisible by 4 because the number formed by its last two digits, ___________, is divisible by 4.
    Answer: 36
20. The number 7648 is divisible by 8 because its last three digits, ___________, are divisible by 8.
    Answer: 648
21. The largest number less than 399 that is divisible by 5 is ___________.
    Answer: 395
22. The smallest number that must be added to 573 to make it divisible by 5 is ___________.
    Answer: 2
23. If a number is divisible by both 5 and 8, it must also be divisible by ___________.
    Answer: 40
24. Among 572, 2352, 5600 and 6000, the smallest number divisible by 2, 4, 5, 8 and 10 is ___________.
    Answer: 5600
25. Two numbers whose product is 10,000 and whose units digits are not zero are 16 and ___________.
    Answer: 625
26. A leap year divisible by 100 must also be divisible by ___________.
    Answer: 400
27. The next twin prime after the pair 17 and 19 is the pair ___________ and ___________.
    Answer: 29 and 31
28. If a prime number $p$satisfies $2p + 1 = 23$, then $p =$___________.
    Answer: 11
29. The only number among 45, 60, 91, 105 and 330 that is a product of exactly three distinct prime numbers is ___________.
    Answer: 105
30. No three-digit prime number can be formed using the digits 2, 4 and 5 exactly once because every such number ends in an even digit or ___________.
    Answer: 5

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

One-Mark Descriptive Questions with Answers – LOTS Type:

1. **What is a factor of a number?**
   Answer: A factor is a number that divides another number exactly without leaving a remainder.
2. **What is a multiple of a number?**
   Answer: A multiple of a number is obtained by multiplying it by a whole number.
3. **What are common factors?**
   Answer: Common factors are numbers that divide each of two or more given numbers exactly.
4. **What are common multiples?**
   Answer: Common multiples are numbers that are multiples of two or more given numbers.
5. **Write the first five multiples of 4.**
   Answer: The first five multiples of 4 are 4, 8, 12, 16 and 20.

6. **Write all the factors of 12.**
   Answer: The factors of 12 are 1, 2, 3, 4, 6 and 12.
7. **What is a prime number?**
   Answer: A prime number is a number greater than 1 that has exactly two factors—1 and itself.
8. **What is a composite number?**
   Answer: A composite number is a number that has more than two factors.
9. **Why is 7 a prime number?**
   Answer: The number 7 is prime because its only factors are 1 and 7.
10. **Why is 12 a composite number?**
    Answer: The number 12 is composite because it has more than two factors.
11. **Is 1 a prime or composite number?**
    Answer: The number 1 is neither prime nor composite because it has only one factor.
12. **Which is the only even prime number?**
    Answer: The number 2 is the only even prime number.
13. **Name the method used to list prime numbers systematically.**
    Answer: The method used to list prime numbers systematically is called the Sieve of Eratosthenes.
14. **What are twin primes?**
    Answer: Twin primes are pairs of prime numbers whose difference is 2.
15. **Give one example of twin primes.**
    Answer: The numbers 11 and 13 are an example of twin primes.
16. **What are co-prime numbers?**
    Answer: Co-prime numbers are two numbers whose only common factor is 1.
17. **Give one example of a pair of co-prime numbers.**
    Answer: The numbers 8 and 15 are co-prime because their only common factor is 1.
18. **What is prime factorisation?**
    Answer: Prime factorisation is the process of expressing a number as a product of prime numbers.
19. **Write the prime factorisation of 18.**
    Answer: The prime factorisation of 18 is $2 \times 3 \times 3$.
20. **Write the prime factorisation of 24.**
    Answer: The prime factorisation of 24 is $2 \times 2 \times 2 \times 3$.
21. **State the divisibility rule for 2.**
    Answer: A number is divisible by 2 when its units digit is 0, 2, 4, 6 or 8.
22. **State the divisibility rule for 4.**
    Answer: A number is divisible by 4 when the number formed by its last two digits is divisible by 4.
23. **State the divisibility rule for 5.**
    Answer: A number is divisible by 5 when its units digit is 0 or 5.
24. **State the divisibility rule for 8.**
    Answer: A number is divisible by 8 when the number formed by its last three digits is divisible by 8.
25. **State the divisibility rule for 10.**
    Answer: A number is divisible by 10 when its units digit is 0.
26. **What is a perfect number?**
    Answer: A perfect number is a number whose factors, including itself, add up to twice the number.
27. **Give an example of a perfect number.**
    Answer: The number 6 is a perfect number because $1 + 2 + 3 + 6 = 12$.

28. **When is a number exactly divisible by another number?**
    Answer: A number is exactly divisible by another number when the remainder is zero.
29. **Write the common factors of 20 and 28.**
    Answer: The common factors of 20 and 28 are 1, 2 and 4.
30. **Write the common factors of 35 and 50.**
    Answer: The common factors of 35 and 50 are 1 and 5.

5.6 One-mark questions with Answers of HOTS Type: (25 Questions)

One-Mark Descriptive Questions with Answers – HOTS Type:

1. **What is the smallest number that is a multiple of both 6 and 8?**
   Answer: The smallest common multiple of 6 and 8 is 24.
2. **Why is 2 the only even prime number?**
   Answer: The number 2 has exactly two factors, while every other even number is divisible by 2 and has more than two factors.
3. **Is 51 a prime number? Give a reason.**
   Answer: No, 51 is composite because it is divisible by 3.
4. **Is 37 a prime number? Give a reason.**
   Answer: Yes, 37 is prime because its only factors are 1 and 37.
5. **Are 18 and 35 co-prime? Give a reason.**
   Answer: Yes, 18 and 35 are co-prime because their only common factor is 1.
6. **Are 15 and 25 co-prime? Give a reason.**
   Answer: No, 15 and 25 are not co-prime because they have 5 as a common factor.
7. **Can two composite numbers be co-prime? Give an example.**
   Answer: Yes, 8 and 9 are composite numbers but are co-prime because their only common factor is 1.
8. **Why are any two different prime numbers co-prime?**
   Answer: Any two different prime numbers are co-prime because they share no factor other than 1.
9. **What is the smallest number having three distinct prime factors?**
   Answer: The smallest number having three distinct prime factors is $2 \times 3 \times 5 = 30$.
10. **What is the smallest number having four distinct prime factors?**
    Answer: The smallest number having four distinct prime factors is $2 \times 3 \times 5 \times 7 = 210$.
11. **Find the number whose prime factorisation is $2 \times 3 \times 3 \times 11$.**
    Answer: The required number is $2 \times 3 \times 3 \times 11 = 198$.
12. **Is 168 divisible by 12 based on prime factorisation?**
    Answer: Yes, 168 is divisible by 12 because its prime factorisation contains all the prime factors of $12 = 2^2 \times 3$.
13. **Is 75 divisible by 21 based on prime factorisation?**
    Answer: No, 75 is not divisible by 21 because its prime factorisation does not contain the factor 7.
14. **Why is the product of two prime numbers always composite?**
    Answer: The product is composite because it is divisible by 1, each of the two primes and the product itself.
15. **What is the first common multiple of 7 and 8?**
    Answer: The first common multiple of 7 and 8 is 56 because the numbers are co-prime.

16. **What is the greatest possible jump size that will land on both 28 and 70?**
    Answer: The greatest possible jump size is 14 because it is the greatest common factor of 28 and 70.
17. **Is 8,536 divisible by 4? Give a reason.**
    Answer: Yes, 8,536 is divisible by 4 because its last two digits form 36, which is divisible by 4.
18. **Is 7,648 divisible by 8? Give a reason.**
    Answer: Yes, 7,648 is divisible by 8 because its last three digits form 648, which is divisible by 8.
19. **What is the smallest number that must be added to 397 to make it divisible by 5?**
    Answer: The smallest number to be added is 3 because $397 + 3 = 400$.
20. **What is the smallest number that must be subtracted from 562 to make it divisible by 10?**
    Answer: The smallest number to be subtracted is 2 because $562 - 2 = 560$.
21. **Is 14,560 divisible by 2, 4, 5, 8 and 10?**
    Answer: Yes, 14,560 satisfies the divisibility rules for all five numbers.
22. **Which is the next twin-prime pair after 17 and 19?**
    Answer: The next twin-prime pair after 17 and 19 is 29 and 31.
23. **Can a three-digit prime number be formed using 2, 4 and 5 exactly once?**
    Answer: No, because every arrangement ends in an even digit or 5 and is therefore composite.
24. **If $2p + 1 = 23$, what is the prime number p?**
    Answer: The prime number is $p = 11$.
25. **Why is 6 called a perfect number?**
    Answer: The number 6 is perfect because the sum of all its factors is $1 + 2 + 3 + 6 = 12$, which is twice 6.

5.7 Two-mark questions with Answers of LOTS Type: (20 Questions)

Two-Mark Descriptive Questions with Answers – LOTS Type:

1. What are factors and multiples?

Answer:

1. A factor divides a given number exactly without leaving a remainder.
2. A multiple is obtained by multiplying a given number by a whole number.

2. Write the factors and first five multiples of 10.

Answer:

1. The factors of 10 are 1, 2, 5 and 10.
2. The first five multiples of 10 are 10, 20, 30, 40 and 50.

3. What are common factors and common multiples?

Answer:

1. Common factors are numbers that divide each of two or more given numbers exactly.
2. Common multiples are numbers that are multiples of each of two or more given numbers.

4. Find the common factors of 20 and 28.

Answer:

1. The factors of 20 are 1, 2, 4, 5, 10 and 20, while the factors of 28 are 1, 2, 4, 7, 14 and 28.
2. Therefore, the common factors of 20 and 28 are 1, 2 and 4.

5. Find the first three common multiples of 3 and 5.

Answer:

1. Multiples of 3 and 5 that occur in both lists are 15, 30, 45 and so on.
2. Therefore, the first three common multiples are 15, 30 and 45.

6. Differentiate between prime and composite numbers.

Answer:

1. A prime number has exactly two factors—1 and the number itself.
2. A composite number has more than two factors.

7. Why is 7 prime while 12 is composite?

Answer:

1. The number 7 is prime because its only factors are 1 and 7.
2. The number 12 is composite because it has the factors 1, 2, 3, 4, 6 and 12.

8. Explain why 1 is neither prime nor composite.

Answer:

1. A prime number must have exactly two factors, but 1 has only one factor.
2. A composite number must have more than two factors, so 1 is not composite either.

9. What is the Sieve of Eratosthenes?

Answer:

1. The Sieve of Eratosthenes is a method used to identify prime numbers from a list of natural numbers.
2. It involves crossing out 1 and the multiples of each prime number while keeping the prime numbers uncrossed.

10. What are twin primes? Give two examples.

Answer:

1. Twin primes are pairs of prime numbers whose difference is 2.
2. Examples include 3 and 5, and 11 and 13.

11. What are co-prime numbers? Give an example.

Answer:

1. Two numbers are co-prime when their only common factor is 1.
2. For example, 8 and 15 are co-prime numbers.

12. Find whether 18 and 35 are co-prime.

Answer:

1. The factors of 18 are 1, 2, 3, 6, 9 and 18, while the factors of 35 are 1, 5, 7 and 35.
2. Their only common factor is 1, so 18 and 35 are co-prime.

13. What is prime factorisation? Find the prime factorisation of 24.

Answer:

1. Prime factorisation means expressing a number as a product of prime numbers.
2. The prime factorisation of 24 is $2 \times 2 \times 2 \times 3$.

14. Find the prime factorisation of 84.

Answer:

1. Dividing 84 successively by prime numbers gives $84 = 2 \times 42 = 2 \times 2 \times 21$.
2. Therefore, the prime factorisation of 84 is $2 \times 2 \times 3 \times 7$.

15. Find the prime factorisation of 105.

Answer:

1. The number 105 can be written as 3×35.
2. Therefore, its prime factorisation is $3 \times 5 \times 7$.

16. State the divisibility rules for 2 and 5.

Answer:

1. A number is divisible by 2 when its units digit is 0, 2, 4, 6 or 8.
2. A number is divisible by 5 when its units digit is 0 or 5.

17. State the divisibility rules for 4 and 8.

Answer:

1. A number is divisible by 4 when the number formed by its last two digits is divisible by 4.
2. A number is divisible by 8 when the number formed by its last three digits is divisible by 8.

18. Check whether 8,536 is divisible by 4.

Answer:

1. The number formed by the last two digits of 8,536 is 36.
2. Since 36 is divisible by 4, the number 8,536 is also divisible by 4.

19. Check whether 5,024 is divisible by 8.

Answer:

1. The number formed by the last three digits of 5,024 is 024, or 24.
2. Since 24 is divisible by 8, the number 5,024 is also divisible by 8.

20. What is a perfect number? Explain using 6.

Answer:

1. A perfect number is a number whose factors, including itself, add up to twice the number.
2. The factors of 6 add up to $1 + 2 + 3 + 6 = 12 = 2 \times 6$, so 6 is a perfect number.

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

Two-Mark Descriptive Questions with Answers – HOTS Type:

1. Find the smallest common multiple of 6 and 8.

Answer:

1. The multiples of 6 are 6, 12, 18, 24, … and the multiples of 8 are 8, 16, 24, ….
2. Therefore, the smallest common multiple of 6 and 8 is **24**.

2. Find all the possible jump sizes that can reach treasures placed at 15 and 30.

Answer:

1. The common factors of 15 and 30 are 1, 3, 5 and 15.
2. Therefore, the possible jump sizes are **1, 3, 5 and 15**.

3. Determine whether 51 is prime or composite.

Answer:

1. The sum of the digits of 51 is $5 + 1 = 6$, so 51 is divisible by 3.
2. Therefore, $51 = 3 \times 17$, and hence it is a **composite number**.

4. Can two consecutive numbers be co-prime? Explain with an example.

Answer:

1. Yes, any two consecutive numbers are co-prime because they cannot have a common factor greater than 1.
2. For example, 8 and 9 have only 1 as their common factor.

5. Can two composite numbers be co-prime? Justify your answer.

Answer:

1. Yes, two composite numbers can be co-prime if they have no common factor other than 1.
2. For example, 8 and 9 are composite, but their only common factor is 1.

6. Determine whether 18 and 35 are co-prime using prime factorisation.

Answer:

1. Their prime factorisations are $18 = 2 \times 3 \times 3$and $35 = 5 \times 7$.
2. Since they have no common prime factor, 18 and 35 are **co-prime**.

7. Determine whether 30 and 45 are co-prime using prime factorisation.

Answer:

1. Their prime factorisations are $30 = 2 \times 3 \times 5$and $45 = 3 \times 3 \times 5$.

2. Since they share the prime factors 3 and 5, they are **not co-prime**.

8. Find the smallest number having three different prime factors.

Answer:

1. The three smallest distinct prime numbers are 2, 3 and 5.
2. Therefore, the smallest required number is $2 \times 3 \times 5 = 30$.

9. Find the smallest number having four different prime factors.

Answer:

1. The four smallest distinct prime numbers are 2, 3, 5 and 7.
2. Therefore, the smallest required number is $2 \times 3 \times 5 \times 7 = 210$.

10. Find the number whose prime factorisation contains one 2, two 3s and one 11.

Answer:

1. The required number is represented by $2 \times 3 \times 3 \times 11$.
2. Multiplying these prime factors gives $2 \times 3 \times 3 \times 11 = 198$.

11. Check whether 168 is divisible by 12 using prime factorisation.

Answer:

1. We have $168 = 2^3 \times 3 \times 7$and $12 = 2^2 \times 3$.
2. Since all the prime factors of 12 occur in 168 with sufficient repetitions, **168 is divisible by 12**.

12. Check whether 75 is divisible by 21 using prime factorisation.

Answer:

1. We have $75 = 3 \times 5^2$and $21 = 3 \times 7$.
2. Since the factor 7 of 21 is absent from 75, **75 is not divisible by 21**.

13. In the Idli-Vada game using 3 and 5, find the number at which "Idli-Vada" is said for the tenth time.

Answer:

1. "Idli-Vada" is said at the common multiples of 3 and 5, which are multiples of 15.
2. Therefore, it is said for the tenth time at $15 \times 10 = 150$.

14. Find the greatest jump size that can reach treasures placed at 28 and 70.

Answer:

1. The common factors of 28 and 70 are 1, 2, 7 and 14.
2. Therefore, the greatest possible jump size is **14**.

15. Explain why the first common multiple of 7 and 8 is equal to their product.

Answer:

1. The numbers 7 and 8 are co-prime because their only common factor is 1.
2. Therefore, their first common multiple is their product, $7 \times 8 = 56$.

16. Check whether 14,560 is divisible by both 5 and 8.

Answer:

1. It is divisible by 5 because its units digit is 0.
2. It is divisible by 8 because its last three digits, 560, are divisible by 8.

17. Find the smallest number that must be added to 853 to make it divisible by 10.

Answer:

1. The next multiple of 10 after 853 is 860.
2. Therefore, the smallest number to be added is $860 - 853 = 7$.

18. Find the smallest number that must be subtracted from 6,527 to make it divisible by 5.

Answer:

1. The nearest lower multiple of 5 is 6,525 because it ends in 5.
2. Therefore, the smallest number to be subtracted is $6527 - 6525 = 2$.

19. Can the product of two prime numbers be prime? Justify your answer.

Answer:

1. No, the product is divisible by each of the two prime numbers used to form it.
2. Therefore, the product has more than two factors and is composite.

20. A number has the prime factorisation $2^3 \times 3^2$. Find the number and state whether it is divisible by 12.

Answer:

1. The number is $2^3 \times 3^2 = 8 \times 9 = 72$.
2. Since $12 = 2^2 \times 3$is included in its prime factorisation, 72 is divisible by 12.

5.9. Three-mark questions with Answers of LOTS Type: (15 Questions)

Three-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain factors, multiples and common factors with examples.

Answer:

1. A factor divides a number exactly; for example, 4 is a factor of 12.
2. A multiple is obtained by multiplying a number by a whole number; for example, 24 is a multiple of 6.
3. Common factors divide two or more numbers exactly; for example, 1 and 2 are common factors of 14 and 36.

2. Find all the factors of 24 and identify whether it is prime or composite.

Answer:

1. The factors of 24 are 1, 2, 3, 4, 6, 8, 12 and 24.
2. The number 24 has more than two factors.
3. Therefore, 24 is a composite number.

3. Differentiate between prime, composite and co-prime numbers.

Answer:

1. A prime number has exactly two factors, namely 1 and itself.
2. A composite number has more than two factors.
3. Two numbers are co-prime when their only common factor is 1.

4. Explain how the Sieve of Eratosthenes is used to find prime numbers.

Answer:

1. First, write the natural numbers in order and cross out 1 because it is neither prime nor composite.
2. Circle 2 and cross out its higher multiples, and repeat the process with the next uncrossed numbers such as 3, 5 and 7.
3. The numbers that remain uncrossed are prime numbers.

5. List the prime and composite numbers from 21 to 30.

Answer:

1. The prime numbers from 21 to 30 are 23 and 29.
2. The composite numbers are 21, 22, 24, 25, 26, 27, 28 and 30.
3. Thus, there are 2 prime numbers and 8 composite numbers in this range.

6. What are twin primes? Write four pairs of twin primes below 50.

Answer:

1. Twin primes are pairs of prime numbers whose difference is 2.
2. The pairs 3 and 5, and 5 and 7 are twin primes.
3. The pairs 11 and 13, and 17 and 19 are also twin primes.

7. Find the common factors of 20 and 28.

Answer:

1. The factors of 20 are 1, 2, 4, 5, 10 and 20.
2. The factors of 28 are 1, 2, 4, 7, 14 and 28.
3. Therefore, the common factors of 20 and 28 are 1, 2 and 4.

8. Find the common factors of 5, 15 and 25.
Answer:
1. The factors of 5 are 1 and 5.
2. Both 15 and 25 are also divisible by 1 and 5.
3. Therefore, the common factors of 5, 15 and 25 are 1 and 5.

9. Explain prime factorisation and find the prime factorisation of 84.
Answer:
1. Prime factorisation is the process of expressing a number as a product of prime numbers.
2. We can write $84 = 2 \times 42 = 2 \times 2 \times 21$.
3. Therefore, the prime factorisation of 84 is $2 \times 2 \times 3 \times 7$.

10. Find the prime factorisation of 320.
Answer:
1. Divide 320 repeatedly by 2 to obtain $320 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 5$.
2. All the factors obtained are prime numbers.
3. Therefore, the prime factorisation is $320 = 2^6 \times 5$.

11. Determine whether 57 and 85 are co-prime using prime factorisation.
Answer:
1. The prime factorisation of 57 is 3×19.
2. The prime factorisation of 85 is 5×17.
3. Since they have no common prime factor, 57 and 85 are co-prime.

12. State and explain the divisibility tests for 2, 5 and 10.
Answer:
1. A number is divisible by 2 when its units digit is 0, 2, 4, 6 or 8.
2. A number is divisible by 5 when its units digit is 0 or 5.
3. A number is divisible by 10 when its units digit is 0.

13. State and explain the divisibility tests for 4 and 8.
Answer:
1. A number is divisible by 4 when the number formed by its last two digits is divisible by 4.
2. A number is divisible by 8 when the number formed by its last three digits is divisible by 8.
3. For example, 8,536 is divisible by 4 and 7,648 is divisible by 8.

14. Explain why 6 is a perfect number.
Answer:
1. The factors of 6 are 1, 2, 3 and 6.
2. Their sum is $1 + 2 + 3 + 6 = 12$.
3. Since 12 is twice 6, the number 6 is a perfect number.

15. Write the rules used to identify a leap year.
Answer:
1. An ordinary year is a leap year when it is divisible by 4.
2. A century year must be divisible by 400 to be a leap year.
3. Therefore, 2024 and 2000 are leap years, while 1900 is not a leap year.

5.10. Three-mark questions with Answers of HOTS Type: (15 Questions)

Three-Mark Descriptive Questions with Answers – HOTS Type:
1. In the Idli-Vada game, "Idli" is said for multiples of 3 and "Vada" for multiples of 5. Find how many times "Idli-Vada" is said from 1 to 90.
Answer:

1. "Idli-Vada" is said for numbers that are common multiples of 3 and 5.
2. These numbers are multiples of 15: 15, 30, 45, 60, 75 and 90.
3. Therefore, "Idli-Vada" is said **6 times**.

2. Find all the jump sizes that can reach treasures placed at 28 and 70.

Answer:

1. The factors of 28 are 1, 2, 4, 7, 14 and 28.
2. The factors of 70 are 1, 2, 5, 7, 10, 14, 35 and 70.
3. Therefore, the possible jump sizes are **1, 2, 7 and 14**.

3. Determine whether 343 and 216 are co-prime using prime factorisation.

Answer:

1. The prime factorisations are $343 = 7^3$and $216 = 2^3 \times 3^3$.
2. The two numbers do not have any common prime factor.
3. Therefore, 343 and 216 are **co-prime**.

4. Determine whether 121 and 1331 are co-prime.

Answer:

1. The prime factorisations are $121 = 11^2$and $1331 = 11^3$.
2. Both numbers have 11 as a common prime factor.
3. Therefore, 121 and 1331 are **not co-prime**.

5. Find the smallest number whose prime factorisation contains three different prime numbers.

Answer:

1. The three smallest different prime numbers are 2, 3 and 5.
2. Their product is $2 \times 3 \times 5 = 30$.
3. Therefore, the smallest required number is **30**.

6. A number has one factor 2, two factors 3 and one factor 11 in its prime factorisation. Find the number.

Answer:

1. The given prime factorisation is $2 \times 3 \times 3 \times 11$.
2. Multiplying the factors gives $2 \times 9 \times 11 = 198$.
3. Therefore, the required number is **198**.

7. Check whether 96 is divisible by 24 using prime factorisation.

Answer:

1. The prime factorisations are $96 = 2^5 \times 3$and $24 = 2^3 \times 3$.
2. All the prime factors of 24 occur in 96 with sufficient repetitions.
3. Therefore, **96 is divisible by 24**.

8. Check whether 999 is divisible by 99 using prime factorisation.

Answer:

1. The prime factorisations are $999 = 3^3 \times 37$and $99 = 3^2 \times 11$.
2. The prime factor 11 required for 99 is absent from 999.
3. Therefore, **999 is not divisible by 99**.

9. Explain why the first common multiple of 8 and 9 is their product.

Answer:

1. The prime factorisations are $8 = 2^3$and $9 = 3^2$, so the numbers have no common prime factor.
2. Therefore, 8 and 9 are co-prime numbers.
3. Hence, their first common multiple is $8 \times 9 = 72$.

10. Find whether 14,560 is divisible by 2, 4, 5, 8 and 10.

Answer:

1. The number ends in 0, so it is divisible by 2, 5 and 10.
2. Its last two digits, 60, are divisible by 4, and its last three digits, 560, are divisible by 8.

3. Therefore, 14,560 is divisible by **all five numbers**.

11. Find the least number that must be added to 8,533 to make it divisible by both 5 and 10.

Answer:

1. A number divisible by both 5 and 10 must end in 0.
2. The next number ending in 0 after 8,533 is 8,540.
3. Therefore, the least number to be added is $8540 - 8533 = 7$.

12. Explain why a three-digit prime number cannot be formed using 2, 4 and 5 exactly once.

Answer:

1. If the number ends in 2 or 4, it is even and therefore divisible by 2.
2. If the number ends in 5, it is divisible by 5.
3. Hence, every possible arrangement is composite, so no prime number can be formed.

13. Find three prime numbers below 30 whose product is 1,955.

Answer:

1. Since 1,955 ends in 5, it is divisible by 5, giving $1955 \div 5 = 391$.
2. The number 391 can be factorised as 17×23.
3. Therefore, the three prime numbers are **5, 17 and 23**.

14. A number is divisible by 8 and 5. Explain why it must also be divisible by 2, 4 and 10.

Answer:

1. Every multiple of 8 is also divisible by 2 and 4.
2. A number divisible by both 2 and 5 is divisible by 10.
3. Therefore, a number divisible by 8 and 5 is also divisible by 2, 4 and 10.

15. Determine whether the sum of two odd numbers is always a multiple of 4.

Answer:

1. The sum $1 + 3 = 4$is a multiple of 4.
2. However, the sum $1 + 5 = 6$is not a multiple of 4.
3. Therefore, the sum of two odd numbers is **sometimes**, but not always, a multiple of 4.

5.11 Five-mark questions with Answers of LOTS Type: (8 Questions)

Five-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain factors, multiples, common factors and common multiples with examples.

Answer:

1. A factor is a number that divides another number exactly without leaving a remainder.
2. For example, 1, 2, 3, 4, 6 and 12 are factors of 12.
3. A multiple is obtained by multiplying a given number by a whole number.
4. Common factors are factors shared by two or more numbers, such as 1 and 2 for 14 and 36.
5. Common multiples are multiples shared by two or more numbers, such as 15, 30 and 45 for 3 and 5.

2. Explain prime numbers, composite numbers and the special nature of 1 and 2.

Answer:

1. A prime number has exactly two factors—1 and the number itself.
2. Examples of prime numbers are 2, 3, 5, 7 and 11.
3. A composite number has more than two factors, such as 4, 6, 8 and 9.
4. The number 1 is neither prime nor composite because it has only one factor.
5. The number 2 is the only even prime number.

3. Describe the Sieve of Eratosthenes method for finding prime numbers up to 100.

Answer:

1. Write all the natural numbers from 1 to 100 in order.
2. Cross out 1 because it is neither prime nor composite.
3. Circle 2 and cross out all its multiples greater than 2.
4. Circle the next uncrossed numbers, such as 3, 5 and 7, and cross out their higher multiples.
5. The circled numbers remaining at the end are the prime numbers up to 100.

4. Explain prime factorisation and find the prime factorisation of 84.

Answer:

1. Prime factorisation means expressing a number as a product of prime numbers.
2. First, write $84 = 2 \times 42$.
3. Next, write $42 = 2 \times 21$.
4. Then, factorise 21as 3×7.
5. Therefore, the prime factorisation of 84 is $2 \times 2 \times 3 \times 7$.

5. Explain co-prime numbers and determine whether 18 and 35 are co-prime.

Answer:

1. Two numbers are co-prime when their only common factor is 1.
2. The prime factorisation of 18 is $2 \times 3 \times 3$.
3. The prime factorisation of 35 is 5×7.
4. The two numbers do not have any common prime factor.
5. Therefore, 18 and 35 are co-prime numbers.

6. State the divisibility rules for 2, 4, 5, 8 and 10.

Answer:

1. A number is divisible by 2 when its units digit is 0, 2, 4, 6 or 8.
2. A number is divisible by 4 when the number formed by its last two digits is divisible by 4.
3. A number is divisible by 5 when its units digit is 0 or 5.
4. A number is divisible by 8 when the number formed by its last three digits is divisible by 8.
5. A number is divisible by 10 when its units digit is 0.

7. Find the common factors of 20 and 28 by listing their factors.

Answer:

1. The factors of 20 are 1, 2, 4, 5, 10 and 20.
2. The factors of 28 are 1, 2, 4, 7, 14 and 28.
3. The numbers appearing in both factor lists are 1, 2 and 4.
4. Hence, 1, 2 and 4 divide both numbers exactly.
5. Therefore, the common factors of 20 and 28 are **1, 2 and 4**.

8. Explain perfect numbers using 6 and 28 as examples.

Answer:

1. A perfect number is a number whose factors, including itself, add up to twice the number.
2. The factors of 6 are 1, 2, 3 and 6, and their sum is 12.
3. Since $12 = 2 \times 6$, the number 6 is perfect.
4. The factors of 28 are 1, 2, 4, 7, 14 and 28, and their sum is 56.
5. Since $56 = 2 \times 28$, the number 28 is also perfect.

5.12 Five-mark questions with Answers of HOTS Type: (8 Questions)

Five-Mark Descriptive Questions with Answers – HOTS Type:

1. In the Idli-Vada game, "Idli" is said for multiples of 3 and "Vada" for multiples of 5. Analyse the game from 1 to 90.

Answer:

1. The number of multiples of 3 from 1 to 90 is $90 \div 3 = 30$.
2. The number of multiples of 5 from 1 to 90 is $90 \div 5 = 18$.
3. The common multiples are multiples of 15, and their number is $90 \div 15 = 6$.
4. Therefore, "Idli" is said 30 times and "Vada" is said 18 times when the common calls are included.
5. "Idli-Vada" is said **6 times**, at 15, 30, 45, 60, 75 and 90.

2. Grumpy places treasures at 84 and 126. Find all possible jump sizes that allow Jumpy to collect both treasures.

Answer:

1. The prime factorisation of 84 is $2^2 \times 3 \times 7$.
2. The prime factorisation of 126 is $2 \times 3^2 \times 7$.
3. The common prime factors with their least repetitions give $2 \times 3 \times 7 = 42$.
4. The factors of 42 are 1, 2, 3, 6, 7, 14, 21 and 42.
5. Therefore, the possible jump sizes are **1, 2, 3, 6, 7, 14, 21 and 42**.

3. Use prime factorisation to compare 168, 12 and 21 and determine the divisibility relationships among them.

Answer:

1. The prime factorisations are $168 = 2^3 \times 3 \times 7$, $12 = 2^2 \times 3$and $21 = 3 \times 7$.
2. All the prime factors of 12 occur in 168 with sufficient repetitions.
3. Therefore, 168 is divisible by 12.
4. All the prime factors of 21 also occur in 168 with sufficient repetitions.
5. Hence, 168 is divisible by both 12 and 21, though 12 and 21 are not divisible by each other.

4. Examine the numbers 30, 45, 57 and 85 and determine which pairs are co-prime.

Answer:

1. Their prime factorisations are $30 = 2 \times 3 \times 5$, $45 = 3^2 \times 5$, $57 = 3 \times 19$and $85 = 5 \times 17$.
2. The numbers 30 and 45 are not co-prime because they share the factors 3 and 5.
3. The numbers 30 and 57 are not co-prime because they share the factor 3.
4. The numbers 30 and 85 are not co-prime because they share the factor 5.
5. The pairs **45 and 57, 45 and 85, and 57 and 85** are co-prime because each pair has no common prime factor.

5. Determine whether 77,622,160 is divisible by 2, 4, 5, 8 and 10.

Answer:

1. The number ends in 0, so it is divisible by 2, 5 and 10.
2. Its last two digits form 60, which is divisible by 4.
3. Its last three digits form 160, which is divisible by 8.
4. Thus, the number satisfies the divisibility tests for 2, 4, 5, 8 and 10.
5. Therefore, **77,622,160 is divisible by all five given numbers**.

6. Find the smallest number that has four different prime factors and verify its important properties.

Answer:

1. The four smallest different prime numbers are 2, 3, 5 and 7.
2. Their product is $2 \times 3 \times 5 \times 7 = 210$.
3. Therefore, 210 is the smallest number having four distinct prime factors.
4. It is divisible by each of 2, 3, 5 and 7.
5. Since it has more than two factors, 210 is a composite number.

7. Investigate whether the sum of two even numbers and the sum of two odd numbers are always multiples of 4.

Answer:

1. The sum $2 + 6 = 8$shows that the sum of two even numbers can be a multiple of 4.
2. The sum $2 + 4 = 6$shows that the sum of two even numbers need not be a multiple of 4.
3. The sum $1 + 3 = 4$shows that the sum of two odd numbers can be a multiple of 4.
4. The sum $1 + 5 = 6$shows that the sum of two odd numbers need not be a multiple of 4.
5. Therefore, both statements are **sometimes true**, depending on the numbers selected.

8. A student claims that every pair of odd numbers is co-prime. Test the claim using suitable examples.

Answer:

1. The numbers 9 and 25 are odd and their only common factor is 1, so they are co-prime.
2. The numbers 15 and 21 are also odd, but they have 3 as a common factor.
3. Thus, some pairs of odd numbers are co-prime, while other pairs are not.
4. Being odd only means that a number is not divisible by 2.
5. Therefore, the student's claim is **false** because odd numbers may share other common factors.

5.13 Five-mark questions with Answers of Applied Type: (7 Questions)

Five-Mark Descriptive Questions with Answers – Applied Type:

1. Two school bells ring at intervals of 6 minutes and 8 minutes. If they ring together at 9:00 a.m., when will they ring together again?

Answer:

1. The first bell rings at multiples of 6 minutes, while the second rings at multiples of 8 minutes.
2. Multiples of 6 are 6, 12, 18, 24, … minutes.
3. Multiples of 8 are 8, 16, 24, … minutes.
4. Their first common multiple is 24, so they will ring together after 24 minutes.
5. Therefore, the bells will ring together again at **9:24 a.m.**

2. A teacher has 48 pencils and 60 erasers and wants to prepare identical prize packets without leaving any items. Find the greatest possible number of packets and the contents of each packet.

Answer:

1. The required number of packets must be a common factor of 48 and 60.
2. The greatest common factor of 48 and 60 is 12.
3. Therefore, the teacher can prepare 12 identical packets.
4. Each packet will contain $48 \div 12 = 4$pencils and $60 \div 12 = 5$erasers.
5. Hence, **12 packets**, each containing **4 pencils and 5 erasers**, can be prepared.

3. A sports ground has two circular tracks that take 12 minutes and 18 minutes to complete. If two runners start together, after how many minutes will they return to the starting point together?

Answer:

1. The runners will meet at the starting point after a common multiple of 12 and 18 minutes.
2. The prime factorisations are $12 = 2^2 \times 3$and $18 = 2 \times 3^2$.
3. The least common multiple is $2^2 \times 3^2 = 36$.
4. Therefore, both runners will return to the starting point together after 36 minutes.
5. In that time, the first runner completes 3 rounds and the second runner completes 2 rounds.

4. A shopkeeper has 84 chocolates and 126 biscuits and wants to arrange them in the greatest possible number of identical gift bags. Find the number of bags and the items in each bag.
Answer:
1. The greatest possible number of bags is the greatest common factor of 84 and 126.
2. The prime factorisations are $84 = 2^2 \times 3 \times 7$and $126 = 2 \times 3^2 \times 7$.
3. Their greatest common factor is $2 \times 3 \times 7 = 42$.
4. Each bag will contain $84 \div 42 = 2$chocolates and $126 \div 42 = 3$biscuits.
5. Therefore, the shopkeeper can prepare **42 identical bags**, each with **2 chocolates and 3 biscuits**.

5. A digital display flashes a red light every 5 seconds and a green light every 8 seconds. If both lights flash together now, determine their next three simultaneous flashes.
Answer:
1. The simultaneous flashes occur at common multiples of 5 and 8.
2. Since 5 and 8 are co-prime, their first common multiple is $5 \times 8 = 40$seconds.
3. The following common multiples are $40 \times 2 = 80$seconds and $40 \times 3 = 120$seconds.
4. Thus, the first three simultaneous flashes occur after 40, 80 and 120 seconds.
5. Therefore, the lights flash together every **40 seconds**.

6. A factory packs 14,560 buttons into boxes of 2, 4, 5, 8 or 10 buttons. Determine whether equal packing is possible for every box size.
Answer:
1. The number ends in 0, so it is divisible by 2, 5 and 10.
2. Its last two digits form 60, which is divisible by 4.
3. Its last three digits form 560, which is divisible by 8.
4. Therefore, 14,560 is divisible by all the proposed box sizes.
5. Hence, the buttons can be packed equally into boxes of **2, 4, 5, 8 or 10** without any remainder.

7. A school plans three activities that repeat every 4 days, 6 days and 10 days. If all three activities are conducted today, after how many days will they occur together again?
Answer:
1. The activities will occur together again after the least common multiple of 4, 6 and 10.
2. Their prime factorisations are $4 = 2^2$, $6 = 2 \times 3$and $10 = 2 \times 5$.
3. Taking the required prime factors gives $2^2 \times 3 \times 5 = 60$.
4. Therefore, the least common multiple of 4, 6 and 10 is 60.
5. Hence, all three activities will occur together again after **60 days**.

5.14 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. Which number has exactly six factors?
A. 8
B. 10
C. 12
D. 16
Answer: C. 12

---

2. What is the smallest common multiple of 12 and 18?
A. 24
B. 36

C. 48
D. 72
Answer: B. 36

---

3. How many common factors do 36 and 48 have?
A. 4
B. 5
C. 6
D. 8
Answer: C. 6

---

4. Which of the following is a prime number?
A. 87
B. 91
C. 93
D. 97
Answer: D. 97

---

5. Which pair consists of co-prime numbers?
A. 14 and 21
B. 14 and 25
C. 18 and 27
D. 22 and 44
Answer: B. 14 and 25

---

6. Which number has exactly three factors?
A. 27
B. 35
C. 49
D. 63
Answer: C. 49

---

7. What is the number represented by $2^3 \times 3 \times 5$?
A. 60
B. 90
C. 120
D. 180
Answer: C. 120

---

8. Which statement is always true?
A. Every odd number is prime.
B. Every prime number is odd.
C. Every multiple of 4 is even.
D. Every composite number is even.
Answer: C. Every multiple of 4 is even.

---

9. Jumpy must land on treasures placed at 36 and 60; what is the greatest possible jump size?
A. 6
B. 10

C. 12
D. 18
Answer: C. 12

---

10. In an Idli-Vada game using 4 and 6, at which number will "Idli-Vada" be said for the tenth time?
A. 60
B. 100
C. 120
D. 240
Answer: C. 120

---

11. Which number is divisible by 8?
A. 4,306
B. 4,312
C. 4,318
D. 4,322
Answer: B. 4,312

---

12. A number divisible by both 5 and 8 must be divisible by:
A. 10
B. 20
C. 40
D. 80
Answer: C. 40

---

13. Which pair is not a pair of twin primes?
A. 11 and 13
B. 17 and 19
C. 29 and 31
D. 37 and 41
Answer: D. 37 and 41

---

14. Which number is the product of exactly three distinct prime numbers?
A. 45
B. 60
C. 91
D. 105
Answer: D. 105

---

15. Which of the following is a perfect number?
A. 4
B. 6
C. 8
D. 10
Answer: B. 6

---

16. What is the smallest number that must be added to 7,254 to make it divisible by 8?
A. 2
B. 4

C. 6
D. 8
Answer: A. 2

---

17. Which pair contains prime numbers formed by reversing the same digits?
A. 13 and 31
B. 23 and 32
C. 17 and 71
D. Both A and C
Answer: D. Both A and C

---

18. If $A = 2^3 \times 3^2 \times 5$, which number is not a factor of A?
A. 24
B. 40
C. 45
D. 54
Answer: D. 54

---

19. Which statement about the number 1 is correct?
A. It is a prime number.
B. It is a composite number.
C. It is both prime and composite.
D. It is neither prime nor composite.
Answer: D. It is neither prime nor composite.

---

20. Two co-prime numbers have a product of 91, and one number is 13; what is the other number?
A. 5
B. 7
C. 9
D. 11
Answer: B. 7

---

21. How many common multiples of 6 and 8 are there from 1 to 200?
A. 6
B. 7
C. 8
D. 9
Answer: C. 8

---

22. How many numbers from 1 to 100 are divisible by both 2 and 5?
A. 5
B. 10
C. 20
D. 25
Answer: B. 10

---

23. What is the prime factorisation of 360?
A. $2^2 \times 3^2 \times 5$
B. $2^3 \times 3^2 \times 5$

C. $2^3 \times 3 \times 5^2$
D. $2^4 \times 3 \times 5$
Answer: B. $2^3 \times 3^2 \times 5$

---

24. What is the remainder when 2,345 is divided by 8?
A. 0
B. 1
C. 3
D. 5
Answer: B. 1

---

25. What is the greatest three-digit number divisible by both 5 and 8?
A. 920
B. 940
C. 960
D. 980
Answer: C. 960

---

26. If $p$is a prime number and $2p + 1 = 47$, what is the value of p?
A. 19
B. 21
C. 23
D. 29
Answer: C. 23

---

27. Which number must replace $x$if $2^x = 1,024$?
A. 8
B. 9
C. 10
D. 11
Answer: C. 10

---

28. Which set contains only composite numbers?
A. 21, 27, 39, 49
B. 23, 27, 39, 49
C. 21, 29, 39, 49
D. 21, 27, 41, 49
Answer: A. 21, 27, 39, 49

---

29. The prime factorisation of a number is $2^2 \times 3 \times 7$; which number is it?
A. 42
B. 56
C. 84
D. 168
Answer: C. 84

---

30. Which statement is false?
A. Any two different prime numbers are co-prime.
B. Two consecutive numbers are always co-prime.

C. Two composite numbers can be co-prime.
D. Any two odd numbers are always co-prime.
Answer: D. Any two odd numbers are always co-prime.

5.15 Best Practices Opportunity List from the Chapter: (15 Ideas)

Best Practices for Teaching Chapter 5: Prime Time:

(1) Begin with familiar real-life examples
Introduce factors and multiples using arrangements of objects, equal grouping, school bells, packing materials and repeated events.

(2) Use the "Idli-Vada" number game
Let students say "Idli," "Vada" or "Idli-Vada" for multiples and common multiples to make the concepts interactive.

(3) Apply the jump-on-a-number-line activity
Use floor number lines and fixed jump sizes to demonstrate multiples, factors and common factors visually.

(4) Teach prime numbers through arrays
Ask students to arrange counters in rectangular arrays and observe that prime numbers allow only $1 \times n$arrangements.

(5) Conduct the Sieve of Eratosthenes activity
Provide a 1–100 number chart and let students circle prime numbers while crossing out multiples.

(6) Use factor trees for prime factorisation
Encourage students to construct different factor trees for the same number and verify that the final prime factors remain identical.

(7) Promote estimation before calculation
Ask students to predict whether a number is prime, composite, divisible or co-prime before checking systematically.

(8) Encourage multiple solution methods
Allow students to solve problems using factor lists, skip counting, number lines, prime factorisation or diagrams and then compare the methods.

(9) Use divisibility-rule cards
Prepare separate cards for divisibility by 2, 4, 5, 8 and 10 and conduct quick classroom classification activities.

(10) Address common misconceptions immediately
Reinforce that 1 is neither prime nor composite, 2 is the only even prime, and co-prime numbers need not themselves be prime.

(11) Include peer explanation and mathematical talk
Ask students to explain why a number is prime, composite or co-prime using complete mathematical reasoning.

(12) Use formative assessment regularly
Conduct exit slips, oral quizzes, matching exercises and short problem-solving tasks to check understanding after each concept.

(13) Connect concepts across the chapter
Show how factors, multiples, prime numbers, co-primes, prime factorisation and divisibility tests are related.

(14) Differentiate classroom activities
Give basic factor-listing exercises to learners needing support and puzzle-based or Olympiad-style problems to advanced learners.

(15) **Maintain a mathematics learning journal**
Encourage students to record definitions, divisibility rules, solved examples, errors and newly discovered number patterns.

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

Innovations in Teaching–Learning Chapter 5: Prime Time:

(1) **Interactive "Prime Number Hunt":**
Display a digital 1–100 number grid and let students identify primes using the Sieve of Eratosthenes with different colours.

(2) **Human Number-Line Activity:**
Create a large number line on the classroom floor and ask students to make equal jumps to explore factors, multiples and common multiples.

(3) **Idli-Vada Classroom Tournament:**
Organise teams to play the chapter's Idli-Vada game using different number pairs and award points for correctly identifying common multiples.

(4) **Factor-Tree Art Gallery:**
Students can create colourful factor trees for different numbers and display them as a "Prime Factorisation Forest."

(5) **QR-Code Challenge Stations:**
Place QR codes around the classroom linking to puzzles on prime numbers, co-primes, divisibility tests and factorisation.

(6) **Digital Divisibility Checker:**
Guide students to create a simple spreadsheet or beginner-friendly program that checks divisibility by 2, 4, 5, 8 and 10.

(7) **Treasure-Hunt Game:**
Hide clue cards containing numbers and ask students to select suitable jump sizes based on common factors to reach the treasure.

(8) **Prime-Factor Puzzle Grid:**
Let students fill grids with prime numbers so that the products of rows and columns match the given numbers.

(9) **Number Detective Cards:**
Give clues such as "I am less than 50, divisible by 5 and have exactly three prime factors," and ask students to identify the number.

(10) **Collaborative Escape-Room Activity:**
Design a sequence of factor, multiple, prime and divisibility puzzles in which each correct answer unlocks the next clue.

(11) **Real-Life Scheduling Project:**
Ask students to calculate when school bells, buses, sports practices or recurring activities will occur together again.

(12) **Student-Created Mathematics Games:**
Encourage groups to invent board games, card games or puzzles based on prime numbers, factors and divisibility rules.

(13) **Augmented-Reality Number Trail**
Use simple AR-supported cards or classroom markers to reveal hints, factor trees or divisibility challenges when scanned.

(14) **Peer-Teaching Video Clips**
Students can create one-minute videos explaining concepts such as prime numbers, co-primes or divisibility tests with examples.

(15) Prime Number Story or Comic
Ask students to create a short illustrated story in which prime, composite and co-prime numbers become characters solving mathematical challenges.

5.17: Practicing Questions/Question Bank

A. Fill in the Blanks:

1. A number that divides another number exactly is called a __________.
   Answer: Factor
2. Numbers having exactly two factors are called __________ numbers.
   Answer: Prime
3. The smallest prime number is __________.
   Answer: 2
4. The number 1 is neither prime nor __________.
   Answer: Composite
5. Two numbers whose only common factor is 1 are called __________ numbers.
   Answer: Co-prime
6. The process of expressing a number as a product of primes is called __________.
   Answer: Prime factorisation
7. The prime factorisation of 18 is __________.
   Answer: $2 \times 3 \times 3$
8. A number ending in 0 or 5 is divisible by __________.
   Answer: 5
9. To test divisibility by 8, we examine the last __________ digits.
   Answer: Three
10. The smallest perfect number is __________.
    Answer: 6
11. The first common multiple of 4 and 6 is __________.
    Answer: 12
12. The only even prime number is __________.
    Answer: 2

B. One-Mark Descriptive Questions:

1. What is a factor?

Answer: A factor is a number that divides another number exactly without leaving a remainder.

2. What is a prime number?

Answer: A prime number is a number greater than 1 having exactly two factors—1 and itself.

3. What is a composite number?

Answer: A composite number is a number having more than two factors.

4. Why is 1 neither prime nor composite?

Answer: The number 1 is neither prime nor composite because it has only one factor.

5. What are twin primes?

Answer: Twin primes are pairs of prime numbers whose difference is 2.

6. Give an example of two composite numbers that are co-prime.

Answer: The numbers 8 and 9 are composite but co-prime.

7. Write the prime factorisation of 42.

Answer: The prime factorisation of 42 is $2 \times 3 \times 7$.

8. State the divisibility rule for 4.

Answer: A number is divisible by 4 when the number formed by its last two digits is divisible by 4.

9. Is 5,024 divisible by 8? Give a reason.

Answer: Yes, 5,024 is divisible by 8 because its last three digits, 024 or 24, are divisible by 8.

10. What is a perfect number?

Answer: A perfect number is a number whose factors, including itself, add up to twice the number.

C. Two-Mark Descriptive Questions:

1. Find the common factors of 18 and 24.

Answer:

1. The factors of 18 are 1, 2, 3, 6, 9 and 18, while those of 24 are 1, 2, 3, 4, 6, 8, 12 and 24.
2. Therefore, their common factors are **1, 2, 3 and 6**.

2. Differentiate between prime and composite numbers.

Answer:

1. A prime number has exactly two factors—1 and itself.
2. A composite number has more than two factors.

3. Determine whether 21 and 40 are co-prime.

Answer:

1. The prime factorisations are $21 = 3 \times 7$and $40 = 2^3 \times 5$.
2. Since they have no common prime factor, 21 and 40 are co-prime.

4. Find the prime factorisation of 72.

Answer:

1. We can write $72 = 2 \times 2 \times 2 \times 3 \times 3$.
2. Therefore, its prime factorisation is $2^3 \times 3^2$.

5. Check whether 7,316 is divisible by 4.

Answer:

1. The number formed by its last two digits is 16.
2. Since 16 is divisible by 4, 7,316 is also divisible by 4.

6. Why is 6 a perfect number?

Answer:

1. The factors of 6 are 1, 2, 3 and 6.
2. Their sum is $12 = 2 \times 6$, so 6 is a perfect number.

D. Three-Mark Descriptive Questions:

1. Explain how the Sieve of Eratosthenes is used to identify prime numbers.

Answer:

1. Write the natural numbers in order and cross out 1 because it is neither prime nor composite.
2. Circle 2 and cross out its higher multiples, then repeat the procedure with 3, 5, 7 and other uncrossed numbers.
3. The numbers that remain uncrossed are prime numbers.

2. Find all the possible jump sizes that can reach treasures placed at 36 and 60.

Answer:

1. The factors of 36 are 1, 2, 3, 4, 6, 9, 12, 18 and 36.
2. The factors of 60 include 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 and 60.
3. Therefore, the possible jump sizes are **1, 2, 3, 4, 6 and 12**.

3. Use prime factorisation to check whether 96 is divisible by 24.

Answer:

1. The prime factorisations are $96 = 2^5 \times 3$and $24 = 2^3 \times 3$.
2. All the prime factors of 24 occur in 96 with sufficient repetitions.
3. Therefore, 96 is divisible by 24.

4. Explain why a three-digit prime number cannot be formed using 2, 4 and 5 exactly once.

Answer:

1. A number ending in 2 or 4 is even and divisible by 2.
2. A number ending in 5 is divisible by 5.
3. Therefore, every possible arrangement is composite.

5. Determine whether the sum of two odd numbers is always a multiple of 4.

Answer:

1. The sum $1 + 3 = 4$is a multiple of 4.
2. However, $1 + 5 = 6$is not a multiple of 4.
3. Therefore, the sum of two odd numbers is only sometimes a multiple of 4.

6. Find three prime numbers below 30 whose product is 1,955.

Answer:

1. Since 1,955 ends in 5, divide it by 5 to obtain 391.
2. The number 391 can be factorised as 17×23.
3. Therefore, the required prime numbers are **5, 17 and 23**.

E. Five-Mark Descriptive Questions:

1. Two bells ring every 12 minutes and 18 minutes. If they ring together at 8:00 a.m., when will they ring together again?

Answer:

1. The bells will ring together again after the first common multiple of 12 and 18.
2. The prime factorisations are $12 = 2^2 \times 3$and $18 = 2 \times 3^2$.
3. Their smallest common multiple is $2^2 \times 3^2 = 36$.
4. Therefore, the bells will ring together again after 36 minutes.
5. Hence, they will next ring together at **8:36 a.m.**

2. A teacher has 72 pencils and 96 erasers and wants to make the greatest possible number of identical kits. Find the number of kits and their contents.

Answer:

1. The number of kits must be the greatest common factor of 72 and 96.
2. Their prime factorisations are $72 = 2^3 \times 3^2$and $96 = 2^5 \times 3$.
3. Their greatest common factor is $2^3 \times 3 = 24$.
4. Each kit will contain $72 \div 24 = 3$pencils and $96 \div 24 = 4$erasers.
5. Therefore, **24 identical kits**, each containing **3 pencils and 4 erasers**, can be made.

3. Check whether 77,622,160 is divisible by 2, 4, 5, 8 and 10.

Answer:

1. It ends in 0, so it is divisible by 2, 5 and 10.
2. Its last two digits form 60, which is divisible by 4.
3. Its last three digits form 160, which is divisible by 8.
4. Thus, the number satisfies all five divisibility tests.

5. Therefore, 77,622,160 is divisible by **2, 4, 5, 8 and 10**.

4. A red light flashes every 6 seconds, a green light every 8 seconds and a blue light every 12 seconds. If they flash together now, when will they next flash together?

Answer:

1. The next simultaneous flash occurs after the smallest common multiple of 6, 8 and 12.
2. Their prime factorisations are $6 = 2 \times 3$, $8 = 2^3$and $12 = 2^2 \times 3$.
3. The smallest common multiple is $2^3 \times 3 = 24$.
4. Therefore, all three lights will flash together after 24 seconds.
5. They will continue to flash together at intervals of **24 seconds**.

5. A student claims that all odd-number pairs are co-prime. Examine the claim.

Answer:

1. The numbers 9 and 25 are odd and have only 1 as their common factor.
2. Therefore, 9 and 25 are co-prime.
3. The numbers 15 and 21 are odd but share the common factor 3.
4. Therefore, 15 and 21 are not co-prime.
5. Hence, the claim is false because odd numbers may have common factors other than 1.

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6th Standard Maths Book Chapter 6

Chapter 6: PERIMETER AND AREA

6.1 Summary of the Chapter:

Chapter 6: Perimeter and Area — Summary:

(1) The **perimeter** of a closed plane figure is the total distance around its boundary.
(2) The perimeter of any polygon is found by adding the lengths of all its sides.
(3) The perimeter of a rectangle is:
$$P = 2 \times (\text{length} + \text{breadth})$$
(4) The perimeter of a square is:
$$P = 4 \times \text{side}$$
(5) The perimeter of a triangle is the sum of the lengths of its three sides. For an equilateral triangle:
$$P = 3 \times \text{side}$$
(6) The perimeter of a regular polygon is:
$$P = \text{number of sides} \times \text{length of one side}$$
(7) Perimeter is useful for calculating the length of fencing, borders, lace, wire or the distance covered around a track.
(8) The **area** of a closed figure is the measure of the region enclosed within its boundary.
(9) Area is measured in **square units**, such as square centimetres (cm^2), square metres (m^2)and square feet $\left(\text{ft}^2\right)$.
(10) The area of a rectangle is:
$$A = \text{length} \times \text{breadth}$$
The area of a square is:
$$A = \text{side} \times \text{side}$$
(11) The area of an irregular or composite figure can be found by dividing it into smaller rectangles, squares or triangles and adding their areas.
(12) Two figures may have the **same area but different perimeters**, or the **same perimeter but different areas**. Therefore, area and perimeter describe different properties of a figure.

6.2 Important Formulas:

Chapter 6: Perimeter and Area — Important Formulas

A. Perimeter Formulas:

1. **Perimeter of any polygon**
$$P = \text{sum of the lengths of all its sides}$$
2. **Perimeter of a rectangle**
$$P = 2(l + b)$$
3. **Length of a rectangle**
$$l = \frac{P}{2} - b$$
4. **Breadth of a rectangle**
$$b = \frac{P}{2} - l$$
5. **Perimeter of a square**
$$P = 4s$$
6. **Side of a square**
$$s = \frac{P}{4}$$

7. **Perimeter of a triangle**

$$P = a + b + c$$

8. **Missing side of a triangle**

$$\text{Missing side} = P - \text{sum of the other two sides}$$

9. **Perimeter of an equilateral triangle**

$$P = 3s$$

10. **Side of an equilateral triangle**

$$s = \frac{P}{3}$$

11. **Perimeter of a regular polygon**

$$P = n \times s$$

where $n$is the number of sides and $s$is the length of each side.

12. **Side of a regular polygon**

$$s = \frac{P}{n}$$

B. Area Formulas:

13. **Area of a rectangle**

$$A = l \times b$$

14. **Length of a rectangle**

$$l = \frac{A}{b}$$

15. **Breadth of a rectangle**

$$b = \frac{A}{l}$$

16. **Area of a square**

$$A = s \times s = s^2$$

17. **Area of a figure made of unit squares**

$$A = \text{number of unit squares}$$

18. **Area of a composite figure**

$$\text{Total area} = \text{sum of the areas of its smaller parts}$$

19. **Area of a remaining region**

$$\text{Remaining area} = \text{total area} - \text{area of the removed or covered part}$$

C. Application Formulas:

20. **Distance covered in several rounds**

$$\text{Total distance} = \text{perimeter of the track} \times \text{number of rounds}$$

21. **Length required for several rounds of fencing**

$$\text{Total fencing length} = P \times \text{number of rounds}$$

22. **Cost of fencing**

$$\text{Cost} = P \times \text{cost per unit length}$$

23. **Cost of covering or tiling**

$$\text{Cost} = A \times \text{cost per unit area}$$

24. **Number of objects accommodated in a region**

$$\text{Number of objects} = \frac{\text{total available area}}{\text{area required for one object}}$$

Symbols Used:

- P= perimeter
- A= area
- l= length
- b= breadth or width
- s= length of a side

- n= number of sides
- a, b, c= sides of a triangle

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

Fill in the Blanks — LOTS Type:

1. The total distance around the boundary of a closed figure is called its __________.
   Answer: Perimeter
2. The perimeter of a polygon is the sum of the lengths of all its __________.
   Answer: Sides
3. The perimeter of a rectangle is __________ times the sum of its length and breadth.
   Answer: Two
4. The formula for the perimeter of a rectangle is __________.
   Answer: $2(l + b)$
5. The opposite sides of a rectangle are __________ in length.
   Answer: Equal
6. The perimeter of a square is __________ times the length of one side.
   Answer: Four
7. The formula for the perimeter of a square is __________.
   Answer: $4s$
8. The perimeter of a triangle is the sum of the lengths of its __________ sides.
   Answer: Three
9. The perimeter of an equilateral triangle is __________ times the length of one side.
   Answer: Three
10. A polygon with all its sides and angles equal is called a __________ polygon.
    Answer: Regular
11. The perimeter of a regular polygon is the number of sides multiplied by the __________ of one side.
    Answer: Length
12. The measure of the region enclosed by a closed figure is called its __________.
    Answer: Area
13. Area is generally measured in __________ units.
    Answer: Square
14. The formula for the area of a rectangle is __________.
    Answer: Length × breadth
15. The formula for the area of a square is __________.
    Answer: Side × side
16. The area of a rectangle having length 8 cm and breadth 5 cm is __________ sq cm.
    Answer: 40
17. The perimeter of a rectangle having length 7 cm and breadth 3 cm is __________ cm.
    Answer: 20
18. The perimeter of a square having a side of 6 cm is __________ cm.
    Answer: 24
19. The area of a square having a side of 5 cm is __________ sq cm.
    Answer: 25
20. The perimeter of a triangle having sides 4 cm, 5 cm and 7 cm is __________ cm.
    Answer: 16
21. The perimeter of an equilateral triangle having a side of 9 cm is __________ cm.
    Answer: 27
22. If the perimeter of a square is 36 cm, the length of each side is __________ cm.
    Answer: 9

23. A rectangle has an area of 48 sq cm and a length of 8 cm. Its breadth is __________ cm.
    Answer: 6
24. The area of a rectangular floor 10 m long and 4 m wide is __________ sq m.
    Answer: 40
25. If a person completes three rounds of a track, the total distance covered is the perimeter of the track multiplied by __________.
    Answer: Three
26. The area of a composite figure can be found by dividing it into smaller and simpler __________.
    Answer: Shapes
27. Two figures can have the same area but different __________.
    Answer: Perimeters
28. Two figures can have the same perimeter but different __________.
    Answer: Areas
29. A square with a side of one unit has an area of __________ square unit.
    Answer: One
30. The amount required for fencing a field is calculated using its __________.
    Answer: Perimeter

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

Fill in the Blanks — HOTS Type:

1. A rectangular field is 15 m long and 10 m wide. The length of fencing required for one round is __________ m.
   Answer: 50
2. A square has a perimeter of 48 cm. The length of each side is __________ cm.
   Answer: 12
3. The perimeter of a triangle is 40 cm. If two sides measure 12 cm and 15 cm, the third side measures __________ cm.
   Answer: 13
4. A rectangle has a perimeter of 30 cm and a length of 9 cm. Its breadth is __________ cm.
   Answer: 6
5. A wire 36 cm long is bent to form a square. The length of each side of the square is __________ cm.
   Answer: 9
6. A wire 42 cm long is bent to form an equilateral triangle. The length of each side is __________ cm.
   Answer: 14
7. A regular hexagon has a perimeter of 54 cm. The length of each side is __________ cm.
   Answer: 9
8. A runner completes four rounds of a rectangular track measuring 60 m by 40 m. The total distance covered is __________ m.
   Answer: 800
9. A farmer fences a rectangular field measuring 25 m by 15 m with three rounds of rope. The total length of rope required is __________ m.
   Answer: 240
10. The cost of fencing a square garden of side 20 m at ₹15 per metre is ₹__________.
    Answer: 1,200

11. The area of a rectangle is 96 sq cm. If its length is 12 cm, its breadth is __________ cm.
Answer: 8
12. The area of a square is 81 sq cm. The length of each side is __________ cm.
Answer: 9
13. A rectangular garden has an area of 360 sq m and a length of 30 m. Its breadth is __________ m.
Answer: 12
14. A room is 8 m long and 6 m wide. A square carpet of side 5 m is placed on its floor. The uncovered area is __________ sq m.
Answer: 23
15. A garden measures 20 m by 15 m. Four flower beds, each measuring 2 m by 1 m, are made in its corners. The area left for the lawn is __________ sq m.
Answer: 292
16. A rectangular plot measuring 18 m by 12 m is divided into two equal parts. The area of each part is __________ sq m.
Answer: 108
17. A square and a rectangle both have a perimeter of 24 cm. If the rectangle measures 8 cm by 4 cm, the square's area is __________ sq cm.
Answer: 36
18. A rectangle measuring 9 cm by 4 cm and a square of side 6 cm have __________ areas.
Answer: Equal
19. A rectangle of dimensions 10 cm by 2 cm and a square of side 5 cm have the same __________ but different areas.
Answer: Perimeter
20. Two rectangles have areas of 40 sq cm each. One measures 8 cm by 5 cm and the other measures 10 cm by 4 cm. The difference between their perimeters is __________ cm.
Answer: 2
21. A 5 cm by 4 cm rectangle is joined to a 3 cm by 2 cm rectangle without overlapping. The combined area is __________ sq cm.
Answer: 26
22. A rectangular sheet measuring 12 cm by 8 cm is cut into two equal rectangles. The area of each smaller rectangle is __________ sq cm.
Answer: 48
23. A square of side 10 cm is divided into 25 equal smaller squares. The area of each smaller square is __________ sq cm.
Answer: 4
24. A rectangular floor has an area of 120 sq m. If each tile covers 2 sq m, the number of tiles required is __________.
Answer: 60
25. A coconut grove has an area of 5,000 sq m. If each tree requires 25 sq m, the maximum number of trees that can be planted is __________.
Answer: 200
26. The cost of tiling a rectangular floor of area 60 sq m at ₹50 per square metre is ₹__________.
Answer: 3,000

27. A square garden has a side of 15 m. After a square pond of side 5 m is constructed inside it, the remaining area is __________ sq m.
    Answer: 200
28. A shape made from 12 unit squares has an area of __________ square units, regardless of how the squares are arranged without overlapping.
    Answer: 12
29. Among rectangles of dimensions 9 cm × 1 cmand 3 cm × 3 cm, the one with the smaller perimeter is the __________.
    Answer: 3 cm × 3 cmrectangle (square)
30. When two shapes of equal area have different arrangements, their perimeters need not be __________.
    Answer: Equal

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

One-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is the perimeter of a closed plane figure?**
   Answer: The perimeter is the total distance around the boundary of a closed plane figure.
2. **How is the perimeter of a polygon calculated?**
   Answer: The perimeter of a polygon is calculated by adding the lengths of all its sides.
3. **State the formula for the perimeter of a rectangle.**
   Answer: The perimeter of a rectangle is 2 × (length + breadth).
4. **State the formula for the perimeter of a square.**
   Answer: The perimeter of a square is 4 × side.
5. **How do you find the perimeter of a triangle?**
   Answer: The perimeter of a triangle is found by adding the lengths of its three sides.
6. **What is an equilateral triangle?**
   Answer: An equilateral triangle is a triangle whose three sides are equal in length.
7. **State the formula for the perimeter of an equilateral triangle.**
   Answer: The perimeter of an equilateral triangle is 3 × side.
8. **What is a regular polygon?**
   Answer: A regular polygon is a polygon in which all sides and all angles are equal.
9. **State the formula for the perimeter of a regular polygon.**
   Answer: The perimeter of a regular polygon is the number of sides multiplied by the length of one side.
10. **What is the area of a closed figure?**
    Answer: The area of a closed figure is the measure of the region enclosed by it.
11. **In what type of units is area measured?**
    Answer: Area is measured in square units.
12. **State the formula for the area of a rectangle.**
    Answer: The area of a rectangle is length × breadth.
13. **State the formula for the area of a square.**
    Answer: The area of a square is side × side.
14. **What is the standard unit of area based on the metre?**
    Answer: The square metre is the standard unit of area based on the metre.
15. **Find the perimeter of a square whose side is 5 cm.**
    Answer: The perimeter of the square is 4 × 5 = 20cm.
16. **Find the area of a square whose side is 6 cm.**
    Answer: The area of the square is 6 × 6 = 36sq cm.

17. **Find the perimeter of a rectangle measuring 8 cm by 4 cm.**
    Answer: The perimeter of the rectangle is $2 \times (8 + 4) = 24$cm.
18. **Find the area of a rectangle measuring 9 cm by 5 cm.**
    Answer: The area of the rectangle is $9 \times 5 = 45$sq cm.
19. **Find the perimeter of a triangle with sides 4 cm, 6 cm and 7 cm.**
    Answer: The perimeter of the triangle is $4 + 6 + 7 = 17$cm.
20. **Find the perimeter of an equilateral triangle whose side is 8 cm.**
    Answer: The perimeter of the equilateral triangle is $3 \times 8 = 24$cm.
21. **How can the area of a figure drawn on a square grid be found?**
    Answer: Its area can be found by counting the number of unit squares covered by the figure.
22. **How can the area of a composite figure be calculated?**
    Answer: Its area can be calculated by dividing it into simpler shapes and adding their areas.
23. **What measurement is used to calculate the length of fencing around a field?**
    Answer: The perimeter of the field is used to calculate the required length of fencing.
24. **What measurement is used to calculate the space covered by a floor?**
    Answer: The area of the floor is used to calculate the space covered by it.
25. **Can two figures with the same area have different perimeters?**
    Answer: Yes, two figures with the same area can have different perimeters.
26. **Can two figures with the same perimeter have different areas?**
    Answer: Yes, two figures with the same perimeter can have different areas.
27. **What is the side length of a square whose perimeter is 28 cm?**
    Answer: The side length of the square is $28 \div 4 = 7$cm.
28. **What is the breadth of a rectangle with an area of 40 sq cm and a length of 8 cm?**
    Answer: The breadth of the rectangle is $40 \div 8 = 5$cm.
29. **What is the area of one unit square?**
    Answer: The area of one unit square is one square unit.
30. **What happens to the perimeter when more rounds of fencing are required?**
    Answer: The total fencing length equals the perimeter multiplied by the number of rounds.

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

One-Mark Descriptive Questions with Answers — HOTS Type:

1. **A rectangular park is 20 m long and 15 m wide; what distance is covered in one round?**
   Answer: The distance covered is $2 \times (20 + 15) = 70$m.
2. **A runner completes five rounds of a square track of side 25 m; what distance does the runner cover?**
   Answer: The runner covers $5 \times 4 \times 25 = 500$m.
3. **A rectangle has a perimeter of 36 cm and a length of 10 cm; find its breadth.**
   Answer: Its breadth is $36 \div 2 - 10 = 8$cm.
4. **A square has a perimeter of 52 cm; find its side length.**
   Answer: Its side length is $52 \div 4 = 13$cm.
5. **A triangle has a perimeter of 45 cm and two sides of 12 cm and 18 cm; find its third side.**
   Answer: Its third side is $45 - (12 + 18) = 15$cm.
6. **A wire 48 cm long is bent into a square; what is the length of each side?**
   Answer: The length of each side is $48 \div 4 = 12$cm.

7. **A 60 cm string is used to form an equilateral triangle; what is the length of each side?**
   Answer: The length of each side is $60 \div 3 = 20$cm.
8. **A regular hexagon has a perimeter of 72 cm; what is the length of one side?**
   Answer: The length of one side is $72 \div 6 = 12$cm.
9. **A farmer puts three rounds of fencing around a rectangular field measuring 30 m by 20 m; how much fencing is needed?**
   Answer: The farmer needs $3 \times 2 \times (30 + 20) = 300$m of fencing.
10. **A square garden has an area of 64 sq m; what is the length of each side?**
    Answer: Each side is 8 m because $8 \times 8 = 64$.
11. **A rectangular garden has an area of 150 sq m and a length of 15 m; find its breadth.**
    Answer: Its breadth is $150 \div 15 = 10$m.
12. **A 12 m by 8 m floor is covered with a 6 m by 5 m carpet; what area remains uncovered?**
    Answer: The uncovered area is $(12 \times 8) - (6 \times 5) = 66$sq m.
13. **A square and a rectangle both have a perimeter of 24 cm; can their areas be different?**
    Answer: Yes, equal perimeters can enclose different areas depending on the side lengths.
14. **Two rectangles measure 8 cm by 3 cm and 6 cm by 4 cm; how do their areas compare?**
    Answer: Both rectangles have an equal area of 24 sq cm.
15. **Which has the greater perimeter: a** $6\text{ cm} \times 4\text{ cm}$**rectangle or a square of side 5 cm?**
    Answer: Both figures have the same perimeter of 20 cm.
16. **Which has the greater area: a** $9\text{ cm} \times 4\text{ cm}$**rectangle or a square of side 6 cm?**
    Answer: Both figures have the same area of 36 sq cm.
17. **A rectangle has an area of 48 sq cm and a breadth of 6 cm; what is its perimeter?**
    Answer: Its length is 8 cm, so its perimeter is $2 \times (8 + 6) = 28$cm.
18. **A square has an area of 49 sq cm; what is its perimeter?**
    Answer: Its side is 7 cm, so its perimeter is $4 \times 7 = 28$cm.
19. **A rectangular plot measures 25 m by 10 m, and fencing costs ₹20 per metre; what is the total cost?**
    Answer: The total cost is $2 \times (25 + 10) \times ₹20 = ₹1{,}400$.
20. **A room measures 10 m by 6 m, and tiling costs ₹50 per square metre; what is the total cost?**
    Answer: The total tiling cost is $10 \times 6 \times ₹50 = ₹3{,}000$.
21. **A** $10\text{ cm} \times 8\text{ cm}$**rectangle is divided into two equal parts; what is the area of each part?**
    Answer: The area of each part is $(10 \times 8) \div 2 = 40$sq cm.
22. **Four flower beds, each measuring 2 m by 1 m, are made in a** $12\text{ m} \times 10\text{ m}$**garden; what area remains?**
    Answer: The remaining area is $(12 \times 10) - 4(2 \times 1) = 112$sq m.
23. **A rectangular field has an area of 200 sq m; how many trees can be planted if each requires 20 sq m?**
    Answer: A maximum of $200 \div 20 = 10$trees can be planted.
24. **Why can two figures made using the same number of unit squares have different perimeters?**

Answer: Their perimeters can differ because different arrangements create different numbers of exposed boundary edges.

25. **Which has the smaller perimeter for an area of 16 sq units: a 1×16rectangle or a 4×4square?**
    Answer: The 4×4square has the smaller perimeter of 16 units.
26. **If the length of a rectangle is doubled while its breadth remains unchanged, what happens to its area?**
    Answer: Its area becomes twice the original area.
27. **If every side of a square is doubled, what happens to its perimeter?**
    Answer: Its perimeter becomes twice the original perimeter.
28. **If every side of a square is doubled, what happens to its area?**
    Answer: Its area becomes four times the original area.
29. **A square is cut into two equal rectangles; how does the total area of the rectangles compare with the square's area?**
    Answer: The combined area of the two rectangles equals the area of the original square.
30. **Why is area used rather than perimeter to calculate the number of tiles needed for a floor?**
    Answer: Area is used because tiles cover the surface enclosed within the floor's boundary.

6.7 Two-mark questions with Answers of LOTS Type: (20 Questions)

Two-Mark Descriptive Questions with Answers — LOTS Type:

1. What is perimeter? How is the perimeter of a polygon calculated?

Answer:

1. Perimeter is the total distance around the boundary of a closed figure.
2. It is calculated by adding the lengths of all the sides of the polygon.

2. State the formula for the perimeter of a rectangle and explain its terms.

Answer:

1. The perimeter of a rectangle is $P = 2(l + b)$.
2. Here, $l$represents the length and $b$represents the breadth.

3. Find the perimeter of a rectangle measuring 12 cm by 8 cm.

Answer:

1. $P = 2(l + b) = 2(12 + 8)$.
2. Therefore, the perimeter is 40cm.

4. State the formula for the perimeter of a square and find the perimeter of a square of side 9 cm.

Answer:

1. The perimeter of a square is $P = 4s$.
2. Therefore, $P = 4 \times 9 = 36$cm.

5. Find the perimeter of a triangle having sides 5 cm, 7 cm and 9 cm.

Answer:

1. The perimeter is $5 + 7 + 9$cm.
2. Therefore, the perimeter of the triangle is 21cm.

6. What is an equilateral triangle? State its perimeter formula.

Answer:

1. An equilateral triangle has three sides of equal length.
2. Its perimeter is $P = 3 \times$ length of one side.

7. Find the perimeter of an equilateral triangle whose side is 11 cm.

Answer:

1. $P = 3 \times 11\text{cm}$.
2. Therefore, its perimeter is 33cm.

8. What is a regular polygon? How is its perimeter calculated?

Answer:

1. A regular polygon has all its sides and all its angles equal.
2. Its perimeter equals the number of sides multiplied by the length of one side.

9. Find the perimeter of a regular hexagon whose side is 6 cm.

Answer:

1. A regular hexagon has six equal sides, so $P = 6 \times 6$.
2. Therefore, its perimeter is 36cm.

10. What is area? Mention any two common units used to measure it.

Answer:

1. Area is the measure of the region enclosed by a closed figure.
2. It may be measured in square centimetres and square metres.

11. State the formula for the area of a rectangle and find the area of a rectangle measuring 10 cm by 6 cm.

Answer:

1. The area of a rectangle is $A = l \times b$.
2. Therefore, $A = 10 \times 6 = 60\text{sq cm}$.

12. State the formula for the area of a square and find the area of a square of side 8 cm.

Answer:

1. The area of a square is $A = s \times s$.
2. Therefore, $A = 8 \times 8 = 64\text{sq cm}$.

13. Find the length of a rectangle whose area is 72 sq cm and breadth is 8 cm.

Answer:

1. $\text{Length} = \text{area} \div \text{breadth} = 72 \div 8$.
2. Therefore, the length of the rectangle is 9cm.

14. Find the breadth of a rectangle whose area is 84 sq m and length is 12 m.

Answer:

1. $\text{Breadth} = \text{area} \div \text{length} = 84 \div 12$.
2. Therefore, the breadth of the rectangle is 7m.

15. Find the side of a square whose perimeter is 44 cm.

Answer:

1. $\text{Side} = \text{perimeter} \div 4 = 44 \div 4$.
2. Therefore, the side of the square is 11cm.

16. Find the third side of a triangle whose perimeter is 50 cm and whose other sides are 18 cm and 14 cm.

Answer:

1. $\text{Third side} = 50 - (18 + 14)\text{cm}$.
2. Therefore, the third side is 18cm.

17. How can the area of a figure drawn on a square grid be found?

Answer:

1. Count the complete unit squares covered by the figure.
2. The number of covered unit squares gives the area in square units.

18. How can the area of a composite figure be calculated?

Answer:

1. Divide the composite figure into simpler rectangles, squares or triangles.
2. Calculate their areas separately and add them to obtain the total area.

19. Can two figures have the same area but different perimeters? Explain.

Answer:
1. Yes, two differently shaped figures can cover the same number of square units.
2. Their boundary lengths may differ, so their perimeters can be different.

20. Can two figures have the same perimeter but different areas? Explain.
Answer:
1. Yes, two figures can have equal total boundary lengths.
2. Their shapes and dimensions may differ, so they can enclose different areas.

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

Two-Mark Descriptive Questions with Answers — HOTS Type:
1. A rectangular park is 35 m long and 20 m wide. Find the distance covered in two rounds.
Answer:
1. Perimeter of the park $= 2(35 + 20) = 110$m.
2. Distance covered in two rounds $= 2 \times 110 = 220$m.

2. A rectangular field has a perimeter of 50 m and a length of 15 m. Find its breadth.
Answer:
1. $2(15 + b) = 50$, so $15 + b = 25$.
2. Therefore, the breadth is $25 - 15 = 10$m.

3. A wire 64 cm long is bent to form a square. Find the length of each side.
Answer:
1. The length of each side is $64 \div 4$.
2. Therefore, each side of the square is 16cm long.

4. A string forms an equilateral triangle with a side of 18 cm. If the same string is used to form a square, find the square's side.
Answer:
1. The string's length is $3 \times 18 = 54$cm.
2. Each side of the square is $54 \div 4 = 13.5$cm.

5. The perimeter of a triangle is 72 cm, and two of its sides are 25 cm and 19 cm. Find the third side.
Answer:
1. The sum of the two known sides is $25 + 19 = 44$cm.
2. Therefore, the third side is $72 - 44 = 28$cm.

6. A farmer fences a rectangular field measuring 40 m by 25 m with three rounds of rope. Find the total rope required.
Answer:
1. The perimeter of the field is $2(40 + 25) = 130$m.
2. The total rope required is $3 \times 130 = 390$m.

7. Fencing a square garden costs ₹25 per metre, and each side is 12 m long. Find the total fencing cost.
Answer:
1. The garden's perimeter is $4 \times 12 = 48$m.
2. Therefore, the fencing cost is $48 \times ₹25 = ₹1{,}200$.

8. A rectangular garden has an area of 240 sq m and a length of 20 m. Find its breadth and perimeter.
Answer:
1. Its breadth is $240 \div 20 = 12$m.
2. Its perimeter is $2(20 + 12) = 64$m.

9. A square has an area of 144 sq cm. Find its side and perimeter.
Answer:

1. Its side is 12 cm because $12 \times 12 = 144$.
2. Therefore, its perimeter is $4 \times 12 = 48$cm.

10. A room measures 9 m by 7 m, and a square carpet of side 5 m is laid on its floor. Find the uncovered area.

Answer:

1. The floor area is $9 \times 7 = 63$sq m, while the carpet area is $5 \times 5 = 25$sq m.
2. Therefore, the uncovered area is $63 - 25 = 38$sq m.

11. A rectangular garden measures 18 m by 12 m. Four flower beds of size 2 m × 1 mare made in it; find the remaining area.

Answer:

1. The garden's area is $18 \times 12 = 216$sq m, and the four beds occupy $4 \times 2 \times 1 = 8$sq m.
2. Therefore, the remaining area is $216 - 8 = 208$sq m.

12. Two rectangles measure 8 cm × 6 cmand 12 cm × 4 cm. Compare their areas.

Answer:

1. Their respective areas are $8 \times 6 = 48$sq cm and $12 \times 4 = 48$sq cm.
2. Thus, both rectangles have equal areas despite having different dimensions.

13. A square of side 6 cm and a rectangle measuring 8 cm × 4 cmare given. Compare their perimeters.

Answer:

1. The square's perimeter is $4 \times 6 = 24$cm, while the rectangle's perimeter is $2(8 + 4) = 24$cm.
2. Therefore, both figures have the same perimeter.

14. A 10 cm × 6 cmrectangle is cut into two equal rectangles along its length. Find the area of each part.

Answer:

1. The original rectangle's area is $10 \times 6 = 60$sq cm.
2. Therefore, each equal part has an area of $60 \div 2 = 30$sq cm.

15. A 12 cm × 8 cmrectangle is divided into a 7 cm × 8 cmpart and another rectangle. Find the area of the other part.

Answer:

1. The width of the other part is $12 - 7 = 5$cm.
2. Therefore, its area is $5 \times 8 = 40$sq cm.

16. A square park has a side of 20 m, with a square pond of side 6 m inside it. Find the land area remaining.

Answer:

1. The areas of the park and pond are $20^2 = 400$sq m and $6^2 = 36$sq m respectively.
2. Therefore, the remaining land area is $400 - 36 = 364$sq m.

17. A floor has an area of 96 sq m, and every tile covers 2 sq m. Find the number of tiles needed.

Answer:

1. The number of tiles equals the floor area divided by the area of one tile.
2. Therefore, $96 \div 2 = 48$tiles are needed.

18. A rectangular plot is 30 m long and 20 m wide. Find the cost of covering it at ₹15 per square metre.

Answer:

1. The area of the plot is $30 \times 20 = 600$sq m.
2. Therefore, the covering cost is $600 \times ₹15 = ₹9{,}000$.

19. A rectangle and a square both have an area of 36 sq cm; the rectangle measures 9 cm × 4 cm. Which has the smaller perimeter?
Answer:
1. The rectangle's perimeter is $2(9 + 4) = 26$cm, while the square's side is 6 cm and its perimeter is 24 cm.
2. Therefore, the square has the smaller perimeter.

20. Nine unit squares are arranged first as a 3×3square and then as a 1×9rectangle. Compare their perimeters.
Answer:
1. The 3×3arrangement has a perimeter of 12 units, while the 1×9arrangement has a perimeter of 20 units.
2. Thus, the long rectangular arrangement has a greater perimeter, although both arrangements have the same area.

6.9. Three-mark questions with Answers of LOTS Type: (15 Questions)

Three-Mark Descriptive Questions with Answers — LOTS Type:
1. Define perimeter and explain how the perimeter of a rectangle is calculated.
Answer:
1. Perimeter is the total distance around the boundary of a closed figure.
2. A rectangle has two equal lengths and two equal breadths.
3. Therefore, its perimeter is $P = 2(l + b)$.

2. Find the perimeter of a rectangular playground measuring 25 m by 15 m.
Answer:
1. Perimeter of a rectangle $= 2(l + b)$.
2. $P = 2(25 + 15) = 2 \times 40$.
3. Therefore, the perimeter of the playground is 80m.

3. Find the perimeter of a square park whose side is 18 m.
Answer:
1. Perimeter of a square $= 4 \times$ side.
2. $P = 4 \times 18 = 72$m.
3. Therefore, the perimeter of the square park is 72m.

4. Find the perimeter of a triangle having sides 12 cm, 15 cm and 17 cm.
Answer:
1. Perimeter of a triangle is the sum of its three sides.
2. $P = 12 + 15 + 17 = 44$cm.
3. Therefore, the perimeter of the triangle is 44cm.

5. What is a regular polygon? Find the perimeter of a regular pentagon whose side is 7 cm.
Answer:
1. A regular polygon has all its sides and all its angles equal.
2. A pentagon has five sides, so its perimeter is 5×7cm.
3. Therefore, the perimeter of the regular pentagon is 35cm.

6. Find the perimeter of an equilateral triangle whose side is 14 cm.
Answer:
1. An equilateral triangle has three equal sides.
2. Its perimeter is $3 \times 14 = 42$cm.
3. Therefore, the perimeter of the equilateral triangle is 42cm.

7. Find the length of a rectangle whose perimeter is 50 cm and breadth is 9 cm.
Answer:

1. $2(l + b) = 50$, so $l + b = 25$.
2. Substituting $b = 9$, we get $l = 25 - 9 = 16$cm.
3. Therefore, the length of the rectangle is 16cm.

8. Find the side of a square whose perimeter is 60 cm.
Answer:
1. The side of a square is its perimeter divided by four.
2. Side $= 60 \div 4 = 15$cm.
3. Therefore, each side of the square measures 15cm.

9. Define area and explain how the area of a rectangle is calculated.
Answer:
1. Area is the measure of the region enclosed by a closed figure.
2. The area of a rectangle is obtained by multiplying its length by its breadth.
3. Thus, $A = l \times b$, and it is expressed in square units.

10. Find the area of a rectangular field measuring 32 m by 18 m.
Answer:
1. Area of a rectangle $=$ length $\times$ breadth.
2. $A = 32 \times 18 = 576$sq m.
3. Therefore, the area of the field is 576sq m.

11. Find the area and perimeter of a square whose side is 9 cm.
Answer:
1. Its area is $9 \times 9 = 81$sq cm.
2. Its perimeter is $4 \times 9 = 36$cm.
3. Therefore, the square has an area of 81sq cm and a perimeter of 36cm.

12. Find the breadth and perimeter of a rectangle whose area is 96 sq cm and length is 12 cm.
Answer:
1. Breadth $=$ area $\div$ length $= 96 \div 12 = 8$cm.
2. Perimeter $= 2(12 + 8) = 40$cm.
3. Therefore, the breadth is 8cm and the perimeter is 40cm.

13. Explain how the area of a figure drawn on a square grid can be determined.
Answer:
1. Observe the unit squares enclosed within the boundary of the figure.
2. Count all the complete unit squares and combine partial squares where necessary.
3. The total number of unit squares gives the figure’s area in square units.

14. Explain how to find the area of a composite figure.
Answer:
1. Divide the composite figure into familiar shapes such as rectangles and squares.
2. Calculate the area of every smaller shape separately.
3. Add these areas to obtain the total area of the composite figure.

15. Distinguish between perimeter and area.
Answer:
1. Perimeter measures the total length of the boundary of a closed figure.
2. Area measures the region enclosed within that boundary.
3. Perimeter is expressed in linear units, while area is expressed in square units.

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

Three-Mark Descriptive Questions with Answers — HOTS Type:
1. A rectangular running track is 70 m long and 40 m wide. Find the distance covered by a runner in five rounds.

Answer:

1. The perimeter of the track is $2(70 + 40) = 220$m.
2. The distance covered in five rounds is $5 \times 220 = 1{,}100$m.
3. Therefore, the runner covers 1,100m or 1.1km.

2. A farmer has a rectangular field measuring 230 m by 160 m and wants to fence it with three rounds of rope. Find the total length of rope required.

Answer:

1. The perimeter of the field is $2(230 + 160) = 780$m.
2. The rope required for three rounds is $3 \times 780 = 2{,}340$m.
3. Therefore, the farmer requires 2,340m of rope.

3. A wire is bent to form a rectangle of length 10 cm and breadth 6 cm. If it is reshaped into a square, find the side of the square.

Answer:

1. The length of the wire is the rectangle's perimeter, $2(10 + 6) = 32$cm.
2. The side of the square is $32 \div 4 = 8$cm.
3. Therefore, the wire forms a square with each side measuring 8cm.

4. A triangle has a perimeter of 64 cm, and two of its sides measure 18 cm and 21 cm. Find its third side.

Answer:

1. The sum of the two known sides is $18 + 21 = 39$cm.
2. The third side is $64 - 39 = 25$cm.
3. Therefore, the third side of the triangle measures 25cm.

5. A rectangular garden has an area of 300 sq m and a length of 25 m. Find its breadth and perimeter.

Answer:

1. The breadth of the garden is $300 \div 25 = 12$m.
2. Its perimeter is $2(25 + 12) = 74$m.
3. Therefore, the garden is 12m wide and has a perimeter of 74m.

6. A room is 8 m long and 6 m wide, and a square carpet of side 5 m is placed on its floor. Find the uncovered area.

Answer:

1. The floor area is $8 \times 6 = 48$sq m.
2. The carpet area is $5 \times 5 = 25$sq m.
3. Therefore, the uncovered area is $48 - 25 = 23$sq m.

7. Four flower beds, each measuring 2 m by 1 m, are made at the corners of a garden measuring 15 m by 12 m. Find the area remaining for a lawn.

Answer:

1. The garden's area is $15 \times 12 = 180$sq m.
2. The four flower beds occupy $4 \times (2 \times 1) = 8$sq m.
3. Therefore, the area remaining for the lawn is $180 - 8 = 172$sq m.

8. A rectangle measuring 9 cm by 4 cm and a square having a side of 6 cm are given. Compare their areas and perimeters.

Answer:

1. Both figures have an area of 36sq cm because $9 \times 4 = 6 \times 6 = 36$.
2. The rectangle's perimeter is $2(9 + 4) = 26$cm, while the square's perimeter is $4 \times 6 = 24$cm.
3. Thus, their areas are equal, but the rectangle has a greater perimeter.

9. A square and a rectangle both have a perimeter of 32 cm. If the rectangle measures 10 cm by 6 cm, compare their areas.

Answer:

1. The square's side is $32 \div 4 = 8$cm, so its area is $8 \times 8 = 64$sq cm.
2. The rectangle's area is $10 \times 6 = 60$sq cm.
3. Therefore, the square has 4sq cm more area than the rectangle.

10. Nine unit squares are arranged as a 3×3square and then as a 1×9rectangle. Compare their areas and perimeters.

Answer:

1. Both arrangements have an area of 9square units.
2. The 3×3square has a perimeter of 12units, while the 1×9rectangle has a perimeter of 20units.
3. Hence, equal areas can have different perimeters depending on their arrangement.

11. A square sheet of side 12 cm is cut into two equal rectangles. Find the area and perimeter of each rectangle.

Answer:

1. Each rectangle measures 12 cm $\times$ 6 cm.
2. Its area is $12 \times 6 = 72$sq cm, and its perimeter is $2(12 + 6) = 36$cm.
3. Therefore, each rectangle has an area of 72sq cm and a perimeter of 36cm.

12. A rectangular plot measures 30 m by 20 m. Find the total cost of fencing it at ₹40 per metre and covering it at ₹8 per square metre.

Answer:

1. Its perimeter is $2(30 + 20) = 100$m, so fencing costs $100 \times$ ₹40 = ₹4,000.
2. Its area is $30 \times 20 = 600$sq m, so covering costs $600 \times$ ₹8 = ₹4,800.
3. Therefore, the total cost is ₹4,000 + ₹4,800 = ₹8,800.

13. A coconut grove measures 100 m by 50 m, and each tree requires 25 sq m. Find the maximum number of trees and explain why perimeter is not used.

Answer:

1. The grove's area is $100 \times 50 = 5{,}000$sq m.
2. The maximum number of trees is $5{,}000 \div 25 = 200$.
3. Area is used because trees occupy the land inside the boundary, whereas perimeter measures only its outer edge.

14. A square park of side 20 m contains a rectangular pond measuring 8 m by 5 m. Find the remaining area and the pond's perimeter.

Answer:

1. The park's area is $20 \times 20 = 400$sq m, while the pond's area is $8 \times 5 = 40$sq m.
2. The remaining area is $400 - 40 = 360$sq m.
3. The pond's perimeter is $2(8 + 5) = 26$m.

15. A rectangle has an area of 48 sq cm; give two possible pairs of whole-number dimensions and compare their perimeters.

Answer:

1. Two possible pairs are 8 cm $\times$ 6 cmand 12 cm $\times$ 4 cm.
2. Their perimeters are $2(8 + 6) = 28$cm and $2(12 + 4) = 32$cm respectively.
3. Thus, rectangles with the same area can have different perimeters.

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

Five-Mark Descriptive Questions with Answers — LOTS Type:

1. Define perimeter and explain the formulas for finding the perimeters of a rectangle, square, triangle and regular polygon.

Answer:

1. Perimeter is the total distance around the boundary of a closed plane figure.

2. The perimeter of a rectangle is $P = 2(l + b)$.
3. The perimeter of a square is $P = 4s$.
4. The perimeter of a triangle is $P = a + b + c$.
5. The perimeter of a regular polygon is $P = n \times s$, where $n$is the number of sides.

2. A rectangular playground is 45 m long and 25 m wide. Find its perimeter and the distance covered in four rounds.

Answer:

1. The length of the playground is 45m and its breadth is 25m.
2. Its perimeter is $2(l + b)$.
3. Therefore, $P = 2(45 + 25) = 2 \times 70 = 140$m.
4. The distance covered in four rounds is $4 \times 140 = 560$m.
5. Hence, the total distance covered is 560m.

3. A farmer wants to fence a rectangular field measuring 60 m by 40 m with two rounds of wire. Find the total wire required.

Answer:

1. The field has a length of 60m and a breadth of 40m.
2. Its perimeter is $2(60 + 40)$m.
3. Therefore, the distance around the field is 200m.
4. The wire needed for two rounds is $2 \times 200 = 400$m.
5. Hence, the farmer requires 400m of wire.

4. Explain the meaning of area and the methods used to find the areas of rectangles, squares and composite figures.

Answer:

1. Area is the measure of the region enclosed within the boundary of a closed figure.
2. Area is expressed in square units such as square centimetres and square metres.
3. The area of a rectangle is $A = l \times b$.
4. The area of a square is $A = s \times s = s^2$.
5. The area of a composite figure is found by dividing it into simpler shapes and adding their areas.

5. A rectangular garden is 35 m long and 20 m wide. Find its area, perimeter and fencing cost at ₹50 per metre.

Answer:

1. The area of the garden is $35 \times 20 = 700$sq m.
2. Its perimeter is $2(35 + 20)$m.
3. Therefore, the perimeter is 110m.
4. The fencing cost is $110 \times$ ₹50 = ₹5,500.
5. Hence, the garden has an area of 700sq m and costs ₹5,500 to fence.

6. A square playground has a side of 16 m. Find its perimeter, area and the distance covered in three rounds.

Answer:

1. The perimeter of the playground is $4 \times 16 = 64$m.
2. Its area is $16 \times 16 = 256$sq m.
3. The distance covered in one round is 64m.
4. The distance covered in three rounds is $3 \times 64 = 192$m.
5. Hence, its perimeter is 64m, area is 256sq m and the three-round distance is 192m.

7. A triangular field has sides measuring 18 m, 24 m and 30 m. Find its perimeter and the fencing cost for two rounds at ₹15 per metre.

Answer:

1. The perimeter of the triangular field is $18 + 24 + 30$m.

2. Therefore, its perimeter is 72m.
3. The fencing required for two rounds is $2 \times 72 = 144$m.
4. The total cost is $144 \times ₹15 = ₹2,160$.
5. Hence, two rounds of fencing will cost ₹2,160.

8. A rectangular floor is 12 m long and 8 m wide. A square carpet of side 6 m is placed on it; find the uncovered area.

Answer:

1. The area of the rectangular floor is $12 \times 8 = 96$sq m.
2. The side of the square carpet is 6m.
3. The carpet's area is $6 \times 6 = 36$sq m.
4. The uncovered area is $96 - 36 = 60$sq m.
5. Hence, 60sq m of the floor remains uncovered.

9. A rectangular coconut grove is 80 m long and 50 m wide. If each tree requires 20 sq m, find the maximum number of trees that can be planted.

Answer:

1. The grove's length is 80m and its breadth is 50m.
2. Its area is $80 \times 50 = 4{,}000$sq m.
3. Each coconut tree requires 20sq m of space.
4. The maximum number of trees is $4{,}000 \div 20 = 200$.
5. Hence, a maximum of 200coconut trees can be planted.

10. Differentiate between perimeter and area with their units and applications.

Answer:

1. Perimeter is the total length of the boundary of a closed figure.
2. Area is the measure of the surface enclosed within that boundary.
3. Perimeter is measured in linear units such as centimetres and metres.
4. Area is measured in square units such as square centimetres and square metres.
5. Perimeter is used for fencing or borders, while area is used for tiling, carpeting or covering surfaces.

6.12 Five-mark questions with Answers of HOTS Type: (8 Questions)

Five-Mark Descriptive Questions with Answers — HOTS Type:

1. A rectangular park is 60 m long and 40 m wide. Akshi completes five rounds, while Toshi completes four rounds of a square park of side 55 m. Who covers the longer distance and by how much?

Answer:

1. The perimeter of the rectangular park is $2(60 + 40) = 200$m.
2. Akshi covers $5 \times 200 = 1{,}000$m.
3. The perimeter of the square park is $4 \times 55 = 220$m.
4. Toshi covers $4 \times 220 = 880$m.
5. Therefore, Akshi covers $1{,}000 - 880 = 120$m more than Toshi.

2. A wire is used to form a rectangle measuring 14 cm by 10 cm. It is then straightened and bent into a square; find the square's side and compare the areas of the two figures.

Answer:

1. The length of the wire is the rectangle's perimeter, $2(14 + 10) = 48$cm.
2. The square's side is $48 \div 4 = 12$cm.
3. The rectangle's area is $14 \times 10 = 140$sq cm.
4. The square's area is $12 \times 12 = 144$sq cm.
5. Therefore, the square has $144 - 140 = 4$sq cm more area than the rectangle.

3. A rectangular garden measures 20 m by 15 m. Four flower beds measuring 3 m by 2 m each are made at its corners, and the remaining portion is used as a lawn; find the lawn area and the cost of laying grass at ₹40 per square metre.

Answer:

1. The total area of the garden is $20 \times 15 = 300$sq m.
2. The area of one flower bed is $3 \times 2 = 6$sq m.
3. The four flower beds occupy $4 \times 6 = 24$sq m.
4. The lawn area is $300 - 24 = 276$sq m.
5. Therefore, the cost of laying grass is $276 \times ₹40 = ₹11{,}040$.

4. A square playground has the same perimeter as a rectangular playground measuring 30 m by 20 m. Find the square's side and determine which playground has the greater area.

Answer:

1. The rectangle's perimeter is $2(30 + 20) = 100$m.
2. Since the square has the same perimeter, its side is $100 \div 4 = 25$m.
3. The rectangle's area is $30 \times 20 = 600$sq m.
4. The square's area is $25 \times 25 = 625$sq m.
5. Therefore, the square playground has $625 - 600 = 25$sq m more area.

5. A floor measures 12 m by 10 m. A square carpet of side 8 m is placed on it, and the remaining floor is tiled at ₹75 per square metre; find the tiling cost.

Answer:

1. The total floor area is $12 \times 10 = 120$sq m.
2. The carpet covers $8 \times 8 = 64$sq m.
3. The area remaining for tiling is $120 - 64 = 56$sq m.
4. The tiling cost is $56 \times ₹75$.
5. Therefore, the total cost of tiling is ₹4,200.

6. Two rectangular plots have the same area of 96 sq m. Plot A measures 12 m by 8 m, while Plot B measures 16 m by 6 m; compare their fencing requirements and costs at ₹50 per metre.

Answer:

1. Plot A has a perimeter of $2(12 + 8) = 40$m.
2. Plot B has a perimeter of $2(16 + 6) = 44$m.
3. The fencing costs are $40 \times ₹50 = ₹2{,}000$for Plot A and $44 \times ₹50 = ₹2{,}200$for Plot B.
4. Plot B needs $44 - 40 = 4$m more fencing and costs ₹200 more.
5. Thus, figures with equal areas can require different lengths and costs of fencing.

7. A square sheet of side 12 cm is cut along the middle into two equal rectangles. Compare the original square's perimeter with the sum of the perimeters of the two rectangles.

Answer:

1. The original square's perimeter is $4 \times 12 = 48$cm.
2. Each resulting rectangle measures 12 cm $\times$ 6 cm.
3. The perimeter of each rectangle is $2(12 + 6) = 36$cm.
4. The sum of the two rectangular perimeters is $36 + 36 = 72$cm.
5. Therefore, the combined perimeter is $72 - 48 = 24$cm greater because the cut creates new boundary edges.

8. Nine unit squares are arranged first as a 3×3square and then as a 1×9rectangle. Compare their areas and perimeters and state the conclusion.

Answer:

1. Both arrangements contain nine unit squares, so each has an area of 9 square units.
2. The 3×3square has a perimeter of $2(3 + 3) = 12$units.

3. The 1×9rectangle has a perimeter of $2(1 + 9) = 20$units.
4. The 1×9arrangement has a perimeter that is $20 - 12 = 8$units greater.
5. Therefore, figures with the same area can have different perimeters depending on their arrangement.

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

Five-Mark Descriptive Questions with Answers — Applied Type:

1. A farmer owns a rectangular field measuring 75 m by 45 m. He wants to fence it with three rounds of wire costing ₹20 per metre. Find the required length of wire and its total cost.

Answer:

1. The perimeter of the field is $2(75 + 45) = 240$m.
2. One round of fencing requires 240m of wire.
3. Three rounds require $3 \times 240 = 720$m of wire.
4. The cost of the wire is $720 \times ₹20 = ₹14{,}400$.
5. Therefore, the farmer needs 720m of wire costing ₹$14{,}400$.

2. A classroom floor is 12 m long and 8 m wide. A square activity mat of side 6 m is placed on the floor, and the remaining portion is tiled at ₹80 per square metre. Find the tiling cost.

Answer:

1. The area of the classroom floor is $12 \times 8 = 96$sq m.
2. The area covered by the activity mat is $6 \times 6 = 36$sq m.
3. The area to be tiled is $96 - 36 = 60$sq m.
4. The cost of tiling is $60 \times ₹80 = ₹4{,}800$.
5. Therefore, ₹$4{,}800$ is required to tile the uncovered floor.

3. A school has a rectangular playground measuring 80 m by 50 m. A student runs around it six times every morning; find the distance covered in metres and kilometres.

Answer:

1. The perimeter of the playground is $2(80 + 50) = 260$m.
2. The student covers 260m in one round.
3. In six rounds, the distance covered is $6 \times 260 = 1{,}560$m.
4. Converting into kilometres gives $1{,}560 \div 1{,}000 = 1.56$km.
5. Therefore, the student covers $1{,}560$m or 1.56km.

4. A rectangular garden is 30 m long and 20 m wide. Four rectangular flower beds, each measuring 4 m by 2 m, are prepared at its corners, while the remaining area is used for grass. Find the grass-covered area and its cost at ₹25 per square metre.

Answer:

1. The total area of the garden is $30 \times 20 = 600$sq m.
2. The area of one flower bed is $4 \times 2 = 8$sq m.
3. The four flower beds cover $4 \times 8 = 32$sq m.
4. The grass-covered area is $600 - 32 = 568$sq m.
5. Therefore, the cost of laying grass is $568 \times ₹25 = ₹14{,}200$.

5. A carpenter has a 72 cm long decorative strip. He can use it to make either a square frame or an equilateral triangular frame. Find the side lengths and compare the enclosed areas using unit-square paper.

Answer:

1. The side of the square frame is $72 \div 4 = 18$cm.
2. The side of the equilateral triangular frame is $72 \div 3 = 24$cm.
3. The area of the square is $18 \times 18 = 324$sq cm.

4. The triangular area can be estimated on unit-square paper by counting its complete and partial squares.
5. Thus, the same strip produces figures with the same perimeter but different shapes and enclosed areas.

6. A square courtyard has a side of 24 m. A rectangular stage measuring 10 m by 8 m is built inside it, and the remaining area is used for seating. Find the seating area.

Answer:

1. The area of the square courtyard is $24 \times 24 = 576$sq m.
2. The area of the rectangular stage is $10 \times 8 = 80$sq m.
3. The stage occupies part of the courtyard's total area.
4. The seating area is $576 - 80 = 496$sq m.
5. Therefore, 496sq m is available for seating.

7. A housing plot measuring 40 m by 25 m contains a house measuring 30 m by 20 m. Find the open area and the cost of paving it at ₹120 per square metre.

Answer:

1. The total area of the plot is $40 \times 25 = 1{,}000$sq m.
2. The area occupied by the house is $30 \times 20 = 600$sq m.
3. The open area is $1{,}000 - 600 = 400$sq m.
4. The paving cost is $400 \times ₹120 = ₹48{,}000$.
5. Therefore, the open area is 400sq m, and paving it costs ₹48,000.

8. A rectangular coconut grove is 100 m long and 60 m wide. Each coconut tree requires 30 sq m, and the boundary is fenced at ₹50 per metre. Find the maximum number of trees and the fencing cost.

Answer:

1. The grove's area is $100 \times 60 = 6{,}000$sq m.
2. The maximum number of trees is $6{,}000 \div 30 = 200$.
3. The grove's perimeter is $2(100 + 60) = 320$m.
4. The fencing cost is $320 \times ₹50 = ₹16{,}000$.
5. Therefore, the grove can accommodate 200trees, and its fencing costs ₹16,000.

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

Olympiad-Type Multiple-Choice Questions:

1. A rectangle has a perimeter of 54 cm and a length of 16 cm. What is its breadth?

A. 9 cm
B. 10 cm
C. 11 cm
D. 12 cm

Answer: C. 11 cm

$$2(16 + b) = 54 \Rightarrow b = 11 \text{ cm}$$

2. A wire is bent into a rectangle measuring 14 cm by 8 cm. If the same wire is bent into a square, what will be the square's side?

A. 9 cm
B. 10 cm
C. 11 cm
D. 12 cm

Answer: C. 11 cm

$$2(14 + 8) = 44 \text{ cm}; \; 44 \div 4 = 11 \text{ cm}$$

3. The perimeter of an equilateral triangle is equal to the perimeter of a square of side 12 cm. What is the triangle's side?

A. 12 cm
B. 14 cm
C. 16 cm
D. 18 cm
Answer: C. 16 cm

$$4 \times 12 = 48 \text{ cm}; \; 48 \div 3 = 16 \text{ cm}$$

4. A regular hexagon and an equilateral triangle have equal perimeters. If the hexagon's side is 7 cm, what is the triangle's side?
A. 12 cm
B. 14 cm
C. 16 cm
D. 21 cm
Answer: B. 14 cm

$$6 \times 7 = 42 \text{ cm}; \; 42 \div 3 = 14 \text{ cm}$$

5. A runner completes four rounds of a rectangular track measuring 75 m by 45 m. What distance does the runner cover?
A. 720 m
B. 840 m
C. 960 m
D. 1,020 m
Answer: C. 960 m

$$4 \times 2(75 + 45) = 960 \text{ m}$$

6. A rectangle and a square have the same perimeter of 40 cm. If the rectangle measures 12 cm by 8 cm, how much greater is the square's area?
A. 2 sq cm
B. 4 sq cm
C. 6 sq cm
D. 8 sq cm
Answer: B. 4 sq cm

$$10^2 - (12 \times 8) = 100 - 96 = 4 \text{ sq cm}$$

7. Which rectangle has the greatest area if each has a perimeter of 24 cm?
A. 1 cm × 11 cm
B. 2 cm × 10 cm
C. 4 cm × 8 cm
D. 6 cm × 6 cm
Answer: D. 6 cm × 6 cm
8. Which rectangle has the smallest perimeter for an area of 36 sq cm?
A. 1 cm × 36 cm
B. 2 cm × 18 cm
C. 3 cm × 12 cm
D. 6 cm × 6 cm
Answer: D. 6 cm × 6 cm
9. A rectangular garden has an area of 480 sq m and a length of 30 m. What is the cost of fencing it at ₹25 per metre?
A. ₹1,900
B. ₹2,000
C. ₹2,300
D. ₹2,500
Answer: C. ₹2,300

$$b = 480 \div 30 = 16 \text{ m}; \; P = 92 \text{ m}; \; 92 \times 25 = ₹2{,}300$$

10. A square floor has an area of 196 sq m. What is its perimeter?
A. 42 m
B. 48 m
C. 56 m
D. 64 m
Answer: C. 56 m

$$s = 14 \text{ m};\ P = 4 \times 14 = 56 \text{ m}$$

11. A rectangle is 4 cm longer than its breadth. If its perimeter is 40 cm, what is its area?
A. 84 sq cm
B. 90 sq cm
C. 96 sq cm
D. 100 sq cm
Answer: C. 96 sq cm

$$l + b = 20,\ l = b + 4 \Rightarrow b = 8, l = 12$$

12. The sides of a triangle are three consecutive whole numbers, and its perimeter is 36 cm. What is the longest side?
A. 11 cm
B. 12 cm
C. 13 cm
D. 14 cm
Answer: C. 13 cm

$$11 + 12 + 13 = 36$$

13. Four equal squares of side 3 cm are placed in one row without gaps. What is the perimeter of the resulting rectangle?
A. 30 cm
B. 36 cm
C. 42 cm
D. 48 cm
Answer: A. 30 cm

$$\text{Dimensions} = 12 \text{ cm} \times 3 \text{ cm};\ P = 30 \text{ cm}$$

14. Nine unit squares are arranged to form a 3 × 3square. What is its perimeter?
A. 9 units
B. 12 units
C. 18 units
D. 36 units
Answer: B. 12 units

15. The same nine unit squares are arranged in a 1 × 9row. By how many units does its perimeter exceed that of the 3 × 3arrangement?
A. 6 units
B. 8 units
C. 9 units
D. 10 units
Answer: B. 8 units

$$20 - 12 = 8 \text{ units}$$

16. A rectangular floor measures 15 m by 10 m. A square carpet of side 8 m is laid on it. What area remains uncovered?
A. 64 sq m
B. 76 sq m
C. 86 sq m
D. 96 sq m

Answer: C. 86 sq m

$$150 - 64 = 86 \text{ sq m}$$

17. Four flower beds, each measuring 3 m × 2 m, are made in a garden measuring 20 m × 15 m. What area remains?
A. 264 sq m
B. 270 sq m
C. 276 sq m
D. 284 sq m
Answer: C. 276 sq m

$$300 - 4(6) = 276 \text{ sq m}$$

18. A rectangular field has an area of 600 sq m. Each tree requires 24 sq m. What is the maximum number of trees that can be planted?
A. 20
B. 24
C. 25
D. 30
Answer: C. 25

$$600 \div 24 = 25$$

19. If the length and breadth of a rectangle are both doubled, its area becomes:
A. Two times the original area
B. Three times the original area
C. Four times the original area
D. Eight times the original area
Answer: C. Four times the original area
20. If the side of a square is tripled, its perimeter becomes:
A. Two times the original perimeter
B. Three times the original perimeter
C. Six times the original perimeter
D. Nine times the original perimeter
Answer: B. Three times the original perimeter
21. If the side of a square is tripled, its area becomes:
A. Three times the original area
B. Six times the original area
C. Nine times the original area
D. Twelve times the original area
Answer: C. Nine times the original area
22. A square sheet is cut into two equal rectangles through the middle. The sum of the perimeters of the two rectangles is how many times the square's perimeter?
A. $\frac{1}{2}$
B. 1
C. $1\frac{1}{2}$
D. 2
Answer: C. $1\frac{1}{2}$
23. A rectangle has an area of 72 sq cm. Which of the following cannot be its whole-number dimensions?
A. 8 cm × 9 cm
B. 6 cm × 12 cm

C. 4 cm × 18 cm
D. 5 cm × 14 cm
Answer: D. 5 cm × 14 cm
24. Two rectangles have dimensions 12 cm × 5 cmand 10 cm × 6 cm. Which statement is correct?
A. Their areas and perimeters are equal.
B. Their areas are equal, but their perimeters are different.
C. Their perimeters are equal, but their areas are different.
D. Both their areas and perimeters are different.
Answer: B. Their areas are equal, but their perimeters are different.
25. A 12 cm × 8 cmrectangle is divided into two parts. One part is a 5 cm × 8 cmrectangle. What is the area of the other part?
A. 40 sq cm
B. 48 sq cm
C. 56 sq cm
D. 64 sq cm
Answer: C. 56 sq cm

$$(12 - 5) \times 8 = 56 \text{ sq cm}$$

26. A square and an equilateral triangle each have a perimeter of 60 cm. What is the difference between their side lengths?
A. 2 cm
B. 3 cm
C. 5 cm
D. 10 cm
Answer: C. 5 cm

$$60 \div 4 = 15 \text{ cm},\ 60 \div 3 = 20 \text{ cm}$$

27. A rectangular plot measures 25 m by 16 m. What is the cost of covering it at ₹12 per square metre?
A. ₹4,200
B. ₹4,500
C. ₹4,800
D. ₹5,000
Answer: C. ₹4,800

$$25 \times 16 \times ₹12 = ₹4{,}800$$

28. The length of a rectangle is three times its breadth. If the perimeter is 64 cm, what is its area?
A. 128 sq cm
B. 160 sq cm
C. 192 sq cm
D. 256 sq cm
Answer: C. 192 sq cm

$$l = 3b,\ 2(3b + b) = 64 \Rightarrow b = 8, l = 24$$

29. A square of side 10 cm contains a smaller square of side 6 cm. What is the area between their boundaries?
A. 36 sq cm
B. 48 sq cm
C. 64 sq cm
D. 100 sq cm
Answer: C. 64 sq cm

$$10^2 - 6^2 = 100 - 36 = 64 \text{ sq cm}$$

30. Which statement is always true?
A. Figures with equal areas always have equal perimeters.
B. Figures with equal perimeters always have equal areas.
C. A square has four equal sides and its area equals side × side.
D. The area of a rectangle is twice its length and breadth.
Answer: C. A square has four equal sides and its area equals side × side.

6.15 Best Practices Opportunity List from the Chapter: (15 Ideas)

Best Practices for Teaching Chapter 6: Perimeter and Area:

(1) **Begin with real-life examples:**
Introduce perimeter using fencing, picture frames and running tracks, and explain area through flooring, gardens, carpets and classroom surfaces.

(2) **Use concrete measuring activities:**
Ask students to measure the length and breadth of books, desks, doors and classroom floors and calculate their perimeters and areas.

(3) **Differentiate perimeter and area clearly:**
Use a string around an object to represent perimeter and unit-square paper inside the boundary to represent area.

(4) **Teach formulas through discovery:**
Let students add the sides of rectangles and squares before guiding them to derive $P = 2(l + b)$, $P = 4s$, $A = l \times b$and $A = s^2$.

(5) **Use grid paper and unit squares:**
Encourage students to draw shapes on square grids, count unit squares for area and count boundary units for perimeter.

(6) **Provide hands-on cut-and-rearrange tasks:**
Allow students to cut rectangular paper into pieces and rearrange them to observe how area may remain unchanged while perimeter changes.

(7) **Connect concepts with regular polygons:**
Ask students to identify regular shapes in their surroundings and derive the general rule:

$$P = \text{number of sides} \times \text{side length}$$

(8) **Emphasise correct units:**
Regularly reinforce that perimeter uses linear units such as cm and m, while area uses square units such as sq cm and sq m.

(9) **Include estimation and verification:**
Ask students to estimate the perimeter or area of classroom objects first and then verify their estimates using scales, measuring tapes or grid paper.

(10) **Use progressive problem-solving:**
Begin with direct formula-based questions and gradually move towards missing dimensions, multiple rounds, fencing costs, uncovered regions and composite figures.

(11) **Encourage multiple solution methods:**
Let students solve composite-area problems by dividing shapes in different ways and compare whether all methods produce the same answer.

(12) **Address common misconceptions:**
Use examples to demonstrate that figures with the same area may have different perimeters and figures with the same perimeter may have different areas.

(13) **Promote mathematical communication:**
Require students to write the formula, substitute the values, show calculations, mention units and state the final answer clearly.

(14) Use peer learning and group work:
Organise students into small groups to measure objects, design shapes and explain their methods to classmates.

(15) Assess through practical tasks:
Evaluate learning by asking students to prepare a floor plan, design a garden, calculate fencing requirements or compare different rectangular layouts.

6.16 Innovations Opportunity List from the Chapter: (15 Ideas)

Innovations in Teaching–Learning :

(1) Digital Floor-Plan Designer
Students can use a simple drawing application or spreadsheet grid to design a house, classroom or garden and calculate the perimeter and area of each section.

(2) Perimeter-and-Area Treasure Hunt
Place measurement challenges around the classroom or school campus and ask teams to measure objects, solve clues and move to the next location.

(3) Shape Transformation Laboratory
Give students equal numbers of paper or magnetic unit squares and ask them to create different shapes, comparing how the area remains constant while the perimeter changes.

(4) Virtual Fencing and Flooring Project
Provide imaginary budgets and rates for fencing, carpeting or tiling so that students can select suitable dimensions and calculate the total cost.

(5) Augmented Grid Exploration
Project a digital square grid on the board and allow students to draw, split, combine and rearrange shapes while observing changes in area and perimeter instantly.

(6) School Measurement Map
Students can prepare a scaled map of the classroom or playground, label its dimensions and calculate the required flooring, painting or fencing materials.

(7) Mathematics Design Challenge
Ask students to design a garden of a fixed area with flower beds, pathways and a lawn while keeping the fencing requirement as small as possible.

(8) Human Perimeter Activity
Students can use ropes or stand in lines to form rectangles, squares and irregular polygons, helping them physically experience boundary length and enclosed space.

(9) Formula Discovery Stations
Arrange activity stations for rectangles, squares, triangles, regular polygons and composite figures so that students rotate and derive the relevant formulas themselves.

(10) Interactive Area Maze
Create puzzles in which students must find missing dimensions or areas of adjoining regions to progress through a maze.

(11) QR-Code Challenge Cards
Attach QR codes to measurement tasks; after solving each problem, students scan the code to check the answer or receive the next clue.

(12) Waste-to-Math Model Making
Students can use cardboard boxes, old newspapers, bottle caps or ice-cream sticks to construct shapes and calculate their perimeters and areas.

(13) Photo-Based Mathematics Journal
Students photograph rectangular, square or polygonal objects at home, estimate their dimensions and record their perimeter and area calculations.

(14) Student-Created Puzzle Exchange
Each student designs a perimeter or area puzzle, exchanges it with a classmate and checks the solution using a prepared answer key.

(15) Mini Mathematics Fair
Groups can display models of parks, houses, farms or sports tracks and explain how perimeter and area are used in their designs.

6.17: Practicing Questions/Question Bank

A. Fill in the Blanks:

1. The total length of the boundary of a closed figure is called its __________.
   Answer: Perimeter

2. The perimeter of a rectangle is __________.
   Answer: $2(l + b)$

3. The area of a square of side $s$is __________.
   Answer: s^2

4. The perimeter of a regular pentagon of side $a$is __________.
   Answer: $5a$

5. A rectangle measuring 12 cm by 5 cm has an area of __________ sq cm.
   Answer: 60

6. The side of a square with a perimeter of 36 cm is __________ cm.
   Answer: 9

7. A triangle with sides 8 cm, 10 cm and 12 cm has a perimeter of __________ cm.
   Answer: 30

8. Area is measured in __________ units.
   Answer: Square

9. The number of rounds multiplied by the perimeter gives the total __________ covered.
   Answer: Distance

10. Figures having equal areas need not have equal __________.
    Answer: Perimeters

B. One-Mark Descriptive Questions:

1. What is perimeter?

Answer: Perimeter is the total distance around the boundary of a closed figure.

2. What is area?

Answer: Area is the measure of the region enclosed by a closed figure.

3. Write the formula for the perimeter of a rectangle.

Answer: The perimeter of a rectangle is $P = 2(l + b)$.

4. Find the perimeter of a square of side 7 cm.

Answer: Its perimeter is $4 \times 7 = 28$cm.

5. Find the area of a rectangle measuring 9 cm by 6 cm.

Answer: Its area is $9 \times 6 = 54$sq cm.

6. Find the side of a square whose perimeter is 48 cm.

Answer: The side of the square is $48 \div 4 = 12$cm.

7. What is a regular polygon?

Answer: A regular polygon is a polygon having all sides and all angles equal.

8. Can two figures with equal areas have different perimeters?

Answer: Yes, figures with equal areas can have different perimeters when their shapes or dimensions differ.

C. Two-Mark Descriptive Questions:

1. Find the perimeter of a rectangle measuring 18 cm by 7 cm.

Answer:

1. $P = 2(l + b) = 2(18 + 7)$.
2. Therefore, the perimeter is 50cm.

2. Find the area and perimeter of a square of side 8 cm.

Answer:

1. Area $= 8 \times 8 = 64$sq cm.
2. Perimeter $= 4 \times 8 = 32$cm.

3. A triangle has a perimeter of 42 cm, and two sides measure 15 cm and 11 cm. Find its third side.

Answer:

1. Sum of the known sides $= 15 + 11 = 26$cm.
2. The third side is $42 - 26 = 16$cm.

4. A rectangular garden has an area of 120 sq m and a length of 15 m. Find its breadth.

Answer:

1. Breadth $=$ area $\div$ length $= 120 \div 15$.
2. Therefore, the breadth is 8m.

5. Explain one difference between perimeter and area.

Answer:

1. Perimeter measures the length of a figure's boundary and is expressed in linear units.
2. Area measures the enclosed region and is expressed in square units.

D. Three-Mark Descriptive Questions:

1. A student walks four times around a rectangular playground measuring 50 m by 30 m. Find the total distance covered.

Answer:

1. Perimeter of the playground $= 2(50 + 30) = 160$m.
2. Distance covered in four rounds $= 4 \times 160 = 640$m.
3. Therefore, the student covers 640m.

2. A wire forms a rectangle measuring 10 cm by 6 cm. It is reshaped into a square; find the square's side.

Answer:

1. The wire's length is $2(10 + 6) = 32$cm.
2. The side of the square is $32 \div 4 = 8$cm.
3. Therefore, each side of the square measures 8cm.

3. A square floor has an area of 144 sq m. Find its side and perimeter.

Answer:

1. The side is 12 m because $12 \times 12 = 144$.
2. Its perimeter is $4 \times 12 = 48$m.
3. Therefore, the side and perimeter are 12m and 48m respectively.

4. A rectangular floor measures 10 m by 8 m, and a square carpet of side 6 m is placed on it. Find the uncovered area.

Answer:

1. The floor area is $10 \times 8 = 80$sq m.
2. The carpet area is $6 \times 6 = 36$sq m.
3. Therefore, the uncovered area is $80 - 36 = 44$sq m.

5. Compare the areas and perimeters of a 9 cm $\times$ 4 cmrectangle and a square of side 6 cm.

Answer:

1. Both figures have an area of 36sq cm.
2. Their perimeters are $2(9 + 4) = 26$cm and $4 \times 6 = 24$cm respectively.
3. Thus, the figures have equal areas but different perimeters.

E. Five-Mark Descriptive Questions:

1. A rectangular park measures 80 m by 50 m. It is fenced twice at ₹30 per metre. Find the total fencing cost.

Answer:

1. The park's perimeter is $2(80 + 50)$m.
2. Therefore, one round of fencing requires 260m.
3. Two rounds require $2 \times 260 = 520$m.
4. The cost is $520 \times ₹30 = ₹15{,}600$.
5. Hence, the total fencing cost is ₹15,600.

2. A garden measures 25 m by 18 m. Four flower beds, each measuring 3 m by 2 m, are prepared inside it. Find the remaining lawn area.

Answer:

1. The garden's total area is $25 \times 18 = 450$sq m.
2. The area of one flower bed is $3 \times 2 = 6$sq m.
3. Four flower beds occupy $4 \times 6 = 24$sq m.
4. The remaining area is $450 - 24 = 426$sq m.
5. Therefore, 426sq m is available for the lawn.

3. A square park and a rectangular park have the same perimeter of 80 m. The rectangle measures 25 m by 15 m; compare their areas.

Answer:

1. The square's side is $80 \div 4 = 20$m.
2. Its area is $20 \times 20 = 400$sq m.
3. The rectangle's area is $25 \times 15 = 375$sq m.
4. The difference between their areas is $400 - 375 = 25$sq m.
5. Therefore, the square park has 25sq m more area.

4. A room is 12 m long and 9 m wide. A square carpet of side 7 m is placed on its floor, and the uncovered portion is tiled at ₹60 per square metre. Find the tiling cost.

Answer:

1. The room's area is $12 \times 9 = 108$sq m.
2. The carpet's area is $7 \times 7 = 49$sq m.
3. The uncovered area is $108 - 49 = 59$sq m.
4. The tiling cost is $59 \times ₹60 = ₹3{,}540$.
5. Therefore, tiling the uncovered floor costs ₹3,540.

5. Twelve unit squares are arranged as a 3×4rectangle and then as a 1×12rectangle. Compare their areas and perimeters.

Answer:

1. Both arrangements have an area of 12square units.
2. The 3×4rectangle has a perimeter of $2(3 + 4) = 14$units.
3. The 1×12rectangle has a perimeter of $2(1 + 12) = 26$units.
4. Their perimeters differ by $26 - 14 = 12$units.
5. Hence, figures with equal areas can have different perimeters.

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6th Standard Maths Book Chapter 7

Chapter 7: FRACTIONS

7.1 Summary of the Chapter:

Chapter 7: Fractions — Summary:

(1) A **fraction** represents an equal share obtained when one or more whole units are divided equally among a certain number of people or groups.

(2) When one whole is divided into equal parts, each part is called a **fractional unit** or **unit fraction**, such as $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$, etc.

(3) The more equal parts a whole is divided into, the smaller each fractional unit becomes. For example, $\frac{1}{5} > \frac{1}{9}$.

(4) A fractional quantity can be measured by counting fractional units. For example, three units of $\frac{1}{4}$ make $\frac{3}{4}$.

(5) In a fraction such as $\frac{5}{6}$, the upper number, 5, is the **numerator**, while the lower number, 6, is the **denominator**.

(6) Fractions can be represented on a **number line** by dividing each unit interval into equal parts. Every fraction corresponds to a particular point on the number line.

(7) Fractions greater than one can be written as **mixed fractions**. A mixed fraction contains a whole-number part and a fractional part, such as $2\frac{1}{3}$.

(8) Fractions that represent the same quantity are called **equivalent fractions**. For example, $\frac{1}{2} = \frac{2}{4} = \frac{3}{6}$.

(9) A fraction is in its **lowest or simplest form** when its numerator and denominator have no common factor other than 1.

(10) Fractions can be compared by using equivalent fractions with the same denominator. When denominators are the same, the fraction with the greater numerator is larger.

(11) To add or subtract fractions, they are first converted into equivalent fractions having a common denominator. The numerators are then added or subtracted while the denominator remains unchanged.

(12) Indian mathematicians such as **Aryabhata, Brahmagupta and Sridharacharya** made important contributions to the development of fractions and their operations. Brahmagupta clearly described systematic methods for adding and subtracting fractions.

7.2 Important Formulas:

Let $a, b, c,$and $d$be whole numbers, where $b \neq 0$and $d \neq 0$.

1. Fraction as Division

$$\frac{a}{b} = a \div b$$

Example:

$$3 \div 4 = \frac{3}{4}$$

2. Fraction as Repeated Unit Fractions

$$\frac{a}{b} = a \times \frac{1}{b}$$

Example:

$$\frac{5}{6} = 5 \times \frac{1}{6}$$

3. Equivalent Fractions

$$\frac{a}{b}=\frac{a\times n}{b\times n}$$

where $n\neq 0$.
Example:

$$\frac{2}{3}=\frac{2\times 3}{3\times 3}=\frac{6}{9}$$

4. Simplifying a Fraction

$$\frac{a}{b}=\frac{a\div n}{b\div n}$$

where $n$is a common factor of $a$and b.

5. Fraction in Lowest Terms

$$\frac{a}{b}=\frac{a\div \mathrm{HCF}(a,b)}{b\div \mathrm{HCF}(a,b)}$$

Example:

$$\frac{18}{24}=\frac{18\div 6}{24\div 6}=\frac{3}{4}$$

6. Improper Fraction to Mixed Fraction

$$\frac{a}{b}=q\frac{r}{b}$$

where

$$a=bq+r$$

Here, $q$is the quotient and $r$is the remainder.
Example:

$$\frac{17}{5}=3\frac{2}{5}$$

7. Mixed Fraction to Improper Fraction

$$p\frac{a}{b}=\frac{p\times b+a}{b}$$

Example:

$$3\frac{2}{5}=\frac{3\times 5+2}{5}=\frac{17}{5}$$

8. Comparing Fractions with the Same Denominator

If $a>c$, then:

$$\frac{a}{b}>\frac{c}{b}$$

Example:

$$\frac{7}{9}>\frac{5}{9}$$

9. Comparing Unit Fractions

If $b<d$, then:

$$\frac{1}{b}>\frac{1}{d}$$

Example:

$$\frac{1}{5}>\frac{1}{9}$$

10. Comparing Fractions with Different Denominators

For positive denominators:

$$\frac{a}{b}>\frac{c}{d}\ \text{if}\ a\times d>c\times b$$

Similarly,

$$\frac{a}{b} = \frac{c}{d} \text{ if } a \times d = c \times b$$

11. Addition of Fractions with the Same Denominator

$$\frac{a}{b} + \frac{c}{b} = \frac{a+c}{b}$$

Example:

$$\frac{3}{7} + \frac{2}{7} = \frac{5}{7}$$

12. Addition of Fractions with Different Denominators

$$\frac{a}{b} + \frac{c}{d} = \frac{ad+bc}{bd}$$

Example:

$$\frac{2}{3} + \frac{3}{4} = \frac{8+9}{12} = \frac{17}{12} = 1\frac{5}{12}$$

13. Subtraction of Fractions with the Same Denominator

$$\frac{a}{b} - \frac{c}{b} = \frac{a-c}{b}$$

Example:

$$\frac{7}{9} - \frac{5}{9} = \frac{2}{9}$$

14. Subtraction of Fractions with Different Denominators

$$\frac{a}{b} - \frac{c}{d} = \frac{ad-bc}{bd}$$

Example:

$$\frac{5}{6} - \frac{4}{9} = \frac{45-24}{54} = \frac{21}{54} = \frac{7}{18}$$

15. Common-Denominator Method Using LCM

$$\text{Common denominator} = \text{LCM}(b, d)$$

Convert both fractions into equivalent fractions with this denominator before adding, subtracting or comparing them.

16. Whole as a Fraction

$$1 = \frac{b}{b}$$

More generally,

$$n = \frac{nb}{b}$$

Example:

$$3 = \frac{12}{4}$$

17. Equal Sharing Relationship

If $a$whole units are shared equally among $b$persons, then:

$$\text{Share received by each person} = \frac{a}{b}$$

18. Useful Fraction Properties

$$\frac{0}{b} = 0$$
$$\frac{a}{a} = 1$$
$$\frac{a}{1} = a$$

where the denominator is not zero.

7.3 Fill-Up the Blank LOTS type questions with Answers: (30 Questions)

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

1. When a whole is divided into equal parts, each part is called a __________ unit.
   Answer: fractional
2. Another name for a fractional unit is a __________ fraction.
   Answer: unit
3. If one roti is shared equally between two children, each child receives __________ of the roti.
   Answer: $\frac{1}{2}$
4. If one whole is divided into five equal parts, each part represents __________.
   Answer: $\frac{1}{5}$
5. In the fraction $\frac{5}{6}$, the number 5 is called the __________.
   Answer: numerator
6. In the fraction $\frac{5}{6}$, the number 6 is called the __________.
   Answer: denominator
7. The fraction $\frac{3}{4}$ means __________ times $\frac{1}{4}$.
   Answer: 3
8. Four times $\frac{1}{4}$ is equal to __________ whole.
   Answer: 1
9. The fraction $\frac{1}{5}$ is __________ than $\frac{1}{9}$.
   Answer: greater
10. The fraction represented by seven parts of the fractional unit $\frac{1}{8}$ is __________.
    Answer: $\frac{7}{8}$
11. Fractions can be represented as points on a __________.
    Answer: number line
12. The point halfway between 0 and 1 on a number line represents __________.
    Answer: $\frac{1}{2}$
13. The fraction $\frac{9}{4}$ is __________ than 1.
    Answer: greater
14. A number containing a whole-number part and a fractional part is called a __________ number.
    Answer: mixed
15. The improper fraction $\frac{7}{2}$ is equal to the mixed fraction __________.
    Answer: $3\frac{1}{2}$
16. The mixed fraction $2\frac{1}{3}$ is equal to the improper fraction __________.
    Answer: $\frac{7}{3}$
17. Fractions that represent the same quantity are called __________ fractions.
    Answer: equivalent
18. The fraction $\frac{1}{2}$ is equivalent to __________ with denominator 4.
    Answer: $\frac{2}{4}$

19. The fraction $\frac{2}{3}$ is equivalent to __________ with denominator 6.
    Answer: $\frac{4}{6}$
20. The lowest form of $\frac{6}{8}$ is __________.
    Answer: $\frac{3}{4}$
21. A fraction is in its lowest form when its numerator and denominator have no common factor other than __________.
    Answer: 1
22. Among fractions having the same denominator, the fraction with the greater __________ is larger.
    Answer: numerator
23. $\frac{3}{7} + \frac{2}{7} =$__________.
    Answer: $\frac{5}{7}$
24. $\frac{8}{9} - \frac{5}{9} =$__________.
    Answer: $\frac{3}{9}$ or $\frac{1}{3}$
25. Before adding fractions with different denominators, they must be converted into equivalent fractions with the same __________.
    Answer: denominator
26. According to Brahmagupta's method, fractions with different denominators must first be changed into fractions with a __________ denominator.
    Answer: common
27. If three rotis are shared equally among four children, each child receives __________ of a roti.
    Answer: $\frac{3}{4}$
28. The fraction $\frac{12}{5}$, written as a mixed fraction, is __________.
    Answer: $2\frac{2}{5}$
29. The sum of $\frac{2}{3}$ and $\frac{1}{3}$ is __________.
    Answer: 1
30. The difference between $\frac{7}{8}$ and $\frac{3}{8}$ is __________.
    Answer: $\frac{4}{8}$ or $\frac{1}{2}$

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

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

1. A roti is divided equally among 8 children. If each child receives one piece, the share of each child is __________.
   Answer: $\frac{1}{8}$
2. When one whole is divided into more equal parts, the size of each fractional part becomes __________.
   Answer: smaller
3. Although 9 is greater than 5, $\frac{1}{9}$ is __________ than $\frac{1}{5}$.
   Answer: smaller

4. Three glasses of juice are shared equally among four children. Each child receives __________ glass of juice.
Answer: $\frac{3}{4}$
5. Two cakes are shared equally among five children. The fraction of a cake received by each child is __________.
Answer: $\frac{2}{5}$
6. A fraction has 5 as its denominator and lies between 1 and 2. Its smallest possible numerator is __________.
Answer: 6
7. The fraction represented by 7 steps of length $\frac{1}{4}$ on a number line is __________.
Answer: $\frac{7}{4}$
8. The mixed fraction corresponding to the point $\frac{11}{4}$ on a number line is __________.
Answer: $2\frac{3}{4}$
9. The improper fraction equivalent to $4\frac{2}{5}$ is __________.
Answer: $\frac{22}{5}$
10. If $\frac{3}{4} = \frac{\square}{20}$, the missing numerator is __________.
Answer: 15
11. If $\frac{5}{6} = \frac{20}{\square}$, the missing denominator is __________.
Answer: 24
12. The fraction $\frac{18}{24}$, expressed in its lowest terms, is __________.
Answer: $\frac{3}{4}$
13. To simplify $\frac{42}{56}$ directly to its lowest terms, both numbers must be divided by __________.
Answer: 14
14. A fraction equivalent to $\frac{4}{7}$, whose numerator and denominator add up to 33, is __________.
Answer: $\frac{12}{21}$
15. The greater fraction between $\frac{7}{10}$ and $\frac{9}{14}$ is __________.
Answer: $\frac{7}{10}$
16. When $\frac{4}{9}$ and $\frac{3}{7}$ are written using the common denominator 63, they become __________ and __________ respectively.
Answer: $\frac{28}{63}$ and $\frac{27}{63}$
17. The fraction that must be added to $\frac{5}{8}$ to make one whole is __________.
Answer: $\frac{3}{8}$
18. The fraction that must be subtracted from $\frac{11}{6}$ to obtain 1 is __________.
Answer: $\frac{5}{6}$
19. The sum of $\frac{2}{3}$ and $\frac{3}{4}$, written as a mixed fraction, is __________.
Answer: $1\frac{5}{12}$

20. The difference between $\frac{5}{6}$and $\frac{4}{9}$, expressed in its lowest terms, is __________.
    Answer: $\frac{7}{18}$
21. Rahim mixes $\frac{2}{3}$litre of yellow paint with $\frac{3}{4}$litre of blue paint. The total volume of paint is __________ litres.
    Answer: $1\frac{5}{12}$
22. Geeta has $\frac{2}{5}$metre of lace and Shamim has $\frac{3}{4}$metre. Together, they have __________ metres of lace.
    Answer: $1\frac{3}{20}$
23. A child travels $\frac{1}{2}$km by auto out of a total distance of $\frac{7}{10}$km. The distance walked is __________ km.
    Answer: $\frac{1}{5}$
24. Four kilograms of potatoes divided equally among 3 bags gives the same quantity per bag as 12 kilograms divided equally among __________ bags.
    Answer: 9
25. Seven rotis divided equally among 5 children gives the same share as 14 rotis divided equally among __________ children.
    Answer: 10
26. If $\frac{a}{8} = \frac{3}{4}$, then the value of $a$is __________.
    Answer: 6
27. If $\frac{5}{12} + \frac{x}{12} = 1$, then $x =$__________.
    Answer: 7
28. The fraction exactly halfway between 0 and $\frac{3}{4}$is __________.
    Answer: $\frac{3}{8}$
29. One possible set of three different unit fractions whose sum is 1 is __________, __________ and __________.
    Answer: $\frac{1}{2}, \frac{1}{3}$and $\frac{1}{6}$
30. The number of fractions that lie between 0 and 1 is __________.
    Answer: infinitely many

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

One-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is a fraction?**
   Answer: A fraction represents an equal part or equal share of a whole.
2. **What is a fractional unit?**
   Answer: A fractional unit is one of the equal parts obtained by dividing a whole into equal parts.
3. **Give one example of a unit fraction.**
   Answer: $\frac{1}{5}$is an example of a unit fraction.
4. **Which is greater: $\frac{1}{5}$or $\frac{1}{9}$?**
   Answer: $\frac{1}{5}$is greater than $\frac{1}{9}$.

5. **What is the numerator of $\frac{5}{6}$?**

   Answer: The numerator of $\frac{5}{6}$ is 5.
6. **What is the denominator of $\frac{5}{6}$?**

   Answer: The denominator of $\frac{5}{6}$ is 6.
7. **How can $\frac{3}{4}$ be described using the unit fraction $\frac{1}{4}$?**

   Answer: $\frac{3}{4}$ means three times the unit fraction $\frac{1}{4}$.
8. **What fraction is formed by five units of $\frac{1}{8}$?**

   Answer: Five units of $\frac{1}{8}$ form the fraction $\frac{5}{8}$.
9. **What does the point halfway between 0 and 1 represent on a number line?**

   Answer: The point halfway between 0 and 1 represents $\frac{1}{2}$.
10. **How many fractions lie between 0 and 1?**
    Answer: Infinitely many fractions lie between 0 and 1.
11. **What is a mixed fraction?**
    Answer: A mixed fraction contains a whole-number part and a proper fractional part.
12. **Convert $\frac{7}{2}$ into a mixed fraction.**

    Answer: The mixed form of $\frac{7}{2}$ is $3\frac{1}{2}$.
13. **Convert $2\frac{1}{3}$ into an improper fraction.**

    Answer: The improper fraction corresponding to $2\frac{1}{3}$ is $\frac{7}{3}$.
14. **What are equivalent fractions?**
    Answer: Equivalent fractions are fractions that represent the same quantity or share.
15. **Write one fraction equivalent to $\frac{1}{2}$.**

    Answer: $\frac{2}{4}$ is equivalent to $\frac{1}{2}$.
16. **Write one fraction equivalent to $\frac{2}{3}$.**

    Answer: $\frac{4}{6}$ is equivalent to $\frac{2}{3}$.
17. **What is meant by the lowest form of a fraction?**
    Answer: A fraction is in its lowest form when its numerator and denominator have no common factor other than 1.
18. **Express $\frac{6}{8}$ in its lowest form.**

    Answer: The lowest form of $\frac{6}{8}$ is $\frac{3}{4}$.
19. **Which is greater: $\frac{5}{7}$ or $\frac{3}{7}$?**

    Answer: $\frac{5}{7}$ is greater than $\frac{3}{7}$.
20. **Find $\frac{3}{8}+\frac{2}{8}$.**

    Answer: The sum of $\frac{3}{8}$ and $\frac{2}{8}$ is $\frac{5}{8}$.
21. **Find $\frac{7}{9}-\frac{4}{9}$.**

    Answer: The difference between $\frac{7}{9}$ and $\frac{4}{9}$ is $\frac{3}{9}$, or $\frac{1}{3}$.
22. **What must be done before adding fractions with different denominators?**
    Answer: They must be converted into equivalent fractions having a common denominator.

23. **What is $\frac{4}{4}$ equal to?**

    Answer: The fraction $\frac{4}{4}$ is equal to 1.

24. **How much does each child receive when three rotis are shared equally among four children?**

    Answer: Each child receives $\frac{3}{4}$ of a roti.

25. **Write the division fact represented by $\frac{3}{4}$.**

    Answer: The division fact represented by $\frac{3}{4}$ is $3 \div 4 = \frac{3}{4}$.

26. **Name the Indian mathematician whose method is used for adding and subtracting fractions in the chapter.**

    Answer: Brahmagupta's method is used for adding and subtracting fractions.

27. **What happens to the value of a unit fraction when its denominator increases?**

    Answer: The value of a unit fraction decreases when its denominator increases.

28. **Is $\frac{9}{4}$ greater than or less than 1?**

    Answer: The fraction $\frac{9}{4}$ is greater than 1.

29. **Write $\frac{12}{5}$ as a mixed fraction.**

    Answer: The mixed form of $\frac{12}{5}$ is $2\frac{2}{5}$.

30. **What is the fractional part of $3\frac{2}{7}$?**

    Answer: The fractional part of $3\frac{2}{7}$ is $\frac{2}{7}$.

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

One-Mark Descriptive Questions with Answers — HOTS Type:

1. **Riya says that $\frac{1}{9}$ is greater than $\frac{1}{5}$ because 9 is greater than 5; is she correct?**

   Answer: No, because a whole divided into nine equal parts gives smaller pieces than when it is divided into five equal parts.

2. **Which is greater, $\frac{1}{100}$ or $\frac{1}{200}$, and why?**

   Answer: $\frac{1}{100}$ is greater because dividing a whole into fewer equal parts produces larger pieces.

3. **Three glasses of juice are shared equally among four children; how much does each child receive?**

   Answer: Each child receives $\frac{3}{4}$ of a glass of juice.

4. **If two cakes are shared equally among five children, what fraction of a cake does each child receive?**

   Answer: Each child receives $\frac{2}{5}$ of a cake.

5. **Which is greater, five units of $\frac{1}{8}$ or three units of $\frac{1}{8}$?**

   Answer: Five units of $\frac{1}{8}$, or $\frac{5}{8}$, are greater than $\frac{3}{8}$.

6. **A point lies seven one-fourth steps from zero on a number line; which fraction does it represent?**

   Answer: The point represents $\frac{7}{4}$, or $1\frac{3}{4}$.

7. **How many complete whole units are contained in $\frac{11}{5}$?**

Answer: The fraction $\frac{11}{5}$ contains two complete whole units.

8. **Why cannot $\frac{8}{4}$ be written as a mixed fraction with a non-zero fractional part?**

Answer: It equals the whole number 2 and therefore has no non-zero fractional part.

9. **What number must replace the blank in $\frac{3}{4} = \frac{\square}{20}$?**

Answer: The number is 15 because both 3 and 4 are multiplied by 5.

10. **What number must replace the blank in $\frac{5}{6} = \frac{20}{\square}$?**

Answer: The number is 24 because both 5 and 6 are multiplied by 4.

11. **Are $\frac{4}{6}$ and $\frac{10}{15}$ equivalent? Give a reason.**

Answer: Yes, because both fractions reduce to $\frac{2}{3}$.

12. **Why is $\frac{18}{24}$ not in its lowest form?**

Answer: It is not in its lowest form because 18 and 24 have common factors other than 1.

13. **Express $\frac{42}{56}$ in its lowest form.**

Answer: Dividing both terms by 14 gives $\frac{42}{56} = \frac{3}{4}$.

14. **Which is greater, $\frac{4}{9}$ or $\frac{3}{7}$?**

Answer: $\frac{4}{9}$ is greater because $\frac{28}{63} > \frac{27}{63}$.

15. **Which is greater, $\frac{7}{10}$ or $\frac{9}{14}$?**

Answer: $\frac{7}{10}$ is greater because $\frac{49}{70} > \frac{45}{70}$.

16. **What fraction must be added to $\frac{5}{8}$ to make one whole?**

Answer: $\frac{3}{8}$ must be added because $\frac{5}{8} + \frac{3}{8} = 1$.

17. **What fraction must be subtracted from $\frac{11}{6}$ to obtain 1?**

Answer: $\frac{5}{6}$ must be subtracted because $\frac{11}{6} - \frac{5}{6} = 1$.

18. **Find the sum of $\frac{2}{3}$ and $\frac{3}{4}$ as a mixed fraction.**

Answer: The sum is $\frac{17}{12} = 1\frac{5}{12}$.

19. **Find the difference between $\frac{5}{6}$ and $\frac{4}{9}$.**

Answer: The difference is $\frac{15}{18} - \frac{8}{18} = \frac{7}{18}$.

20. **A ribbon is $\frac{7}{10}$ metre long and $\frac{1}{2}$ metre is used; how much remains?**

Answer: The remaining ribbon is $\frac{7}{10} - \frac{5}{10} = \frac{1}{5}$ metre.

21. **Four kilograms of potatoes are shared equally among three bags; how many bags are needed to share 12 kilograms in the same proportion?**

Answer: Nine bags are needed because $\frac{4}{3} = \frac{12}{9}$.

22. **Seven rotis are shared equally among five children; among how many children should 14 rotis be shared to give the same share?**

Answer: Fourteen rotis should be shared among ten children because $\frac{7}{5} = \frac{14}{10}$.

23. **What fraction lies exactly halfway between 0 and $\frac{3}{4}$?**

Answer: The fraction $\frac{3}{8}$ lies exactly halfway between 0 and $\frac{3}{4}$.

24. **Find three different unit fractions whose sum is 1.**
Answer: The three unit fractions are $\frac{1}{2}, \frac{1}{3}$, and $\frac{1}{6}$.
25. **Why are there infinitely many fractions between 0 and 1?**
Answer: There are infinitely many because a new fraction can always be found between any two given fractions.
26. **If the numerator increases while the denominator remains unchanged, what happens to the fraction?**
Answer: The fraction becomes larger because it contains more parts of the same fractional unit.
27. **If the same positive number multiplies the numerator and denominator, why does the fraction's value remain unchanged?**
Answer: Its value remains unchanged because the whole is divided into proportionally more parts and the same proportion is selected.
28. **A student claims that $\frac{4}{8}$and $\frac{5}{10}$are unequal because their numerators differ; is the claim correct?**
Answer: No, because both fractions simplify to $\frac{1}{2}$.
29. **Arrange $\frac{1}{2}, \frac{3}{4}$, and $\frac{2}{3}$in ascending order.**
Answer: The ascending order is $\frac{1}{2} < \frac{2}{3} < \frac{3}{4}$.
30. **Why must fractions have a common denominator before their numerators are added or subtracted?**
Answer: A common denominator ensures that the fractions are expressed using parts of the same size.

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

Two-Mark Descriptive Questions with Answers — LOTS Type:
1. What is a fractional unit? Give one example.
Answer:
1. A fractional unit is one of the equal parts obtained by dividing a whole into equal parts.
2. For example, when a whole is divided into five equal parts, each part is $\frac{1}{5}$.

2. Compare $\frac{1}{5}$and $\frac{1}{9}$.
Answer:
1. Dividing a whole into five equal parts produces larger pieces than dividing it into nine equal parts.
2. Therefore, $\frac{1}{5} > \frac{1}{9}$.

3. Explain the numerator and denominator of $\frac{5}{6}$.
Answer:
1. The numerator 5 shows that five fractional units are taken.
2. The denominator 6 shows that the whole is divided into six equal parts.

4. Express $\frac{3}{4}$using fractional units.
Answer:
1. The fractional unit in $\frac{3}{4}$is $\frac{1}{4}$.
2. Therefore, $\frac{3}{4} = 3 \times \frac{1}{4}$.

5. How is $\frac{3}{5}$represented on a number line?

Answer:
1. Divide the distance between 0 and 1 into five equal parts.
2. The third mark from 0 represents $\frac{3}{5}$.

6. What is a mixed fraction? Give one example.
Answer:
1. A mixed fraction consists of a whole-number part and a proper fractional part.
2. For example, $2\frac{3}{5}$ is a mixed fraction.

7. Convert $\frac{11}{4}$ into a mixed fraction.
Answer:
1. Dividing 11 by 4 gives quotient 2 and remainder 3.
2. Therefore, $\frac{11}{4} = 2\frac{3}{4}$.

8. Convert $3\frac{2}{5}$ into an improper fraction.
Answer:
1. Multiply 3 by 5 and add 2 to obtain $3 \times 5 + 2 = 17$.
2. Therefore, $3\frac{2}{5} = \frac{17}{5}$.

9. What are equivalent fractions? Give an example.
Answer:
1. Equivalent fractions are fractions that represent the same quantity or share.
2. For example, $\frac{1}{2} = \frac{2}{4} = \frac{3}{6}$.

10. Find two fractions equivalent to $\frac{2}{3}$.
Answer:
1. Multiplying its numerator and denominator by 2 gives $\frac{2}{3} = \frac{4}{6}$.
2. Multiplying them by 3 gives $\frac{2}{3} = \frac{6}{9}$.

11. Express $\frac{18}{24}$ in its lowest form.
Answer:
1. The highest common factor of 18 and 24 is 6.
2. Dividing both terms by 6 gives $\frac{18}{24} = \frac{3}{4}$.

12. When is a fraction said to be in its lowest form?
Answer:
1. A fraction is in its lowest form when its numerator and denominator have no common factor other than 1.
2. For example, $\frac{3}{5}$ is in its lowest form.

13. Compare $\frac{5}{8}$ and $\frac{3}{8}$.
Answer:
1. Both fractions have the same denominator, so their numerators can be compared directly.
2. Since $5 > 3$, $\frac{5}{8} > \frac{3}{8}$.

14. Compare $\frac{2}{3}$ and $\frac{3}{4}$.
Answer:
1. Using the common denominator 12, $\frac{2}{3} = \frac{8}{12}$ and $\frac{3}{4} = \frac{9}{12}$.
2. Since $8 < 9$, $\frac{2}{3} < \frac{3}{4}$.

15. Add $\frac{3}{7}$and $\frac{2}{7}$.

Answer:

1. Since the denominators are equal, add the numerators while keeping the denominator unchanged.
2. Thus, $\frac{3}{7} + \frac{2}{7} = \frac{5}{7}$.

16. Add $\frac{1}{2}$and $\frac{1}{3}$.

Answer:

1. Using the common denominator 6, $\frac{1}{2} = \frac{3}{6}$and $\frac{1}{3} = \frac{2}{6}$.
2. Therefore, $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$.

17. Subtract $\frac{3}{8}$from $\frac{7}{8}$.

Answer:

1. Since the denominators are equal, subtract the numerators and retain the denominator.
2. Thus, $\frac{7}{8} - \frac{3}{8} = \frac{4}{8} = \frac{1}{2}$.

18. Subtract $\frac{1}{3}$from $\frac{3}{4}$.

Answer:

1. Using the common denominator 12, $\frac{3}{4} = \frac{9}{12}$and $\frac{1}{3} = \frac{4}{12}$.
2. Therefore, $\frac{3}{4} - \frac{1}{3} = \frac{5}{12}$.

19. Three rotis are shared equally among four children. Find each child's share.

Answer:

1. Each child's share is represented by the division $3 \div 4$.
2. Therefore, each child receives $\frac{3}{4}$of a roti.

20. State Brahmagupta's method for adding fractions.

Answer:

1. Convert the given fractions into equivalent fractions having a common denominator.
2. Add their numerators while retaining the common denominator and simplify the result.

7.8. Two-mark questions with Answers of HOTS Type: (20 Questions)

Two-Mark Descriptive Questions with Answers — HOTS Type:

1. Amit says that $\frac{1}{8} > \frac{1}{5}$because $8 > 5$. Is he correct? Justify.

Answer:

1. Amit is incorrect because dividing a whole into more equal parts produces smaller parts.
2. Therefore, $\frac{1}{8} < \frac{1}{5}$.

2. Three rotis are shared equally among four children. Find each child's share and write the corresponding division fact.

Answer:

1. Each child receives $\frac{3}{4}$of a roti.
2. The corresponding division fact is $3 \div 4 = \frac{3}{4}$.

3. Find the missing number in $\frac{3}{5} = \frac{\square}{20}$and explain your method.

Answer:

1. Since 5 is multiplied by 4 to obtain 20, the numerator must also be multiplied by 4.
2. Therefore, the missing number is $3 \times 4 = 12$.

4. Determine whether $\frac{6}{8}$ and $\frac{9}{12}$ are equivalent fractions.

Answer:

1. Both $\frac{6}{8}$ and $\frac{9}{12}$ simplify to $\frac{3}{4}$.
2. Therefore, the given fractions are equivalent.

5. Convert $\frac{17}{5}$ into a mixed fraction and state the number of complete wholes.

Answer:

1. Dividing 17 by 5 gives quotient 3 and remainder 2, so it contains three complete wholes.
2. Therefore, $\frac{17}{5} = 3\frac{2}{5}$.

6. Convert $4\frac{3}{7}$ into an improper fraction and explain the calculation.

Answer:

1. Multiplying the whole-number part by the denominator and adding the numerator gives $4 \times 7 + 3 = 31$.
2. Therefore, $4\frac{3}{7} = \frac{31}{7}$.

7. Place $\frac{7}{4}$ on a number line and identify the two whole numbers between which it lies.

Answer:

1. Since $\frac{7}{4} = 1\frac{3}{4}$, it is located three fourths of a unit after 1.
2. Therefore, it lies between the whole numbers 1 and 2.

8. Express $\frac{36}{48}$ in its lowest form and justify your answer.

Answer:

1. Dividing the numerator and denominator by their HCF, 12, gives $\frac{36}{48} = \frac{3}{4}$.
2. Since 3 and 4 have no common factor other than 1, $\frac{3}{4}$ is the lowest form.

9. Which fraction is greater, $\frac{5}{6}$ or $\frac{7}{9}$? Show your reasoning.

Answer:

1. Using the common denominator 18, $\frac{5}{6} = \frac{15}{18}$ and $\frac{7}{9} = \frac{14}{18}$.
2. Since $15 > 14$, $\frac{5}{6} > \frac{7}{9}$.

10. Arrange $\frac{1}{2}, \frac{3}{4}$, and $\frac{2}{3}$ in ascending order.

Answer:

1. Using denominator 12, the fractions become $\frac{6}{12}, \frac{9}{12}$, and $\frac{8}{12}$, respectively.
2. Therefore, the ascending order is $\frac{1}{2} < \frac{2}{3} < \frac{3}{4}$.

11. Find the fraction that must be added to $\frac{7}{12}$ to make one whole.

Answer:

1. One whole can be written as $\frac{12}{12}$.
2. Therefore, the required fraction is $\frac{12}{12} - \frac{7}{12} = \frac{5}{12}$.

12. Find the fraction that must be subtracted from $\frac{13}{8}$ to obtain 1.

Answer:

1. One whole can be written as $\frac{8}{8}$.
2. Therefore, the required fraction is $\frac{13}{8} - \frac{8}{8} = \frac{5}{8}$.

13. A ribbon is $\frac{5}{6}$ metre long, and $\frac{1}{4}$ metre is cut from it. Find the remaining length.

Answer:

1. Using denominator 12, $\frac{5}{6} - \frac{1}{4} = \frac{10}{12} - \frac{3}{12}$.
2. Therefore, the remaining ribbon is $\frac{7}{12}$metre long.

14. Meera walked $\frac{2}{5}$km in the morning and $\frac{3}{4}$km in the evening. Find the total distance.

Answer:

1. Using denominator 20, $\frac{2}{5} + \frac{3}{4} = \frac{8}{20} + \frac{15}{20}$.
2. Therefore, Meera walked $\frac{23}{20} = 1\frac{3}{20}$km altogether.

15. Four kilograms of rice are packed equally into three bags. How much rice does each bag contain, and is it more than 1 kg?

Answer:

1. Each bag contains $4 \div 3 = \frac{4}{3} = 1\frac{1}{3}$kg of rice.
2. It is more than 1 kg because the numerator of $\frac{4}{3}$is greater than its denominator.

16. Find two fractions equivalent to $\frac{4}{7}$whose denominators are 21 and 35.

Answer:

1. Multiplying by $\frac{3}{3}$gives $\frac{4}{7} = \frac{12}{21}$.
2. Multiplying by $\frac{5}{5}$gives $\frac{4}{7} = \frac{20}{35}$.

17. A student says that $\frac{4}{6}$is in its lowest form because 4 and 6 are different numbers. Is the statement correct?

Answer:

1. The statement is incorrect because 4 and 6 have the common factor 2.
2. Dividing both by 2 gives the lowest form $\frac{2}{3}$.

18. Compare the shares received when three cakes are divided among four children and seven cakes are divided among ten children.

Answer:

1. The two shares are $\frac{3}{4} = \frac{15}{20}$and $\frac{7}{10} = \frac{14}{20}$.
2. Therefore, each child receives a larger share when three cakes are divided among four children.

19. Find three different unit fractions whose sum is 1 and verify your answer.

Answer:

1. One suitable set is $\frac{1}{2}, \frac{1}{3}$, and $\frac{1}{6}$.
2. Since $\frac{3}{6} + \frac{2}{6} + \frac{1}{6} = \frac{6}{6} = 1$, the answer is verified.

20. A student adds $\frac{2}{3} + \frac{1}{4}$as $\frac{3}{7}$. Identify and correct the mistake.

Answer:

1. The student incorrectly added both numerators and denominators instead of first finding a common denominator.
2. The correct sum is $\frac{8}{12} + \frac{3}{12} = \frac{11}{12}$.

7.9. Three-mark questions with Answers of LOTS Type: (15 Questions)

Three-Mark Descriptive Questions with Answers — LOTS Type:

1. Explain a fractional unit with an example.

Answer:

1. When one whole is divided into equal parts, each part is called a fractional unit or unit fraction.
2. A fractional unit always has 1 as its numerator.
3. For example, when a whole is divided into five equal parts, each part is $\frac{1}{5}$.

2. Explain the numerator and denominator of the fraction $\frac{5}{8}$.

Answer:

1. In $\frac{5}{8}$, the number 5 is the numerator.
2. It shows that five fractional units are being considered.
3. The denominator 8 shows that the whole is divided into eight equal parts.

3. Explain how $\frac{3}{5}$ can be represented on a number line.

Answer:

1. Divide the distance between 0 and 1 into five equal parts.
2. Each equal part represents the fractional unit $\frac{1}{5}$.
3. The third mark from 0 represents the fraction $\frac{3}{5}$.

4. Convert $\frac{14}{5}$ into a mixed fraction.

Answer:

1. Divide 14 by 5 to obtain quotient 2 and remainder 4.
2. The quotient becomes the whole-number part, while the remainder becomes the numerator of the fractional part.
3. Therefore, $\frac{14}{5} = 2\frac{4}{5}$.

5. Convert $3\frac{2}{7}$ into an improper fraction.

Answer:

1. Multiply the whole-number part 3 by the denominator 7 to obtain 21.
2. Add the numerator 2 to obtain $21 + 2 = 23$.
3. Therefore, $3\frac{2}{7} = \frac{23}{7}$.

6. Explain equivalent fractions with an example.

Answer:

1. Equivalent fractions are fractions that represent the same quantity or share.
2. They can be obtained by multiplying the numerator and denominator by the same non-zero number.
3. For example, $\frac{2}{3} = \frac{4}{6} = \frac{6}{9}$.

7. Find two fractions equivalent to $\frac{3}{4}$.

Answer:

1. Multiplying the numerator and denominator by 2 gives $\frac{3}{4} = \frac{6}{8}$.
2. Multiplying the numerator and denominator by 3 gives $\frac{3}{4} = \frac{9}{12}$.
3. Thus, $\frac{6}{8}$ and $\frac{9}{12}$ are equivalent to $\frac{3}{4}$.

8. Express $\frac{24}{36}$ in its lowest form.

Answer:

1. The highest common factor of 24 and 36 is 12.
2. Dividing the numerator and denominator by 12 gives $\frac{24 \div 12}{36 \div 12} = \frac{2}{3}$.
3. Therefore, the lowest form of $\frac{24}{36}$ is $\frac{2}{3}$.

9. Compare $\frac{3}{4}$ and $\frac{5}{8}$.

Answer:

1. Convert the fractions to the common denominator 8.
2. We get $\frac{3}{4} = \frac{6}{8}$, while the other fraction is $\frac{5}{8}$.
3. Since $6 > 5$, $\frac{3}{4} > \frac{5}{8}$.

10. Add $\frac{2}{3}$ and $\frac{1}{4}$.

Answer:

1. The common denominator of 3 and 4 is 12.
2. Convert the fractions as $\frac{2}{3} = \frac{8}{12}$ and $\frac{1}{4} = \frac{3}{12}$.
3. Therefore, $\frac{2}{3} + \frac{1}{4} = \frac{11}{12}$.

11. Subtract $\frac{2}{5}$ from $\frac{3}{4}$.

Answer:

1. The common denominator of 4 and 5 is 20.
2. Convert the fractions as $\frac{3}{4} = \frac{15}{20}$ and $\frac{2}{5} = \frac{8}{20}$.
3. Therefore, $\frac{3}{4} - \frac{2}{5} = \frac{7}{20}$.

12. Explain Brahmagupta's method for adding fractions.

Answer:

1. First, convert the fractions into equivalent fractions having the same denominator.
2. Add the numerators while retaining the common denominator.
3. Express the resulting fraction in its lowest form whenever possible.

13. Explain Brahmagupta's method for subtracting fractions.

Answer:

1. First, convert the fractions into equivalent fractions having a common denominator.
2. Subtract the numerator of the second fraction from that of the first while retaining the denominator.
3. Simplify the resulting fraction to its lowest form.

14. Three rotis are shared equally among four children. Explain each child's share using division, addition and multiplication facts.

Answer:

1. Each child receives $\frac{3}{4}$ of a roti, so the division fact is $3 \div 4 = \frac{3}{4}$.
2. The addition fact is $3 = \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4}$.
3. The multiplication fact is $3 = 4 \times \frac{3}{4}$.

15. Arrange $\frac{1}{2}, \frac{3}{4}$, and $\frac{2}{3}$ in ascending order.

Answer:

1. Using the common denominator 12, the fractions become $\frac{6}{12}, \frac{9}{12}$, and $\frac{8}{12}$.
2. Their numerators in increasing order are $6 < 8 < 9$.
3. Therefore, $\frac{1}{2} < \frac{2}{3} < \frac{3}{4}$.

7.10. Three-mark questions with Answers of HOTS Type: (15 Questions)

Three-Mark Descriptive Questions with Answers — HOTS Type:

1. Ravi says that $\frac{1}{10}$ is greater than $\frac{1}{6}$ because 10 is greater than 6. Examine his statement.

Answer:

1. Ravi's statement is incorrect because a larger denominator divides the whole into more equal parts.
2. Dividing a whole into ten equal parts produces smaller pieces than dividing it into six equal parts.
3. Therefore, $\frac{1}{10} < \frac{1}{6}$.

2. Four glasses of juice are shared equally among six children. Find each child's share and express it in its lowest form.

Answer:

1. Each child's share is represented by $4 \div 6 = \frac{4}{6}$ of a glass.
2. Dividing the numerator and denominator by their common factor 2 gives $\frac{4}{6} = \frac{2}{3}$.
3. Therefore, each child receives $\frac{2}{3}$ of a glass.

3. A point is located at $\frac{11}{4}$ on a number line. Convert it into a mixed fraction and describe its position.

Answer:

1. Dividing 11 by 4 gives quotient 2 and remainder 3.
2. Therefore, $\frac{11}{4} = 2\frac{3}{4}$.
3. The point lies between 2 and 3, three-fourths of a unit after 2.

4. Determine whether $\frac{8}{12}, \frac{10}{15}$, and $\frac{14}{21}$ are equivalent.

Answer:

1. The fraction $\frac{8}{12}$ simplifies to $\frac{2}{3}$.
2. The fractions $\frac{10}{15}$ and $\frac{14}{21}$ also simplify to $\frac{2}{3}$.
3. Therefore, all three fractions are equivalent.

5. Find the missing numbers in $\frac{3}{5} = \frac{\square}{20} = \frac{21}{\triangle}$.

Answer:

1. Multiplying $\frac{3}{5}$ by $\frac{4}{4}$ gives $\frac{12}{20}$, so $\square = 12$.
2. Multiplying $\frac{3}{5}$ by $\frac{7}{7}$ gives $\frac{21}{35}$, so $\triangle = 35$.
3. Therefore, $\frac{3}{5} = \frac{12}{20} = \frac{21}{35}$.

6. A student simplifies $\frac{36}{48}$ to $\frac{6}{8}$ and says the answer is in its lowest form. Analyse the answer.

Answer:

1. The student has obtained an equivalent fraction, but $\frac{6}{8}$ is not in its lowest form because 6 and 8 have the common factor 2.
2. Dividing both terms by 2 gives $\frac{6}{8} = \frac{3}{4}$.
3. Therefore, the correct lowest form of $\frac{36}{48}$ is $\frac{3}{4}$.

7. Compare $\frac{7}{10}$ and $\frac{9}{14}$ using equivalent fractions.

Answer:

1. The common denominator of 10 and 14 is 70.
2. The fractions become $\frac{7}{10} = \frac{49}{70}$ and $\frac{9}{14} = \frac{45}{70}$.
3. Since $49 > 45$, $\frac{7}{10} > \frac{9}{14}$.

8. Arrange $\frac{5}{6}, \frac{7}{9}$, and $\frac{3}{4}$ in descending order.

Answer:

1. Using the common denominator 36, the fractions become $\frac{30}{36}, \frac{28}{36}$, and $\frac{27}{36}$, respectively.
2. Their numerators are ordered as $30 > 28 > 27$.
3. Therefore, the descending order is $\frac{5}{6} > \frac{7}{9} > \frac{3}{4}$.

9. A student adds $\frac{2}{3}$and $\frac{3}{5}$and writes $\frac{5}{8}$. Identify and correct the error.

Answer:

1. The student incorrectly added the numerators and denominators directly.
2. Using denominator 15, the fractions become $\frac{10}{15}$and $\frac{9}{15}$.
3. Therefore, the correct sum is $\frac{19}{15} = 1\frac{4}{15}$.

10. A water tank is $\frac{3}{4}$full, and $\frac{2}{5}$of the tank's capacity is used. What fraction remains?

Answer:

1. Convert the fractions to twentieths: $\frac{3}{4} = \frac{15}{20}$and $\frac{2}{5} = \frac{8}{20}$.
2. Subtracting gives $\frac{15}{20} - \frac{8}{20} = \frac{7}{20}$.
3. Therefore, $\frac{7}{20}$of the tank's capacity remains.

11. Find the fraction that must be added to $1\frac{2}{5}$to obtain $2\frac{1}{4}$.

Answer:

1. Convert the mixed fractions into improper fractions: $1\frac{2}{5} = \frac{7}{5}$and $2\frac{1}{4} = \frac{9}{4}$.
2. Their difference is $\frac{9}{4} - \frac{7}{5} = \frac{45}{20} - \frac{28}{20} = \frac{17}{20}$.
3. Therefore, $\frac{17}{20}$must be added.

12. Group A shares three cakes among four children, while Group B shares seven cakes among ten children. Which group gives each child a larger share?

Answer:

1. Each child in Group A receives $\frac{3}{4} = \frac{15}{20}$of a cake.
2. Each child in Group B receives $\frac{7}{10} = \frac{14}{20}$of a cake.
3. Therefore, children in Group A receive a larger share.

13. Find three different unit fractions whose sum equals 1 and verify the result.

Answer:

1. Consider the unit fractions $\frac{1}{2}, \frac{1}{3}$, and $\frac{1}{6}$.
2. Using denominator 6, their sum is $\frac{3}{6} + \frac{2}{6} + \frac{1}{6} = \frac{6}{6}$.
3. Therefore, $\frac{1}{2} + \frac{1}{3} + \frac{1}{6} = 1$.

14. If five glasses of juice shared among four children gives the same share as $x$glasses shared among twelve children, find x.

Answer:

1. The equal shares give the equation $\frac{5}{4} = \frac{x}{12}$.
2. Since 4 is multiplied by 3 to obtain 12, the numerator 5 must also be multiplied by 3.
3. Therefore, $x = 15$glasses.

15. A student claims that no fraction exists between $\frac{1}{2}$and $\frac{2}{3}$. Disprove the claim.

Answer:

1. Write the fractions as $\frac{1}{2} = \frac{6}{12}$and $\frac{2}{3} = \frac{8}{12}$.
2. The fraction $\frac{7}{12}$lies between $\frac{6}{12}$and $\frac{8}{12}$.

3. Therefore, $\frac{1}{2} < \frac{7}{12} < \frac{2}{3}$, so the claim is false.

7.11 Five-mark questions with Answers of LOTS Type: (8 Questions)

Five-Mark Descriptive Questions with Answers — LOTS Type:

1. Explain fractional units and the different parts of a fraction with an example.

Answer:

1. When a whole is divided into equal parts, each part is called a fractional unit or unit fraction.
2. A fractional unit has 1 as its numerator, as in $\frac{1}{5}$.
3. In the fraction $\frac{3}{5}$, the numerator 3 shows the number of fractional units taken.
4. The denominator 5 shows that the whole has been divided into five equal parts.
5. Thus, $\frac{3}{5} = 3 \times \frac{1}{5}$.

2. Explain how to represent $\frac{7}{4}$ on a number line.

Answer:

1. Divide each unit interval on the number line into four equal parts.
2. Each small interval represents the fractional unit $\frac{1}{4}$.
3. Beginning from 0, move seven intervals of length $\frac{1}{4}$.
4. The seventh mark represents $\frac{7}{4} = 1\frac{3}{4}$.
5. Therefore, $\frac{7}{4}$ lies between 1 and 2 on the number line.

3. Convert $\frac{17}{5}$ into a mixed fraction and $3\frac{2}{5}$ into an improper fraction.

Answer:

1. Divide 17 by 5 to obtain quotient 3 and remainder 2.
2. Therefore, $\frac{17}{5} = 3\frac{2}{5}$.
3. To reverse the process, multiply the whole-number part 3 by the denominator 5.
4. Add the numerator 2 to the product: $3 \times 5 + 2 = 17$.
5. Thus, $3\frac{2}{5} = \frac{17}{5}$.

4. Explain equivalent fractions and find three fractions equivalent to $\frac{2}{3}$.

Answer:

1. Equivalent fractions are fractions that represent the same quantity or share.
2. They are obtained by multiplying the numerator and denominator by the same non-zero number.
3. Multiplying by 2 gives $\frac{2}{3} = \frac{4}{6}$.
4. Multiplying by 3 gives $\frac{2}{3} = \frac{6}{9}$.
5. Multiplying by 4 gives $\frac{2}{3} = \frac{8}{12}$.

5. Express $\frac{36}{48}$ in its lowest form and explain the process.

Answer:

1. A fraction is in its lowest form when its numerator and denominator have no common factor other than 1.
2. The highest common factor of 36 and 48 is 12.
3. Divide both the numerator and denominator by 12.
4. Thus, $\frac{36}{48} = \frac{36 \div 12}{48 \div 12} = \frac{3}{4}$.

5. Since 3 and 4 have no common factor other than 1, $\frac{3}{4}$is the lowest form.

6. Compare $\frac{2}{3}, \frac{3}{4}$, and $\frac{5}{6}$, and arrange them in ascending order.

Answer:

1. The least common denominator of 3, 4 and 6 is 12.
2. Convert $\frac{2}{3}$into $\frac{8}{12}$.
3. Convert $\frac{3}{4}$into $\frac{9}{12}$and $\frac{5}{6}$into $\frac{10}{12}$.
4. Since $8 < 9 < 10$, we have $\frac{8}{12} < \frac{9}{12} < \frac{10}{12}$.
5. Therefore, the ascending order is $\frac{2}{3} < \frac{3}{4} < \frac{5}{6}$.

7. Add $\frac{2}{3}$and $\frac{3}{4}$using Brahmagupta's method.

Answer:

1. The least common denominator of 3 and 4 is 12.
2. Convert $\frac{2}{3}$into the equivalent fraction $\frac{8}{12}$.
3. Convert $\frac{3}{4}$into the equivalent fraction $\frac{9}{12}$.
4. Add the numerators: $\frac{8}{12} + \frac{9}{12} = \frac{17}{12}$.
5. Therefore, the sum is $\frac{17}{12} = 1\frac{5}{12}$.

8. Subtract $\frac{4}{9}$from $\frac{5}{6}$using Brahmagupta's method.

Answer:

1. The least common denominator of 6 and 9 is 18.
2. Convert $\frac{5}{6}$into the equivalent fraction $\frac{15}{18}$.
3. Convert $\frac{4}{9}$into the equivalent fraction $\frac{8}{18}$.
4. Subtract the numerators: $\frac{15}{18} - \frac{8}{18} = \frac{7}{18}$.
5. Therefore, the required difference is $\frac{7}{18}$.

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

Five-Mark Descriptive Questions with Answers — HOTS Type:

1. Rohan says that $\frac{1}{12}$is greater than $\frac{1}{8}$because $12 > 8$. Analyse his statement with a suitable explanation.

Answer:

1. Rohan's statement is incorrect because the denominator indicates the number of equal parts into which a whole is divided.
2. When a whole is divided into 12 equal parts, each part is smaller than when it is divided into 8 equal parts.
3. Therefore, a piece of size $\frac{1}{12}$is smaller than a piece of size $\frac{1}{8}$.
4. Using denominator 24, $\frac{1}{12} = \frac{2}{24}$and $\frac{1}{8} = \frac{3}{24}$.
5. Hence, $\frac{1}{12} < \frac{1}{8}$.

2. A student claims that $\frac{12}{18}, \frac{16}{24}$, and $\frac{20}{30}$represent different quantities. Verify the claim.

Answer:

1. Simplifying $\frac{12}{18}$by dividing both terms by 6 gives $\frac{2}{3}$.

2. Simplifying $\frac{16}{24}$by dividing both terms by 8 also gives $\frac{2}{3}$.
3. Simplifying $\frac{20}{30}$by dividing both terms by 10 again gives $\frac{2}{3}$.
4. Since all three fractions have the same simplest form, they represent the same quantity.
5. Therefore, the student's claim is incorrect, and the three fractions are equivalent.

3. Arrange $\frac{7}{10}, \frac{5}{6}, \frac{3}{4}$, and $\frac{2}{3}$in descending order.

Answer:

1. The least common denominator of 10, 6, 4 and 3 is 60.
2. The equivalent fractions are $\frac{42}{60}, \frac{50}{60}, \frac{45}{60}$, and $\frac{40}{60}$, respectively.
3. Comparing their numerators gives $50 > 45 > 42 > 40$.
4. Therefore, $\frac{5}{6} > \frac{3}{4} > \frac{7}{10} > \frac{2}{3}$.
5. Hence, the required descending order is $\frac{5}{6}, \frac{3}{4}, \frac{7}{10}, \frac{2}{3}$.

4. A student calculates $\frac{3}{4} + \frac{2}{5}$as $\frac{5}{9}$. Identify the error and find the correct answer.

Answer:

1. The student has incorrectly added the numerators and denominators directly.
2. Fractions with different denominators must first be converted into equivalent fractions with a common denominator.
3. Using denominator 20, $\frac{3}{4} = \frac{15}{20}$and $\frac{2}{5} = \frac{8}{20}$.
4. Their sum is $\frac{15}{20} + \frac{8}{20} = \frac{23}{20}$.
5. Therefore, the correct answer is $\frac{23}{20} = 1\frac{3}{20}$.

5. A tank is $\frac{5}{6}$full, and $\frac{3}{8}$of its total capacity is used. Determine the fraction of water remaining.

Answer:

1. The quantity remaining is obtained by calculating $\frac{5}{6} - \frac{3}{8}$.
2. The least common denominator of 6 and 8 is 24.
3. The equivalent fractions are $\frac{5}{6} = \frac{20}{24}$and $\frac{3}{8} = \frac{9}{24}$.
4. Subtracting gives $\frac{20}{24} - \frac{9}{24} = \frac{11}{24}$.
5. Therefore, $\frac{11}{24}$of the tank's total capacity remains filled.

6. Group A shares five rotis among six children, while Group B shares seven rotis among nine children. Determine which group gives each child a larger share.

Answer:

1. Each child in Group A receives $\frac{5}{6}$of a roti.
2. Each child in Group B receives $\frac{7}{9}$of a roti.
3. Using denominator 18, the shares become $\frac{5}{6} = \frac{15}{18}$and $\frac{7}{9} = \frac{14}{18}$.
4. Since $\frac{15}{18} > \frac{14}{18}$, the children in Group A receive more.
5. Therefore, Group A gives each child a larger share by $\frac{1}{18}$of a roti.

7. Find the fraction that must be added to $2\frac{1}{3}$to obtain $4\frac{1}{4}$.

Answer:

1. Convert the mixed fractions into improper fractions: $2\frac{1}{3} = \frac{7}{3}$and $4\frac{1}{4} = \frac{17}{4}$.
2. The required fraction is $\frac{17}{4} - \frac{7}{3}$.

3. Using denominator 12, the fractions become $\frac{51}{12}$and $\frac{28}{12}$.
4. Their difference is $\frac{51}{12} - \frac{28}{12} = \frac{23}{12}$.
5. Therefore, the required fraction is $\frac{23}{12} = 1\frac{11}{12}$.

8. Find four different unit fractions whose sum is 1 and verify your answer.

Answer:

1. Consider the four different unit fractions $\frac{1}{2}, \frac{1}{4}, \frac{1}{6}$, and $\frac{1}{12}$.
2. Their common denominator is 12.
3. The equivalent fractions are $\frac{6}{12}, \frac{3}{12}, \frac{2}{12}$, and $\frac{1}{12}$.
4. Their sum is $\frac{6+3+2+1}{12} = \frac{12}{12}$.
5. Therefore, $\frac{1}{2} + \frac{1}{4} + \frac{1}{6} + \frac{1}{12} = 1$.

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

Five-Mark Descriptive Questions with Answers — Applied Type:

1. Sharing Fruit Juice:

At a school celebration, 7 litres of fruit juice are shared equally among 10 students. How much juice does each student receive? If each student drinks $\frac{1}{2}$litre, how much remains with each student?

Answer:

1. The quantity received by each student is $7 \div 10 = \frac{7}{10}$litre.
2. Each student drinks $\frac{1}{2}$litre.
3. Using denominator 10, $\frac{1}{2} = \frac{5}{10}$.
4. The quantity remaining is $\frac{7}{10} - \frac{5}{10} = \frac{2}{10} = \frac{1}{5}$litre.
5. Therefore, each student receives $\frac{7}{10}$litre, of which $\frac{1}{5}$litre remains.

2. Distance Travelled to School

Meera's school is $2\frac{1}{4}$km from her home. She travels $\frac{3}{5}$km by bus and walks the remaining distance. How far does she walk?

Answer:

1. Convert $2\frac{1}{4}$into an improper fraction: $2\frac{1}{4} = \frac{9}{4}$.
2. The distance walked is $\frac{9}{4} - \frac{3}{5}$.
3. Using denominator 20, $\frac{9}{4} = \frac{45}{20}$and $\frac{3}{5} = \frac{12}{20}$.
4. The remaining distance is $\frac{45}{20} - \frac{12}{20} = \frac{33}{20}$km.
5. Therefore, Meera walks $\frac{33}{20} = 1\frac{13}{20}$km.

3. Mixing Paint

An artist mixes $\frac{3}{4}$litre of blue paint, $\frac{2}{3}$litre of yellow paint and $\frac{1}{6}$litre of white paint. Find the total quantity of paint prepared.

Answer:

1. The total quantity is $\frac{3}{4} + \frac{2}{3} + \frac{1}{6}$litres.
2. The least common denominator of 4, 3 and 6 is 12.
3. The equivalent fractions are $\frac{9}{12}, \frac{8}{12}$, and $\frac{2}{12}$.

4. Their sum is $\frac{9+8+2}{12} = \frac{19}{12}$litres.
5. Therefore, the artist prepares $\frac{19}{12} = 1\frac{7}{12}$litres of paint.

4. Using a Ribbon

A tailor has $3\frac{1}{2}$metres of ribbon. He uses $\frac{5}{6}$metre for a dress and $\frac{3}{4}$metre for a bag. Find the length of ribbon left.

Answer:

1. Convert the total length into an improper fraction: $3\frac{1}{2} = \frac{7}{2}$metres.
2. The ribbon used is $\frac{5}{6} + \frac{3}{4} = \frac{10}{12} + \frac{9}{12} = \frac{19}{12}$metres.
3. Convert $\frac{7}{2}$into twelfths to get $\frac{42}{12}$.
4. The ribbon left is $\frac{42}{12} - \frac{19}{12} = \frac{23}{12}$metres.
5. Therefore, $1\frac{11}{12}$metres of ribbon remain.

5. Completing a Book

Ananya reads $\frac{2}{5}$of a book on Monday and $\frac{1}{4}$on Tuesday. What fraction of the book has she read, and what fraction is left?

Answer:

1. The fraction read is $\frac{2}{5} + \frac{1}{4}$.
2. Using denominator 20, $\frac{2}{5} = \frac{8}{20}$and $\frac{1}{4} = \frac{5}{20}$.
3. She has read $\frac{8}{20} + \frac{5}{20} = \frac{13}{20}$of the book.
4. The unread portion is $1 - \frac{13}{20} = \frac{20}{20} - \frac{13}{20} = \frac{7}{20}$.
5. Therefore, Ananya has read $\frac{13}{20}$of the book, and $\frac{7}{20}$remains.

6. Filling a Water Tank

A water tank is $\frac{3}{8}$full in the morning. Later, water equal to $\frac{5}{12}$of its capacity is added. What fraction of the tank is filled now, and is it completely full?

Answer:

1. The total filled portion is $\frac{3}{8} + \frac{5}{12}$.
2. The least common denominator of 8 and 12 is 24.
3. The fractions become $\frac{9}{24}$and $\frac{10}{24}$.
4. The filled portion is $\frac{9}{24} + \frac{10}{24} = \frac{19}{24}$.
5. Therefore, the tank is $\frac{19}{24}$full and still needs $\frac{5}{24}$of its capacity to become full.

7. Distributing Rice

A shopkeeper packs 8 kg of rice equally into 6 bags. Find the quantity of rice in each bag and express it in its simplest and mixed forms.

Answer:

1. The quantity in each bag is $8 \div 6 = \frac{8}{6}$kg.
2. The numerator and denominator of $\frac{8}{6}$have the common factor 2.
3. Dividing both by 2 gives $\frac{8}{6} = \frac{4}{3}$kg.
4. Converting the improper fraction into a mixed fraction gives $\frac{4}{3} = 1\frac{1}{3}$.
5. Therefore, each bag contains $\frac{4}{3}$kg, or $1\frac{1}{3}$kg, of rice.

7.14: Five-Mark Descriptive Questions with Answers — Applied Type:

Five-Mark Descriptive Questions with Answers — Applied Type:

1. A fruit seller sold $\frac{3}{8}$of his apples in the morning and $\frac{1}{4}$in the evening. What fraction of the apples did he sell, and what fraction remained?

Answer:

1. The fraction sold in the evening is $\frac{1}{4} = \frac{2}{8}$.
2. The total fraction sold is $\frac{3}{8} + \frac{2}{8} = \frac{5}{8}$.
3. The whole quantity of apples is represented by $1 = \frac{8}{8}$.
4. The fraction remaining is $\frac{8}{8} - \frac{5}{8} = \frac{3}{8}$.
5. Therefore, the seller sold $\frac{5}{8}$of the apples, and $\frac{3}{8}$remained.

2. Riya walked $\frac{3}{5}$km to a library and then $\frac{7}{10}$km to a park. Find the total distance she walked.

Answer:

1. The total distance is $\frac{3}{5} + \frac{7}{10}$km.
2. Convert $\frac{3}{5}$into the equivalent fraction $\frac{6}{10}$.
3. Add the fractions: $\frac{6}{10} + \frac{7}{10} = \frac{13}{10}$.
4. Convert the improper fraction into a mixed fraction: $\frac{13}{10} = 1\frac{3}{10}$.
5. Therefore, Riya walked $1\frac{3}{10}$km altogether.

3. A water tank was $\frac{7}{8}$full. If $\frac{1}{3}$of the tank's total capacity was used, what fraction of the tank remained filled?

Answer:

1. The fraction remaining is $\frac{7}{8} - \frac{1}{3}$.
2. The least common denominator of 8 and 3 is 24.
3. Convert the fractions as $\frac{7}{8} = \frac{21}{24}$and $\frac{1}{3} = \frac{8}{24}$.
4. Subtracting gives $\frac{21}{24} - \frac{8}{24} = \frac{13}{24}$.
5. Therefore, $\frac{13}{24}$of the tank's capacity remained filled.

4. A tailor has $4\frac{1}{2}$metres of cloth and uses $2\frac{3}{4}$metres to stitch a dress. How much cloth remains?

Answer:

1. Convert the mixed fractions as $4\frac{1}{2} = \frac{9}{2}$and $2\frac{3}{4} = \frac{11}{4}$.
2. Convert $\frac{9}{2}$into the equivalent fraction $\frac{18}{4}$.
3. Subtract the cloth used: $\frac{18}{4} - \frac{11}{4} = \frac{7}{4}$.
4. Convert $\frac{7}{4}$into the mixed fraction $1\frac{3}{4}$.
5. Therefore, $1\frac{3}{4}$metres of cloth remains.

5. Five litres of juice are shared equally among eight students. How much juice does each student receive, and how much will three students receive altogether?

Answer:

1. The share of each student is represented by $5 \div 8 = \frac{5}{8}$litre.

2. Thus, each student receives $\frac{5}{8}$litre of juice.
3. Three students together receive $3 \times \frac{5}{8} = \frac{15}{8}$litres.
4. Convert the improper fraction into a mixed fraction: $\frac{15}{8} = 1\frac{7}{8}$.
5. Therefore, each student receives $\frac{5}{8}$litre, while three students receive $1\frac{7}{8}$litres.

6. Meera used $\frac{2}{3}$litre of yellow paint and $\frac{3}{4}$litre of blue paint to make green paint. If she needs 2 litres of green paint, how much more paint must she prepare?
Answer:

1. The quantity already prepared is $\frac{2}{3} + \frac{3}{4}$litres.
2. Using denominator 12, the sum is $\frac{8}{12} + \frac{9}{12} = \frac{17}{12} = 1\frac{5}{12}$litres.
3. Two litres can be written as $\frac{24}{12}$litres.
4. The additional quantity required is $\frac{24}{12} - \frac{17}{12} = \frac{7}{12}$litre.
5. Therefore, Meera must prepare $\frac{7}{12}$litre more paint.

7. A school day lasts 6 hours. Students spend $2\frac{1}{2}$hours studying languages and $1\frac{3}{4}$hours studying mathematics and science. How much time remains for other activities?
Answer:

1. Convert the mixed fractions as $2\frac{1}{2} = \frac{5}{2}$and $1\frac{3}{4} = \frac{7}{4}$.
2. The total study time is $\frac{10}{4} + \frac{7}{4} = \frac{17}{4} = 4\frac{1}{4}$hours.
3. The entire school day can be written as $6 = \frac{24}{4}$hours.
4. The time remaining is $\frac{24}{4} - \frac{17}{4} = \frac{7}{4} = 1\frac{3}{4}$hours.
5. Therefore, $1\frac{3}{4}$hours remain for other activities.

8. A recipe requires $\frac{3}{4}$cup of flour for one cake. Priya has $2\frac{1}{2}$cups of flour and makes three cakes. Is the flour sufficient, and how much remains?
Answer:

1. Flour required for three cakes is $3 \times \frac{3}{4} = \frac{9}{4} = 2\frac{1}{4}$cups.
2. Priya has $2\frac{1}{2} = \frac{5}{2} = \frac{10}{4}$cups of flour.
3. Since $\frac{10}{4} > \frac{9}{4}$, the available flour is sufficient.
4. The flour remaining is $\frac{10}{4} - \frac{9}{4} = \frac{1}{4}$cup.
5. Therefore, Priya can make three cakes and will have $\frac{1}{4}$cup of flour left.

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

Olympiad-Type Multiple-Choice Questions:
1. Which of the following unit fractions is the greatest?

A. $\frac{1}{6}$
B. $\frac{1}{8}$
C. $\frac{1}{10}$
D. $\frac{1}{12}$

Answer: A. $\frac{1}{6}$

2. Which fraction is equivalent to $\frac{3}{4}$?

A. $\frac{6}{10}$
B. $\frac{9}{12}$
C. $\frac{12}{20}$
D. $\frac{15}{24}$
Answer: B. $\frac{9}{12}$

3. Which fraction lies between $\frac{1}{2}$ and $\frac{2}{3}$?

A. $\frac{5}{12}$
B. $\frac{7}{12}$
C. $\frac{3}{4}$
D. $\frac{4}{5}$
Answer: B. $\frac{7}{12}$

4. The mixed fraction corresponding to $\frac{23}{5}$ is:

A. $3\frac{3}{5}$
B. $4\frac{2}{5}$
C. $4\frac{3}{5}$
D. $5\frac{3}{5}$
Answer: C. $4\frac{3}{5}$

5. The improper fraction corresponding to $3\frac{4}{7}$ is:

A. $\frac{21}{7}$
B. $\frac{24}{7}$
C. $\frac{25}{7}$
D. $\frac{28}{7}$
Answer: C. $\frac{25}{7}$

6. Find the missing number:

$$\frac{5}{8} = \frac{\square}{40}$$

A. 20
B. 24
C. 25
D. 30
Answer: C. 25

7. The lowest form of $\frac{42}{63}$ is:

A. $\frac{2}{3}$

B. $\frac{3}{4}$

C. $\frac{6}{9}$

D. $\frac{7}{9}$

Answer: A. $\frac{2}{3}$

---

8. Which statement is correct?

A. $\frac{5}{6} < \frac{7}{9}$

B. $\frac{5}{6} > \frac{7}{9}$

C. $\frac{5}{6} = \frac{7}{9}$

D. The fractions cannot be compared.

Answer: B. $\frac{5}{6} > \frac{7}{9}$

---

9. Find:

$$\frac{3}{4} + \frac{5}{6}$$

A. $1\frac{5}{12}$

B. $1\frac{7}{12}$

C. $1\frac{3}{10}$

D. $2\frac{1}{12}$

Answer: B. $1\frac{7}{12}$

---

10. Find:

$$\frac{7}{8} - \frac{1}{3}$$

A. $\frac{5}{24}$

B. $\frac{11}{24}$

C. $\frac{13}{24}$

D. $\frac{17}{24}$

Answer: C. $\frac{13}{24}$

---

11. Five cakes are shared equally among eight children. How much cake does each child receive?

A. $\frac{5}{8}$ cake

B. $\frac{8}{5}$ cakes

C. $\frac{3}{8}$ cake

D. $\frac{1}{8}$ cake

Answer: A. $\frac{5}{8}$cake

---

12. A point is seven one-fourth steps away from 0 on a number line. Which number does it represent?

A. $\frac{4}{7}$
B. $\frac{7}{4}$
C. $2\frac{1}{4}$
D. $\frac{7}{8}$
Answer: B. $\frac{7}{4}$

---

13. Which pair does not contain equivalent fractions?

A. $\frac{2}{3}$and $\frac{8}{12}$
B. $\frac{3}{5}$and $\frac{12}{20}$
C. $\frac{4}{7}$and $\frac{16}{28}$
D. $\frac{5}{8}$and $\frac{15}{20}$
Answer: D. $\frac{5}{8}$and $\frac{15}{20}$

---

14. Which is the smallest fraction greater than 1 with denominator 5?

A. $\frac{4}{5}$
B. $\frac{5}{5}$
C. $\frac{6}{5}$
D. $\frac{7}{5}$
Answer: C. $\frac{6}{5}$

---

15. If

$$\frac{7}{12} + \frac{x}{12} = 1,$$

then $x$is:
A. 3
B. 4
C. 5
D. 7
Answer: C. 5

---

16. Which set of different unit fractions has a sum equal to 1?

A. $\frac{1}{2}, \frac{1}{3}, \frac{1}{6}$
B. $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}$
C. $\frac{1}{3}, \frac{1}{4}, \frac{1}{5}$
D. $\frac{1}{2}, \frac{1}{5}, \frac{1}{10}$
Answer: A. $\frac{1}{2}, \frac{1}{3}, \frac{1}{6}$

17. What must be added to $2\frac{1}{4}$ to obtain 4?
A. $1\frac{1}{4}$
B. $1\frac{1}{2}$
C. $1\frac{3}{4}$
D. $2\frac{1}{4}$
Answer: C. $1\frac{3}{4}$

18. If $\frac{3}{7} = \frac{15}{n}$, what is the value of n?
A. 21
B. 28
C. 35
D. 42
Answer: C. 35

19. A student calculates

$$\frac{2}{5} + \frac{1}{3} = \frac{3}{8}.$$

Which statement correctly identifies the error?
A. The numerators should be subtracted.
B. The denominators should remain unchanged.
C. The fractions should first be changed to equivalent fractions with a common denominator.
D. The answer should always be a mixed fraction.
Answer: C. The fractions should first be changed to equivalent fractions with a common denominator.

20. Which is the correct ascending order?
A. $\frac{3}{4} < \frac{2}{3} < \frac{1}{2}$
B. $\frac{1}{2} < \frac{2}{3} < \frac{3}{4}$
C. $\frac{2}{3} < \frac{1}{2} < \frac{3}{4}$
D. $\frac{1}{2} < \frac{3}{4} < \frac{2}{3}$
Answer: B. $\frac{1}{2} < \frac{2}{3} < \frac{3}{4}$

21. Rahim mixes $\frac{2}{3}$ litre of yellow paint with $\frac{3}{4}$ litre of blue paint. What is the total volume?
A. $1\frac{1}{12}$ litres
B. $1\frac{3}{12}$ litres
C. $1\frac{5}{12}$ litres
D. $1\frac{7}{12}$ litres
Answer: C. $1\frac{5}{12}$ litres

22. Four kilograms of rice are shared equally among three bags. The same quantity per bag will be obtained by sharing 20 kg equally among:
A. 12 bags
B. 15 bags
C. 16 bags
D. 18 bags
Answer: B. 15 bags

---

23. Which fraction lies exactly halfway between $\frac{1}{4}$and $\frac{3}{4}$?
A. $\frac{1}{3}$
B. $\frac{2}{5}$
C. $\frac{1}{2}$
D. $\frac{5}{8}$
Answer: C. $\frac{1}{2}$

---

24. Find:

$$2\frac{1}{3}-\frac{5}{6}$$

A. $1\frac{1}{3}$
B. $1\frac{1}{2}$
C. $1\frac{2}{3}$
D. $1\frac{5}{6}$
Answer: B. $1\frac{1}{2}$

---

25. Which fraction is equal to 0.75?
A. $\frac{1}{4}$
B. $\frac{2}{5}$
C. $\frac{3}{4}$
D. $\frac{4}{5}$
Answer: C. $\frac{3}{4}$

---

26. The sum of two fractions is 1. If one fraction is $\frac{7}{15}$, the other fraction is:
A. $\frac{6}{15}$
B. $\frac{7}{15}$
C. $\frac{8}{15}$
D. $\frac{9}{15}$
Answer: C. $\frac{8}{15}$

---

27. Which fraction is nearest to 1?

A. $\frac{5}{8}$
B. $\frac{7}{9}$
C. $\frac{11}{12}$
D. $\frac{3}{4}$
Answer: C. $\frac{11}{12}$

---

28. If $\frac{a}{24} = \frac{3}{4}$, then the value of $a$is:
A. 6
B. 12
C. 18
D. 21
Answer: C. 18

---

29. How many fractions with denominator 8 lie strictly between 0 and 1?
A. 6
B. 7
C. 8
D. Infinitely many
Answer: B. 7

---

30. Which expression has the greatest value?
A. $\frac{1}{2} + \frac{1}{4}$
B. $\frac{2}{3} + \frac{1}{6}$
C. $\frac{3}{5} + \frac{1}{5}$
D. $\frac{5}{8} + \frac{1}{8}$
Answer: B. $\frac{2}{3} + \frac{1}{6} = \frac{5}{6}$

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

Best Practices for Teaching Chapter 7: Fractions:

(1) Begin with real-life sharing situations
Introduce fractions by equally sharing rotis, fruits, chocolates or paper strips among students so that they understand fractions as equal shares.

(2) Use concrete learning materials
Use fraction strips, fraction circles, folded paper, measuring cups and coloured blocks to demonstrate fractional units, equivalent fractions and comparison.

(3) Follow the concrete–pictorial–abstract approach
Begin with physical objects, move to drawings and number lines, and finally introduce fraction symbols and calculations.

(4) Emphasise equal parts
Provide examples and non-examples to clarify that a whole must be divided into equal parts before the parts can be represented as fractions.

(5) Use number lines regularly
Ask students to locate proper fractions, improper fractions and mixed fractions on number lines to strengthen their understanding of magnitude.

(6) **Build a classroom fraction wall**
Let students construct a fraction wall using paper strips to discover equivalent fractions and compare fractions visually.
(7) **Connect multiple representations**
Link each fraction with its verbal form, symbol, picture, number-line position, division fact and real-life meaning.
(8) **Encourage mathematical reasoning**
Ask students to explain why $\frac{1}{5} > \frac{1}{9}$, why two fractions are equivalent or why common denominators are needed.
(9) **Address common misconceptions immediately**
Discuss errors such as believing that a larger denominator gives a larger fraction or adding numerators and denominators directly.
(10) **Teach operations through fractional units**
Explain that fractions can be added or subtracted only after they are expressed using parts of the same size, that is, a common denominator.
(11) **Use collaborative learning activities**
Arrange students in groups to solve fraction puzzles, compare solution methods and explain their reasoning to classmates.
(12) **Integrate Indian mathematical heritage**
Discuss traditional fraction words and the contributions of Aryabhata, Brahmagupta and Sridharacharya to make the lesson culturally meaningful.
(13) **Provide differentiated practice**
Give basic pictorial tasks to learners needing support and challenging comparison or application problems to advanced learners.
(14) **Use frequent formative assessment**
Conduct quick oral questions, exit slips, matching activities and error-analysis exercises to identify learning gaps.
(15) **Relate fractions to daily measurements**
Use examples involving recipes, distance, time, money, weight, cloth, water and paint to demonstrate the practical importance of fractions.

7.16 Innovations Opportunity List from the Chapter: (15 Ideas)

Innovations in Teaching–Learning Chapter 7: Fractions:
(1) **Interactive Digital Fraction Wall:**
Use a smartboard or digital tool through which students can move, resize and combine fraction strips to explore equivalent fractions and compare their values.
(2) **Fraction Café Simulation:**
Create a classroom café where students use fractional quantities of ingredients, divide food items into equal shares and calculate the quantities used or remaining.
(3) **Augmented-Reality Fraction Hunt:**
Use an AR application or QR codes placed around the classroom to reveal fraction diagrams, puzzles and number-line challenges for students to solve.
(4) **Fraction Escape Room:**
Organise a series of fraction-based clues involving equivalent fractions, mixed numbers, comparison, addition and subtraction that students must solve to complete a mission.
(5) **Build-Your-Own Fraction Kit:**
Let students create reusable fraction strips, circles and number lines from coloured paper or waste cardboard and use them to explain mathematical ideas.

(6) **Human Fraction Number Line:**
Mark a large number line on the classroom floor and ask students holding fraction cards to stand at their correct positions, including positions beyond 1.

(7) **Fraction Stop-Motion Videos:**
Students can use paper cut-outs or blocks to create short stop-motion videos explaining improper fractions, mixed fractions or equivalent fractions.

(8) **QR-Code Learning Stations:**
Set up stations for fraction identification, comparison, simplification, number-line representation and operations, with QR codes providing instructions and instant feedback.

(9) **Design-a-Fraction-Game Challenge:**
Ask groups to develop their own board games or card games based on matching equivalent fractions, simplifying fractions or reaching a target sum.

(10) **Digital Error-Detective Activity:**
Present incorrect solutions such as $\frac{2}{3}+\frac{1}{4}=\frac{3}{7}$, and ask students to identify, explain and correct the errors.

(11) **Fraction Photography Project:**
Students photograph real-life examples of fractions—such as sliced fruits, tiled floors or divided playgrounds—and create a digital "Fractions Around Us" gallery.

(12) **Brahmagupta Method Comic Strip:**
Students create a comic strip in which Brahmagupta guides characters through the steps of adding and subtracting fractions using common denominators.

(13) **AI-Assisted Fraction Quiz:**
Use a supervised digital quiz tool that adjusts the difficulty level according to each student's responses and provides immediate hints.

(14) **Fraction Art and Rangoli:**
Students design symmetrical artwork or rangoli patterns and describe the fraction occupied by each colour, shape or repeated design.

(15) **Collaborative Fraction Story Creation:**
Groups create and exchange real-life stories involving sharing, cooking, travel or measurement and challenge classmates to solve the fraction problems embedded in them.

7.17: Practicing Questions/Question Bank:

A. Fill in the Blanks:

1. When a whole is divided into equal parts, each part is called a __________ unit.
   Answer: fractional

2. In the fraction $\frac{7}{9}$, 7 is the __________.
   Answer: numerator

3. In the fraction $\frac{7}{9}$, 9 is the __________.
   Answer: denominator

4. Five units of $\frac{1}{8}$ make the fraction __________.
   Answer: $\frac{5}{8}$

5. The mixed form of $\frac{11}{4}$is __________.

   Answer: $2\frac{3}{4}$

6. The improper fraction corresponding to $3\frac{2}{5}$is __________.

   Answer: $\frac{17}{5}$

7. The fraction $\frac{3}{4}$is equivalent to $\frac{\square}{20}$.

   Answer: $\frac{15}{20}$

8. The lowest form of $\frac{18}{24}$is __________.

   Answer: $\frac{3}{4}$

9. $\frac{3}{7}+\frac{2}{7}=$__________.

   Answer: $\frac{5}{7}$

10. $\frac{5}{6}-\frac{1}{3}=$__________.

    Answer: $\frac{1}{2}$

11. The fraction that must be added to $\frac{5}{8}$to make 1 is __________.

    Answer: $\frac{3}{8}$

12. Three rotis shared equally among four children give each child __________ of a roti.

    Answer: $\frac{3}{4}$

B. One-Mark Descriptive Questions:

1. What is a fractional unit?
   Answer: A fractional unit is one of the equal parts obtained by dividing a whole into equal parts.

2. Give one example of a unit fraction.

   Answer: $\frac{1}{6}$is a unit fraction.

3. Which is greater: $\frac{1}{5}$or $\frac{1}{9}$?

   Answer: $\frac{1}{5}$is greater than $\frac{1}{9}$.

4. What does the denominator of a fraction indicate?
   Answer: It indicates the number of equal parts into which the whole is divided.

5. Write $\frac{9}{4}$as a mixed fraction.

   Answer: $\frac{9}{4}=2\frac{1}{4}$.

6. Write $2\frac{3}{7}$as an improper fraction.

   Answer: $2\frac{3}{7}=\frac{17}{7}$.

7. Write one fraction equivalent to $\frac{2}{3}$.
   Answer: $\frac{4}{6}$is equivalent to $\frac{2}{3}$.

8. What is meant by the lowest form of a fraction?
   Answer: A fraction is in its lowest form when its numerator and denominator have no common factor other than 1.

9. Find $\frac{4}{9} + \frac{2}{9}$.
   Answer: $\frac{4}{9} + \frac{2}{9} = \frac{2}{3}$.

10. Name the Indian mathematician whose method of adding and subtracting fractions is discussed in the chapter.
    Answer: Brahmagupta.

C. Two-Mark Descriptive Questions:

1. Explain the numerator and denominator of $\frac{5}{8}$.

Answer:

1. The numerator 5 shows that five fractional units are being considered.
2. The denominator 8 shows that the whole is divided into eight equal parts.

2. Represent $\frac{3}{5}$on a number line.

Answer:

1. Divide the interval between 0 and 1 into five equal parts.
2. The third mark from 0 represents $\frac{3}{5}$.

3. Convert $\frac{17}{5}$into a mixed fraction.

Answer:

1. Dividing 17 by 5 gives quotient 3 and remainder 2.
2. Therefore, $\frac{17}{5} = 3\frac{2}{5}$.

4. Find two fractions equivalent to $\frac{3}{4}$.

Answer:

1. Multiplying by $\frac{2}{2}$gives $\frac{3}{4} = \frac{6}{8}$.
2. Multiplying by $\frac{3}{3}$gives $\frac{3}{4} = \frac{9}{12}$.

5. Express $\frac{24}{36}$in its lowest form.

Answer:

1. Divide the numerator and denominator by their HCF, 12.

2. Therefore, $\frac{24}{36} = \frac{2}{3}$.

6. Compare $\frac{2}{3}$ and $\frac{3}{4}$.

Answer:

1. Using denominator 12, $\frac{2}{3} = \frac{8}{12}$ and $\frac{3}{4} = \frac{9}{12}$.
2. Therefore, $\frac{2}{3} < \frac{3}{4}$.

7. Add $\frac{1}{2}$ and $\frac{1}{3}$.

Answer:

1. Convert them into $\frac{3}{6}$ and $\frac{2}{6}$.
2. Therefore, $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$.

8. Four kilograms of rice are shared equally among three bags. Find the amount in each bag.

Answer:

1. The amount in each bag is $4 \div 3 = \frac{4}{3}$ kg.
2. Therefore, each bag contains $1\frac{1}{3}$ kg of rice.

D. Three-Mark Descriptive Questions:

1. Explain how $\frac{7}{4}$ is represented on a number line.

Answer:

1. Divide each unit interval into four equal parts.
2. Move seven intervals of length $\frac{1}{4}$ from 0.
3. The point reached is $\frac{7}{4} = 1\frac{3}{4}$, which lies between 1 and 2.

2. Convert $4\frac{2}{5}$ into an improper fraction.

Answer:

1. Multiply the whole-number part 4 by the denominator 5 to obtain 20.
2. Add the numerator 2 to get $20 + 2 = 22$.
3. Therefore, $4\frac{2}{5} = \frac{22}{5}$.

3. Determine whether $\frac{6}{9}$ and $\frac{10}{15}$ are equivalent.

Answer:

1. Simplifying $\frac{6}{9}$gives $\frac{2}{3}$.
2. Simplifying $\frac{10}{15}$also gives $\frac{2}{3}$.
3. Therefore, the two fractions are equivalent.

4. Arrange $\frac{1}{2}, \frac{3}{4}$, and $\frac{2}{3}$in ascending order.

Answer:

1. Using denominator 12, the fractions become $\frac{6}{12}, \frac{9}{12}$, and $\frac{8}{12}$.
2. Their numerators are ordered as $6 < 8 < 9$.
3. Therefore, $\frac{1}{2} < \frac{2}{3} < \frac{3}{4}$.

5. Add $\frac{2}{3}$and $\frac{3}{4}$.

Answer:

1. The common denominator of 3 and 4 is 12.
2. Convert the fractions into $\frac{8}{12}$and $\frac{9}{12}$.
3. Therefore, the sum is $\frac{17}{12} = 1\frac{5}{12}$.

6. A ribbon is $\frac{5}{6}$metre long, and $\frac{1}{4}$metre is cut off. Find the remaining length.

Answer:

1. Convert the fractions into $\frac{10}{12}$and $\frac{3}{12}$.
2. Subtracting gives $\frac{10}{12} - \frac{3}{12} = \frac{7}{12}$.
3. Therefore, $\frac{7}{12}$metre of ribbon remains.

E. Five-Mark Descriptive Questions:

1. Explain equivalent fractions and find three fractions equivalent to $\frac{3}{5}$.

Answer:

1. Equivalent fractions represent the same quantity or share.
2. They are obtained by multiplying the numerator and denominator by the same non-zero number.
3. Multiplying by 2 gives $\frac{3}{5} = \frac{6}{10}$.
4. Multiplying by 3 gives $\frac{3}{5} = \frac{9}{15}$.
5. Multiplying by 4 gives $\frac{3}{5} = \frac{12}{20}$.

2. Compare and arrange $\frac{5}{6}, \frac{7}{9}, \frac{3}{4},$ and $\frac{2}{3}$ in descending order.

Answer:

1. The common denominator of 6, 9, 4 and 3 is 36.
2. The equivalent fractions are $\frac{30}{36}, \frac{28}{36}, \frac{27}{36},$ and $\frac{24}{36}$.
3. Their numerators are ordered as $30 > 28 > 27 > 24$.
4. Therefore, the fractions can be compared directly using these numerators.
5. The descending order is $\frac{5}{6} > \frac{7}{9} > \frac{3}{4} > \frac{2}{3}$.

3. Add $\frac{3}{4}$ and $\frac{5}{6}$ using Brahmagupta's method.

Answer:

1. The least common denominator of 4 and 6 is 12.
2. Convert $\frac{3}{4}$ into $\frac{9}{12}$.
3. Convert $\frac{5}{6}$ into $\frac{10}{12}$.
4. Add the fractions: $\frac{9}{12} + \frac{10}{12} = \frac{19}{12}$.
5. Therefore, the sum is $\frac{19}{12} = 1\frac{7}{12}$.

4. A fruit seller sold $\frac{3}{8}$ of his fruits in the morning and $\frac{1}{4}$ in the evening. Find the fraction sold and the fraction remaining.

Answer:

1. Convert $\frac{1}{4}$ into $\frac{2}{8}$.
2. The total fraction sold is $\frac{3}{8} + \frac{2}{8} = \frac{5}{8}$.
3. The whole quantity is represented by $\frac{8}{8}$.
4. The fraction remaining is $\frac{8}{8} - \frac{5}{8} = \frac{3}{8}$.
5. Therefore, $\frac{5}{8}$ was sold and $\frac{3}{8}$ remained.

5. A tailor has $5\frac{1}{2}$ metres of cloth and uses $2\frac{3}{4}$ metres. Find the length remaining.

Answer:

1. Convert $5\frac{1}{2}$ into $\frac{11}{2}$.
2. Convert $2\frac{3}{4}$ into $\frac{11}{4}$.
3. Write $\frac{11}{2}$ as $\frac{22}{4}$.

4. Subtracting gives $\frac{22}{4} - \frac{11}{4} = \frac{11}{4}$.

5. Therefore, $2\frac{3}{4}$metres of cloth remains.

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6th Standard Maths Book Chapter 8

CHAPTER 8: PLAYING WITH CONSTRUCTIONS

8.1 Summary of the Chapter:

Chapter 8: Playing with Constructions — Summary:

(1) Geometrical figures can be drawn more accurately using instruments such as a ruler and compass instead of drawing them freehand.
(2) A compass is used to draw circles, semicircles, arcs and other curved figures of a fixed radius.
(3) A circle is formed by all the points that are at the same distance from a fixed point called the centre.
(4) The fixed distance between the centre and any point on the circle is called its radius.
(5) Interesting artwork such as a person, waves and eyes can be constructed by combining straight lines, circles and arcs.
(6) A rectangle has two pairs of equal opposite sides, and all its four angles measure 90°.
(7) A square has four equal sides, and all its four angles measure 90°.
(8) Rotating a square or rectangle does not change its properties; therefore, a rotated square remains a square and a rotated rectangle remains a rectangle.
(9) A square or rectangle can be constructed accurately by drawing sides of the required lengths and making perpendicular lines at their endpoints.
(10) A rectangle can be constructed when the lengths of its two sides are given or when one side and the length of a diagonal are given.
(11) The diagonals of a rectangle are equal in length and bisect each other, while the diagonals of a square additionally divide its opposite angles equally.
(12) A point that is at the same distance from two given points can be located by drawing equal-radius arcs from those points; their intersection gives the required point. This method is useful for constructing figures such as a house or a four-sided figure with equal sides.

8.2 Important Formulas:

Important Formulas and Relations:

This chapter mainly involves geometrical properties and construction rules rather than numerical formulas.

1. **Radius of a circle**

$$r = \text{distance from the centre to any point on the circle}$$

2. **Diameter of a circle**

$$d = 2r$$

3. **Radius from diameter**

$$r = \frac{d}{2}$$

4. **Semicircle constructed on a line segment**

If line segment AB is the diameter:

$$r = \frac{AB}{2}$$

5. **Opposite sides of a rectangle**

For rectangle $ABCD$:

$$AB = CD$$
$$BC = AD$$

6. **Angles of a rectangle**

$$\angle A = \angle B = \angle C = \angle D = 90^\circ$$

7. **Equal sides of a square**

For square $PQRS$:

$$PQ = QR = RS = SP$$

8. **Angles of a square**

$$\angle P = \angle Q = \angle R = \angle S = 90^\circ$$

9. **Diagonals of a rectangle**

$$AC = BD$$

10. **Diagonals bisect each other**

If diagonals AC and BD intersect at O:

$$AO = OC$$
$$BO = OD$$

11. **Distance from the centre to the vertices of a rectangle**

Since the diagonals bisect each other:

$$AO = BO = CO = DO$$

12. **Diagonals of a square**

For square $PQRS$:

$$PR = QS$$

The diagonals also bisect each other at right angles:

$$\angle POQ = 90^\circ$$

13. **Angle division by the diagonal of a rectangle**

A diagonal divides a right angle into two complementary angles:

$$\angle 1 + \angle 2 = 90^\circ$$

Example:

$$50^\circ + 40^\circ = 90^\circ$$

14. **Diagonal of a square bisects a corner angle**

$$90^\circ \div 2 = 45^\circ$$

Therefore, each angle formed by the diagonal is 45°.

15. **Rectangle divided into identical squares**

For a rectangle divided into n identical squares in one row:

$$\text{Length} = n \times \text{breadth}$$

Examples:

- For two identical squares: $\text{Length} = 2 \times \text{breadth}$
- For three identical squares: $\text{Length} = 3 \times \text{breadth}$

16. **Equidistant point relation**

If point P is equally distant from points A and B:

$$PA = PB$$

Such a point can be located by drawing equal-radius arcs centred at A and B.

17. **Required compass radius**

To locate a point at a given distance x from another point:

$$\text{Compass radius} = x$$

18. **Diagonal using the Pythagorean relation**

For a rectangle with length l, breadth b, and diagonal d:

$$d^2 = l^2 + b^2$$

Therefore:

$$d = \sqrt{l^2 + b^2}$$

If one side and the diagonal are known:

$$l = \sqrt{d^2 - b^2}$$

or

$$b = \sqrt{d^2 - l^2}$$

Note: The Pythagorean relation is useful for checking construction measurements, although it is not directly developed in this chapter.

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

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

1. A __________ is used to draw circles and arcs accurately.
   Answer: Compass
2. A __________ is used to draw and measure straight line segments.
   Answer: Ruler
3. All the points on a circle are at the same distance from its __________.
   Answer: Centre
4. The distance between the centre and any point on a circle is called its __________.
   Answer: Radius
5. The fixed point of a circle is known as its __________.
   Answer: Centre
6. A part of a circle is called an __________.
   Answer: Arc
7. Half of a circle is called a __________.
   Answer: Semicircle
8. A rectangle has __________ sides.
   Answer: Four
9. The opposite sides of a rectangle are __________ in length.
   Answer: Equal
10. Every angle of a rectangle measures __________.
    Answer: 90°
11. A square has __________ equal sides.
    Answer: Four
12. Every angle of a square is a __________ angle.
    Answer: Right
13. The opposite sides of a rectangle lie __________ to each other.
    Answer: Opposite
14. The corners of a square or rectangle are called __________.
    Answer: Vertices
15. A line segment joining two opposite vertices of a rectangle is called a __________.
    Answer: Diagonal
16. A rectangle has __________ diagonals.
    Answer: Two
17. The diagonals of a rectangle are __________ in length.
    Answer: Equal
18. The diagonals of a rectangle __________ each other.
    Answer: Bisect
19. The diagonals of a square intersect at __________ angles.
    Answer: Right
20. The diagonals of a square divide each other into __________ parts.
    Answer: Equal
21. A diagonal of a square divides a 90°angle into two angles of __________ each.
    Answer: 45°
22. Rotating a square does not change the lengths of its sides or its __________.
    Answer: Angles

23. A rotated rectangle is still a __________.
    Answer: Rectangle
24. A rough __________ helps us plan the construction of a geometrical figure.
    Answer: Diagram
25. To construct a square, adjacent sides must be drawn __________ to each other.
    Answer: Perpendicular
26. Perpendicular lines meet at an angle of __________.
    Answer: 90°
27. A rectangle can be constructed when the lengths of its two __________ are given.
    Answer: Sides
28. A rectangle can also be constructed when one side and a __________ are given.
    Answer: Diagonal
29. Equal-radius arcs drawn from two given points help locate a point __________ from them.
    Answer: Equidistant
30. If a point $P$is equidistant from points $A$and B, then $PA$is __________ to PB.
    Answer: Equal
31. In the "House" construction, the top point is located using intersecting __________.
    Answer: Arcs
32. To draw points exactly 4 cm away from a fixed point, the compass must be opened to __________.
    Answer: 4 cm
33. The central line used in the "Wavy Wave" construction is a line __________.
    Answer: Segment
34. Supporting curves used in a construction may not form part of the __________ figure.
    Answer: Final
35. A four-sided figure with all sides equal but without four right angles is not necessarily a __________.
    Answer: Square

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

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

1. If every point on a curve is exactly 6 cm from point O, the curve is a __________ with centre O.
   Answer: Circle
2. To draw a circle of diameter 10 cm, the compass must be opened to a radius of __________.
   Answer: 5 cm
3. A semicircle drawn on a line segment of length 8 cm requires a compass radius of __________.
   Answer: 4 cm
4. If $P$is the centre of a circle and $PA = PB = 4$cm, then points $A$and Blie on the same __________.
   Answer: Circle
5. If a quadrilateral has four equal sides and four right angles, it must be a __________.
   Answer: Square
6. A quadrilateral with four right angles and opposite sides equal is a __________.
   Answer: Rectangle

7. A quadrilateral has four right angles, one side of 5 cm and its adjacent side of 8 cm. Its opposite sides measure __________ and __________ respectively.
   Answer: 5 cm; 8 cm
8. If three identical squares, each of side 4 cm, are arranged in one row, the resulting rectangle measures __________ by __________.
   Answer: 12 cm; 4 cm
9. A rectangle measuring 15 cm by 5 cm can be divided into __________ identical squares of side 5 cm.
   Answer: Three
10. A rectangle measuring 12 cm by 6 cm can be divided into __________ identical squares of side 6 cm.
    Answer: Two
11. If a square is tilted or rotated, it continues to be a square because its side lengths and __________ remain unchanged.
    Answer: Angles
12. If the diagonals of a rectangle intersect at O and $AC = 10$cm, then $AO =$__________.
    Answer: 5 cm
13. If one diagonal of a rectangle is 8 cm long, its other diagonal is __________ cm long.
    Answer: 8
14. If AC and BD are the diagonals of a rectangle and $AO = 4$cm, then $AC =$__________.
    Answer: 8 cm
15. The centre of a circle passing through all four vertices of a rectangle is located at the __________ of its diagonals.
    Answer: Intersection
16. A diagonal divides a corner of a rectangle into angles of $35°$ and __________.
    Answer: $55°$
17. If a diagonal divides a corner of a rectangle into two equal angles, each angle measures __________.
    Answer: $45°$
18. A rectangle whose diagonal divides its corner into two $45°$ angles is also a __________.
    Answer: Square
19. To construct a rectangle when one side and a diagonal are given, the endpoint of the adjacent side must lie on a perpendicular line and on an __________ drawn using the diagonal as radius.
    Answer: Arc
20. If point P is 7 cm from both A and B, then P lies at the intersection of two arcs of radius __________.
    Answer: 7 cm
21. When equal-radius arcs drawn from points A and B intersect at P, the relation between the distances is PA__________ PB.
    Answer: =
22. To locate the roof point of a house at a distance of 5 cm from both B and C, arcs of radius __________ must be drawn with B and C as centres.
    Answer: 5 cm
23. Two full circles are not always necessary for locating an equidistant point; drawing only the intersecting __________ is sufficient.
    Answer: Arcs

24. If two arcs of equal radius drawn from points $A$and Bdo not intersect, the chosen radius may be too __________ compared with the distance AB.
Answer: Small
25. In a square of side 6 cm, the compass can transfer the same length to construct all __________ sides accurately.
Answer: Four
26. If $PQRS$is a square and $PQ = 7$cm, then $QR + RS + SP =$__________.
Answer: 21 cm
27. If $ABCD$is a rectangle with $AB = 9$cm and $BC = 4$cm, then $CD + DA =$__________.
Answer: 13 cm
28. A quadrilateral with all sides equal but without right angles need not be a square; it can be a __________.
Answer: Rhombus
29. To draw two identical waves, the same compass opening or __________ must be maintained.
Answer: Radius
30. Temporary lines, circles or arcs drawn to help complete a construction are called __________ figures or curves.
Answer: Supporting

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

One-Mark Descriptive Questions with Answers — LOTS Type:

1. **What is a circle?**
A circle is a curve whose every point is at the same distance from a fixed point.
2. **What is the centre of a circle?**
The fixed point from which every point on a circle is equally distant is called its centre.
3. **What is the radius of a circle?**
The distance from the centre of a circle to any point on it is called its radius.
4. **Which instrument is used to draw a circle?**
A compass is used to draw a circle.
5. **How is the required radius set on a compass?**
The compass is opened against a ruler to the required measurement.
6. **What is an arc?**
An arc is a part of the circumference of a circle.
7. **What is a semicircle?**
A semicircle is half of a circle.
8. **Name the instruments mainly used in geometrical constructions.**
A ruler and a compass are mainly used in geometrical constructions.
9. **State one use of a rough diagram in construction.**
A rough diagram helps us plan the steps needed to construct a figure.
10. **How many sides does a rectangle have?**
A rectangle has four sides.
11. **State the relationship between the opposite sides of a rectangle.**
The opposite sides of a rectangle are equal in length.
12. **What is the measure of each angle of a rectangle?**
Each angle of a rectangle measures 90°.
13. **How many equal sides does a square have?**
A square has four equal sides.

14. **What is the measure of each angle of a square?**
    Each angle of a square measures 90°.
15. **What are the corners of a square or rectangle called?**
    The corners of a square or rectangle are called vertices.
16. **What are opposite sides of a rectangle?**
    Opposite sides are the two sides that lie opposite each other in a rectangle.
17. **Does rotating a square change it into another shape?**
    No, a rotated square remains a square because its sides and angles remain unchanged.
18. **What is a perpendicular line?**
    A perpendicular line meets another line at an angle of 90°.
19. **What is a diagonal of a rectangle?**
    A diagonal is a line segment joining two opposite vertices of a rectangle.
20. **How many diagonals does a rectangle have?**
    A rectangle has two diagonals.
21. **State one property of the diagonals of a rectangle.**
    The diagonals of a rectangle are equal in length.
22. **What does it mean when diagonals bisect each other?**
    It means that each diagonal divides the other into two equal parts.
23. **Where is the centre of a rectangle located?**
    The centre of a rectangle is located at the intersection of its diagonals.
24. **What happens when a diagonal is drawn in a rectangle?**
    A diagonal divides a rectangle into two triangles.
25. **How does a diagonal divide a corner of a square?**
    A diagonal divides a 90°corner of a square into two angles of 45°each.
26. **What information can be used to construct a rectangle?**
    A rectangle can be constructed using the lengths of its two sides.
27. **What other measurements can be used to construct a rectangle?**
    A rectangle can be constructed when the length of one side and a diagonal are given.
28. **What is an equidistant point?**
    An equidistant point is a point located at the same distance from two or more given points.
29. **How can a point equidistant from two given points be located?**
    It can be located by drawing equal-radius arcs from the two given points.
30. **Why are supporting curves drawn during geometrical constructions?**
    Supporting curves help locate the required points and complete the final figure.

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

One-Mark Descriptive Questions with Answers — HOTS Type:

1. **Why do all points on a circle remain equally distant from its centre?**
   All points are equally distant because the compass opening remains fixed while drawing the circle.
2. **What figure is formed when all points at a distance of 5 cm from point *P* are joined?**
   A circle of radius 5 cm with *P* as its centre is formed.
3. **Why is a compass more suitable than a ruler for locating several points 4 cm from a fixed point?**
   A compass maintains the fixed distance and marks all such points accurately.

4. **What compass radius is required to draw a semicircle on a line segment of length 8 cm?**
   A compass radius of 4 cm is required.
5. **How can you determine whether a tilted quadrilateral is a square?**
   Check whether all four sides are equal and all four angles measure $90°$.
6. **Why does a rotated rectangle remain a rectangle?**
   Rotation does not change the equality of its opposite sides or its right angles.
7. **Can a quadrilateral with four right angles have unequal opposite sides? Give a reason.**
   No, a quadrilateral with four right angles is a rectangle, whose opposite sides are equal.
8. **If one side of a square is 7 cm, what should the compass opening be to mark its adjacent side?**
   The compass should be opened to 7 cm.
9. **Why must adjacent sides be perpendicular while constructing a rectangle?**
   They must be perpendicular to produce the required $90°$corner angles.
10. **If three identical squares of side 4 cm are arranged in a row, what is the length of the resulting rectangle?**
    The resulting rectangle is $3 \times 4 = 12$cm long.
11. **Can a rectangle measuring 7 cm by 2 cm be divided into three identical squares of side 2 cm?**
    No, because three squares of side 2 cm require a rectangle measuring 6 cm by 2 cm.
12. **If the diagonals of a rectangle intersect at $O$and $AC = 12$cm, what is AO?**
    $AO = 6$cm because the diagonals bisect each other.
13. **If one diagonal of a rectangle measures 9 cm, what is the length of its other diagonal?**
    The other diagonal also measures 9 cm because the diagonals of a rectangle are equal.
14. **Where should the centre of a circle passing through all four corners of a rectangle be placed?**
    It should be placed at the intersection of the rectangle's diagonals.
15. **If a diagonal divides a corner of a rectangle into $35°$and another angle, what is the other angle?**
    The other angle is $55°$because the two angles together form $90°$.
16. **What special rectangle is formed when a diagonal divides its corner into two angles of $45°$?**
    A square is formed because its adjacent sides become equal.
17. **Why can a rectangle be constructed when one side and one diagonal are given?**
    The diagonal determines the position of the opposite vertex on a perpendicular line.
18. **How can point P, located 6 cm from both $A$and B, be found?**
    Draw arcs of radius 6 cm from $A$and B, and mark their intersection as P.
19. **Why is it unnecessary to draw two complete circles to locate an equidistant point?**
    Only the intersecting portions of the circles are needed to identify the required point.
20. **What happens if equal-radius arcs drawn from two points do not intersect?**
    The chosen radius is too small in relation to the distance between the two points.
21. **Why should the same compass opening be used to draw identical waves?**
    The same compass opening ensures that the arcs have equal radii and matching shapes.
22. **Can a quadrilateral with four equal sides always be called a square?**
    No, it is a square only when all four of its angles are $90°$.

23. **Why are temporary supporting curves useful in a geometrical construction?**
    They help locate exact points needed to complete the required figure.
24. **If $ABCD$ is a rectangle with $AB = 8$cm and $BC = 5$cm, what are the lengths of CD and DA?**
    $CD = 8$cm and $DA = 5$cm because opposite sides of a rectangle are equal.
25. **If $PQRS$ is a square and $PQ = 6$cm, what is $QR + RS + SP$?**
    $QR + RS + SP = 18$cm because each side of the square measures 6 cm.
26. **How can you check whether a construction is a rectangle after completing it?**
    Verify that its opposite sides are equal and all four angles are 90°.
27. **Why is a rough diagram helpful before constructing a complex figure such as a house?**
    It helps determine the correct sequence for drawing its lines and arcs.
28. **If an arc passes through points B and C with A as its centre, what can you conclude about AB and AC?**
    $AB = AC$ because both are radii of the same circle.
29. **How would increasing the compass radius affect a circle?**
    Increasing the compass radius produces a larger circle.
30. **Why is accurate measurement important when constructing a square?**
    Accurate measurement ensures that all sides are equal and all angles are right angles.

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

Two-Mark Descriptive Questions with Answers — LOTS Type:

1. What is a circle? Define its radius.

Answer:

1. A circle is a curve consisting of all points that are at the same distance from a fixed point called its centre.
2. The distance between the centre and any point on the circle is called its radius.

---

2. How can a circle of radius 4 cm be drawn using a compass?

Answer:

1. Open the compass to 4 cm using a ruler and place its pointed end at the selected centre P.
2. Keep the pointed end fixed and rotate the compass completely to draw the circle.

---

3. Mention two uses of a compass in geometrical constructions.

Answer:

1. A compass is used to draw circles, semicircles and arcs of a given radius.
2. It is also used to transfer equal lengths and locate points at a fixed distance.

---

4. State the two main properties of a rectangle.

Answer:

1. The opposite sides of a rectangle are equal in length.
2. All four angles of a rectangle measure 90°.

---

5. State the two main properties of a square.

Answer:

1. All four sides of a square are equal in length.
2. All four angles of a square measure 90°.

---

6. What are adjacent sides and opposite sides of a rectangle?
Answer:
1. Adjacent sides are two sides that meet at a common vertex.
2. Opposite sides lie across from each other and do not share a common vertex.

---

7. How should the vertices of a rectangle be named?
Answer:
1. The vertices must be named consecutively while moving around the rectangle.
2. For rectangle $ABCD$, names such as $ABCD$, $BCDA$ and $DCBA$ are valid.

---

8. Why does a rotated square remain a square?
Answer:
1. Rotation does not change the equal lengths of the square's four sides.
2. It also does not change its four $90°$ angles.

---

9. How can you verify whether a quadrilateral is a rectangle?
Answer:
1. Measure and confirm that both pairs of opposite sides are equal.
2. Check that each of its four angles measures $90°$.

---

10. How can you verify whether a quadrilateral is a square?
Answer:
1. Measure and confirm that all four sides are equal.
2. Check that all four interior angles measure $90°$.

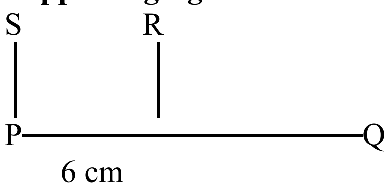
---

11. What is the role of perpendicular lines in constructing a square?
Answer:
1. Perpendicular lines form the $90°$ angles required at the corners of a square.
2. Equal lengths are marked on these lines to obtain the square's four equal sides.

---

12. Write the first two steps for constructing a square of side 6 cm.
Answer:
1. Draw a line segment $PQ = 6$cm using a ruler.
2. Draw perpendicular lines to PQ through points P and Q.

Supporting figure:



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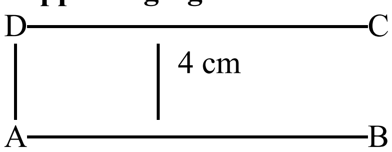
13. How can a rectangle of length 6 cm and breadth 4 cm be constructed?
Answer:
1. Draw $AB = 6$cm and construct perpendiculars at A and B, marking $AD = BC = 4$cm.
2. Join C and D to complete rectangle $ABCD$.

Supporting figure:



6 cm

14. What is a diagonal, and how many diagonals does a rectangle have?
Answer:
1. A diagonal is a line segment joining two opposite vertices of a polygon.
2. A rectangle has two diagonals joining its two pairs of opposite vertices.

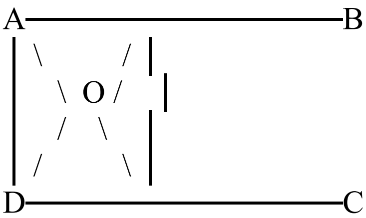
15. State two properties of the diagonals of a rectangle.
Answer:
1. The two diagonals of a rectangle are equal in length.
2. They bisect each other at their point of intersection.

16. State two additional properties of the diagonals of a square.
Answer:
1. The diagonals of a square intersect each other at right angles.
2. Each diagonal divides a pair of opposite corner angles into two equal angles.

17. What happens when a diagonal is drawn in a rectangle?
Answer:
1. A diagonal divides the rectangle into two triangles.
2. It also divides each of the two opposite 90°angles through which it passes into two smaller angles.

18. How can the centre of a rectangle be located?
Answer:
1. Draw both diagonals by joining the opposite vertices of the rectangle.
2. Their point of intersection is the centre of the rectangle.

Supporting figure:



19. What is meant by points equidistant from two given points?
Answer:
1. An equidistant point is located at the same distance from two given points.
2. If $P$is equidistant from $A$and B, then $PA = PB$.

20. How can a point equidistant from two given points be constructed?
Answer:
1. With the two given points as centres, draw arcs of the same radius so that they intersect.
2. The intersection of the arcs is equidistant from the two given points.

21. How is the top point of the roof located in the "House" construction?
Answer:
1. Draw equal-radius arcs with the two upper corners of the walls as centres.
2. The intersection of the arcs gives the top point of the roof.

22. Why is a rough diagram useful in geometrical construction?
Answer:
1. A rough diagram helps identify the different lines, arcs and shapes in the required figure.
2. It also helps decide the correct sequence of construction steps.

---

23. What are supporting curves in a geometrical construction?
Answer:
1. Supporting curves are temporary circles or arcs drawn to locate required points accurately.
2. They assist the construction but may not form part of the final figure.

---

24. How can three identical squares be used to form a rectangle?
Answer:
1. Place three identical squares side by side in a straight row.
2. The resulting rectangle has a length three times its breadth.

---

25. How can a rectangle be constructed when one side and one diagonal are given?
Answer:
1. Draw the given side and construct a perpendicular at one endpoint.
2. Draw an arc whose radius equals the diagonal to locate the opposite vertex on the perpendicular.

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

Two-Mark Descriptive Questions with Answers — HOTS Type:
1. Riya marks many points exactly 5 cm from point O. What figure will be formed when the points are joined? Explain.
Answer:
1. The joined points will form a circle with Oas its centre.
2. This is because every point on the circle is exactly 5 cm from O.

2. A circle has a diameter of 12 cm. How should the compass be set to draw it?
Answer:
1. The radius is half the diameter, so $12 \div 2 = 6$cm.
2. Therefore, the compass should be opened to 6 cm.

3. How would you construct a semicircle on a line segment of length 10 cm?
Answer:
1. Mark the midpoint of the 10 cm segment so that each half measures 5 cm.
2. Take the midpoint as centre and draw a semicircle with a compass radius of 5 cm.

4. A student draws a quadrilateral with four equal sides but does not check its angles. Can it be called a square? Justify.
Answer:
1. It cannot necessarily be called a square because its angles may not be right angles.
2. A square must have four equal sides and four angles of 90°.

5. A square appears like a diamond after being rotated. Is it still a square? Give reasons.
Answer:
1. Yes, it remains a square because rotation does not change the lengths of its sides.
2. Its four angles also remain equal to 90°.

6. A quadrilateral has four right angles and adjacent sides measuring 5 cm and 8 cm. Identify the figure and determine its other two sides.
Answer:

1. The figure is a rectangle because all its angles are 90°.
2. Its opposite sides are equal, so the remaining sides measure 5 cm and 8 cm.

7. Can a four-sided figure have four right angles but unequal opposite sides? Explain.
Answer:
1. No, a four-sided figure with four right angles is a rectangle.
2. The opposite sides of every rectangle are necessarily equal.

8. A student constructs a square of side 6 cm, but one corner measures 85°. Is the construction correct?
Answer:
1. No, the construction is incorrect because every angle of a square must measure 90°.
2. The student should reconstruct the sides using perpendicular lines.

9. A rectangle measures 12 cm by 4 cm. Can it be divided into three identical squares? Explain.
Answer:
1. Yes, three squares of side 4 cm will occupy a total length of $3 \times 4 = 12$cm.
2. Therefore, the 12 cm by 4 cm rectangle can be divided into three identical squares.

10. A rectangle measures 10 cm by 4 cm. Can it be divided into two identical squares of side 4 cm?
Answer:
1. No, two squares of side 4 cm require a rectangle measuring 8 cm by 4 cm.
2. The given rectangle has an extra length of 2 cm.

11. The diagonals of rectangle $ABCD$intersect at O, and $AC = 14$cm. Find $AO$and OC.
Answer:
1. The diagonals of a rectangle bisect each other at their intersection.
2. Therefore, $AO = OC = 14 \div 2 = 7$cm.

12. One diagonal of a rectangle is 9 cm. Find the length of the other diagonal and justify your answer.
Answer:
1. The other diagonal is also 9 cm long.
2. This is because the diagonals of a rectangle are equal in length.

13. Where should the compass point be placed to draw a circle through all four vertices of a rectangle?
Answer:
1. The compass point should be placed at the intersection of the rectangle's diagonals.
2. This point is equidistant from all four vertices of the rectangle.

14. A diagonal divides a corner of a rectangle into angles of $32^\circ$and x°. Find x.
Answer:
1. A corner of a rectangle measures 90°, so $32^\circ + x^\circ = 90^\circ$.
2. Therefore, $x = 90^\circ - 32^\circ = 58^\circ$.

15. A diagonal divides an angle of a rectangle into two equal angles. What special rectangle is formed?
Answer:
1. Each part of the 90°angle measures 45°.
2. The adjacent sides become equal, so the rectangle is a square.

16. How can you locate a point Pthat is exactly 6 cm from both $A$and B?
Answer:
1. Draw arcs of radius 6 cm with $A$and Bas centres.
2. The intersection of the arcs gives point P, for which $PA = PB = 6$cm.

17. Equal-radius arcs drawn from two points do not intersect. What could be the reason, and how can it be corrected?

Answer:

1. The chosen radius may be too small compared with the distance between the points.
2. Increase the compass opening sufficiently and draw the arcs again.

18. Why are complete circles unnecessary while locating the roof point in the "House" construction?

Answer:

1. Only the intersecting parts of the two circles are needed to locate the roof point.
2. Therefore, drawing two suitable arcs is sufficient and makes the construction clearer.

19. A point P lies at the intersection of arcs drawn from A and B using the same compass opening. What can you conclude?

Answer:

1. Point P is at the same distance from A and B.
2. Therefore, $PA = PB$.

20. Why must the compass opening remain unchanged while drawing two identical waves?

Answer:

1. An unchanged compass opening produces arcs with the same radius.
2. Equal radii help make the two waves identical in size and shape.

21. A student uses a ruler repeatedly to locate a point 5 cm from two fixed points. Suggest a more accurate method.

Answer:

1. Draw arcs of radius 5 cm from each of the two fixed points using a compass.
2. Their intersection locates the required point accurately without repeated trials.

22. How can you verify that a constructed quadrilateral is a square rather than only a rectangle?

Answer:

1. Check that all four angles are 90°, confirming that it is a rectangle.
2. Measure all four sides and verify that they are equal, confirming that it is a square.

23. If $ABCD$ is a rectangle with $AB = 9$cm and $BC = 5$cm, find $AB + BC + CD + DA$.

Answer:

1. Since opposite sides are equal, $CD = 9$cm and $DA = 5$cm.
2. Thus, the total length is $9 + 5 + 9 + 5 = 28$cm.

24. Can a circle be drawn through all four vertices of any rectangle? Explain.

Answer:

1. Yes, the intersection of the diagonals is equidistant from all four vertices.
2. A circle centred at this intersection and passing through one vertex passes through the other three vertices.

25. Why is a rough diagram helpful before constructing a complex figure?

Answer:

1. It helps separate the figure into simpler parts such as lines, circles and arcs.
2. It also helps determine the appropriate order and instruments for the construction.

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

Three-Mark Descriptive Questions with Answers — LOTS Type:

1. Explain how to draw a circle of radius 4 cm using a compass.

Answer:

1. Mark a point P to represent the centre of the circle.
2. Use a ruler to open the compass to exactly 4 cm.
3. Place its pointed end at P and rotate the compass to draw the circle.

2. Define the centre, radius and arc of a circle.

Answer:

1. The fixed point from which all points on a circle are equally distant is called its centre.
2. The distance from the centre to any point on the circle is called its radius.
3. A part of the circle's curved boundary is called an arc.

3. Explain how to draw a semicircle on a line segment of length 8 cm.

Answer:

1. Draw a line segment $AB = 8$cm and mark its midpoint O.
2. Open the compass to $OA = OB = 4$cm and place its pointed end at O.
3. Draw an arc from $A$to Bon one side of the line segment to form a semicircle.

4. State three properties of a rectangle.

Answer:

1. A rectangle has four sides and four vertices.
2. Its opposite sides are equal in length.
3. Each of its four interior angles measures $90°$.

5. State three properties of a square.

Answer:

1. A square has four equal sides.
2. Each of its four interior angles measures $90°$.
3. Its opposite sides are parallel to each other.

6. Explain how the vertices of a rectangle may be named correctly.

Answer:

1. The vertices must be written in their consecutive order around the rectangle.
2. The naming may begin from any one of its four vertices.
3. For rectangle $ABCD$, names such as $ABCD$, $BCDA$, $DCBA$and $DABC$are valid.

7. Explain why a rotated square remains a square.

Answer:

1. Rotation does not change the lengths of the square's sides.
2. All four sides continue to remain equal after rotation.
3. Its four angles also remain $90°$, so it remains a square.

8. Describe how to construct a square of side 6 cm.

Answer:

1. Draw $PQ = 6$cm and construct perpendicular lines at $P$and Q.
2. Mark $PS = 6$cm and $QR = 6$cm on the perpendiculars.
3. Join $S$and $R$to complete square $PQRS$.

9. Describe how to construct a rectangle of length 6 cm and breadth 4 cm.

Answer:

1. Draw $AB = 6$cm and construct perpendicular lines at $A$and B.
2. On the perpendiculars, mark $AD = 4$cm and $BC = 4$cm.
3. Join $C$and $D$to complete rectangle $ABCD$.

10. State three properties of the diagonals of a rectangle.

Answer:

1. A rectangle has two diagonals joining its opposite vertices.
2. The two diagonals are equal in length.
3. They bisect each other at their point of intersection.

11. State three important properties of the diagonals of a square.

Answer:

1. The diagonals of a square are equal in length.
2. They bisect each other at right angles.
3. Each diagonal bisects a pair of opposite corner angles.

12. Explain how to locate the centre of a rectangle.
Answer:
1. Join one pair of opposite vertices to draw the first diagonal.
2. Join the other pair of opposite vertices to draw the second diagonal.
3. The point at which the diagonals intersect is the centre of the rectangle.

13. Explain how a rectangle can be divided into three identical squares.
Answer:
1. Take the rectangle's length as three times its breadth.
2. Mark two division points on the longer side at intervals equal to the breadth.
3. Draw perpendicular lines through these points to obtain three identical squares.

14. Describe how to locate a point equidistant from two given points $A$and B.
Answer:
1. Select a suitable radius and draw an arc with Aas the centre.
2. Without changing the compass opening, draw another arc with Bas the centre.
3. The point where the two arcs intersect is equidistant from $A$and B.

15. Explain how the roof point is located in the "House" construction.
Answer:
1. Set the compass to the required roof-side length.
2. Draw arcs of the same radius from the two upper corners of the house.
3. Mark their intersection as the roof point and join it to both upper corners.

16. What is the importance of a rough diagram in geometrical construction?
Answer:
1. A rough diagram gives a general idea of the required figure.
2. It helps identify the lines, arcs, circles and measurements involved.
3. It assists in deciding the correct order of construction steps.

17. Explain the use of supporting curves in geometrical constructions.
Answer:
1. Supporting curves are temporary circles or arcs used during construction.
2. They help locate points accurately through their intersections.
3. They may be erased because they are not necessarily part of the final figure.

18. Explain how to check whether a constructed quadrilateral is a rectangle.
Answer:
1. Measure and verify that each angle of the quadrilateral is 90°.
2. Check that one pair of opposite sides is equal in length.
3. Verify that the other pair of opposite sides is also equal.

19. Explain how to check whether a constructed figure is a square.
Answer:
1. Measure all four sides and confirm that they are equal.
2. Measure all four interior angles and confirm that each is 90°.
3. The figure is a square if it satisfies both these conditions.

20. Describe three uses of a compass in this chapter.
Answer:
1. A compass is used to draw circles, semicircles and arcs.
2. It is used to transfer equal lengths without repeated ruler measurements.
3. It is used to locate points at equal or specified distances from given points.

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

Three-Mark Descriptive Questions with Answers — HOTS Type:

1. All the points marked by Aarav are exactly 6 cm from point O. What figure will they form when joined, and how can it be constructed?

Answer:

1. The points will form a circle because they are equally distant from the fixed point O.
2. Point Owill be the centre, and 6 cm will be the radius.
3. Open the compass to 6 cm, place its pointed end at O, and rotate it completely.

2. A semicircle must be drawn on a line segment of length 12 cm. Explain the construction.

Answer:

1. Draw $AB = 12$cm and mark its midpoint O, giving $AO = OB = 6$cm.
2. Set the compass radius to 6 cm and place its pointed end at O.
3. Draw an arc from $A$to Bon one side of the segment to obtain the semicircle.

3. A quadrilateral has four equal sides but one angle measures $70°$. Can it be a square? Justify.

Answer:

1. No, the quadrilateral cannot be a square because one of its angles is not $90°$.
2. Equal sides alone are insufficient to prove that a quadrilateral is a square.
3. A square must have four equal sides as well as four right angles.

4. A square looks like a diamond after being rotated. Explain how you would prove that it is still a square.

Answer:

1. Measure its four sides and verify that they are still equal.
2. Measure its four interior angles and confirm that each is still $90°$.
3. Since rotation changes only the position and not these properties, the figure remains a square.

5. A student constructs a quadrilateral with four right angles and adjacent sides of 7 cm and 5 cm. Identify the figure and determine the remaining side lengths.

Answer:

1. The quadrilateral is a rectangle because all its angles are $90°$.
2. The side opposite the 7 cm side is also 7 cm.
3. The side opposite the 5 cm side is also 5 cm.

6. A rectangle measuring 15 cm by 5 cm must be divided into identical squares. Determine the number and dimensions of the squares.

Answer:

1. Each square must have a side of 5 cm, equal to the breadth of the rectangle.
2. The number of squares is $15 \div 5 = 3$.
3. Therefore, the rectangle can be divided into three identical 5 cm $\times$ 5 cmsquares.

7. A rectangle measures 14 cm by 4 cm. Can it be divided completely into three identical squares of side 4 cm? Explain.

Answer:

1. Three squares of side 4 cm require a total length of $3 \times 4 = 12$cm.
2. The rectangle is 14 cm long, leaving a strip of $14 - 12 = 2$cm.
3. Therefore, it cannot be divided completely into three identical squares of side 4 cm.

8. The diagonals of rectangle $ABCD$intersect at O, and $AC = 16$cm. Find AO, $OC$and BD.

Answer:

1. Since the diagonals bisect each other, $AO = OC = 16 \div 2 = 8$cm.
2. The diagonals of a rectangle are equal, so $BD = AC$.
3. Therefore, $AO = 8$cm, $OC = 8$cm and $BD = 16$cm.

9. A diagonal divides a corner of a rectangle into angles of $38°$and $x°$. Find $x$and explain.

Answer:

1. Each corner of a rectangle measures $90°$.

2. Therefore, $38^\circ + x^\circ = 90^\circ$.
3. Hence, $x = 90^\circ - 38^\circ = 52^\circ$.

10. A diagonal divides a corner of a rectangle into two equal angles. What can you infer about the rectangle?

Answer:

1. Each of the two equal angles measures $90^\circ \div 2 = 45^\circ$.
2. This condition makes the adjacent sides of the rectangle equal.
3. Therefore, the rectangle is a square.

11. Explain how to construct a rectangle when one side is 4 cm and its diagonal is 8 cm.

Answer:

1. Draw $AB = 4$cm and construct a perpendicular line at B.
2. With Aas centre and radius 8 cm, draw an arc intersecting the perpendicular at C.
3. Draw a perpendicular to ABat $A$and complete rectangle $ABCD$through C.

12. A point Pmust be located exactly 7 cm from both $A$and B. Explain an accurate construction.

Answer:

1. With Aas centre and radius 7 cm, draw an arc.
2. Without changing the compass opening, draw another arc with Bas centre.
3. Their intersection gives point P, for which $PA = PB = 7$cm.

13. Equal-radius arcs drawn from points $A$and Bfail to intersect. Analyse the problem and suggest a correction.

Answer:

1. The selected radius is probably too small in comparison with the distance AB.
2. Increase the compass opening until the arcs can cross each other.
3. Redraw equal-radius arcs from $A$and $B$to locate their intersection.

14. How can you construct the roof point of a house when it must be 5 cm from each upper corner?

Answer:

1. Set the compass to a radius of 5 cm and draw an arc from the first upper corner.
2. Using the same radius, draw another arc from the second upper corner.
3. Their intersection is the roof point because it is 5 cm from both corners.

15. Why are full circles unnecessary when locating a point equidistant from two given points?

Answer:

1. The required point is obtained where the two equal-radius circles intersect.
2. Only the portions near the expected intersection are needed to locate that point.
3. Therefore, drawing two intersecting arcs is sufficient and keeps the construction clear.

16. A student wants to draw two identical waves but changes the compass opening for the second wave. Explain the result.

Answer:

1. Changing the compass opening changes the radius of the second arc.
2. The two waves will consequently differ in size or curvature.
3. The same compass opening must be maintained to obtain identical waves.

17. How can you locate the centre of a circle that passes through all four vertices of a rectangle?

Answer:

1. Draw both diagonals of the rectangle and mark their intersection as O.
2. The point $O$is equidistant from all four vertices because the diagonals are equal and bisect each other.

3. Therefore, a circle centred at O and passing through one vertex will pass through all four vertices.

18. A quadrilateral has all four sides equal but does not have right angles. Identify a possible figure and distinguish it from a square.

Answer:

1. The quadrilateral may be a rhombus because all its sides are equal.
2. It is not a square because its interior angles are not all 90°.
3. Thus, equal sides alone do not guarantee that a figure is a square.

19. A student constructs a square of side 6 cm, but the last side measures 6.5 cm. What error might have occurred, and how can it be corrected?

Answer:

1. The compass opening may have changed, or the perpendicular lines may have been drawn inaccurately.
2. The student should reset the compass to exactly 6 cm and verify the right angles.
3. The incorrect point should then be remarked before joining the final side.

20. Explain why a rough diagram is valuable when constructing a complex figure such as "A Person" or "Eyes."

Answer:

1. A rough diagram helps separate the complex figure into straight lines, circles and arcs.
2. It indicates suitable positions for the compass centres and the radii required.
3. It also helps arrange the construction steps in a logical order.

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

Five-Mark Descriptive Questions with Answers — LOTS Type:

1. Explain how to construct a square $PQRS$ of side 6 cm.

Answer:

1. Draw a line segment $PQ = 6$cm using a ruler.
2. Construct perpendicular lines to PQ at points P and Q.
3. Mark point S on the perpendicular at P such that $PS = 6$cm.
4. Mark point R on the perpendicular at Q such that $QR = 6$cm.
5. Join S and R to complete square $PQRS$, and verify that $SR = 6$cm.

---

2. Explain how to construct a rectangle $ABCD$ of length 6 cm and breadth 4 cm.

Answer:

1. Draw the line segment $AB = 6$cm.
2. Construct perpendicular lines to AB at points A and B.
3. Mark $AD = 4$cm on the perpendicular drawn at A.
4. Mark $BC = 4$cm on the perpendicular drawn at B.
5. Join C and D to complete rectangle $ABCD$, where $AB = CD$ and $AD = BC$.

---

3. Describe the main properties of a square.

Answer:

1. A square is a four-sided closed geometrical figure.
2. All four sides of a square are equal in length.
3. Each of its four interior angles measures 90°.
4. Its opposite sides are parallel to each other.
5. A square continues to remain a square even when it is rotated.

---

4. Describe the main properties of a rectangle.

Answer:

1. A rectangle is a quadrilateral with four sides and four vertices.
2. Its opposite sides are equal in length.
3. Its opposite sides are parallel to each other.
4. Each of its four interior angles measures $90°$.
5. Rotating a rectangle does not change its side lengths or angles, so it remains a rectangle.

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5. Explain how to construct a rectangle that can be divided into three identical squares.
Answer:

1. Choose the side of each square, for example 4 cm.
2. Draw a line segment of length $3 \times 4 = 12$cm as the rectangle's length.
3. Construct perpendiculars of 4 cm at both endpoints of the line segment.
4. Join their upper endpoints to complete a rectangle measuring 12 cm by 4 cm.
5. Draw perpendicular division lines at 4 cm and 8 cm to obtain three identical squares.

---

6. Explain how to locate a point equidistant from two given points A and B.
Answer:

1. Draw or mark the two given points A and B.
2. Select a compass radius large enough for the arcs to intersect.
3. With A as the centre, draw an arc on one side of AB.
4. Without changing the radius, draw another arc with B as the centre.
5. Mark the intersection as P; then $PA = PB$, so P is equidistant from A and B.

---

7. Explain how the upper part of the "House" figure is constructed when its roof sides are 5 cm each.
Answer:

1. First construct the rectangular part of the house and mark its upper corners as B and C.
2. Open the compass to a radius of 5 cm.
3. With B as the centre, draw an arc above the rectangular part.
4. With C as the centre and the same radius, draw another arc intersecting the first at A.
5. Join A to B and A to C, and use the required arc to complete the roof.

---

8. Explain the usefulness of a ruler, compass and rough diagram in geometrical constructions.
Answer:

1. A ruler is used to draw straight line segments and measure their lengths.
2. A compass is used to draw circles and arcs of a fixed radius.
3. A compass also helps transfer equal lengths from one part of a figure to another.
4. A rough diagram helps identify the simpler shapes and measurements in a complex figure.
5. Together, these tools help construct figures more accurately and in the correct sequence.

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9. Explain how to draw the "Wavy Wave" on a central line of 8 cm.
Answer:

1. Draw the central line segment $AB = 8$cm.
2. Mark its midpoint X, so that $AX = XB = 4$cm.
3. Mark the midpoint of AX and open the compass to a radius of 2 cm.
4. Draw the first semicircular wave on AX and the second semicircular wave on XB on the opposite side.

5. Keep the same compass radius so that both waves are equal and form the required wavy pattern.

10. Explain how circles and arcs are used to make geometrical artwork.
Answer:
1. A circle is drawn by keeping the compass point fixed and rotating its pencil end.
2. An arc is obtained by drawing only a required portion of a circle.
3. Semicircular arcs can be combined to create wave-like patterns.
4. Arcs drawn from carefully chosen centres can form symmetrical figures such as eyes.
5. Straight lines, circles and arcs can be combined to construct figures such as "A Person," "Wavy Wave" and "House."

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

Five-Mark Descriptive Questions with Answers — HOTS Type:
1. A student has marked several points exactly 5 cm from point O. Explain what figure these points form and how it can be constructed accurately.
Answer:
1. The marked points lie on a circle because they are all equally distant from O.
2. Point O is the centre, and 5 cm is the radius of the circle.
3. Open the compass to exactly 5 cm using a ruler.
4. Place the pointed end at O and rotate the compass while keeping its opening unchanged.
5. The resulting circle passes through all the points located 5 cm from O.

2. A quadrilateral has four equal sides but appears tilted. Explain how you would determine whether it is a square.
Answer:
1. Measure all four sides to confirm that they are equal.
2. Measure each of the four interior angles using an appropriate instrument.
3. If every angle measures $90°$, the quadrilateral is a square.
4. If its angles are not $90°$, it may be a rhombus rather than a square.
5. The tilted position does not affect the classification because rotation does not change lengths or angles.

3. A rectangle measuring 18 cm by 6 cm must be divided into identical squares. Analyse the dimensions and explain the division.
Answer:
1. The breadth of the rectangle is 6 cm, so each square can have a side of 6 cm.
2. Divide the rectangle's length by the side of a square: $18 \div 6 = 3$.
3. Mark points at 6 cm and 12 cm along each longer side of the rectangle.
4. Join the corresponding points with perpendicular line segments.
5. The rectangle is thereby divided into three identical squares, each measuring $6 \text{ cm} \times 6 \text{ cm}$.

4. A rectangle measures 14 cm by 4 cm. Determine whether it can be divided completely into three identical squares of side 4 cm.
Answer:
1. Three squares of side 4 cm require a total length of $3 \times 4 = 12$cm.
2. The given rectangle has a length of 14 cm.
3. After placing three squares, a strip of $14 - 12 = 2$cm remains.

4. The remaining strip does not form another square of side 4 cm.
5. Therefore, the rectangle cannot be divided completely into three identical squares of the stated size.

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5. Explain how to construct a rectangle when one side is 4 cm and its diagonal is 8 cm.
Answer:

1. Draw a line segment $AB = 4\text{cm}$ and construct a perpendicular ray at B.
2. With Aas centre and radius 8 cm, draw an arc cutting the perpendicular at C.
3. Construct a perpendicular to ABat A.
4. Through C, draw a line perpendicular to $BC$to meet the perpendicular at Aat D.
5. The figure $ABCD$is the required rectangle with side $AB = 4\text{cm}$ and diagonal $AC = 8\text{cm}$.

---

6. A rectangle's diagonal divides one of its corner angles into two equal parts. Analyse the figure and identify the special rectangle formed.
Answer:

1. Every corner angle of a rectangle measures $90°$.
2. When the diagonal divides it equally, each resulting angle measures $45°$.
3. The triangle formed by the diagonal then has two equal angles.
4. Hence, the two adjacent sides of the rectangle are equal in length.
5. Therefore, the rectangle satisfies the properties of a square.

---

7. Points $A$and $B$are 8 cm apart, and point Pmust be 5 cm from each of them. Explain how to locate P.
Answer:

1. Draw the line segment $AB = 8\text{cm}$.
2. Open the compass to a radius of 5 cm.
3. With Aas centre, draw an arc on one side of AB.
4. With Bas centre and the same radius, draw another arc intersecting the first at P.
5. The intersection is the required point because $PA = PB = 5\text{cm}$.

---

8. Equal-radius arcs drawn from two given points do not intersect. Analyse the possible error and suggest a correction.
Answer:

1. The selected compass radius may be too small compared with the distance between the given points.
2. Two equal-radius arcs can intersect only when their combined reach is sufficient to bridge that distance.
3. Check that the compass opening has not changed while drawing the second arc.
4. Increase the radius equally for both arcs if the original radius is insufficient.
5. Redraw the arcs carefully and mark their intersection as the required equidistant point.

---

9. Explain how to construct the roof of a house when each sloping roof side must measure 7 cm.
Answer:

1. Mark the upper corners of the house as $B$and C.
2. Open the compass to exactly 7 cm using a ruler.
3. With Bas centre, draw an arc above the house.
4. With Cas centre and the same radius, draw another arc intersecting the first at A.
5. Join $A$to $B$and $A$to $C$to form two roof sides of 7 cm each.

10. A student wants to draw two identical waves but changes the compass opening while drawing the second wave. Analyse the error and suggest a remedy.

Answer:

1. Changing the compass opening changes the radius and curvature of the second wave.
2. Therefore, the second wave will not be identical to the first one.
3. The student should first decide the common radius required for both waves.
4. The same compass opening must be maintained while drawing every corresponding arc.
5. The completed waves should be compared for equal width, height and curvature.

---

11. Explain how you can locate the centre of a circle passing through all four vertices of a rectangle.

Answer:

1. Draw both diagonals of the rectangle by joining its opposite vertices.
2. Mark their intersection as O.
3. The diagonals of a rectangle are equal and bisect each other.
4. Therefore, $O$is equally distant from all four vertices.
5. A circle centred at $O$and passing through one vertex will pass through the other three vertices.

---

12. A student draws a square of side 6 cm, but the final side measures 6.5 cm. Identify possible causes and explain how to correct the construction.

Answer:

1. The compass opening may have changed while equal sides were being marked.
2. One or both perpendicular lines may also have been drawn inaccurately.
3. The student should redraw the base of exactly 6 cm and construct accurate perpendiculars at its endpoints.
4. The remaining sides should be marked using an unchanged compass opening of 6 cm.
5. The completed figure must be checked for four equal sides and four $90°$angles.

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

Five-Mark Descriptive Questions with Answers — Applied Type:

1. A circular flower bed of radius 4 m is to be marked in a school garden. Explain how it can be marked accurately.

Answer:

1. Select and mark a point Oas the centre of the flower bed.
2. Take a rope of length 4 m and fix one end firmly at O.
3. Stretch the rope completely and attach a marking tool to its other end.
4. Move the marking end around Owhile keeping the rope stretched.
5. The completed boundary is a circle of radius 4 m because every point on it is 4 m from O.

---

2. A square display board of side 80 cm is required for a classroom. Explain how its outline can be constructed.

Answer:

1. Draw a base $AB = 80$cm using a ruler or measuring tape.
2. Construct perpendicular lines at $A$and B.
3. Mark $AD = 80$cm and $BC = 80$cm on the perpendiculars.

4. Join C and D to complete quadrilateral $ABCD$.
5. Verify that all four sides measure 80 cm and all four angles are 90°.

---

3. A rectangular notice board must measure 120 cm by 80 cm. Describe how its shape can be marked and verified.

Answer:

1. Draw or mark $AB = 120\text{cm}$ as the length of the notice board.
2. Construct perpendicular lines at A and B.
3. Measure $AD = 80\text{cm}$ and $BC = 80\text{cm}$ along these perpendiculars.
4. Join C and D to complete rectangle $ABCD$.
5. Verify that $AB = CD = 120\text{cm}$, $AD = BC = 80\text{cm}$ and all corners are right angles.

---

4. Three square paintings, each measuring 30 cm by 30 cm, are to be placed side by side inside one rectangular frame. Determine and construct the frame's inner boundary.

Answer:

1. The frame's breadth must equal the side of one painting, which is 30 cm.
2. Its length must be $3 \times 30 = 90\text{cm}$.
3. Draw a line segment $AB = 90\text{cm}$ and construct perpendiculars at its endpoints.
4. Mark $AD = BC = 30\text{cm}$ and join C and D to form the rectangular boundary.
5. Divide the 90 cm length at 30 cm and 60 cm to obtain spaces for the three paintings.

---

5. A triangular roof is to be fitted above a wall so that both sloping sides are 5 m long. Explain how the roof point can be located.

Answer:

1. Mark the two upper corners of the wall as B and C.
2. Set a compass or rope to a length of 5 m.
3. With B as centre, draw an arc above the wall.
4. With C as centre and the same radius, draw another arc intersecting the first at A.
5. Join A to B and A to C to obtain two roof sides of 5 m each.

---

6. A circular hole must be made exactly at the centre of a rectangular cardboard sheet. Explain how to locate the centre and draw the hole.

Answer:

1. Label the four corners of the cardboard as A, B, C and D.
2. Draw diagonal AC by joining two opposite corners.
3. Draw diagonal BD by joining the other pair of opposite corners.
4. Mark their intersection O, which is the centre of the rectangle.
5. Place the compass point at O, set the required radius and draw the circular hole.

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7. A designer wants to create a wave pattern along an 8 cm greeting-card border using two equal semicircular arcs. Explain the construction.

Answer:

1. Draw the border segment $AB = 8\text{cm}$ and mark its midpoint X, so $AX = XB = 4\text{cm}$.
2. Mark the midpoint of AX and draw a semicircle on AX with radius 2 cm.
3. Mark the midpoint of XB and keep the compass opening unchanged at 2 cm.
4. Draw the second semicircle on the opposite side of XB.
5. The two equal arcs form a balanced wave pattern along the border.

---

8. A rectangular gate has one side measuring 3 m, and its diagonal must be 5 m. Explain how its outline can be constructed.
Answer:
1. Draw $AB = 3$m to represent the given side of the gate.
2. Construct a perpendicular line at B.
3. With Aas centre and radius 5 m, draw an arc intersecting the perpendicular at C.
4. Draw a perpendicular to ABat $A$and a line through Cparallel to AB, meeting it at D.
5. The completed figure $ABCD$is the required rectangle with side $AB = 3$m and diagonal $AC = 5$m.

---

9. Two trees are marked as points $A$and B, and a lamp must be placed at an equal distance from both. Explain how a suitable position can be located.
Answer:
1. Choose a compass or rope radius large enough for arcs from the two trees to intersect.
2. With Aas centre, draw an arc in the region where the lamp may be placed.
3. Without changing the radius, draw another arc with Bas centre.
4. Mark an intersection of the two arcs as P.
5. Since $PA = PB$, point $P$is equally distant from both trees.

---

10. A carpenter constructs a four-sided tabletop with all sides measuring 60 cm. Explain how to verify whether it is a square.
Answer:
1. Measure all four sides and confirm that each is 60 cm.
2. Check each corner using a right-angle tool or set square.
3. Every corner must measure $90^\circ$for the tabletop to be a square.
4. Draw both diagonals and verify that they are equal and bisect each other.
5. If the sides are equal and all angles are right angles, the tabletop is a square; otherwise, it may only be a rhombus.

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

Olympiad-Type Multiple-Choice Questions:
1. All the points located exactly 7 cm from a fixed point Oform a:
A. Straight line
B. Circle
C. Rectangle
D. Square
Answer: B. Circle

---

2. Which instrument is most suitable for marking several points at the same distance from a fixed point?
A. Protractor
B. Set square
C. Compass
D. Measuring cylinder
Answer: C. Compass

---

3. A semicircle is drawn on a line segment of length 10 cm. What should be the compass radius?

A. 2.5 cm
B. 5 cm
C. 10 cm
D. 20 cm
Answer: B. 5 cm

---

4. Point $P$is the centre of a circle. If $PA = 6$cm and Blies on the same circle, then $PB$is:
A. 3 cm
B. 6 cm
C. 9 cm
D. 12 cm
Answer: B. 6 cm

---

5. Which set of properties is sufficient to identify a quadrilateral as a square?
A. Four equal sides only
B. Four right angles only
C. Four equal sides and four right angles
D. Equal diagonals only
Answer: C. Four equal sides and four right angles

---

6. Which quadrilateral has four right angles but does not necessarily have four equal sides?
A. Rhombus
B. Rectangle
C. Kite
D. Trapezium
Answer: B. Rectangle

---

7. A square is rotated through 45°. Which statement is correct?
A. It becomes a rhombus.
B. It becomes a rectangle but not a square.
C. It remains a square.
D. It becomes a kite.
Answer: C. It remains a square.

---

8. Which of the following is not a valid name for rectangle $ABCD$, whose vertices occur in that order?
A. $BCDA$
B. $DCBA$
C. $ADCB$
D. $ACBD$
Answer: D. $ACBD$

---

9. A rectangle has one side of 9 cm and its adjacent side of 4 cm. Which pair gives the lengths of its opposite sides?
A. 4 cm and 4 cm
B. 9 cm and 9 cm
C. 9 cm and 4 cm
D. 13 cm and 13 cm
Answer: C. 9 cm and 4 cm

10. A square has a side of 7 cm. The total length of any three of its sides is:
A. 14 cm
B. 21 cm
C. 28 cm
D. 49 cm
Answer: B. 21 cm

11. A rectangle can be divided into three identical squares of side 5 cm arranged in one row. Its dimensions are:
A. 10 cm × 5 cm
B. 15 cm × 5 cm
C. 15 cm × 10 cm
D. 20 cm × 5 cm
Answer: B. 15 cm × 5 cm

12. Which rectangle cannot be divided into three identical squares whose sides equal the rectangle's breadth?
A. 12 cm × 4 cm
B. 15 cm × 5 cm
C. 18 cm × 6 cm
D. 14 cm × 4 cm
Answer: D. 14 cm × 4 cm

13. Which step is essential while constructing a rectangle after drawing its first side?
A. Drawing a circle at each endpoint
B. Drawing perpendiculars at the endpoints
C. Bisecting the first side
D. Drawing two unequal arcs
Answer: B. Drawing perpendiculars at the endpoints

14. A student constructs a quadrilateral with four right angles. Which statement must be true?
A. All its sides are equal.
B. Its opposite sides are equal.
C. Its diagonals are perpendicular.
D. It has only one diagonal.
Answer: B. Its opposite sides are equal.

15. The diagonals of a rectangle $ABCD$intersect at O. If $AC = 14$cm, then AOequals:
A. 3.5 cm
B. 7 cm
C. 14 cm
D. 28 cm
Answer: B. 7 cm

16. One diagonal of a rectangle measures 12 cm. The length of its other diagonal is:
A. 6 cm
B. 10 cm

C. 12 cm
D. Cannot be determined
Answer: C. 12 cm

---

17. The diagonals of a rectangle divide each other into:
A. Four unequal parts
B. Two equal parts each
C. Three equal parts
D. Two perpendicular sides
Answer: B. Two equal parts each

---

18. Which property is always true for the diagonals of a square?
A. They are unequal.
B. They never intersect.
C. They bisect each other at right angles.
D. They are parallel.
Answer: C. They bisect each other at right angles.

---

19. A diagonal of a square divides a corner angle into:
A. 30° and 60°
B. 40° and 50°
C. 45° and 45°
D. 20° and 70°
Answer: C. 45° **and** 45°

---

20. A diagonal divides a corner of a rectangle into angles of 38° and x°. The value of x is:
A. 42°
B. 52°
C. 62°
D. 142°
Answer: B. 52°

---

21. If a diagonal divides a corner of a rectangle into two equal angles, the rectangle is a:
A. Kite
B. Trapezium
C. Square
D. General parallelogram
Answer: C. Square

---

22. A point P is obtained by intersecting two arcs of radius 6 cm drawn from A and B. Which relation is correct?
A. $PA + PB = 6$cm
B. $PA = PB = 6$cm
C. $PA = 3$cm and $PB = 6$cm
D. $PA > PB$
Answer: B. $PA = PB = 6$**cm**

---

23. Points A and B are 12 cm apart. Equal arcs of radius 5 cm are drawn from them. What will happen?

A. The arcs intersect at one point.
B. The arcs intersect at two points.
C. The arcs do not intersect.
D. The arcs form a square.
Answer: C. The arcs do not intersect.

---

24. Points $A$and $B$are 10 cm apart. Equal arcs of radius 5 cm are drawn from them. The arcs meet at:
A. No point
B. Exactly one point
C. Exactly two points
D. Four points
Answer: B. Exactly one point

---

25. Points $A$and $B$are 8 cm apart. Which compass radius will allow arcs drawn from them to intersect at two points?
A. 2 cm
B. 3 cm
C. 4 cm
D. 5 cm
Answer: D. 5 cm

---

26. Two equal-radius arcs intersect at P. If $PA = 7$cm, what is PB?
A. 3.5 cm
B. 7 cm
C. 14 cm
D. It cannot be determined
Answer: B. 7 cm

---

27. Why are only arcs, rather than complete circles, often drawn during construction?
A. Arcs have no centre.
B. Arcs are always larger than circles.
C. Only the intersecting portions are required to locate a point.
D. Complete circles cannot intersect.
Answer: C. Only the intersecting portions are required to locate a point.

---

28. Which condition is necessary for drawing two identical semicircular waves?
A. Different compass radii must be used.
B. The compass opening must remain the same.
C. One wave must be drawn freehand.
D. Their central lines must have different lengths.
Answer: B. The compass opening must remain the same.

---

29. The best way to locate the centre of a rectangle is to draw its:
A. Four sides again
B. Two diagonals
C. Two adjacent sides
D. Perpendicular bisector of only one side
Answer: B. Two diagonals

---

30. A circle must pass through all four vertices of a rectangle. Its centre should be placed at:
A. Any one vertex
B. The midpoint of one side
C. The intersection of the diagonals
D. A point outside the rectangle
Answer: C. The intersection of the diagonals

---

31. A four-sided figure has all sides equal, but its angles are not 90°. It is most likely a:
A. Rectangle
B. Rhombus
C. Trapezium
D. Circle
Answer: B. Rhombus

---

32. Which statement about supporting curves is correct?
A. They must always appear in the final figure.
B. They are used only for decoration.
C. They help locate points during construction.
D. They can be drawn only with a ruler.
Answer: C. They help locate points during construction.

---

33. A student draws a square of side 6 cm, but its fourth side is 6.5 cm. The most likely reason is:
A. The square was rotated.
B. The compass opening or perpendicular construction was inaccurate.
C. The ruler was used to draw straight lines.
D. All the angles were right angles.
Answer: B. The compass opening or perpendicular construction was inaccurate.

---

34. Which information is sufficient to construct a unique rectangle?
A. Only one side
B. Only one angle
C. Two adjacent side lengths
D. Only the number of vertices
Answer: C. Two adjacent side lengths

---

35. Which pair of measurements can also be used to construct a rectangle?
A. One side and one diagonal
B. One angle and one vertex
C. One side only
D. One diagonal only
Answer: A. One side and one diagonal

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

Best Practices for Teaching Chapter 8: Playing with Constructions:

(1) Begin with freehand drawing:

Ask students to draw simple figures such as circles, waves, eyes, squares and rectangles freehand before using instruments, enabling them to compare approximate drawings with accurate constructions.

(2) **Demonstrate the correct use of instruments:**
Show students how to hold a ruler, adjust a compass, keep the compass point fixed and draw smooth arcs without changing the radius.

(3) **Follow the "Plan–Construct–Verify" method:**
Encourage students to first draw a rough diagram, then perform the construction and finally verify the lengths, angles and symmetry of the completed figure.

(4) **Use clear, numbered construction steps:**
Present every construction in a logical sequence and ask students to write one action per step using correct geometrical terminology.

(5) **Connect constructions with artwork:**
Use chapter activities such as "A Person," "Wavy Wave," "Eyes" and "House" to show how straight lines, circles and arcs can create attractive designs.

(6) **Emphasise properties before procedures:**
Review the properties of squares and rectangles before teaching their construction so that students understand why perpendicular lines and equal lengths are required.

(7) **Teach through teacher modelling and guided practice:**
Demonstrate each construction slowly on the board, complete another example with the class and then allow students to attempt one independently.

(8) **Encourage estimation before construction:**
Ask students to predict the compass centre, radius or position of the required point before drawing, thereby developing spatial reasoning.

(9) **Use dot-grid and graph paper activities:**
Let students draw rotated squares and rectangles on dot grids and verify their properties even when the figures appear tilted.

(10) **Maintain instrument accuracy:**
Remind students to use a sharp pencil, draw light supporting lines, read measurements at eye level and avoid changing the compass opening accidentally.

(11) **Promote peer checking:**
Pair students so that they can verify one another's side lengths, right angles, equal arcs and sequence of construction.

(12) **Encourage mathematical discussion:**
Ask students to explain why a construction works, such as why intersecting equal-radius arcs locate a point equidistant from two given points.

(13) **Use error-analysis activities:**
Display an incorrect square, rectangle or arc construction and ask students to identify whether the error arose from measurement, perpendicularity or compass setting.

(14) **Connect learning with real-life applications:**
Relate the constructions to floor plans, picture frames, notice boards, garden layouts, circular designs, roof structures and decorative patterns.

(15) **Assess both process and final product:**
Evaluate students on correct steps, safe instrument use, accuracy, neatness, labelling and verification instead of judging only the completed figure.

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

Innovations in Teaching–Learning:

(1) **Geometry Art Gallery:**

Students can create flowers, faces, waves, houses and rangoli designs using only a ruler and compass, followed by a classroom exhibition.

(2) Human Compass Playground Activity:
One student stands at the centre while another moves around using a fixed-length rope, helping the class physically understand the centre, radius and circle.

(3) GeoGebra Construction Laboratory:
Students can digitally construct and rotate squares and rectangles, change their dimensions and observe that rotation does not alter their geometrical properties.

(4) Mystery Figure Challenge:
Give students measurements and construction clues without naming the figure; they construct it and decide whether it is a square, rectangle, rhombus or another shape.

(5) Geometry Error Detectives:
Present inaccurate constructions containing unequal sides, incorrect radii or non-perpendicular lines and ask students to identify and correct the errors.

(6) Construction Relay Game:
Team members complete successive steps of a construction—drawing the base, making perpendiculars, marking equal lengths and joining points—while maintaining accuracy.

(7) Real-Life Design Project:
Students can design a miniature playground, park or classroom containing rectangular areas, square zones, circular gardens and curved decorative paths.

(8) Interactive Challenge Cards:
Prepare cards such as “Construct a rectangle using one side and a diagonal,” “Locate a point equidistant from two points” and “Create identical waves.”

(9) Stop-Motion Construction Video:
Students can photograph every stage of a geometrical construction and combine the images into a short animation explaining the process.

(10) Low-Cost Geometry Makerspace:
Use cardboard, sticks, strings, pins and paper fasteners to build models of squares, rectangles, circles and arcs and explore how they are formed.

(11) Compass Design Coding:
Using beginner-friendly block coding tools, students can program a digital character to draw circles, squares, rectangles and repeated geometric patterns.

(12) Peer QR Learning Stations:
Place QR codes around the classroom linking to construction hints, short demonstrations and self-check questions that students access while completing tasks.

(13) Symmetry and Mirror Laboratory:
Students can use small mirrors to examine symmetry in constructed eyes, waves, squares and artwork and then refine their designs.

(14) Geometry Escape-Room Activity:
Learners solve construction challenges and missing-angle problems to obtain clues that unlock the next classroom task.

(15) Digital Construction Portfolio:
Students can maintain a portfolio containing photographs of their constructions, measurements, steps followed, mistakes corrected and short reflections.

8.17: Practicing Questions/Question Bank:

A. Fill in the Blanks:

1. The fixed point of a circle is called its __________.
   Answer: Centre

2. The distance from the centre to any point on a circle is called the __________.
   Answer: Radius
3. A __________ is used to draw circles and arcs accurately.
   Answer: Compass
4. The opposite sides of a rectangle are __________ in length.
   Answer: Equal
5. Every angle of a rectangle measures __________.
   Answer: 90°
6. All four sides of a __________ are equal.
   Answer: Square
7. A line segment joining two opposite vertices is called a __________.
   Answer: Diagonal
8. A rotated square continues to remain a __________.
   Answer: Square
9. Lines meeting at an angle of 90°are called __________ lines.
   Answer: Perpendicular
10. Equal-radius arcs can be used to locate a point __________ from two given points.
    Answer: Equidistant
11. A part of the circumference of a circle is called an __________.
    Answer: Arc
12. The diagonals of a rectangle __________ each other.
    Answer: Bisect

B. One-Mark Descriptive Questions:

1. What is the radius of a circle?

Answer: The distance between the centre and any point on a circle is called its radius.

2. Which instrument is used to draw a circle?

Answer: A compass is used to draw a circle.

3. What is an arc?

Answer: An arc is a part of the circumference of a circle.

4. State one property of a rectangle.

Answer: The opposite sides of a rectangle are equal in length.

5. State one property of a square.

Answer: All four sides of a square are equal in length.

6. What is a diagonal?

Answer: A diagonal is a line segment joining two opposite vertices of a figure.

7. What is an equidistant point?

Answer: An equidistant point is located at the same distance from two given points.

8. Why does a rotated square remain a square?

Answer: Rotation does not change the equal sides or right angles of a square.

C. Two-Mark Descriptive Questions:

1. State two properties of a rectangle.

Answer:

1. The opposite sides of a rectangle are equal in length.
2. All four angles of a rectangle measure 90°.

2. State two properties of a square.

Answer:

1. All four sides of a square are equal.
2. All four angles of a square measure 90°.

3. How can a circle of radius 4 cm be drawn?

Answer:

1. Open the compass to 4 cm and place its pointed end at the selected centre.
2. Keep the pointed end fixed and rotate the compass to draw the circle.

4. How can a point equidistant from points A and B be located?

Answer:

1. Draw equal-radius arcs with A and B as centres.
2. Their intersection gives a point equidistant from A and B.

5. Why is a rough diagram useful in geometrical construction?

Answer:

1. It helps identify the lines, arcs and measurements required.
2. It helps determine the correct sequence of construction steps.

6. How can you verify that a quadrilateral is a square?

Answer:

1. Check that all four sides are equal.
2. Confirm that all four angles measure 90°.

D. Three-Mark Descriptive Questions:

1. Explain how to construct a square of side 5 cm.

Answer:

1. Draw $AB = 5$cm and construct perpendiculars at $A$and B.
2. Mark $AD = 5$cm and $BC = 5$cm on the perpendiculars.
3. Join $C$and $D$to complete square $ABCD$.

2. Explain how to construct a rectangle of length 7 cm and breadth 4 cm.

Answer:

1. Draw $PQ = 7$cm and construct perpendiculars at $P$and Q.
2. Mark $PS = 4$cm and $QR = 4$cm on the perpendiculars.
3. Join $R$and $S$to complete rectangle $PQRS$.

3. Explain why a rotated rectangle remains a rectangle.

Answer:

1. Rotation does not change the lengths of its sides.
2. Its opposite sides continue to remain equal.
3. Its four angles also remain $90°$.

4. Describe how to locate the centre of a rectangle.

Answer:

1. Join one pair of opposite vertices to draw the first diagonal.
2. Join the other pair to draw the second diagonal.
3. Their point of intersection is the centre of the rectangle.

5. A diagonal divides a corner of a rectangle into $35°$and $x°$. Find x.

Answer:

1. A corner of a rectangle measures $90°$.
2. Therefore, $35° + x = 90°$.
3. Hence, $x = 55°$.

6. Explain how to construct the roof point of a house at a distance of 6 cm from both upper corners.

Answer:

1. Open the compass to a radius of 6 cm.
2. Draw equal-radius arcs from the two upper corners.
3. Their intersection gives the required roof point.

E. Five-Mark Descriptive Questions:

1. Explain how to construct a rectangle when one side is 4 cm and its diagonal is 7 cm.

Answer:

1. Draw the given side $AB = 4$cm.
2. Construct a perpendicular line to AB at B.
3. With A as centre and radius 7 cm, draw an arc cutting the perpendicular at C.
4. Draw a perpendicular at A and a line through C parallel to AB, meeting it at D.
5. The quadrilateral $ABCD$ is the required rectangle with diagonal $AC = 7$cm.

2. Explain how to construct a rectangular strip containing three identical squares of side 4 cm.

Answer:

1. Calculate the length of the rectangle as $3 \times 4 = 12$cm.
2. Draw a line segment $AB = 12$cm.
3. Construct perpendiculars of 4 cm at A and B and complete the rectangle.
4. Mark points at 4 cm and 8 cm along each longer side.
5. Join the corresponding points to obtain three identical squares.

3. Explain how to locate a point P that is 5 cm from each of two given points A and B.

Answer:

1. Draw or mark the two given points A and B.
2. Open the compass to exactly 5 cm.
3. With A as centre, draw an arc.
4. With B as centre and the same radius, draw another intersecting arc.
5. Mark the intersection as P; therefore, $PA = PB = 5$cm.

4. Describe how geometrical artwork can be produced using a ruler and compass.

Answer:

1. Begin with a rough diagram of the required artwork.
2. Divide it into simple components such as lines, circles and arcs.
3. Use a ruler to draw straight line segments accurately.
4. Use a compass with suitable centres and radii to draw the curved portions.
5. Combine the components neatly to create designs such as waves, eyes, a person or a house.

5. A square appears tilted like a diamond. Explain how to verify that it is still a square.

Answer:

1. Measure all four sides of the tilted figure.

2. Confirm that the four side lengths are equal.
3. Measure each of its four interior angles.
4. Confirm that every angle measures 90°.
5. Since rotation does not change lengths or angles, the tilted figure remains a square.

6. Explain how to check and correct an inaccurate square construction.

Answer:

1. Measure all four sides and identify any unequal side.
2. Check whether each corner is a right angle.
3. Reset the compass to the required side length.
4. Redraw inaccurate sides using correctly constructed perpendicular lines.
5. Verify again that all sides are equal and all angles measure 90°.

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6th Standard Maths Book Chapter 9

Chapter 9: SYMMETRY

9.1 Summary of the Chapter:

Chapter 9: Symmetry — Summary:

(1) **Symmetry** occurs when parts of a figure repeat in a definite and balanced pattern.
(2) A figure is called **symmetrical** if it can be divided or transformed so that its parts match exactly.
(3) A **line of symmetry** divides a figure into two identical mirror halves that overlap completely when folded along the line.
(4) A figure may have **no line of symmetry, one line of symmetry, or several lines of symmetry**.
(5) A square has **four lines of symmetry**—one horizontal, one vertical and two diagonal lines—whereas a non-square rectangle has only two.
(6) **Reflection symmetry** means that one half of a figure is the mirror image of the other half across its line of symmetry.
(7) Symmetrical designs can be created through activities such as **paper folding, paper cutting, inkblot printing and hole punching**.
(8) A figure has **rotational symmetry** when it matches its original position after being rotated through an angle smaller than 360°.
(9) The fixed point around which a figure is rotated is called the **centre of rotation**, and the matching angle is called an **angle of symmetry**.
(10) The **order of rotational symmetry** tells us how many times a figure matches itself during one complete rotation of 360°.
(11) The smallest angle of rotational symmetry can be calculated using

$$\text{Smallest angle of symmetry} = \frac{360^\circ}{\text{Order of rotational symmetry}}$$

(12) Some figures have only reflection symmetry, some have only rotational symmetry, and some—such as squares, regular polygons and circles—have **both types of symmetry**. A circle has infinitely many lines and angles of symmetry.

9.2 Important Formulas:

Chapter 9: Symmetry — Important Formulas:

1. Smallest Angle of Rotational Symmetry

$$\boxed{\text{Smallest angle of symmetry} = \frac{360^\circ}{\text{Order of rotational symmetry}}}$$

Example: If the order is 6:

$$\frac{360^\circ}{6} = 60^\circ$$

---

2. Order of Rotational Symmetry

$$\boxed{\text{Order of rotational symmetry} = \frac{360^\circ}{\text{Smallest angle of symmetry}}}$$

Example: If the smallest angle is 45°:

$$\frac{360^\circ}{45^\circ} = 8$$

---

3. Angles of Rotational Symmetry

If the smallest angle of symmetry is θ, the other angles are its multiples:

$$\boxed{\theta, 2\theta, 3\theta, \dots, 360^\circ}$$

Example: If $\theta = 60^\circ$, the angles of symmetry are:

$$60^\circ, 120^\circ, 180^\circ, 240^\circ, 300^\circ, 360^\circ$$

---

4. Number of Angles of Symmetry

$$\boxed{\text{Number of angles of symmetry} = \frac{360^\circ}{\theta}}$$

where $\theta$is the smallest angle of symmetry.

---

5. Smallest Angle for Equally Spaced Radial Arms

If a figure has $n$equally spaced radial arms:

$$\boxed{\text{Angle between adjacent arms} = \frac{360^\circ}{n}}$$

Example: For 5 radial arms:

$$\frac{360^\circ}{5} = 72^\circ$$

---

6. Rotational Angles for nIdentical Parts

For a figure containing $n$identical and equally spaced parts:

$$\boxed{\text{Angles of symmetry} = k\left(\frac{360^\circ}{n}\right)}$$

where:

$$k = 1,2,3, \dots, n$$

---

7. Symmetry of a Regular Polygon

For a regular polygon with $n$sides:

$$\boxed{\text{Number of lines of symmetry} = n}$$

$$\boxed{\text{Order of rotational symmetry} = n}$$

$$\boxed{\text{Smallest angle of rotational symmetry} = \frac{360^\circ}{n}}$$

Example: For a regular hexagon, $n = 6$:

- Lines of symmetry $= 6$
- Order of rotational symmetry $= 6$
- Smallest angle $= 360^\circ \div 6 = 60^\circ$

---

8. Complete Rotation

$$\boxed{\text{One complete rotation} = 360^\circ}$$

Every figure returns to its original position after a rotation of 360°.

---

9. Half, Quarter and Three-Quarter Rotations

$$\boxed{\text{Half rotation} = 180^\circ}$$

$$\boxed{\text{Quarter rotation} = 90^\circ}$$

$$\boxed{\text{Three-quarter rotation} = 270^\circ}$$

---

10. Condition for a Possible Smallest Angle

A given whole-number angle θ can be the smallest angle of rotational symmetry only when:

$$\boxed{360^\circ \div \theta \text{ is a whole number}}$$

Thus, θ must be a factor of 360°.

Examples:

- 45° is possible because $360^\circ \div 45^\circ = 8$.
- 17° is not possible because $360^\circ \div 17^\circ$ is not a whole number.

Important Note

A **circle** has infinitely many lines of symmetry, and every angle of rotation is an angle of symmetry.

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

Fill in the Blanks – LOTS Type:

1. A figure made up of parts that repeat in a definite pattern is called a __________ figure.
   Answer: symmetrical
2. A line that divides a figure into two identical mirror halves is called a __________.
   Answer: line of symmetry
3. The line of symmetry is also known as the __________ of symmetry.
   Answer: axis
4. When a symmetrical figure is folded along its line of symmetry, its two halves __________ completely.
   Answer: overlap
5. The two identical parts formed by a line of symmetry are called __________ halves.
   Answer: mirror
6. A figure having a line of symmetry is said to possess __________ symmetry.
   Answer: reflection
7. A square has __________ lines of symmetry.
   Answer: four
8. A non-square rectangle has __________ lines of symmetry.
   Answer: two
9. An equilateral triangle has __________ lines of symmetry.
   Answer: three
10. A regular hexagon has __________ lines of symmetry.
    Answer: six
11. A circle has __________ many lines of symmetry.
    Answer: infinitely
12. Every __________ of a circle is a line of symmetry.
    Answer: diameter
13. A figure that has no line of symmetry is called an __________ figure.
    Answer: asymmetrical
14. A figure has rotational symmetry when it coincides with itself after being __________ about a fixed point.
    Answer: rotated
15. The fixed point around which a figure is rotated is called the __________ of rotation.
    Answer: centre
16. An angle through which a figure matches its original position is called an angle of __________.
    Answer: symmetry
17. A figure must match itself at least once during a complete rotation of __________.
    Answer: 360°

18. A figure has rotational symmetry if it matches itself at an angle strictly between 0°and __________.
    Answer: 360°
19. The number of times a figure matches itself during a complete rotation is called the __________ of rotational symmetry.
    Answer: order
20. The smallest angle of rotational symmetry is calculated by dividing 360°by the __________ of rotational symmetry.
    Answer: order
21. A square has rotational symmetry of order __________.
    Answer: four
22. The smallest angle of rotational symmetry of a square is __________.
    Answer: 90°
23. A half-turn is equal to __________.
    Answer: 180°
24. A quarter-turn is equal to __________.
    Answer: 90°
25. A three-quarter turn is equal to __________.
    Answer: 270°
26. If the smallest angle of symmetry is 60°, the order of rotational symmetry is __________.
    Answer: six
27. A figure with five identical and equally spaced radial arms has a smallest angle of symmetry of __________.
    Answer: 72°
28. A regular polygon with $n$sides has __________ lines of symmetry.
    Answer: n
29. The order of rotational symmetry of a regular polygon with $n$sides is __________.
    Answer: n
30. An isosceles triangle has exactly __________ line of symmetry.
    Answer: one
31. A scalene triangle has __________ line of symmetry.
    Answer: no
32. A parallelogram has rotational symmetry of order __________.
    Answer: two
33. The smallest angle of rotational symmetry of a parallelogram is __________.
    Answer: 180°
34. Every angle of rotation is an angle of symmetry for a __________.
    Answer: circle
35. Symmetrical patterns can be created by paper folding, cutting and __________ punching.
    Answer: hole

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

Fill in the Blanks – HOTS Type:

1. A square is rotated through 90°about its centre. It will __________ with its original position.
   Answer: coincide

2. The smallest angle of rotational symmetry of a figure with an order of 8 is __________.
   Answer: 45°
3. If the smallest angle of rotational symmetry is 72°, the order of rotational symmetry is __________.
   Answer: 5
4. A regular polygon has seven lines of symmetry. Therefore, it has __________ sides.
   Answer: seven
5. A figure matches itself at 120°, 240°and 360°. Its order of rotational symmetry is __________.
   Answer: 3
6. A figure has a smallest angle of rotational symmetry of 30°. It matches itself __________ times during a complete rotation.
   Answer: 12
7. If a figure has rotational symmetry of order 10, the angle between two consecutive matching positions is __________.
   Answer: 36°
8. A regular hexagon is rotated through 120°. It will coincide with itself because 120°is a multiple of __________.
   Answer: 60°
9. A rectangle that is not a square has rotational symmetry of order __________ but has only two lines of symmetry.
   Answer: 2
10. The diagonals of a square are lines of symmetry, but the diagonals of a non-square rectangle are __________ lines of symmetry.
    Answer: not
11. If one half of a figure does not exactly cover the other half when folded along a line, that line is __________ a line of symmetry.
    Answer: not
12. A triangle has three equal sides and three equal angles. Therefore, it has __________ lines of symmetry.
    Answer: three
13. A triangle has exactly one line of symmetry. It is most likely an __________ triangle.
    Answer: isosceles
14. It is impossible for a triangle to have exactly __________ lines of symmetry.
    Answer: two
15. A parallelogram generally has rotational symmetry but __________ reflection symmetry.
    Answer: no
16. If 45°is the smallest angle of symmetry, the next three angles of symmetry are __________, __________ and __________.
    Answer: 90°, 135°and 180°
17. If 60°is an angle of symmetry and there are two angles of symmetry below it, the smallest angle of symmetry is __________.
    Answer: 20°
18. A figure cannot have 17°as its smallest whole-number angle of rotational symmetry because 17 is not a __________ of 360.
    Answer: factor

19. A design has 12 identical sectors arranged around its centre. Its smallest angle of rotational symmetry is __________.
    Answer: 30°
20. A figure with six equally spaced radial arms has consecutive arms separated by an angle of __________.
    Answer: 60°
21. When a square sheet is folded vertically and a single hole is punched, unfolding it produces __________ holes placed symmetrically.
    Answer: two
22. A paper is folded once vertically and once horizontally before one hole is punched away from the folds. When completely unfolded, it generally shows __________ holes.
    Answer: four
23. A point lying directly on a line of symmetry remains in the __________ position after reflection.
    Answer: same
24. In a reflection, corresponding points on opposite sides are at __________ distances from the line of symmetry.
    Answer: equal
25. If a regular polygon has a smallest rotational angle of 40°, it has __________ sides.
    Answer: nine
26. An Ashoka Chakra with 24 equally spaced spokes has a smallest rotational angle of __________.
    Answer: 15°
27. The outer boundary of a three-sided Parliament building design with three identical sections has rotational symmetry of order __________.
    Answer: three
28. A circle has infinitely many lines of symmetry because every __________ passing through its centre divides it into identical halves.
    Answer: diameter
29. A circle coincides with itself after rotation through any angle; therefore, it has __________ many angles of symmetry.
    Answer: infinitely
30. A figure has both horizontal and vertical lines of symmetry. Rotating it through 180°will necessarily make it __________ with itself.
    Answer: coincide

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

One-Mark Descriptive Questions with Answers – LOTS Type:

1. **What is symmetry?**
   Answer: Symmetry is the balanced repetition of parts of a figure in a definite pattern.
2. **What is a symmetrical figure?**
   Answer: A figure whose parts repeat or match in a definite pattern is called a symmetrical figure.
3. **What is a line of symmetry?**
   Answer: A line of symmetry divides a figure into two parts that overlap exactly when folded along it.
4. **What is another name for a line of symmetry?**
   Answer: A line of symmetry is also called an axis of symmetry.

5. **What are mirror halves?**
   Answer: Mirror halves are two identical parts of a figure that are reflections of each other.
6. **What is reflection symmetry?**
   Answer: Reflection symmetry occurs when one half of a figure is the mirror image of the other half.
7. **How many lines of symmetry does a square have?**
   Answer: A square has four lines of symmetry.
8. **How many lines of symmetry does a non-square rectangle have?**
   Answer: A non-square rectangle has two lines of symmetry.
9. **Is the diagonal of a non-square rectangle a line of symmetry?**
   Answer: No, the diagonal of a non-square rectangle is not a line of symmetry.
10. **How many lines of symmetry does an equilateral triangle have?**
    Answer: An equilateral triangle has three lines of symmetry.
11. **How many lines of symmetry does an isosceles triangle have?**
    Answer: An isosceles triangle has one line of symmetry.
12. **How many lines of symmetry does a scalene triangle have?**
    Answer: A scalene triangle has no line of symmetry.
13. **How many lines of symmetry does a regular hexagon have?**
    Answer: A regular hexagon has six lines of symmetry.
14. **What happens to a point lying on a line of symmetry after reflection?**
    Answer: A point lying on the line of symmetry remains in the same position after reflection.
15. **What is rotational symmetry?**
    Answer: Rotational symmetry occurs when a figure coincides with itself after rotation through an angle smaller than 360°.
16. **What is the centre of rotation?**
    Answer: The centre of rotation is the fixed point around which a figure is rotated.
17. **What is an angle of symmetry?**
    Answer: An angle of symmetry is an angle through which a figure can be rotated to match its original position.
18. **What is the order of rotational symmetry?**
    Answer: The order of rotational symmetry is the number of times a figure matches itself during one complete rotation.
19. **What is the measure of one complete rotation?**
    Answer: One complete rotation measures 360°.
20. **What is the measure of a half-turn?**
    Answer: A half-turn measures 180°.
21. **What is the measure of a quarter-turn?**
    Answer: A quarter-turn measures 90°.
22. **What is the measure of a three-quarter turn?**
    Answer: A three-quarter turn measures 270°.
23. **What is the order of rotational symmetry of a square?**
    Answer: The order of rotational symmetry of a square is four.
24. **What is the smallest angle of rotational symmetry of a square?**
    Answer: The smallest angle of rotational symmetry of a square is 90°.
25. **What is the order of rotational symmetry of a non-square rectangle?**
    Answer: The order of rotational symmetry of a non-square rectangle is two.
26. **What is the smallest angle of rotational symmetry of a regular hexagon?**
    Answer: The smallest angle of rotational symmetry of a regular hexagon is 60°.

27. **How is the smallest angle of rotational symmetry calculated?**
    Answer: It is calculated by dividing $360°$by the order of rotational symmetry.
28. **What is special about the reflection symmetry of a circle?**
    Answer: Every diameter of a circle is a line of reflection symmetry.
29. **How many angles of symmetry does a circle have?**
    Answer: A circle has infinitely many angles of symmetry.
30. **Name one activity used to create symmetrical patterns.**
    Answer: Paper folding and cutting can be used to create symmetrical patterns.

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

One-Mark Descriptive Questions with Answers – HOTS Type:

1. **A square is rotated through $90°$about its centre; will it coincide with its original position?**
   Answer: Yes, a square coincides with itself after a rotation of $90°$.
2. **A non-square rectangle is folded along a diagonal; will its two parts overlap completely?**
   Answer: No, the diagonal of a non-square rectangle does not divide it into identical mirror halves.
3. **A figure has rotational symmetry of order 8; what is its smallest angle of symmetry?**
   Answer: Its smallest angle of symmetry is $360° \div 8 = 45°$.
4. **A figure has $72°$as its smallest angle of symmetry; what is its rotational order?**
   Answer: Its rotational order is $360° \div 72° = 5$.
5. **Can $17°$be the smallest whole-number angle of rotational symmetry of a figure? Give a reason.**
   Answer: No, because $17°$does not divide $360°$exactly.
6. **A regular polygon has seven lines of symmetry; identify the polygon.**
   Answer: The figure is a regular heptagon because a regular n-sided polygon has $n$lines of symmetry.
7. **A figure matches itself at $120°$, $240°$and $360°$; what is its order of rotational symmetry?**
   Answer: Its order of rotational symmetry is 3 because it matches itself three times in one complete rotation.
8. **Can a triangle have exactly two lines of symmetry? Give a reason.**
   Answer: No, a triangle can have zero, one or three lines of symmetry but never exactly two.
9. **A triangle has three lines of symmetry; what type of triangle is it?**
   Answer: It is an equilateral triangle because all its sides and angles are equal.
10. **A triangle has only one line of symmetry; what type of triangle is it likely to be?**
    Answer: It is an isosceles triangle because its two equal sides form identical mirror halves.
11. **A figure has two perpendicular lines of symmetry; what rotation must make it coincide with itself?**
    Answer: A rotation of $180°$must make the figure coincide with itself.
12. **A parallelogram has no line of symmetry; can it still possess rotational symmetry?**
    Answer: Yes, a parallelogram coincides with itself after a rotation of $180°$.

13. **A design has 12 identical sectors around its centre; what is its smallest rotational angle?**
    Answer: Its smallest rotational angle is $360° \div 12 = 30°$.
14. **If the smallest angle of symmetry is $60°$, name the next two angles of symmetry.**
    Answer: The next two angles of symmetry are $120°$and $180°$.
15. **A figure has five equally spaced radial arms; what angle separates two adjacent arms?**
    Answer: The angle between two adjacent arms is $360° \div 5 = 72°$.
16. **Why does every figure match itself after a rotation of $360°$?**
    Answer: Every figure returns to its starting position after one complete rotation of $360°$.
17. **A square sheet is folded once vertically and punched once away from the fold; how many holes appear when it is opened?**
    Answer: Two symmetrically placed holes appear because the punch passes through two layers.
18. **A square sheet is folded once vertically and once horizontally before being punched; how many holes generally appear after unfolding?**
    Answer: Four symmetrically placed holes generally appear because the sheet has four layers.
19. **A point lies exactly on the line of symmetry; where will its reflected image lie?**
    Answer: Its reflected image will lie at the same point on the line of symmetry.
20. **Why is every diameter of a circle a line of symmetry?**
    Answer: Every diameter divides the circle into two identical semicircular mirror halves.
21. **Why does a circle have infinitely many angles of rotational symmetry?**
    Answer: A circle coincides with itself after rotation through any angle about its centre.
22. **An Ashoka Chakra has 24 equally spaced spokes; what is its smallest angle of rotational symmetry?**
    Answer: Its smallest angle of rotational symmetry is $360° \div 24 = 15°$.
23. **A regular hexagon is rotated through $120°$; will it match its original position?**
    Answer: Yes, because $120°$is a multiple of its smallest symmetry angle of $60°$.
24. **A figure has $45°$as its smallest angle of symmetry; how many times will it match itself in a complete rotation?**
    Answer: It will match itself $360° \div 45° = 8$times.
25. **A shape has rotational symmetry of order 2 but no reflection symmetry; name one possible shape.**
    Answer: A general parallelogram is a possible shape because it matches after $180°$but has no line of symmetry.
26. **Can a figure possess reflection symmetry without having rotational symmetry below $360°$? Give an example.**
    Answer: Yes, a non-equilateral isosceles triangle has one line of symmetry but no rotational symmetry below $360°$.
27. **Can a figure have rotational symmetry without reflection symmetry? Give an example.**
    Answer: Yes, a general parallelogram has rotational symmetry of order 2 but no reflection symmetry.
28. **If $60°$is an angle of symmetry and two smaller angles of symmetry exist, what could the smallest angle be?**
    Answer: The smallest angle is $20°$, giving the smaller angles $20°$and $40°$.

29. **A regular polygon has a smallest rotational angle of $40°$; how many sides does it have?**
    Answer: It has $360° \div 40° = 9$sides and is therefore a regular nonagon.
30. **The outer boundary of a three-part symmetrical design matches after $120°$; what other non-zero angles make it coincide within one complete turn?**
    Answer: The other angles are $240°$and $360°$.

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

Two-Mark Descriptive Questions with Answers – LOTS Type:

1. What is symmetry? Give one example.

Answer:

1. Symmetry is the repetition of parts of a figure in a definite and balanced pattern.
2. A butterfly is an example of an object showing symmetry.

2. Define a line of symmetry.

Answer:

1. A line of symmetry divides a figure into two identical mirror halves.
2. The two parts overlap completely when the figure is folded along this line.

3. What are mirror halves?

Answer:

1. Mirror halves are two identical parts of a symmetrical figure.
2. Each half is the reflection or mirror image of the other half.

4. Explain reflection symmetry.

Answer:

1. A figure has reflection symmetry when one part is the mirror image of the other part.
2. The line separating the two identical parts is called its line of symmetry.

5. State the lines of symmetry of a square.

Answer:

1. A square has four lines of symmetry.
2. They are the horizontal line, vertical line and its two diagonals.

6. State the lines of symmetry of a non-square rectangle.

Answer:

1. A non-square rectangle has two lines of symmetry—one horizontal and one vertical.
2. Its diagonals are not lines of symmetry because folding along them does not produce overlapping halves.

7. Compare the lines of symmetry of an equilateral triangle and an isosceles triangle.

Answer:

1. An equilateral triangle has three lines of symmetry.
2. An isosceles triangle has only one line of symmetry.

8. How many lines of symmetry do a regular hexagon and a circle have?

Answer:

1. A regular hexagon has six lines of symmetry.
2. A circle has infinitely many lines of symmetry because every diameter is a line of symmetry.

9. How can an inkblot pattern be used to create a symmetrical figure?

Answer:

1. Place a few drops of ink or paint on one half of a folded sheet and press both halves together.
2. When the sheet is opened, the fold acts as the line of symmetry of the resulting pattern.

10. How can symmetrical shapes be produced by paper folding and cutting?

Answer:

1. Fold a sheet of paper into equal parts and make a cut through the folded layers.
2. When the sheet is unfolded, identical cut-outs appear symmetrically around the folds.

11. What happens when a hole is punched into a sheet folded once?

Answer:

1. The punch passes through two layers of the folded sheet.
2. When the sheet is opened, two holes appear as mirror images across the fold.

12. Define rotational symmetry.

Answer:

1. A figure has rotational symmetry when it matches its original position after being rotated through an angle smaller than $360°$.
2. The rotation takes place around a fixed point called the centre of rotation.

13. What is an angle of symmetry?

Answer:

1. An angle of symmetry is an angle through which a figure can be rotated to coincide with itself.
2. Every figure has $360°$as an angle of symmetry.

14. What is the centre of rotation?

Answer:

1. The centre of rotation is the fixed point around which a figure is turned.
2. During rotation, every part of the figure moves around this point.

15. What is the order of rotational symmetry?

Answer:

1. The order of rotational symmetry is the number of times a figure coincides with itself during one complete rotation.
2. A square has rotational symmetry of order 4.

16. Find the smallest angle of rotational symmetry of a square.

Answer:

1. A square has rotational symmetry of order 4.
2. Therefore, its smallest angle of symmetry is $360° \div 4 = 90°$.

17. Find the smallest angle of rotational symmetry of a regular hexagon.

Answer:

1. A regular hexagon has rotational symmetry of order 6.
2. Therefore, its smallest angle of symmetry is $360° \div 6 = 60°$.

18. State the angles of rotational symmetry of a rectangle.

Answer:

1. A non-square rectangle matches itself after rotations of $180°$and $360°$.
2. Therefore, its rotational symmetry is of order 2.

19. State the reflection and rotational symmetries of an equilateral triangle.

Answer:

1. An equilateral triangle has three lines of reflection symmetry.
2. It has rotational symmetry of order 3, with symmetry angles $120°$, $240°$and $360°$.

20. Describe the symmetries of a circle.

Answer:

1. A circle has infinitely many lines of symmetry because every diameter divides it into identical halves.
2. It also has infinitely many angles of symmetry because it coincides with itself after rotation through any angle.

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

Two-Mark Descriptive Questions with Answers – HOTS Type:

1. A figure has rotational symmetry of order 8. Find its smallest angle of symmetry.

Answer:

1. The smallest angle of symmetry is calculated as $360^\circ \div 8$.
2. Therefore, the smallest angle of symmetry is 45°.

2. The smallest angle of rotational symmetry of a figure is 72°. Find its order.

Answer:

1. The order of rotational symmetry is $360^\circ \div 72^\circ$.
2. Therefore, the figure has rotational symmetry of order 5.

3. Can 45° be the smallest angle of rotational symmetry? Justify your answer.

Answer:

1. Dividing 360° by 45° gives the whole number 8.
2. Therefore, 45° can be the smallest angle of a figure with rotational symmetry of order 8.

4. Can 17° be the smallest whole-number angle of rotational symmetry? Give a reason.

Answer:

1. The angle 17° does not divide 360° exactly.
2. Therefore, 17° cannot be the smallest whole-number angle of rotational symmetry.

5. A figure has five identical radial arms. Find its smallest angle and order of rotational symmetry.

Answer:

1. Its smallest angle of symmetry is $360^\circ \div 5 = 72^\circ$.
2. It has rotational symmetry of order 5.

6. Why is a diagonal of a square a line of symmetry, while that of a non-square rectangle is not?

Answer:

1. Folding a square along a diagonal makes its two triangular halves overlap exactly.
2. Folding a non-square rectangle along a diagonal does not make its two parts overlap exactly.

7. A triangle has two equal sides. State and explain its reflection symmetry.

Answer:

1. The triangle is isosceles and has one line of symmetry from the unequal vertex to the midpoint of the opposite side.
2. Folding it along this line makes its two equal halves overlap completely.

8. Is it possible for a triangle to have exactly two lines of symmetry? Explain.

Answer:

1. If a triangle has two lines of symmetry, the reflection conditions force all three sides to be equal.
2. It would then be equilateral and have three lines of symmetry rather than two.

9. A figure matches itself at 90°, 180°, 270° and 360°. Find its smallest angle and order.

Answer:

1. The smallest angle at which the figure matches itself is 90°.
2. Since $360^\circ \div 90^\circ = 4$, its rotational order is 4.

10. A figure has 60° as its smallest angle of symmetry. List all its other angles of symmetry.

Answer:

1. The angles of symmetry are multiples of 60° up to 360°.
2. The other angles are $120^\circ, 180^\circ, 240^\circ, 300^\circ$ and 360°.

11. A square sheet is folded vertically and horizontally before one hole is punched away from the folds. Predict the result after unfolding.

Answer:

1. The two folds divide the sheet into four matching layers around the fold lines.
2. When unfolded, four holes appear in positions symmetrical about both fold lines.

12. A point lies on the line of symmetry of a figure. What happens to it after reflection, and why?

Answer:

1. The point remains in its original position after reflection.
2. This happens because its perpendicular distance from the line of symmetry is zero.

13. A regular polygon has nine lines of symmetry. Identify it and state its order of rotational symmetry.

Answer:

1. A regular polygon with nine lines of symmetry is a regular nonagon.
2. Its order of rotational symmetry is also 9.

14. Find the smallest angle of rotational symmetry of a regular nonagon.

Answer:

1. A regular nonagon has rotational symmetry of order 9.
2. Its smallest angle of symmetry is $360^\circ \div 9 = 40^\circ$.

15. Compare the reflection and rotational symmetries of a general parallelogram.

Answer:

1. A general parallelogram has no line of reflection symmetry.
2. It has rotational symmetry of order 2 because it matches itself after a rotation of 180°.

16. An isosceles triangle has one line of symmetry; does it have rotational symmetry below 360°?

Answer:

1. A non-equilateral isosceles triangle has one line of reflection symmetry.
2. It does not match itself under any rotation smaller than 360°, so it has no rotational symmetry.

17. The Ashoka Chakra has 24 equally spaced spokes. Find its smallest rotational angle and order.

Answer:

1. Its smallest rotational angle is $360^\circ \div 24 = 15^\circ$.
2. Therefore, the Ashoka Chakra has rotational symmetry of order 24.

18. A figure has 60°as an angle of symmetry and exactly two symmetry angles below it. Find its smallest angle.

Answer:

1. The two smaller angles must be $20^\circ$and 40°, which are consecutive multiples of the smallest angle.
2. Therefore, the smallest angle of symmetry is 20°.

19. Explain why every diameter of a circle is a line of symmetry.

Answer:

1. Every diameter passes through the centre and divides the circle into two equal semicircles.
2. Folding the circle along any diameter makes the two semicircles overlap exactly.

20. Why does a circle have infinitely many angles of rotational symmetry?

Answer:

1. A circle looks unchanged after rotation through any angle about its centre.
2. Since infinitely many angles can be chosen, the circle has infinitely many angles of symmetry.

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

Three-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain symmetry and give two examples of symmetrical objects.

Answer:

1. Symmetry refers to the repetition of parts of a figure in a definite and balanced pattern.
2. A symmetrical figure can be divided into matching parts.
3. A butterfly and a flower are common examples of symmetrical objects.

2. Define a line of symmetry and explain it using paper folding.

Answer:

1. A line of symmetry divides a figure into two identical mirror halves.
2. When the figure is folded along this line, one half covers the other half completely.
3. Therefore, the fold represents the line or axis of symmetry.

3. Describe the four lines of symmetry of a square.

Answer:

1. A square has one vertical and one horizontal line of symmetry.
2. Each of its two diagonals is also a line of symmetry.
3. Therefore, a square has four lines of symmetry altogether.

4. Compare the lines of symmetry of equilateral, isosceles and scalene triangles.

Answer:

1. An equilateral triangle has three lines of symmetry.
2. An isosceles triangle has one line of symmetry.
3. A scalene triangle has no line of symmetry.

5. Explain reflection symmetry using a square.

Answer:

1. Reflection symmetry occurs when one part of a figure is the mirror image of its other part.
2. A square can be divided into identical mirror halves along its horizontal, vertical or diagonal symmetry lines.
3. Corresponding points on its two halves are equally distant from the selected line of symmetry.

6. Describe how a symmetrical inkblot pattern can be created.

Answer:

1. Fold a sheet of paper in half, open it and place a few drops of ink or paint on one side.
2. Fold the sheet again and press both halves firmly together.
3. When the sheet is opened, the ink patterns form mirror images across the fold.

7. Explain how folding and cutting paper creates a symmetrical design.

Answer:

1. A sheet of paper is first folded into two or more layers.
2. A shape is cut through all the folded layers at the same time.
3. When the paper is unfolded, identical cut-outs appear symmetrically around the fold lines.

8. Define rotational symmetry, centre of rotation and angle of symmetry.

Answer:

1. Rotational symmetry occurs when a figure coincides with itself after being turned through an angle smaller than $360°$.
2. The fixed point around which the figure is turned is called the centre of rotation.
3. The angle through which the figure matches itself is called an angle of symmetry.

9. Explain the rotational symmetry of a square.

Answer:

1. A square matches itself after rotations of $90°$, $180°$, $270°$and $360°$.
2. Its smallest angle of rotational symmetry is $90°$.

3. Therefore, the order of its rotational symmetry is 4.

10. Explain the rotational symmetry of a non-square rectangle.

Answer:

1. A non-square rectangle coincides with itself after rotations of $180°$ and $360°$.
2. Its smallest angle of rotational symmetry is $180°$.
3. Therefore, its order of rotational symmetry is 2.

11. Describe the reflection and rotational symmetries of a regular hexagon.

Answer:

1. A regular hexagon has six lines of reflection symmetry.
2. It matches itself after every rotation of $60°$ about its centre.
3. Therefore, its rotational symmetry is of order 6.

12. Explain how the order and smallest angle of rotational symmetry are related.

Answer:

1. The order tells us how many times a figure matches itself in a complete rotation.
2. The smallest angle is found using $360° \div$ order.
3. For example, a figure of order 5 has a smallest rotational angle of $72°$.

13. Describe the reflection symmetry of a circle.

Answer:

1. A circle can be divided into two identical semicircles by any diameter.
2. The two semicircles overlap completely when the circle is folded along that diameter.
3. Therefore, a circle has infinitely many lines of reflection symmetry.

14. Describe the rotational symmetry of a circle.

Answer:

1. A circle coincides with itself when rotated through any angle about its centre.
2. Hence, every angle is an angle of symmetry for a circle.
3. Therefore, a circle has infinitely many angles of rotational symmetry.

15. Explain the three possible relationships between reflection and rotational symmetry.

Answer:

1. Some figures, such as an isosceles triangle, have reflection symmetry but no rotational symmetry below $360°$.
2. Some figures, such as a general parallelogram, have rotational symmetry but no reflection symmetry.
3. Other figures, such as a square, possess both reflection and rotational symmetry.

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

Three-Mark Descriptive Questions with Answers – HOTS Type:

1. A figure has rotational symmetry of order 8. Find its smallest angle and write the first three angles of symmetry.

Answer:

1. The smallest angle of symmetry is $360° \div 8 = 45°$.
2. The angles of symmetry are multiples of $45°$.
3. Therefore, the first three angles are $45°$, $90°$ and $135°$.

2. A figure has $60°$ as its smallest angle of symmetry. Find its order and list all its angles of symmetry.

Answer:

1. The order of rotational symmetry is $360° \div 60° = 6$.
2. Its angles of symmetry are multiples of $60°$.
3. Therefore, they are $60°, 120°, 180°, 240°, 300°$ and $360°$.

3. Can $45°$ and $17°$ be the smallest angles of rotational symmetry? Justify your answer.

Answer:

1. Since $360^\circ \div 45^\circ = 8$, 45°can be a smallest angle of rotational symmetry.
2. Since $360^\circ \div 17^\circ$is not a whole number, 17°cannot be such an angle.
3. A whole-number smallest angle of rotational symmetry must divide 360°exactly.

4. A regular polygon has nine lines of symmetry. Identify it and determine its rotational symmetry.

Answer:

1. A regular polygon with nine lines of symmetry has nine sides and is called a regular nonagon.
2. Its order of rotational symmetry is also 9.
3. Its smallest angle of rotational symmetry is $360^\circ \div 9 = 40^\circ$.

5. Explain why a triangle cannot have exactly two lines of symmetry.

Answer:

1. One line of symmetry can divide an isosceles triangle into two identical halves.
2. If a second line of symmetry exists, the reflection conditions make all three sides equal.
3. The triangle then becomes equilateral and has three lines of symmetry, not two.

6. A square and a non-square rectangle both have rotational symmetry; compare their symmetries.

Answer:

1. A square has four lines of symmetry and rotational symmetry of order 4.
2. A non-square rectangle has two lines of symmetry and rotational symmetry of order 2.
3. Their smallest rotational angles are $90^\circ$and 180°, respectively.

7. A general parallelogram has no line of symmetry; explain why it still has rotational symmetry.

Answer:

1. Its opposite sides and opposite angles are equal.
2. A rotation of 180°around its centre interchanges opposite vertices and sides.
3. Thus, it coincides with itself and has rotational symmetry of order 2.

8. A paper is folded once vertically and once horizontally before a hole is punched away from the folds; predict the unfolded pattern.

Answer:

1. The two folds create four layers of paper.
2. A single punch passes through all four layers.
3. On unfolding, four holes appear symmetrically across the vertical and horizontal fold lines.

9. A paper is folded along a line, and a hole is punched directly on the fold; explain the result after unfolding.

Answer:

1. The punched point lies on the line of symmetry.
2. Its reflected position is the same because its distance from the fold is zero.
3. Therefore, the unfolded paper shows one hole on the fold rather than two separate holes.

10. A design contains 12 identical sectors around its centre. Determine its rotational symmetry.

Answer:

1. The smallest angle of rotation is $360^\circ \div 12 = 30^\circ$.
2. The design coincides with itself after every multiple of 30°.
3. Therefore, its order of rotational symmetry is 12.

11. The Ashoka Chakra has 24 equally spaced spokes. Find its smallest angle and explain its symmetries.

Answer:

1. Its smallest rotational angle is $360° \div 24 = 15°$.
2. It has rotational symmetry of order 24 because it matches itself 24 times in a complete turn.
3. It also has 24 lines of reflection symmetry passing through its centre.

12. A figure has 60°as an angle of symmetry and exactly two symmetry angles below it; find the smallest angle.

Answer:

1. The symmetry angles are multiples of the smallest angle.
2. The two angles below 60°must be 20°and 40°.
3. Therefore, the smallest angle of symmetry is 20°.

13. Compare the symmetry of an equilateral triangle and a non-equilateral isosceles triangle.

Answer:

1. An equilateral triangle has three lines of symmetry and rotational symmetry of order 3.
2. A non-equilateral isosceles triangle has one line of symmetry and no rotational symmetry below 360°.
3. Thus, both have reflection symmetry, but only the equilateral triangle has non-trivial rotational symmetry.

14. Explain why a circle is considered more symmetrical than a regular polygon.

Answer:

1. A regular polygon has a fixed finite number of lines and angles of symmetry.
2. Every diameter of a circle is a line of symmetry, giving it infinitely many symmetry lines.
3. A circle also coincides with itself after rotation through any angle and therefore has infinitely many rotational symmetries.

15. A figure has both horizontal and vertical lines of symmetry; prove that it has rotational symmetry.

Answer:

1. Reflection across the vertical line exchanges the left and right parts of the figure.
2. Reflection across the horizontal line then exchanges its upper and lower parts.
3. Together, these reflections are equivalent to a 180°rotation, so the figure has rotational symmetry of at least order 2.

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

Five-Mark Descriptive Questions with Answers – LOTS Type:

1. Explain line symmetry and describe the lines of symmetry of common geometrical figures.

Answer:

1. A line of symmetry divides a figure into two identical mirror halves.
2. The two halves overlap completely when the figure is folded along this line.
3. A square has four lines of symmetry, while a non-square rectangle has two.
4. An equilateral triangle has three lines of symmetry, while an isosceles triangle has one.
5. A circle has infinitely many lines of symmetry because every diameter is a line of symmetry.

2. Describe how symmetrical designs can be created using inkblots, paper folding and cutting.

Answer:

1. Fold a sheet of paper into two equal parts to create a fold line.
2. Place a few drops of ink or paint on one side and press the two halves together.

3. On opening the sheet, identical ink patterns appear on both sides of the fold.
4. Symmetrical designs can also be created by cutting or punching a folded sheet.
5. The fold lines become lines of symmetry when the sheet is completely unfolded.

3. Explain rotational symmetry and its important terms.

Answer:

1. A figure has rotational symmetry when it matches itself after a rotation smaller than 360°.
2. The fixed point around which the figure turns is called the centre of rotation.
3. An angle through which the figure matches its original position is called an angle of symmetry.
4. The smallest such angle is called the smallest angle of rotational symmetry.
5. The number of times the figure matches itself in a complete turn is called the order of rotational symmetry.

4. Describe the reflection and rotational symmetries of a square.

Answer:

1. A square has four lines of reflection symmetry.
2. Two symmetry lines pass through the midpoints of its opposite sides.
3. The other two symmetry lines are its diagonals.
4. A square matches itself after rotations of 90°, 180°, 270°and 360°.
5. Therefore, its smallest rotational angle is 90°and its rotational order is 4.

5. Describe the reflection and rotational symmetries of a regular hexagon.

Answer:

1. A regular hexagon has six equal sides and six equal angles.
2. It has six lines of reflection symmetry.
3. It matches itself after rotations of 60°, 120°, 180°, 240°, 300°and 360°.
4. Its smallest angle of rotational symmetry is 60°.
5. Therefore, the order of its rotational symmetry is 6.

6. Explain the symmetry properties of different types of triangles.

Answer:

1. An equilateral triangle has three lines of symmetry.
2. It has rotational symmetry of order 3, with the smallest angle 120°.
3. A non-equilateral isosceles triangle has exactly one line of symmetry.
4. It does not have rotational symmetry at any angle smaller than 360°.
5. A scalene triangle has neither reflection symmetry nor rotational symmetry below 360°.

7. Describe the reflection and rotational symmetries of a circle.

Answer:

1. Every diameter divides a circle into two identical semicircles.
2. Therefore, every diameter is a line of reflection symmetry.
3. Since infinitely many diameters can be drawn, a circle has infinitely many lines of symmetry.
4. A circle coincides with itself after rotation through any angle about its centre.
5. Hence, it also has infinitely many angles of rotational symmetry.

8. Explain the relationship between rotational order, the smallest angle and other angles of symmetry.

Answer:

1. A complete rotation measures 360°.
2. The smallest angle of symmetry is calculated using 360° ÷ order.
3. The order is calculated using 360° ÷ smallest angle.
4. All other angles of symmetry are multiples of the smallest angle.

5. For a figure of order 5, the smallest angle is $72°$, and the other angles are $144°, 216°, 288°$ and $360°$.

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

Five-Mark Descriptive Questions with Answers – HOTS Type:

1. A figure has $30°$ as its smallest angle of rotational symmetry. Find its order and list all its angles of symmetry.

Answer:

1. The order of rotational symmetry is calculated as $360° \div 30°$.
2. Therefore, the figure has rotational symmetry of order 12.
3. Every angle of symmetry is a multiple of $30°$.
4. The angles are $30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, 300°, 330°$ and $360°$.
5. Thus, the figure coincides with itself 12 times during one complete rotation.

2. Compare the reflection and rotational symmetries of a square and a non-square rectangle.

Answer:

1. A square has four lines of symmetry, while a non-square rectangle has two.
2. The diagonals of a square are lines of symmetry, but those of a non-square rectangle are not.
3. A square matches itself after every rotation of $90°$, whereas a rectangle first matches after $180°$.
4. Therefore, their rotational orders are 4 and 2, respectively.
5. Both figures possess reflection and rotational symmetry, but the square has a higher degree of symmetry.

3. Can $45°$, $50°$ and $72°$ be the smallest whole-number angles of rotational symmetry? Justify your answer.

Answer:

1. A smallest whole-number angle of symmetry must divide $360°$ exactly.
2. Since $360° \div 45° = 8$, $45°$ is possible.
3. Since $360° \div 50° = 7.2$, $50°$ is not possible.
4. Since $360° \div 72° = 5$, $72°$ is possible.
5. Therefore, figures can have $45°$ and $72°$, but not $50°$, as their smallest angles of symmetry.

4. A square sheet is folded once vertically and once horizontally, and a hole is punched away from the folds. Explain the resulting pattern after unfolding.

Answer:

1. The vertical fold first divides the square into two equal mirror halves.
2. The horizontal fold then creates four layers of paper.
3. One punch passes through all four layers simultaneously.
4. When unfolded, four holes appear at equal corresponding distances from the two fold lines.
5. The resulting pattern has both the vertical and horizontal folds as lines of symmetry.

5. Explain why a triangle can have zero, one or three lines of symmetry but not exactly two.

Answer:

1. A scalene triangle has no equal sides and therefore has no line of symmetry.
2. A non-equilateral isosceles triangle has two equal sides and exactly one line of symmetry.
3. An equilateral triangle has three equal sides and three lines of symmetry.

4. If a triangle had two lines of symmetry, the reflections would force all three sides to be equal.
5. It would then become equilateral and possess three lines of symmetry rather than two.

6. The Ashoka Chakra has 24 equally spaced spokes. Analyse its reflection and rotational symmetries.

Answer:
1. The 24 spokes are equally spaced around the centre of the Chakra.
2. Its smallest rotational angle is $360° \div 24 = 15°$.
3. Therefore, its order of rotational symmetry is 24.
4. It also has 24 lines of reflection symmetry passing through its centre.
5. Hence, the Ashoka Chakra possesses both reflection and rotational symmetry of a high order.

7. A figure has $60°$ as an angle of symmetry and exactly two angles of symmetry below $60°$. Find its smallest angle and rotational order.

Answer:
1. All angles of rotational symmetry are multiples of the smallest angle.
2. Since two symmetry angles lie below $60°$, they must be $20°$ and $40°$.
3. Therefore, the smallest angle of symmetry is $20°$.
4. Its rotational order is $360° \div 20° = 18$.
5. Thus, the figure coincides with itself 18 times during a complete rotation.

8. Compare the symmetry of an equilateral triangle, a general parallelogram and a circle.

Answer:
1. An equilateral triangle has three lines of symmetry and rotational symmetry of order 3.
2. Its smallest angle of rotational symmetry is $120°$.
3. A general parallelogram has no line of symmetry but has rotational symmetry of order 2.
4. A circle has infinitely many lines of symmetry because every diameter is a symmetry line.
5. It also has infinitely many rotational symmetries because it matches itself after rotation through any angle.

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

Five-Mark Descriptive Questions with Answers – Applied Type:

1. A designer wants to create a rangoli with eight identical petals arranged equally around its centre. Determine its rotational symmetry.

Answer:
1. The rangoli contains eight identical and equally spaced petals.
2. The angle between two adjacent petals is $360° \div 8 = 45°$.
3. Therefore, its smallest angle of rotational symmetry is $45°$.
4. It coincides with itself at every multiple of $45°$, including $90°, 135°$ and $180°$.
5. Hence, the rangoli has rotational symmetry of order 8.

2. A craft student folds a square sheet once vertically and once horizontally and punches a hole away from the folds. Predict and explain the pattern obtained after unfolding.

Answer:
1. The first vertical fold creates two layers, and the horizontal fold creates four layers.
2. A single punch passes through all four layers of the folded sheet.
3. When unfolded, four holes appear at corresponding positions.
4. The holes are equally distant from the vertical and horizontal fold lines.
5. Therefore, the final pattern has two perpendicular lines of symmetry.

3. An architect designs a circular window with 12 identical spokes. Analyse its reflection and rotational symmetries.

Answer:

1. The 12 spokes are equally spaced around the centre of the circular window.
2. The smallest angle of rotational symmetry is $360^\circ \div 12 = 30^\circ$.
3. The window matches itself 12 times in one complete rotation.
4. Lines passing through the centre and corresponding opposite spokes form lines of reflection symmetry.
5. Thus, the window has rotational symmetry of order 12 and reflection symmetry.

4. A school emblem contains a regular hexagon with six identical stars placed at its vertices. Explain its symmetry.

Answer:

1. The six identical stars are placed equally around the centre of the regular hexagon.
2. The emblem matches itself after every rotation of $360^\circ \div 6 = 60^\circ$.
3. Hence, its smallest angle of rotational symmetry is 60°.
4. It has rotational symmetry of order 6 and six lines of reflection symmetry if all the stars have matching orientations.
5. Changing the orientation of even one star may destroy some or all of these symmetries.

5. A manufacturer is designing a fan with five identical blades. Find its rotational symmetry and explain why balanced spacing is important.

Answer:

1. The five blades must be identical and equally spaced around the centre of the fan.
2. The angle between two consecutive blades is $360^\circ \div 5 = 72^\circ$.
3. The fan therefore has a smallest rotational angle of 72°.
4. It has rotational symmetry of order 5 because it matches itself five times in a complete rotation.
5. Equal spacing keeps the design symmetrical and helps the fan rotate in a balanced manner.

6. A floor tile is shaped like a square and has the same flower design in all four corners. Discuss its symmetry.

Answer:

1. The square boundary has four lines of symmetry and rotational symmetry of order 4.
2. The identical corner designs must be placed at equal distances from the centre.
3. If their orientations match properly, the tile coincides with itself after rotations of $90^\circ, 180^\circ, 270^\circ$and 360°.
4. Its smallest angle of rotational symmetry is therefore 90°.
5. Changing the design or orientation of one corner would disturb the symmetry of the complete tile.

7. A gardener plans a circular flower bed divided into six equal sectors with the same flowers in each sector. Determine its symmetry.

Answer:

1. The six equal sectors are arranged uniformly around the centre of the flower bed.
2. The angle occupied by each sector is $360^\circ \div 6 = 60^\circ$.
3. Therefore, the smallest angle of rotational symmetry is 60°.
4. The flower bed has rotational symmetry of order 6 and can have six lines of reflection symmetry.
5. The symmetry will be maintained only when the flower type and arrangement are identical in every sector.

8. A company wants a logo that has rotational symmetry but no reflection symmetry. Suggest a suitable design and explain it.

Answer:

1. A pinwheel with four identical bent arms can be used for the logo.
2. The arms should be equally spaced around a common centre and point in the same turning direction.
3. The logo will coincide with itself after rotations of $90°, 180°, 270°$and $360°$.
4. It will not have reflection symmetry because reflection reverses the turning direction of the arms.
5. Thus, the logo has rotational symmetry of order 4 but no line of symmetry.

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

Olympiad-Type Multiple-Choice Questions: Symmetry:

1. A figure has rotational symmetry of order 9. What is its smallest angle of rotational symmetry?

A. 20°
B. 30°
C. 40°
D. 45°

Answer: C. 40°

$$360° \div 9 = 40°$$

---

2. Which figure has rotational symmetry but generally no line of symmetry?

A. Square
B. General parallelogram
C. Equilateral triangle
D. Rectangle

Answer: B. General parallelogram

---

3. Which of the following cannot be the smallest whole-number angle of rotational symmetry?

A. 24°
B. 30°
C. 40°
D. 50°

Answer: D. 50°

50°does not divide 360°exactly.

---

4. A figure matches itself at $72°$, $144°$, $216°$, $288°$and $360°$. What is its rotational order?

A. 4
B. 5
C. 6
D. 8

Answer: B. 5

---

5. Which triangle has both reflection symmetry and rotational symmetry below $360°$?

A. Scalene triangle
B. Non-equilateral isosceles triangle
C. Equilateral triangle
D. Right-angled scalene triangle

Answer: C. Equilateral triangle

---

6. How many lines of symmetry can a triangle have?
A. Only 0 or 1
B. Only 1 or 2
C. 0, 1 or 3
D. 0, 2 or 3
Answer: C. 0, 1 or 3

---

7. A regular polygon has a smallest rotational angle of 30°. How many sides does it have?
A. 10
B. 11
C. 12
D. 15
Answer: C. 12

$$360^\circ \div 30^\circ = 12$$

---

8. Which statement about a circle is correct?
A. It has one line of symmetry.
B. It has four lines of symmetry.
C. It has rotational symmetry only at 180°.
D. It has infinitely many lines and angles of symmetry.
Answer: D. It has infinitely many lines and angles of symmetry.

---

9. A square is rotated clockwise through 630°. With which simpler rotation is this equivalent?
A. 45°
B. 90°
C. 180°
D. 270°
Answer: D. 270°

$$630^\circ - 360^\circ = 270^\circ$$

---

10. How many times does a regular hexagon coincide with itself during one complete rotation?
A. 3
B. 4
C. 6
D. 12
Answer: C. 6

---

11. A figure has 60°as an angle of symmetry and exactly two angles of symmetry below it. What is its smallest angle of symmetry?
A. 10°
B. 15°
C. 20°
D. 30°
Answer: C. 20°

---

12. Which quadrilateral has exactly two lines of symmetry and rotational symmetry of order 2?
A. Square
B. Non-square rectangle
C. General parallelogram
D. Irregular quadrilateral
Answer: B. Non-square rectangle

---

13. The Ashoka Chakra has 24 equally spaced spokes. What is its smallest rotational angle?
A. 10°
B. 12°
C. 15°
D. 24°
Answer: C. 15°

$$360^\circ \div 24 = 15^\circ$$

---

14. A regular octagon has:
A. 4 lines of symmetry and rotational order 8
B. 8 lines of symmetry and rotational order 4
C. 8 lines of symmetry and rotational order 8
D. 16 lines of symmetry and rotational order 8
Answer: C. 8 lines of symmetry and rotational order 8

---

15. A square paper is folded once vertically and once horizontally, and one hole is punched away from the folds and edges. How many holes generally appear after unfolding?
A. 2
B. 3
C. 4
D. 8
Answer: C. 4

---

16. Under reflection in a line, which property is always true?
A. Corresponding points are at unequal distances from the line.
B. Corresponding points are equally distant from the line.
C. Every point moves to the line of symmetry.
D. Points on the line move twice as far.
Answer: B. Corresponding points are equally distant from the line.

---

17. A point lies exactly on a line of symmetry. Where will its reflected image lie?
A. On the opposite side of the figure
B. At twice its original distance
C. At the same point
D. At the centre of the figure
Answer: C. At the same point

---

18. Which smallest rotational angle gives the greatest order of symmetry?
A. 90°
B. 60°

C. 45°
D. 30°
Answer: D. 30°
Its order is $360^\circ \div 30^\circ = 12$.

---

19. A design has rotational symmetry of order 15. What is the angle between consecutive matching positions?
A. 15°
B. 18°
C. 24°
D. 30°
Answer: C. 24°

$$360^\circ \div 15 = 24^\circ$$

---

20. Which set contains all the rotational symmetry angles of a non-square rectangle up to 360°?
A. $90^\circ, 180^\circ, 270^\circ, 360^\circ$
B. $120^\circ, 240^\circ, 360^\circ$
C. $180^\circ, 360^\circ$
D. 360°only
Answer: C. $180^\circ, 360^\circ$

---

21. A figure has exactly one line of symmetry and no rotational symmetry below 360°. Which could be the figure?
A. Square
B. Equilateral triangle
C. Non-equilateral isosceles triangle
D. Regular hexagon
Answer: C. Non-equilateral isosceles triangle

---

22. If the order of rotational symmetry of a figure is doubled, what happens to its smallest rotational angle?
A. It doubles.
B. It becomes half.
C. It remains unchanged.
D. It becomes 360°.
Answer: B. It becomes half.

---

23. A pinwheel with four identical arms pointing in the same turning direction usually has:
A. Reflection symmetry only
B. Rotational symmetry only
C. Neither type of symmetry
D. Infinitely many symmetries
Answer: B. Rotational symmetry only

---

24. A figure matches itself after a rotation of 120°, but not after 60°. Which could be its rotational order?
A. 2
B. 3

C. 6
D. 12
Answer: B. 3

---

25. Which statement is always true for a regular polygon with $n$sides?
A. It has $n-1$lines of symmetry.
B. Its rotational order is $2n$.
C. Its smallest rotational angle is $\frac{360^\circ}{n}$.
D. It has no reflection symmetry when $n$is odd.
Answer: C. Its smallest rotational angle is $\frac{360^\circ}{n}$.

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

Best Practices for Teaching the Chapter "Symmetry":

(1) Begin with familiar objects:
Introduce symmetry using butterflies, flowers, leaves, rangoli, wheels, monuments and classroom objects so that students can connect mathematical ideas with daily life.

(2) Use paper-folding activities:
Let students fold squares, rectangles, circles and triangles to identify lines of symmetry through direct observation.

(3) Practise inkblot and paper-cut designs:
Use inkblot printing, folding, cutting and hole-punching activities to demonstrate reflection symmetry practically.

(4) Encourage prediction before verification:
Before folding, cutting, punching or rotating a figure, ask students to predict the result and then verify it experimentally.

(5) Use mirrors for reflection symmetry:
Place a small mirror along possible symmetry lines so students can determine whether the complete reflected figure is formed.

(6) Teach rotational symmetry with manipulatives:
Use transparent sheets, tracing paper, paper shapes, pins and cardboard cut-outs to rotate figures around their centres.

(7) Connect formulas with visual understanding:
Derive the relationship

$$\text{Smallest angle} = \frac{360^\circ}{\text{order}}$$

through actual rotations instead of asking students to memorise it directly.

(8) Compare similar geometrical figures:
Ask students to compare a square with a rectangle, an equilateral triangle with an isosceles triangle, and a regular polygon with an irregular polygon.

(9) Maintain a symmetry observation chart:
Students can record the number of lines of symmetry, rotational order and smallest angle of symmetry for different figures.

(10) Address common misconceptions:
Clarify that the diagonal of every quadrilateral is not necessarily a line of symmetry and that a 360°rotation alone does not indicate non-trivial rotational symmetry.

(11) Integrate art and local culture:
Use rangoli, kolam, textile patterns, temple designs and the Ashoka Chakra to connect symmetry with Indian art and architecture.

(12) **Promote mathematical discussion:**
Encourage students to explain why a line or angle represents symmetry instead of merely stating the answer.

(13) **Use differentiated learning tasks:**
Provide basic folding and identification activities for learners needing support and design-based symmetry challenges for advanced learners.

(14) **Encourage peer learning:**
Allow students to work in pairs or groups to construct, inspect and correct symmetrical patterns.

(15) **Assess through activities and reasoning:**
Evaluate students using practical demonstrations, drawings, oral explanations and problem-solving tasks in addition to written tests.

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

Innovations in Teaching–Learning the Chapter "Symmetry":

(1) **Digital Symmetry Laboratory:**
Use interactive geometry applications such as GeoGebra to let students reflect, rotate and transform figures while observing symmetry dynamically.

(2) **Symmetry Photography Hunt:**
Ask students to photograph symmetrical objects found at home, school or in nature and classify them according to reflection and rotational symmetry.

(3) **Augmented Mirror Activity:**
Use mirror strips or a digital mirror application to complete half-drawn pictures and identify possible lines of symmetry.

(4) **Rangoli and Kolam Design Studio:**
Let students create rangoli or kolam designs and calculate their lines of symmetry, rotational order and smallest rotational angle.

(5) **Human Symmetry Formation:**
Students can form symmetrical arrangements using body positions, classroom objects or group formations around a marked line or centre.

(6) **Symmetry Animation Project:**
Students can create simple stop-motion animations showing a figure rotating through its different angles of symmetry.

(7) **Transparent Rotation Wheel:**
Make a reusable rotation wheel using transparent sheets, a cardboard base and a split pin so students can test rotational symmetry physically.

(8) **Fold–Punch–Predict Challenge:**
Show students a folded sheet and a punching position, ask them to predict the unfolded pattern, and then verify it through an experiment.

(9) **Symmetry Coding Activity:**
Use child-friendly coding platforms such as Scratch to create repeating shapes, rotating patterns, flowers and pinwheels.

(10) **Design-a-Logo Challenge:**
Ask students to design logos having only reflection symmetry, only rotational symmetry, both types or no symmetry.

(11) **Symmetry in Architecture Gallery:**
Create a digital or classroom gallery featuring the Taj Mahal, temple gopurams, the Parliament building, wheels and patterned windows for symmetry analysis.

(12) Symmetry Escape-Room Game:
Organise clue-based tasks in which students solve symmetry problems to obtain codes and progress through successive stages.

(13) Collaborative Symmetry Mural:
Divide students into groups and ask each group to complete one section of a large mural while maintaining a chosen line or order of symmetry.

(14) Error-Detection Cards:
Give students intentionally incorrect symmetrical drawings and ask them to locate, explain and correct the errors.

(15) Student-Created Symmetry Museum:
Let students prepare models, paper cut-outs, rotating designs and explanatory cards for a classroom exhibition on symmetry.

9.17: Practicing Questions/Question Bank

A. Fill in the Blanks:

1. A line that divides a figure into two identical mirror halves is called a __________.
   Answer: line of symmetry

2. A square has __________ lines of symmetry.
   Answer: four

3. A non-square rectangle has rotational symmetry of order __________.
   Answer: two

4. The fixed point around which a figure rotates is called the __________.
   Answer: centre of rotation

5. One complete rotation is equal to __________.
   Answer: 360°

6. The smallest angle of rotational symmetry of a square is __________.
   Answer: 90°

7. An equilateral triangle has __________ lines of symmetry.
   Answer: three

8. Every __________ of a circle is a line of symmetry.
   Answer: diameter

9. A regular hexagon has rotational symmetry of order __________.
   Answer: six

10. A figure with rotational order 8 has the smallest angle of symmetry equal to __________.
    Answer: 45°

B. One-Mark Descriptive Questions:

1. What is a symmetrical figure?

Answer: A figure whose parts repeat or match in a definite pattern is called a symmetrical figure.

2. Define a line of symmetry.

Answer: A line of symmetry divides a figure into two parts that overlap exactly when folded along the line.

3. What is reflection symmetry?

Answer: Reflection symmetry occurs when one half of a figure is the mirror image of its other half.

4. What is rotational symmetry?

Answer: A figure has rotational symmetry when it matches itself after rotation through an angle smaller than $360°$.

5. What is an angle of symmetry?

Answer: An angle of symmetry is an angle through which a figure can be rotated to match its original position.

6. How many lines of symmetry does an isosceles triangle have?

Answer: A non-equilateral isosceles triangle has one line of symmetry.

7. What is the rotational order of a square?

Answer: The rotational order of a square is 4.

8. Can a triangle have exactly two lines of symmetry?

Answer: No, a triangle can have zero, one or three lines of symmetry but not exactly two.

C. Two-Mark Descriptive Questions

1. Differentiate between reflection symmetry and rotational symmetry.

Answer:

1. Reflection symmetry occurs when a figure can be divided into identical mirror halves.
2. Rotational symmetry occurs when a figure matches itself after being rotated around a fixed point.

2. State the lines of symmetry of a square.

Answer:

1. A square has one horizontal and one vertical line of symmetry.
2. Its two diagonals are also lines of symmetry, giving four in total.

3. Find the smallest angle of rotational symmetry of a regular hexagon.

Answer:

1. A regular hexagon has rotational symmetry of order 6.
2. Its smallest angle is $360° \div 6 = 60°$.

4. Why is the diagonal of a non-square rectangle not a line of symmetry?

Answer:

1. Folding a non-square rectangle along its diagonal does not make its two parts overlap.

2. Therefore, its diagonal does not divide it into mirror halves.

5. A figure has a smallest rotational angle of 40°; find its rotational order.

Answer:

1. Rotational order = 360° ÷ 40°.
2. Therefore, the figure has rotational symmetry of order 9.

6. What happens when a paper folded once is punched away from its fold?

Answer:

1. The punch passes through both layers of the folded paper.
2. On unfolding, two holes appear as mirror images across the fold.

D. Three-Mark Descriptive Questions:

1. Explain the symmetry properties of the three types of triangles.

Answer:

1. An equilateral triangle has three lines of symmetry and rotational symmetry of order 3.
2. A non-equilateral isosceles triangle has one line of symmetry but no rotational symmetry below 360°.
3. A scalene triangle has neither reflection symmetry nor rotational symmetry below 360°.

2. Describe how an inkblot can be used to demonstrate symmetry.

Answer:

1. Fold a paper in half, open it and place some ink on one side.
2. Refold and press the two halves together.
3. On opening, identical patterns appear on both sides of the fold.

3. A figure has rotational symmetry of order 12; find its smallest angle and the next two angles of symmetry.

Answer:

1. The smallest angle is 360° ÷ 12 = 30°.
2. The angles of symmetry are multiples of 30°.
3. Hence, the first three angles are 30°, 60°and 90°.

4. Explain why a triangle cannot have exactly two lines of symmetry.

Answer:

1. A triangle with one line of symmetry may be isosceles.
2. A second line of symmetry would make all three sides equal.
3. It would then be equilateral and have three lines of symmetry.

5. Describe the symmetry of a circle.

Answer:

1. Every diameter of a circle is a line of reflection symmetry.
2. A circle therefore has infinitely many lines of symmetry.
3. It also has infinitely many rotational symmetries because it matches itself after rotation through any angle.

E. Five-Mark Descriptive Questions:

1. Explain rotational symmetry and the relationship between its order and smallest angle.

Answer:

1. Rotational symmetry occurs when a figure matches itself after rotation through an angle smaller than $360°$.
2. The fixed point around which it turns is called the centre of rotation.
3. The number of matching positions in one complete rotation is its rotational order.
4. The smallest angle is calculated using $360° \div$ order.
5. For example, a figure of order 8 has the smallest rotational angle $360° \div 8 = 45°$.

2. Compare the symmetries of a square and a non-square rectangle.

Answer:

1. A square has four lines of symmetry, while a non-square rectangle has two.
2. The diagonals of a square are symmetry lines, but those of a non-square rectangle are not.
3. A square has rotational symmetry of order 4.
4. A non-square rectangle has rotational symmetry of order 2.
5. Their smallest rotational angles are $90°$and $180°$, respectively.

3. A circular window contains 12 identical, equally spaced spokes; analyse its symmetry.

Answer:

1. The spokes divide the complete $360°$turn into 12 equal parts.
2. The angle between consecutive spokes is $360° \div 12 = 30°$.
3. Therefore, the smallest rotational angle is $30°$.
4. The rotational order of the window is 12.
5. If opposite spokes are identical, the design also possesses reflection symmetry.

4. Explain how folding, cutting and punching can be used to produce symmetrical designs.

Answer:

1. A sheet is folded along one or more lines to form equal layers.

2. A cut or hole is made through all the folded layers.
3. Corresponding cut-outs or holes appear when the sheet is unfolded.
4. These corresponding shapes lie at equal distances from the fold lines.
5. Hence, the fold lines become lines of symmetry of the completed design.

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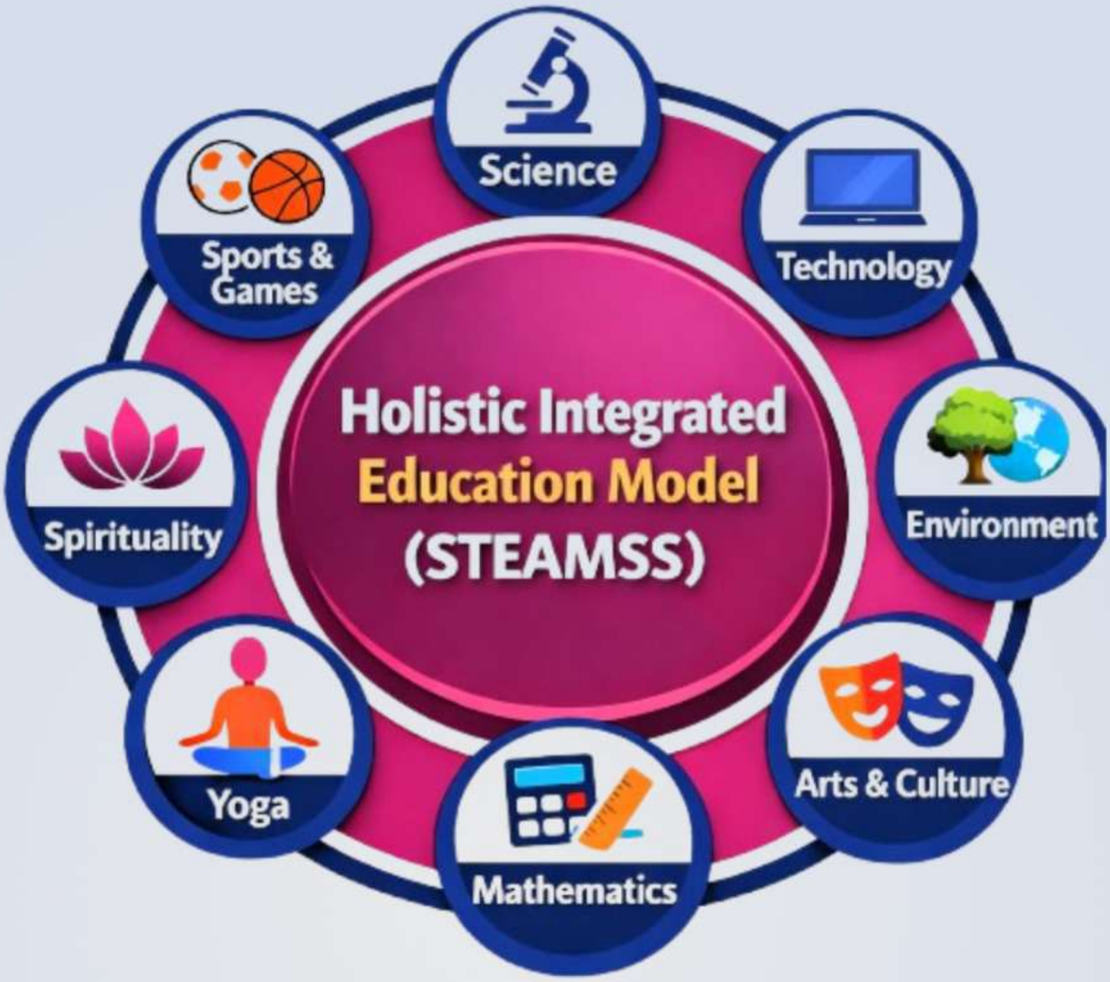
ALEVOOR POORNAPRAJNA PUBLIC SCHOOL

(Proposed CBSE Tech School)



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