SUPER POWER SERIES BOOK

GANITA PRAKASH
FOR YOUNG INTELLECTS

Study Material Book

for 8th Standard Mathematics Subject

(Part Two)

Based on NCERT/CBSE Curriculum

COMPILED BY

Dr. P. S. Aithal

Alevoor Poornaprajna Public School, Udupi

www.alevoorpps.in

PUBLISHED BY

Poornaprajna Publication, Udupi, India

www.poornaprajnapublication.com

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Year of Publication: October, 2026

DOI: https://doi.org/10.5281/zenodo.23291113

www.poornaprajnapublication.com

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(Part Two)

(Prepared as per Poornaprajna Integrated Student Support Model)

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PREFACE

GANITHA PRAKASH FOR YOUNG INTELLECTS – Study Material Book for 8th Standard Mathematics Subject (Part Two) has been thoughtfully developed with the help of AI-driven GPTs in accordance with the Poornaprajna Integrated Student Service Model to provide comprehensive and learner-centred academic support to Grade 8 students. Based on the NCERT/CBSE Curriculum, the book aims to strengthen mathematical foundations while nurturing conceptual understanding, logical reasoning, analytical thinking, problem-solving abilities, and mathematical creativity, making Mathematics meaningful, engaging, and enjoyable.

The book systematically covers seven important chapters, including Fractions in Disguise, The Baudhāyana-Pythagoras Theorem, Proportional Reasoning–2, Exploring Some Geometric Themes, Tales by Dots and Lines, Algebra Play, and Area. Each chapter provides structured learning support through chapter summaries, important formulas, LOTS and HOTS questions, fill-in-the-blanks, one-mark to five-mark descriptive questions, application-oriented problems, and Olympiad-type multiple-choice questions. This integrated approach encourages students to progress from fundamental mathematical understanding to higher-order reasoning, analytical problem-solving, and practical application of mathematical concepts.

Designed to support students in preparing confidently for both CBSE school examinations and competitive examinations such as Mathematics Olympiads, GANITHA PRAKASH FOR YOUNG INTELLECTS (Part Two) seeks to bridge classroom learning with competitive-examination readiness. Through systematic practice, conceptual clarity, real-life applications, and challenging mathematical exercises, the book aims to develop accuracy, confidence, independent thinking, creativity, and a positive attitude towards Mathematics. We hope this book inspires every young intellect to explore mathematical ideas, discover fascinating patterns, reason logically, solve problems creatively, and experience the lifelong joy of learning Mathematics.

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8th Standard Maths Part 2 Book Chapter 1

Chapter 1: FRACTIONS IN DISGUISE

1.1 Summary of the Chapter:

SUMMARY: FRACTIONS IN DISGUISE:

(1) A percentage means "per hundred" and is written using the symbol %. For example, 25% means 25 out of 100.

(2) A percentage is a fraction with 100 as its denominator. For example, 35% = 35/100.

(3) To convert a fraction into a percentage, multiply the fraction by 100. For example, 3/4 = 75%.

(4) To convert a percentage into a fraction, write it over 100 and simplify. For example, 24% = 24/100 = 6/25.

(5) Fractions, decimals and percentages can represent the same quantity. For example, 4/10 = 0.4 = 40%.

(6) To find a percentage of a quantity, multiply the quantity by the percentage written as a fraction or decimal. For example, 25% of 120 is 30.

(7) Some percentages make mental calculations easier: 50% is half, 25% is one quarter, and 10% is one tenth of a quantity.

(8) Percentages help compare parts of a whole. Before comparing percentages, check that they refer to the same whole or quantity.

(9) An increase or decrease in a quantity can be expressed as a percentage. After an increase of r%, multiply the original value by 1 + r/100; after a decrease of r%, multiply it by 1 − r/100.

(10) Percentages are used to calculate profit, loss, discounts and taxes. A discount reduces the price, while a tax increases the amount to be paid.

(11) Successive percentage changes are applied to the updated quantity each time. Therefore, two discounts in succession are generally not equal to one discount whose percentage is their sum.

(12) When a percentage increase or decrease is repeated over time, the quantity changes by compounding. Compound interest is one example, where interest is calculated on the updated amount.

1.2 Important Formulas:

IMPORTANT FORMULAS: FRACTIONS IN DISGUISE:

A. Fractions, Decimals and Percentages:

1. **Percentage as a fraction:**
   x% = x/100
2. **Fraction to percentage:**
   Percentage = (Fraction × 100)%
3. **Percentage to fraction:**
   x% = x/100, then simplify the fraction if possible.
4. **Decimal to percentage:**
   Percentage = Decimal × 100%
5. **Percentage to decimal:**
   Decimal = Percentage ÷ 100
6. **Ratio or part-to-whole fraction to percentage:**
   Percentage = (Part ÷ Whole) × 100%

B. Finding a Percentage or the Whole:

7. **Finding x% of a quantity Q:**
   x% of Q = (x/100) × Q
8. **Finding the whole when a part and its percentage are known:**
   Whole = Part ÷ (Percentage ÷ 100)
9. **Useful relationship:**
   x% of y = y% of x

C. Percentage Increase and Decrease:

10. **Percentage increase:**
    Percentage increase = (Amount of increase ÷ Original amount) × 100%
11. **Percentage decrease:**
    Percentage decrease = (Amount of decrease ÷ Original amount) × 100%
12. **Value after an increase of x%:**
    New value = Original value × (1 + x/100)
13. **Value after a decrease of x%:**
    New value = Original value × (1 − x/100)
14. **Finding the original value after a percentage change:**
    Original value = New value ÷ (1 + x/100) for an increase
    Original value = New value ÷ (1 − x/100) for a decrease

D. Profit, Loss and Discount:

15. **Profit:**
    Profit = Selling Price (SP) − Cost Price (CP)
16. **Loss:**
    Loss = Cost Price (CP) − Selling Price (SP)
17. **Profit percentage, based on cost price:**
    Profit percentage = (Profit ÷ CP) × 100%
18. **Loss percentage, based on cost price:**
    Loss percentage = (Loss ÷ CP) × 100%
19. **Selling price after a profit of x%:**
    SP = CP × (1 + x/100)
20. **Selling price after a loss of x%:**
    SP = CP × (1 − x/100)
21. **Discount amount:**
    Discount = Marked Price (MP) × (Discount percentage ÷ 100)
22. **Selling price after discount:**
    SP = MP − Discount
    or
    SP = MP × (1 − Discount percentage/100)
23. **Price after tax:**
    Price including tax = Original price × (1 + Tax rate/100)

E. Repeated Percentage Changes and Interest:

24. **Overall multiplier for successive percentage changes:**
    Final value = Original value × (Multiplier 1) × (Multiplier 2) × …

Use (1 + x/100) for an increase of x% and (1 − x/100) for a decrease of x%.

25. **Amount without compounding:**
    A = P × (1 + r × t)
26. **Amount with compounding each term:**
    A = P × (1 + r)^t
27. **Interest earned:**
    Interest = Amount − Principal

Symbols: P = principal or starting amount; A = final amount; r = rate written as a decimal; t = number of terms or years. For example, 10% = 0.10. Profit and loss percentages are based on cost price unless the question states another basis.

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

FILL IN THE BLANKS – LOTS TYPE:

1. The symbol used to represent "per cent" is _____.
   Answer: %
2. The phrase "per cent" means _____.
   Answer: per hundred
3. A percentage is a fraction with _____ as its denominator.
   Answer: 100
4. 50% is equal to the fraction _____.
   Answer: 1/2
5. 25% is equal to the fraction _____.
   Answer: 1/4
6. 75% is equal to the fraction _____.
   Answer: 3/4
7. 10% written as a decimal is _____.
   Answer: 0.1
8. 50% written as a decimal is _____.
   Answer: 0.5
9. The fraction 1/2 expressed as a percentage is _____.
   Answer: 50%
10. The fraction 1/4 expressed as a percentage is _____.
    Answer: 25%
11. The fraction 3/4 expressed as a percentage is _____.
    Answer: 75%
12. To convert a fraction into a percentage, we multiply it by _____.
    Answer: 100
13. To find 20% of a quantity, we multiply the quantity by _____.
    Answer: 0.2
14. 10% of 80 is _____.
    Answer: 8
15. 50% of 36 is _____.
    Answer: 18
16. 25% of 40 is _____.
    Answer: 10
17. 100% of a quantity is equal to _____ of that quantity.
    Answer: the whole
18. A percentage is useful for comparing parts when they refer to the same _____.
    Answer: whole
19. The amount by which a quantity rises is called the amount of _____.
    Answer: increase
20. Percentage increase is calculated using the original amount as the _____.
    Answer: base
21. Percentage increase = (Amount of increase ÷ Original amount) × _____.
    Answer: 100%
22. The amount by which a quantity falls is called the amount of _____.
    Answer: decrease

23. Percentage decrease = (Amount of decrease ÷ Original amount) × _____.
    Answer: 100%
24. The price paid to buy an item is called its _____.
    Answer: cost price
25. The price at which an item is sold is called its _____.
    Answer: selling price
26. The price marked or quoted for an item is called its _____.
    Answer: marked price
27. When the selling price is greater than the cost price, there is a _____.
    Answer: profit
28. When the selling price is less than the cost price, there is a _____.
    Answer: loss
29. Profit = Selling Price − _____.
    Answer: Cost Price
30. Loss = Cost Price − _____.
    Answer: Selling Price
31. Profit percentage is generally calculated with reference to the _____.
    Answer: cost price
32. A reduction in the marked price is called a _____.
    Answer: discount
33. A tax added to the price increases the amount the customer has to _____.
    Answer: pay
34. "p.a." is the abbreviation for _____.
    Answer: per annum
35. The original amount deposited or invested is called the _____.
    Answer: principal
36. When interest is added to the principal for the next term, the process is called _____.
    Answer: compounding
37. A reduction in the value of an item due to age or use is called _____.
    Answer: depreciation
38. The amount after a 10% increase is 110% of the _____ amount.
    Answer: original
39. The amount remaining after a 10% decrease is _____% of the original amount.
    Answer: 90
40. In compound growth, the percentage change is applied to the _____ amount in each term.
    Answer: updated

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

FILL IN THE BLANKS – HOTS TYPE:

1. A paint mixture contains 3/5 red paint. The percentage of red paint in the mixture is _____.
   Answer: 60%
2. A quantity equal to 7/4 of a whole is _____% of the whole.
   Answer: 175%
3. 18 is _____% of 72.
   Answer: 25%
4. A student scores 15% of 240 marks. The student scores _____ marks.
   Answer: 36 marks

5. A 200 g mixture contains 35% sugar. It contains _____ g of sugar.
   Answer: 70 g
6. A price rises from ₹30 to ₹42. The percentage increase is _____.
   Answer: 40%
7. The number of visitors to a theatre falls from 160 to 100. The percentage decrease is _____.
   Answer: 37.5%
8. A quantity is 120% of 50. The quantity is _____.
   Answer: 60
9. The population of a town is 50,000. A neighbouring town has 250% of its population. The neighbouring town's population is _____.
   Answer: 125,000
10. A ₹1,000 item increases in price by 15%. Its new price is _____.
    Answer: ₹1,150
11. A quantity of 800 decreases by 12.5%. The new quantity is _____.
    Answer: 700
12. A ₹500 item has a 20% discount. Its selling price is _____.
    Answer: ₹400
13. An item priced at ₹1,000 has 18% tax added. The final price is _____.
    Answer: ₹1,180
14. A quantity of 100 increases by 10% and then decreases by 10%. Its final value is _____.
    Answer: 99
15. A ₹200 cake receives successive discounts of 30% and 20%. Its final price is _____.
    Answer: ₹112
16. 50% of 80 and 80% of 50 are both equal to _____.
    Answer: 40
17. 20% and 5% of ₹300 together make _____.
    Answer: ₹75
18. If 40% of a quantity is 60, the whole quantity is _____.
    Answer: 150
19. 45 is 30% of _____.
    Answer: 150
20. A quantity of 72 is 120% of _____.
    Answer: 60
21. An item bought for ₹400 is sold for ₹500. The profit percentage is _____.
    Answer: 25%
22. An item bought for ₹800 is sold for ₹680. The loss percentage is _____.
    Answer: 15%
23. A cooker marked at ₹1,200 is sold at a 25% discount. Its selling price is _____.
    Answer: ₹900
24. A ₹1,000 item receives a 20% discount, and then 10% tax is added to the discounted price. The final price is _____.
    Answer: ₹880
25. A shopkeeper buys an item for ₹600 and earns a 20% profit. The selling price is _____.
    Answer: ₹720
26. An item bought for ₹1,000 is sold at a 25% loss. The selling price is _____.
    Answer: ₹750

27. ₹1,000 invested at 10% annual interest, compounded yearly for 2 years, becomes _____.
    Answer: ₹1,210
28. ₹1,000 invested at 10% annual interest for 2 years without compounding becomes _____.
    Answer: ₹1,200
29. A machine worth ₹1,000 depreciates by 10% each year. Its value after 2 years is _____.
    Answer: ₹810
30. A bus fare rises by 5% one year and 4% the next year. The overall percentage increase is _____.
    Answer: 9.2%
31. A ₹200 purchase receives a flat discount of ₹50. The discount is _____% of the original price.
    Answer: 25%
32. An item is sold for ₹600 at a profit of 20%. Its cost price is _____.
    Answer: ₹500
33. An item is sold for ₹720 at a loss of 10%. Its cost price is _____.
    Answer: ₹800
34. A shopkeeper marks an item 50% above its cost price and then gives a 50% discount on the marked price. The final selling price is _____% of the cost price.
    Answer: 75%
35. Following the situation in Question 34, the shopkeeper makes a _____% loss.
    Answer: 25%
36. A quantity becomes 165% of its original value. This is an increase of _____%.
    Answer: 65%

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

ONE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – LOTS TYPE:

1. **What does the symbol % mean?**
   Answer: The symbol % means "per hundred."
2. **What is the denominator of a fraction that represents a percentage?**
   Answer: The denominator is 100.
3. **Write 40% as a fraction.**
   Answer: 40% = 40/100 = 2/5.
4. **Write 1/2 as a percentage.**
   Answer: 1/2 = 50%.
5. **Write 1/4 as a percentage.**
   Answer: 1/4 = 25%.
6. **Write 3/4 as a percentage.**
   Answer: 3/4 = 75%.
7. **Write 0.6 as a percentage.**
   Answer: 0.6 = 60%.
8. **Write 35% as a decimal.**
   Answer: 35% = 0.35.
9. **What is 10% of 90?**
   Answer: 10% of 90 is 9.
10. **What is 50% of 64?**
    Answer: 50% of 64 is 32.

11. **What is 25% of 80?**
    Answer: 25% of 80 is 20.
12. **What is 100% of a quantity?**
    Answer: 100% of a quantity is the whole quantity.
13. **What percentage is 20 out of 100?**
    Answer: 20 out of 100 is 20%.
14. **What percentage of 50 is 10?**
    Answer: 10 is 20% of 50.
15. **What is the amount of increase when a price rises from ₹25 to ₹40?**
    Answer: The amount of increase is ₹15.
16. **What is the amount of decrease when a quantity falls from 90 to 70?**
    Answer: The amount of decrease is 20.
17. **What is the formula for percentage increase?**
    Answer: Percentage increase = (Amount of increase ÷ Original amount) × 100%.
18. **What is the formula for percentage decrease?**
    Answer: Percentage decrease = (Amount of decrease ÷ Original amount) × 100%.
19. **What is the price paid to buy an item called?**
    Answer: The price paid to buy an item is called its cost price.
20. **What is the price at which an item is sold called?**
    Answer: The price at which an item is sold is called its selling price.
21. **What is the price written or quoted for an item called?**
    Answer: The written or quoted price is called the marked price.
22. **When does a shopkeeper make a profit?**
    Answer: A shopkeeper makes a profit when the selling price is greater than the cost price.
23. **When does a shopkeeper incur a loss?**
    Answer: A shopkeeper incurs a loss when the selling price is less than the cost price.
24. **How is profit calculated?**
    Answer: Profit = Selling Price − Cost Price.
25. **How is loss calculated?**
    Answer: Loss = Cost Price − Selling Price.
26. **On which amount is profit percentage usually calculated?**
    Answer: Profit percentage is usually calculated on the cost price.
27. **What is a discount?**
    Answer: A discount is a reduction from the marked price.
28. **What happens to the price when a discount is given?**
    Answer: The price paid by the customer decreases.
29. **What happens to the amount paid when tax is added to a price?**
    Answer: The amount paid increases.
30. **What does "p.a." mean in an interest rate?**
    Answer: "p.a." means "per annum," or per year.
31. **What is the original amount deposited or invested called?**
    Answer: The original amount deposited or invested is called the principal.
32. **What is compounding?**
    Answer: Compounding is adding interest to the principal so that it earns interest in later terms.
33. **What is depreciation?**
    Answer: Depreciation is a reduction in an item's value due to age or use.
34. **What percentage of a quantity remains after a 20% decrease?**
    Answer: 80% of the quantity remains.

35. **What percentage of the original value is a quantity after a 30% increase?**
    Answer: The new quantity is 130% of the original value.

1.6 One-mark questions with Answers of HOTS Type: (35 Questions)

ONE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – HOTS TYPE:

1. **Is 25% of 80 equal to 20% of 100?**
   Answer: Yes, both quantities are 20.
2. **A price rises from ₹100 to ₹120; what is the percentage increase?**
   Answer: The percentage increase is 20%.
3. **An item costing ₹500 is reduced by 20%; what is its new price?**
   Answer: Its new price is ₹400.
4. **A ₹100 item receives successive discounts of 30% and 20%; what is the final price?**
   Answer: The final price is ₹56.
5. **A quantity increases by 20% and then decreases by 20%; what is the overall percentage change?**
   Answer: The quantity decreases overall by 4%.
6. **A customer gets ₹50 off an item marked at ₹250; what is the discount percentage?**
   Answer: The discount percentage is 20%.
7. **An item bought for ₹400 is sold for ₹360; what is the loss percentage?**
   Answer: The loss percentage is 10%.
8. **An item is sold for ₹540 at a profit of 20%; what was its cost price?**
   Answer: Its cost price was ₹450.
9. **A quantity of 60 is 120% of another quantity; what is the other quantity?**
   Answer: The other quantity is 50.
10. **What percentage of 60 is 15?**
    Answer: 15 is 25% of 60.
11. **Which is greater: 3/5 or 62%?**
    Answer: 62% is greater because 3/5 is 60%.
12. **Express 0.75 as a percentage and a fraction in simplest form.**
    Answer: 0.75 is 75%, or 3/4.
13. **A value is 125% of a whole; what fraction of the whole is it?**
    Answer: It is 5/4 of the whole.
14. **A ₹200 price increases by 10%; what is the new price?**
    Answer: The new price is ₹220.
15. **A quantity of 200 decreases by 10% and then increases by 10%; what is its final value?**
    Answer: Its final value is 198.
16. **A student scores 45 out of 60 marks; what percentage did the student score?**
    Answer: The student scored 75%.
17. **An item costs ₹250 before a 12% tax is added; what is the total price?**
    Answer: The total price is ₹280.
18. **After a 10% increase, a price is ₹220; what was its original price?**
    Answer: Its original price was ₹200.
19. **An item costs ₹400 after a 20% discount; what was its marked price?**
    Answer: Its marked price was ₹500.
20. **Which gives more after two years: ₹1,000 at 10% annual interest compounded yearly or without compounding?**
    Answer: Compounding gives ₹1,210, which is ₹10 more than the ₹1,200 without compounding.

21. **How do 5% of 80 and 80% of 5 compare?**
    Answer: They are equal because both are 4.
22. **A 200 g mixture is 35% sugar; how much sugar does it contain?**
    Answer: It contains 70 g of sugar.
23. **A test is marked out of 75, and a grade requires 80%; what is the minimum score needed?**
    Answer: The minimum score is 60 marks.
24. **In a group of 160 students, 40% are in Grade 8; how many are in Grade 8?**
    Answer: There are 64 Grade 8 students.
25. **A group has 200 students; 40% are in Grade 8, and 60% of the Grade 8 students are girls; how many Grade 8 girls are there?**
    Answer: There are 48 Grade 8 girls.
26. **A population of 1,000 increases by 3% in each of two years; what is its population after two years?**
    Answer: Its population will be 1,060.9, or about 1,061.
27. **A machine worth ₹1,000 depreciates by 10% each year; what is its value after three years?**
    Answer: Its value will be ₹729.
28. **An item marked at ₹600 receives a 25% discount; what is its selling price?**
    Answer: Its selling price is ₹450.
29. **An item bought for ₹250 is sold for ₹300; what is the profit percentage?**
    Answer: The profit percentage is 20%.
30. **An item costs ₹1,000, is marked 25% above cost, and then receives a 20% discount; what is the final profit or loss?**
    Answer: The selling price is ₹1,000, so there is no profit or loss.
31. **An item priced at ₹1,000 receives a 30% discount and then 18% tax on the discounted price; what is the final amount paid?**
    Answer: The final amount is ₹826.
32. **A population becomes 165% of its original size; by what percentage did it increase?**
    Answer: It increased by 65%.
33. **A quantity is reduced by 25%; what percentage of it remains?**
    Answer: 75% of the original quantity remains.
34. **In a room of 100 people, 99% are left-handed; how many left-handed people must leave so that 98% of those remaining are left-handed?**
    Answer: 50 left-handed people must leave.
35. **A shopkeeper buys an item for ₹800 and sells it at a 15% loss; what is the selling price?**
    Answer: The selling price is ₹680.

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

TWO-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – LOTS TYPE:

1. **What does 35% mean? Express it as a fraction.**
   Answer:
   a. 35% means 35 out of 100.
   b. As a fraction, 35% = 35/100 = 7/20.
2. **Convert 3/5 into a percentage.**
   Answer:

a. Multiply the fraction by 100: (3/5) × 100.
b. Therefore, 3/5 = 60%.

3. **Convert 7/20 into a percentage.**
   Answer:
   a. (7/20) × 100 = 35.
   b. Therefore, 7/20 = 35%.
4. **Express 45% as a fraction in simplest form.**
   Answer:
   a. 45% = 45/100.
   b. Simplifying, 45/100 = 9/20.
5. **Express 0.35 as a percentage and a fraction.**
   Answer:
   a. 0.35 × 100 = 35%, so 0.35 is 35%.
   b. As a fraction, 0.35 = 35/100 = 7/20.
6. **Find 10% and 50% of 80.**
   Answer:
   a. 10% of 80 = 8.
   b. 50% of 80 = 40.
7. **Find 25% and 75% of 120.**
   Answer:
   a. 25% of 120 = 30.
   b. 75% of 120 = 90.
8. **A student scores 36 marks out of 60. Find the percentage scored.**
   Answer:
   a. Percentage = (36/60) × 100.
   b. The student scored 60%.
9. **In a group of 80 students, 20 walk to school. What percentage walk to school?**
   Answer:
   a. Percentage = (20/80) × 100.
   b. Therefore, 25% walk to school.
10. **Find 20% of ₹250.**
    Answer:
    a. 20% of ₹250 = (20/100) × ₹250.
    b. The answer is ₹50.
11. **The price of an item rises from ₹40 to ₹50. Find the amount and percentage of increase.**
    Answer:
    a. Amount of increase = ₹50 − ₹40 = ₹10.
    b. Percentage increase = (₹10/₹40) × 100 = 25%.
12. **A quantity decreases from 200 to 150. Find the amount and percentage of decrease.**
    Answer:
    a. Amount of decrease = 200 − 150 = 50.
    b. Percentage decrease = (50/200) × 100 = 25%.
13. **An item marked at ₹800 is discounted by 10%. Find the discount and the selling price.**
    Answer:
    a. Discount = 10% of ₹800 = ₹80.
    b. Selling price = ₹800 − ₹80 = ₹720.

14. **A toy costs ₹600 and is sold for ₹660. Find the profit and profit percentage.**
    Answer:
    a. Profit = ₹660 − ₹600 = ₹60.
    b. Profit percentage = (₹60/₹600) × 100 = 10%.
15. **An item bought for ₹500 is sold for ₹450. Find the loss and loss percentage.**
    Answer:
    a. Loss = ₹500 − ₹450 = ₹50.
    b. Loss percentage = (₹50/₹500) × 100 = 10%.
16. **An item costs ₹1,000 before a 5% tax is added. Find the tax and final price.**
    Answer:
    a. Tax = 5% of ₹1,000 = ₹50.
    b. Final price = ₹1,000 + ₹50 = ₹1,050.
17. **A quantity of 400 increases by 15%. Find the increase and the new quantity.**
    Answer:
    a. Increase = 15% of 400 = 60.
    b. New quantity = 400 + 60 = 460.
18. **A quantity of 600 decreases by 20%. Find the decrease and the remaining quantity.**
    Answer:
    a. Decrease = 20% of 600 = 120.
    b. Remaining quantity = 600 − 120 = 480.
19. **A value of 40 is 20% of what number?**
    Answer:
    a. The whole number = 40 ÷ 0.20.
    b. The whole number is 200.
20. **An item sells for ₹720 after a 10% discount. Find its marked price.**
    Answer:
    a. After a 10% discount, the selling price is 90% of the marked price.
    b. Marked price = ₹720 ÷ 0.90 = ₹800.
21. **A population of 2,000 increases by 5%. Find the increase and the new population.**
    Answer:
    a. Increase = 5% of 2,000 = 100.
    b. New population = 2,000 + 100 = 2,100.
22. **An item worth ₹2,000 depreciates by 10%. Find the decrease in value and its new value.**
    Answer:
    a. Decrease in value = 10% of ₹2,000 = ₹200.
    b. New value = ₹2,000 − ₹200 = ₹1,800.
23. **A principal of ₹1,000 earns 10% interest for one year. Find the interest and total amount.**
    Answer:
    a. Interest = 10% of ₹1,000 = ₹100.
    b. Total amount = ₹1,000 + ₹100 = ₹1,100.
24. **₹1,000 is invested at 10% annual interest, compounded yearly for two years. Find the amount after two years.**
    Answer:
    a. Amount after Year 1 = ₹1,000 × 1.10 = ₹1,100.
    b. Amount after Year 2 = ₹1,100 × 1.10 = ₹1,210.

25. **A quantity is 120% of 50. Find the quantity and state how much it is above 50.**
Answer:
a. 120% of 50 = 1.20 × 50 = 60.
b. It is 10 more than 50.

1.8. Two-mark questions with Answers of HOTS Type: (22 Questions)

TWO-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – HOTS TYPE:

1. **A cake priced at ₹500 receives successive discounts of 30% and 20%. Find the final price and the overall discount percentage.**
Answer:
a. After the discounts, the price is ₹500 × 0.70 × 0.80 = ₹280.
b. The total discount is ₹220, which is 44% of ₹500.
2. **A quantity of 1,000 increases by 40% and then decreases by 25%. Find its final value and overall percentage change.**
Answer:
a. The final value is 1,000 × 1.40 × 0.75 = 1,050.
b. The quantity has increased overall by 5%.
3. **A price of ₹1,000 increases by 10% in each of two successive years. Find the final price and overall increase percentage.**
Answer:
a. The final price is ₹1,000 × 1.10 × 1.10 = ₹1,210.
b. The overall increase is ₹210, or 21%.
4. **A ₹1,200 item receives a 25% discount, and then 18% tax is added. Find the amount paid.**
Answer:
a. The price after discount is ₹1,200 × 0.75 = ₹900.
b. The final price after tax is ₹900 × 1.18 = ₹1,062.
5. **An item costs ₹800, is marked 25% above cost, and receives a 10% discount. Find the selling price and profit percentage.**
Answer:
a. The marked price is ₹800 × 1.25 = ₹1,000, and the selling price is ₹1,000 × 0.90 = ₹900.
b. The profit is ₹100, which is 12.5% of the cost price.
6. **A shopkeeper marks an item 50% above its cost price and then gives a 50% discount. If its cost price is ₹1,000, find the selling price and loss percentage.**
Answer:
a. The marked price is ₹1,500, and the selling price after discount is ₹750.
b. The loss is ₹250, which is 25% of the cost price.
7. **An item costs ₹300 and must sell for ₹360 after a 10% discount. Find the marked price and the markup percentage on the cost price.**
Answer:
a. Since ₹360 is 90% of the marked price, the marked price is ₹400.
b. The markup is ₹100, which is 33⅓% of the cost price.
8. **A value of 84 is 120% of an original number. Find the original number and 20% of it.**
Answer:
a. The original number is 84 ÷ 1.20 = 70.
b. 20% of 70 is 14.

9. **After a 20% decrease, a price becomes ₹640. Find the original price and the amount of decrease.**
   Answer:
   a. ₹640 is 80% of the original price, so the original price was ₹800.
   b. The decrease was ₹800 − ₹640 = ₹160.
10. **Show that 25% of 80 and 80% of 25 are equal.**
    Answer:
    a. 25% of 80 = 0.25 × 80 = 20.
    b. 80% of 25 = 0.80 × 25 = 20, so the results are equal.
11. **A population of 5,000 grows by 10% each year for two years. Find the final population and total percentage growth.**
    Answer:
    a. The final population is 5,000 × 1.10 × 1.10 = 6,050.
    b. The increase is 1,050, or 21% of the original population.
12. **₹20,000 earns 5% annual interest for two years. Compare the amount with annual compounding to the amount without compounding.**
    Answer:
    a. With compounding, the amount is ₹20,000 × 1.05 × 1.05 = ₹22,050.
    b. Without compounding, the amount is ₹22,000, so compounding gives ₹50 more.
13. **An item depreciates by 20% in each of two years. Find its value after two years if its original value was ₹1,000, and state the total percentage decrease.**
    Answer:
    a. Its value is ₹1,000 × 0.80 × 0.80 = ₹640.
    b. The total decrease is ₹360, or 36% of the original value.
14. **If 15% of a number is 45, find the number and then find 20% of it.**
    Answer:
    a. The number is 45 ÷ 0.15 = 300.
    b. 20% of 300 is 60.
15. **In a group of 200 students, 40% are in Grade 8 and 60% of the Grade 8 students are girls. Find the number of Grade 8 girls and their percentage of the whole group.**
    Answer:
    a. There are 80 Grade 8 students, and 60% of 80 is 48 girls.
    b. The 48 girls make up 24% of the whole group.
16. **In a room of 100 people, 99% are left-handed. How many left-handed people must leave so that 98% of those remaining are left-handed?**
    Answer:
    a. After 50 left-handed people leave, 49 left-handed and 1 right-handed person remain.
    b. Since 49 out of 50 is 98%, 50 left-handed people must leave.
17. **A store offers either a 20% discount or a flat ₹50 discount on a ₹300 purchase. Which offer saves more, and by how much?**
    Answer:
    a. The 20% discount saves ₹60, while the flat discount saves ₹50.
    b. The 20% discount saves ₹10 more.
18. **A store offers either a 20% discount or a flat ₹50 discount on a ₹180 purchase. Which offer saves more, and by how much?**
    Answer:
    a. The 20% discount saves ₹36, while the flat discount saves ₹50.
    b. The flat discount saves ₹14 more.

19. **An item priced at ₹500 receives a 30% discount, followed by 5% tax on the discounted price. Find the final price.**
    Answer:
    a. The discounted price is ₹500 × 0.70 = ₹350.
    b. The final price after tax is ₹350 × 1.05 = ₹367.50.
20. **A price of ₹800 decreases by 10% in each of two successive periods. Find the final price and the overall percentage decrease.**
    Answer:
    a. The final price is ₹800 × 0.90 × 0.90 = ₹648.
    b. The total decrease is ₹152, or 19% of the original price.
21. **A shopkeeper sells goods for ₹12,000 after marking their price 50% above cost and giving a 50% discount. Find the cost price and loss.**
    Answer:
    a. The selling price is 75% of the cost price, so the cost price was ₹16,000.
    b. The loss was ₹4,000, or 25% of the cost price.
22. **A price increases by 3% in one year and 4% in the next year. Find the overall percentage increase.**
    Answer:
    a. The overall multiplier is 1.03 × 1.04 = 1.0712.
    b. The overall increase is 7.12%.

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

THREE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – LOTS TYPE:

1. **Convert 3/5 into a percentage.**
   Answer:
   a. Multiply the fraction by 100.
   b. (3/5) × 100 = 60.
   c. Therefore, 3/5 = 60%.
2. **Convert 7/20 into a percentage.**
   Answer:
   a. Write the fraction as 7/20.
   b. Calculate (7/20) × 100 = 35.
   c. Therefore, 7/20 = 35%.
3. **Express 45% as a fraction in simplest form.**
   Answer:
   a. Write 45% as 45/100.
   b. Divide the numerator and denominator by 5.
   c. The simplest form is 9/20.
4. **Express 0.65 as a percentage and a fraction in simplest form.**
   Answer:
   a. Multiply 0.65 by 100 to get 65%.
   b. Write 65% as the fraction 65/100.
   c. Simplify to get 13/20.
5. **Find 15% of 200.**
   Answer:
   a. Write 15% as 15/100.
   b. Calculate (15/100) × 200 = 30.
   c. Therefore, 15% of 200 is 30.

6. **Find 25%, 50% and 75% of 120.**
   Answer:
   a. 25% of 120 is 30.
   b. 50% of 120 is 60.
   c. 75% of 120 is 90.
7. **A student scores 42 marks out of 60. Find the percentage scored.**
   Answer:
   a. Percentage = (Marks scored ÷ Total marks) × 100.
   b. Percentage = (42 ÷ 60) × 100 = 70%.
   c. The student scored 70%.
8. **In a class of 80 students, 20 walk to school. Find the percentage who walk to school.**
   Answer:
   a. The part is 20 students and the whole is 80 students.
   b. Percentage = (20 ÷ 80) × 100 = 25%.
   c. Therefore, 25% of the students walk to school.
9. **A price increases from ₹40 to ₹50. Find the increase and the percentage increase.**
   Answer:
   a. Increase = ₹50 − ₹40 = ₹10.
   b. Percentage increase = (₹10 ÷ ₹40) × 100 = 25%.
   c. The price increased by ₹10, or 25%.
10. **A quantity decreases from 240 to 180. Find the decrease and the percentage decrease.**
    Answer:
    a. Decrease = 240 − 180 = 60.
    b. Percentage decrease = (60 ÷ 240) × 100 = 25%.
    c. The quantity decreased by 60, or 25%.
11. **An item marked at ₹1,000 is sold at a 15% discount. Find the discount and the selling price.**
    Answer:
    a. Discount = 15% of ₹1,000 = ₹150.
    b. Selling price = ₹1,000 − ₹150 = ₹850.
    c. The discount is ₹150, and the selling price is ₹850.
12. **An item costs ₹600 and is sold for ₹720. Find the profit and profit percentage.**
    Answer:
    a. Profit = ₹720 − ₹600 = ₹120.
    b. Profit percentage = (₹120 ÷ ₹600) × 100 = 20%.
    c. The profit is ₹120, or 20% of the cost price.
13. **An item bought for ₹800 is sold for ₹680. Find the loss and loss percentage.**
    Answer:
    a. Loss = ₹800 − ₹680 = ₹120.
    b. Loss percentage = (₹120 ÷ ₹800) × 100 = 15%.
    c. The loss is ₹120, or 15% of the cost price.
14. **A product costs ₹2,000 before 5% tax is added. Find the tax and the final price.**
    Answer:
    a. Tax = 5% of ₹2,000 = ₹100.
    b. Final price = ₹2,000 + ₹100 = ₹2,100.
    c. The tax is ₹100, and the final price is ₹2,100.
15. **A population of 4,000 increases by 10%. Find the increase and the new population.**

Answer:
a. Increase = 10% of 4,000 = 400.
b. New population = 4,000 + 400 = 4,400.
c. The population increases by 400 to 4,400.

16. **A bicycle worth ₹10,000 depreciates by 20%. Find the decrease in value and its new value.**
Answer:
a. Decrease = 20% of ₹10,000 = ₹2,000.
b. New value = ₹10,000 − ₹2,000 = ₹8,000.
c. The bicycle's value decreases by ₹2,000 to ₹8,000.
17. **Find the amount after investing ₹5,000 at 10% annual interest for one year.**
Answer:
a. Interest = 10% of ₹5,000 = ₹500.
b. Amount = Principal + Interest = ₹5,000 + ₹500.
c. The amount after one year is ₹5,500.
18. **Find the amount after investing ₹1,000 at 10% annual interest compounded yearly for two years.**
Answer:
a. Amount after the first year = ₹1,000 × 1.10 = ₹1,100.
b. Amount after the second year = ₹1,100 × 1.10 = ₹1,210.
c. The amount after two years is ₹1,210.
19. **A quantity of 500 decreases by 10%. Find the decrease and the remaining quantity.**
Answer:
a. Decrease = 10% of 500 = 50.
b. Remaining quantity = 500 − 50 = 450.
c. The quantity decreases by 50 to 450.
20. **A shirt marked at ₹800 receives a 25% discount. Find the discount and the price after the discount.**
Answer:
a. Discount = 25% of ₹800 = ₹200.
b. Price after discount = ₹800 − ₹200 = ₹600.
c. The discount is ₹200, and the shirt costs ₹600 after discount.

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

THREE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – HOTS TYPE:

1. **A shop gives successive discounts of 30% and 20% on an item marked at ₹500. Find the final price and the overall discount percentage.**
Answer:
a. After the 30% discount, the price is ₹500 × 0.70 = ₹350.
b. After the further 20% discount, the price is ₹350 × 0.80 = ₹280.
c. The overall discount is ₹220, or 44% of ₹500.
2. **A quantity of 1,000 increases by 40% and then decreases by 25%. Find its final value and overall percentage change.**
Answer:
a. After the increase, the quantity is 1,000 × 1.40 = 1,400.
b. After the decrease, it is 1,400 × 0.75 = 1,050.
c. The overall change is an increase of 50, or 5%.

3. **Compare the amounts from investing ₹20,000 at 5% annual interest for two years, with and without annual compounding.**
   Answer:
   a. Without compounding, the amount is ₹20,000 × (1 + 0.05 × 2) = ₹22,000.
   b. With compounding, the amount is ₹20,000 × 1.05 × 1.05 = ₹22,050.
   c. Compounding gives ₹50 more.
4. **In an excursion group of 200 students, 40% are in Grade 8 and 60% of the Grade 8 students are girls. Find the number and percentage of the group who are Grade 8 girls.**
   Answer:
   a. Grade 8 students = 40% of 200 = 80.
   b. Grade 8 girls = 60% of 80 = 48.
   c. They make up 48/200 × 100 = 24% of the group.
5. **An item costs ₹800, is marked 25% above cost, and then receives a 10% discount. Find its selling price and profit percentage.**
   Answer:
   a. The marked price is ₹800 × 1.25 = ₹1,000.
   b. The selling price after discount is ₹1,000 × 0.90 = ₹900.
   c. The profit is ₹100, or 12.5% of the cost price.
6. **An item sells for ₹720 after a 10% discount. Find its marked price and the discount amount.**
   Answer:
   a. The selling price is 90% of the marked price.
   b. The marked price is ₹720 ÷ 0.90 = ₹800.
   c. The discount amount is ₹800 − ₹720 = ₹80.
7. **After a 15% increase, a price becomes ₹920. Find the original price and the amount of increase.**
   Answer:
   a. The new price is 115% of the original price.
   b. The original price is ₹920 ÷ 1.15 = ₹800.
   c. The increase is ₹920 − ₹800 = ₹120.
8. **An item marked at ₹1,200 receives a 25% discount, followed by 18% tax on the discounted price. Find the final price.**
   Answer:
   a. The discount is 25% of ₹1,200 = ₹300.
   b. The discounted price is ₹1,200 − ₹300 = ₹900.
   c. The final price after tax is ₹900 × 1.18 = ₹1,062.
9. **A bus fare of ₹1,000 increases by 3% one year and 4% the next year. Find the fare after two years and the overall percentage increase.**
   Answer:
   a. After the first increase, the fare is ₹1,000 × 1.03 = ₹1,030.
   b. After the second increase, it is ₹1,030 × 1.04 = ₹1,071.20.
   c. The overall increase is ₹71.20, or 7.12%.
10. **In a room of 100 people, 99% are left-handed. How many left-handed people must leave so that 98% of those remaining are left-handed?**
    Answer:
    a. Initially, there are 99 left-handed people and 1 right-handed person.
    b. If 50 left-handed people leave, 49 left-handed and 1 right-handed person remain.
    c. Since 49 out of 50 is 98%, 50 left-handed people must leave.

11. **Show that 25% of 80 equals 80% of 25, and state the common value.**
    Answer:
    a. 25% of 80 = 0.25 × 80 = 20.
    b. 80% of 25 = 0.80 × 25 = 20.
    c. Both expressions have the common value 20.
12. **A quantity is 165% of its original value. Express this as an increase and find the new value if the original value was 400.**
    Answer:
    a. 165% of the original consists of 100% original value and 65% increase.
    b. The increase is 65% of 400 = 260.
    c. The new value is 400 + 260 = 660.
13. **Explain why successive discounts of 30% and 20% do not equal a single discount of 50%, using an item marked at ₹200.**
    Answer:
    a. After a 30% discount, the price is ₹200 × 0.70 = ₹140.
    b. After a further 20% discount, the price is ₹140 × 0.80 = ₹112.
    c. The total discount is ₹88, or 44%, so it is not 50%.
14. **A shopkeeper marks goods 50% above their cost price. What discount percentage on the marked price would let the shopkeeper sell at cost price?**
    Answer:
    a. Let the cost price be ₹100, so the marked price is ₹150.
    b. To sell at cost price, the discount must be ₹150 − ₹100 = ₹50.
    c. The discount is 50/150 × 100 = 33⅓%.
15. **A village population of 1,000 decreases by 10% each decade. Find the expected population after two decades and the overall percentage decrease.**
    Answer:
    a. After the first decade, the population is 1,000 × 0.90 = 900.
    b. After the second decade, it is 900 × 0.90 = 810.
    c. The total decrease is 190, or 19% of the original population.
16. **An item is sold for ₹680 at a loss of 15%. Find its cost price and the amount of loss.**
    Answer:
    a. The selling price is 85% of the cost price.
    b. The cost price is ₹680 ÷ 0.85 = ₹800.
    c. The loss is ₹800 − ₹680 = ₹120.
17. **A student needs at least 80% to earn a grade, and the test is marked out of 75. Find the minimum score needed.**
    Answer:
    a. The required score is 80% of 75.
    b. 0.80 × 75 = 60.
    c. The student must score at least 60 marks.
18. **Madhu eats 120 g of biscuits containing 25% sugar, while Madhav eats 95 g containing 35% sugar. Who eats more sugar, and by how much?**
    Answer:
    a. Madhu eats 25% of 120 g = 30 g of sugar.
    b. Madhav eats 35% of 95 g = 33.25 g of sugar.
    c. Madhav eats 3.25 g more sugar.
19. **A population of 10,000 grows by 10% each year for two years. Find the final population and total percentage growth.**
    Answer:

a. After the first year, the population is 10,000 × 1.10 = 11,000.
b. After the second year, it is 11,000 × 1.10 = 12,100.
c. The total growth is 2,100, or 21% of the original population.

20. **A store offers either a 20% discount or a flat ₹50 discount on purchases of ₹180, ₹225 and ₹300. Identify the better offer for each purchase.**
Answer:
a. On ₹180, 20% is ₹36, so the flat ₹50 discount is better.
b. On ₹225, 20% is ₹45, so the flat ₹50 discount is better.
c. On ₹300, 20% is ₹60, so the percentage discount is better.

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

FIVE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – LOTS TYPE:

1. **Convert 7/20 into a percentage and a decimal.**
Answer:
a. The given fraction is 7/20.
b. Multiply the fraction by 100 to convert it to a percentage.
c. (7/20) × 100 = 35.
d. Therefore, 7/20 = 35%.
e. As a decimal, 7/20 = 0.35.
2. **Express 62.5% as a fraction in simplest form and as a decimal.**
Answer:
a. Write 62.5% as 62.5/100.
b. Remove the decimal by multiplying the numerator and denominator by 10.
c. This gives 625/1000.
d. Simplifying gives 5/8.
e. As a decimal, 62.5% = 0.625.
3. **In a class of 80 students, 30% walk to school and 25% travel by bicycle. Find how many students use each method and how many use neither method.**
Answer:
a. The number who walk is 30% of 80 = 24.
b. The number who travel by bicycle is 25% of 80 = 20.
c. Together, 24 + 20 = 44 students use these methods.
d. The number who use neither method is 80 − 44 = 36.
e. Therefore, 36 students use neither method.
4. **A student scores 68 marks out of 80. Find the percentage scored and the number of marks needed to reach 90%.**
Answer:
a. Percentage scored = (68 ÷ 80) × 100.
b. The student scored 85%.
c. 90% of 80 marks is 72 marks.
d. The student needs 72 − 68 = 4 more marks.
e. Therefore, 4 more marks are needed to reach 90%.
5. **A price increases from ₹240 to ₹300. Find the amount and percentage of increase, and state the new price as a percentage of the original price.**
Answer:
a. Amount of increase = ₹300 − ₹240 = ₹60.
b. Percentage increase = (₹60 ÷ ₹240) × 100.
c. The percentage increase is 25%.

d. The new price is ₹300 ÷ ₹240 × 100 = 125% of the original price.
e. Therefore, ₹300 is 125% of ₹240.

6. **A quantity decreases from 800 to 680. Find the amount and percentage of decrease, and state what percentage of the original quantity remains.**
   Answer:
   a. Amount of decrease = 800 − 680 = 120.
   b. Percentage decrease = (120 ÷ 800) × 100.
   c. The percentage decrease is 15%.
   d. Percentage remaining = (680 ÷ 800) × 100.
   e. Therefore, 85% of the original quantity remains.
7. **A cooker marked at ₹2,400 is sold at a 15% discount. Find the discount amount and selling price.**
   Answer:
   a. The marked price is ₹2,400.
   b. Discount = 15% of ₹2,400 = ₹360.
   c. Selling price = ₹2,400 − ₹360.
   d. The selling price is ₹2,040.
   e. Therefore, the cooker is sold for ₹2,040.
8. **An item costs ₹1,500 and is sold for ₹1,800. Find the profit and profit percentage.**
   Answer:
   a. Cost price = ₹1,500.
   b. Selling price = ₹1,800.
   c. Profit = ₹1,800 − ₹1,500 = ₹300.
   d. Profit percentage = (₹300 ÷ ₹1,500) × 100.
   e. The profit percentage is 20%.
9. **An item bought for ₹2,000 is sold for ₹1,700. Find the loss and loss percentage.**
   Answer:
   a. Cost price = ₹2,000.
   b. Selling price = ₹1,700.
   c. Loss = ₹2,000 − ₹1,700 = ₹300.
   d. Loss percentage = (₹300 ÷ ₹2,000) × 100.
   e. The loss percentage is 15%.
10. **A product costs ₹3,500 before 18% tax is added. Find the tax amount and final price.**
    Answer:
    a. Original price = ₹3,500.
    b. Tax = 18% of ₹3,500.
    c. The tax amount is ₹630.
    d. Final price = ₹3,500 + ₹630.
    e. The final price is ₹4,130.
11. **A bicycle worth ₹24,000 depreciates by 10% in one year. Find the depreciation and its value after one year.**
    Answer:
    a. Original value = ₹24,000.
    b. Depreciation = 10% of ₹24,000.
    c. The depreciation is ₹2,400.
    d. Value after one year = ₹24,000 − ₹2,400.
    e. The bicycle is worth ₹21,600 after one year.
12. **A principal of ₹8,000 earns 5% annual interest for three years without compounding. Find the interest for the whole period and the total amount.**

Answer:
a. Principal = ₹8,000.
b. Interest for one year = 5% of ₹8,000 = ₹400.
c. Interest for three years = ₹400 × 3 = ₹1,200.
d. Total amount = ₹8,000 + ₹1,200.
e. The total amount is ₹9,200.

13. **A principal of ₹10,000 earns 10% annual interest compounded yearly for two years. Find the amount after each year and the final interest earned.**
Answer:
a. Principal at the start is ₹10,000.
b. Amount after the first year = ₹10,000 × 1.10 = ₹11,000.
c. Amount after the second year = ₹11,000 × 1.10 = ₹12,100.
d. Interest earned over two years = ₹12,100 − ₹10,000.
e. The total interest earned is ₹2,100.
14. **A shopkeeper buys 40 bags for ₹500 each and sells each bag for ₹575. Find the total cost, total sales and total profit.**
Answer:
a. Total cost = 40 × ₹500 = ₹20,000.
b. Selling price per bag = ₹575.
c. Total sales = 40 × ₹575 = ₹23,000.
d. Total profit = ₹23,000 − ₹20,000 = ₹3,000.
e. The shopkeeper makes a total profit of ₹3,000.
15. **A village has a population of 5,000, which increases by 10% in the first year and 10% in the second year. Find the population after each year and the overall percentage increase.**
Answer:
a. Population at the start = 5,000.
b. Population after the first year = 5,000 × 1.10 = 5,500.
c. Population after the second year = 5,500 × 1.10 = 6,050.
d. Total increase = 6,050 − 5,000 = 1,050.
e. Overall percentage increase = (1,050 ÷ 5,000) × 100 = 21%.

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

FIVE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – HOTS TYPE:

1. **An item marked at ₹1,600 receives successive discounts of 25% and 10%. Find the price after each discount, the total discount and the overall discount percentage.**
Answer:
a. The first discount is 25% of ₹1,600 = ₹400.
b. The price after the first discount is ₹1,600 − ₹400 = ₹1,200.
c. The second discount is 10% of ₹1,200 = ₹120.
d. The final price is ₹1,200 − ₹120 = ₹1,080, so the total discount is ₹520.
e. The overall discount percentage is (₹520 ÷ ₹1,600) × 100 = 32.5%.
2. **A shopkeeper marks an item 50% above its cost price of ₹800 and then gives a 30% discount. Find the marked price, selling price, profit and profit percentage.**
Answer:
a. The markup is 50% of ₹800 = ₹400.
b. The marked price is ₹800 + ₹400 = ₹1,200.
c. The discount is 30% of ₹1,200 = ₹360.

d. The selling price is ₹1,200 − ₹360 = ₹840, so the profit is ₹40.
e. The profit percentage is (₹40 ÷ ₹800) × 100 = 5%.

3. **An item is sold for ₹960 at a loss of 20%. Find its cost price, the loss amount and the selling price that would have given a 20% profit.**
   Answer:
   a. At a 20% loss, the selling price is 80% of the cost price.
   b. Cost price = ₹960 ÷ 0.80 = ₹1,200.
   c. Loss = ₹1,200 − ₹960 = ₹240.
   d. A 20% profit on ₹1,200 would be ₹240.
   e. The selling price for a 20% profit would be ₹1,200 + ₹240 = ₹1,440.
4. **A quantity of 2,500 increases by 10% and then decreases by 10%. Find its value after each change and explain the overall change.**
   Answer:
   a. The increase is 10% of 2,500 = 250.
   b. The value after the increase is 2,500 + 250 = 2,750.
   c. The decrease is 10% of 2,750 = 275.
   d. The final value is 2,750 − 275 = 2,475.
   e. The overall decrease is 25, or 1% of the original value.
5. **A fare of ₹5,000 increases by 3% in one year and 4% in the next. Find the fare after each increase and the overall percentage increase.**
   Answer:
   a. The first increase is 3% of ₹5,000 = ₹150.
   b. The fare after the first year is ₹5,000 + ₹150 = ₹5,150.
   c. The second increase is 4% of ₹5,150 = ₹206.
   d. The fare after the second year is ₹5,150 + ₹206 = ₹5,356.
   e. The overall increase is ₹356, or 7.12% of the original fare.
6. **Compare simple interest and annual compound interest on ₹10,000 at 8% per year for two years. Find each final amount and the difference.**
   Answer:
   a. The simple interest for two years is ₹10,000 × 0.08 × 2 = ₹1,600.
   b. The amount with simple interest is ₹10,000 + ₹1,600 = ₹11,600.
   c. With compounding, the amount after the first year is ₹10,000 × 1.08 = ₹10,800.
   d. The amount after the second year is ₹10,800 × 1.08 = ₹11,664.
   e. Compound interest gives ₹11,664 − ₹11,600 = ₹64 more.
7. **An item marked at ₹2,500 receives a 25% discount, and then 18% tax is added to the discounted price. Find the discount, taxable price, tax and final amount.**
   Answer:
   a. The discount is 25% of ₹2,500 = ₹625.
   b. The price after discount is ₹2,500 − ₹625 = ₹1,875.
   c. The tax is 18% of ₹1,875 = ₹337.50.
   d. The final amount is ₹1,875 + ₹337.50 = ₹2,212.50.
   e. The customer pays ₹2,212.50 in total.
8. **A store offers either a 20% discount or a flat ₹50 discount on purchases of ₹180, ₹225 and ₹300. Find the savings under each offer and choose the better offer for each purchase.**
   Answer:
   a. On ₹180, 20% is ₹36, so the ₹50 discount saves ₹14 more.
   b. On ₹225, 20% is ₹45, so the ₹50 discount saves ₹5 more.
   c. On ₹300, 20% is ₹60, so the percentage discount saves ₹10 more.

d. The flat discount is better for purchases of ₹180 and ₹225.
e. The 20% discount is better for a purchase of ₹300.

9. **In a room of 100 people, 99% are left-handed. How many left-handed people must leave so that 98% of those remaining are left-handed? Show how the percentage changes.**
   Answer:
   a. Initially, there are 99 left-handed people and 1 right-handed person.
   b. If 50 left-handed people leave, 49 left-handed people remain.
   c. The right-handed person remains, so 50 people are left in total.
   d. The left-handed percentage is now (49 ÷ 50) × 100 = 98%.
   e. Therefore, 50 left-handed people must leave.
10. **In a group of 250 students, 40% are in Grade 8 and 60% of the Grade 8 students are girls. Find the number of Grade 8 girls and the percentage they represent of the whole group.**
    Answer:
    a. The number of Grade 8 students is 40% of 250 = 100.
    b. The number of Grade 8 girls is 60% of 100 = 60.
    c. There are 60 Grade 8 girls.
    d. Their percentage of the whole group is (60 ÷ 250) × 100.
    e. Grade 8 girls make up 24% of all the students.
11. **A mixture contains 3/8 red paint, and the rest is yellow paint. Find the percentage of each colour and compare their quantities in a 400 mL mixture.**
    Answer:
    a. The red paint fraction is 3/8.
    b. Red paint is (3/8) × 100 = 37.5% of the mixture.
    c. Yellow paint is 100% − 37.5% = 62.5%.
    d. In 400 mL, red paint is 37.5% of 400 = 150 mL.
    e. Yellow paint is 62.5% of 400 = 250 mL, which is 100 mL more than the red paint.
12. **A machine worth ₹25,000 depreciates by 20% each year for two years. Find its value after each year and its total percentage depreciation.**
    Answer:
    a. The first year's depreciation is 20% of ₹25,000 = ₹5,000.
    b. Its value after the first year is ₹25,000 − ₹5,000 = ₹20,000.
    c. The second year's depreciation is 20% of ₹20,000 = ₹4,000.
    d. Its value after the second year is ₹20,000 − ₹4,000 = ₹16,000.
    e. The total decrease is ₹9,000, or 36% of the original value.
13. **A shopkeeper buys goods for ₹20,000 and sells them for ₹24,000. Find the gross profit, profit percentage on cost price and profit as a percentage of sales.**
    Answer:
    a. Gross profit = ₹24,000 − ₹20,000 = ₹4,000.
    b. Profit percentage on cost price = (₹4,000 ÷ ₹20,000) × 100.
    c. The profit is 20% of the cost price.
    d. Profit as a percentage of sales = (₹4,000 ÷ ₹24,000) × 100.
    e. The profit is about 16.67% of the sales amount.
14. **A student needs at least 80% to earn a grade on a test marked out of 75. If the student scores 54 marks, find the score percentage and the additional marks needed for the grade.**
    Answer:
    a. The grade threshold is 80% of 75 = 60 marks.
    b. The student's percentage is (54 ÷ 75) × 100.

c. The student scored 72%.
d. The student is 60 − 54 = 6 marks below the threshold.
e. The student needs 6 more marks to reach the grade threshold.

15. **Ariba has 120% as many marbles as Arun, and Arun has 50 marbles. Find Ariba's number of marbles and express Arun's number as a percentage of Ariba's.**
Answer:
a. Ariba's marbles = 120% of 50.
b. Ariba has 1.20 × 50 = 60 marbles.
c. Arun has 50 marbles.
d. Arun's marbles as a percentage of Ariba's = (50 ÷ 60) × 100.
e. Arun has about 83.33% as many marbles as Ariba.

1.13 Five-mark questions with Answers of Applied Type: (15 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – APPLIED TYPE:

1. **A refrigerator is marked at ₹24,000. A shop offers a 20% discount and then adds 18% tax to the discounted price. Find the discount, price after discount, tax and final amount paid.**
Answer:
a. The discount is 20% of ₹24,000 = ₹4,800.
b. Price after discount = ₹24,000 − ₹4,800 = ₹19,200.
c. Tax = 18% of ₹19,200 = ₹3,456.
d. Final amount = ₹19,200 + ₹3,456 = ₹22,656.
e. The customer pays ₹22,656 in total.
2. **A retailer buys a chair for ₹2,000, marks it 40% above cost, and gives a 15% discount. Find its marked price, selling price, profit and profit percentage.**
Answer:
a. Markup = 40% of ₹2,000 = ₹800.
b. Marked price = ₹2,000 + ₹800 = ₹2,800.
c. Discount = 15% of ₹2,800 = ₹420.
d. Selling price = ₹2,800 − ₹420 = ₹2,380, so profit = ₹380.
e. Profit percentage = (₹380 ÷ ₹2,000) × 100 = 19%.
3. **A family buys a washing machine for ₹40,000. Its value depreciates by 15% each year. Find its value after two years and the total percentage decrease.**
Answer:
a. Depreciation in the first year = 15% of ₹40,000 = ₹6,000.
b. Value after the first year = ₹40,000 − ₹6,000 = ₹34,000.
c. Depreciation in the second year = 15% of ₹34,000 = ₹5,100.
d. Value after the second year = ₹34,000 − ₹5,100 = ₹28,900.
e. The total decrease is ₹11,100, or 27.75% of the original value.
4. **A student deposits ₹15,000 in a bank at 8% annual interest, compounded yearly. Find the amount after two years and the interest earned.**
Answer:
a. Amount after the first year = ₹15,000 × 1.08 = ₹16,200.
b. Interest added in the second year = 8% of ₹16,200 = ₹1,296.
c. Amount after the second year = ₹16,200 + ₹1,296 = ₹17,496.
d. Total interest earned = ₹17,496 − ₹15,000 = ₹2,496.
e. The student receives ₹17,496 after two years.

5. **A family borrows ₹25,000 at 6% annual interest for three years without compounding. Find the yearly interest, total interest and total repayment.**
   Answer:
   a. Interest for one year = 6% of ₹25,000 = ₹1,500.
   b. Total interest for three years = ₹1,500 × 3 = ₹4,500.
   c. The principal borrowed is ₹25,000.
   d. Total repayment = ₹25,000 + ₹4,500 = ₹29,500.
   e. The family repays ₹29,500 in total.
6. **A school surveys 400 students. If 35% travel by bus and 25% walk to school, find the number and percentage who travel by other means.**
   Answer:
   a. Students travelling by bus = 35% of 400 = 140.
   b. Students who walk = 25% of 400 = 100.
   c. Students using other means = 400 − 140 − 100 = 160.
   d. Their percentage is (160 ÷ 400) × 100 = 40%.
   e. Therefore, 160 students, or 40%, use other means.
7. **A town has a population of 12,000. It grows by 5% each year for two years. Find the population after each year and the overall percentage growth.**
   Answer:
   a. Increase in the first year = 5% of 12,000 = 600.
   b. Population after the first year = 12,000 + 600 = 12,600.
   c. Increase in the second year = 5% of 12,600 = 630.
   d. Population after the second year = 12,600 + 630 = 13,230.
   e. The overall increase is 1,230, or 10.25% of the original population.
8. **A laptop is priced at ₹50,000 before tax. The shop gives a 10% discount and then adds 12% tax to the discounted price. Find the final amount paid.**
   Answer:
   a. Discount = 10% of ₹50,000 = ₹5,000.
   b. Price after discount = ₹50,000 − ₹5,000 = ₹45,000.
   c. Tax = 12% of ₹45,000 = ₹5,400.
   d. Final amount = ₹45,000 + ₹5,400 = ₹50,400.
   e. The customer pays ₹50,400 in total.
9. **A shop buys 60 school bags for ₹800 each and sells them for ₹1,000 each. Find the total cost, total sales, total profit and profit percentage.**
   Answer:
   a. Total cost = 60 × ₹800 = ₹48,000.
   b. Total sales = 60 × ₹1,000 = ₹60,000.
   c. Total profit = ₹60,000 − ₹48,000 = ₹12,000.
   d. Profit percentage = (₹12,000 ÷ ₹48,000) × 100.
   e. The profit percentage is 25%.
10. **A student scores 68 out of 80 in Mathematics and 72 out of 90 in Science. Find the percentage in each subject and identify the higher percentage.**
    Answer:
    a. Mathematics percentage = (68 ÷ 80) × 100 = 85%.
    b. Science percentage = (72 ÷ 90) × 100 = 80%.
    c. The Mathematics percentage is higher.
    d. The difference is 85% − 80% = 5 percentage points.
    e. The student's higher percentage is in Mathematics.
11. **A bakery offers a 30% discount followed by a 20% discount on a cake marked at ₹800. Find the final price and compare the total discount with a single 50%**

discount.
Answer:
a. After the 30% discount, the price is ₹800 × 0.70 = ₹560.
b. The next discount is 20% of ₹560 = ₹112.
c. The final price is ₹560 − ₹112 = ₹448.
d. The total discount is ₹800 − ₹448 = ₹352, or 44%.
e. A single 50% discount would cost ₹400, which is ₹48 less.

12. **A farmer has 800 kg of grain. He sells 35% in the morning and 25% in the afternoon. Find how much grain he sells altogether and how much remains.**
Answer:
a. Grain sold in the morning = 35% of 800 kg = 280 kg.
b. Grain sold in the afternoon = 25% of 800 kg = 200 kg.
c. Total grain sold = 280 kg + 200 kg = 480 kg.
d. Grain remaining = 800 kg − 480 kg = 320 kg.
e. Therefore, 320 kg of grain remains.
13. **A household's monthly electricity bill is ₹2,400. The bill increases by 12% one month and decreases by 5% the next month. Find the bill after both changes and the overall percentage change.**
Answer:
a. Increase = 12% of ₹2,400 = ₹288.
b. Bill after the increase = ₹2,400 + ₹288 = ₹2,688.
c. Decrease = 5% of ₹2,688 = ₹134.40.
d. Bill after the decrease = ₹2,688 − ₹134.40 = ₹2,553.60.
e. The net increase is ₹153.60, or 6.4% of the original bill.
14. **A school library buys books worth ₹20,000 and receives a 15% discount. It then pays 5% tax on the discounted price. Find the discount, tax and final amount paid.**
Answer:
a. Discount = 15% of ₹20,000 = ₹3,000.
b. Price after discount = ₹20,000 − ₹3,000 = ₹17,000.
c. Tax = 5% of ₹17,000 = ₹850.
d. Final amount = ₹17,000 + ₹850 = ₹17,850.
e. The library pays ₹17,850 for the books.
15. **A shopkeeper buys a bicycle for ₹12,000 and marks it 25% above cost. To clear the stock, the shopkeeper gives a 20% discount on the marked price. Find the final selling price and determine whether there is a profit or loss.**
Answer:
a. Markup = 25% of ₹12,000 = ₹3,000.
b. Marked price = ₹12,000 + ₹3,000 = ₹15,000.
c. Discount = 20% of ₹15,000 = ₹3,000.
d. Selling price = ₹15,000 − ₹3,000 = ₹12,000.
e. The selling price equals the cost price, so there is no profit or loss.

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

MULTIPLE-CHOICE QUESTIONS – OLYMPIAD TYPE:

1. What is 3/8 expressed as a percentage?
A. 35% B. 37.5% C. 40% D. 42.5%
Answer: B. 37.5%

2. Which fraction is equivalent to 35% in simplest form?
   A. 7/20 B. 3/10 C. 7/25 D. 4/15
   Answer: A. 7/20
3. What is 0.125 expressed as a percentage?
   A. 1.25% B. 12.5% C. 25% D. 125%
   Answer: B. 12.5%
4. Which fraction is equivalent to 45% in simplest form?
   A. 4/9 B. 9/20 C. 5/9 D. 3/5
   Answer: B. 9/20
5. 24 is what percentage of 80?
   A. 24% B. 30% C. 32% D. 36%
   Answer: B. 30%
6. What is 25% of 360?
   A. 80 B. 85 C. 90 D. 95
   Answer: C. 90
7. 72 is 40% of which number?
   A. 160 B. 170 C. 180 D. 190
   Answer: C. 180
8. What percentage of 60 is 15?
   A. 20% B. 25% C. 30% D. 35%
   Answer: B. 25%
9. What is 80% of 75?
   A. 55 B. 60 C. 65 D. 70
   Answer: B. 60
10. A quantity is 125% of 240. What is the quantity?
    A. 280 B. 290 C. 300 D. 320
    Answer: C. 300
11. A price rises from ₹30 to ₹42. What is the percentage increase?
    A. 30% B. 35% C. 40% D. 42%
    Answer: C. 40%
12. A theatre's average footfall drops from 160 people to 100. What is the percentage decrease?
    A. 30% B. 35% C. 37.5% D. 40%
    Answer: C. 37.5%
13. What is the price of a ₹500 item after a 12% increase?
    A. ₹540 B. ₹550 C. ₹560 D. ₹570
    Answer: C. ₹560
14. What is the value of an ₹800 item after a 15% decrease?
    A. ₹660 B. ₹680 C. ₹700 D. ₹720
    Answer: B. ₹680
15. A quantity increases by 20% and then decreases by 20%. What is the overall change?
    A. No change B. 4% increase C. 4% decrease D. 2% decrease
    Answer: C. 4% decrease
16. A price increases by 10% in each of two successive years. What is the total percentage increase?
    A. 20% B. 21% C. 22% D. 25%
    Answer: B. 21%
17. An item marked at ₹400 receives successive discounts of 25% and 20%. What is its final price?

A. ₹220 B. ₹230 C. ₹240 D. ₹250
Answer: C. ₹240

18. A shop offers "Buy 1 and get 1 free" on identical items. What is the effective discount per item when two items are taken?
A. 25% B. 40% C. 50% D. 100%
Answer: C. 50%
19. A shopkeeper buys an item for ₹600 and sells it for ₹750. What is the profit percentage?
A. 20% B. 25% C. 30% D. 35%
Answer: B. 25%
20. An item bought for ₹1,000 is sold for ₹850. What is the loss percentage?
A. 10% B. 12% C. 15% D. 18%
Answer: C. 15%
21. An item costing ₹750 is sold at a profit of 20%. What is its selling price?
A. ₹850 B. ₹875 C. ₹900 D. ₹925
Answer: C. ₹900
22. A cooker marked at ₹1,500 receives a 20% discount. What is its selling price before tax?
A. ₹1,100 B. ₹1,200 C. ₹1,250 D. ₹1,300
Answer: B. ₹1,200
23. A ₹2,000 item has 18% tax added. What is the final price?
A. ₹2,180 B. ₹2,300 C. ₹2,360 D. ₹2,400
Answer: C. ₹2,360
24. An item priced at ₹1,000 receives a 10% discount, followed by 10% tax on the discounted price. What is the final price?
A. ₹990 B. ₹1,000 C. ₹1,010 D. ₹1,100
Answer: A. ₹990
25. ₹5,000 is invested at 8% annual interest for two years without compounding. What is the total amount?
A. ₹5,400 B. ₹5,800 C. ₹5,832 D. ₹5,880
Answer: B. ₹5,800
26. ₹10,000 is invested at 10% annual interest, compounded yearly for two years. What is the final amount?
A. ₹12,000 B. ₹12,100 C. ₹12,200 D. ₹12,210
Answer: B. ₹12,100
27. ₹6,000 earns 10% interest each year for three years. How much more is received with annual compounding than without compounding?
A. ₹186 B. ₹198 C. ₹210 D. ₹300
Answer: B. ₹198
28. A machine worth ₹1,000 depreciates by 10% each year. What is its value after two years?
A. ₹800 B. ₹810 C. ₹820 D. ₹900
Answer: B. ₹810
29. A town with a population of 5,000 grows by 10% each year for two years. What is its population after two years?
A. 6,000 B. 6,050 C. 6,100 D. 6,250
Answer: B. 6,050
30. After a 15% increase, a price becomes ₹920. What was the original price?
A. ₹780 B. ₹800 C. ₹820 D. ₹850
Answer: B. ₹800

31. An item costs ₹640 after a 20% discount. What was its marked price?
    A. ₹768 B. ₹780 C. ₹800 D. ₹820
    Answer: C. ₹800
32. A shop offers either a 20% discount or a flat ₹50 discount on a ₹225 purchase. Which offer saves more?
    A. 20% discount by ₹5 B. Flat ₹50 discount by ₹5
    C. Both save the same amount D. 20% discount by ₹10
    Answer: B. Flat ₹50 discount by ₹5
33. What is the relationship between 12% of 50 and 50% of 12?
    A. 12% of 50 is greater B. 50% of 12 is greater
    C. They are equal to 6 D. They are equal to 12
    Answer: C. They are equal to 6
34. A population becomes 165% of its original size. What is the percentage increase?
    A. 35% B. 55% C. 65% D. 165%
    Answer: C. 65%
35. A shopkeeper marks an item 50% above its cost price and then gives a 20% discount on the marked price. What is the profit percentage?
    A. 15% B. 20% C. 25% D. 30%
    Answer: B. 20%
36. A student scores 60 marks out of 75. What percentage did the student score?
    A. 75% B. 80% C. 85% D. 90%
    Answer: B. 80%
37. In a group of 200 students, 40% are in Grade 8, and 60% of those Grade 8 students are girls. How many Grade 8 girls are there?
    A. 40 B. 44 C. 48 D. 60
    Answer: C. 48
38. In a room of 100 people, 99% are left-handed. How many left-handed people must leave so that 98% of those remaining are left-handed?
    A. 25 B. 40 C. 49 D. 50
    Answer: D. 50
39. A price increases by 3% one year and 4% the next. What is the overall percentage increase?
    A. 7% B. 7.12% C. 7.5% D. 12%
    Answer: B. 7.12%
40. A shopkeeper buys a product for ₹1,000, marks it 50% above cost, then gives a 50% discount on the marked price. What is the result?
    A. 25% profit B. 25% loss C. No profit or loss D. 50% loss
    Answer: B. 25% loss

1.15 Best Practices Opportunity List from the Chapter: (18 Ideas)

BEST PRACTICES FOR TEACHING "FRACTIONS IN DISGUISE":

(1) Begin with familiar examples: Introduce percentages through sale discounts, exam marks, sports scores, taxes and food labels.

(2) Connect fractions, decimals and percentages: Use conversion charts and number lines to show how forms such as 1/2, 0.5 and 50% represent the same value.

(3) Use visual models: Draw 10 × 10 grids, bar models and shaded diagrams to help students see percentages as parts of a whole.

(4) Check what the percentage refers to: When comparing percentages, ask students to identify the whole or base quantity in each example.

(5) **Teach mental calculation strategies:** Practise finding 10%, 50%, 25%, 75% and 1% of quantities, then combine these to work out other percentages.
(6) **Use estimation before calculation:** Ask students to predict whether an answer is reasonable before they solve a problem, especially in shopping and tax examples.
(7) **Model each calculation clearly:** Have students identify the original amount, the percentage rate and the amount being found before selecting a formula.
(8) **Highlight the base in percentage change:** Emphasise that percentage increase and decrease are calculated using the original amount as the base.
(9) **Teach successive changes step by step:** Use a price tag or bar model to show that each discount, increase or decrease applies to the updated amount.
(10) **Compare discounts with fixed reductions:** Give students examples involving percentage discounts and flat-amount discounts so they can decide which offer gives greater savings.
(11) **Use realistic word problems:** Ask students to solve problems about budgets, bills, population, savings, depreciation, profit and loss.
(12) **Encourage different solution methods:** Invite students to use fractions, decimals, proportions, mental maths or diagrams, and discuss how their methods compare.
(13) **Use pair and group activities:** Set up a classroom shop or percentage challenge where students calculate discounts, selling prices, taxes and savings collaboratively.
(14) **Address common misconceptions directly:** Discuss why a 20% increase followed by a 20% decrease does not return a quantity to its original value.
(15) **Check understanding throughout the lesson:** Use short questions, mini-whiteboards or quick exercises after each concept before moving to the next one.
(16) **Differentiate practice tasks:** Provide straightforward percentage conversions first, followed by multi-step problems for students ready for greater challenge.
(17) **Give immediate, specific feedback:** Point out whether an error comes from choosing the wrong base, converting the percentage incorrectly or making a calculation mistake.
(18) **End with an exit question:** Ask each student to solve one short application problem, such as finding a sale price or percentage increase, to check individual understanding.

1.16 Innovations Opportunity List from the Chapter: (17 Ideas)

INNOVATIONS IN TEACHING AND LEARNING "FRACTIONS IN DISGUISE":

(1) **Create a student-run "Percentage Market":** Set up a classroom shop with marked prices, discount cards and play money; students take turns calculating final prices and checking one another's work.
(2) **Use a digital discount simulator:** Let students adjust an item's price and discount on a spreadsheet or simple online calculator, then compare single and successive discounts.
(3) **Make a "Percentages Around Us" photo walk:** Students photograph or list percentage examples from labels, advertisements, bills and notices, then explain what the percentage refers to.
(4) **Run a class data survey:** Students collect anonymous information, such as preferred sports or travel methods, and display the results as fractions, decimals and percentages.
(5) **Design a percentage escape room:** Place short conversion, discount and percentage-change problems at stations; each correct answer gives a clue to the next task.
(6) **Produce short student-made teaching videos:** In small groups, students explain one concept—such as finding 25% of a number or calculating a discount—using a drawing and a worked example.

(7) **Use QR-code challenge cards:** Place QR codes around the classroom that reveal a percentage problem; students solve each one and record their working on a response sheet.
(8) **Build a "percentage wall":** Students add examples and visual models of common percentages, including 1%, 10%, 25%, 50%, 75% and 100%, throughout the unit.
(9) **Explore percentage changes with a spreadsheet:** Students enter a starting value and apply repeated increases or decreases to see how compounding changes the result over time.
(10) **Create an advertisement comparison project:** Students compare two imaginary sale offers, calculate the final prices and prepare a short explanation of which offer gives better value.
(11) **Use a human number line:** Mark 0% to 100% across the classroom and ask students to stand where fractions, decimals or real-life situations belong.
(12) **Make an interactive quiz with student-created distractors:** Students write multiple-choice questions and plausible wrong answers, then explain why each distractor is incorrect.
(13) **Connect percentages to school activities:** Students calculate attendance, participation or survey results using class data, while avoiding the display of individual students' private information.
(14) **Create a "spot the mistake" challenge:** Present worked examples containing common errors—such as applying a second discount to the original price—and have students find and correct them.
(15) **Use a visual compound-change tracker:** Let students move counters or update a bar model after each increase, discount or depreciation step to show that each percentage applies to the new amount.
(16) **Design a personal budget challenge:** Give teams a fictional budget and a list of items with discounts and taxes; ask them to plan purchases and justify their calculations.
(17) **Offer choice in how students show learning:** Allow students to explain a percentage problem through a diagram, a written solution, a voice recording, a short video or a worked example poster.

1.17: Practicing Questions/Question Bank:

QUESTION BANK: FRACTIONS IN DISGUISE:

A. Fill in the Blanks:

1. 45% written as a fraction in simplest form is _____.
   Answer: 9/20

2. The fraction 3/4 is equal to _____%.
   Answer: 75%

3. 10% of 250 is _____.
   Answer: 25

4. When the selling price is greater than the cost price, the result is a _____.
   Answer: profit

5. "p.a." means _____.
   Answer: per annum

B. One-Mark Descriptive Questions:

1. **Express 0.35 as a percentage.**
   Answer: 0.35 = 35%.

2. **What is 20% of 150?**
   Answer: 20% of 150 is 30.

3. **What is the amount of increase when a price rises from ₹40 to ₹55?**
   Answer: The amount of increase is ₹15.

4. **What is a discount?**
   Answer: A discount is a reduction from the marked price.

5. **What is the value of a ₹200 item after a 10% increase?**
   Answer: The new value is ₹220.

C. Two-Mark Descriptive Questions:

1. **Convert 5/8 into a percentage.**
   Answer:
   a. (5/8) × 100 = 62.5.
   b. Therefore, 5/8 = 62.5%.

2. **An item marked at ₹500 receives a 30% discount. Find the discount and selling price.**
   Answer:
   a. Discount = 30% of ₹500 = ₹150.
   b. Selling price = ₹500 − ₹150 = ₹350.

3. **A quantity decreases from 900 to 720. Find the amount and percentage of decrease.**
   Answer:
   a. Decrease = 900 − 720 = 180.
   b. Percentage decrease = (180 ÷ 900) × 100 = 20%.

4. **Find the simple interest and total amount on ₹4,000 at 5% per annum for two years.**
   Answer:
   a. Interest = ₹4,000 × 0.05 × 2 = ₹400.
   b. Total amount = ₹4,000 + ₹400 = ₹4,400.

5. **An item bought for ₹800 is sold for ₹920. Find the profit and profit percentage.**
   Answer:
   a. Profit = ₹920 − ₹800 = ₹120.
   b. Profit percentage = (₹120 ÷ ₹800) × 100 = 15%.

D. Three-Mark Descriptive Questions:

1. **Convert 3/5 into a percentage and a decimal.**
   Answer:
   a. (3/5) × 100 = 60.
   b. Therefore, 3/5 = 60%.
   c. As a decimal, 3/5 = 0.6.

2. **A price of ₹1,200 increases by 15%. Find the increase and the new price.**
   Answer:
   a. Increase = 15% of ₹1,200 = ₹180.
   b. New price = ₹1,200 + ₹180 = ₹1,380.
   c. The price after the increase is ₹1,380.

3. **A product marked at ₹1,500 receives a 20% discount, followed by 5% tax on the discounted price. Find the final price.**
   Answer:
   a. Discount = 20% of ₹1,500 = ₹300.
   b. Price after discount = ₹1,500 − ₹300 = ₹1,200.
   c. Tax = 5% of ₹1,200 = ₹60, so the final price is ₹1,260.

4. **Find the amount after investing ₹5,000 at 10% annual interest, compounded yearly for two years.**
   Answer:
   a. Amount after the first year = ₹5,000 × 1.10 = ₹5,500.
   b. Amount after the second year = ₹5,500 × 1.10 = ₹6,050.
   c. The amount after two years is ₹6,050.

5. **In a group of 200 students, 35% travel by bus and 25% walk. Find how many use each method and how many use other means.**
   Answer:
   a. Bus travellers = 35% of 200 = 70.
   b. Students who walk = 25% of 200 = 50.
   c. Students using other means = 200 − 70 − 50 = 80.

E. Five-Mark Descriptive Questions:

1. **An item marked at ₹1,000 receives successive discounts of 20% and 10%. Find the price after each discount, the total discount and the overall discount percentage.**
   Answer:
   a. The first discount is 20% of ₹1,000 = ₹200.
   b. The price after the first discount is ₹1,000 − ₹200 = ₹800.
   c. The second discount is 10% of ₹800 = ₹80.
   d. The final price is ₹800 − ₹80 = ₹720, so the total discount is ₹280.
   e. The overall discount is (₹280 ÷ ₹1,000) × 100 = 28%.

2. **A machine worth ₹50,000 depreciates by 10% each year for three years. Find its value after each year and the total decrease in value.**
   Answer:
   a. First-year depreciation = 10% of ₹50,000 = ₹5,000.
   b. Value after the first year = ₹50,000 − ₹5,000 = ₹45,000.
   c. Value after the second year = ₹45,000 × 0.90 = ₹40,500.
   d. Value after the third year = ₹40,500 × 0.90 = ₹36,450.
   e. Total decrease = ₹50,000 − ₹36,450 = ₹13,550.

3. **A shopkeeper buys an item for ₹2,400, marks it 25% above cost, and then gives a 10% discount. Find the marked price, selling price and profit percentage.**
   Answer:
   a. Markup = 25% of ₹2,400 = ₹600.
   b. Marked price = ₹2,400 + ₹600 = ₹3,000.
   c. Discount = 10% of ₹3,000 = ₹300.
   d. Selling price = ₹3,000 − ₹300 = ₹2,700, so profit = ₹300.
   e. Profit percentage = (₹300 ÷ ₹2,400) × 100 = 12.5%.

4. **A town has a population of 8,000, which increases by 5% each year for two years. Find the population after each year and the overall percentage increase.**
   Answer:

a. First-year increase = 5% of 8,000 = 400.
b. Population after the first year = 8,000 + 400 = 8,400.
c. Second-year increase = 5% of 8,400 = 420.
d. Population after the second year = 8,400 + 420 = 8,820.
e. Overall increase = 820, or (820 ÷ 8,000) × 100 = 10.25%.

5. **Compare the amounts from investing ₹10,000 at 10% annual interest for three years, with and without annual compounding.**
Answer:
a. Without compounding, interest = ₹10,000 × 0.10 × 3 = ₹3,000.
b. The amount without compounding is ₹10,000 + ₹3,000 = ₹13,000.
c. With compounding, the amount after the first year is ₹10,000 × 1.10 = ₹11,000.
d. The amount after the second and third years is ₹11,000 × 1.10 × 1.10 = ₹13,310.
e. Compounding gives ₹13,310 − ₹13,000 = ₹310 more.

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8th Standard Maths Part 2 Book Chapter 2

Chapter 2: THE BAUDHĀYANA-PYTHAGORAS THEOREM

2.1 Summary of the Chapter:

Chapter Summary: The Baudhāyana–Pythagoras Theorem:

(1) In the *Śulba-Sūtra*, Baudhāyana explained how to construct a square with twice the area of a given square: construct a new square using the original square's diagonal as its side.

(2) The same idea can be reversed to make a square with half the area of a given square. Paper cutting and folding help demonstrate these constructions.

(3) A right isosceles triangle with equal sides of 1 unit has a hypotenuse of length $\sqrt{2}$ units, because the square on the hypotenuse has twice the area of a 1-unit square.

(4) The value of $\sqrt{2}$ lies between 1.414 and 1.415. Its decimal expansion does not terminate, and $\sqrt{2}$ cannot be expressed as a fraction of two positive integers.

(5) For an isosceles right triangle with equal sides of length a and hypotenuse c, the relationship is $c^2 = 2a^2$. This can be used to find either the hypotenuse or an equal side.

(6) Baudhāyana's method for combining two squares of different sizes is to form a right-angled triangle using their side lengths. The square on the triangle's hypotenuse has an area equal to the sum of the two original square areas.

(7) This construction leads to the Baudhāyana–Pythagoras theorem: for a right-angled triangle with shorter sides a and b and hypotenuse c, $\mathbf{a^2 + b^2 = c^2}$.

(8) The theorem can be used to find a missing side in a right-angled triangle. For example, sides of 3 cm and 4 cm give a hypotenuse of 5 cm.

(9) Positive-integer triples that satisfy $a^2 + b^2 = c^2$ are called Baudhāyana or Pythagorean triples. Examples include (3, 4, 5), (5, 12, 13), and (8, 15, 17).

(10) Multiplying every number in a Baudhāyana triple by the same positive integer produces another triple. A triple with no common factor greater than 1 is called primitive.

(11) The chapter connects the study of square numbers and right triangles to Fermat's Last Theorem, which states that $x^n + y^n = z^n$ has no positive-integer solutions when n is greater than 2. Andrew Wiles proved the theorem in 1994.

(12) The theorem also helps solve practical geometry problems, such as finding the depth of a lake from the movement of a leaning lotus stem, and calculating diagonals and unknown lengths in shapes.

2.2 Important Formulas:

Important Formulas: The Baudhāyana–Pythagoras Theorem:

Symbols: a and b are the perpendicular sides of a right-angled triangle; c is its hypotenuse; s is a square's side; A is its area.

1. **Area of a square**
   $A = s^2$
2. **Baudhāyana–Pythagoras theorem**
   $a^2 + b^2 = c^2$
3. **Finding the hypotenuse**
   $c = \sqrt{(a^2 + b^2)}$
4. **Finding a shorter side**
   $a = \sqrt{(c^2 - b^2)}$
   $b = \sqrt{(c^2 - a^2)}$

5. **Isosceles right triangle**
   If the equal sides are a: $c^2 = 2a^2$
   Therefore, $c = a\sqrt{2}$ and $a = c/\sqrt{2}$
6. **Square with double the area**
   If the original square has side s, the new square's side is its diagonal:
   New side = $s\sqrt{2}$
   New area = $2s^2$
7. **Square with half the area**
   If the original square has side s:
   New square's side = $s/\sqrt{2}$
   New area = $s^2/2$
8. **Combining two squares**
   If the smaller squares have sides a and b, the side c of the square with their combined area satisfies:
   $c^2 = a^2 + b^2$
   $c = \sqrt{(a^2 + b^2)}$
9. **Baudhāyana–Pythagoras triples and scaling**
   A positive-integer triple (a, b, c) is a right-triangle triple when:
   $a^2 + b^2 = c^2$
   If (a, b, c) is a triple, then (ka, kb, kc) is also a triple for any positive integer k.
10. **Generating triples from an odd square**
    The nth odd number is $2n - 1$, and the sum of the first n odd numbers is:
    $1 + 3 + 5 + \ldots + (2n - 1) = n^2$
    If $2n - 1$ is a square, then:
    $(n - 1)^2 + (2n - 1) = n^2$
11. **Lotus-and-lake problem**
    If the lotus is k units above the water and its tip moves horizontally d units, with lake depth x:
    $d^2 + x^2 = (x + k)^2$
    Solving gives: $x = (d^2 - k^2)/(2k)$
12. **Approximate bounds for $\sqrt{2}$**
    $1.414 < \sqrt{2} < 1.415$
13. **Fermat's Last Theorem statement**
    For positive integers x, y, and z, there are no solutions to:
    $x^n + y^n = z^n$, when $n > 2$

These formulas and relationships are drawn from the uploaded chapter.

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

Fill in the Blanks – LOTS Questions:

The Baudhāyana–Pythagoras Theorem:

1. Baudhāyana's Śulba-Sūtra dates to approximately _____ BCE.
   Answer: 800
2. The side of the square constructed on a square's diagonal is the _____ of the original square.
   Answer: diagonal
3. A square constructed on the diagonal of a given square has _____ times its area.
   Answer: twice
4. The side of a square with double the area of a square of side s is _____.
   Answer: $s\sqrt{2}$

5. To construct a square with half the area of a given square, one method is to draw a smaller, tilted square _____ the original square.
   Answer: inside
6. The side opposite the right angle in a right-angled triangle is called the _____.
   Answer: hypotenuse
7. The square of the hypotenuse of a right-angled triangle is equal to the sum of the squares of the other two _____.
   Answer: sides
8. The Baudhāyana–Pythagoras theorem is written as _____.
   Answer: $a^2 + b^2 = c^2$
9. In the formula $a^2 + b^2 = c^2$, *c* represents the _____.
   Answer: hypotenuse
10. A right-angled triangle with shorter sides 3 and 4 has a hypotenuse of _____.
    Answer: 5
11. A square with side length 1 unit has an area of _____ square unit.
    Answer: 1
12. The hypotenuse of an isosceles right triangle with equal sides of 1 unit is _____ units.
    Answer: √2
13. In an isosceles right triangle with equal sides *a* and hypotenuse *c*, the relation is _____.
    Answer: $c^2 = 2a^2$
14. The value of √2 is greater than _____ and less than 2.
    Answer: 1
15. The value of √2 lies between _____ and 1.415.
    Answer: 1.414
16. The decimal representation of √2 is _____.
    Answer: non-terminating
17. The number √2 cannot be expressed as a fraction of two _____ numbers.
    Answer: positive integers
18. The approximate decimal representation of √2 begins _____.
    Answer: 1.41421356…
19. To combine two squares with sides *a* and *b*, the side of the resulting square is the _____ of a right-angled triangle with perpendicular sides *a* and *b*.
    Answer: hypotenuse
20. The area of the square on the hypotenuse is equal to the _____ of the areas of the squares on the other two sides.
    Answer: sum
21. A triple of positive integers satisfying $a^2 + b^2 = c^2$ is called a _____ triple.
    Answer: Baudhāyana–Pythagoras
22. The triple (3, 4, 5) is an example of a _____ triple.
    Answer: Baudhāyana
23. The triple (5, 12, 13) satisfies the equation _____.
    Answer: $5^2 + 12^2 = 13^2$
24. The triple (8, 15, 17) is a _____ triangle triple.
    Answer: right-angled
25. Multiplying each number in a Baudhāyana triple by the same positive integer gives a _____ version of that triple.
    Answer: scaled
26. A Baudhāyana triple with no common factor greater than 1 is called _____.
    Answer: primitive

27. The triple (3, 4, 5) is _____ because its numbers have no common factor greater than 1.
    Answer: primitive
28. The triple (6, 8, 10) is obtained by multiplying (3, 4, 5) by _____.
    Answer: 2
29. The sum of the first *n* odd numbers is _____.
    Answer: n^2
30. The nth odd number is _____.
    Answer: 2n − 1
31. The first three odd numbers are 1, 3, and _____.
    Answer: 5
32. Baudhāyana's triple examples include (12, 35, _____).
    Answer: 37
33. Fermat's Last Theorem concerns the equation $x^n + y^n =$ _____.
    Answer: z^n
34. Fermat's Last Theorem states that the equation $x^n + y^n = z^n$ has no positive-integer solutions when *n* is _____ than 2.
    Answer: greater
35. Andrew Wiles proved Fermat's Last Theorem in _____.
    Answer: 1994
36. A lotus stem problem in the chapter uses the Baudhāyana–Pythagoras theorem to find the _____ of a lake.
    Answer: depth
37. In the lotus problem, the tip of the stem touches the water _____ units from its original position.
    Answer: 3
38. In the lotus problem, the tip of the lotus is _____ unit above the water.
    Answer: 1
39. A rhombus's diagonals can be used with the theorem to find the length of one of its _____.
    Answer: sides
40. The Baudhāyana–Pythagoras theorem is a fundamental theorem of _____.
    Answer: geometry

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

Fill in the Blanks – HOTS Questions:

The Baudhāyana–Pythagoras Theorem:

1. A right-angled triangle has shorter sides of 9 cm and 12 cm. Its hypotenuse is _____ cm.
   Answer: 15
2. A right-angled triangle has a hypotenuse of 17 cm and one shorter side of 8 cm. The other shorter side is _____ cm.
   Answer: 15
3. A right-angled triangle has a hypotenuse of 13 units and one shorter side of 5 units. Its other shorter side is _____ units.
   Answer: 12
4. A right-angled triangle has shorter sides of 7 units and 24 units. Its hypotenuse is _____ units.
   Answer: 25

5. A ladder reaches 12 m up a wall, and its foot is 5 m from the wall. The ladder is _____ m long.
   Answer: 13
6. A rectangular field is 5 m wide and has a diagonal of 13 m. Its length is _____ m.
   Answer: 12
7. A right-angled triangle has shorter sides of 8 cm and 15 cm. The area of the square constructed on its hypotenuse is _____ cm^2.
   Answer: 289
8. The squares on the shorter sides of a right triangle have areas 36 cm^2 and 64 cm^2. The hypotenuse is _____ cm.
   Answer: 10
9. A right triangle has hypotenuse 10 units and one shorter side 6 units. Its third side is _____ units.
   Answer: 8
10. A right triangle has hypotenuse 25 units and one shorter side 7 units. Its other shorter side is _____ units.
    Answer: 24
11. The equal sides of an isosceles right triangle are each 6 cm. Its hypotenuse is _____ cm.
    Answer: $6\sqrt{2}$
12. The hypotenuse of an isosceles right triangle is 10 cm. Each equal side is _____ cm.
    Answer: $5\sqrt{2}$
13. An isosceles right triangle has equal sides of 12 units. Its hypotenuse is $\sqrt{288}$ units, which lies between _____ and _____ units.
    Answer: 16 and 17
14. An isosceles right triangle has a hypotenuse of $\sqrt{72}$ units. Each equal side is _____ units.
    Answer: 6
15. A square has side 5 cm. A square with double its area has side _____ cm.
    Answer: $5\sqrt{2}$
16. A square has side 10 cm. A square with half its area has side _____ cm.
    Answer: $5\sqrt{2}$
17. A square has side 8 cm. The area of a square constructed on its diagonal is _____ cm^2.
    Answer: 128
18. A square has side 14 cm. The area of a square with half its area is _____ cm^2.
    Answer: 98
19. A square's side is doubled. Its area becomes _____ times the original area.
    Answer: 4
20. A square with side 3 cm is replaced by a square constructed on its diagonal. The new square's area is _____ cm^2.
    Answer: 18
21. Two squares have side lengths 6 cm and 8 cm. The side of a square equal in area to their combined area is _____ cm.
    Answer: 10
22. Two squares have side lengths 5 cm and 12 cm. The side of a square equal in area to their combined area is _____ cm.
    Answer: 13

23. The areas of two squares are 49 cm² and 144 cm². The side of a square with their combined area is _____ cm.
    Answer: 13
24. Two square areas are 9 cm² and 16 cm². Their combined area is equal to the area of a square with side _____ cm.
    Answer: 5
25. A square has area 100 cm². Another square has area 44 cm². The area of a square equal to their combined area is _____ cm².
    Answer: 144
26. A square with side 9 cm is constructed on the hypotenuse of an isosceles right triangle. Each equal side of the triangle is _____ cm.
    Answer: 9/√2
27. A tilted square inside a larger square is made by joining the midpoints of its sides. If the larger square has area 64 cm², the inner square has area _____ cm².
    Answer: 32
28. A square with side 4 cm is divided into two congruent right triangles. The area of each triangle is _____ cm².
    Answer: 8
29. The triple (3, 4, 5) is scaled by a factor of 4. The resulting triple is (_____, _____, _____).
    Answer: (12, 16, 20)
30. The triple (5, 12, 13) is scaled by a factor of 3. The resulting triple is (_____, _____, _____).
    Answer: (15, 36, 39)
31. The triple (9, 12, 15) can be reduced by dividing each number by _____ to obtain the primitive triple (3, 4, 5).
    Answer: 3
32. The odd square 25 is the _____th odd number.
    Answer: 13th
33. Using the chapter's odd-square method, the odd square 25 gives the Baudhāyana triple (_____, _____, _____).
    Answer: (12, 5, 13)
34. Using the same method, the odd square 49 gives the Baudhāyana triple (_____, _____, _____).
    Answer: (24, 7, 25)
35. In the lotus problem, the tip is 1 unit above the water and touches the water 3 units away. The lake is _____ units deep.
    Answer: 4
36. In a lotus-stem problem, the stem is 2 units above the water and its tip moves 5 units horizontally. The lake depth is _____ units.
    Answer: 21/4 or 5.25
37. A student claims that a triangle with sides 6, 8, and 11 is right-angled. Since $6^2 + 8^2 = 100$ while $11^2 = 121$, the claim is _____.
    Answer: incorrect
38. A triangle has sides 10, 24, and 26. Since $10^2 + 24^2 = 26^2$, it _____ a right-angled triangle.
    Answer: is
39. A student says that a square with double the side length has double the area. Since doubling the side multiplies area by 2^2, its area becomes _____ times the original.
    Answer: 4

40. Fermat's Last Theorem rules out positive-integer solutions to $x^n + y^n = z^n$ when *n* is _____ than 2.
Answer: greater

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

One-Mark Descriptive Questions – LOTS:

The Baudhāyana–Pythagoras Theorem:

1. **What is the hypotenuse of a right-angled triangle?**
Answer: The hypotenuse is the side opposite the right angle.
2. **State the Baudhāyana–Pythagoras theorem.**
Answer: In a right-angled triangle, the square of the hypotenuse equals the sum of the squares of the other two sides.
3. **Write the formula for the Baudhāyana–Pythagoras theorem.**
Answer: The formula is $a^2 + b^2 = c^2$.
4. **What does *c* represent in the formula $a^2 + b^2 = c^2$?**
Answer: The letter *c* represents the hypotenuse.
5. **What is the area of a square with side length *s*?**
Answer: Its area is s^2 square units.
6. **How can a square with double the area of a given square be constructed?**
Answer: Construct a square using the diagonal of the given square as its side.
7. **How many times the original area is the area of the square on its diagonal?**
Answer: It is twice the original area.
8. **What is the side length of a square with double the area of a square of side *s*?**
Answer: Its side length is $s\sqrt{2}$.
9. **What kind of triangle is formed by cutting a square along its diagonal?**
Answer: It forms two congruent isosceles right triangles.
10. **What is the side length of a square with half the area of a square of side *s*?**
Answer: Its side length is $s/\sqrt{2}$.
11. **What is the length of the hypotenuse of an isosceles right triangle with equal sides of 1 unit?**
Answer: Its hypotenuse is $\sqrt{2}$ units long.
12. **Write the relationship between the equal side *a* and hypotenuse *c* of an isosceles right triangle.**
Answer: The relationship is $c^2 = 2a^2$.
13. **What is the approximate decimal value of $\sqrt{2}$ given in the chapter?**
Answer: The value of $\sqrt{2}$ begins approximately 1.41421356.
14. **Between which two decimals does $\sqrt{2}$ lie, to three decimal places?**
Answer: $\sqrt{2}$ lies between 1.414 and 1.415.
15. **Is $\sqrt{2}$ a terminating decimal?**
Answer: No, $\sqrt{2}$ has a non-terminating decimal expansion.
16. **Can $\sqrt{2}$ be expressed as a fraction of two positive integers?**
Answer: No, $\sqrt{2}$ cannot be expressed as such a fraction.
17. **What is a Baudhāyana–Pythagoras triple?**
Answer: It is a triple of positive integers satisfying $a^2 + b^2 = c^2$.
18. **Give one example of a Baudhāyana–Pythagoras triple.**
Answer: One example is (3, 4, 5).
19. **Is (5, 12, 13) a Baudhāyana–Pythagoras triple?**
Answer: Yes, because $5^2 + 12^2 = 13^2$.
20. **What is a primitive Baudhāyana triple?**
Answer: It is a triple whose numbers have no common factor greater than 1.

21. **Is (3, 4, 5) primitive?**
    Answer: Yes, (3, 4, 5) is primitive.
22. **Is (6, 8, 10) primitive?**
    Answer: No, its three numbers have a common factor of 2.
23. **What happens when each number in a Baudhāyana triple is multiplied by the same positive integer?**
    Answer: The resulting numbers form another Baudhāyana triple.
24. **What triple is obtained by multiplying (3, 4, 5) by 2?**
    Answer: The resulting triple is (6, 8, 10).
25. **What is the nth odd number?**
    Answer: The nth odd number is $2n - 1$.
26. **What is the sum of the first *n* odd numbers?**
    Answer: Their sum is n^2.
27. **Who stated the theorem on right-angled triangles in the Śulba-Sūtra?**
    Answer: Baudhāyana stated the theorem in the Śulba-Sūtra.
28. **Which Greek mathematician is also associated with the theorem?**
    Answer: The theorem is also associated with Pythagoras.
29. **What is the hypotenuse of a right-angled triangle with shorter sides 3 and 4 units?**
    Answer: The hypotenuse is 5 units.
30. **What is the missing side of a right-angled triangle with hypotenuse 17 units and one shorter side 8 units?**
    Answer: The missing side is 15 units.
31. **What did Baudhāyana's method show about combining squares of different sizes?**
    Answer: It showed that the square on the hypotenuse has an area equal to the sum of the two smaller square areas.
32. **What is the area relationship for squares constructed on the sides of a right triangle?**
    Answer: The areas on the two shorter sides add up to the area on the hypotenuse.
33. **What is the main subject of Fermat's Last Theorem?**
    Answer: It concerns whether a sum of two like powers can equal another like power in positive integers.
34. **For which values of *n* does Fermat's Last Theorem rule out positive-integer solutions to $x^n + y^n = z^n$?**
    Answer: It rules out solutions when *n* is greater than 2.
35. **Who proved Fermat's Last Theorem?**
    Answer: Andrew Wiles proved Fermat's Last Theorem.
36. **In what year did Andrew Wiles prove Fermat's Last Theorem?**
    Answer: He proved it in 1994.
37. **In the lotus problem, what does *x* represent?**
    Answer: The variable *x* represents the depth of the lake.
38. **How far from its original position does the lotus tip touch the water in the chapter's problem?**
    Answer: It touches the water 3 units away.
39. **How far above the water is the lotus tip before it bends in the chapter's problem?**
    Answer: It is 1 unit above the water.
40. **What is the depth of the lake in the chapter's lotus problem?**
    Answer: The lake is 4 units deep.

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

One-Mark Descriptive Questions – HOTS:

The Baudhāyana–Pythagoras Theorem:

1. **A right triangle has shorter sides of 6 cm and 8 cm; what is its hypotenuse?**
   Answer: Its hypotenuse is 10 cm.
2. **A right triangle has a hypotenuse of 13 cm and one shorter side of 5 cm; what is the other side?**
   Answer: The other side is 12 cm.
3. **A right triangle has a hypotenuse of 17 units and one shorter side of 8 units; find the remaining side.**
   Answer: The remaining side is 15 units.
4. **A rectangular garden is 9 m long and 12 m wide; how long is its diagonal?**
   Answer: Its diagonal is 15 m.
5. **A square has side length 7 cm; what is the side length of a square with twice its area?**
   Answer: The new square's side length is $7\sqrt{2}$ cm.
6. **A square has side length 7 cm; what is the area of the square constructed on its diagonal?**
   Answer: The new square's area is 98 cm^2.
7. **A square has area 50 cm^2; what is its side length?**
   Answer: Its side length is $5\sqrt{2}$ cm.
8. **An isosceles right triangle has equal sides of 8 cm; what is its hypotenuse?**
   Answer: Its hypotenuse is $8\sqrt{2}$ cm.
9. **An isosceles right triangle has a hypotenuse of 14 cm; what is the length of each equal side?**
   Answer: Each equal side is $7\sqrt{2}$ cm.
10. **Two squares have side lengths 7 cm and 24 cm; what is the side length of a square equal in area to their combined area?**
    Answer: The resulting square has side length 25 cm.
11. **Two squares have areas 25 cm^2 and 144 cm^2; what is the side length of a square with their combined area?**
    Answer: The resulting square has side length 13 cm.
12. **A right triangle has sides 9, 12, and 15; which side is its hypotenuse?**
    Answer: The hypotenuse is the side of length 15.
13. **A student claims that 6, 8, and 11 form a right-triangle triple; is the claim correct?**
    Answer: No, because $6^2 + 8^2 = 100$, which is not equal to 11^2.
14. **Do 10, 24, and 26 form a Baudhāyana triple?**
    Answer: Yes, because $10^2 + 24^2 = 26^2$.
15. **The triple (3, 4, 5) is multiplied by 5; what triple is formed?**
    Answer: The resulting triple is (15, 20, 25).
16. **The triple (5, 12, 13) is multiplied by 2; what triple is formed?**
    Answer: The resulting triple is (10, 24, 26).
17. **Is (9, 12, 15) primitive, or can it be reduced to a smaller triple?**
    Answer: It is not primitive because dividing each number by 3 gives (3, 4, 5).
18. **The odd square 9 is the fifth odd number; which triple does the chapter's method generate?**
    Answer: The method generates the triple (4, 3, 5).

19. **The odd square 25 is the thirteenth odd number; which triple does the method generate?**
    Answer: The method generates the triple (12, 5, 13).
20. **The odd square 49 is the twenty-fifth odd number; which triple does the method generate?**
    Answer: The method generates the triple (24, 7, 25).
21. **What is the sum of the first six odd numbers, using the chapter's pattern?**
    Answer: Their sum is 36.
22. **A square is folded along lines joining the midpoints of its sides; what fraction of its area is the inner square?**
    Answer: The inner square has half the area of the original square.
23. **The area of a square is 72 cm²; what is the area of a square with twice its area?**
    Answer: The doubled-area square has an area of 144 cm².
24. **The area of a square is 200 cm²; what is the area of a square with half its area?**
    Answer: The half-area square has an area of 100 cm².
25. **A square has side length 10 cm; what is the length of its diagonal?**
    Answer: Its diagonal is $10\sqrt{2}$ cm.
26. **A square has a diagonal of $10\sqrt{2}$ cm; what is its side length?**
    Answer: Its side length is 10 cm.
27. **The hypotenuse of an isosceles right triangle is $\sqrt{72}$ units; what is the length of either equal side?**
    Answer: Each equal side is 6 units.
28. **The equal sides of an isosceles right triangle are 12 units; between which consecutive integers does its hypotenuse lie?**
    Answer: Its hypotenuse, $\sqrt{288}$, lies between 16 and 17.
29. **A right triangle has hypotenuse 25 units and one shorter side 7 units; find the other shorter side.**
    Answer: The other shorter side is 24 units.
30. **A right triangle has legs of 1.5 units and 3.5 units; what is the square of its hypotenuse?**
    Answer: The square of its hypotenuse is 14.5 square units.
31. **In the lotus problem, the tip is 1 unit above the water and moves 3 units horizontally; what is the lake's depth?**
    Answer: The lake is 4 units deep.
32. **In the lotus problem, why is the bent stem treated as the hypotenuse of a right triangle?**
    Answer: It is the sloping side opposite the right angle formed by the vertical depth and horizontal movement.
33. **A square with side 4 cm is divided along its diagonal; what is the area of each resulting triangle?**
    Answer: Each triangle has an area of 8 cm².
34. **A square has side 6 cm; what is the area of the square constructed on its diagonal?**
    Answer: The diagonal square has an area of 72 cm².
35. **A student doubles a square's side to make a square of double its area; how many times larger will the area actually be?**
    Answer: The area will be four times as large.
36. **A square has side 4 cm; what side length should a square have to contain twice its area?**
    Answer: The required side length is $4\sqrt{2}$ cm.

37. **A square's area is 18 cm²; what is the area of the square constructed on its diagonal?**
Answer: The diagonal square has an area of 36 cm².
38. **A right triangle has shorter sides of 5 cm and 12 cm; what is the area of the square on its hypotenuse?**
Answer: The square on the hypotenuse has an area of 169 cm².
39. **According to Fermat's Last Theorem, can positive integers satisfy $x^3 + y^3 = z^3$?**
Answer: No, positive integers cannot satisfy that equation.
40. **If a right triangle's shorter sides are *a* and *b*, what expression gives the side length of the square equal in area to the two squares on those sides?**
Answer: The required side length is $\sqrt{(a^2 + b^2)}$.

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

Two-Mark Descriptive Questions – LOTS:
The Baudhāyana–Pythagoras Theorem

1. **State the Baudhāyana–Pythagoras theorem and write its formula.**
Answer: 1) In a right-angled triangle, the square of the hypotenuse equals the sum of the squares of the other two sides.
2. The formula is $a^2 + b^2 = c^2$.
2. **What is the hypotenuse, and where is it located in a right-angled triangle?**
Answer: 1) The hypotenuse is the side opposite the right angle.
2. It is the longest side of a right-angled triangle.
3. **How can a square with twice the area of a given square be constructed?**
Answer: 1) Draw the diagonal of the given square.
2. Construct a new square using that diagonal as its side.
4. **A square has side 4 cm; find the area of the square constructed on its diagonal.**
Answer: 1) The original square has area $4^2 = 16$ cm².
2. The diagonal square has twice that area, which is 32 cm².
5. **How can a square with half the area of a given square be made?**
Answer: 1) Join the midpoints of the sides of the original square to form an inner square.
2. The inner square has half the area of the original.
6. **Give the relationship between the equal side *a* and hypotenuse *c* of an isosceles right triangle.**
Answer: 1) The two shorter sides are both *a*.
2. The relationship is $c^2 = 2a^2$.
7. **Find the hypotenuse of a right-angled triangle with shorter sides 3 cm and 4 cm.**
Answer: 1) Using the theorem, $c^2 = 3^2 + 4^2 = 25$.
2. Therefore, the hypotenuse is 5 cm.
8. **Find the missing shorter side of a right-angled triangle with hypotenuse 17 cm and one shorter side 8 cm.**
Answer: 1) The missing side's square is $17^2 - 8^2 = 225$.
2. Therefore, the missing side is 15 cm.
9. **What is a Baudhāyana–Pythagoras triple? Give one example.**
Answer: 1) It is a triple of positive integers satisfying $a^2 + b^2 = c^2$.
2. The triple (3, 4, 5) is one example.
10. **Show that (5, 12, 13) is a Baudhāyana–Pythagoras triple.**
Answer: 1) $5^2 + 12^2 = 25 + 144 = 169$.
2. Since $13^2 = 169$, the triple satisfies the theorem.

11. **What is a primitive Baudhāyana triple? Give one example.**
Answer: 1) It is a triple whose numbers have no common factor greater than 1.
2. The triple (3, 4, 5) is primitive.
12. **Is (6, 8, 10) primitive? Explain briefly.**
Answer: 1) The numbers 6, 8, and 10 have the common factor 2.
2. Therefore, (6, 8, 10) is not primitive.
13. **What happens when all the numbers in a Baudhāyana triple are multiplied by the same positive integer? Give an example.**
Answer: 1) The resulting numbers form another Baudhāyana triple.
2. Multiplying (3, 4, 5) by 2 gives (6, 8, 10).
14. **Between which decimals does √2 lie to three decimal places, and what does this indicate about its value?**
Answer: 1) √2 lies between 1.414 and 1.415.
2. Its decimal expansion continues without terminating.
15. **Can √2 be expressed as a fraction of two positive integers? State the chapter's conclusion.**
Answer: 1) √2 cannot be expressed as a fraction of two positive integers.
2. Such numbers are called irrational numbers.
16. **State the relationship between the sum of the first *n* odd numbers and *n*.**
Answer: 1) The sum of the first *n* odd numbers is n^2.
2. For example, $1 + 3 + 5 + 7 = 4^2 = 16$.
17. **What is the nth odd number, and what is the fifth odd number?**
Answer: 1) The nth odd number is $2n - 1$.
2. The fifth odd number is $2 \times 5 - 1 = 9$.
18. **Use the chapter's odd-square method to give the triple formed from the odd square 9.**
Answer: 1) The odd square 9 is the fifth odd number.
2. The method gives the triple (4, 3, 5).
19. **Two squares have side lengths 6 cm and 8 cm; find the side of a square equal in area to their combined area.**
Answer: 1) The combined area is $6^2 + 8^2 = 36 + 64 = 100$ cm^2.
2. The required square has side 10 cm.
20. **How does Baudhāyana's theorem help combine two squares of different sizes?**
Answer: 1) Use the two square side lengths as the shorter sides of a right-angled triangle.
2. The square on the hypotenuse has an area equal to the sum of the two square areas.
21. **Who stated the theorem in the Śulba-Sūtra, and approximately when?**
Answer: 1) Baudhāyana stated the theorem in the Śulba-Sūtra.
2. The text dates to approximately 800 BCE.
22. **Why is the theorem also called the Pythagorean Theorem?**
Answer: 1) Pythagoras also studied and admired the theorem.
2. He lived a few centuries after Baudhāyana.
23. **In the chapter's lotus problem, what horizontal distance does the tip move, and how far above the water is it initially?**
Answer: 1) The tip moves 3 units horizontally.
2. It is initially 1 unit above the water.
24. **What is the lake's depth in the chapter's lotus problem?**
Answer: 1) The right-triangle relationship is $3^2 + x^2 = (x + 1)^2$.
2. Solving this gives a lake depth of 4 units.

25. **Find the hypotenuse of a right-angled triangle with shorter sides 8 units and 15 units.**
Answer: 1) $c^2 = 8^2 + 15^2 = 64 + 225 = 289$.
2. Therefore, c = 17 units.
26. **Check whether sides 6, 8, and 11 form a right-angled triangle.**
Answer: 1) The sum of the squares of 6 and 8 is 36 + 64 = 100.
2. Since $11^2 = 121$, these sides do not form a right-angled triangle.
27. **A square has side 8 cm; find the area of a square with half its area.**
Answer: 1) The original square's area is $8^2 = 64$ cm².
2. The half-area square has an area of 32 cm².
28. **What does Fermat's Last Theorem state for powers greater than 2?**
Answer: 1) It states that $x^n + y^n = z^n$ has no positive-integer solutions when $n > 2$.
2. Andrew Wiles proved the theorem in 1994.
29. **How did Euclid show that √2 cannot be written as a fraction of positive integers?**
Answer: 1) Assuming $\sqrt{2} = m/n$ leads to $2n^2 = m^2$.
2. This would make the prime factor 2 occur an odd number of times on one side and an even number on the other, which is impossible.
30. **What does dividing a square into triangles help show in the double-area construction?**
Answer: 1) The original square is made of two congruent small triangles.
2. The square on its diagonal is made of four congruent small triangles, so its area is double.

2.8. Two-mark questions with Answers of HOTS Type: (30 Questions)

Two-Mark Descriptive Questions – HOTS:
The Baudhāyana–Pythagoras Theorem:

1. **A right-angled triangle has shorter sides of 20 cm and 21 cm; find its hypotenuse.**
Answer: 1) $c^2 = 20^2 + 21^2 = 400 + 441 = 841$.
2. Therefore, c = 29 cm.
2. **A right-angled triangle has a hypotenuse of 29 cm and one shorter side of 20 cm; find its other shorter side.**
Answer: 1) The square of the missing side is $29^2 - 20^2 = 841 - 400 = 441$.
2. The missing side is 21 cm.
3. **A right-angled triangle has legs of 12 cm and 35 cm; calculate its hypotenuse.**
Answer: 1) $c^2 = 12^2 + 35^2 = 144 + 1225 = 1369$.
2. Therefore, c = 37 cm.
4. **A right-angled triangle has legs of 10 units and 24 units; find the hypotenuse.**
Answer: 1) $c^2 = 10^2 + 24^2 = 100 + 576 = 676$.
2. Therefore, c = 26 units.
5. **A right-angled triangle has hypotenuse 25 units and one shorter side 15 units; find the other shorter side.**
Answer: 1) The missing side squared is $25^2 - 15^2 = 625 - 225 = 400$.
2. The missing side is 20 units.
6. **Two squares have areas of 49 cm² and 576 cm²; find the side of a square equal in area to their combined area.**
Answer: 1) Their combined area is 49 + 576 = 625 cm².
2. The required square has side length 25 cm.
7. **A square has side 12 cm; find the area and side of a square with twice its area.**
Answer: 1) The new square's area is $2 \times 12^2 = 288$ cm².

2. Its side is $\sqrt{288} = 12\sqrt{2}$ cm.

8. **A square has side 12 cm; find the side length of a square with half its area.**
Answer: 1) The original area is $12^2 = 144$ cm², so half its area is 72 cm².
2. The side of the smaller square is $\sqrt{72} = 6\sqrt{2}$ cm.

9. **Two squares have areas of 64 cm² and 225 cm²; find the side length of a square with their combined area.**
Answer: 1) The combined area is $64 + 225 = 289$ cm².
2. The required side length is $\sqrt{289} = 17$ cm.

10. **An isosceles right triangle has equal sides of 5 cm; find its hypotenuse and give consecutive whole-number bounds for it.**
Answer: 1) The hypotenuse is $\sqrt{(5^2 + 5^2)} = 5\sqrt{2}$ cm.
2. Since $7^2 < 50 < 8^2$, it lies between 7 cm and 8 cm.

11. **An isosceles right triangle has equal sides of 10 cm; find its hypotenuse and give consecutive whole-number bounds for it.**
Answer: 1) The hypotenuse is $\sqrt{(10^2 + 10^2)} = 10\sqrt{2}$ cm.
2. Since $14^2 < 200 < 15^2$, it lies between 14 cm and 15 cm.

12. **An isosceles right triangle has a hypotenuse of 15 cm; find the length of each equal side.**
Answer: 1) If each equal side is *a*, then $2a^2 = 15^2$, so $a^2 = 225/2$.
2. Therefore, each equal side is $15/\sqrt{2}$ cm, or $15\sqrt{2}/2$ cm.

13. **Check whether (15, 20, 25) is a Baudhāyana triple and state whether it is primitive.**
Answer: 1) $15^2 + 20^2 = 225 + 400 = 625 = 25^2$, so it is a triple.
2. It is not primitive because all three numbers are divisible by 5.

14. **Scale the triple (8, 15, 17) by 3 and verify that the new triple satisfies the theorem.**
Answer: 1) Multiplying each number by 3 gives (24, 45, 51).
2. Since $24^2 + 45^2 = 576 + 2025 = 2601 = 51^2$, it is a triple.

15. **Reduce the triple (30, 40, 50) to its primitive form.**
Answer: 1) The greatest common factor of 30, 40, and 50 is 10.
2. Dividing each number by 10 gives (3, 4, 5).

16. **Use the chapter's odd-square method to generate a triple from the odd square 169.**
Answer: 1) Since $169 = 13^2$ and is the 85th odd number, take $n = 85$.
2. The generated triple is (84, 13, 85).

17. **Use the chapter's odd-square method to generate a triple from the odd square 225.**
Answer: 1) Since $225 = 15^2$ and is the 113th odd number, take $n = 113$.
2. The generated triple is (112, 15, 113).

18. **Find the sum of the first nine odd numbers using the pattern in the chapter.**
Answer: 1) The sum of the first *n* odd numbers is n^2.
2. For $n = 9$, the sum is $9^2 = 81$.

19. **Explain why the square constructed on a given square's diagonal has twice the area.**
Answer: 1) The original square can be divided into two congruent right triangles.
2. The square on its diagonal consists of four such triangles, so its area is double.

20. **Two squares have side lengths of 8 units and 15 units; find the side of a square equal in area to both combined.**
Answer: 1) Their combined area is $8^2 + 15^2 = 64 + 225 = 289$ square units.
2. The required square has side $\sqrt{289} = 17$ units.

21. **A lotus is 2 units above the water, and its tip touches the water 6 units away horizontally; find the lake's depth.**
Answer: 1) If the depth is x, then $6^2 + x^2 = (x + 2)^2$, giving $36 = 4x + 4$.
2. Solving gives $x = 8$ units.
22. **A rectangle has a diagonal of 25 cm and one side of 7 cm; find its other side.**
Answer: 1) The square of the other side is $25^2 - 7^2 = 625 - 49 = 576$.
2. The other side is 24 cm.
23. **A rhombus has diagonals of 16 units and 30 units; find the length of one side.**
Answer: 1) Half the diagonals are 8 and 15 units, forming a right triangle with the side as hypotenuse.
2. The side length is $\sqrt{(8^2 + 15^2)} = 17$ units.
24. **An equilateral triangle has side length 10 units; find its altitude.**
Answer: 1) The altitude bisects the base, forming a right triangle with legs h and 5 and hypotenuse 10.
2. Therefore, $h = \sqrt{(10^2 - 5^2)} = 5\sqrt{3}$ units.
25. **A student claims that 1.414 is exactly equal to $\sqrt{2}$; check the claim.**
Answer: 1) $1.414^2 = 1.999396$, which is close to but not equal to 2.
2. Therefore, 1.414 is an approximation of $\sqrt{2}$.
26. **Can positive integers satisfy $x^4 + y^4 = z^4$ according to Fermat's Last Theorem? Explain.**
Answer: 1) The exponent 4 is greater than 2.
2. Fermat's Last Theorem says there are no positive-integer solutions in this case.
27. **A square has area 98 cm²; find the area and side length of a square with twice its area.**
Answer: 1) The doubled area is $2 \times 98 = 196$ cm².
2. The side length is $\sqrt{196} = 14$ cm.
28. **A square has area 200 cm²; find the area and side length of a square with half its area.**
Answer: 1) Half the original area is $200 \div 2 = 100$ cm².
2. The side length of the half-area square is $\sqrt{100} = 10$ cm.
29. **A right-angled triangle has legs of 1.5 units and 3.5 units; find the square of its hypotenuse and express its hypotenuse.**
Answer: 1) $c^2 = 1.5^2 + 3.5^2 = 2.25 + 12.25 = 14.5$.
2. Therefore, $c = \sqrt{14.5}$ units.
30. **Explain how a right triangle can be used to construct a square whose area equals the sum of two given square areas.**
Answer: 1) Take the side lengths of the given squares as the perpendicular sides of a right triangle.
2. Construct a square on the hypotenuse, whose area equals the sum of the two original areas.

2.9. Three-mark questions with Answers of LOTS Type: (25 Questions)

Three-Mark Descriptive Questions – LOTS:

The Baudhāyana–Pythagoras Theorem

1. **State the Baudhāyana–Pythagoras theorem and identify its three sides.**
Answer:
1. The theorem applies to a right-angled triangle.
2. The two shorter sides are represented by a and b.
3. If the hypotenuse is c, then $a^2 + b^2 = c^2$.

2. **Find the hypotenuse of a right-angled triangle with shorter sides 6 cm and 8 cm.**
   Answer:
   1. Use the formula $c^2 = a^2 + b^2$.
   2. Substitute the values: $c^2 = 6^2 + 8^2 = 100$.
   3. Therefore, $c = 10$ cm.
3. **Find the missing shorter side when a right-angled triangle has a hypotenuse of 13 cm and one shorter side of 5 cm.**
   Answer:
   1. Use $b^2 = c^2 - a^2$.
   2. Substitute the values: $b^2 = 13^2 - 5^2 = 144$.
   3. Therefore, the missing side is 12 cm.
4. **Show that (5, 12, 13) is a Baudhāyana–Pythagoras triple.**
   Answer:
   1. Square the first two numbers: $5^2 = 25$ and $12^2 = 144$.
   2. Add the squares: $25 + 144 = 169$.
   3. Since $13^2 = 169$, the triple satisfies the theorem.
5. **A square has side length 4 cm; find the area and side length of a square with double its area.**
   Answer:
   1. The original square's area is $4^2 = 16$ cm^2.
   2. Double the area to get 32 cm^2.
   3. The new square's side is $\sqrt{32} = 4\sqrt{2}$ cm.
6. **A square has side length 10 cm; find the area and side length of a square with half its area.**
   Answer:
   1. The original square's area is $10^2 = 100$ cm^2.
   2. Half the area is 50 cm^2.
   3. The smaller square's side is $\sqrt{50} = 5\sqrt{2}$ cm.
7. **Find the hypotenuse of an isosceles right triangle whose equal sides are 5 cm.**
   Answer:
   1. The two shorter sides are each 5 cm.
   2. The hypotenuse satisfies $c^2 = 5^2 + 5^2 = 50$.
   3. Therefore, $c = 5\sqrt{2}$ cm.
8. **Find each equal side of an isosceles right triangle with a hypotenuse of 10 cm.**
   Answer:
   1. Let each equal side be a.
   2. Use $2a^2 = 10^2$, so $a^2 = 50$.
   3. Each equal side is $5\sqrt{2}$ cm.
9. **Give the bounds for $\sqrt{2}$ stated in the chapter.**
   Answer:
   1. The chapter gives 1.414 as a lower bound.
   2. It gives 1.415 as an upper bound.
   3. Therefore, $1.414 < \sqrt{2} < 1.415$.
10. **What does the chapter say about the decimal and fractional forms of $\sqrt{2}$?**
    Answer:
    1. $\sqrt{2}$ has a non-terminating decimal expansion.
    2. It cannot be expressed as a fraction of two positive integers.
    3. Therefore, $\sqrt{2}$ is an irrational number.
11. **Define a Baudhāyana triple and give an example.**
    Answer:

1. A Baudhāyana triple consists of three positive integers.
2. The numbers satisfy $a^2 + b^2 = c^2$.
3. The triple (3, 4, 5) is an example.

12. **Multiply the triple (3, 4, 5) by 3 and check that the result is a triple.**
Answer:
1. Multiplying each number by 3 gives (9, 12, 15).
2. Calculate $9^2 + 12^2 = 81 + 144 = 225$.
3. Since $15^2 = 225$, the new triple satisfies the theorem.

13. **Find the sum of the first five odd numbers using the rule in the chapter.**
Answer:
1. The rule is that the sum of the first *n* odd numbers is n^2.
2. For five odd numbers, calculate $5^2 = 25$.
3. Thus, $1 + 3 + 5 + 7 + 9 = 25$.

14. **Use the odd-square method to obtain a triple from the odd square 9.**
Answer:
1. The odd square 9 is the fifth odd number, so n = 5.
2. The square root of 9 is 3.
3. The method gives the triple (4, 3, 5).

15. **Two squares have side lengths of 9 cm and 12 cm; find the side of a square equal in area to their combined area.**
Answer:
1. The first square's area is $9^2 = 81$ cm^2.
2. The second square's area is $12^2 = 144$ cm^2, so their total is 225 cm^2.
3. The combined-area square has side $\sqrt{225} = 15$ cm.

16. **A rectangle has a diagonal of 25 cm and a side of 7 cm; find its other side.**
Answer:
1. The diagonal is the hypotenuse of a right triangle.
2. The other side squared is $25^2 - 7^2 = 576$.
3. Therefore, the other side is 24 cm.

17. **A right-angled triangle has sides of 8 cm and 15 cm; find its hypotenuse.**
Answer:
1. Use $c^2 = a^2 + b^2$.
2. Calculate $c^2 = 8^2 + 15^2 = 64 + 225 = 289$.
3. Therefore, c = 17 cm.

18. **In the chapter's lotus problem, the lotus is 1 unit above the water and bends 3 units horizontally; find the lake's depth.**
Answer:
1. Let the depth of the lake be *x* units, making the full stem length x + 1.
2. Apply the theorem: $3^2 + x^2 = (x + 1)^2$, which gives $9 = 2x + 1$.
3. Therefore, the lake is 4 units deep.

19. **State Fermat's Last Theorem as presented in the chapter and name its prover.**
Answer:
1. The equation $x^n + y^n = z^n$ has no positive-integer solutions when $n > 2$.
2. This statement is known as Fermat's Last Theorem.
3. Andrew Wiles proved it in 1994.

20. **Who stated the right-triangle theorem in the Śulba-Sūtra, and how is it also commonly named?**
Answer:
1. Baudhāyana stated the theorem in the Śulba-Sūtra.
2. It is also known as the Pythagorean Theorem.

3. The combined name Baudhāyana–Pythagoras Theorem acknowledges both names.

21. **A rhombus has diagonals of 16 units and 30 units; find the length of one side.**
Answer:
    1. The half-diagonals are 8 units and 15 units.
    2. These form the shorter sides of a right triangle, so the side squared is $8^2 + 15^2 = 289$.
    3. Therefore, each side is 17 units long.
22. **Check whether (8, 15, 17) is a Baudhāyana triple.**
Answer:
    1. Calculate $8^2 + 15^2 = 64 + 225 = 289$.
    2. Calculate $17^2 = 289$.
    3. Since the results are equal, (8, 15, 17) is a triple.
23. **Find the diagonal and the area of the square on that diagonal for a square with side 6 cm.**
Answer:
    1. The diagonal is $\sqrt{(6^2 + 6^2)} = 6\sqrt{2}$ cm.
    2. The original square's area is 36 cm².
    3. The square on the diagonal has area 72 cm².
24. **An equilateral triangle has side length 6 units; find its altitude.**
Answer:
    1. The altitude bisects the opposite side into two segments of 3 units.
    2. Apply the theorem: $h^2 = 6^2 - 3^2 = 27$.
    3. The altitude is $3\sqrt{3}$ units.
25. **Explain how the theorem helps find a missing side when the hypotenuse and one shorter side are known.**
Answer:
    1. Start with $a^2 + b^2 = c^2$, where *c* is the hypotenuse.
    2. Subtract the known shorter side's square from c^2.
    3. Take the square root of the result to find the missing side.

2.10. Three-mark questions with Answers of HOTS Type: (25 Questions)

Three-Mark Descriptive Questions – HOTS:
The Baudhāyana–Pythagoras Theorem:

1. **A right-angled triangle has shorter sides of 20 cm and 21 cm; find its hypotenuse.**
Answer:
    1. Use $c^2 = a^2 + b^2$.
    2. $c^2 = 20^2 + 21^2 = 400 + 441 = 841$.
    3. Therefore, c = 29 cm.
2. **A right-angled triangle has a hypotenuse of 41 cm and one shorter side of 9 cm; find the other shorter side.**
Answer:
    1. Let the missing side be *b*.
    2. $b^2 = 41^2 - 9^2 = 1681 - 81 = 1600$.
    3. Therefore, b = 40 cm.
3. **A student claims that 7, 24, and 25 form a Baudhāyana triple; verify the claim.**
Answer:
    1. Calculate $7^2 + 24^2 = 49 + 576 = 625$.
    2. Calculate $25^2 = 625$.

3. Since the values are equal, the claim is correct.

4. **A rectangle has a diagonal of 17 cm and a width of 8 cm; find its length.**
   Answer:
   1. Treat the diagonal as the hypotenuse of a right triangle.
   2. The length squared is $17^2 - 8^2 = 289 - 64 = 225$.
   3. Therefore, the length is 15 cm.
5. **A rhombus has diagonals of 10 units and 24 units; find the length of one side.**
   Answer:
   1. The half-diagonals are 5 units and 12 units.
   2. The side squared is $5^2 + 12^2 = 25 + 144 = 169$.
   3. Therefore, each side is 13 units.
6. **A square has side 9 cm; find the side and area of a square with double its area.**
   Answer:
   1. The new square's side is the diagonal of the original, so it is $9\sqrt{2}$ cm.
   2. The original area is $9^2 = 81$ cm², so the double area is 162 cm².
   3. The new square's area is $(9\sqrt{2})^2 = 162$ cm².
7. **A square has area 98 cm²; find the area and side of a square with twice its area.**
   Answer:
   1. The doubled area is $2 \times 98 = 196$ cm².
   2. The side of the new square is $\sqrt{196}$.
   3. Therefore, its side is 14 cm.
8. **A square has area 288 cm²; find the area and side of a square with half its area.**
   Answer:
   1. Half the original area is $288 \div 2 = 144$ cm².
   2. The side length is $\sqrt{144}$.
   3. Therefore, the half-area square has a side of 12 cm.
9. **Two squares have sides of 10 cm and 24 cm; find the side of a square equal in area to both combined.**
   Answer:
   1. Their combined area is $10^2 + 24^2 = 100 + 576 = 676$ cm².
   2. The side of the required square is $\sqrt{676}$.
   3. Therefore, its side is 26 cm.
10. **Two squares have areas of 36 cm² and 121 cm²; between which consecutive whole numbers does the side of a square with their combined area lie?**
    Answer:
    1. The combined area is $36 + 121 = 157$ cm².
    2. Its square root lies between $\sqrt{144}$ and $\sqrt{169}$.
    3. Therefore, the side lies between 12 and 13 units.
11. **An isosceles right triangle has equal sides of 7 units; find its hypotenuse and give whole-number bounds for it.**
    Answer:
    1. $c^2 = 7^2 + 7^2 = 98$.
    2. Therefore, $c = \sqrt{98} = 7\sqrt{2}$ units.
    3. Since $9^2 < 98 < 10^2$, the hypotenuse lies between 9 and 10 units.
12. **An isosceles right triangle has a hypotenuse of 18 cm; find the length of each equal side.**
    Answer:
    1. Let each equal side be a, so $2a^2 = 18^2$.
    2. Then $a^2 = 324 \div 2 = 162$.
    3. Each equal side is $\sqrt{162} = 9\sqrt{2}$ cm.

13. **Scale the triple (7, 24, 25) by 4 and verify that the result is also a triple.**
    Answer:
    1. Multiplying by 4 gives (28, 96, 100).
    2. $28^2 + 96^2 = 784 + 9216 = 10{,}000$.
    3. Since $100^2 = 10{,}000$, the scaled triple satisfies the theorem.
14. **Show how the triple (12, 16, 20) can be reduced to a primitive triple.**
    Answer:
    1. The common factor of 12, 16, and 20 is 4.
    2. Divide each number by 4 to get (3, 4, 5).
    3. The reduced triple is primitive because its numbers have no common factor greater than 1.
15. **Use the odd-square method to generate a triple from 289.**
    Answer:
    1. Since $289 = 17^2$, its square root is 17.
    2. Also, 289 is the 145th odd number because $2 \times 145 - 1 = 289$.
    3. The method gives the triple (144, 17, 145).
16. **Explain how the chapter's odd-square method produces a triple when an odd square is selected.**
    Answer:
    1. Let the selected odd square be m^2 and its position in the odd-number sequence be *n*.
    2. Then $m^2 = 2n - 1$, so $(n - 1)^2 + m^2 = n^2$.
    3. Therefore, $(n - 1, m, n)$ is a Baudhāyana triple.
17. **Use squared decimal values to show that $\sqrt{2}$ lies between 1.414 and 1.415.**
    Answer:
    1. $1.414^2 = 1.999396$, which is less than 2.
    2. $1.415^2 = 2.002225$, which is greater than 2.
    3. Therefore, $1.414 < \sqrt{2} < 1.415$.
18. **Explain the contradiction in assuming that $\sqrt{2}$ can be written as a fraction of positive integers.**
    Answer:
    1. If $\sqrt{2} = m/n$, then squaring gives $m^2 = 2n^2$.
    2. The prime factor 2 would occur an odd number of times on one side and an even number on the other.
    3. This is impossible, so $\sqrt{2}$ cannot be written as such a fraction.
19. **In the chapter's lotus problem, the tip is 1 unit above water and lands 3 units horizontally from its starting point; find the lake depth.**
    Answer:
    1. Let the lake depth be *x*, so the stem's full length is $x + 1$.
    2. Apply the theorem: $3^2 + x^2 = (x + 1)^2$, which simplifies to $9 = 2x + 1$.
    3. Therefore, $x = 4$ units.
20. **A student claims that positive integers can satisfy $x^3 + y^3 = z^3$; use Fermat's Last Theorem to assess the claim.**
    Answer:
    1. The equation is of the form $x^n + y^n = z^n$ with $n = 3$.
    2. Since 3 is greater than 2, Fermat's Last Theorem rules out positive-integer solutions.
    3. Therefore, the student's claim is incorrect.

21. **A square has side 5 cm; find the diagonal and the area of the square constructed on it.**
    Answer:
    1. The diagonal is $\sqrt{(5^2 + 5^2)} = \sqrt{50} = 5\sqrt{2}$ cm.
    2. The original square's area is 25 cm².
    3. The square on the diagonal has area $2 \times 25 = 50$ cm².
22. **An equilateral triangle has side 6 units; find its altitude and area.**
    Answer:
    1. The altitude bisects the base into two parts of 3 units each.
    2. By the theorem, the altitude is $\sqrt{(6^2 - 3^2)} = 3\sqrt{3}$ units.
    3. The area is $\frac{1}{2} \times 6 \times 3\sqrt{3} = 9\sqrt{3}$ square units.
23. **A square has side 8 cm; compare the area of the square on its diagonal with the original area.**
    Answer:
    1. The original square's area is $8^2 = 64$ cm².
    2. The square on its diagonal has area $2 \times 64 = 128$ cm².
    3. Thus, the diagonal square's area is twice the original area.
24. **Show that the hypotenuse is longer than either shorter side in a right-angled triangle.**
    Answer:
    1. The theorem gives $c^2 = a^2 + b^2$.
    2. Since both a^2 and b^2 are positive, c^2 is greater than a^2 and greater than b^2.
    3. Therefore, c is longer than either shorter side.
25. **Two squares have sides 5 cm and 12 cm; show how their areas can be combined into one square.**
    Answer:
    1. Their areas are $5^2 = 25$ cm² and $12^2 = 144$ cm².
    2. The combined area is $25 + 144 = 169$ cm².
    3. A square with side 13 cm has area 169 cm², so it matches their combined area.

2.11 Five-mark questions with Answers of LOTS Type: (18 Questions)

Five-Mark Descriptive Questions – LOTS:

The Baudhāyana–Pythagoras Theorem:

1. **Find the hypotenuse of a right-angled triangle whose shorter sides are 9 cm and 12 cm.**
   Answer:
   1. Let the hypotenuse be *c*.
   2. Use the formula $c^2 = a^2 + b^2$.
   3. Substitute the given sides: $c^2 = 9^2 + 12^2$.
   4. Calculate $c^2 = 81 + 144 = 225$.
   5. Therefore, c = 15 cm.
2. **Find the missing shorter side of a right-angled triangle with hypotenuse 25 cm and another side 7 cm.**
   Answer:
   1. Let the missing side be *b*.
   2. Use $b^2 = c^2 - a^2$.
   3. Substitute the known lengths: $b^2 = 25^2 - 7^2$.
   4. Calculate $b^2 = 625 - 49 = 576$.
   5. Therefore, b = 24 cm.

3. **Verify that (8, 15, 17) is a Baudhāyana–Pythagoras triple.**
   Answer:
   1. A Baudhāyana triple must satisfy $a^2 + b^2 = c^2$.
   2. Square the first number: $8^2 = 64$.
   3. Square the second number: $15^2 = 225$.
   4. Add these values: $64 + 225 = 289$.
   5. Since $17^2 = 289$, the triple is valid.
4. **A square has side length 5 cm; find the area and side length of a square with double its area.**
   Answer:
   1. The original square's area is $5^2 = 25$ cm².
   2. Double the area: $2 \times 25 = 50$ cm².
   3. The side of the new square is $\sqrt{50}$ cm.
   4. Simplify $\sqrt{50}$ to $5\sqrt{2}$ cm.
   5. The new square has area 50 cm² and side $5\sqrt{2}$ cm.
5. **A square has side length 12 cm; find the side length of a square with half its area.**
   Answer:
   1. The original square's area is $12^2 = 144$ cm².
   2. Half of 144 cm² is 72 cm².
   3. Let the new square's side be *s*.
   4. Since $s^2 = 72$, $s = \sqrt{72} = 6\sqrt{2}$ cm.
   5. Therefore, the half-area square has side length $6\sqrt{2}$ cm.
6. **Find the hypotenuse of an isosceles right triangle whose equal sides are 6 cm.**
   Answer:
   1. Both shorter sides are 6 cm.
   2. Use $c^2 = a^2 + b^2$.
   3. Substitute: $c^2 = 6^2 + 6^2$.
   4. Calculate $c^2 = 36 + 36 = 72$.
   5. Therefore, $c = \sqrt{72} = 6\sqrt{2}$ cm.
7. **Find each equal side of an isosceles right triangle with hypotenuse 14 cm.**
   Answer:
   1. Let each equal side be *a*.
   2. For this triangle, $c^2 = 2a^2$.
   3. Substitute the hypotenuse: $14^2 = 2a^2$.
   4. Divide by 2: $a^2 = 98$.
   5. Each equal side is $\sqrt{98} = 7\sqrt{2}$ cm.
8. **Two squares have side lengths 8 cm and 15 cm; find the side length of a square equal in area to their combined area.**
   Answer:
   1. The first square's area is $8^2 = 64$ cm².
   2. The second square's area is $15^2 = 225$ cm².
   3. Add the areas: $64 + 225 = 289$ cm².
   4. Find the square root of the combined area: $\sqrt{289} = 17$.
   5. The required square has side length 17 cm.
9. **Show that $\sqrt{2}$ lies between 1.4 and 1.5.**
   Answer:
   1. Square the lower number: $1.4^2 = 1.96$.
   2. Square the upper number: $1.5^2 = 2.25$.
   3. The number 2 is greater than 1.96.
   4. The number 2 is less than 2.25.

5. Therefore, $1.4 < \sqrt{2} < 1.5$.

10. **Explain whether the triple (6, 8, 10) is primitive.**
Answer:
    1. A primitive triple has no common factor greater than 1.
    2. The numbers 6, 8, and 10 are all divisible by 2.
    3. Divide each number by 2.
    4. The reduced triple is (3, 4, 5).
    5. Therefore, (6, 8, 10) is not primitive.
11. **Use the odd-square method to find a Baudhāyana triple from the odd square 25.**
Answer:
    1. The square root of 25 is 5.
    2. The odd number 25 is the 13th odd number.
    3. Set n = 13 in the method.
    4. The two other numbers are $n - 1 = 12$ and $\sqrt{25} = 5$.
    5. The triple is (12, 5, 13).
12. **Find the depth of the lake in the chapter's lotus problem. The lotus tip is 1 unit above the water and touches the water 3 units away horizontally.**
Answer:
    1. Let the lake depth be x units.
    2. The full length of the stem is $x + 1$ units.
    3. The right-triangle equation is $3^2 + x^2 = (x + 1)^2$.
    4. Simplifying gives $9 + x^2 = x^2 + 2x + 1$, so $x = 4$.
    5. Therefore, the lake is 4 units deep.
13. **A rectangle has a diagonal of 13 cm and one side of 5 cm; find the other side.**
Answer:
    1. The diagonal and two sides form a right-angled triangle.
    2. Let the unknown side be b.
    3. Use $b^2 = 13^2 - 5^2$.
    4. Calculate $b^2 = 169 - 25 = 144$.
    5. Therefore, the other side is 12 cm.
14. **A rhombus has diagonals of 24 units and 70 units; find the length of one side.**
Answer:
    1. The diagonals bisect each other at right angles.
    2. Half of the diagonals are 12 units and 35 units.
    3. These halves and a side form a right-angled triangle.
    4. The side squared is $12^2 + 35^2 = 144 + 1225 = 1369$.
    5. Therefore, each side is $\sqrt{1369} = 37$ units.
15. **Find the area of an equilateral triangle with side length 6 units.**
Answer:
    1. The altitude bisects the opposite side into two lengths of 3 units.
    2. The altitude and half-base form a right triangle with hypotenuse 6 units.
    3. The altitude is $\sqrt{(6^2 - 3^2)} = \sqrt{27} = 3\sqrt{3}$ units.
    4. The area is one-half × base × height.
    5. Therefore, the area is $\frac{1}{2} \times 6 \times 3\sqrt{3} = 9\sqrt{3}$ square units.
16. **Find the diagonal and the area of the square constructed on that diagonal when the original square has side 7 cm.**
Answer:
    1. The diagonal is the hypotenuse of a right triangle with sides 7 cm and 7 cm.
    2. Its square is $7^2 + 7^2 = 98$.
    3. Therefore, the diagonal is $\sqrt{98} = 7\sqrt{2}$ cm.

4. The area of the square on the diagonal is the diagonal squared.
5. That square's area is 98 cm².

17. **Two squares have areas 49 cm² and 576 cm²; find the side of a square equal in area to both combined.**
Answer:
1. The first square has area 49 cm².
2. The second square has area 576 cm².
3. The combined area is 49 + 576 = 625 cm².
4. The side of a square with area 625 cm² is √625.
5. Therefore, the required side is 25 cm.

18. **State Fermat's Last Theorem and give the year Andrew Wiles proved it.**
Answer:
1. The theorem concerns the equation $x^n + y^n = z^n$.
2. It states that there are no positive-integer solutions when $n > 2$.
3. Fermat stated the theorem in the 17th century.
4. Mathematicians tried to prove it for more than 300 years.
5. Andrew Wiles proved it in 1994.

2.12 Five-mark questions with Answers of HOTS Type: (18 Questions)

Five-Mark Descriptive Questions – HOTS:
The Baudhāyana–Pythagoras Theorem:

1. **A square has side length 11 cm. Find the side and area of the square constructed on its diagonal, and compare its area with the original.**
Answer:
1. The original square's area is 11² = 121 cm².
2. Its diagonal is the side of the new square.
3. The diagonal is √(11² + 11²) = 11√2 cm.
4. The new square's area is (11√2)² = 242 cm².
5. The new area is twice the original area.

2. **Two squares have side lengths of 20 cm and 21 cm. Find the side length and area of a square equal in area to both combined.**
Answer:
1. The first square's area is 20² = 400 cm².
2. The second square's area is 21² = 441 cm².
3. The combined area is 400 + 441 = 841 cm².
4. The side of the required square is √841 = 29 cm.
5. Therefore, the combined-area square has side 29 cm and area 841 cm².

3. **A right-angled triangle has a hypotenuse of 26 cm and one shorter side of 10 cm. Find the other side and verify your answer.**
Answer:
1. Let the unknown side be *b*.
2. By the theorem, b² = 26² − 10².
3. Therefore, b² = 676 − 100 = 576.
4. Taking the square root gives b = 24 cm.
5. Check: 10² + 24² = 100 + 576 = 676 = 26².

4. **An isosceles right triangle has equal sides of 12 cm. Find its hypotenuse and show between which consecutive whole numbers it lies.**
Answer:
1. The hypotenuse satisfies c² = 12² + 12².

2. Therefore, $c^2 = 288$.
3. Thus, $c = \sqrt{288} = 12\sqrt{2}$ cm.
4. Since $16^2 = 256$ and $17^2 = 289$, 288 lies between those squares.
5. The hypotenuse lies between 16 cm and 17 cm.

5. **An isosceles right triangle has a hypotenuse of $\sqrt{72}$ units. Find each equal side and verify the result.**
   Answer:
   1. Let each equal side be *a*.
   2. The relationship is $c^2 = 2a^2$.
   3. Substitute $c = \sqrt{72}$ to get $72 = 2a^2$.
   4. Therefore, $a^2 = 36$ and $a = 6$ units.
   5. Check: $6^2 + 6^2 = 72 = (\sqrt{72})^2$.
6. **Determine whether (9, 12, 15) is primitive and reduce it to its primitive form.**
   Answer:
   1. Check the triple: $9^2 + 12^2 = 81 + 144 = 225$.
   2. Since $15^2 = 225$, it is a Baudhāyana triple.
   3. The three numbers have a common factor of 3.
   4. Divide each number by 3 to get (3, 4, 5).
   5. Therefore, (9, 12, 15) is not primitive, and its primitive form is (3, 4, 5).
7. **Use the odd-square method to generate a triple from 81, then verify it.**
   Answer:
   1. The square root of 81 is 9.
   2. The odd square 81 is the 41st odd number because $2 \times 41 - 1 = 81$.
   3. The method gives the triple (40, 9, 41).
   4. Calculate $40^2 + 9^2 = 1600 + 81 = 1681$.
   5. Since $41^2 = 1681$, the triple is valid.
8. **Show by squaring suitable decimals that $\sqrt{2}$ lies between 1.414 and 1.415.**
   Answer:
   1. Square the lower bound: $1.414^2 = 1.999396$.
   2. This value is less than 2.
   3. Square the upper bound: $1.415^2 = 2.002225$.
   4. This value is greater than 2.
   5. Therefore, $1.414 < \sqrt{2} < 1.415$.
9. **Explain why $\sqrt{2}$ cannot be written as a fraction of positive integers.**
   Answer:
   1. Suppose $\sqrt{2} = m/n$, where *m* and *n* are positive integers.
   2. Squaring both sides gives $m^2 = 2n^2$.
   3. In a perfect square, every prime factor occurs an even number of times.
   4. The factor 2 would occur an odd number of times in $2n^2$ but an even number of times in m^2.
   5. This contradiction shows that $\sqrt{2}$ cannot be written as such a fraction.
10. **In the lotus problem, the tip is 1 unit above the water and touches the water 3 units horizontally away. Find the lake's depth using an equation.**
    Answer:
    1. Let the lake depth be *x* units.
    2. The full length of the lotus stem is $x + 1$ units.
    3. The triangle gives $3^2 + x^2 = (x + 1)^2$.
    4. Simplifying gives $9 + x^2 = x^2 + 2x + 1$, so $2x = 8$.
    5. Therefore, the lake is 4 units deep.

11. **An equilateral triangle has side length 10 units. Find its altitude and area using the theorem.**
Answer:
    1. The altitude bisects the opposite side into two parts of 5 units.
    2. The altitude forms a right triangle with hypotenuse 10 and one side 5.
    3. Its height is $\sqrt{(10^2 - 5^2)} = \sqrt{75} = 5\sqrt{3}$ units.
    4. The triangle's area is ½ × base × height.
    5. Therefore, its area is ½ × 10 × $5\sqrt{3} = 25\sqrt{3}$ square units.
12. **A rhombus has diagonals of 16 units and 30 units. Find its side length and perimeter.**
Answer:
    1. The diagonals bisect each other at right angles.
    2. Half-diagonals measure 8 units and 15 units.
    3. A side is the hypotenuse of a triangle with legs 8 and 15.
    4. The side length is $\sqrt{(8^2 + 15^2)} = \sqrt{289} = 17$ units.
    5. The perimeter is 4 × 17 = 68 units.
13. **A student doubles a square's side to make a square with double the area. Explain the error and state the correct construction.**
Answer:
    1. Let the original square's side be *s*.
    2. Its area is s^2.
    3. Doubling the side gives area $(2s)^2 = 4s^2$, which is four times the original.
    4. A square with double the area should have side $s\sqrt{2}$.
    5. This is constructed by using the original square's diagonal as the new side.
14. **Two squares have side lengths 8 units and 15 units. Show how a right triangle gives a square with their combined area.**
Answer:
    1. The squares have areas $8^2 = 64$ and $15^2 = 225$ square units.
    2. Use 8 and 15 as the perpendicular sides of a right triangle.
    3. The hypotenuse satisfies $c^2 = 64 + 225 = 289$.
    4. Therefore, c = 17 units.
    5. The square on this hypotenuse has area $17^2 = 289$ square units, equal to the combined area.
15. **A triangle has sides 10, 24, and 26 units. Identify its hypotenuse and verify that it is right-angled.**
Answer:
    1. The longest side is 26 units, so it is the possible hypotenuse.
    2. Square the shorter sides: $10^2 = 100$ and $24^2 = 576$.
    3. Add those squares: 100 + 576 = 676.
    4. Square the longest side: $26^2 = 676$.
    5. Since the values match, the triangle is right-angled with hypotenuse 26 units.
16. **Andrew Wiles proved Fermat's Last Theorem. Explain what the theorem says and how its exponent differs from the right-triangle theorem.**
Answer:
    1. The right-triangle theorem uses squares, as in $a^2 + b^2 = c^2$.
    2. Fermat considered the equation $x^n + y^n = z^n$.
    3. His theorem states that there are no positive-integer solutions when $n > 2$.
    4. Andrew Wiles proved the theorem in 1994.
    5. Thus, the chapter contrasts the possible square relationship with the impossibility for higher powers.

17. **A square has side length 7 cm. Find its diagonal, the area of the square on that diagonal, and compare the areas.**
    Answer:
    1. The original square's area is $7^2 = 49$ cm².
    2. The diagonal is $\sqrt{(7^2 + 7^2)} = 7\sqrt{2}$ cm.
    3. The square on the diagonal has area $(7\sqrt{2})^2 = 98$ cm².
    4. Compare the areas: $98 \div 49 = 2$.
    5. The diagonal square has twice the area of the original.
18. **A rectangle has a diagonal of 25 cm and a side of 7 cm. Find its other side and area.**
    Answer:
    1. Treat the diagonal as the hypotenuse of a right triangle.
    2. The unknown side squared is $25^2 - 7^2$.
    3. This gives $625 - 49 = 576$, so the unknown side is 24 cm.
    4. The rectangle's area is 7×24.
    5. Therefore, its area is 168 cm².

2.13 Five-mark questions with Answers of Applied Type: (15 Questions)

Five-Mark Descriptive Questions – Applied Type:
The Baudhāyana–Pythagoras Theorem:

1. **A firefighter places a 13 m ladder 5 m from a building. How high up the building does the ladder reach?**
   Answer:
   1. The wall, ground, and ladder form a right-angled triangle.
   2. The ladder is the hypotenuse, so $c = 13$ m.
   3. The distance from the wall is $a = 5$ m.
   4. The height squared is $b^2 = 13^2 - 5^2 = 169 - 25 = 144$.
   5. The ladder reaches 12 m up the building.
2. **A rectangular school ground is 30 m long and 40 m wide. Find the length of a straight path across it from one corner to the opposite corner.**
   Answer:
   1. The sides of the ground and its diagonal form a right-angled triangle.
   2. Let the diagonal be *d*.
   3. Use $d^2 = 30^2 + 40^2$.
   4. Calculate $d^2 = 900 + 1600 = 2500$.
   5. The straight path is 50 m long.
3. **A wheelchair ramp rises 5 m vertically and extends 12 m horizontally. Find the ramp's sloping length.**
   Answer:
   1. The vertical rise and horizontal distance are the shorter sides of a right triangle.
   2. Let the ramp length be *c*.
   3. Use $c^2 = 5^2 + 12^2$.
   4. Calculate $c^2 = 25 + 144 = 169$.
   5. The ramp is 13 m long.
4. **A rectangular display screen is 24 cm wide and 7 cm high. Find the length of its diagonal.**
   Answer:
   1. The screen's width, height, and diagonal form a right triangle.

2. Let the diagonal be *d*.
3. Use $d^2 = 24^2 + 7^2$.
4. Calculate $d^2 = 576 + 49 = 625$.
5. The screen's diagonal is 25 cm.

5. **A 12 m pole is held upright by a wire fixed to the ground 5 m from its base. Find the wire's length.**
   Answer:
   1. The pole and ground distance form the shorter sides of a right triangle.
   2. The wire is the hypotenuse.
   3. Use $c^2 = 12^2 + 5^2$.
   4. Calculate $c^2 = 144 + 25 = 169$.
   5. The wire is 13 m long.
6. **A carpenter is fitting a diagonal brace across a rectangular gate measuring 6 m by 8 m. Find the required brace length.**
   Answer:
   1. The gate's sides and brace form a right-angled triangle.
   2. Let the brace length be *d*.
   3. Use $d^2 = 6^2 + 8^2$.
   4. Calculate $d^2 = 36 + 64 = 100$.
   5. The brace should be 10 m long.
7. **A square garden has side length 20 m. Find the distance from one corner to the opposite corner.**
   Answer:
   1. The garden's diagonal divides it into two right-angled triangles.
   2. Each shorter side of the triangle is 20 m.
   3. Use $d^2 = 20^2 + 20^2$.
   4. Calculate $d^2 = 400 + 400 = 800$.
   5. The corner-to-corner distance is $20\sqrt{2}$ m.
8. **A planner combines two square plots with side lengths 9 m and 12 m into one square of equal total area. Find the side length of the new square.**
   Answer:
   1. The first plot has area $9^2 = 81$ m².
   2. The second plot has area $12^2 = 144$ m².
   3. Their total area is $81 + 144 = 225$ m².
   4. The new square's side is $\sqrt{225}$.
   5. The new square has side length 15 m.
9. **A designer wants one square tile to have the combined area of square tiles with side lengths 10 cm and 24 cm. Find the side of the larger tile.**
   Answer:
   1. The first tile's area is $10^2 = 100$ cm².
   2. The second tile's area is $24^2 = 576$ cm².
   3. The combined area is $100 + 576 = 676$ cm².
   4. The side of the required square tile is $\sqrt{676}$.
   5. The larger tile should have a side of 26 cm.
10. **In the chapter's lotus problem, the flower tip is 1 unit above the water and touches the water 3 units away horizontally. Find the lake's depth.**
    Answer:
    1. Let the lake's depth be *x* units.
    2. The full length of the stem is $x + 1$ units.
    3. The situation gives $3^2 + x^2 = (x + 1)^2$.

4. Simplifying gives $9 = 2x + 1$, so $x = 4$.
5. The lake is 4 units deep.

11. **A rhombus-shaped garden has diagonals of 24 m and 70 m. Find the length of one side and the garden's perimeter.**
Answer:
    1. The diagonals bisect each other at right angles.
    2. Half the diagonals measure 12 m and 35 m.
    3. The garden's side is the hypotenuse of a triangle with those legs.
    4. The side is $\sqrt{(12^2 + 35^2)} = \sqrt{1369} = 37$ m.
    5. The perimeter is $4 \times 37 = 148$ m.
12. **A staircase rises 15 m and covers a horizontal distance of 8 m. Find the length of the sloping staircase.**
Answer:
    1. The rise and horizontal distance are perpendicular sides.
    2. The sloping staircase is the hypotenuse.
    3. Use $c^2 = 15^2 + 8^2$.
    4. Calculate $c^2 = 225 + 64 = 289$.
    5. The sloping length is 17 m.
13. **A craft project uses a square piece of paper with side 5 cm to make a square with double its area. Find the new square's side and area.**
Answer:
    1. The original paper's area is $5^2 = 25$ cm².
    2. Double this area to get 50 cm².
    3. The new square's side is the original square's diagonal.
    4. Its side length is $\sqrt{50} = 5\sqrt{2}$ cm.
    5. The new square has area 50 cm² and side $5\sqrt{2}$ cm.
14. **A square courtyard has an area of 196 m². A smaller square flower bed is planned to cover half the courtyard. Find the flower bed's area and side length.**
Answer:
    1. The courtyard's area is 196 m².
    2. Half its area is $196 \div 2 = 98$ m².
    3. Let the flower bed's side be *s*.
    4. Then $s^2 = 98$, so $s = \sqrt{98} = 7\sqrt{2}$ m.
    5. The flower bed's area is 98 m² and its side is $7\sqrt{2}$ m.
15. **A straight walking path crosses a rectangular park that is 48 m long and 14 m wide. Find the path's length.**
Answer:
    1. The park's length, width, and diagonal form a right triangle.
    2. Let the diagonal path be *d*.
    3. Use $d^2 = 48^2 + 14^2$.
    4. Calculate $d^2 = 2304 + 196 = 2500$.
    5. The walking path is 50 m long.

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

Olympiad-Style Multiple-Choice Questions:

The Baudhāyana–Pythagoras Theorem:

1. **Which equation represents the Baudhāyana–Pythagoras theorem for a right-angled triangle with hypotenuse *c*?**
A. $a + b = c$

B. $a^2 + b^2 = c^2$
C. $a^2 - b^2 = c^2$
D. $ab = c^2$
Answer: B. $a^2 + b^2 = c^2$

2. **A right-angled triangle has shorter sides 9 cm and 12 cm. What is its hypotenuse?**
A. 13 cm
B. 14 cm
C. 15 cm
D. 16 cm
Answer: C. 15 cm

3. **A right-angled triangle has hypotenuse 25 cm and one shorter side 7 cm. What is its other shorter side?**
A. 18 cm
B. 20 cm
C. 24 cm
D. 32 cm
Answer: C. 24 cm

4. **A right-angled triangle has shorter sides of 6 cm and 8 cm. What is the area of the square constructed on its hypotenuse?**
A. 50 cm^2
B. 64 cm^2
C. 80 cm^2
D. 100 cm^2
Answer: D. 100 cm^2

5. **Which set is a Baudhāyana–Pythagoras triple?**
A. (6, 8, 11)
B. (8, 15, 17)
C. (9, 12, 14)
D. (10, 12, 15)
Answer: B. (8, 15, 17)

6. **Which set does not form a right-angled triangle?**
A. (3, 4, 5)
B. (5, 12, 13)
C. (6, 8, 11)
D. (8, 15, 17)
Answer: C. (6, 8, 11)

7. **An isosceles right triangle has equal sides of 4 cm. What is its hypotenuse?**
A. 4 cm
B. $4\sqrt{2}$ cm
C. 8 cm
D. $8\sqrt{2}$ cm
Answer: B. $4\sqrt{2}$ cm

8. **An isosceles right triangle has a hypotenuse of 10 cm. What is the length of each equal side?**
A. 5 cm
B. $5\sqrt{2}$ cm
C. $10\sqrt{2}$ cm
D. 25 cm
Answer: B. $5\sqrt{2}$ cm

9. **A square has side length *s*. What is the side length of a square with twice its area?**
   A. 2s
   B. s/2
   C. $s\sqrt{2}$
   D. $2s^2$
   Answer: C. $s\sqrt{2}$
10. **A square has side length 6 cm. What is the area of the square on its diagonal?**
   A. 36 cm^2
   B. 48 cm^2
   C. 72 cm^2
   D. 144 cm^2
   Answer: C. 72 cm^2
11. **What is the diagonal of a square with side length 10 cm?**
   A. 10 cm
   B. $10\sqrt{2}$ cm
   C. 20 cm
   D. 100 cm
   Answer: B. $10\sqrt{2}$ cm
12. **Two squares have sides 5 cm and 12 cm. What is the side of a square equal in area to both combined?**
   A. 13 cm
   B. 15 cm
   C. 17 cm
   D. 25 cm
   Answer: A. 13 cm
13. **Two squares have areas 64 cm^2 and 225 cm^2. What is the side of a square with their combined area?**
   A. 15 cm
   B. 16 cm
   C. 17 cm
   D. 19 cm
   Answer: C. 17 cm
14. **A rectangular field has a diagonal of 25 m and a side of 7 m. What is the other side?**
   A. 18 m
   B. 20 m
   C. 24 m
   D. 32 m
   Answer: C. 24 m
15. **Which interval contains $\sqrt{2}$?**
   A. $1.3 < \sqrt{2} < 1.4$
   B. $1.4 < \sqrt{2} < 1.5$
   C. $1.5 < \sqrt{2} < 1.6$
   D. $2 < \sqrt{2} < 3$
   Answer: B. $1.4 < \sqrt{2} < 1.5$
16. **Which statement about $\sqrt{2}$ is correct?**
   A. It is a terminating decimal.
   B. It is a positive integer.
   C. It cannot be expressed as a fraction of two positive integers.

D. It is exactly equal to 1.414.
Answer: C. It cannot be expressed as a fraction of two positive integers.

17. **What is the sum of the first eight odd numbers?**
A. 49
B. 56
C. 64
D. 72
Answer: C. 64

18. **What is the 15th odd number?**
A. 27
B. 29
C. 30
D. 31
Answer: B. 29

19. **Using the chapter's odd-square method, which triple is generated from the odd square 25?**
A. (10, 5, 13)
B. (12, 5, 13)
C. (12, 6, 13)
D. (13, 12, 5)
Answer: B. (12, 5, 13)

20. **Which triple is primitive?**
A. (6, 8, 10)
B. (9, 12, 15)
C. (3, 4, 5)
D. (12, 16, 20)
Answer: C. (3, 4, 5)

21. **What triple results when each number in (3, 4, 5) is multiplied by 4?**
A. (7, 8, 9)
B. (12, 16, 20)
C. (9, 16, 20)
D. (12, 20, 24)
Answer: B. (12, 16, 20)

22. **Two square plots have sides 9 m and 12 m. What side length would a single square plot need to have the same combined area?**
A. 13 m
B. 14 m
C. 15 m
D. 21 m
Answer: C. 15 m

23. **Compared with an original square, how many times larger is the area of the square constructed on its diagonal?**
A. One-half
B. The same
C. Twice
D. Four times
Answer: C. Twice

24. **A square has side length 8 cm. What is the side length of a square with half its area?**
A. $2\sqrt{2}$ cm

B. 4√2 cm
C. 8√2 cm
D. 16 cm
Answer: B. 4√2 cm

25. **A right-angled triangle has shorter sides 1.5 units and 3.5 units. What is the square of its hypotenuse?**
A. 12.5
B. 14.5
C. 16.5
D. 25
Answer: B. 14.5

26. **Why is the hypotenuse the longest side of a right-angled triangle?**
A. Its square equals the difference of the squares of the other sides.
B. Its square is the sum of two positive squares.
C. It is always twice the shorter side.
D. It is equal to the sum of the other two sides.
Answer: B. Its square is the sum of two positive squares.

27. **In the lotus problem, the tip is 1 unit above the water and touches the water 3 units horizontally away. What is the lake's depth?**
A. 2 units
B. 3 units
C. 4 units
D. 5 units
Answer: C. 4 units

28. **In a similar lotus problem, the tip is 2 units above the water and moves 5 units horizontally. What depth satisfies the right-triangle relationship?**
A. 4 units
B. 5 units
C. 21/4 units
D. 7 units
Answer: C. 21/4 units

29. **A rhombus has diagonals 10 units and 24 units. What is the length of one side?**
A. 12 units
B. 13 units
C. 17 units
D. 26 units
Answer: B. 13 units

30. **What is the area of an equilateral triangle with side length 6 units?**
A. 6√3 square units
B. 9√3 square units
C. 18 square units
D. 36 square units
Answer: B. 9√3 square units

31. **According to Fermat's Last Theorem, when does $x^n + y^n = z^n$ have no positive-integer solutions?**
A. When n = 1
B. When n = 2
C. When n > 2
D. For all values of n
Answer: C. When n > 2

32. **Who proved Fermat's Last Theorem, and in what year?**
    A. Pythagoras, 500 BCE
    B. Euclid, 300 BCE
    C. Andrew Wiles, 1994
    D. Baudhāyana, 800 BCE
    Answer: C. Andrew Wiles, 1994
33. **Baudhāyana's Śulba-Sūtra is dated to approximately which period?**
    A. 800 BCE
    B. 300 BCE
    C. 500 CE
    D. 1994 CE
    Answer: A. 800 BCE
34. **Which set is a scaled version of (5, 12, 13) by a factor of 2?**
    A. (7, 14, 15)
    B. (10, 24, 26)
    C. (10, 12, 13)
    D. (15, 24, 26)
    Answer: B. (10, 24, 26)
35. **Which statement about the triple (7, 24, 25) is correct?**
    A. It is not a triple because $7 + 24 \neq 25$.
    B. It is a primitive triple.
    C. It is a scaled version of (3, 4, 5).
    D. It is not a triple because $7^2 + 24^2 \neq 25^2$.
    Answer: B. It is a primitive triple.
36. **A square has area 200 cm². What is the side of a square with half its area?**
    A. 5 cm
    B. 10 cm
    C. $10\sqrt{2}$ cm
    D. 20 cm
    Answer: B. 10 cm
37. **The number 289 is the square of which number and the (which) odd number?**
    A. 17 and 144th
    B. 17 and 145th
    C. 18 and 145th
    D. 19 and 147th
    Answer: B. 17 and 145th
38. **Which triple is generated from the odd square 81 by the chapter's method?**
    A. (39, 9, 41)
    B. (40, 9, 41)
    C. (40, 8, 41)
    D. (41, 9, 40)
    Answer: B. (40, 9, 41)
39. **Between which consecutive integers does $\sqrt{288}$ lie?**
    A. 14 and 15
    B. 15 and 16
    C. 16 and 17
    D. 17 and 18
    Answer: C. 16 and 17
40. **A right triangle has hypotenuse 17 cm and one shorter side 8 cm. What is its area?**

A. 48 cm²
B. 60 cm²
C. 64 cm²
D. 120 cm²
Answer: B. 60 cm²

2.15 Best Practices Opportunity List from the Chapter: (17 Ideas)

Best Practices for Teaching the Chapter:
The Baudhāyana–Pythagoras Theorem – Class 8:

(1) Begin with a visual problem. Ask students how to make a square with double the area of a given square before introducing the theorem.
(2) Use paper-square construction. Have students draw, cut, and rearrange square pieces to explore why the square on a diagonal can have double the original square's area.
(3) Connect the theorem to its history. Introduce Baudhāyana's work in the *Śulba-Sūtra* and explain why the theorem is also known as the Pythagorean Theorem.
(4) Teach key vocabulary explicitly. Clarify *right angle*, *perpendicular sides*, *hypotenuse*, *diagonal*, *triple*, and *primitive triple* before students solve problems.
(5) Use diagrams consistently. Ask students to mark the right angle and label the hypotenuse as c before substituting values into $a^2 + b^2 = c^2$.
(6) Model the calculation process. Solve examples in clear stages: identify the known sides, write the formula, substitute values, calculate, and state the answer with units.
(7) Let students test the theorem through measurement. Have them draw and measure right triangles, then compare the measurements with results from the formula.
(8) Use familiar real-life contexts. Discuss ladders, rectangular fields, ramps, screens, and diagonal braces to show how the theorem helps find unknown lengths.
(9) Include hands-on square-area comparisons. Use square grids or cut-outs to show that the areas on the two shorter sides combine to equal the area on the hypotenuse.
(10) Teach square roots through bounds. Before using a calculator, help students estimate values such as $\sqrt{2}$ by comparing nearby whole-number squares and decimals.
(11) Use number patterns to explore triples. Guide students to check examples such as (3, 4, 5), identify scaled triples, and distinguish primitive from non-primitive triples.
(12) Encourage students to explain their reasoning. Ask them to describe why they selected a formula and how they know the hypotenuse has been identified correctly.
(13) Address common errors through examples. Compare correct and incorrect methods, such as adding side lengths instead of their squares or treating the longest side as a shorter side.
(14) Provide graduated practice. Begin with identifying the hypotenuse, continue to finding a missing side, and then move to applied problems and square-area constructions.
(15) Check understanding during the lesson. Use brief oral questions, mini-whiteboard calculations, peer checks, or an exit question to identify misunderstandings before moving on.
(16) Support varied learning needs. Provide diagrams, worked examples, multiplication-square references, and extension problems so students can work at an appropriate level.
(17) Close with a short reflection. Ask students to write one real-life use of the theorem and one step they follow when solving a right-triangle problem.

2.16 Innovations Opportunity List from the Chapter: (17 Ideas)

Innovations for Teaching and Learning:

The Baudhāyana–Pythagoras Theorem :

(1) **Create a "Pythagoras in Our School" photo hunt.** Students photograph rectangular objects or spaces, estimate their dimensions, and use the theorem to calculate a diagonal.
(2) **Build a human right triangle.** Use ropes or floor tape to mark two perpendicular sides; students measure them and predict the diagonal before checking it.
(3) **Run a "Square Construction Lab."** Teams use paper squares, scissors, and rearrangement to demonstrate how squares can be doubled or combined.
(4) **Make a theorem animation.** Students draw successive frames showing the squares on the sides of a right triangle and how their areas relate.
(5) **Design a classroom escape challenge.** Students solve a sequence of missing-side puzzles to reveal a code or unlock the next clue.
(6) **Create a Baudhāyana–Pythagoras timeline.** Groups present the chapter's mathematical ideas through a visual timeline, short role-play, or illustrated display.
(7) **Set up learning stations.** Rotate groups through stations for diagonal measurement, square-area construction, triple checking, $\sqrt{2}$ estimation, and real-life applications.
(8) **Use "Find the error" cards.** Give students worked solutions with one mistake, such as using the wrong side as the hypotenuse, and ask them to identify and correct it.
(9) **Make a triple-card matching game.** Students match integer triples, their scaled forms, and verification cards showing whether $a^2 + b^2 = c^2$.
(10) **Create a school-ground diagonal challenge.** Teams measure a rectangular space and calculate its diagonal, then compare their prediction with a safe direct measurement.
(11) **Explore $\sqrt{2}$ on a giant number line.** Students place decimal estimates and use nearby squares to narrow down where $\sqrt{2}$ lies.
(12) **Build an interactive triangle model.** Use a geometry drawing tool or a simple spreadsheet where students change the two shorter sides and observe how the hypotenuse changes.
(13) **Produce a "Maths in a Minute" video.** Each group explains one idea—such as finding a missing side, doubling a square's area, or checking a triple—in a short student-made clip.
(14) **Try a lotus-stem modelling activity.** Students act out or sketch the chapter's lake problem, label the known and unknown lengths, and form the right-triangle equation.
(15) **Combine maths and art.** Students create a geometric design from right triangles and squares, then label side lengths and compare the areas of the squares.
(16) **Invent a real-world problem for another team.** Each group creates a short scenario involving a ladder, ramp, screen, field, or diagonal brace and prepares its solution for peer review.
(17) **Use a "Which method fits?" challenge.** Present mixed problems involving square area, triangle side lengths, and triples; students choose and explain the suitable method before calculating.

These activity ideas draw on the chapter's square constructions, theorem, $\sqrt{2}$ exploration, triples, and applications.

2.17: Practicing Questions/Question Bank:

Question Bank: The Baudhāyana–Pythagoras Theorem

A. Fill in the Blanks:

1. In a right-angled triangle, the side opposite the right angle is called the _____.
   Answer: hypotenuse

2. The Baudhāyana–Pythagoras theorem is written as _____.
   Answer: $a^2 + b^2 = c^2$

3. A square constructed on the diagonal of a given square has _____ times the area of the original square.
   Answer: twice

4. The triple (3, 4, 5) is an example of a _____ triple.
   Answer: Baudhāyana–Pythagoras

5. The sum of the first *n* odd numbers is _____.
   Answer: n^2

6. The value of √2 lies between _____ and _____ to three decimal places.
   Answer: 1.414 and 1.415

7. A Baudhāyana triple with no common factor greater than 1 is called a _____ triple.
   Answer: primitive

8. Fermat's Last Theorem concerns the equation $x^n + y^n = z^n$ for powers *n* _____ than 2.
   Answer: greater

B. One-Mark Descriptive Questions:

1. **What is the hypotenuse of a right-angled triangle?**
   Answer: The hypotenuse is the side opposite the right angle.

2. **What is the area of a square with side length 6 cm?**
   Answer: Its area is $6^2 = 36$ cm².

3. **Find the hypotenuse of a right-angled triangle with shorter sides 5 cm and 12 cm.**
   Answer: The hypotenuse is 13 cm.

4. **Write the relationship between the equal sides *a* and hypotenuse *c* of an isosceles right triangle.**
   Answer: The relationship is $c^2 = 2a^2$.

5. **Who proved Fermat's Last Theorem?**
   Answer: Andrew Wiles proved Fermat's Last Theorem.

6. **What is the 10th odd number?**
   Answer: The 10th odd number is $2 \times 10 - 1 = 19$.

C. Two-Mark Descriptive Questions:

1. **Find the missing side of a right-angled triangle with hypotenuse 17 cm and one shorter side 8 cm.**
   Answer:
   1. The missing side squared is $17^2 - 8^2 = 225$.
   2. Therefore, the missing side is 15 cm.

2. **Check whether (5, 12, 13) is a Baudhāyana triple.**
   Answer:
   1. $5^2 + 12^2 = 25 + 144 = 169$.
   2. Since $13^2 = 169$, it is a Baudhāyana triple.

3. **A square has side 4 cm; find the area of a square with double its area.**
   Answer:
   1. The original area is $4^2 = 16$ cm², so double the area is 32 cm².
   2. The square with double the area has an area of 32 cm².
4. **Explain what happens when each number in a Baudhāyana triple is multiplied by the same positive integer.**
   Answer:
   1. The resulting three numbers form another Baudhāyana triple.
   2. For example, multiplying (3, 4, 5) by 2 gives (6, 8, 10).

D. Three-Mark Descriptive Questions:

1. **Two squares have side lengths of 6 cm and 8 cm. Find the side length of a square equal in area to both combined.**
   Answer:
   1. The first square's area is $6^2 = 36$ cm².
   2. The second square's area is $8^2 = 64$ cm², giving a combined area of 100 cm².
   3. The required square's side is $\sqrt{100} = 10$ cm.
2. **Find the hypotenuse of a right-angled triangle with shorter sides 8 cm and 15 cm.**
   Answer:
   1. Use $c^2 = a^2 + b^2$.
   2. $c^2 = 8^2 + 15^2 = 64 + 225 = 289$.
   3. Therefore, c = 17 cm.
3. **Use the odd-square method to obtain a triple from the odd square 25.**
   Answer:
   1. The odd square 25 is the 13th odd number.
   2. Its square root is 5.
   3. The method gives the triple (12, 5, 13).
4. **Explain why $\sqrt{2}$ lies between 1 and 2.**
   Answer:
   1. The square of 1 is 1.
   2. The square of 2 is 4, and $1 < 2 < 4$.
   3. Therefore, $1 < \sqrt{2} < 2$.

E. Five-Mark Descriptive Questions:

1. **A rectangular garden is 9 m long and 12 m wide. Find the length of the diagonal path across it.**
   Answer:
   1. The garden's length, width, and diagonal form a right-angled triangle.

2. Let the diagonal be c.
3. Use $c^2 = 9^2 + 12^2$.
4. Calculate $c^2 = 81 + 144 = 225$.
5. The diagonal path is 15 m long.

2. **A square has side length 5 cm. Find the side and area of a square with double its area.**
   Answer:
   1. The original square's area is $5^2 = 25$ cm².
   2. Double the area to get 50 cm².
   3. The new square's side is $\sqrt{50}$ cm.
   4. Simplify $\sqrt{50}$ to $5\sqrt{2}$ cm.
   5. The new square has side $5\sqrt{2}$ cm and area 50 cm².
3. **In the chapter's lotus problem, the flower tip is 1 unit above the water and touches the water 3 units away horizontally. Find the depth of the lake.**
   Answer:
   1. Let the lake's depth be x units.
   2. The full length of the stem is $x + 1$ units.
   3. The right-triangle relationship is $3^2 + x^2 = (x + 1)^2$.
   4. Simplifying gives $9 = 2x + 1$, so $x = 4$.
   5. The lake is 4 units deep.

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8th Standard Maths Part 2 Book Chapter 3

Chapter 3: PROPORTIONAL REASONING–2

3.1 Summary of the Chapter:

Chapter 3: Proportional Reasoning–2 — Summary:

(1) A ratio compares quantities. Two ratios are proportional when they represent the same relationship; this can be checked by cross-multiplying. For example, 6 : 3 and 4 : 2 are proportional because both cross-products equal 12.

(2) A map's **representative fraction (RF)** compares a distance on the map with the corresponding geographical distance on the ground. The units must be converted consistently to find the actual distance.

(3) Ratios can have more than two terms. For example, a spice mixture may use coriander, chillies, toor dal and fenugreek in the ratio 8 : 4 : 2 : 1.

(4) When a mixture is scaled up or down, every term in its ratio must be multiplied or divided by the same factor to preserve the proportions.

(5) A whole can be divided in a given ratio by adding the ratio terms, dividing the total by their sum, and multiplying each term by the result. This method works for ratios with two or more terms.

(6) Ratios help solve practical problems involving mixtures, such as paint colours and concrete. The quantities needed for each ingredient are found by scaling the ratio to the required total or known quantity.

(7) Ratios can also divide a total into parts such as triangle angles. The angles in a triangle add up to 180°, so a ratio of 1 : 3 : 5 gives angles of 20°, 60° and 100°.

(8) A pie chart represents parts of a whole using slices of a circle. Since a circle has 360°, each category's angle is calculated according to its share of the total.

(9) In **direct proportion**, two quantities change by the same factor, and their ratio remains constant. The rule of three can be used to find an unknown quantity when the other three values are known.

(10) In **inverse proportion**, one quantity increases as the other decreases by the corresponding factor. Their product remains constant; for example, for a fixed journey, increasing speed reduces travel time.

(11) Inverse proportion applies to situations such as the number of workers and the time needed to finish a fixed task, the number of pumps and the time needed to fill a tank, or the number of students and how long fixed food supplies will last. These problems assume other conditions, such as work rate or consumption per person, stay the same.

3.2 Important Formulas:

IMPORTANT FORMULAS – CHAPTER 3: PROPORTIONAL REASONING–2:

1. **Equivalent ratios**
   a : b = c : d when **a × d = b × c**
2. **Scaling a ratio**
   Multiply or divide every term by the same number:
   a : b : c = ka : kb : kc
3. **Dividing a total in a ratio**
   For total **T** divided in the ratio **a : b : c**, let **S = a + b + c**.
   - First part = T × a ÷ S
   - Second part = T × b ÷ S
   - Third part = T × c ÷ S

4. **Finding quantities from a ratio**
   If the ratio is **a : b : c** and the quantity for **a** is known to be **A**:
   Scale factor, k = A ÷ a
   Other quantities = k × b and k × c
5. **Map scale or representative fraction (RF)**
   RF = Map distance ÷ Ground distance
   For RF **1 : n**:
   Ground distance = Map distance × n
   (Use the same units for both distances.)
6. **Direct proportion**
   If x and y are directly proportional:
   x ÷ y = constant
   For corresponding values: $x_1 \div y_1 = x_2 \div y_2$
7. **Rule of three**
   If **a : b = c : d**, then:
   d = (b × c) ÷ a
8. **Inverse proportion**
   If x and y are inversely proportional:
   x × y = constant
   For two pairs of values: $x_1 \times y_1 = x_2 \times y_2$
   Therefore, $y_2 = (x_1 \times y_1) \div x_2$
9. **Pie-chart angles**
   Angle for a category = (Category frequency ÷ Total frequency) × 360°
   If data is given as a percentage:
   Angle = Percentage × 3.6°
10. **Dividing triangle angles in a ratio**
    If the angles are in the ratio **a : b : c**:
    Each angle = 180° × (its ratio term ÷ (a + b + c))
11. **Speed, distance and time**
    Speed = Distance ÷ Time
    Distance = Speed × Time
    Time = Distance ÷ Speed
    For a fixed distance, speed and time are inversely proportional.
12. **Work rate and combined work**
    Work rate = Work completed ÷ Time
    Combined work rate = Sum of the individual work rates
    Time to complete the work = Total work ÷ Combined work rate

For problems involving workers, pumps or food supplies, assume that each worker, pump or person works or consumes at a constant rate.

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

Fill in the Blanks – LOTS Type:

1. A comparison of two quantities using division is called a _____.
   Answer: ratio
2. The ratio of 6 : 3 is equivalent to _____.
   Answer: 2 : 1
3. Two ratios are proportional when their cross-products are _____.
   Answer: equal
4. The cross-products of 6 : 3 and 4 : 2 are both _____.
   Answer: 12

5. A map's representative fraction compares map distance with the corresponding _____ distance.
   Answer: ground
6. In an RF of 1 : 60,00,000, 1 cm on the map represents _____ cm on the ground.
   Answer: 60,00,000
7. An RF of 1 : 60,00,000 means that 1 cm on the map represents _____ km on the ground.
   Answer: 60
8. In a map scale, the map distance and ground distance should be written in the _____ units.
   Answer: same
9. A ratio that compares more than two quantities is called a _____ ratio.
   Answer: multi-term
10. The spice mixture in the chapter uses coriander, red chillies, toor dal and fenugreek in the ratio _____.
    Answer: 8 : 4 : 2 : 1
11. To keep a mixture's taste the same, all the quantities in its ratio must be changed by the _____ factor.
    Answer: same
12. If every term in a ratio is multiplied by the same number, the new ratio is _____ to the original ratio.
    Answer: proportional
13. To divide a total in a given ratio, first add the _____ of the ratio.
    Answer: terms
14. To divide a total into parts in a ratio, divide the total by the _____ of the ratio terms.
    Answer: sum
15. In the ratio 2 : 3 : 5, the sum of the terms is _____.
    Answer: 10
16. In a red : blue : white paint ratio of 2 : 3 : 5, white paint makes up _____ parts.
    Answer: 5
17. If 5 parts of white paint equal 10 litres, 1 part equals _____ litres.
    Answer: 2
18. In the paint mixture ratio 2 : 3 : 5, if white paint is 10 litres, red paint is _____ litres.
    Answer: 4
19. In the paint mixture ratio 2 : 3 : 5, if white paint is 10 litres, blue paint is _____ litres.
    Answer: 6
20. A total of 50 ml divided in the ratio 2 : 3 : 5 gives _____ ml of white paint.
    Answer: 25
21. The sum of the interior angles of a triangle is _____ degrees.
    Answer: 180
22. If a triangle's angles are in the ratio 1 : 3 : 5, the sum of the ratio terms is _____.
    Answer: 9
23. In a triangle whose angles are in the ratio 1 : 3 : 5, the smallest angle is _____ degrees.
    Answer: 20
24. In a triangle whose angles are in the ratio 1 : 3 : 5, the largest angle is _____ degrees.
    Answer: 100
25. A pie chart represents parts of a _____.
    Answer: whole

26. The total angle in a circle is _____ degrees.
    Answer: 360
27. To make a pie chart, each slice's angle is proportional to the number of _____ in that category.
    Answer: observations (or people)
28. The grade distribution ratio 12 : 10 : 8 : 6 : 4 can be simplified to _____.
    Answer: 6 : 5 : 4 : 3 : 2
29. In the chapter's grade pie chart, Grade A is represented by an angle of _____ degrees.
    Answer: 108
30. In the chapter's grade pie chart, Grade B is represented by an angle of _____ degrees.
    Answer: 90
31. In the chapter's grade pie chart, Grade E is represented by an angle of _____ degrees.
    Answer: 36
32. In direct proportion, two quantities change by the _____ factor.
    Answer: same
33. In direct proportion, the _____ of corresponding values remains constant.
    Answer: ratio
34. The rule of three is used to find an unknown quantity when _____ quantities are known.
    Answer: three
35. If 5 workers move 4,500 bricks in a day, the number of workers needed to move 18,000 bricks in a day is _____.
    Answer: 20
36. For a fixed journey, when speed increases, travel time _____.
    Answer: decreases
37. In inverse proportion, when one quantity changes by a factor of n, the other changes by a factor of _____.
    Answer: 1/n
38. If x and y are inversely proportional, their product is _____.
    Answer: constant
39. Twenty workers take 4 days to complete a fixed job. The product of workers and days is _____.
    Answer: 80
40. If the number of workers is halved for the same amount of work, the time required _____.
    Answer: doubles

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

Fill in the Blanks – HOTS Type:

1. On a map with an RF of 1 : 2,500,000, a distance of 4 cm represents _____ km on the ground.
   Answer: 100 km
2. A 3.5 cm map distance represents _____ km on the ground when the RF is 1 : 4,000,000.
   Answer: 140 km

3. A map has an RF of 1 : 5,000,000. If two places are 1.2 cm apart on the map, their ground distance is _____ km.
   Answer: 60 km
4. A spice mix uses coriander, chillies, toor dal and fenugreek in the ratio 8 : 4 : 2 : 1. If 6 spoons of chillies are used, the amount of coriander needed is _____ spoons.
   Answer: 12 spoons
5. A paint mixture has red : blue : white paint in the ratio 2 : 3 : 5. For 40 litres of paint, the amount of blue paint needed is _____ litres.
   Answer: 12 litres
6. In a paint mixture with red : blue : white in the ratio 2 : 3 : 5, using 15 litres of white paint requires _____ litres of red paint.
   Answer: 6 litres
7. Concrete is mixed in the ratio cement : sand : gravel = 1 : 1.5 : 3. For 110 units of concrete, _____ units of sand are needed.
   Answer: 30 units
8. A total of 120 minutes is divided in the ratio 2 : 3 : 1. The largest share is _____ minutes.
   Answer: 60 minutes
9. A sum of ₹500 is divided in the ratio 4 : 3 : 2 : 1. The share corresponding to the third term is _____.
   Answer: ₹100
10. A school has 360 books in the ratio English : Hindi : Kannada = 3 : 2 : 1. The number of Hindi books is _____.
    Answer: 120
11. A total of 50 ml of paint is mixed in the ratio red : blue : white = 2 : 3 : 5. The amount of red paint is _____ ml.
    Answer: 10 ml
12. A triangle's angles are in the ratio 1 : 3 : 5. The difference between its largest and smallest angles is _____ degrees.
    Answer: 80°
13. A pie chart represents 30 students. If 15 students prefer one category, its slice angle is _____ degrees.
    Answer: 180°
14. In a pie chart, a category represents 20% of the total. Its angle is _____ degrees.
    Answer: 72°
15. A pie chart has four categories in the ratio 1 : 2 : 3 : 4. The angle for the category with 3 parts is _____ degrees.
    Answer: 108°
16. In a class of 40 students, the grade counts are in the ratio 6 : 5 : 4 : 3 : 2. The number of students represented by the 4-part category is _____.
    Answer: 8 students
17. In the same grade distribution, the angle representing the 3-part category in a pie chart is _____ degrees.
    Answer: 54°
18. If 5 workers can move 4,500 bricks in a day, _____ workers are needed to move 13,500 bricks in a day at the same rate.
    Answer: 15 workers
19. If 24 pencils cost ₹120, the cost of 40 pencils at the same rate is _____.
    Answer: ₹200

20. A car travels 180 km in 3 hours at a constant speed. In 5 hours, it will travel _____ km.
    Answer: 300 km
21. A journey takes 4 hours at 45 km/h. At 60 km/h, the same journey takes _____ hours.
    Answer: 3 hours
22. Twenty workers complete a job in 4 days. If 10 workers do the same job at the same rate, they will take _____ days.
    Answer: 8 days
23. A tank is filled by 2 identical pumps in 18 hours. Four such pumps will fill it in _____ hours.
    Answer: 9 hours
24. Food supplies last 15 days for 80 students. If 100 students use the supplies at the same rate, they will last _____ days.
    Answer: 12 days
25. Three workers paint a fence in 4 days. If the work rate stays the same, 6 workers will take _____ days.
    Answer: 2 days
26. A factory needs 42 machines to complete a fixed production target in 63 days. To finish it in 54 days, it needs _____ machines.
    Answer: 49 machines
27. A car covers a fixed route in 2 hours at 60 km/h. At 80 km/h, it will take _____ hours.
    Answer: 1.5 hours
28. A tank is filled by a small pump in 3 hours and by a large pump in 2 hours. Working together, they fill the tank in _____ hours.
    Answer: 1.2 hours (or 1 hour 12 minutes)
29. Ram completes a task in 1 hour, while Shyam completes the same task in 1.5 hours. Working together, they complete it in _____ hours.
    Answer: 0.6 hours (or 36 minutes)
30. If a quantity is divided in the ratio 3 : 2 : 1 and the largest share is 45, the total quantity is _____.
    Answer: 90
31. A total quantity of 84 is divided in the ratio 2 : 5 : 7. The middle-sized share is _____.
    Answer: 30
32. A 180° pie-chart sector represents 45 students. The total number of students represented is _____.
    Answer: 90 students
33. A 90° pie-chart sector represents 18 students. A 60° sector represents _____ students.
    Answer: 12 students
34. Two ratios are proportional: 4 : 7 = 12 : x. The value of x is _____.
    Answer: 21
35. Two ratios are proportional: 5 : 8 = x : 40. The value of x is _____.
    Answer: 25
36. In the ratio 1 : 1.5 : 3, 4 bags of cement require _____ bags of gravel.
    Answer: 12 bags
37. A recipe uses flour and sugar in the ratio 5 : 2. If 750 g of flour is used, the amount of sugar needed is _____ g.
    Answer: 300 g

38. A class's 360° pie chart has category counts in the ratio 3 : 2 : 1. The angle for the largest category is _____ degrees.
Answer: 180°
39. A 150-minute practice session is divided among warm-up/cool-down, batting, bowling and fielding in the ratio 3 : 4 : 3 : 5. The time for fielding is _____ minutes.
Answer: 50 minutes
40. A library has English : Hindi : Odia books in the ratio 1 : 2 : 3. If there are 288 Odia books, the total number of books is _____.
Answer: 576 books

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

One-Mark Descriptive Questions – LOTS Type:

1. **What does a ratio compare?**
Answer: A ratio compares two or more quantities by division.
2. **When are two ratios proportional?**
Answer: Two ratios are proportional when their cross-products are equal.
3. **Are 6 : 3 and 4 : 2 proportional?**
Answer: Yes, they are proportional because both cross-products equal 12.
4. **What does RF stand for in map reading?**
Answer: RF stands for Representative Fraction.
5. **What does a representative fraction compare?**
Answer: A representative fraction compares a map distance with the corresponding ground distance.
6. **In an RF of 1 : 60,00,000, what does 1 cm on the map represent?**
Answer: It represents 60,00,000 cm, or 60 km, on the ground.
7. **Should map distance and ground distance be in the same units when using an RF?**
Answer: Yes, both distances should be expressed in the same units.
8. **Can a ratio have more than two terms?**
Answer: Yes, a ratio can compare three or more quantities.
9. **Write the spice-mix ratio of coriander, chillies, toor dal and fenugreek given in the chapter.**
Answer: The ratio is 8 : 4 : 2 : 1.
10. **How should the quantities in a mixture be changed to keep its proportions the same?**
Answer: All the quantities should be multiplied or divided by the same factor.
11. **What is the first step in dividing a total in a given ratio?**
Answer: Add all the terms of the ratio.
12. **How do you find the value of one part when a total is divided in a ratio?**
Answer: Divide the total by the sum of the ratio terms.
13. **What is the sum of the terms in the ratio 2 : 3 : 5?**
Answer: The sum is 10.
14. **In the paint ratio 2 : 3 : 5, which colour has the greatest share?**
Answer: White paint has the greatest share.
15. **How many litres of red paint are needed when red, blue and white are mixed in the ratio 2 : 3 : 5 and white paint is 10 litres?**
Answer: Four litres of red paint are needed.
16. **How many litres of blue paint are needed when white paint is 10 litres in the ratio 2 : 3 : 5?**
Answer: Six litres of blue paint are needed.

17. **What is the total angle in a circle?**
    Answer: The total angle in a circle is 360°.
18. **What does a pie chart show?**
    Answer: A pie chart shows the proportions of different categories in a whole.
19. **How is the angle for a pie-chart category calculated?**
    Answer: Multiply the category's fraction of the total by 360°.
20. **What is the simplified form of 12 : 10 : 8 : 6 : 4?**
    Answer: Its simplified form is 6 : 5 : 4 : 3 : 2.
21. **What is the pie-chart angle for Grade A in the chapter's grade distribution?**
    Answer: The angle for Grade A is 108°.
22. **What is the pie-chart angle for Grade B in the chapter's grade distribution?**
    Answer: The angle for Grade B is 90°.
23. **What is the pie-chart angle for Grade E in the chapter's grade distribution?**
    Answer: The angle for Grade E is 36°.
24. **What is the sum of the interior angles of a triangle?**
    Answer: The interior angles of a triangle add up to 180°.
25. **What are the angles of a triangle in the ratio 1 : 3 : 5?**
    Answer: The angles are 20°, 60° and 100°.
26. **When are two quantities in direct proportion?**
    Answer: Two quantities are in direct proportion when they change by the same factor.
27. **What remains constant for two directly proportional quantities?**
    Answer: The ratio of the corresponding quantities remains constant.
28. **What is the rule of three used to find?**
    Answer: The rule of three is used to find an unknown fourth quantity in a proportion.
29. **What happens to travel time when speed increases for the same journey?**
    Answer: Travel time decreases when speed increases for the same journey.
30. **When are two quantities inversely proportional?**
    Answer: Two quantities are inversely proportional when one increases as the other decreases by a corresponding factor.
31. **What remains constant for two inversely proportional quantities?**
    Answer: The product of the two quantities remains constant.
32. **How does the time required for a fixed job change when the number of workers is halved?**
    Answer: The time required doubles if all workers work at the same rate.
33. **How does the time to fill a tank change when the number of identical pumps is doubled?**
    Answer: The filling time is halved if each pump works at the same rate.
34. **What is the distance between Lucknow and Kanpur in the chapter's speed-and-time example?**
    Answer: The distance is 90 km.
35. **How long do 20 workers take to complete the roadwork in the chapter's example?**
    Answer: They take 4 days.
36. **How long would 10 workers take to complete the same roadwork at the same rate?**
    Answer: They would take 8 days.
37. **If 80 students' food supplies last 15 days, what type of proportion connects the number of students and the number of days?**
    Answer: The number of students and the number of days are inversely proportional.

38. **What is the relationship between speed and time for a fixed distance?**
    Answer: Speed and time are inversely proportional for a fixed distance.
39. **What must be assumed when solving a workers-and-days problem using inverse proportion?**
    Answer: Each worker must be assumed to work at the same constant rate.
40. **What should be done to every term when simplifying a ratio?**
    Answer: Divide every term by the same common factor.

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

One-Mark Descriptive Questions – HOTS Type:

1. A map has an RF of 1 : 3,000,000, and two towns are 2 cm apart on it; what is their ground distance?
   Answer: The ground distance is 60 km.
2. On a map with an RF of 1 : 50,000, a road measures 4 cm; what ground distance does this represent?
   Answer: It represents 2 km.
3. A map distance of 3 cm represents 18 km on the ground; what is the RF in simplest form?
   Answer: The RF is 1 : 600,000.
4. Viswanath uses the spice ratio 8 : 4 : 2 : 1, but Puneet has only 2 chillies; how much coriander should Puneet use to preserve the ratio?
   Answer: Puneet should use 4 spoons of coriander.
5. In the same spice mix, if 2 chillies are used, how much fenugreek is required?
   Answer: Half a spoon of fenugreek is required.
6. Concrete is mixed in the ratio 1 : 1.5 : 3; if 2 bags of cement are used, how many bags of sand are needed?
   Answer: Three bags of sand are needed.
7. In that concrete mixture, if 2 bags of cement are used, how many bags of gravel are needed?
   Answer: Six bags of gravel are needed.
8. A total of 55 units of concrete is made using the ratio 1 : 1.5 : 3; how many units of gravel are used?
   Answer: Thirty units of gravel are used.
9. Paint is mixed red : blue : white in the ratio 2 : 3 : 5; in a 40-litre batch, how much white paint is needed?
   Answer: Twenty litres of white paint are needed.
10. A 30-litre paint batch follows the ratio 2 : 3 : 5; how much red paint is in the batch?
    Answer: Six litres of red paint are in the batch.
11. A total of 72 is divided in the ratio 3 : 4 : 5; what is the largest part?
    Answer: The largest part is 30.
12. A total of 84 is divided in the ratio 2 : 5 : 7; what is the smallest part?
    Answer: The smallest part is 12.
13. A triangle's angles are in the ratio 2 : 3 : 4; what is its largest angle?
    Answer: Its largest angle is 80°.
14. A triangle has angles in the ratio 1 : 3 : 5; what is the difference between its two smaller angles?
    Answer: The difference is 40°.

15. In a class of 30 students, 12 choose one subject; what angle should represent them in a pie chart?
    Answer: Their pie-chart angle is 144°.
16. A pie-chart sector is 72°; what percentage of the whole does it represent?
    Answer: It represents 20% of the whole.
17. A pie chart represents 360 students, and a category's sector is 90°; how many students are in that category?
    Answer: Ninety students are in that category.
18. Grade counts are in the ratio 6 : 5 : 4 : 3 : 2 for a class of 40; how many students received the grade represented by 5 parts?
    Answer: Ten students received that grade.
19. In the same grade distribution, what angle represents the category with 4 parts?
    Answer: The angle is 72°.
20. Five workers move 4,500 bricks in one day; how many bricks can 10 workers move in one day at the same rate?
    Answer: They can move 9,000 bricks.
21. If 5 workers move 4,500 bricks in a day, how many workers are needed to move 18,000 bricks in a day?
    Answer: Twenty workers are needed.
22. Twenty-four pencils cost ₹120; what is the cost of 36 pencils at the same rate?
    Answer: The cost is ₹180.
23. A car covers 150 km in 3 hours at a constant speed; how far will it travel in 5 hours?
    Answer: It will travel 250 km.
24. A fixed journey takes 3 hours at 40 km/h; how long will it take at 60 km/h?
    Answer: It will take 2 hours.
25. Twenty workers finish a job in 6 days; how many days would 30 workers take at the same rate?
    Answer: They would take 4 days.
26. Three identical pumps fill a tank in 12 hours; how long would 6 such pumps take?
    Answer: They would take 6 hours.
27. Food supplies last 80 students for 15 days; how long will they last 120 students if each student consumes the same amount?
    Answer: They will last 10 days.
28. A factory needs 42 machines to complete an order in 63 days; how many machines are needed to complete it in 54 days?
    Answer: Forty-nine machines are needed.
29. A car takes 2 hours to complete a journey at 60 km/h; how long would it take at 80 km/h?
    Answer: It would take 1.5 hours.
30. One pump fills a tank in 4 hours and another in 6 hours; how long will they take working together?
    Answer: They will take 2.4 hours.
31. Ram can complete a task in 1 hour and Shyam in 1.5 hours; how long will they take working together?
    Answer: They will take 0.6 hours, or 36 minutes.
32. A 150-minute practice session is divided in the ratio 3 : 4 : 3 : 5; how much time is assigned to the activity represented by 5 parts?
    Answer: Fifty minutes are assigned to it.

33. A library has English : Hindi : Odia books in the ratio 1 : 2 : 3; if there are 288 Odia books, how many Hindi books are there?
    Answer: There are 192 Hindi books.
34. If 4 cm on a map represents 20 km on the ground, what distance on the map represents 35 km?
    Answer: A map distance of 7 cm represents 35 km.
35. Two ratios are proportional as 4 : 7 = 12 : x; what is the value of x?
    Answer: The value of x is 21.
36. Two ratios are proportional as 5 : 8 = x : 40; what is the value of x?
    Answer: The value of x is 25.
37. A pie chart has categories in the ratio 1 : 2 : 3 : 4; what angle represents the category with 4 parts?
    Answer: The angle is 144°.
38. A mixture uses 2 parts red, 3 parts blue and 5 parts white; if the total is 60 litres, how much blue paint is used?
    Answer: Eighteen litres of blue paint are used.
39. A 180° pie-chart sector represents 45 people; how many people are represented by the complete chart?
    Answer: The complete chart represents 90 people.
40. Three workers paint a fence in 4 days; how long would 4 workers take if they work at the same rate?
    Answer: Four workers would take 3 days.

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

Two-Mark Descriptive Questions – LOTS Type:

1. **What is a ratio, and how is it written?**
   Answer:
   1. A ratio compares two or more quantities by division.
   2. It is commonly written using a colon, such as 2 : 1.
2. **How can you check whether two ratios are proportional?**
   Answer:
   1. Multiply the first term of each ratio by the opposite term in the other ratio.
   2. The ratios are proportional if the two products are equal.
3. **Are 6 : 3 and 4 : 2 proportional? Show the check.**
   Answer:
   1. The cross-products are 6 × 2 = 12 and 3 × 4 = 12.
   2. Since the products are equal, the ratios are proportional.
4. **What does a representative fraction on a map show?**
   Answer:
   1. It compares a distance on the map with the corresponding distance on the ground.
   2. The two distances must be expressed in the same units.
5. **What does an RF of 1 : 60,00,000 mean?**
   Answer:
   1. It means that 1 cm on the map represents 60,00,000 cm on the ground.
   2. This ground distance is 60 km.
6. **What is a multi-term ratio? Give an example.**
   Answer:
   1. A multi-term ratio compares three or more quantities.

2. An example from the chapter is 8 : 4 : 2 : 1 for a spice mixture.

7. **How can a mixture be increased while keeping its proportions unchanged?**
   Answer:
   1. Multiply every term in the ratio by the same factor.
   2. For example, doubling 2 : 3 : 5 gives 4 : 6 : 10.
8. **How do you divide a total into parts using a given ratio?**
   Answer:
   1. Add the terms of the ratio and divide the total by their sum to find the value of one part.
   2. Multiply that value by each ratio term to find each share.
9. **Divide 12 in the ratio 2 : 1.**
   Answer:
   1. The sum of the ratio terms is 3, so one part is $12 \div 3 = 4$.
   2. The shares are $2 \times 4 = 8$ and $1 \times 4 = 4$.
10. **In the ratio 2 : 3 : 5, what fraction of the total is represented by the last term?**
    Answer:
    1. The sum of the terms is 10.
    2. The last term represents 5/10, or one-half, of the total.
11. **A paint mixture uses red, blue and white in the ratio 2 : 3 : 5; how much red and blue paint is needed if there are 10 litres of white paint?**
    Answer:
    1. Five parts of white paint equal 10 litres, so one part is 2 litres.
    2. The mixture needs 4 litres of red paint and 6 litres of blue paint.
12. **What is a pie chart used for?**
    Answer:
    1. A pie chart shows how a whole is divided among different categories.
    2. Each category is represented by a slice of a circle.
13. **How do you find the angle for a category in a pie chart?**
    Answer:
    1. Divide the category's frequency by the total frequency.
    2. Multiply the result by 360°.
14. **A class has 40 students, and 10 received Grade B; what fraction and pie-chart angle represent Grade B?**
    Answer:
    1. Grade B represents 10/40, or 1/4, of the class.
    2. Its pie-chart angle is $1/4 \times 360° = 90°$.
15. **What is direct proportion?**
    Answer:
    1. Two quantities are in direct proportion when they change by the same factor.
    2. Their ratio remains constant.
16. **What is inverse proportion?**
    Answer:
    1. Two quantities are in inverse proportion when one increases as the other decreases by a corresponding factor.
    2. Their product remains constant.
17. **How are speed and travel time related for a fixed distance?**
    Answer:
    1. Speed and travel time are inversely proportional for a fixed distance.
    2. If speed increases by a factor, travel time decreases by the same factor.

18. **Twenty workers complete a job in 4 days; how long would 10 workers take at the same rate?**
    Answer:
    1. The number of workers and the number of days are inversely proportional.
    2. Halving the workers doubles the time, so 10 workers take 8 days.
19. **Two pumps fill a tank in 18 hours; how long would four identical pumps take?**
    Answer:
    1. The number of pumps and filling time are inversely proportional.
    2. Doubling the pumps halves the time, so the tank takes 9 hours to fill.
20. **A triangle has angles in the ratio 1 : 3 : 5; find the smallest angle.**
    Answer:
    1. The sum of the ratio terms is 9, so one part is $180° \div 9 = 20°$.
    2. The smallest angle is 20°.
21. **What is the total angle in a circle, and why is it important for pie charts?**
    Answer:
    1. A circle has a total angle of 360°.
    2. This total is divided among the pie-chart categories in proportion to their frequencies.
22. **How can you simplify a ratio with several terms?**
    Answer:
    1. Find the highest common factor of all the terms.
    2. Divide every term by that factor.
23. **In the chapter's grade distribution, the ratio 12 : 10 : 8 : 6 : 4 is simplified to what ratio?**
    Answer:
    1. The highest common factor of the terms is 2.
    2. Dividing each term by 2 gives 6 : 5 : 4 : 3 : 2.
24. **What does the product of speed and time represent when the speed is constant?**
    Answer:
    1. The product of speed and time gives the distance travelled.
    2. For a fixed journey, this distance remains constant.
25. **What assumption is made when using inverse proportion to solve worker and time problems?**
    Answer:
    1. Each worker is assumed to work at the same constant rate.
    2. The amount of work to be completed is assumed to stay fixed.

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

Two-Mark Descriptive Questions – HOTS Type:

1. A map has an RF of 1 : 2,000,000, and two towns are 3.6 cm apart on it. What is their ground distance?
   Answer:
   1. Ground distance = $3.6 \times 2{,}000{,}000 = 7{,}200{,}000$ cm.
   2. The towns are 72 km apart.
2. On a map, 4 cm represents 28 km on the ground. Find the RF in simplest form.
   Answer:
   1. Convert 28 km to 2,800,000 cm, so the scale is 4 : 2,800,000.
   2. Dividing both terms by 4 gives an RF of 1 : 700,000.

3. A spice mixture uses coriander, chillies, toor dal and fenugreek in the ratio 8 : 4 : 2 : 1. If 6 chillies are used, how much coriander and fenugreek are needed?
   Answer:
   1. The scale factor is 6 ÷ 4 = 1.5.
   2. Use 12 spoons of coriander and 1.5 spoons of fenugreek.
4. Concrete is mixed in the ratio 1 : 1.5 : 3. Find the quantities of cement, sand and gravel needed for 110 units of concrete.
   Answer:
   1. The sum of the ratio terms is 5.5, so the scale factor is 110 ÷ 5.5 = 20.
   2. Use 20 units of cement, 30 units of sand and 60 units of gravel.
5. A 75-litre paint mixture has red, blue and white paint in the ratio 2 : 3 : 5. Find the quantity of each colour.
   Answer:
   1. The ratio terms total 10, so each part represents 75 ÷ 10 = 7.5 litres.
   2. Use 15 litres of red, 22.5 litres of blue and 37.5 litres of white paint.
6. Divide 84 in the ratio 2 : 5 : 7.
   Answer:
   1. The ratio terms total 14, so one part is 84 ÷ 14 = 6.
   2. The three shares are 12, 30 and 42.
7. A triangle's angles are in the ratio 2 : 3 : 4. Find the angles.
   Answer:
   1. The ratio terms total 9, so one part is 180° ÷ 9 = 20°.
   2. The angles are 40°, 60° and 80°.
8. In a survey of 120 students, 30 prefer one category. What angle should represent that category in a pie chart?
   Answer:
   1. The category represents 30 ÷ 120 = 1/4 of the students.
   2. Its pie-chart angle is 1/4 × 360° = 90°.
9. A pie chart has categories in the ratio 1 : 2 : 3 : 4. Find the angle for the category represented by 4 parts.
   Answer:
   1. The ratio terms total 10, so each part represents 360° ÷ 10 = 36°.
   2. The 4-part category has an angle of 144°.
10. A class of 40 students has grades distributed in the ratio 6 : 5 : 4 : 3 : 2. Find the number of students and the pie-chart angle for the category represented by 3 parts.
    Answer:
    1. The ratio terms total 20, so one part represents 40 ÷ 20 = 2 students.
    2. The category has 6 students and a pie-chart angle of 54°.
11. Five workers move 4,500 bricks in a day. How many bricks can 8 workers move in a day at the same rate?
    Answer:
    1. One worker moves 4,500 ÷ 5 = 900 bricks in a day.
    2. Eight workers move 8 × 900 = 7,200 bricks in a day.
12. Five workers move 4,500 bricks in a day. How many workers are needed to move 18,000 bricks in a day?
    Answer:
    1. The number of bricks increases by a factor of 18,000 ÷ 4,500 = 4.
    2. The number of workers must also increase fourfold, so 20 workers are needed.
13. Twenty-four pencils cost ₹120. What will 30 pencils cost at the same rate?
    Answer:

1. One pencil costs ₹120 ÷ 24 = ₹5.
2. Thirty pencils cost 30 × ₹5 = ₹150.

14. A car travels 30 km in half an hour at a constant speed. How long will it take to travel 90 km?
Answer:
1. The car's speed is 30 ÷ 0.5 = 60 km/h.
2. The time for 90 km is 90 ÷ 60 = 1.5 hours.

15. A fixed journey takes 3 hours at 40 km/h. How long will it take at 60 km/h?
Answer:
1. The journey is 40 × 3 = 120 km.
2. At 60 km/h, it takes 120 ÷ 60 = 2 hours.

16. Twenty-four workers complete a job in 5 days. How long would 15 workers take at the same rate?
Answer:
1. The total work is 24 × 5 = 120 worker-days.
2. The time for 15 workers is 120 ÷ 15 = 8 days.

17. Food supplies last 80 students for 15 days. How long will the supplies last 120 students if each student consumes the same amount?
Answer:
1. The supplies provide 80 × 15 = 1,200 student-days of food.
2. For 120 students, they last 1,200 ÷ 120 = 10 days.

18. Three identical pumps fill a tank in 8 hours. How long would 4 such pumps take?
Answer:
1. The work requires 3 × 8 = 24 pump-hours.
2. Four pumps take 24 ÷ 4 = 6 hours.

19. A factory needs 42 machines to complete an order in 63 days. How many machines are needed to complete the same order in 54 days?
Answer:
1. The work requires 42 × 63 = 2,646 machine-days.
2. The number needed is 2,646 ÷ 54 = 49 machines.

20. Two pumps fill a tank in 18 hours. How long would 6 identical pumps take?
Answer:
1. The work requires 2 × 18 = 36 pump-hours.
2. Six pumps take 36 ÷ 6 = 6 hours.

21. A small pump fills a tank in 3 hours and a large pump fills it in 2 hours. How long do they take working together?
Answer:
1. Their combined rate is 1/3 + 1/2 = 5/6 of a tank per hour.
2. They fill the tank in 1 ÷ (5/6) = 1.2 hours, or 1 hour 12 minutes.

22. Ram takes 1 hour to complete a task, while Shyam takes 1.5 hours. How long do they take working together?
Answer:
1. Their combined work rate is 1 + 1/1.5 = 1 + 2/3 = 5/3 tasks per hour.
2. They complete one task in 1 ÷ (5/3) = 0.6 hours, or 36 minutes.

23. In a survey of 360 people, 90 prefer summer, 120 prefer the rainy season and the rest prefer winter. Find the pie-chart angle for each season.
Answer:
1. The number who prefer winter is 360 − 90 − 120 = 150.
2. The angles are 90° for summer, 120° for the rainy season and 150° for winter.

24. A school has supplies for 20 families for 6 days. How long will they last 30 families if each family uses the same amount?
Answer:
    1. The supplies equal 20 × 6 = 120 family-days.
    2. For 30 families, they last 120 ÷ 30 = 4 days.
25. A person has 100 coins in the ratio ₹10 coins : ₹5 coins : ₹2 coins : ₹1 coins = 4 : 3 : 2 : 1. What is the total value of the coins?
Answer:
    1. The ratio terms total 10, so the coin counts are 40, 30, 20 and 10.
    2. Their total value is (40 × ₹10) + (30 × ₹5) + (20 × ₹2) + (10 × ₹1) = ₹600.

3.9. Three-mark questions with Answers of LOTS Type: (25 Questions)

Three-Mark Descriptive Questions – LOTS Type:

1. **A map has an RF of 1 : 60,00,000. What ground distance does 3 cm on the map represent?**
Answer:
    1. One centimetre on the map represents 60,00,000 cm on the ground.
    2. Three centimetres represent 3 × 60,00,000 = 18,000,000 cm.
    3. This is equal to 180 km.
2. **A map distance of 2 cm represents 10 km on the ground. Find the RF in simplest form.**
Answer:
    1. Convert 10 km to 1,000,000 cm.
    2. Write the ratio as 2 : 1,000,000.
    3. Divide both terms by 2 to get the RF 1 : 500,000.
3. **Check whether 8 : 4 and 10 : 5 are proportional.**
Answer:
    1. Multiply the first term of the first ratio by the second term of the second ratio: 8 × 5 = 40.
    2. Multiply the second term of the first ratio by the first term of the second ratio: 4 × 10 = 40.
    3. Since the products are equal, the ratios are proportional.
4. **A spice mixture uses coriander, chillies, toor dal and fenugreek in the ratio 8 : 4 : 2 : 1. If 3 spoons of toor dal are used, how much of each ingredient is needed?**
Answer:
    1. The scale factor is 3 ÷ 2 = 1.5.
    2. Coriander and chillies are 8 × 1.5 = 12 spoons and 4 × 1.5 = 6 spoons.
    3. Fenugreek is 1 × 1.5 = 1.5 spoons, so the quantities are 12, 6, 3 and 1.5 spoons.
5. **A paint mixture has red, blue and white paint in the ratio 2 : 3 : 5. Find the amount of each colour in a 100-litre batch.**
Answer:
    1. The sum of the ratio terms is 2 + 3 + 5 = 10.
    2. Each part represents 100 ÷ 10 = 10 litres.
    3. The mixture needs 20 litres of red, 30 litres of blue and 50 litres of white paint.
6. **Divide 144 in the ratio 2 : 3 : 7.**
Answer:
    1. The sum of the ratio terms is 2 + 3 + 7 = 12.
    2. One part is 144 ÷ 12 = 12.

3. The shares are 24, 36 and 84.

7. **Divide 110 units of concrete in the ratio cement : sand : gravel = 1 : 1.5 : 3.**
   Answer:
   1. The sum of the ratio terms is 1 + 1.5 + 3 = 5.5.
   2. The scale factor is 110 ÷ 5.5 = 20.
   3. The mixture needs 20 units of cement, 30 units of sand and 60 units of gravel.
8. **A triangle has angles in the ratio 1 : 3 : 5. Find its three angles.**
   Answer:
   1. The sum of the ratio terms is 1 + 3 + 5 = 9.
   2. One part is 180° ÷ 9 = 20°.
   3. The angles are 20°, 60° and 100°.
9. **A total of 360 students is divided among five grades in the ratio 6 : 5 : 4 : 3 : 2. Find the number of students represented by each term.**
   Answer:
   1. The ratio terms add up to 20, so one part represents 360 ÷ 20 = 18 students.
   2. The first three groups have 108, 90 and 72 students.
   3. The last two groups have 54 and 36 students.
10. **Find the pie-chart angle for each category when the data is in the ratio 1 : 2 : 3.**
    Answer:
    1. The sum of the ratio terms is 1 + 2 + 3 = 6.
    2. One part represents 360° ÷ 6 = 60°.
    3. The pie-chart angles are 60°, 120° and 180°.
11. **In a class of 40 students, 10 received Grade B. Find the fraction and pie-chart angle for Grade B.**
    Answer:
    1. The fraction is 10 ÷ 40 = 1/4.
    2. The angle is 1/4 × 360° = 90°.
    3. Grade B should be shown by a 90° sector.
12. **Five workers move 4,500 bricks in one day. How many bricks can 10 workers move in one day at the same rate?**
    Answer:
    1. The number of workers doubles from 5 to 10.
    2. The number of bricks moved also doubles.
    3. They can move 4,500 × 2 = 9,000 bricks.
13. **If 5 workers move 4,500 bricks in a day, how many workers are needed to move 18,000 bricks in a day?**
    Answer:
    1. The number of bricks increases by a factor of 18,000 ÷ 4,500 = 4.
    2. The number of workers must increase by the same factor.
    3. The required number is 5 × 4 = 20 workers.
14. **Twenty-four pencils cost ₹120. Find the cost of 36 pencils at the same rate.**
    Answer:
    1. The cost of one pencil is ₹120 ÷ 24 = ₹5.
    2. The cost of 36 pencils is 36 × ₹5.
    3. Therefore, 36 pencils cost ₹180.
15. **A car travels 120 km in 2 hours. How far will it travel in 5 hours at the same speed?**
    Answer:
    1. Its speed is 120 ÷ 2 = 60 km/h.
    2. In 5 hours, it travels 60 × 5 km.

3. It will travel 300 km.

16. **A journey takes 3 hours at 40 km/h. How long will the same journey take at 60 km/h?**
Answer:
    1. The journey distance is 40 × 3 = 120 km.
    2. At 60 km/h, the time is 120 ÷ 60 hours.
    3. The journey will take 2 hours.
17. **Twenty workers complete a job in 4 days. How long will 10 workers take at the same rate?**
Answer:
    1. The total work is 20 × 4 = 80 worker-days.
    2. The time for 10 workers is 80 ÷ 10 days.
    3. They will take 8 days.
18. **Two pumps fill a tank in 18 hours. How long will four identical pumps take?**
Answer:
    1. The work requires 2 × 18 = 36 pump-hours.
    2. The time for four pumps is 36 ÷ 4 hours.
    3. Four pumps will fill the tank in 9 hours.
19. **Food supplies last 80 students for 15 days. How long will they last 100 students if each student consumes the same amount?**
Answer:
    1. The supplies provide 80 × 15 = 1,200 student-days of food.
    2. For 100 students, the supplies last 1,200 ÷ 100 days.
    3. They will last 12 days.
20. **A factory needs 42 machines to complete a fixed order in 63 days. How many machines are needed to finish it in 54 days?**
Answer:
    1. The total work is 42 × 63 = 2,646 machine-days.
    2. The number of machines needed is 2,646 ÷ 54.
    3. The factory needs 49 machines.
21. **A small pump fills a tank in 3 hours and a large pump fills it in 2 hours. How long do they take working together?**
Answer:
    1. The small pump fills 1/3 of the tank per hour and the large pump fills 1/2 per hour.
    2. Together, they fill 1/3 + 1/2 = 5/6 of the tank per hour.
    3. They take 1 ÷ 5/6 = 6/5 hours, or 1 hour 12 minutes.
22. **Ram takes 1 hour to cut a quantity of vegetables, while Shyam takes 1.5 hours. How long will they take working together?**
Answer:
    1. Ram's rate is 1 task per hour and Shyam's rate is 2/3 task per hour.
    2. Their combined rate is 1 + 2/3 = 5/3 tasks per hour.
    3. They will take 1 ÷ 5/3 = 3/5 hour, or 36 minutes.
23. **A survey of 360 people finds that 90 prefer summer, 120 prefer the rainy season and the rest prefer winter. Find the pie-chart angle for each season.**
Answer:
    1. The number who prefer winter is 360 − 90 − 120 = 150.
    2. Summer and rainy-season angles are 90/360 × 360° = 90° and 120/360 × 360° = 120°.
    3. Winter's angle is 150/360 × 360° = 150°.

24. **A school has enough water for 20 families for 6 days. How long will it last 30 families at the same rate of use?**
    Answer:
    1. The water supply equals 20 × 6 = 120 family-days.
    2. For 30 families, it lasts 120 ÷ 30 days.
    3. The water will last 4 days.
25. **A person has 100 coins in the ratio ₹10 coins : ₹5 coins : ₹2 coins : ₹1 coins = 4 : 3 : 2 : 1. Find the number of each type and the total value.**
    Answer:
    1. The ratio terms total 10, so one part represents 100 ÷ 10 = 10 coins.
    2. The numbers of coins are 40, 30, 20 and 10, respectively.
    3. Their total value is ₹400 + ₹150 + ₹40 + ₹10 = ₹600.

3.10. Three-mark questions with Answers of HOTS Type: (25 Questions)

Three-Mark Descriptive Questions – HOTS Type:

1. Viswanath's spice mixture uses coriander, chillies, toor dal and fenugreek in the ratio 8 : 4 : 2 : 1. If a cook uses 6 chillies, how much of each ingredient should be used?
   Answer:
   1. The scale factor is 6 ÷ 4 = 1.5.
   2. Coriander and toor dal needed are 8 × 1.5 = 12 spoons and 2 × 1.5 = 3 spoons.
   3. Fenugreek needed is 1 × 1.5 = 1.5 spoons.
2. A paint mixture must contain red, blue and white paint in the ratio 2 : 3 : 5. If 15 litres of blue paint are available, how much of each colour is needed?
   Answer:
   1. The scale factor is 15 ÷ 3 = 5.
   2. Red paint needed is 2 × 5 = 10 litres.
   3. White paint needed is 5 × 5 = 25 litres.
3. Concrete is mixed in the ratio cement : sand : gravel = 1 : 1.5 : 3. If a builder uses 3 bags of cement, how many bags of each component and how many total bags are there?
   Answer:
   1. The scale factor is 3 ÷ 1 = 3.
   2. The builder needs 4.5 bags of sand and 9 bags of gravel.
   3. The total mixture is 3 + 4.5 + 9 = 16.5 bags.
4. A total of 132 units is divided in the ratio 2 : 3 : 6. Find the three shares and verify the total.
   Answer:
   1. The ratio terms sum to 11, so one part equals 132 ÷ 11 = 12.
   2. The shares are 24, 36 and 72.
   3. Their sum is 24 + 36 + 72 = 132, which matches the total.
5. A school has English, Hindi and Odia books in the ratio 1 : 2 : 3. If there are 240 Hindi books, how many books are there altogether?
   Answer:
   1. The scale factor is 240 ÷ 2 = 120.
   2. The numbers of English and Odia books are 120 and 360.
   3. The total number of books is 120 + 240 + 360 = 720.
6. A triangle's angles are in the ratio 2 : 3 : 4. Find the angles and check that they form a triangle.
   Answer:

1. The ratio terms sum to 9, so one part equals 180° ÷ 9 = 20°.
2. The angles are 40°, 60° and 80°.
3. Their sum is 40° + 60° + 80° = 180°, so they satisfy the triangle angle rule.

7. A student tries to make a triangle with side lengths in the ratio 1 : 3 : 5. Can the student construct it?
   Answer:
   1. The two shorter sides together have 1 + 3 = 4 parts.
   2. The longest side is 5 parts, which is greater than the sum of the shorter sides.
   3. The student cannot construct a triangle with these side lengths.
8. Two students draw triangles with side lengths in the ratio 3 : 4 : 5, but one uses sides 3 cm, 4 cm and 5 cm while the other uses 6 cm, 8 cm and 10 cm. Are the triangles congruent?
   Answer:
   1. Each side of the second triangle is twice the corresponding side of the first.
   2. The triangles have the same shape but different sizes.
   3. They are not congruent because their corresponding side lengths are not equal.
9. A class of 40 students has grades in the ratio 6 : 5 : 4 : 3 : 2. Find the number of students with each grade and the pie-chart angle for the largest group.
   Answer:
   1. The ratio terms sum to 20, so one part represents 40 ÷ 20 = 2 students.
   2. The grade counts are 12, 10, 8, 6 and 4 students.
   3. The largest group's pie-chart angle is 12/40 × 360° = 108°.
10. A pie-chart sector of 72° represents one category in a survey of 250 students. How many students chose that category, and what fraction of the class is it?
    Answer:
    1. The sector represents 72 ÷ 360 = 1/5 of the circle.
    2. The number of students is 250 × 1/5 = 50.
    3. Thus, 50 students, or one-fifth of the class, chose the category.
11. In a survey of 360 people, 90 prefer summer, 120 prefer the rainy season and the rest prefer winter. Find the winter count and compare its pie-chart angle with the summer angle.
    Answer:
    1. The number preferring winter is 360 − 90 − 120 = 150.
    2. The winter and summer angles are 150° and 90°, respectively.
    3. The winter sector is 60° larger than the summer sector.
12. A pie chart shows categories in the ratio 3 : 2 : 1. If the smallest category has 24 people, find the total number surveyed and the angle for the largest category.
    Answer:
    1. The smallest category represents 1 part, so one part equals 24 people.
    2. The total is 6 × 24 = 144 people.
    3. The largest category's angle is 3/6 × 360° = 180°.
13. A map has an RF of 1 : 1,500,000, and two places are 3.2 cm apart on the map. Find their ground distance in kilometres.
    Answer:
    1. The ground distance is 3.2 × 1,500,000 = 4,800,000 cm.
    2. Since 100,000 cm equals 1 km, convert 4,800,000 cm to kilometres.
    3. The places are 48 km apart.
14. Two maps show the same geographical distance: one uses RF 1 : 1,000,000 and the other uses RF 1 : 2,000,000. If the distance on the first map is 8 cm, what is the

distance on the second map?

Answer:

1. The actual distance is 8 × 1,000,000 = 8,000,000 cm.
2. On the second map, the map distance is 8,000,000 ÷ 2,000,000 = 4 cm.
3. The same distance is shown as 4 cm on the second map.

15. Five workers move 4,500 bricks in a day. At the same rate, how many workers are needed to move 27,000 bricks in a day?

Answer:

1. The number of bricks increases by a factor of 27,000 ÷ 4,500 = 6.
2. The number of workers must also increase by a factor of 6.
3. The required number is 5 × 6 = 30 workers.

16. A car takes 3 hours to travel a fixed route at 40 km/h. If it travels at 60 km/h, how long will the trip take?

Answer:

1. The route distance is 40 × 3 = 120 km.
2. The time at 60 km/h is 120 ÷ 60 = 2 hours.
3. The faster speed reduces the travel time by 1 hour.

17. Eighteen workers complete a job in 10 days. How many days would 30 workers take at the same rate?

Answer:

1. The total work is 18 × 10 = 180 worker-days.
2. The time for 30 workers is 180 ÷ 30 = 6 days.
3. Therefore, 30 workers finish the job in 6 days.

18. A school has food for 80 students for 15 days. If 20 more students join, how long will the food last?

Answer:

1. The total supply equals 80 × 15 = 1,200 student-days.
2. The new number of students is 80 + 20 = 100.
3. The food will last 1,200 ÷ 100 = 12 days.

19. Two pumps fill a tank in 18 hours. How long would 6 identical pumps take, and how much time would they save?

Answer:

1. The work requires 2 × 18 = 36 pump-hours.
2. Six pumps take 36 ÷ 6 = 6 hours.
3. They save 18 − 6 = 12 hours.

20. A small pump fills a tank in 3 hours and a large pump fills it in 2 hours. How long do they take working together?

Answer:

1. The small pump fills 1/3 of the tank per hour, and the large pump fills 1/2 per hour.
2. Together, they fill 1/3 + 1/2 = 5/6 of the tank per hour.
3. The time needed is 1 ÷ 5/6 = 6/5 hours, or 1 hour 12 minutes.

21. Ram takes 1 hour to complete a task, while Shyam takes 1.5 hours. How long do they take working together?

Answer:

1. Ram's rate is 1 task per hour, and Shyam's rate is 2/3 task per hour.
2. Their combined rate is 1 + 2/3 = 5/3 tasks per hour.
3. They complete the task in 1 ÷ 5/3 = 3/5 hour, or 36 minutes.

22. A factory needs 42 machines to finish an order in 63 days. If only 54 days are available, how many machines are required?
Answer:
    1. The fixed work is 42 × 63 = 2,646 machine-days.
    2. The number of machines needed is 2,646 ÷ 54 = 49.
    3. The factory needs 49 machines to meet the shorter deadline.
23. A 150-minute sports session divides time among warm-up/cool-down, batting, bowling and fielding in the ratio 3 : 4 : 3 : 5. How many minutes are spent on each activity?
Answer:
    1. The ratio terms sum to 15, so one part equals 150 ÷ 15 = 10 minutes.
    2. The times for warm-up/cool-down, batting and bowling are 30, 40 and 30 minutes.
    3. Fielding receives 50 minutes.
24. A person has 100 coins in the ratio ₹10 coins : ₹5 coins : ₹2 coins : ₹1 coins = 4 : 3 : 2 : 1. Find the number of each coin and their total value.
Answer:
    1. The ratio terms sum to 10, so one part represents 100 ÷ 10 = 10 coins.
    2. The person has 40, 30, 20 and 10 coins of the respective values.
    3. The total value is ₹400 + ₹150 + ₹40 + ₹10 = ₹600.
25. A table gives x-values 40, 80, 25 and 16, and corresponding y-values 20, 10, 32 and 50. Are x and y inversely proportional?
Answer:
    1. The products are 40 × 20 = 800 and 80 × 10 = 800.
    2. The remaining products are 25 × 32 = 800 and 16 × 50 = 800.
    3. Since every product is constant, x and y are inversely proportional.

3.11 Five-mark questions with Answers of LOTS Type: (20 Questions)

Five-Mark Descriptive Questions – LOTS Type:

1. **Check whether the ratios 6 : 3 and 4 : 2 are proportional. Show the cross-multiplication steps.**
Answer:
    1. Write the ratios as 6 : 3 and 4 : 2.
    2. Multiply the first term of the first ratio by the second term of the second ratio: 6 × 2 = 12.
    3. Multiply the second term of the first ratio by the first term of the second ratio: 3 × 4 = 12.
    4. Compare the two products.
    5. Since both products equal 12, the ratios are proportional.
2. **A map has an RF of 1 : 60,00,000. Find the ground distance represented by 2.5 cm on the map.**
Answer:
    1. The RF means 1 cm on the map represents 60,00,000 cm on the ground.
    2. For 2.5 cm, multiply 60,00,000 by 2.5.
    3. The ground distance is 15,000,000 cm.
    4. Since 100,000 cm equals 1 km, convert the distance to kilometres.
    5. The ground distance is 150 km.

3. **A spice mixture uses coriander, chillies, toor dal and fenugreek in the ratio 8 : 4 : 2 : 1. Find the amount of each ingredient needed if 3 spoons of toor dal are used.**
   Answer:
   1. In the given ratio, toor dal represents 2 parts.
   2. The scale factor is $3 \div 2 = 1.5$.
   3. Coriander needed is $8 \times 1.5 = 12$ spoons.
   4. Chillies and toor dal needed are $4 \times 1.5 = 6$ spoons and 3 spoons.
   5. Fenugreek needed is $1 \times 1.5 = 1.5$ spoons.
4. **Divide 120 in the ratio 2 : 3 : 5.**
   Answer:
   1. Add the ratio terms: $2 + 3 + 5 = 10$.
   2. Find the value of one part: $120 \div 10 = 12$.
   3. The first share is $2 \times 12 = 24$.
   4. The second and third shares are $3 \times 12 = 36$ and $5 \times 12 = 60$.
   5. The shares are 24, 36 and 60, and their sum is 120.
5. **Red, blue and white paint are mixed in the ratio 2 : 3 : 5. Find the amount of each colour in a 50-litre mixture.**
   Answer:
   1. Add the ratio terms: $2 + 3 + 5 = 10$.
   2. Find the value of one part: $50 \div 10 = 5$ litres.
   3. Red paint required is $2 \times 5 = 10$ litres.
   4. Blue and white paint required are $3 \times 5 = 15$ litres and $5 \times 5 = 25$ litres.
   5. The mixture contains 10 litres of red, 15 litres of blue and 25 litres of white paint.
6. **Cement, sand and gravel are mixed in the ratio 1 : 1.5 : 3. Find the amount of each component needed to make 110 units of concrete.**
   Answer:
   1. Add the ratio terms: $1 + 1.5 + 3 = 5.5$.
   2. Find the scale factor: $110 \div 5.5 = 20$.
   3. Cement required is $1 \times 20 = 20$ units.
   4. Sand and gravel required are $1.5 \times 20 = 30$ units and $3 \times 20 = 60$ units.
   5. The mixture contains 20 units of cement, 30 units of sand and 60 units of gravel.
7. **Find the angles of a triangle whose angles are in the ratio 1 : 3 : 5.**
   Answer:
   1. The angles of a triangle add up to 180°.
   2. Add the ratio terms: $1 + 3 + 5 = 9$.
   3. Find the value of one part: $180° \div 9 = 20°$.
   4. The angles are $1 \times 20° = 20°$, $3 \times 20° = 60°$ and $5 \times 20° = 100°$.
   5. The three angles are 20°, 60° and 100°.
8. **Forty students receive grades in the ratio A : B : C : D : E = 6 : 5 : 4 : 3 : 2. Find the number of students and the pie-chart angle for each grade.**
   Answer:
   1. Add the ratio terms: $6 + 5 + 4 + 3 + 2 = 20$.
   2. One part represents $40 \div 20 = 2$ students.
   3. The numbers of students receiving A, B, C, D and E are 12, 10, 8, 6 and 4.
   4. One part of the pie chart represents $360° \div 20 = 18°$.
   5. The grade angles are A = 108°, B = 90°, C = 72°, D = 54° and E = 36°.
9. **In a survey of 360 people, 90 prefer summer, 120 prefer the rainy season and the rest prefer winter. Find the number of people and pie-chart angle for each**

season.

Answer:

1. The number who prefer winter is 360 − 90 − 120 = 150.
2. Summer represents 90/360 of the people, so its angle is 90°.
3. The rainy season represents 120/360 of the people, so its angle is 120°.
4. Winter represents 150/360 of the people, so its angle is 150°.
5. The angles are 90°, 120° and 150°, which total 360°.

10. **Five workers move 4,500 bricks in one day. How many workers are required to move 18,000 bricks in one day at the same rate?**

Answer:

1. The number of bricks increases from 4,500 to 18,000.
2. The scale factor is 18,000 ÷ 4,500 = 4.
3. The number of workers must increase by the same factor.
4. Multiply 5 workers by 4.
5. Twenty workers are required.

11. **Twenty-four pencils cost ₹120. Find the cost of 40 pencils at the same rate.**

Answer:

1. The cost of 24 pencils is ₹120.
2. The cost of one pencil is ₹120 ÷ 24 = ₹5.
3. The cost of 40 pencils is 40 × ₹5.
4. Calculate 40 × 5 = 200.
5. Forty pencils cost ₹200.

12. **A car travels 150 km in 3 hours. Find its speed and the time it will take to travel 250 km at the same speed.**

Answer:

1. Speed = distance ÷ time.
2. The car's speed is 150 ÷ 3 = 50 km/h.
3. Time for 250 km = distance ÷ speed.
4. The time is 250 ÷ 50 = 5 hours.
5. The car will take 5 hours to travel 250 km.

13. **Twenty workers complete a job in 4 days. How many days will 10 workers take to complete the same job at the same rate?**

Answer:

1. Workers and days are inversely proportional for the same amount of work.
2. Calculate the total work as 20 × 4 = 80 worker-days.
3. Divide the total work by 10 workers.
4. The required time is 80 ÷ 10 = 8 days.
5. Ten workers will take 8 days.

14. **Two pumps fill a tank in 18 hours. How long will four identical pumps take?**

Answer:

1. The number of pumps and filling time are inversely proportional.
2. The total work is 2 × 18 = 36 pump-hours.
3. Divide 36 pump-hours by 4 pumps.
4. The time required is 36 ÷ 4 = 9 hours.
5. Four pumps will fill the tank in 9 hours.

15. **Food supplies last 80 students for 15 days. For how many days will they last 100 students if each student consumes the same amount?**

Answer:

1. The number of students and the number of days are inversely proportional.
2. The supply equals 80 × 15 = 1,200 student-days.

3. Divide 1,200 student-days by 100 students.
4. The supplies will last 12 days.
5. Therefore, 100 students can be fed for 12 days.

16. **A factory needs 42 machines to complete an order in 63 days. How many machines are needed to finish it in 54 days?**
Answer:
1. The number of machines and the number of days are inversely proportional.
2. The total work is 42 × 63 = 2,646 machine-days.
3. Divide 2,646 machine-days by 54 days.
4. The calculation gives 49 machines.
5. The factory needs 49 machines.

17. **A car takes 2 hours to travel at 60 km/h. Find the distance and the time needed to cover it at 80 km/h.**
Answer:
1. Distance = speed × time.
2. The distance is 60 × 2 = 120 km.
3. Time = distance ÷ speed.
4. At 80 km/h, the time is 120 ÷ 80 = 1.5 hours.
5. The car will take 1.5 hours.

18. **A small pump fills a tank in 3 hours, while a large pump fills it in 2 hours. Find how long they take working together.**
Answer:
1. The small pump fills 1/3 of the tank in one hour.
2. The large pump fills 1/2 of the tank in one hour.
3. Together they fill 1/3 + 1/2 = 5/6 of the tank per hour.
4. The time for one tank is 1 ÷ 5/6 = 6/5 hours.
5. They fill the tank in 1 hour 12 minutes.

19. **Ram takes 1 hour to cut a quantity of vegetables, while Shyam takes 1.5 hours. Find how long they take working together.**
Answer:
1. Ram completes 1 task per hour.
2. Shyam completes 1 ÷ 1.5 = 2/3 of the task per hour.
3. Their combined rate is 1 + 2/3 = 5/3 tasks per hour.
4. The time for one task is 1 ÷ 5/3 = 3/5 hour.
5. They finish in 36 minutes.

20. **A practice session of 150 minutes is divided in the ratio 3 : 4 : 3 : 5 for warm-up/cool-down, batting, bowling and fielding. Find the time for each activity.**
Answer:
1. The ratio terms total 3 + 4 + 3 + 5 = 15.
2. One part represents 150 ÷ 15 = 10 minutes.
3. Warm-up/cool-down and batting receive 30 and 40 minutes.
4. Bowling and fielding receive 30 and 50 minutes.
5. The times are 30, 40, 30 and 50 minutes, respectively.

3.12 Five-mark questions with Answers of HOTS Type: (20 Questions)

Five-Mark Descriptive Questions – HOTS Type:

1. A map has an RF of 1 : 4,000,000. Two cities are 6.5 cm apart on the map. Find the ground distance in kilometres.
Answer:

1. The RF means 1 cm represents 4,000,000 cm on the ground.
2. For 6.5 cm, the ground distance is 6.5 × 4,000,000 = 26,000,000 cm.
3. Convert centimetres to kilometres by dividing by 100,000.
4. The distance is 26,000,000 ÷ 100,000 = 260 km.
5. The cities are 260 km apart geographically.

2. The same 260 km distance is shown on a second map with an RF of 1 : 2,000,000. What map distance will be used?

Answer:

1. Convert 260 km to centimetres: 260 × 100,000 = 26,000,000 cm.
2. The RF states that 1 cm represents 2,000,000 cm.
3. Divide the ground distance by the scale factor: 26,000,000 ÷ 2,000,000 = 13.
4. The map distance is 13 cm.
5. The second map shows the same journey as 13 cm.

3. A classroom is 9 m long and 6 m wide. Drawings use a scale of 1 : 50. Find the classroom's dimensions on the drawing in centimetres.

Answer:

1. Convert 9 m to 900 cm and 6 m to 600 cm.
2. At a scale of 1 : 50, divide each actual dimension by 50.
3. The drawing length is 900 ÷ 50 = 18 cm.
4. The drawing width is 600 ÷ 50 = 12 cm.
5. The classroom should be drawn as 18 cm by 12 cm.

4. A spice mixture uses coriander, chillies, toor dal and fenugreek in the ratio 8 : 4 : 2 : 1. If 1.5 spoons of fenugreek are used, find the amount of each ingredient and the total mixture.

Answer:

1. The scale factor is 1.5 ÷ 1 = 1.5.
2. Coriander needed is 8 × 1.5 = 12 spoons.
3. Chillies and toor dal needed are 4 × 1.5 = 6 spoons and 2 × 1.5 = 3 spoons.
4. Fenugreek needed is 1.5 spoons.
5. The total mixture is 12 + 6 + 3 + 1.5 = 22.5 spoons.

5. Red, blue and white paint are mixed in the ratio 2 : 3 : 5. If 18 litres of white paint are used, find the amount of each colour and the total paint.

Answer:

1. The scale factor is 18 ÷ 5 = 3.6.
2. Red paint needed is 2 × 3.6 = 7.2 litres.
3. Blue paint needed is 3 × 3.6 = 10.8 litres.
4. White paint needed is 18 litres.
5. The total paint is 7.2 + 10.8 + 18 = 36 litres.

6. Concrete is mixed in the ratio cement : sand : gravel = 1 : 1.5 : 3. Find the amount of each component needed for 220 units of concrete.

Answer:

1. Add the ratio terms: 1 + 1.5 + 3 = 5.5.
2. Find the scale factor: 220 ÷ 5.5 = 40.
3. Cement needed is 1 × 40 = 40 units.
4. Sand and gravel needed are 1.5 × 40 = 60 units and 3 × 40 = 120 units.
5. The mixture requires 40 units of cement, 60 units of sand and 120 units of gravel.

7. Divide 168 units among three groups in the ratio 3 : 4 : 5, and check that the shares add up to the total.

Answer:

1. Add the ratio terms: 3 + 4 + 5 = 12.
2. One part is 168 ÷ 12 = 14 units.
3. The first share is 3 × 14 = 42 units.
4. The second and third shares are 4 × 14 = 56 units and 5 × 14 = 70 units.
5. The shares total 42 + 56 + 70 = 168 units.

8. A triangle's angles are in the ratio 2 : 5 : 5. Find all the angles and state what type of triangle it is by its angles.

Answer:

1. The angles total 180°.
2. The ratio terms sum to 2 + 5 + 5 = 12.
3. One part is 180° ÷ 12 = 15°.
4. The angles are 30°, 75° and 75°.
5. The triangle is acute-angled because all its angles are less than 90°.

9. A triangle's sides are in the ratio 3 : 4 : 5, and its perimeter is 60 cm. Find its side lengths and area.

Answer:

1. The ratio terms sum to 3 + 4 + 5 = 12.
2. One part is 60 ÷ 12 = 5 cm.
3. The side lengths are 15 cm, 20 cm and 25 cm.
4. These sides form a right triangle because $15^2 + 20^2 = 25^2$.
5. Its area is ½ × 15 × 20 = 150 cm^2.

10. Can a triangle be constructed with side lengths in the ratio 1 : 3 : 5? Explain using the triangle inequality.

Answer:

1. The two shorter sides represent 1 part and 3 parts.
2. Their sum is 1 + 3 = 4 parts.
3. The longest side is 5 parts.
4. The sum of the two shorter sides is less than the longest side.
5. Therefore, these lengths cannot form a triangle.

11. A class of 40 students receives grades in the ratio A : B : C : D : E = 6 : 5 : 4 : 3 : 2. Find the number of students and the pie-chart angle for each grade.

Answer:

1. The ratio terms sum to 6 + 5 + 4 + 3 + 2 = 20, so one part represents 2 students.
2. The numbers of students receiving A, B and C are 12, 10 and 8.
3. The numbers receiving D and E are 6 and 4.
4. One part of the pie chart represents 360° ÷ 20 = 18°.
5. The grade angles are A = 108°, B = 90°, C = 72°, D = 54° and E = 36°.

12. In a survey of 360 people, 90 prefer summer, 120 prefer the rainy season and the rest prefer winter. Find the number of winter voters and the pie-chart angle for each season.

Answer:

1. The number preferring winter is 360 − 90 − 120 = 150.
2. Summer represents 90/360 of the survey, so its angle is 90°.
3. The rainy season represents 120/360, so its angle is 120°.
4. Winter represents 150/360, so its angle is 150°.
5. The angles total 90° + 120° + 150° = 360°.

13. A 54° sector in a pie chart represents 30 students. Find the total number of students represented by the chart.

Answer:

1. The sector is 54° out of the circle's total 360°.
2. The fraction represented is 54/360 = 3/20.
3. The 30 students therefore represent 3/20 of the total.
4. The total is 30 ÷ (3/20) = 200 students.
5. The pie chart represents 200 students.

14. Five workers move 4,500 bricks in one day. At the same rate, how many bricks can 12 workers move in one day?

Answer:

1. The number of workers increases from 5 to 12.
2. One worker moves 4,500 ÷ 5 = 900 bricks in a day.
3. Twelve workers move 12 × 900 bricks.
4. The total is 10,800 bricks.
5. Twelve workers can move 10,800 bricks in one day.

15. Twenty-four pencils cost ₹120. Find the cost of 40 pencils and the number of pencils that can be bought for ₹250 at the same rate.

Answer:

1. One pencil costs ₹120 ÷ 24 = ₹5.
2. Forty pencils cost 40 × ₹5 = ₹200.
3. For ₹250, divide ₹250 by the ₹5 cost per pencil.
4. The number of pencils is 250 ÷ 5 = 50.
5. Therefore, 40 pencils cost ₹200, and ₹250 buys 50 pencils.

16. A car takes 4 hours to travel a fixed route at 60 km/h. Find the route distance and the time needed at 80 km/h.

Answer:

1. Distance = speed × time.
2. The route distance is 60 × 4 = 240 km.
3. Time at 80 km/h is 240 ÷ 80 = 3 hours.
4. The time saved is 4 − 3 = 1 hour.
5. At 80 km/h, the car completes the route in 3 hours.

17. Twenty-four workers complete a job in 15 days. How many days would 40 workers take to complete the same job at the same rate?

Answer:

1. Workers and days are inversely proportional for a fixed amount of work.
2. The work equals 24 × 15 = 360 worker-days.
3. Divide the work by 40 workers.
4. The required time is 360 ÷ 40 = 9 days.
5. Forty workers would complete the job in 9 days.

18. A factory needs 42 machines to complete an order in 63 days. How many machines are needed to finish it in 54 days?

Answer:

1. The total work is 42 × 63 = 2,646 machine-days.
2. The deadline is reduced to 54 days.
3. Divide the total machine-days by 54.
4. The calculation is 2,646 ÷ 54 = 49.
5. The factory needs 49 machines.

19. Two pumps fill a tank in 18 hours. How long would six identical pumps take, and how much time would they save?

Answer:

1. The work requires 2 × 18 = 36 pump-hours.
2. Six pumps take 36 ÷ 6 = 6 hours.

3. The original time was 18 hours.
4. The time saved is 18 − 6 = 12 hours.
5. Six pumps fill the tank in 6 hours and save 12 hours.

20. A small pump fills a tank in 3 hours, while a large pump fills it in 2 hours. Find how long they take working together.
Answer:
1. The small pump fills 1/3 of the tank per hour.
2. The large pump fills 1/2 of the tank per hour.
3. Together they fill 1/3 + 1/2 = 5/6 of the tank per hour.
4. The time required is 1 ÷ 5/6 = 6/5 hours.
5. They fill the tank in 1 hour 12 minutes.

3.13 Five-mark questions with Answers of Applied Type: (20 Questions)

1. **A teacher is drawing a classroom plan. The classroom is 8 m long and 6 m wide, and the scale is 1 : 50. What dimensions should the teacher draw?**
Answer:
1. Convert 8 m and 6 m to 800 cm and 600 cm.
2. Divide each actual dimension by 50.
3. The drawing length is 800 ÷ 50 = 16 cm.
4. The drawing width is 600 ÷ 50 = 12 cm.
5. The teacher should draw a plan measuring 16 cm by 12 cm.

2. **On a map with an RF of 1 : 2,000,000, a bus route measures 7.5 cm. What is the geographical distance represented?**
Answer:
1. The RF means that 1 cm on the map represents 2,000,000 cm on the ground.
2. Multiply 7.5 by 2,000,000 to get 15,000,000 cm.
3. Divide by 100,000 to convert centimetres to kilometres.
4. The geographical distance is 150 km.
5. The bus route shown on the map represents a 150 km geographical distance.

3. **A cook uses coriander, chillies, toor dal and fenugreek in the ratio 8 : 4 : 2 : 1. If the cook has 10 chillies, how much of each ingredient should be used?**
Answer:
1. The scale factor is 10 ÷ 4 = 2.5.
2. The coriander required is 8 × 2.5 = 20 spoons.
3. The toor dal required is 2 × 2.5 = 5 spoons.
4. The fenugreek required is 1 × 2.5 = 2.5 spoons.
5. The mixture uses 20 spoons of coriander, 10 chillies, 5 spoons of toor dal and 2.5 spoons of fenugreek.

4. **A paint shop prepares a 90-litre batch using red, blue and white paint in the ratio 2 : 3 : 5. How much of each colour is required?**
Answer:
1. The ratio terms add up to 2 + 3 + 5 = 10.
2. One part represents 90 ÷ 10 = 9 litres.
3. Red paint required is 2 × 9 = 18 litres.
4. Blue and white paint required are 27 litres and 45 litres.
5. The shop needs 18 litres of red, 27 litres of blue and 45 litres of white paint.

5. **A builder needs 165 units of concrete mixed in the ratio cement : sand : gravel = 1 : 1.5 : 3. Find the amount of each component.**
Answer:

1. The ratio terms total 1 + 1.5 + 3 = 5.5.
2. The scale factor is 165 ÷ 5.5 = 30.
3. Cement required is 1 × 30 = 30 units.
4. Sand and gravel required are 45 and 90 units.
5. The builder needs 30 units of cement, 45 units of sand and 90 units of gravel.

6. **A community group divides a ₹12,000 activity fund among three projects in the ratio 3 : 2 : 1. How much money does each project receive?**
   Answer:
   1. The ratio terms total 3 + 2 + 1 = 6.
   2. One part is ₹12,000 ÷ 6 = ₹2,000.
   3. The first project receives 3 × ₹2,000 = ₹6,000.
   4. The second and third projects receive ₹4,000 and ₹2,000.
   5. The full fund is divided as ₹6,000, ₹4,000 and ₹2,000.
7. **A 150-minute sports practice is divided among warm-up/cool-down, batting, bowling and fielding in the ratio 3 : 4 : 3 : 5. How much time is allotted to each activity?**
   Answer:
   1. The ratio terms total 15.
   2. One part represents 150 ÷ 15 = 10 minutes.
   3. Warm-up/cool-down and batting receive 30 and 40 minutes.
   4. Bowling and fielding receive 30 and 50 minutes.
   5. The four activities receive 30, 40, 30 and 50 minutes, respectively.
8. **A library has English, Hindi and Odia books in the ratio 1 : 2 : 3. If it has 288 Odia books, how many books are there in total?**
   Answer:
   1. The 3-part Odia share equals 288 books.
   2. One part equals 288 ÷ 3 = 96 books.
   3. English books number 1 × 96 = 96.
   4. Hindi books number 2 × 96 = 192.
   5. The library has 96 + 192 + 288 = 576 books in total.
9. **A student has 100 coins in the ratio ₹10 coins : ₹5 coins : ₹2 coins : ₹1 coins = 4 : 3 : 2 : 1. Find how many coins of each type the student has and their total value.**
   Answer:
   1. The ratio terms total 10, so one part represents 100 ÷ 10 = 10 coins.
   2. The student has 40 ₹10 coins and 30 ₹5 coins.
   3. The student has 20 ₹2 coins and 10 ₹1 coins.
   4. The total value is ₹400 + ₹150 + ₹40 + ₹10.
   5. The 100 coins are worth ₹600.
10. **A school surveys 360 students about their favourite seasons. Ninety choose summer, 120 choose the rainy season and the rest choose winter. Find the number of winter choices and the pie-chart angle for each season.**
    Answer:
    1. The number choosing winter is 360 − 90 − 120 = 150.
    2. Summer's angle is 90/360 × 360° = 90°.
    3. The rainy season's angle is 120/360 × 360° = 120°.
    4. Winter's angle is 150/360 × 360° = 150°.
    5. The pie chart uses sectors of 90°, 120° and 150°.
11. **A school survey of 240 students shows that the transport categories are represented by pie-chart angles of 90° for walking, 120° for bus, 60° for cycling**

and 90° for other transport. How many students use each category?
Answer:

1. The full 360° represents 240 students, so each degree represents 240 ÷ 360 = 2/3 of a student.
2. The 90° walking sector represents 90 × 2/3 = 60 students.
3. The 120° bus sector represents 120 × 2/3 = 80 students.
4. The 60° cycling sector represents 60 × 2/3 = 40 students.
5. The other 90° sector represents 60 students.

12. **Twenty-four pencils cost ₹120. A teacher needs 60 pencils for a class. Find the total cost and the change from ₹500.**
Answer:
    1. One pencil costs ₹120 ÷ 24 = ₹5.
    2. Sixty pencils cost 60 × ₹5 = ₹300.
    3. The teacher pays ₹500.
    4. The change is ₹500 − ₹300 = ₹200.
    5. The teacher receives ₹200 in change.
13. **Five workers can move 4,500 bricks in a day. How many workers are needed to move 27,000 bricks in one day at the same rate?**
Answer:
    1. The target of 27,000 bricks is 27,000 ÷ 4,500 = 6 times the original amount.
    2. The number of workers must increase by the same factor.
    3. Multiply the original 5 workers by 6.
    4. The calculation is 5 × 6 = 30.
    5. Thirty workers are needed.
14. **A family plans a 240 km trip. How long will the trip take at 60 km/h, and how long at 80 km/h?**
Answer:
    1. At 60 km/h, the time is 240 ÷ 60 = 4 hours.
    2. At 80 km/h, the time is 240 ÷ 80 = 3 hours.
    3. The higher speed reduces the travel time by 1 hour.
    4. The distance stays fixed while speed and time change inversely.
    5. The trip takes 4 hours at 60 km/h and 3 hours at 80 km/h.
15. **Twenty-four workers can complete a school-cleaning task in 15 days. If 40 workers are available and all work at the same rate, how many days will the task take?**
Answer:
    1. The total work is 24 × 15 = 360 worker-days.
    2. The number of workers increases to 40.
    3. Divide the total work by 40.
    4. The time is 360 ÷ 40 = 9 days.
    5. Forty workers will complete the task in 9 days.
16. **A water tank can be filled by 3 identical pumps in 12 hours. How long will 6 such pumps take?**
Answer:
    1. The total work is 3 × 12 = 36 pump-hours.
    2. The number of pumps is doubled from 3 to 6.
    3. Divide 36 pump-hours by 6 pumps.
    4. The filling time is 36 ÷ 6 = 6 hours.
    5. Six pumps will fill the tank in 6 hours.

17. **A school has food supplies for 80 students for 15 days. If 20 more students join and each student consumes the same amount, how long will the food last?**
    Answer:
    1. The original supply equals 80 × 15 = 1,200 student-days.
    2. The new number of students is 80 + 20 = 100.
    3. Divide 1,200 student-days by 100 students.
    4. The food will last 12 days.
    5. The additional students reduce the supply duration from 15 days to 12 days.
18. **A factory needs 42 machines to produce a fixed order in 63 days. How many machines are needed to complete the order in 54 days?**
    Answer:
    1. The fixed work equals 42 × 63 = 2,646 machine-days.
    2. The available time is reduced to 54 days.
    3. Divide 2,646 machine-days by 54 days.
    4. The calculation gives 49 machines.
    5. The factory needs 49 machines to meet the shorter deadline.
19. **A small pump fills a tank in 3 hours, and a large pump fills it in 2 hours. If both are used together, how long will the tank take to fill?**
    Answer:
    1. The small pump fills 1/3 of the tank per hour.
    2. The large pump fills 1/2 of the tank per hour.
    3. Together they fill 1/3 + 1/2 = 5/6 of the tank per hour.
    4. The time required is 1 ÷ 5/6 = 6/5 hours.
    5. The tank fills in 1 hour 12 minutes.
20. **Ram takes 1 hour to cut a quantity of vegetables, while Shyam takes 1.5 hours. If they work together, how long will they take?**
    Answer:
    1. Ram's work rate is 1 task per hour.
    2. Shyam's work rate is 1 ÷ 1.5 = 2/3 of a task per hour.
    3. Their combined rate is 1 + 2/3 = 5/3 tasks per hour.
    4. The time for one task is 1 ÷ 5/3 = 3/5 hour.
    5. They complete the task in 36 minutes.

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

Olympiad-Type Multiple-Choice Questions:

1. Which ratio is equivalent to 9 : 12?
   A. 2 : 3 B. 3 : 4 C. 4 : 5 D. 6 : 7
   Answer: B. 3 : 4
2. If 6 : 9 = 14 : x, what is the value of x?
   A. 18 B. 21 C. 24 D. 27
   Answer: B. 21
3. Which pair of ratios is proportional?
   A. 4 : 7 and 12 : 21 B. 3 : 5 and 9 : 10 C. 2 : 3 and 6 : 8 D. 5 : 8 and 15 : 20
   Answer: A. 4 : 7 and 12 : 21
4. A map has an RF of 1 : 5,000,000. What ground distance does 3.6 cm represent?
   A. 18 km B. 36 km C. 180 km D. 1,800 km
   Answer: C. 180 km

5. On a map, 90 km on the ground is represented by 3 cm. What is the RF?
   A. 1 : 300,000 B. 1 : 3,000,000 C. 1 : 30,000,000 D. 3 : 90,000
   Answer: B. 1 : 3,000,000
6. A map has an RF of 1 : 400,000. What ground distance is represented by 7.5 cm?
   A. 3 km B. 30 km C. 300 km D. 3,000 km
   Answer: B. 30 km
7. A classroom is 8.4 m long. What length should it have on a plan drawn to a scale of 1 : 50?
   A. 4.2 cm B. 8.4 cm C. 16.8 cm D. 42 cm
   Answer: C. 16.8 cm
8. A spice mixture uses coriander, chillies, toor dal and fenugreek in the ratio 8 : 4 : 2 : 1. If 6 chillies are used, how much fenugreek is needed?
   A. 0.5 spoon B. 1 spoon C. 1.5 spoons D. 2 spoons
   Answer: C. 1.5 spoons
9. Red, blue and white paint are mixed in the ratio 2 : 3 : 5. How much blue paint is in a 60-litre mixture?
   A. 12 litres B. 18 litres C. 24 litres D. 30 litres
   Answer: B. 18 litres
10. Concrete is mixed in the ratio cement : sand : gravel = 1 : 1.5 : 3. How much gravel is needed to make 110 units of concrete?
    A. 30 units B. 45 units C. 60 units D. 90 units
    Answer: C. 60 units
11. Divide 180 in the ratio 2 : 3 : 4. What is the largest share?
    A. 40 B. 60 C. 80 D. 100
    Answer: C. 80
12. Divide 210 in the ratio 3 : 4 : 7. What is the smallest share?
    A. 30 B. 45 C. 60 D. 105
    Answer: B. 45
13. A triangle's angles are in the ratio 1 : 2 : 3. What is the largest angle?
    A. 60° B. 75° C. 90° D. 120°
    Answer: C. 90°
14. Which set of lengths cannot form a triangle?
    A. 3, 4, 5 B. 5, 5, 8 C. 2, 3, 6 D. 6, 8, 10
    Answer: C. 2, 3, 6
15. A triangle has side lengths in the ratio 3 : 4 : 5 and a perimeter of 72 cm. What is its longest side?
    A. 24 cm B. 30 cm C. 36 cm D. 40 cm
    Answer: B. 30 cm
16. What angle should represent 45 students in a pie chart of 180 students?
    A. 45° B. 60° C. 90° D. 120°
    Answer: C. 90°
17. What angle represents 25% of a pie chart?
    A. 45° B. 72° C. 90° D. 120°
    Answer: C. 90°
18. Forty students' grades are distributed in the ratio A : B : C : D : E = 6 : 5 : 4 : 3 : 2. How many students received Grade D?
    A. 4 B. 6 C. 8 D. 10
    Answer: B. 6

19. In the same grade distribution, what angle represents Grade C in a pie chart?
    A. 54° B. 60° C. 72° D. 90°
    Answer: C. 72°
20. In a survey of 600 students, 150 choose one category. What angle should represent that category in a pie chart?
    A. 60° B. 90° C. 120° D. 150°
    Answer: B. 90°
21. What is the simplest form of 12 : 18 : 30?
    A. 2 : 3 : 5 B. 3 : 4 : 5 C. 4 : 6 : 10 D. 6 : 9 : 15
    Answer: A. 2 : 3 : 5
22. Five kilograms of rice cost ₹240. At the same rate, what is the cost of 8 kg?
    A. ₹320 B. ₹360 C. ₹384 D. ₹400
    Answer: C. ₹384
23. Five workers move 4,500 bricks in a day. At the same rate, how many bricks can 8 workers move in a day?
    A. 6,400 B. 7,200 C. 8,000 D. 9,000
    Answer: B. 7,200
24. If 5 workers move 4,500 bricks in a day, how many workers are needed to move 18,000 bricks in a day?
    A. 15 B. 18 C. 20 D. 25
    Answer: C. 20
25. If 3 : 5 = 21 : x, what is x?
    A. 30 B. 35 C. 40 D. 45
    Answer: B. 35
26. Twelve workers complete a job in 15 days. How many days would 20 workers take at the same rate?
    A. 6 B. 9 C. 12 D. 25
    Answer: B. 9
27. Three identical pumps fill a tank in 8 hours. How long would 4 such pumps take?
    A. 4 hours B. 6 hours C. 8 hours D. 10 hours
    Answer: B. 6 hours
28. Food supplies last 75 students for 16 days. How long will they last 100 students at the same rate of use?
    A. 10 days B. 12 days C. 14 days D. 20 days
    Answer: B. 12 days
29. A fixed journey takes 3 hours at 60 km/h. How long will it take at 90 km/h?
    A. 1 hour B. 2 hours C. 2.5 hours D. 4.5 hours
    Answer: B. 2 hours
30. A car travels 240 km at 80 km/h. How long does the journey take?
    A. 2 hours B. 3 hours C. 4 hours D. 5 hours
    Answer: B. 3 hours
31. One pump fills a tank in 4 hours and another fills it in 6 hours. How long do they take working together?
    A. 2 hours B. 2.4 hours C. 3 hours D. 5 hours
    Answer: B. 2.4 hours
32. Ram takes 1 hour to complete a task, and Shyam takes 2 hours. How long will they take working together?
    A. 30 minutes B. 40 minutes C. 45 minutes D. 90 minutes
    Answer: B. 40 minutes

33. For the pairs (x, y) = (40, 20), (80, 10), (25, 32) and (16, 50), how are x and y related?
A. Directly proportional B. Inversely proportional C. Equal D. Neither proportional
Answer: B. Inversely proportional
34. Which table shows inverse proportion between x and y?
A. x: 2, 4; y: 3, 6
B. x: 2, 4; y: 6, 3
C. x: 2, 4; y: 6, 12
D. x: 2, 4; y: 3, 3
Answer: B. x: 2, 4; y: 6, 3
35. If x and y are inversely proportional and x doubles, what happens to y?
A. It doubles B. It is halved C. It stays the same D. It becomes four times greater
Answer: B. It is halved
36. Twenty workers take 12 days to finish a job. How many days will 30 workers take at the same rate?
A. 6 days B. 8 days C. 10 days D. 18 days
Answer: B. 8 days
37. A 54° sector in a pie chart represents how many students if the chart represents 360 students?
A. 36 B. 45 C. 54 D. 72
Answer: B. 54 students
(Correction: 54° is 54/360 of the circle, so it represents 54 students.)
38. A 72° sector in a pie chart represents 24 people. How many people does the complete chart represent?
A. 100 B. 120 C. 144 D. 180
Answer: B. 120
39. A person has 100 coins in the ratio ₹10 coins : ₹5 coins : ₹2 coins : ₹1 coins = 4 : 3 : 2 : 1. What is the total value?
A. ₹500 B. ₹550 C. ₹600 D. ₹650
Answer: C. ₹600
40. A 150-minute session is divided in the ratio 3 : 4 : 3 : 5. How many minutes are assigned to the activity represented by 5 parts?
A. 30 minutes B. 40 minutes C. 50 minutes D. 60 minutes
Answer: C. 50 minutes

3.15 Best Practices Opportunity List from the Chapter: (14 Ideas)

Best Practices for Teaching "Proportional Reasoning–2":

(1) Begin with familiar examples
Introduce ratios through recipes, spice mixtures, paint colours and classroom objects so students connect the concept to everyday life.

(2) Use concrete materials to model ratios
Let students group counters, coloured beads or paper shapes to represent ratios such as 2 : 3 : 5 before solving numerical problems.

(3) Teach equivalent ratios visually
Use ratio tables and multiplication patterns to show that multiplying or dividing every term by the same number preserves a ratio.

(4) Model cross-multiplication step by step
Demonstrate how to test whether two ratios are proportional, then ask students to explain why equal cross-products confirm proportionality.

(5) **Bring maps and atlases into the lesson**
Have students identify representative fractions, measure map distances and convert them to ground distances using consistent units.

(6) **Use a classroom scale-drawing activity**
Ask groups to measure the classroom and create a scaled plan, marking objects such as desks, doors, windows and the board.

(7) **Use real recipes to practise multi-term ratios**
Students can scale ingredient quantities up or down while keeping the taste ratio unchanged, then check their calculations with peers.

(8) **Teach division of a whole using a clear routine**
Reinforce the sequence: add the ratio terms, find the value of one part, calculate each share and check that the shares total the original amount.

(9) **Connect pie charts to student-collected data**
Survey the class on favourite subjects, transport or sports, then calculate each category's angle and construct a pie chart.

(10) **Use diagrams to explain direct and inverse proportion**
Compare examples such as workers and output, or speed and travel time, using tables and arrows to show how the quantities change.

(11) **Ask students to state assumptions in word problems**
For worker, pump and food-supply problems, have students identify conditions such as equal work rates or constant consumption.

(12) **Use peer explanation and error checking**
Pair students to solve a problem independently, compare their methods and check calculations by adding shares, checking angle totals or testing products for inverse proportion.

(13) **Differentiate practice by readiness**
Provide ratio tables or unit-part prompts for students who need support, and multi-step map, mixture or pie-chart problems for students ready for a challenge.

(14) **End with a short retrieval check**
Ask students to explain one key idea or solve one quick problem on equivalent ratios, dividing a total, pie-chart angles or inverse proportion.

3.16 Innovations Opportunity List from the Chapter: (14 Ideas)

Innovations in Teaching–Learning "Proportional Reasoning–2":

(1) **Interactive Ratio Builder**
Use coloured counters, blocks or a simple digital tool so students can change ratio terms and see how equivalent ratios are formed.

(2) **Map-Scale Explorer**
Give groups different maps or atlas pages and ask them to measure selected locations, calculate geographical distances and compare their results.

(3) **Classroom-to-Scale Design Challenge**
Students measure the classroom and create a scaled floor plan, adding desks, doors, windows and the board with symbols.

(4) **Recipe Scaling Lab**
Present a recipe as a multi-term ratio and ask teams to adapt it for a different number of people while preserving the proportions.

(5) **Paint-Mixing Investigation**
Students use coloured water or digital colour sliders to model paint ratios, predict the quantities needed and compare the shades produced.

(6) Human Pie Chart
Use a large circle marked on the floor. Students represent survey categories by standing in sectors with angles calculated from the class data.

(7) Class Data to Digital Infographic
Students collect data on favourite subjects, sports or transport, then calculate proportions and present the results as a labelled pie chart.

(8) Direct-or-Inverse Sorting Game
Give students situation cards—such as speed and time for a fixed journey or workers and days for a fixed task—and have them sort, justify and solve them.

(9) Ratio Escape Challenge
Create a sequence of ratio puzzles involving map scales, mixtures, sharing and pie-chart angles; each correct solution gives a clue to the next task.

(10) Student-Created Explainer Videos
Small groups record short demonstrations of one chapter concept, such as scaling a mixture or identifying inverse proportion, using a worked example.

(11) Error Detective
Show a worked solution with a deliberate mistake, such as inconsistent units or an incorrect pie-chart angle, and ask students to locate and correct it.

(12) Real-Life Proportion Walk
Students photograph or note examples of ratios around the school—such as floor tiles, classroom seating or sports-team arrangements—and present the ratios they find.

(13) Collaborative Problem Stations
Set up stations for map scales, multi-term ratios, dividing a whole, pie charts and inverse proportion; groups rotate and record their reasoning at each station.

(14) Reflection and Peer Feedback Cards
After a problem-solving activity, students write one strategy they used and one step they want checked, then exchange cards for peer feedback.

These activities apply the chapter's work with ratios, map scales, pie charts, direct proportion and inverse proportion.

3.17: Practicing Questions/Question Bank:

Question Bank: Proportional Reasoning–2:

A. Fill in the Blanks:

1. Two ratios are proportional when their cross-products are _____.
   Answer: equal

2. A map's representative fraction compares map distance with _____ distance.
   Answer: ground

3. The total angle in a circle is _____ degrees.
   Answer: 360

4. If two quantities are inversely proportional, their product remains _____.
   Answer: constant

5. In the spice-mixture example, the ratio of coriander, chillies, toor dal and fenugreek is _____.
   Answer: 8 : 4 : 2 : 1

B. One-Mark Descriptive Questions:

1. **What does an RF of 1 : 60,00,000 mean?**
   Answer: One centimetre on the map represents 60 km on the ground.
2. **What is a pie chart used to show?**
   Answer: A pie chart shows the proportions of different categories in a whole.
3. **What is the sum of the angles in a triangle?**
   Answer: The angles in a triangle add up to 180°.
4. **What happens to travel time when speed increases for a fixed distance?**
   Answer: Travel time decreases when speed increases for a fixed distance.
5. **What is the first step when dividing a total in a given ratio?**
   Answer: Add the terms of the ratio.

C. Two-Mark Descriptive Questions:

1. **Divide 72 in the ratio 2 : 3 : 4.**
   Answer:
   1. The ratio terms total 9, so one part is 72 ÷ 9 = 8.
   2. The shares are 16, 24 and 32.
2. **A map has an RF of 1 : 2,000,000. What ground distance does 4.5 cm represent?**
   Answer:
   1. The ground distance is 4.5 × 2,000,000 = 9,000,000 cm.
   2. This is 90 km.
3. **Red, blue and white paint are mixed in the ratio 2 : 3 : 5. If 15 litres of white paint are used, how much red and blue paint are needed?**
   Answer:
   1. One part equals 15 ÷ 5 = 3 litres.
   2. The mixture needs 6 litres of red paint and 9 litres of blue paint.
4. **Twelve workers complete a job in 10 days. How long would 15 workers take at the same rate?**
   Answer:
   1. The work equals 12 × 10 = 120 worker-days.
   2. Fifteen workers take 120 ÷ 15 = 8 days.
5. **A category has 30 students out of a total of 120. What angle should represent it in a pie chart?**
   Answer:
   1. The category represents 30/120 = 1/4 of the total.
   2. Its pie-chart angle is 1/4 × 360° = 90°.

D. Three-Mark Descriptive Questions:

1. **Find the angles of a triangle whose angles are in the ratio 2 : 3 : 4.**
   Answer:

1. The ratio terms total 9.
2. One part is 180° ÷ 9 = 20°.
3. The angles are 40°, 60° and 80°.

2. **Divide 150 in the ratio 2 : 3 : 5.**
   Answer:
   1. The ratio terms total 10.
   2. One part is 150 ÷ 10 = 15.
   3. The shares are 30, 45 and 75.
3. **Forty students' grades are in the ratio 6 : 5 : 4 : 3 : 2. Find the number receiving Grade A and Grade E, and their pie-chart angles.**
   Answer:
   1. The ratio terms total 20, so one part represents 40 ÷ 20 = 2 students.
   2. Grade A has 12 students and Grade E has 4 students.
   3. Their pie-chart angles are 108° and 36°, respectively.
4. **Six workers can move 9,000 bricks in a day. How many bricks can 10 workers move in a day at the same rate?**
   Answer:
   1. One worker moves 9,000 ÷ 6 = 1,500 bricks in a day.
   2. Ten workers move 10 × 1,500 bricks.
   3. They can move 15,000 bricks in a day.
5. **A 210 km journey takes 3 hours at a certain speed. How long would the same journey take at 105 km/h?**
   Answer:
   1. The original speed is 210 ÷ 3 = 70 km/h.
   2. At 105 km/h, the time is 210 ÷ 105 = 2 hours.
   3. The faster speed reduces the journey time by 1 hour.

E. Five-Mark Descriptive Questions:

1. **A builder needs 165 units of concrete mixed in the ratio cement : sand : gravel = 1 : 1.5 : 3. Find the amount of each component.**
   Answer:
   1. The ratio terms total 1 + 1.5 + 3 = 5.5.
   2. The scale factor is 165 ÷ 5.5 = 30.
   3. Cement required is 1 × 30 = 30 units.
   4. Sand and gravel required are 45 units and 90 units.
   5. The builder needs 30 units of cement, 45 units of sand and 90 units of gravel.

2. **Eighteen workers complete a job in 12 days. How long would 24 workers take to complete the same job at the same rate?**
   Answer:
   1. Workers and days are inversely proportional for a fixed job.
   2. The total work is 18 × 12 = 216 worker-days.
   3. Divide the work by 24 workers.
   4. The time is 216 ÷ 24 = 9 days.
   5. Twenty-four workers will complete the job in 9 days.
3. **A 150-minute sports session is divided among warm-up/cool-down, batting, bowling and fielding in the ratio 3 : 4 : 3 : 5. Find the time for each activity.**
   Answer:
   1. The ratio terms total 15.
   2. One part represents 150 ÷ 15 = 10 minutes.
   3. Warm-up/cool-down and batting receive 30 and 40 minutes.
   4. Bowling and fielding receive 30 and 50 minutes.
   5. The four activities receive 30, 40, 30 and 50 minutes, respectively.
4. **A school surveys 360 students about their favourite seasons. Ninety prefer summer, 120 prefer the rainy season and the rest prefer winter. Find the number of winter choices and the pie-chart angle for each season.**
   Answer:
   1. The number preferring winter is 360 − 90 − 120 = 150.
   2. Summer's angle is 90/360 × 360° = 90°.
   3. The rainy season's angle is 120/360 × 360° = 120°.
   4. Winter's angle is 150/360 × 360° = 150°.
   5. The sectors are 90°, 120° and 150°, totalling 360°.
5. **A small pump fills a tank in 3 hours, while a large pump fills it in 2 hours. How long will they take working together?**
   Answer:
   1. The small pump fills 1/3 of the tank per hour.
   2. The large pump fills 1/2 of the tank per hour.
   3. Together, they fill 1/3 + 1/2 = 5/6 of the tank per hour.
   4. The time needed is 1 ÷ 5/6 = 6/5 hours.
   5. They fill the tank in 1 hour 12 minutes.

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8th Standard Maths Part 2 Book Chapter 4

Chapter 4: EXPLORING SOME GEOMETRIC THEMES

4.1 Summary of the Chapter:

Chapter 4: Exploring Some Geometric Themes:

(1) **Fractals** are shapes with patterns that repeat at smaller and smaller scales. They appear in nature, such as in ferns, trees, clouds, coastlines and mountains.

(2) The **Sierpinski Carpet** is formed by dividing a square into nine equal squares, removing the centre square, and repeating the process on the remaining squares. The number of squares remaining at Step n is 8^n.

(3) In the Sierpinski Carpet, each remaining square creates a new hole in the next step. The number of holes follows the pattern $H_{n+1} = H_n + R_n$, where H_n is the number of holes and R_n is the number of remaining squares.

(4) The **Sierpinski Gasket**, or Sierpinski Triangle, is made by dividing an equilateral triangle into four equal triangles, removing the middle one, and repeating the process on the three remaining triangles.

(5) The **Koch Snowflake** begins with an equilateral triangle. Each side is divided into three equal parts, and the middle part is replaced by two sides of a small outward-pointing equilateral triangle. This step is repeated on every new side.

(6) Fractal patterns are found in human art and architecture as well as in nature. Examples include Indian temple designs, Nigerian Fulani blankets and the artwork of M. C. Escher.

(7) **Visualising solids** means imagining three-dimensional objects and considering how they look from different viewpoints. The same solid can have different profiles when viewed from different directions.

(8) A **net** is a flat arrangement of shapes that can be folded to form a solid. Nets can be used to construct solids such as cuboids, cylinders, cones, prisms, pyramids, tetrahedrons and octahedrons.

(9) To find the **shortest path on the surface of a cuboid**, imagine unfolding the cuboid into a suitable net. The shortest route on the surface becomes a straight line on the net.

(10) A solid can be shown on flat surfaces through **projections**. The front view, top view and side view show the object as projected onto vertical, horizontal and side planes.

(11) An **isometric projection** represents a solid so that edges along its three main directions—length, depth and height—are shown with equal projected lengths. Isometric grids help draw and understand three-dimensional shapes.

4.2 Important Formulas:

IMPORTANT FORMULAS – CHAPTER 4: EXPLORING SOME GEOMETRIC THEMES:

Let n denote the step number. Step 0 is the starting shape.

A. FRACTALS:

1. Sierpinski Carpet – Remaining Squares

$R_0 = 1$

$R_{n+1} = 8R_n$

Therefore, $R_n = 8^n$

2. Sierpinski Carpet – Number of Holes

$H_0 = 0$

$H_{n+1} = H_n + R_n$

Therefore, $H_n = 1 + 8 + 8^2 + \ldots + 8^{n-1} = (8^n - 1) \div 7$

3. Sierpinski Carpet – Remaining Area

If the starting square has area A_0:
$A_n = A_0 \times (8 \div 9)^n$
If $A_0 = 1$ square unit:
$A_n = (8 \div 9)^n$

4. Sierpinski Gasket – Remaining Triangles

$T_0 = 1$
$T_{n+1} = 3T_n$
Therefore, $T_n = 3^n$

5. Sierpinski Gasket – Number of Holes

$G_0 = 0$
$G_{n+1} = G_n + T_n$
Therefore, $G_n = 1 + 3 + 3^2 + \ldots + 3^{n-1} = (3^n - 1) \div 2$

6. Sierpinski Gasket – Remaining Area

If the starting triangle has area A_0:
$A_n = A_0 \times (3 \div 4)^n$
If $A_0 = 1$ square unit:
$A_n = (3 \div 4)^n$

7. Koch Snowflake – Number of Sides

Starting with an equilateral triangle:
$S_0 = 3$
$S_{n+1} = 4S_n$
Therefore, $S_n = 3 \times 4^n$

8. Koch Snowflake – Side Length and Perimeter

If the starting side length is a:
Length of each small side at Step n = $a \div 3^n$
Perimeter at Step n = $3a \times (4 \div 3)^n$
For a starting side length of 1 unit:
Perimeter at Step n = $3 \times (4 \div 3)^n$

B. SOLIDS AND SHORTEST PATHS:

9. Prism with an n-Sided Base

Number of faces: F = n + 2
Number of edges: E = 3n
Number of vertices: V = 2n

10. Pyramid with an n-Sided Base

Number of faces: F = n + 1
Number of edges: E = 2n
Number of vertices: V = n + 1

11. Shortest Path on a Solid's Net

When the straight path on a net forms a right triangle, use the Pythagorean theorem:
$d^2 = x^2 + y^2$
$d = \sqrt{(x^2 + y^2)}$
Here, x and y are the perpendicular sides of the right triangle, and d is the path length.

12. Cylinder Net

Length of the rectangle formed by unrolling the curved surface = circumference of the base = $2\pi r$
Width of the rectangle = height of the cylinder = h

C. USEFUL AREA FORMULA:

Area of an equilateral triangle with side length a:

Area = $(\sqrt{3} \div 4) \times a^2$
When the side length is halved, the area becomes one-fourth of the original area.

4.3 Fill-Up the Blank LOTS type questions with Answers: (54 Questions)

FILL IN THE BLANKS – LOTS TYPE:

1. A geometric shape that repeats the same or a similar pattern at smaller scales is called a _____.
   Answer: fractal
2. A fern is an example of a naturally occurring _____.
   Answer: fractal
3. In the Sierpinski Carpet, the starting square is divided into _____ smaller squares.
   Answer: 9
4. In the first step of making a Sierpinski Carpet, the _____ square is removed.
   Answer: central
5. Each square that remains in the Sierpinski Carpet gives rise to _____ smaller squares in the next step.
   Answer: 8
6. If R_n is the number of remaining squares at Step n of the Sierpinski Carpet, then R_{n+1} = _____.
   Answer: $8R_n$
7. The number of remaining squares at Step n of the Sierpinski Carpet is R_n = _____.
   Answer: 8^n
8. At Step 0 of the Sierpinski Carpet, the number of remaining squares is _____.
   Answer: 1
9. At Step 0 of the Sierpinski Carpet, the number of holes is _____.
   Answer: 0
10. Each remaining square in the Sierpinski Carpet creates _____ new hole in the next step.
    Answer: one
11. The Sierpinski Gasket begins with an _____ triangle.
    Answer: equilateral
12. Joining the midpoints of an equilateral triangle divides it into _____ identical triangles.
    Answer: 4
13. In the Sierpinski Gasket, the _____ triangle is removed at each step.
    Answer: central
14. After removing the central triangle, _____ triangles remain in the Sierpinski Gasket.
    Answer: 3
15. The Sierpinski Triangle is also called the Sierpinski _____.
    Answer: Gasket
16. The Koch Snowflake begins with an _____ triangle.
    Answer: equilateral
17. To construct the Koch Snowflake, each side is divided into _____ equal parts.
    Answer: 3
18. In the Koch Snowflake, a small triangle is raised over the _____ part of each side.
    Answer: middle

19. The raised parts of the Koch Snowflake form structures called _____.
    Answer: bumps
20. The Koch Snowflake is named after the Swedish mathematician Von _____.
    Answer: Koch
21. Von Koch first described the Koch Snowflake in _____.
    Answer: 1904
22. Fractal-like patterns can be seen in trees, clouds, mountains and _____.
    Answer: coastlines
23. The Kandariya Mahadev Temple, which displays fractal-like patterns, is in _____, Madhya Pradesh.
    Answer: Khajuraho
24. The Kandariya Mahadev Temple was completed around _____ C.E.
    Answer: 1025
25. Fractal patterns are found on traditional Nigerian _____ wedding blankets.
    Answer: Fulani
26. The Dutch artist M. C. _____ created artwork inspired by fractal patterns.
    Answer: Escher
27. One of Escher's works involving repeated patterns is called "_____ and Smaller."
    Answer: Smaller
28. A flat shape that can be folded to form a solid is called a _____.
    Answer: net
29. A net is obtained by _____ a solid onto a plane.
    Answer: unfolding
30. A cube has _____ faces.
    Answer: 6
31. A cube has _____ edges.
    Answer: 12
32. A cube has _____ vertices.
    Answer: 8
33. A prism has two congruent _____ faces opposite each other.
    Answer: polygonal
34. The other faces of a prism are _____.
    Answer: parallelograms
35. A prism is named according to the shape of its _____.
    Answer: base
36. A pyramid has a polygonal base and a point called its _____.
    Answer: apex
37. A triangular pyramid is also known as a _____.
    Answer: tetrahedron
38. A cube has _____ possible net structures, when rotations and flips are counted as the same.
    Answer: 11
39. A regular tetrahedron has _____ possible nets.
    Answer: 2
40. An octahedron can be made by joining two square _____ at their bases.
    Answer: pyramids
41. A dodecahedron has faces shaped like _____.
    Answer: pentagons

42. A dodecahedron has _____ different nets.
    Answer: 43,380
43. To find a shortest path on the surface of a cuboid, the cuboid can be unfolded into a _____.
    Answer: net
44. On a flat surface, the shortest path between two points is a _____ line.
    Answer: straight
45. In an isometric projection of a cube, the projected lengths of all its edges are _____.
    Answer: equal
46. The word "isometric" means "equal _____."
    Answer: measure
47. The isometric representation of a cube appears as a regular _____.
    Answer: hexagon
48. Isometric drawings show the three main directions of a solid: length, depth and _____.
    Answer: height
49. The front view of an object is its projection on the _____ plane.
    Answer: vertical
50. The top view of an object is its projection on the _____ plane.
    Answer: horizontal
51. The side view of an object is its projection on the _____ plane.
    Answer: side
52. In an isometric drawing, the three principal axes represent length, depth and _____.
    Answer: height
53. In a projection, parallel lines on a solid project as _____ lines.
    Answer: parallel

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

FILL IN THE BLANKS – HOTS TYPE:

1. A Sierpinski Carpet has _____ small squares remaining at Step 3.
   Answer: 512
2. The number of remaining squares in a Sierpinski Carpet at Step 4 is _____.
   Answer: 4,096
3. If a Sierpinski Carpet has 64 remaining squares at one step, it will have _____ remaining squares at the next step.
   Answer: 512
4. The number of holes in a Sierpinski Carpet at Step 3 is _____.
   Answer: 73
5. The number of holes in a Sierpinski Carpet at Step 4 is _____.
   Answer: 585
6. If the starting square has an area of 1 square unit, the area remaining in the Sierpinski Carpet at Step 3 is _____ square units.
   Answer: 512/729
7. If the starting square has an area of 81 square units, the area remaining after Step 2 of the Sierpinski Carpet construction is _____ square units.
   Answer: 64

8. If the starting square has an area of 45 square units, the area remaining after Step 1 of the Sierpinski Carpet construction is _____ square units.
   Answer: 40
9. If the starting square has an area of 81 square units, the total area removed by Step 2 of the Sierpinski Carpet construction is _____ square units.
   Answer: 17
10. A Sierpinski Gasket has _____ small triangles remaining at Step 3.
    Answer: 27
11. The number of holes in a Sierpinski Gasket at Step 3 is _____.
    Answer: 13
12. If the starting triangle has an area of 1 square unit, the area remaining in the Sierpinski Gasket at Step 2 is _____ square units.
    Answer: 9/16
13. If a starting triangle has an area of 64 square units, the area remaining after Step 1 of the Sierpinski Gasket construction is _____ square units.
    Answer: 48
14. The number of triangles remaining in a Sierpinski Gasket at Step 4 is _____.
    Answer: 81
15. At Step 3, the Sierpinski Carpet has _____ more remaining pieces than the Sierpinski Gasket.
    Answer: 485
16. A Koch Snowflake has _____ sides at Step 2.
    Answer: 48
17. A Koch Snowflake has _____ sides at Step 3.
    Answer: 192
18. If the starting side of a Koch Snowflake is 9 units long, each small side at Step 3 is _____ unit long.
    Answer: 1/3
19. If the starting side of a Koch Snowflake is 1 unit long, its perimeter at Step 2 is _____ units.
    Answer: 16/3
20. If the starting side of a Koch Snowflake is 3 units long, its perimeter at Step 1 is _____ units.
    Answer: 12
21. If the starting side of a Koch Snowflake is 2 units long, its perimeter at Step 3 is _____ units.
    Answer: 128/9
22. From one step to the next, the perimeter of a Koch Snowflake is multiplied by _____.
    Answer: 4/3
23. A prism with a 7-sided base has _____ faces.
    Answer: 9
24. A prism with a 7-sided base has _____ edges.
    Answer: 21
25. A prism with a 7-sided base has _____ vertices.
    Answer: 14
26. A prism with a 10-sided base has _____ faces, _____ edges and _____ vertices.
    Answer: 12 faces, 30 edges and 20 vertices

27. A pyramid with a 6-sided base has _____ faces, _____ edges and _____ vertices.
    Answer: 7 faces, 12 edges and 7 vertices
28. A pyramid with an 8-sided base has _____ faces, _____ edges and _____ vertices.
    Answer: 9 faces, 16 edges and 9 vertices
29. A prism with 24 edges has a base shaped like a _____-sided polygon.
    Answer: 8
30. A pyramid with 18 edges has a base shaped like a _____-sided polygon.
    Answer: 9
31. A prism with 8 faces must have a base shaped like a _____-sided polygon.
    Answer: 6
32. On a cuboid net, a straight path forms a right triangle with perpendicular sides of 6 cm and 8 cm. The path length is _____ cm.
    Answer: 10
33. A straight path on a cuboid net has perpendicular sides of 5 cm and 12 cm. Its length is _____ cm.
    Answer: 13
34. Two possible unfolded routes have lengths of 13 cm and 15 cm. The shorter surface path is _____ cm long.
    Answer: 13
35. A straight path on a cuboid net has perpendicular sides of 7 cm and 24 cm. The path length is _____ cm.
    Answer: 25
36. A cylinder has a base radius of 7 cm. Using $\pi = 22/7$, the length of the rectangle in its net is _____ cm.
    Answer: 44
37. A cylinder is 10 cm high and has a base radius of 7 cm. Using $\pi = 22/7$, the dimensions of the rectangle in its net are _____ cm by _____ cm.
    Answer: 44 cm by 10 cm
38. A projection shows cube edges with lengths 4 cm, 4 cm and 5 cm. Since these projected lengths are _____, the drawing is not an isometric projection.
    Answer: not all equal
39. An isometric drawing represents a solid along three principal directions. If two are length and height, the third is _____.
    Answer: depth
40. If a cuboid's surface path is not a straight line on the chosen net, that net does not show the path as the _____ route.
    Answer: shortest

4.5 One-mark questions with Answers of LOTS Type: (45 Questions)

ONE-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. What is a fractal?
   Answer: A fractal is a shape with a pattern that repeats at smaller scales.
2. Name one plant that displays fractal patterns.
   Answer: A fern displays fractal patterns.
3. Name one natural feature, other than a plant, that may show fractal patterns.
   Answer: A coastline may show fractal patterns.
4. Who discovered the Sierpinski Carpet?
   Answer: The Polish mathematician Sierpinski discovered the Sierpinski Carpet.

5. How is the first hole made in a Sierpinski Carpet?
   Answer: The square is divided into nine smaller squares and the central square is removed.
6. How many smaller squares remain after the central square is removed from a square in the Sierpinski Carpet process?
   Answer: Eight smaller squares remain.
7. What does R_n represent in the Sierpinski Carpet sequence?
   Answer: R_n represents the number of remaining squares at Step n.
8. What does H_n represent in the Sierpinski Carpet sequence?
   Answer: H_n represents the number of holes at Step n.
9. How many squares remain at Step 0 of the Sierpinski Carpet?
   Answer: One square remains at Step 0.
10. How many holes are present at Step 0 of the Sierpinski Carpet?
    Answer: No holes are present at Step 0.
11. What is the rule for the number of remaining squares in the Sierpinski Carpet?
    Answer: Each remaining square produces eight squares at the next step.
12. What is the Sierpinski Triangle also called?
    Answer: The Sierpinski Triangle is also called the Sierpinski Gasket.
13. What shape is used to begin the Sierpinski Gasket?
    Answer: An equilateral triangle is used to begin the Sierpinski Gasket.
14. Into how many equal triangles is an equilateral triangle divided by joining its midpoints?
    Answer: It is divided into four equal triangles.
15. Which triangle is removed in each step of the Sierpinski Gasket construction?
    Answer: The central triangle is removed in each step.
16. How many triangles remain after the central triangle is removed in the Sierpinski Gasket?
    Answer: Three triangles remain.
17. Who is the Koch Snowflake named after?
    Answer: The Koch Snowflake is named after the Swedish mathematician Von Koch.
18. What is the starting shape of the Koch Snowflake?
    Answer: The Koch Snowflake starts with an equilateral triangle.
19. Into how many equal parts is each side divided when constructing the Koch Snowflake?
    Answer: Each side is divided into three equal parts.
20. What is raised over the middle part of each side in the Koch Snowflake construction?
    Answer: An equilateral triangle is raised over the middle part.
21. What happens to the middle part of a side in the Koch Snowflake construction?
    Answer: The middle part is removed after the triangular bump is formed.
22. Name one Indian temple where fractal-like patterns can be seen.
    Answer: Fractal-like patterns can be seen at the Kandariya Mahadev Temple.
23. Where is the Kandariya Mahadev Temple located?
    Answer: It is located in Khajuraho, Madhya Pradesh.
24. Name one example of fractal patterns in traditional African art.
    Answer: Nigerian Fulani wedding blankets display fractal patterns.
25. Who is the artist associated with the work “Smaller and Smaller”?
    Answer: M. C. Escher is associated with the work “Smaller and Smaller.”
26. What is a net of a solid?
    Answer: A net is a flat shape that can be folded to form a solid.

27. What are the flat surfaces that form the boundary of a solid called?
    Answer: They are called faces.
28. What are the line segments forming the sides of the faces of a solid called?
    Answer: They are called edges.
29. What are the points where the edges of a solid meet called?
    Answer: They are called vertices.
30. How many faces does a cube have?
    Answer: A cube has six faces.
31. How many edges does a cube have?
    Answer: A cube has twelve edges.
32. How many vertices does a cube have?
    Answer: A cube has eight vertices.
33. What two congruent faces does a prism have?
    Answer: A prism has two congruent polygonal faces opposite each other.
34. What are the other faces of a prism generally shaped like?
    Answer: The other faces of a prism are parallelograms.
35. What is a triangular pyramid also called?
    Answer: A triangular pyramid is also called a tetrahedron.
36. How many possible nets does a cube have, counting rotations and flips as the same?
    Answer: A cube has eleven possible nets.
37. How many possible nets does a regular tetrahedron have?
    Answer: A regular tetrahedron has two possible nets.
38. How is an octahedron described in the chapter?
    Answer: An octahedron is made by joining two square pyramids at their bases.
39. What is the shortest path between two points on a plane?
    Answer: The shortest path between two points on a plane is a straight line.
40. Which three views are commonly used to represent a solid on a plane?
    Answer: The front view, top view and side view are commonly used.
41. On which plane is the front view of an object projected?
    Answer: The front view is projected on the vertical plane.
42. On which plane is the top view of an object projected?
    Answer: The top view is projected on the horizontal plane.
43. What is an isometric projection?
    Answer: An isometric projection shows the edges of a solid with equal projected lengths.
44. What are the three principal directions represented in an isometric drawing?
    Answer: They are length, depth and height.
45. What happens to parallel lines when they are projected onto a plane?
    Answer: Parallel lines project as parallel lines.

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

ONE-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. A Sierpinski Carpet starts with one square; how many squares remain at Step 2?
   Answer: Sixty-four squares remain at Step 2.
2. How many holes are present in a Sierpinski Carpet at Step 3?
   Answer: Seventy-three holes are present at Step 3.
3. A student counts nine holes in a Sierpinski Carpet; at which step is the carpet?
   Answer: The carpet is at Step 2.

4. What fraction of the starting square's area remains after Step 1 of the Sierpinski Carpet construction?
   Answer: Eight-ninths of the starting area remains.
5. If the starting square has an area of 27 square units, what area remains after Step 2 of the Sierpinski Carpet construction?
   Answer: Eight and one-third square units remain.
6. If the starting square has an area of 81 square units, what area remains after Step 3 of the Sierpinski Carpet construction?
   Answer: Fifty-six and eight-ninths square units remain.
7. A Sierpinski Carpet has 512 remaining squares; which step has been completed?
   Answer: Step 3 has been completed.
8. How many more squares remain in a Sierpinski Carpet than in a Sierpinski Gasket at Step 2?
   Answer: Fifty-five more squares remain in the carpet.
9. How many small triangles remain in a Sierpinski Gasket at Step 4?
   Answer: Eighty-one triangles remain at Step 4.
10. A Sierpinski Gasket has 40 holes; at which step is it?
    Answer: It is at Step 4.
11. What fraction of the starting area remains in a Sierpinski Gasket after Step 2?
    Answer: Nine-sixteenths of the starting area remains.
12. If the starting triangle has an area of 16 square units, what area remains after Step 2 of the Sierpinski Gasket construction?
    Answer: Nine square units remain.
13. A Sierpinski Gasket has 27 remaining triangles; at which step is it?
    Answer: It is at Step 3.
14. If the side length of the starting Koch Snowflake is 1 unit, how many sides does it have at Step 2?
    Answer: It has 48 sides at Step 2.
15. If the starting side length of a Koch Snowflake is 9 units, what is the length of each small side at Step 2?
    Answer: Each small side is 1 unit long.
16. If the starting side length of a Koch Snowflake is 3 units, what is its perimeter at Step 2?
    Answer: Its perimeter is 16 units.
17. A Koch Snowflake has 192 sides; which step has been completed?
    Answer: Step 3 has been completed.
18. By what factor does the perimeter of a Koch Snowflake change from one step to the next?
    Answer: The perimeter is multiplied by four-thirds at each step.
19. If the perimeter of a Koch Snowflake is 12 units at one step, what is its perimeter at the next step?
    Answer: Its perimeter at the next step is 16 units.
20. If a Koch Snowflake begins with side length 2 units, what is its perimeter at Step 1?
    Answer: Its perimeter at Step 1 is 8 units.
21. A prism has 21 edges; how many sides does each of its congruent polygonal faces have?
    Answer: Each polygonal face has seven sides.
22. A prism has a 10-sided base; how many vertices does it have?
    Answer: It has 20 vertices.

23. A prism has 9 faces; how many sides does each base have?
    Answer: Each base has seven sides.
24. A pyramid has 16 edges; how many sides does its base have?
    Answer: Its base has eight sides.
25. A pyramid has a 6-sided base; how many faces does it have?
    Answer: It has seven faces.
26. A pyramid has 9 vertices; how many sides does its base have?
    Answer: Its base has eight sides.
27. A solid has two congruent polygonal faces and parallelograms joining their corresponding edges; what type of solid is it?
    Answer: It is a prism.
28. A solid has a polygonal base and triangular faces meeting at one point; what type of solid is it?
    Answer: It is a pyramid.
29. A cube is unfolded to find a route across its surface; what should the shortest route look like on the net?
    Answer: It should appear as a straight line on the net.
30. A path on an unfolded cuboid forms a right triangle with sides 6 cm and 8 cm; what is the path length?
    Answer: The path length is 10 cm.
31. A route on a cuboid net forms a right triangle with sides 5 cm and 12 cm; what is its length?
    Answer: Its length is 13 cm.
32. Two valid cuboid nets show straight paths of 13 cm and 15 cm between the same points; which path is shorter?
    Answer: The 13 cm path is shorter.
33. A drawing shows a cube's projected edges with lengths 4 cm, 4 cm and 5 cm; is it isometric?
    Answer: No, because the projected lengths of all edges are not equal.
34. An isometric drawing keeps projected edge lengths equal along which three directions?
    Answer: It keeps them equal along the length, depth and height directions.
35. A cuboid is unfolded in a way that makes a straight line pass outside the net; can that line represent a path on the cuboid's surface?
    Answer: No, because part of the line lies outside the unfolded surface.
36. A cylinder has a base radius of 7 cm; using $\pi = 22/7$, how long is the rectangle in its net?
    Answer: The rectangle is 44 cm long.
37. A cylinder has a height of 10 cm and a base radius of 7 cm; using $\pi = 22/7$, what are the rectangle's dimensions in its net?
    Answer: The rectangle measures 44 cm by 10 cm.
38. An object's front view is projected onto which plane?
    Answer: Its front view is projected onto the vertical plane.
39. An object's top view is projected onto which plane?
    Answer: Its top view is projected onto the horizontal plane.
40. An engineer wants to show length, depth and height in a single drawing; which type of projection is useful?
    Answer: An isometric projection is useful for showing all three directions.

4.7 Two-mark questions with Answers of LOTS Type: (33 Questions)

TWO-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. What is a fractal? Give one example from nature.
   Answer:
   (i) A fractal is a shape with a pattern that repeats at smaller scales.
   (ii) A fern is an example of a natural fractal.
2. Name two natural objects that may show fractal patterns.
   Answer:
   (i) Trees may show fractal patterns.
   (ii) Clouds may also show fractal patterns.
3. Describe how the Sierpinski Carpet is started.
   Answer:
   (i) Divide a square into nine smaller squares.
   (ii) Remove the central square.
4. What happens to the remaining squares at each step of the Sierpinski Carpet construction?
   Answer:
   (i) Each remaining square is divided into nine smaller squares.
   (ii) The central square is removed, leaving eight squares.
5. State the rule for finding the number of remaining squares in a Sierpinski Carpet.
   Answer:
   (i) Each remaining square produces eight squares at the next step.
   (ii) The number at Step n is $R_n = 8^n$.
6. How are the holes formed in a Sierpinski Carpet?
   Answer:
   (i) A hole is formed when the centre square is removed.
   (ii) Every square remaining at one step creates a new hole at the next step.
7. Describe how the Sierpinski Gasket is constructed.
   Answer:
   (i) Join the midpoints of the sides of an equilateral triangle to form four smaller triangles.
   (ii) Remove the central triangle and repeat the process on the three remaining triangles.
8. How does joining the midpoints of an equilateral triangle divide it?
   Answer:
   (i) The triangle is divided into four smaller triangles.
   (ii) These four triangles are identical and equilateral.
9. What happens to the number of remaining triangles in a Sierpinski Gasket at each step?
   Answer:
   (i) Each remaining triangle produces three smaller triangles.
   (ii) The number of remaining triangles is multiplied by three at each step.
10. Describe the first construction step of the Koch Snowflake.
    Answer:
    (i) Start with an equilateral triangle and divide each side into three equal parts.
    (ii) Raise a small equilateral triangle over the middle part and remove its base.
11. What happens to each side when the Koch Snowflake construction is repeated?
    Answer:
    (i) Each side is replaced by four smaller sides.
    (ii) The procedure is repeated on all the new sides.

12. Give two examples of fractal-like patterns in human-made art or architecture.
    Answer:
    (i) Fractal-like patterns appear in the Kandariya Mahadev Temple.
    (ii) They also appear in Nigerian Fulani wedding blankets.
13. What is one way fractal patterns appear in the Kandariya Mahadev Temple?
    Answer:
    (i) The temple has a large structure made up of smaller copies of itself.
    (ii) Those smaller structures also contain still smaller copies.
14. How do diamond patterns on a Nigerian Fulani wedding blanket show self-similarity?
    Answer:
    (i) The blanket has large diamond-shaped patterns.
    (ii) Smaller diamond patterns appear inside them.
15. Name the artist associated with the work “Smaller and Smaller” and describe its pattern.
    Answer:
    (i) The work is associated with the Dutch artist M. C. Escher.
    (ii) It shows the same lizard pattern at smaller and smaller scales.
16. What are faces, edges and vertices of a solid?
    Answer:
    (i) Faces are the flat surfaces that form the boundary of a solid, and edges are the line segments where faces meet.
    (ii) Vertices are the points where edges meet.
17. State the numbers of faces, edges and vertices in a cube.
    Answer:
    (i) A cube has six faces and twelve edges.
    (ii) A cube has eight vertices.
18. What is a prism?
    Answer:
    (i) A prism has two congruent polygonal faces opposite each other.
    (ii) Its other faces are parallelograms.
19. How are prisms named? Give two examples.
    Answer:
    (i) A prism is named according to the shape of its congruent polygonal faces.
    (ii) Examples include a triangular prism and a pentagonal prism.
20. What is a pyramid?
    Answer:
    (i) A pyramid has a polygonal base and a point outside the base.
    (ii) Edges connect that point to each vertex of the base.
21. How are pyramids named? Give two examples.
    Answer:
    (i) A pyramid is named according to the shape of its base.
    (ii) Examples include a square pyramid and a pentagonal pyramid.
22. What is a tetrahedron?
    Answer:
    (i) A triangular pyramid is also called a tetrahedron.
    (ii) A regular tetrahedron has four equilateral-triangle faces.
23. What is a net of a solid, and how is it made?
    Answer:
    (i) A net is a flat arrangement of shapes that can be folded to form a solid.
    (ii) It is made by unfolding the solid onto a plane.

24. State two facts about the nets of a cube.
    Answer:
    (i) A cube has eleven possible nets when rotations and flips are counted as the same.
    (ii) A cube net must fold to form six square faces.
25. State two facts about the nets of a regular tetrahedron.
    Answer:
    (i) A regular tetrahedron has two possible nets.
    (ii) Each net consists of four equilateral triangles.
26. Describe the net of a cylinder.
    Answer:
    (i) The curved surface unfolds into a rectangle.
    (ii) The two circular ends form the cylinder's circular faces.
27. How can a shortest path on the surface of a cuboid be found?
    Answer:
    (i) Unfold the cuboid into a suitable net.
    (ii) Find the straight-line path between the points on the net.
28. Why does unfolding help to find the shortest surface path on a cuboid?
    Answer:
    (i) Unfolding preserves the lengths of paths on the cuboid's surface.
    (ii) The shortest path between two points on the flat net is a straight line.
29. Name the three standard views used to represent a solid.
    Answer:
    (i) The front view and top view are two of the standard views.
    (ii) The side view is the third standard view.
30. On which planes are the front, top and side views projected?
    Answer:
    (i) The front view is projected on the vertical plane, and the top view is projected on the horizontal plane.
    (ii) The side view is projected on the side plane.
31. What is an isometric projection of a cube?
    Answer:
    (i) It is a projection in which all the cube's edges have equal projected lengths.
    (ii) The cube is imagined as balanced on one corner and projected onto a plane.
32. How does an isometric grid help when drawing solids?
    Answer:
    (i) It provides three directions for representing length, depth and height.
    (ii) It helps keep the projected unit lengths equal along these directions.
33. What happens to parallel lines in a projection?
    Answer:
    (i) Parallel lines on a solid project as parallel lines.
    (ii) This helps preserve the shape's arrangement of edges in a drawing.

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

TWO-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. A Sierpinski Carpet has completed Step 2. How many squares remain, and how many holes are present?
   Answer:
   (i) Sixty-four squares remain.
   (ii) Nine holes are present.

2. A Sierpinski Carpet has 585 holes. At which step is it, and how many squares remain then?
   Answer:
   (i) It is at Step 4 because the number of holes is 1 + 8 + 64 + 512.
   (ii) It has 4,096 remaining squares.
3. A Sierpinski Carpet starts with an area of 81 square units. What area remains after Step 2, and what fraction of the original area is this?
   Answer:
   (i) The remaining area is 64 square units.
   (ii) This is 64/81 of the original area.
4. A Sierpinski Carpet has 64 remaining squares at one step. How many will remain at the next step, and what rule gives this result?
   Answer:
   (i) Five hundred and twelve squares will remain.
   (ii) The number of squares is multiplied by eight at each step.
5. At Step 3, how many more pieces remain in the Sierpinski Carpet than in the Sierpinski Gasket?
   Answer:
   (i) The carpet has 512 remaining squares, while the gasket has 27 remaining triangles.
   (ii) The carpet has 485 more remaining pieces.
6. A Sierpinski Gasket has 40 holes. At which step is it, and how many triangles remain?
   Answer:
   (i) It is at Step 4 because 1 + 3 + 9 + 27 = 40.
   (ii) Eighty-one triangles remain.
7. A Sierpinski Gasket starts with an area of 64 square units. What area remains after Step 2?
   Answer:
   (i) The remaining area is 36 square units.
   (ii) This follows because the remaining-area fraction at Step 2 is $(3/4)^2$.
8. At Step 2, which fractal has a greater fraction of its original area remaining: the Sierpinski Carpet or the Sierpinski Gasket?
   Answer:
   (i) The carpet retains 64/81 of its original area, while the gasket retains 9/16.
   (ii) The carpet retains the greater fraction.
9. A Koch Snowflake begins with three sides. How many sides does it have at Step 3, and what happens to the side count at each step?
   Answer:
   (i) It has 192 sides at Step 3.
   (ii) The side count is multiplied by four at every step.
10. A Koch Snowflake starts with a side length of 2 units. What is its perimeter at Step 2?
    Answer:
    (i) Its perimeter at Step 2 is 32/3 units.
    (ii) This is found by multiplying its starting perimeter of 6 by $(4/3)^2$.
11. A Koch Snowflake starts with a side length of 3 units. What is its perimeter at Step 3?
    Answer:
    (i) Its perimeter is 64/3 units.
    (ii) The perimeter grows by a factor of 4/3 at each step.
12. At Step 2, each small side of a Koch Snowflake is 1/9 unit long. What was the starting side length?
    Answer:

(i) The starting side length was 1 unit.
(ii) Each iteration divides the side length by three.

13. Why does the perimeter of a Koch Snowflake increase even though each new side is shorter?
    Answer:
    (i) Every side is replaced by four sides, each one-third as long.
    (ii) The total perimeter is therefore multiplied by 4/3 at each step.
14. A prism has 18 edges. How many sides does each base have, and how many vertices does the prism have?
    Answer:
    (i) Each base has six sides because the number of edges is three times the number of base sides.
    (ii) The prism has 12 vertices.
15. A pyramid has 10 faces. How many sides does its base have, and how many edges does the pyramid have?
    Answer:
    (i) Its base has nine sides because a pyramid has one more face than its base has sides.
    (ii) It has 18 edges.
16. A prism and a pyramid each have a pentagonal base. How many faces does each solid have, and which has more?
    Answer:
    (i) The prism has seven faces, and the pyramid has six faces.
    (ii) The prism has one more face.
17. A route across a cuboid's unfolded net forms a right triangle with perpendicular sides of 9 cm and 12 cm. What is the route length?
    Answer:
    (i) The route is 15 cm long.
    (ii) This follows from the Pythagorean theorem.
18. Two valid cuboid nets show straight routes between the same points, measuring 13 cm and 15 cm. Which route gives the shorter surface path?
    Answer:
    (i) The 13 cm route gives the shorter path.
    (ii) Both routes can be compared because each represents a path on a valid unfolding.
19. A line drawn across an unfolded cuboid passes outside the net. Can it represent a path on the cuboid's surface, and why?
    Answer:
    (i) It cannot represent a path on the cuboid's surface.
    (ii) The part outside the net does not lie on any face of the cuboid.
20. An isometric drawing shows projected edges of 4 cm, 4 cm and 5 cm along the three main directions. What is wrong with the drawing?
    Answer:
    (i) The projected edge lengths are not all equal.
    (ii) The drawing does not satisfy the defining condition of an isometric projection.
21. A solid's front view is needed for an engineering drawing. Which plane should show the projection, and what plane is used for its top view?
    Answer:
    (i) The front view is projected onto the vertical plane.
    (ii) The top view is projected onto the horizontal plane.
22. A cylinder has radius 7 cm and height 10 cm. Using $\pi = 22/7$, what are the dimensions of the rectangular part of its net?

Answer:
(i) The rectangle's length is 44 cm, the circumference of the base.
(ii) Its width is 10 cm, the cylinder's height.

23. A student says the central triangle in the Sierpinski Gasket is divided into four smaller triangles at every step. What is the correction?
Answer:
(i) The original equilateral triangle is divided into four smaller triangles by joining its midpoints.
(ii) The central triangle is removed, and the process is repeated on the three remaining triangles.
24. A drawing of a solid preserves parallel edges but shows different projected lengths along its three main directions. What can be concluded?
Answer:
(i) Preserving parallel edges alone does not make the drawing isometric.
(ii) An isometric projection must also show equal projected lengths along the three directions.
25. A large temple structure contains smaller copies of itself, and those contain still smaller copies. What geometric idea does this illustrate, and why?
Answer:
(i) It illustrates self-similarity, a defining feature of fractals.
(ii) The same or a similar pattern appears repeatedly at smaller scales.

4.9. Three-mark questions with Answers of LOTS Type: (22 Questions)

THREE-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. What is a fractal? Give two examples found in nature.
Answer:
(i) A fractal is a shape with a pattern that repeats at smaller scales.
(ii) A fern is an example of a natural fractal.
(iii) Trees, clouds and coastlines may also show fractal patterns.
2. Describe how to construct the Sierpinski Carpet up to Step 1.
Answer:
(i) Begin with a square.
(ii) Divide it into nine equal smaller squares.
(iii) Remove the central square.
3. Describe how the Sierpinski Carpet develops from one step to the next.
Answer:
(i) Consider each square that remains.
(ii) Divide it into nine equal smaller squares.
(iii) Remove the central square, leaving eight squares.
4. Explain how the numbers of remaining squares in a Sierpinski Carpet grow.
Answer:
(i) At Step 0, one square remains.
(ii) Each remaining square produces eight squares at the next step.
(iii) The number of remaining squares at Step n is 8^n.
5. Explain how the holes form in the Sierpinski Carpet.
Answer:
(i) A hole is formed by removing the central square.
(ii) Each square remaining at a step creates one new hole at the next step.
(iii) The holes from earlier steps remain in the pattern.

6. Describe how to construct the Sierpinski Gasket.
   Answer:
   (i) Begin with an equilateral triangle.
   (ii) Join the midpoints of its sides to divide it into four equal triangles.
   (iii) Remove the central triangle and repeat on the three remaining triangles.
7. Describe the division of an equilateral triangle used to form the Sierpinski Gasket.
   Answer:
   (i) Mark the midpoint of each side of the triangle.
   (ii) Join the three midpoints.
   (iii) The original triangle is divided into four identical equilateral triangles.
8. Describe how the Koch Snowflake is constructed.
   Answer:
   (i) Begin with an equilateral triangle.
   (ii) Divide each side into three equal parts and form an outward-pointing equilateral triangle on the middle part.
   (iii) Remove the base of each small triangle and repeat the process on the new sides.
9. What happens to the number and length of the sides in each step of the Koch Snowflake?
   Answer:
   (i) Each side is replaced by four smaller sides.
   (ii) Each new side is one-third the length of the side it replaces.
   (iii) The process is repeated on all the new sides.
10. Give three examples of fractal patterns in human-made art or architecture.
    Answer:
    (i) The Kandariya Mahadev Temple displays fractal-like patterns.
    (ii) Nigerian Fulani wedding blankets contain repeated diamond patterns.
    (iii) M. C. Escher's "Smaller and Smaller" shows repeated lizard patterns at smaller scales.
11. Define the terms face, edge and vertex of a solid.
    Answer:
    (i) A face is a flat surface forming part of a solid's boundary.
    (ii) An edge is a line segment forming the side of a face.
    (iii) A vertex is a point where edges meet.
12. State the number of faces, edges and vertices in a cube.
    Answer:
    (i) A cube has six faces.
    (ii) A cube has twelve edges.
    (iii) A cube has eight vertices.
13. Describe the main features of a prism.
    Answer:
    (i) A prism has two congruent polygonal faces opposite each other.
    (ii) Edges connect the corresponding vertices of those faces.
    (iii) The other faces are parallelograms.
14. Explain how prisms are named and give two examples.
    Answer:
    (i) A prism is named according to the shape of its congruent polygonal faces.
    (ii) A prism with triangular bases is called a triangular prism.
    (iii) A prism with pentagonal bases is called a pentagonal prism.
15. Describe the main features of a pyramid.
    Answer:

(i) A pyramid has a polygonal base.
(ii) It has a point outside the base.
(iii) Edges connect that point to every vertex of the base.

16. Explain how pyramids are named and give two examples.
    Answer:
    (i) A pyramid is named according to the shape of its base.
    (ii) A pyramid with a square base is called a square pyramid.
    (iii) A pyramid with a pentagonal base is called a pentagonal pyramid.
17. What is a net, and how does it relate to a solid?
    Answer:
    (i) A net is a flat arrangement of shapes.
    (ii) It is formed by unfolding a solid onto a plane.
    (iii) Folding the net can produce the solid.
18. Describe two facts about the possible nets of solids discussed in the chapter.
    Answer:
    (i) A cube has eleven different nets when rotations and flips are counted as the same.
    (ii) A regular tetrahedron has two possible nets.
    (iii) An octahedron has eleven different nets.
19. Explain how to use a net to find the shortest path across the surface of a cuboid.
    Answer:
    (i) Unfold the cuboid into a suitable net.
    (ii) Mark the two points on the net.
    (iii) Join them with a straight line and compare suitable unfoldings.
20. Describe the three standard views used to represent a solid.
    Answer:
    (i) The front view is the projection on the vertical plane.
    (ii) The top view is the projection on the horizontal plane.
    (iii) The side view is the projection on the side plane.
21. What is an isometric projection, and how is it used?
    Answer:
    (i) An isometric projection shows a solid with equal projected lengths along its three main directions.
    (ii) Those directions represent length, depth and height.
    (iii) Isometric grid paper helps draw solids while showing these directions.
22. What does an isometric projection of a cube look like, and what does “isometric” mean?
    Answer:
    (i) An isometric projection of a cube appears as a regular hexagon.
    (ii) In this orientation, the projected lengths of all the cube’s edges are equal.
    (iii) “Isometric” means “equal measure.”

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

THREE-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. A Sierpinski Carpet has completed Step 3. Find the number of remaining squares, the number of holes and the fraction of the starting area that remains.
   Answer:
   (i) It has 512 remaining squares because $8^3 = 512$.
   (ii) It has 73 holes because $1 + 8 + 64 = 73$.
   (iii) The remaining area is 512/729 of the starting area.

2. A Sierpinski Carpet has completed Step 4. Find its remaining squares, holes and remaining area as a fraction of the starting area.
   Answer:
   (i) It has 4,096 remaining squares because $8^4 = 4{,}096$.
   (ii) It has 585 holes because $1 + 8 + 64 + 512 = 585$.
   (iii) The remaining area is 4,096/6,561 of the starting area.
3. A Sierpinski Carpet starts with an area of 729 square units. Find the area remaining and the area removed after Step 3.
   Answer:
   (i) The remaining fraction after Step 3 is 512/729.
   (ii) The remaining area is 512 square units.
   (iii) The removed area is 217 square units.
4. A Sierpinski Gasket has completed Step 3. Find its remaining triangles, holes and remaining area as a fraction of its starting area.
   Answer:
   (i) It has 27 remaining triangles because $3^3 = 27$.
   (ii) It has 13 holes because $1 + 3 + 9 = 13$.
   (iii) The remaining area is 27/64 of the starting area.
5. A Sierpinski Gasket starts with an area of 128 square units. Find its remaining area after Step 2.
   Answer:
   (i) The remaining-area fraction after Step 2 is $(3/4)^2$.
   (ii) This fraction is 9/16.
   (iii) The remaining area is 72 square units.
6. Compare the fractions of starting area remaining in the Sierpinski Carpet and Sierpinski Gasket at Step 2.
   Answer:
   (i) The carpet retains 64/81 of its starting area.
   (ii) The gasket retains 9/16 of its starting area.
   (iii) The carpet retains the greater fraction.
7. At Step 3, compare the number of pieces remaining in the Sierpinski Carpet and Sierpinski Gasket.
   Answer:
   (i) The carpet has 512 remaining squares.
   (ii) The gasket has 27 remaining triangles.
   (iii) The carpet has 485 more remaining pieces.
8. A Koch Snowflake starts with side length 1 unit. Find its number of sides, length of each small side and perimeter at Step 2.
   Answer:
   (i) It has 48 sides because $3 \times 4^2 = 48$.
   (ii) Each small side is 1/9 unit long.
   (iii) Its perimeter is 16/3 units.
9. A Koch Snowflake starts with side length 3 units. Find its perimeter and number of sides at Step 2.
   Answer:
   (i) Its starting perimeter is 9 units.
   (ii) Its Step 2 perimeter is 16 units because the perimeter is multiplied by $(4/3)^2$.
   (iii) It has 48 sides at Step 2.
10. Explain why the perimeter of a Koch Snowflake increases at every step.
    Answer:

(i) Each side is replaced by four new sides.
(ii) Each new side is one-third the length of the side it replaces.
(iii) The total perimeter is therefore multiplied by 4/3.

11. A prism has an octagonal base. Find its number of faces, edges and vertices.
Answer:
(i) It has 10 faces because a prism has n + 2 faces.
(ii) It has 24 edges because a prism has 3n edges.
(iii) It has 16 vertices because a prism has 2n vertices.
12. A pyramid has a nonagonal base. Find its number of faces, edges and vertices.
Answer:
(i) It has 10 faces because a pyramid has n + 1 faces.
(ii) It has 18 edges because a pyramid has 2n edges.
(iii) It has 10 vertices because it has nine base vertices and one apex.
13. Compare a prism and a pyramid that each have a hexagonal base.
Answer:
(i) The prism has 8 faces, 18 edges and 12 vertices.
(ii) The pyramid has 7 faces, 12 edges and 7 vertices.
(iii) The prism has more faces, edges and vertices.
14. A cuboid net creates a right triangle with perpendicular sides of 9 cm and 12 cm. Find the straight path length and explain what it represents.
Answer:
(i) The path length is 15 cm because $9^2 + 12^2 = 15^2$.
(ii) The straight line on the net represents a path across the unfolded surface.
(iii) When folded, that line corresponds to a path on the cuboid.
15. Two suitable cuboid nets produce straight paths of 15 cm and 20 cm between the same points. Which path is shorter, and how should the shortest surface path be identified?
Answer:
(i) The 15 cm path is shorter than the 20 cm path.
(ii) Each valid unfolding gives a candidate surface path.
(iii) The shortest valid candidate is the shortest surface path.
16. On a cuboid net, a proposed straight line passes outside the unfolded faces. Explain why it cannot be the required surface path.
Answer:
(i) The line includes points outside the net.
(ii) Those points do not lie on the cuboid's surface.
(iii) Therefore, the line does not represent a valid surface path.
17. A cylinder has radius 3.5 cm and height 8 cm. Using $\pi = 22/7$, find the dimensions of its rectangular net section.
Answer:
(i) The rectangle's length equals the base circumference, $2\pi r$.
(ii) Its length is 22 cm.
(iii) Its dimensions are 22 cm by 8 cm.
18. An engineer wants an isometric drawing of a cube. What should be true of the projected edge lengths and the three directions shown?
Answer:
(i) The projected lengths of the cube's edges should be equal.
(ii) The drawing should show length, depth and height.
(iii) An isometric grid can help maintain these directions and equal lengths.

19. A drawing preserves parallel edges but shows projected unit lengths of 3 cm, 3 cm and 4 cm along the three main directions. Is it isometric, and what needs correction?
    Answer:
    (i) It is not an isometric projection because the projected lengths are unequal.
    (ii) The length, depth and height directions should have equal projected unit lengths.
    (iii) The 4 cm direction should be adjusted to match the other two.
20. A solid is shown using front, top and side views. Identify the projection plane for each view and explain why all three views are useful.
    Answer:
    (i) The front view is projected onto the vertical plane.
    (ii) The top and side views are projected onto the horizontal and side planes, respectively.
    (iii) Together, the views provide information about the solid from three directions.

4.11 Five-mark questions with Answers of LOTS Type: (15 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. What is a fractal? Describe its patterns and give examples.
   Answer:
   (i) A fractal is a geometric shape with a pattern that repeats at smaller scales.
   (ii) This repeating pattern is called self-similarity.
   (iii) Ferns and trees show fractal patterns in nature.
   (iv) Clouds, coastlines and mountains may also show such patterns.
   (v) Fractal patterns are found in human-made art and architecture too.
2. Describe how to construct the Sierpinski Carpet.
   Answer:
   (i) Begin with a square.
   (ii) Divide the square into nine equal smaller squares.
   (iii) Remove the central square.
   (iv) Repeat the process on each of the eight remaining squares.
   (v) Continue repeating the process to create smaller and smaller patterns.
3. Explain how the numbers of remaining squares and holes develop in the Sierpinski Carpet.
   Answer:
   (i) At Step 0, one square remains and there are no holes.
   (ii) Each remaining square produces eight squares at the next step.
   (iii) The number of remaining squares is multiplied by eight at each step.
   (iv) Each remaining square also creates one new hole in the next step.
   (v) Holes formed in earlier steps remain in the figure.
4. Describe how to construct the Sierpinski Gasket.
   Answer:
   (i) Begin with an equilateral triangle.
   (ii) Join the midpoints of its three sides.
   (iii) This divides the triangle into four identical smaller triangles.
   (iv) Remove the central triangle.
   (v) Repeat the process on each of the three remaining triangles.
5. Describe how to construct the Koch Snowflake.
   Answer:
   (i) Begin with an equilateral triangle.
   (ii) Divide each side into three equal parts.

(iii) Construct a small equilateral triangle over the middle part of each side.
(iv) Remove the base of each small triangle to form a bump.
(v) Repeat the process on every new side of the shape.

6. Explain how fractal patterns appear in art and architecture.
   Answer:
   (i) Fractal patterns repeat similar shapes at smaller scales.
   (ii) The Kandariya Mahadev Temple in Khajuraho displays fractal-like architecture.
   (iii) Similar patterns are found in temples in places such as Madurai, Hampi and Varanasi.
   (iv) Nigerian Fulani wedding blankets may contain nested diamond patterns.
   (v) M. C. Escher's "Smaller and Smaller" shows repeated lizard patterns at smaller scales.
7. Define face, edge and vertex, and state these features for a cube.
   Answer:
   (i) A face is a flat surface forming part of a solid's boundary.
   (ii) An edge is a line segment that forms the side of a face.
   (iii) A vertex is a point where edges meet.
   (iv) A cube has six faces and twelve edges.
   (v) A cube has eight vertices.
8. Describe the main features of a prism and give examples.
   Answer:
   (i) A prism has two congruent polygonal faces opposite each other.
   (ii) Edges connect the corresponding vertices of these faces.
   (iii) The other faces of a prism are parallelograms.
   (iv) A prism is named according to the shape of its congruent faces.
   (v) Examples include triangular, pentagonal and hexagonal prisms.
9. Describe the main features of a pyramid and give examples.
   Answer:
   (i) A pyramid has a polygonal base.
   (ii) It has a point outside the base.
   (iii) Edges connect this point to each vertex of the base.
   (iv) A pyramid is named according to the shape of its base.
   (v) Examples include triangular, square and pentagonal pyramids.
10. What is a net? Describe how a net is used to make a solid.
    Answer:
    (i) A net is a flat arrangement of shapes that can be folded to form a solid.
    (ii) It can be made by unfolding the surfaces of a solid onto a plane.
    (iii) The shapes in the net become the faces of the solid.
    (iv) The faces are folded along their edges to build the solid.
    (v) Extra flaps may be added when making a physical model to help join its faces.
11. Describe the possible nets of a cube, a regular tetrahedron and an octahedron.
    Answer:
    (i) A cube has eleven different nets when rotations and flips are counted as the same.
    (ii) A regular tetrahedron has two possible nets.
    (iii) Each face of a regular tetrahedron is an equilateral triangle.
    (iv) An octahedron has eleven different nets.
    (v) An octahedron can be made by joining two square pyramids at their bases.
12. Explain how a cylinder and a cone are represented by nets.
    Answer:
    (i) The curved surface of a cylinder unfolds into a rectangle.

(ii) The cylinder's two circular ends form the circular faces of its net.
(iii) The length of the rectangle equals the circumference of the cylinder's base.
(iv) A cone's curved surface unfolds into part of a circle.
(v) The cone's base remains a circle in its net.

13. Explain how a net helps find the shortest path on the surface of a cuboid.
Answer:
(i) Choose a way to unfold the cuboid into a net.
(ii) Mark the starting point and destination on the net.
(iii) Draw the straight line between the points on the net.
(iv) Check that the line stays within the unfolded faces.
(v) Compare suitable nets, since different unfoldings may produce paths of different lengths.
14. Describe the three standard views used to represent a solid.
Answer:
(i) The front view shows the object projected onto a vertical plane.
(ii) The top view shows the object projected onto a horizontal plane.
(iii) The side view shows the object projected onto a side plane.
(iv) Each view shows the object from a different direction.
(v) Using all three views gives more information about the solid.
15. Describe isometric projection and how isometric grids are used.
Answer:
(i) An isometric projection is an orientation in which the projected lengths of a cube's edges are equal.
(ii) The isometric representation of a cube appears as a regular hexagon.
(iii) An isometric grid provides three directions for drawing a solid.
(iv) These directions represent length, depth and height.
(v) The grid helps draw solids while keeping parallel edges parallel and unit lengths equal along the three directions.

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

FIVE-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. A Sierpinski Carpet starts with a square of area 729 square units. At Step 3, find the remaining squares, holes, remaining area and area removed.
Answer:
(i) The number of remaining squares is $8^3 = 512$.
(ii) The number of holes is $1 + 8 + 64 = 73$.
(iii) The fraction of the starting area remaining is $(8/9)^3 = 512/729$.
(iv) The remaining area is 512 square units.
(v) The area removed is $729 - 512 = 217$ square units.
2. A Sierpinski Carpet has completed Step 4. Find its remaining squares, holes and remaining area as a fraction of the starting area.
Answer:
(i) The number of remaining squares is $8^4 = 4{,}096$.
(ii) The number of holes is $1 + 8 + 64 + 512 = 585$.
(iii) The remaining-area fraction is $(8/9)^4$.
(iv) This fraction is 4,096/6,561.
(v) The carpet retains 4,096/6,561 of its starting area.
3. A Sierpinski Gasket starts with an area of 256 square units. At Step 3, find the remaining triangles, holes and area.

Answer:
(i) The number of remaining triangles is $3^3 = 27$.
(ii) The number of holes is $1 + 3 + 9 = 13$.
(iii) The remaining-area fraction is $(3/4)^3 = 27/64$.
(iv) The remaining area is $256 \times 27/64 = 108$ square units.
(v) The removed area is $256 - 108 = 148$ square units.

4. A Sierpinski Gasket has 81 remaining triangles. Find its step number, number of holes and remaining-area fraction.
Answer:
(i) Since $81 = 3^4$, the gasket is at Step 4.
(ii) The number of holes is $1 + 3 + 9 + 27 = 40$.
(iii) The remaining-area fraction is $(3/4)^4$.
(iv) This fraction simplifies to 81/256.
(v) The gasket retains 81/256 of its starting area.
5. A Koch Snowflake begins with side length 2 units. At Step 2, find its number of sides, the length of each small side and its perimeter.
Answer:
(i) The number of sides is $3 \times 4^2 = 48$.
(ii) Each side is divided by a factor of 3 at every step.
(iii) Each small side is $2/3^2 = 2/9$ unit long.
(iv) The perimeter is $48 \times 2/9$.
(v) The perimeter is 32/3 units.
6. A Koch Snowflake begins with side length 1 unit. Compare its perimeters at Steps 0, 1 and 2.
Answer:
(i) At Step 0, the perimeter is 3 units.
(ii) At Step 1, the perimeter is 4 units.
(iii) At Step 2, the perimeter is 16/3 units.
(iv) The perimeter increases by a factor of 4/3 at each step.
(v) The increase from Step 1 to Step 2 is 4/3 unit.
7. An engineer is modelling a prism with an octagonal base. Find its faces, edges and vertices, and explain the formulas used.
Answer:
(i) The base has 8 sides, so let $n = 8$.
(ii) The number of faces is $n + 2 = 10$.
(iii) The number of edges is $3n = 24$.
(iv) The number of vertices is $2n = 16$.
(v) The prism has 10 faces, 24 edges and 16 vertices.
8. A model maker builds a pyramid with a heptagonal base. Find its faces, edges and vertices.
Answer:
(i) The base has 7 sides, so let $n = 7$.
(ii) The number of faces is $n + 1 = 8$.
(iii) The number of edges is $2n = 14$.
(iv) The number of vertices is $n + 1 = 8$.
(v) The pyramid has 8 faces, 14 edges and 8 vertices.
9. A solid has 9 faces, 21 edges and 14 vertices. Identify the solid and verify your choice.
Answer:
(i) The solid has two more faces than its base has sides, which fits a prism.

(ii) Its 21 edges give n = 21/3 = 7 base sides.
(iii) A 7-sided prism has 9 faces.
(iv) A 7-sided prism has 14 vertices.
(v) Therefore, the solid is a heptagonal prism.

10. Two possible cuboid nets show straight paths between the same points. One path forms a right triangle with sides 8 cm and 15 cm, and the other with sides 9 cm and 12 cm. Which path is shorter?
Answer:
(i) The first path has length $\sqrt{(8^2 + 15^2)} = 17$ cm.
(ii) The second path has length $\sqrt{(9^2 + 12^2)} = 15$ cm.
(iii) Both lengths are found using the Pythagorean theorem.
(iv) The 15 cm path is shorter than the 17 cm path.
(v) The second net gives the shorter surface route.
11. On a cuboid net, a proposed shortest route passes outside the unfolded faces. Explain how to assess this route and find a valid shortest path.
Answer:
(i) A path on the cuboid must lie on its faces.
(ii) The part outside the net does not correspond to a surface of the cuboid.
(iii) Therefore, that line is not a valid surface route.
(iv) Try a different unfolding that keeps the route on the faces.
(v) Compare straight-line lengths on the valid nets and choose the shortest.
12. A cylinder has a radius of 3.5 cm and a height of 12 cm. Using $\pi = 22/7$, find the dimensions of the rectangular part of its net.
Answer:
(i) The rectangle's length is the circumference of the circular base.
(ii) The circumference is $2\pi r = 2 \times 22/7 \times 3.5$.
(iii) The rectangle's length is 22 cm.
(iv) Its width equals the cylinder's height, which is 12 cm.
(v) The rectangular part of the net measures 22 cm by 12 cm.
13. A drawing of a cube preserves parallel edges but shows projected unit lengths of 3 cm, 3 cm and 4 cm along its three directions. Assess whether it is isometric and state how to correct it.
Answer:
(i) The three directions represent length, depth and height.
(ii) An isometric projection has equal projected unit lengths in all three directions.
(iii) The lengths 3 cm, 3 cm and 4 cm are not all equal.
(iv) Therefore, the drawing is not isometric.
(v) Adjust the 4 cm direction so its projected unit length matches the other two.
14. A student says that a straight line drawn on any net always gives the shortest surface route on a cuboid. Evaluate the statement.
Answer:
(i) A straight line is the shortest path between two points on a flat plane.
(ii) A net represents the cuboid's surface only when the route stays on its unfolded faces.
(iii) A line that passes outside the net is not a valid surface route.
(iv) Different unfoldings can produce different candidate path lengths.
(v) The student must compare valid nets before identifying the shortest route.
15. A temple has a large structure containing smaller versions of itself, which contain still smaller versions. Explain why this is an example of a fractal pattern.
Answer:

(i) The same or a similar shape appears repeatedly.
(ii) Each repeated version is smaller than the one containing it.
(iii) This repetition at smaller scales is called self-similarity.
(iv) Self-similarity is a defining feature of fractals.
(v) Therefore, the temple's repeated structure is fractal-like.

4.13 Five-mark questions with Answers of Applied Type: (15 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS – APPLIED TYPE:

1. A school plans a Sierpinski Carpet pattern on a square courtyard of area 81 m². If the pattern is constructed through Step 2, find the remaining area, the removed area and the numbers of remaining squares and holes.
   Answer:
   (i) The remaining-area fraction at Step 2 is $(8/9)^2 = 64/81$.
   (ii) The area with the pattern remaining is $81 \times 64/81 = 64$ m².
   (iii) The removed area is $81 - 64 = 17$ m².
   (iv) There are $8^2 = 64$ remaining squares.
   (v) There are $1 + 8 = 9$ holes.
2. An art teacher uses a Sierpinski Gasket pattern on a triangular panel with an area of 64 m². Find the remaining area after Step 2 and the number of holes formed.
   Answer:
   (i) At Step 2, the remaining-area fraction is $(3/4)^2 = 9/16$.
   (ii) The remaining panel area is $64 \times 9/16 = 36$ m².
   (iii) The area removed is $64 - 36 = 28$ m².
   (iv) The number of holes is $1 + 3 = 4$.
   (v) There are $3^2 = 9$ small triangles remaining.
3. A decorative triangular frame has a Koch Snowflake outline that begins with side length 4 m. Find the perimeter after Step 2.
   Answer:
   (i) The starting perimeter is $3 \times 4 = 12$ m.
   (ii) The perimeter is multiplied by 4/3 at each step.
   (iii) After Step 2, the perimeter is $12 \times (4/3)^2$.
   (iv) This gives a perimeter of 64/3 m.
   (v) The frame requires 21⅓ m of edging material, before allowing for joins or wastage.
4. A designer wants to make a Koch Snowflake border from a triangle with 1 m sides. How many line segments will the border have at Step 3, and how long will each segment be?
   Answer:
   (i) The border starts with three sides.
   (ii) Each side is replaced by four sides at every step.
   (iii) At Step 3, it has $3 \times 4^3 = 192$ segments.
   (iv) Each segment is $1/3^3$ m long.
   (v) Each segment is 1/27 m long.
5. A student is making a cardboard octagonal-prism model for a display. Determine the number of faces, edges and vertices the model will have.
   Answer:
   (i) The prism has an 8-sided base, so $n = 8$.
   (ii) It has $n + 2 = 10$ faces.
   (iii) It has $3n = 24$ edges.

(iv) It has $2n = 16$ vertices.
(v) The student should prepare two octagonal bases and eight parallelogram side faces.

6. A craft club makes a pyramid with a hexagonal base. Find the number of faces, edges and vertices, and describe the faces needed for its net.
   Answer:
   (i) The base has six sides, so $n = 6$.
   (ii) The pyramid has $n + 1 = 7$ faces.
   (iii) It has $2n = 12$ edges and $n + 1 = 7$ vertices.
   (iv) The net needs one hexagonal base.
   (v) The net also needs six triangular side faces.
7. A shipping box is a cuboid, and a label must travel from a point on one face to a point on another while staying on the outside. Explain how a worker can find the shortest route.
   Answer:
   (i) Mark the starting and ending points on the box.
   (ii) Unfold the box into a suitable net.
   (iii) Draw a straight line between the points on the net.
   (iv) Check that the line remains within the unfolded faces.
   (v) Compare valid unfoldings and use the one with the shortest line.
8. A gift box net offers two valid route options for a ribbon: one forms a right triangle with sides 6 cm and 8 cm, and the other with sides 5 cm and 12 cm. Which route uses less ribbon?
   Answer:
   (i) The first route has length $\sqrt{(6^2 + 8^2)} = 10$ cm.
   (ii) The second route has length $\sqrt{(5^2 + 12^2)} = 13$ cm.
   (iii) Both lengths are calculated using the Pythagorean theorem.
   (iv) The 10 cm route is shorter.
   (v) The first route uses 3 cm less ribbon.
9. A company needs a rectangular label for a cylindrical container with radius 7 cm and height 20 cm. Using $\pi = 22/7$, find the label dimensions if it covers the curved surface exactly.
   Answer:
   (i) The label length must equal the circumference of the base.
   (ii) The circumference is $2\pi r = 2 \times 22/7 \times 7 = 44$ cm.
   (iii) The label height must equal the container height of 20 cm.
   (iv) The rectangular label measures 44 cm by 20 cm.
   (v) Extra material may be needed for an overlap seam.
10. An engineer is preparing drawings of a machine part for construction. Which three views should be included, and what does each show?
    Answer:
    (i) Include the front view to show the projection on the vertical plane.
    (ii) Include the top view to show the projection on the horizontal plane.
    (iii) Include the side view to show the projection on the side plane.
    (iv) Each view records the shape from a different direction.
    (v) Together, they communicate more information about the part than one view alone.
11. A student draws a stack of cubes on isometric grid paper for a design project. Which directions should the student use, and what should be true of the projected unit lengths?
    Answer:

(i) The student should represent the length direction.
(ii) The student should also represent the depth and height directions.
(iii) Each direction corresponds to one of the three principal axes of the solid.
(iv) The projected unit lengths along these directions should be equal for an isometric projection.
(v) The grid helps keep the directions and lengths consistent.

12. A school art project uses a Nigerian Fulani blanket as inspiration. How can students use the chapter's idea of fractals to plan their design?
Answer:
(i) Start with a large diamond pattern.
(ii) Place a smaller diamond pattern inside it.
(iii) Repeat the smaller pattern at still smaller scales.
(iv) Keep the shapes similar to create self-similarity.
(v) Use colour changes to make the repeated pattern clear.
13. A school is building a model of an octahedron for a geometry exhibition. Describe how the solid can be assembled from pyramids and state the number of different nets it has.
Answer:
(i) An octahedron can be formed from two square pyramids.
(ii) Join the pyramids at their square bases.
(iii) The resulting solid has triangular faces.
(iv) An octahedron has eleven different nets.
(v) Students can test a net by cutting it out and folding it.
14. A student claims that any straight line drawn between two points on a flattened cuboid must be a valid shortest route on the cuboid. Explain how the student can check the claim.
Answer:
(i) First check whether the line stays within the faces of the net.
(ii) A line that passes outside the net cannot represent a surface route.
(iii) Confirm that the chosen net folds to the original cuboid.
(iv) Compare the route with paths on other suitable unfoldings.
(v) The shortest valid straight-line route represents the shortest surface path.
15. A museum plans a display showing how the same pattern appears in a temple, a blanket and an artwork. Explain how the display can connect these examples to fractals.
Answer:
(i) Show a repeated architectural pattern from the Kandariya Mahadev Temple.
(ii) Include the nested diamond patterns found in Nigerian Fulani wedding blankets.
(iii) Include M. C. Escher's "Smaller and Smaller" as an art example.
(iv) Point out how similar shapes repeat at smaller scales in each example.
(v) Explain that this repeated pattern is called self-similarity and is characteristic of fractals.

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

MULTIPLE-CHOICE QUESTIONS – OLYMPIAD TYPE:

1. How many squares remain in a Sierpinski Carpet at Step 2?
A. 16
B. 32
C. 64

D. 81
Answer: C. 64

2. How many holes are present in a Sierpinski Carpet at Step 3?
   A. 64
   B. 72
   C. 73
   D. 81
   Answer: C. 73
3. A Sierpinski Carpet starts with a square of area 162 cm². What area remains after Step 1?
   A. 18 cm²
   B. 72 cm²
   C. 144 cm²
   D. 162 cm²
   Answer: C. 144 cm²
4. A Sierpinski Carpet starts with a square of area 81 cm². What area remains after Step 2?
   A. 48 cm²
   B. 64 cm²
   C. 72 cm²
   D. 73 cm²
   Answer: B. 64 cm²
5. At which step of the Sierpinski Carpet construction are there 512 remaining squares?
   A. Step 2
   B. Step 3
   C. Step 4
   D. Step 5
   Answer: B. Step 3
6. How many holes are present in a Sierpinski Carpet at Step 4?
   A. 512
   B. 584
   C. 585
   D. 4,096
   Answer: C. 585
7. How many triangles remain in a Sierpinski Gasket at Step 4?
   A. 27
   B. 64
   C. 81
   D. 256
   Answer: C. 81
8. How many holes are present in a Sierpinski Gasket at Step 3?
   A. 9
   B. 12
   C. 13
   D. 27
   Answer: C. 13
9. A Sierpinski Gasket starts with an area of 256 cm². What area remains after Step 2?
   A. 64 cm²
   B. 128 cm²
   C. 144 cm²

D. 192 cm²
Answer: C. 144 cm²

10. What fraction of the starting area remains in a Sierpinski Gasket at Step 3?
A. 9/16
B. 27/64
C. 27/81
D. 64/81
Answer: B. 27/64
11. Joining the midpoints of an equilateral triangle divides it into how many identical triangles?
A. 3
B. 4
C. 6
D. 8
Answer: B. 4
12. How many sides does a Koch Snowflake have at Step 3?
A. 48
B. 64
C. 192
D. 256
Answer: C. 192
13. A Koch Snowflake starts with side length 2 cm. What is its perimeter at Step 2?
A. 8 cm
B. 12 cm
C. 16 cm
D. 32/3 cm
Answer: D. 32/3 cm
14. A Koch Snowflake starts with side length 9 cm. How long is each small side at Step 2?
A. 1 cm
B. 2 cm
C. 3 cm
D. 9 cm
Answer: A. 1 cm
15. A Koch Snowflake has 768 sides. Which step has been completed?
A. Step 3
B. Step 4
C. Step 5
D. Step 6
Answer: B. Step 4
16. By what factor does the perimeter of a Koch Snowflake increase from one step to the next?
A. 1/3
B. 3/4
C. 4/3
D. 4
Answer: C. 4/3
17. A prism has an octagonal base. How many edges does it have?
A. 16
B. 20

C. 24
D. 32
Answer: C. 24

18. A prism has a base with n sides. Which expression gives its number of faces?
A. n + 1
B. n + 2
C. 2n
D. 3n
Answer: B. n + 2

19. A prism has 18 edges. How many sides does each base have?
A. 5
B. 6
C. 9
D. 12
Answer: B. 6

20. A pyramid has a nonagonal base. How many edges does it have?
A. 9
B. 10
C. 18
D. 27
Answer: C. 18

21. A pyramid has 10 faces. How many sides does its base have?
A. 8
B. 9
C. 10
D. 12
Answer: B. 9

22. How many faces, edges and vertices does a cube have, respectively?
A. 6, 12, 8
B. 6, 8, 12
C. 8, 12, 6
D. 12, 6, 8
Answer: A. 6, 12, 8

23. An octahedron can be formed by joining two:
A. Triangular prisms at their bases
B. Square pyramids at their square bases
C. Cubes at one face
D. Cones at their circular bases
Answer: B. Square pyramids at their square bases

24. How many different nets does a cube have when rotations and flips are counted as the same?
A. 6
B. 8
C. 11
D. 12
Answer: C. 11

25. How many possible nets does a regular tetrahedron have?
A. 2
B. 4
C. 6

D. 11
Answer: A. 2

26. How many different nets does a dodecahedron have?
A. 11
B. 20
C. 120
D. 43,380
Answer: D. 43,380

27. A straight path on a cuboid net forms a right triangle with sides 6 cm and 8 cm. What is the path length?
A. 10 cm
B. 12 cm
C. 14 cm
D. 48 cm
Answer: A. 10 cm

28. A route on a cuboid net forms a right triangle with sides 9 cm and 12 cm. What is the straight-line distance?
A. 13 cm
B. 15 cm
C. 18 cm
D. 21 cm
Answer: B. 15 cm

29. Two valid cuboid nets give straight routes of 10 cm and 13 cm between the same points. Which route is shorter?
A. 10 cm
B. 13 cm
C. Both are equal
D. The information is insufficient
Answer: A. 10 cm

30. A straight line drawn on an unfolded cuboid passes outside the net. What can be concluded?
A. It is always the shortest path.
B. It represents a path through the cuboid's interior.
C. It is not a valid path on the cuboid's surface.
D. It proves that the cuboid has no net.
Answer: C. It is not a valid path on the cuboid's surface.

31. A cylinder has a base radius of 7 cm. Using $\pi = 22/7$, what is the length of the rectangular part of its net?
A. 14 cm
B. 22 cm
C. 44 cm
D. 154 cm
Answer: C. 44 cm

32. A cylinder has radius 3.5 cm and height 12 cm. Using $\pi = 22/7$, what are the dimensions of the rectangular part of its net?
A. 11 cm by 12 cm
B. 22 cm by 12 cm
C. 44 cm by 12 cm
D. 22 cm by 7 cm
Answer: B. 22 cm by 12 cm

33. The front view of a solid is projected onto which plane?
    A. Horizontal plane
    B. Vertical plane
    C. Side plane
    D. Isometric plane
    Answer: B. Vertical plane
34. The top view of a solid is projected onto which plane?
    A. Horizontal plane
    B. Vertical plane
    C. Side plane
    D. Curved plane
    Answer: A. Horizontal plane
35. Which three directions are represented in an isometric drawing?
    A. Front, back and centre
    B. Length, depth and height
    C. Top, bottom and side
    D. Width, angle and area
    Answer: B. Length, depth and height
36. In an isometric projection of a cube, the projected lengths of the edges are:
    A. All equal
    B. All different
    C. Equal only on the front face
    D. Proportional to the face areas
    Answer: A. All equal
37. The isometric representation of a cube appears as a regular:
    A. Pentagon
    B. Hexagon
    C. Octagon
    D. Rectangle
    Answer: B. Hexagon
38. When parallel lines are projected onto a plane, they generally appear as:
    A. Perpendicular lines
    B. Curved lines
    C. Parallel lines
    D. Intersecting lines
    Answer: C. Parallel lines
39. Which artwork by M. C. Escher is mentioned in the chapter as showing repeated patterns at smaller scales?
    A. “The Cube”
    B. “Smaller and Smaller”
    C. “The Net”
    D. “The Projection”
    Answer: B. “Smaller and Smaller”
40. Which statement best describes self-similarity in a fractal?
    A. The shape has no repeated parts.
    B. The same or a similar pattern appears at smaller scales.
    C. The shape can only be seen from above.
    D. The pattern consists only of straight lines.
    Answer: B. The same or a similar pattern appears at smaller scales.

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

BEST PRACTICES FOR TEACHING "EXPLORING SOME GEOMETRIC THEMES":

(1) **Begin with familiar examples.** Invite students to identify repeating patterns in ferns, trees, clouds, coastlines, temple designs and textiles before introducing the term "fractal."
(2) **Build fractal patterns step by step.** Have students draw the Sierpinski Carpet and Gasket from Step 0 onward, predicting what changes at each stage.
(3) **Use "predict, draw, check."** Before displaying the next stage of a fractal, ask students to predict the number of shapes or holes, then draw and check their answer.
(4) **Connect diagrams to number patterns.** Guide students to record the remaining squares, triangles and holes at each step in a table, then describe how the counts change.
(5) **Use paper cut-outs to explore triangles.** Students can mark side midpoints, join them and compare the four triangles to understand the Sierpinski Gasket construction.
(6) **Model the Koch Snowflake with a ruler.** Ask students to divide each side into three equal parts and add the "bump" carefully, helping them see how the pattern develops.
(7) **Let students make and fold nets.** Provide paper copies of cube, prism, pyramid and cylinder nets for students to cut, fold and test.
(8) **Use hands-on models for faces, edges and vertices.** Ask students to label these features on constructed solids and compare the shapes of different solids.
(9) **Investigate shortest paths with nets.** Mark two points on a cuboid model, unfold it in different ways, and compare the straight-line routes on the nets.
(10) **Teach projections using real objects.** Place a box or classroom object on a desk and have students sketch its front, top and side views from the correct directions.
(11) **Use isometric grid paper for drawing practice.** Demonstrate how the grid's three directions represent length, depth and height, then guide students in drawing cubes and joined-cube shapes.
(12) **Use pair explanations and math vocabulary.** Have students explain terms such as *fractal*, *self-similarity*, *net*, *projection* and *isometric* to a partner using an example.
(13) **Connect the chapter to local and cultural examples.** Discuss the fractal-like patterns in the Kandariya Mahadev Temple and compare them with repeated patterns in textiles and artwork.
(14) **Check understanding throughout the lesson.** Use short questions, quick sketches, exit tickets or a "show me" response to find misconceptions before moving to the next concept.
(15) **Offer tasks at different levels.** Provide guided templates for students who need support, and ask confident learners to predict later stages or design their own repeating pattern.

4.16 Innovations Opportunity List from the Chapter: (14 Ideas)

INNOVATIONS IN TEACHING–LEARNING:

(1) **Create a classroom fractal wall.** Each student adds one part of a class Sierpinski Carpet, building the pattern collaboratively and discussing how it grows at each step.
(2) **Make a stop-motion fractal video.** Students photograph each stage of a Sierpinski Gasket or Koch Snowflake and combine the images to show the pattern developing.
(3) **Use a simple coding activity.** Students create a repeating pattern using block-based coding or a spreadsheet, changing the number of iterations to explore how the shape and counts change.

(4) **Run a "fractal detective" photo task.** Students photograph or sketch repeated patterns in plants, architecture, textiles or everyday objects, then explain what makes each pattern similar across scales.
(5) **Build a human Sierpinski Triangle.** Students form a large triangle on the playground, mark its midpoint divisions with ropes or chalk, and identify the central triangle to be removed at each stage.
(6) **Create a digital net-folding challenge.** Students use a simple presentation, drawing app or interactive geometry tool to test which flat arrangements can fold into cubes and other solids.
(7) **Set up a shortest-path escape challenge.** Place a "start" and "destination" marker on a box; teams unfold paper models in different ways and compare possible routes across the surface.
(8) **Design an isometric cube sculpture.** Students draw a 3D object on isometric grid paper, then use small blocks or recycled boxes to build and check the model.
(9) **Make a projection-view guessing game.** Show the front, top and side views of a simple cube arrangement and ask teams to build or sketch a solid that matches them.
(10) **Connect geometry with local art and architecture.** Students create a poster comparing self-similar patterns in the chapter's examples with patterns they observe in local temples, buildings or textiles.
(11) **Create a "math museum" display.** Teams exhibit a fractal drawing, a folded net, a solid model or an isometric sketch, with a short label explaining the mathematical idea behind it.
(12) **Use a QR-code learning trail.** Place QR codes around the classroom that lead to short prompts, diagrams or student-made explanations on fractals, nets, shortest paths and projections.
(13) **Invite students to invent a pattern rule.** Students choose a starting shape and a repeat operation, then present the first few stages and explain how their pattern changes.
(14) **Use a digital or physical "spot the error" task.** Present a net that will not fold into the intended solid or an inaccurate isometric drawing, and ask students to find and correct the mistake.

4.17: Practicing Questions/Question Bank:

QUESTION BANK – EXPLORING SOME GEOMETRIC THEMES:

A. FILL IN THE BLANKS:

1. A shape with a pattern that repeats at smaller scales is called a _____.
   Answer: fractal

2. The Sierpinski Carpet begins with a _____.
   Answer: square

3. At each step of the Sierpinski Carpet construction, each remaining square gives rise to _____ smaller squares.
   Answer: eight

4. In the Sierpinski Gasket, the _____ triangle is removed at each step.
   Answer: central

5. Each side of the starting triangle in the Koch Snowflake is divided into _____ equal parts.
   Answer: three

6. A flat shape that can be folded to form a solid is called a _____.
   Answer: net

7. A cube has _____ vertices.
   Answer: eight

8. An isometric projection shows equal projected lengths along the three main directions of a solid: length, depth and _____.
   Answer: height

B. ONE-MARK DESCRIPTIVE QUESTIONS:

1. What is self-similarity?
   Answer: Self-similarity is the repetition of the same or a similar pattern at smaller scales.

2. Name one natural object that displays a fractal pattern.
   Answer: A fern displays a fractal pattern.

3. What is a vertex of a solid?
   Answer: A vertex is a point where edges meet.

4. What is the shortest path between two points on a flat surface?
   Answer: The shortest path is a straight line.

5. Name the three standard views used to represent a solid.
   Answer: The front view, top view and side view are the three standard views.

6. What is a triangular pyramid also called?
   Answer: A triangular pyramid is also called a tetrahedron.

C. TWO-MARK DESCRIPTIVE QUESTIONS:

1. Describe how the Sierpinski Carpet is started.
   Answer:
   (i) Divide a square into nine equal smaller squares.
   (ii) Remove the central square.

2. State two features of a prism.
   Answer:
   (i) A prism has two congruent polygonal faces opposite each other.
   (ii) Its other faces are parallelograms.

3. How can a net help find the shortest path on a cuboid?
   Answer:
   (i) Unfold the cuboid into a suitable net.
   (ii) Find the straight-line path between the points on the net.

4. What are the front view and top view of an object projected onto?
   Answer:
   (i) The front view is projected onto the vertical plane.
   (ii) The top view is projected onto the horizontal plane.

5. How does the Koch Snowflake change at each step?
   Answer:
   (i) Each side is replaced by four smaller sides.
   (ii) Each new side is one-third the length of the side it replaces.

D. THREE-MARK DESCRIPTIVE QUESTIONS:

1. Explain how to construct the Sierpinski Gasket.
   Answer:
   (i) Begin with an equilateral triangle.
   (ii) Join the midpoints of its sides to divide it into four equal triangles.
   (iii) Remove the central triangle and repeat the process on the remaining triangles.

2. A prism has a pentagonal base. How many faces, edges and vertices does it have?
   Answer:
   (i) It has seven faces: five side faces and two pentagonal bases.
   (ii) It has 15 edges.
   (iii) It has 10 vertices.

3. A route on a cuboid net forms a right triangle with sides 5 cm and 12 cm. Find the route length.
   Answer:
   (i) Use the Pythagorean theorem: $d^2 = 5^2 + 12^2$.
   (ii) Therefore, $d^2 = 25 + 144 = 169$.
   (iii) The route length is 13 cm.

4. What are the three principal directions shown in an isometric drawing, and what is one useful feature of the projection?
   Answer:
   (i) The directions are length, depth and height.
   (ii) The projected lengths along these directions are equal.
   (iii) This helps represent a solid clearly on a flat grid.

E. FIVE-MARK DESCRIPTIVE QUESTIONS:

1. Describe how to construct the Koch Snowflake.
   Answer:
   (i) Begin with an equilateral triangle.
   (ii) Divide each side into three equal parts.
   (iii) Construct an equilateral triangle over the middle part of each side.
   (iv) Remove the base of each small triangle to form a bump.
   (v) Repeat the process on all the new sides.

2. Explain how the three standard views help represent a solid.
   Answer:
   (i) The front view is the projection onto the vertical plane.
   (ii) The top view is the projection onto the horizontal plane.
   (iii) The side view is the projection onto the side plane.
   (iv) Each view shows the solid from a different direction.
   (v) Together, the views provide more information about the solid's shape.

3. A Sierpinski Carpet starts with a square of area 81 cm^2. Find the number of remaining squares, the number of holes and the remaining area at Step 2.
   Answer:
   (i) At Step 2, the number of remaining squares is $8^2 = 64$.
   (ii) The holes are $1 + 8 = 9$.
   (iii) The remaining-area fraction is $(8/9)^2 = 64/81$.
   (iv) The remaining area is $81 \times 64/81 = 64$ cm^2.
   (v) Therefore, 64 cm^2 remains, arranged in 64 smaller squares, with 9 holes.

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8th Standard Maths Part 2 Book Chapter 5

Chapter 5: TALES BY DOTS AND LINES

5.1 Summary of the Chapter:

Chapter Summary: "Tales by Dots and Lines":

(1) The **mean (arithmetic average)** represents the balance point of a data set: the total distances of the values on either side of the mean are equal.

(2) Adding a value greater than the current mean increases the mean; adding one below it decreases the mean. A value equal to the mean leaves it unchanged.

(3) If the same number is added to or subtracted from every value, the mean changes by that number. If every value is multiplied by a number, the mean is multiplied by the same number.

(4) The **median** is the middle value after data is arranged in order. When a data set has an even number of values, the median is the average of the two middle values.

(5) Mean and median can change when values are added or removed. The chapter uses examples to show how to find a missing value from a known mean and how an error in data affects an average.

(6) **Frequency tables** record how often each value occurs. To find the mean, multiply each value by its frequency, add the products, and divide by the total frequency.

(7) To find the median from a frequency table, add frequencies in order to locate the middle position or positions in the data.

(8) **Spreadsheets** organise information in rows, columns, and cells. Formulas such as =SUM(B3:G3) and =AVERAGE(B7:D7) can quickly calculate totals and averages.

(9) **Line graphs** show how data changes over time. They are useful for displaying trends, such as changes in temperature, rainfall, or the number of events across years.

(10) To interpret a graph, first identify its title, axes, scale, and plotted data; then describe patterns and draw conclusions supported by the information shown.

(11) **Infographics** combine visual elements and data to communicate information clearly. Readers should check the scale and key before interpreting comparisons or drawing conclusions.

(12) Activity strips can represent how time is spent across a day. Collecting and comparing everyday data—such as sleep, school schedules, or activities—helps learners notice patterns and ask further questions.

5.2 Important Formulas:

IMPORTANT FORMULAS: "TALES BY DOTS AND LINES":

1. Arithmetic Mean:

Mean = Sum of all values / Number of values

2. Sum of Values:

Sum of values = Mean x Number of values

3. Mean Using a Frequency Table:

Mean = Sum of (Value x Frequency) / Sum of frequencies

4. Finding a Missing Value:

Missing value = (Mean x Number of values) - Sum of known values

5. Mean After Adding One Value:

New mean = (n x M + y) / (n + 1)

Here, n = original number of values, M = original mean, and y = added value.

6. Mean After Removing One Value:

New mean = (n x M - y) / (n - 1)

Here, y = removed value.

7. Mean After Adding Several Values:

New mean = (n x M + Sum of added values) / (n + k)
Here, k = number of values added.

8. Adding or Subtracting the Same Number from Every Value:

If c is added to every value:
New mean = M + c
If c is subtracted from every value:
New mean = M - c

9. Multiplying Every Value by the Same Number:

If every value is multiplied by c:
New mean = c x M

10. Correcting a Mean When One Value Was Recorded Incorrectly:

If one value was recorded d too high:
Correct mean = Recorded mean - (d / n)
If one value was recorded d too low:
Correct mean = Recorded mean + (d / n)

11. Median of Ordered Data:

When the number of values, n, is odd:
Median = Value at position (n + 1) / 2
When n is even:
Median = (Value at position n / 2 + Value at position (n / 2 + 1)) / 2

12. Spreadsheet Formulas:

To find the total of a range of cells:
=SUM(start_cell:end_cell)
To find the average of a range of cells:
=AVERAGE(start_cell:end_cell)

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

FILL IN THE BLANKS – LOTS TYPE:

1. The sum of all values divided by the number of values gives the _____.
   Answer: mean
2. The middle value in data arranged in order is the _____.
   Answer: median
3. Before finding the median, the data must be arranged in _____ order.
   Answer: numerical
4. The mean is also called the arithmetic _____.
   Answer: average
5. The mean can be understood as the balance point of a collection of _____.
   Answer: values
6. When a value greater than the current mean is added, the mean generally _____.
   Answer: increases
7. When a value smaller than the current mean is added, the mean generally _____.
   Answer: decreases
8. Adding a value equal to the mean leaves the mean _____.
   Answer: unchanged
9. If the same number is added to every value, the mean increases by that _____.
   Answer: number

10. If every value is multiplied by 5, the mean is also multiplied by _____.
    Answer: 5
11. A value that occurs repeatedly in a data set is counted according to its _____.
    Answer: frequency
12. In a frequency table, the total number of data values is found by adding all the _____.
    Answer: frequencies
13. To find the mean from a frequency table, each value is multiplied by its _____.
    Answer: frequency
14. The mean from a frequency table is calculated by dividing the sum of value-times-frequency products by the total _____.
    Answer: frequency
15. If a data set has an odd number of values, its median is the value in the _____ position.
    Answer: middle
16. If a data set has an even number of values, its median is the average of the two _____ values.
    Answer: middle
17. In an ordered data set of 10 values, the median is the average of the values in the _____ and _____ positions.
    Answer: 5th; 6th
18. The total of a data set can be found by multiplying its mean by the number of _____.
    Answer: values
19. If the mean and number of values are known, their product gives the _____ of the data.
    Answer: sum
20. In the chapter's example, the missing wrestler's weight is found using the known mean and the _____ weights.
    Answer: other
21. If one recorded value is 3 more than the actual value, the correct total is found by _____ 3 from the recorded total.
    Answer: subtracting
22. A spreadsheet is organised into rows and _____.
    Answer: columns
23. The individual boxes in a spreadsheet are called _____.
    Answer: cells
24. Spreadsheet columns are labelled with _____.
    Answer: letters
25. Spreadsheet rows are labelled with _____.
    Answer: numbers
26. The spreadsheet formula =SUM(B3:G3) calculates the _____ of the selected cells.
    Answer: sum
27. The spreadsheet formula =AVERAGE(B7:D7) calculates the _____ of the selected cells.
    Answer: average
28. A range written as B3:G3 identifies the first and last _____ in that range.
    Answer: cells

29. A graph that shows how data changes over time is called a _____ graph.
    Answer: line
30. In a line graph, the horizontal axis often shows the _____ being observed.
    Answer: time
31. In a temperature line graph, temperature may be shown on the _____ axis.
    Answer: vertical
32. A line graph connects plotted data points with line _____.
    Answer: segments
33. A steeper line segment represents a _____ change between two points.
    Answer: greater
34. A line graph is useful for showing patterns and _____ over time.
    Answer: trends
35. Before interpreting a graph, readers should check its axes and _____.
    Answer: scale
36. A key or colour scale helps readers understand the meaning of symbols and _____ in an infographic.
    Answer: colours
37. An infographic presents information using a combination of data and _____ elements.
    Answer: visual
38. Manoj's activity strip divides a full day into 48 boxes, with each box representing _____ minutes.
    Answer: 30
39. An activity strip can show how a person spends time during a _____.
    Answer: day
40. Collecting and examining data can help us notice patterns and ask further _____.
    Answer: questions

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

FILL IN THE BLANKS – HOTS TYPE:

1. The mean of 4, 6, 8, and 10 is 7. If 14 is added, the new mean is _____.
   Answer: 8.4
2. A data set has 5 values and a mean of 12. Its total is _____.
   Answer: 60
3. The mean of 5 values is 8. If one value, 13, is added, the new mean is _____.
   Answer: 8.83 (approximately)
4. The mean of 10 values is 20. If a value of 30 is added, the new mean is _____.
   Answer: 20.91 (approximately)
5. A class has a mean height of 150 cm. A new student whose height is 155 cm joins. The class mean will _____.
   Answer: increase
6. A data set has a mean of 15. Adding two values whose mean is also 15 will _____ the overall mean.
   Answer: leave it unchanged
7. The mean of 8 values is 10. A value of 10 is removed. The new mean is _____.
   Answer: 10
8. A data set has 6 values with a mean of 9. Its total is 54. If a value of 12 is removed, the new mean is _____.
   Answer: 8.4

9. Every value in a data set is increased by 4. If the original mean is 11, the new mean is _____.
   Answer: 15
10. Every value in a data set is decreased by 3. If the original mean is 18, the new mean is _____.
    Answer: 15
11. Every value in a data set is doubled. If the original mean is 7.5, the new mean is _____.
    Answer: 15
12. The mean of 5 numbers is 14. Four numbers add up to 52. The fifth number is _____.
    Answer: 18
13. The mean weight of 10 players is 40 kg. The sum of the weights of 9 players is 356 kg. The tenth player weighs _____.
    Answer: 44 kg
14. A harvest total of 384 coconuts was calculated using an incorrect count that was 3 too high. The corrected total is _____.
    Answer: 381
15. The corrected total harvest is 381 coconuts from 15 trees. The correct mean harvest per tree is _____.
    Answer: 25.4 coconuts
16. A recorded mean based on 20 values is 31. One value was recorded 5 too high. The corrected mean is _____.
    Answer: 30.75
17. A frequency table has values 2 and 6, with frequencies 3 and 1 respectively. The mean is _____.
    Answer: 3
18. A frequency table shows the values 4, 6, and 8 with frequencies 2, 3, and 1. The total number of data values is _____.
    Answer: 6
19. In the table from Question 18, the sum of all the data values is _____.
    Answer: 36
20. In the table from Question 18, the mean is _____.
    Answer: 6
21. In a frequency table, the first two values occur 5 and 7 times. The cumulative frequency after these two values is _____.
    Answer: 12
22. In an ordered set of 8 values, the median is calculated using the values in the _____ and _____ positions.
    Answer: 4th; 5th
23. The middle two values of an even-sized data set are 12 and 18. Its median is _____.
    Answer: 15
24. The median of 3, 5, 7, 9, and 11 is 7. If 13 is added, the new median is _____.
    Answer: 8
25. The median of 2, 4, 6, 8, and 10 is 6. If 20 is added, the new median is _____.
    Answer: 7
26. The median of 2, 4, 6, 8, and 10 is 6. If 1 is added, the new median is _____.
    Answer: 5

27. A value much larger than every other value is added to a data set. This will usually affect the _____ more directly than the median.
    Answer: mean
28. A line graph rises from January to June and falls from June to December. The data's highest point occurs in _____.
    Answer: June
29. In a line graph, one line segment is steeper than another over the same time interval. The steeper segment shows a _____ change.
    Answer: greater
30. A graph has monthly values on the horizontal axis and temperature on the vertical axis. The graph is showing how temperature changes with _____.
    Answer: time
31. A line graph shows nearly the same temperature each month. The temperature is relatively _____ over the year.
    Answer: stable
32. A line graph contains many closely spaced data points over time. It can show a trend more clearly than a crowded graph with many _____.
    Answer: columns
33. A graph shows that the number of objects launched worldwide is lower in 2024 than in 2023. The worldwide count did not increase from 2023 to _____.
    Answer: 2024
34. The counts for three countries do not add up to the worldwide count. This suggests that the graph may leave out data from _____ countries.
    Answer: other
35. Monthly rainfall data is averaged across several years. The value for June represents the average rainfall recorded in _____ across those years.
    Answer: June
36. A city's rainfall line reaches its highest point in November. November is the city's rainfall _____ month.
    Answer: peak
37. A strip chart uses 48 equal boxes to show a full day. If each box represents 30 minutes, the full strip represents _____ hours.
    Answer: 24
38. A student's activity strip shows 16 boxes for sleep. At 30 minutes per box, the student slept for _____ hours.
    Answer: 8
39. If two students' daily activity strips show different amounts of sleep, comparing the strips helps identify a difference in their _____ patterns.
    Answer: daily
40. A graph's scale begins at a value other than zero. Readers should check the scale carefully before making _____ between the values.
    Answer: comparisons

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

ONE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – LOTS TYPE:

1. What is the arithmetic mean of a set of values?
   Answer: It is the sum of all the values divided by the number of values.
2. What does the mean represent in a data set?
   Answer: The mean represents the balance point of the data.

3. How can the mean be described using distances from its values?
   Answer: The total distances of the values on either side of the mean are equal.
4. What is the median of a data set?
   Answer: The median is the middle value when the data is arranged in order.
5. How should data be arranged before finding its median?
   Answer: The data should be arranged in numerical order.
6. How is the median found when a data set has an even number of values?
   Answer: It is the average of the two middle values.
7. What happens to the mean when a value greater than it is added to the data?
   Answer: The mean increases.
8. What happens to the mean when a value less than it is added to the data?
   Answer: The mean decreases.
9. What happens to the mean when a value equal to it is added?
   Answer: The mean remains unchanged.
10. What happens to the mean if the same number is added to every value?
    Answer: The mean increases by that number.
11. What happens to the mean if the same number is subtracted from every value?
    Answer: The mean decreases by that number.
12. What happens to the mean if every value is doubled?
    Answer: The mean is also doubled.
13. What is meant by the frequency of a value?
    Answer: Frequency is the number of times that value occurs in the data.
14. What does a frequency table show?
    Answer: It shows each data value and how many times it occurs.
15. How do you find the total number of values from a frequency table?
    Answer: Add all the frequencies in the table.
16. How is the mean calculated from a frequency table?
    Answer: Multiply each value by its frequency, add the products, and divide by the total frequency.
17. How is the median located using a frequency table?
    Answer: Add the frequencies in order to locate the middle position or positions.
18. What information is needed to find the sum of a data set from its mean?
    Answer: The mean and the number of values are needed.
19. How can a missing value be found when the mean is known?
    Answer: Subtract the sum of the known values from the product of the mean and the number of values.
20. What was the missing wrestler's weight in the chapter's example?
    Answer: The missing weight was 43 kilograms.
21. What was the corrected average coconut harvest per tree in the chapter's example?
    Answer: The corrected average was 25.4 coconuts per tree.
22. What is a spreadsheet?
    Answer: A spreadsheet is a digital tool that organises information in rows and columns.
23. What are the small boxes in a spreadsheet called?
    Answer: They are called cells.
24. How are spreadsheet columns labelled?
    Answer: Spreadsheet columns are labelled with letters.
25. How are spreadsheet rows labelled?
    Answer: Spreadsheet rows are labelled with numbers.

26. What does the spreadsheet formula =SUM(B3:G3) calculate?
    Answer: It calculates the sum of the values in cells B3 through G3.
27. What does the spreadsheet formula =AVERAGE(B7:D7) calculate?
    Answer: It calculates the average of the values in cells B7 through D7.
28. What is a line graph used to show?
    Answer: A line graph shows how data changes over time.
29. What does the horizontal axis commonly represent in a time-based line graph?
    Answer: It commonly represents time.
30. What does the vertical axis show in a temperature line graph?
    Answer: It shows temperature.
31. What do line segments connect in a line graph?
    Answer: They connect the plotted data points.
32. What does a steeper line segment indicate?
    Answer: It indicates a greater change between two data points.
33. Why is a line graph useful for showing many data points over time?
    Answer: It displays trends clearly without making the graph look crowded.
34. What should be checked before interpreting a graph?
    Answer: The title, axes, scale, and plotted data should be checked.
35. What is an infographic?
    Answer: An infographic presents information through visual elements and data.
36. What does a colour scale in an infographic explain?
    Answer: It explains what the different colours or shades represent.
37. What does an activity strip represent?
    Answer: It represents how a person spends time during a day.
38. How many boxes did Manoj use to represent a full day in his activity strip?
    Answer: He used 48 boxes.
39. How much time did each box in Manoj's activity strip represent?
    Answer: Each box represented 30 minutes.
40. What can examining data help learners do?
    Answer: It can help them notice patterns, draw conclusions, and ask further questions.

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

ONE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – HOTS TYPE:

1. A data set has 5 values and a mean of 12; what is the sum of the values?
   Answer: The sum is 60.
2. The mean of 4, 6, 8, and 10 is 7; what is the new mean after adding 12?
   Answer: The new mean is 8.
3. The mean of 5 numbers is 10; what is the new mean if 10 is added?
   Answer: The mean remains 10.
4. A class average is 150 cm, and a new student is taller than 150 cm; what happens to the class average?
   Answer: The class average increases.
5. A data set has 6 values with a mean of 9; what is its total sum?
   Answer: The total sum is 54.
6. The mean of 4 values is 8, and three values total 21; what is the fourth value?
   Answer: The fourth value is 11.
7. A set of 10 values has a mean of 25; what is its mean if 3 is added to every value?
   Answer: The new mean is 28.

8. A set has a mean of 18; what is its new mean if each value is reduced by 2?
   Answer: The new mean is 16.
9. A set has a mean of 6; what is its new mean if every value is multiplied by 4?
   Answer: The new mean is 24.
10. A mean of 20 was calculated from 5 values; what is the new mean if a value of 30 is added?
    Answer: The new mean is approximately 21.67.
11. The mean of 5 values is 8; if one value equal to 8 is removed, what is the new mean?
    Answer: The mean remains 8.
12. A recorded total is 100, but one value was recorded 4 too high; what is the corrected total?
    Answer: The corrected total is 96.
13. One measurement in a group of 10 was recorded 2 units too high; by how much is the recorded mean too high?
    Answer: The recorded mean is 0.2 units too high.
14. The ordered data are 2, 4, 6, 8, and 10; what is the median?
    Answer: The median is 6.
15. The ordered data are 3, 5, 7, and 9; what is the median?
    Answer: The median is 6.
16. The median of five ordered values is 12; which position contains the median?
    Answer: The median is in the third position.
17. The middle values of an even-sized ordered data set are 10 and 16; what is the median?
    Answer: The median is 13.
18. The ordered data are 2, 4, 6, 8, and 10; what is the new median after adding 20?
    Answer: The new median is 7.
19. The ordered data are 2, 4, 6, 8, and 10; what is the new median after adding 1?
    Answer: The new median is 5.
20. A value much greater than all the others is added to a data set; which measure, mean or median, is usually affected more?
    Answer: The mean is usually affected more.
21. Values 2 and 6 occur 3 times and 1 time respectively; what is their mean?
    Answer: Their mean is 3.
22. In a frequency table, values 4, 6, and 8 have frequencies 2, 3, and 1; how many observations are there?
    Answer: There are 6 observations.
23. For the frequency table in Question 22, what is the sum of all observations?
    Answer: The sum is 36.
24. For the frequency table in Question 22, what is the mean?
    Answer: The mean is 6.
25. In an ordered data set of 12 values, which positions are used to find the median?
    Answer: The 6th and 7th positions are used.
26. A line graph rises steadily from January to April; what does this show about the data?
    Answer: The data increased from January to April.
27. A line graph is flat between two months; what does this indicate?
    Answer: The measured value remained unchanged during that interval.
28. One line segment is steeper than another over the same time interval; what does this indicate?
    Answer: It indicates a greater change in the data.

29. A line graph shows the highest point in June; which month has the maximum value?
    Answer: June has the maximum value.
30. A graph's line falls from August to October; what happened to the measured value?
    Answer: The measured value decreased during that period.
31. A line graph shows similar temperatures throughout the year; what can be inferred about the temperature pattern?
    Answer: The temperature remained relatively stable throughout the year.
32. A graph uses different symbols for two cities; why is this helpful?
    Answer: Different symbols help distinguish the cities' data.
33. A worldwide total is larger than the totals shown for three countries; what can be inferred?
    Answer: Other countries' data are included in the worldwide total.
34. A graph shows a sudden rise between two consecutive years; what should be examined to understand the rise?
    Answer: The data sources and events during those years should be examined.
35. Monthly rainfall figures are averaged over several years; what does the June figure represent?
    Answer: It represents the average rainfall recorded in June across those years.
36. A city's rainfall graph peaks in November; when does the city receive its greatest average rainfall?
    Answer: It receives its greatest average rainfall in November.
37. Manoj's activity strip has 48 boxes, each representing 30 minutes; how many hours does the strip represent?
    Answer: The strip represents 24 hours.
38. A student's activity strip shows 12 half-hour boxes for sleep; how long did the student sleep?
    Answer: The student slept for 6 hours.
39. Two people's activity strips show different sleep durations; what can be compared using the strips?
    Answer: Their daily sleep patterns can be compared.
40. An infographic uses a colour scale from negative to positive values; what should a reader check before comparing regions?
    Answer: The reader should check what the colour scale's values represent.

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

TWO-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – LOTS TYPE:

1. How is the mean of a set of numbers calculated?
   Answer: Add all the numbers to find their sum. Divide the sum by the number of values.
2. How do you find the median of a data set with an odd number of values?
   Answer: Arrange the values in numerical order. The value in the middle position is the median.
3. How do you find the median of a data set with an even number of values?
   Answer: Arrange the values in numerical order. Find the average of the two middle values.
4. What does the mean show about the distribution of values?
   Answer: The mean acts as a balance point for the data. The total distances on its two sides are equal.

5. What happens to the mean when a value greater than it is added to the data?
   Answer: The added value is above the current mean. The mean increases.
6. What happens to the mean when a value less than it is added to the data?
   Answer: The added value is below the current mean. The mean decreases.
7. What happens to the mean when a value equal to it is added?
   Answer: The added value is equal to the current mean. The mean remains unchanged.
8. How does adding the same number to every value affect the mean?
   Answer: Every value becomes greater by the same amount. The mean increases by that amount.
9. How does subtracting the same number from every value affect the mean?
   Answer: Every value becomes smaller by the same amount. The mean decreases by that amount.
10. How does multiplying all the values by the same number affect the mean?
    Answer: Each value is multiplied by that number. The mean is multiplied by the same number.
11. How can you find the sum of a data set if its mean and number of values are known?
    Answer: Identify the mean and the number of values. Multiply them to find the sum.
12. How can you find an unknown value when the mean is known?
    Answer: Multiply the mean by the number of values to find the total. Subtract the sum of the known values.
13. What is the frequency of a value in a data set?
    Answer: Frequency is the number of times a value occurs. A frequency table records this count.
14. How do you calculate the mean from a frequency table?
    Answer: Multiply each value by its frequency and add the products. Divide by the total frequency.
15. How can a frequency table help you find the median?
    Answer: Add the frequencies in order from the smallest value. Use the cumulative totals to locate the middle position or positions.
16. What is a spreadsheet cell?
    Answer: A cell is one box in a spreadsheet. It can contain text, a number, or a formula.
17. How are rows and columns labelled in a spreadsheet?
    Answer: Columns are labelled with letters. Rows are labelled with numbers.
18. What does a spreadsheet formula beginning with =SUM do?
    Answer: It adds the values in the specified cells. The result is displayed in the cell containing the formula.
19. What does a spreadsheet formula beginning with =AVERAGE do?
    Answer: It calculates the average of the values in the specified cells. The result is displayed in the formula cell.
20. What does a cell range such as B3:G3 represent?
    Answer: It identifies a range of cells from B3 to G3. The range includes the cells between these two endpoints.
21. What is the main purpose of a line graph?
    Answer: A line graph displays data values in visual form. It is commonly used to show changes over time.
22. What is usually shown on the horizontal axis of a line graph about change over time?
    Answer: The horizontal axis usually shows time. It may be labelled with days, months, or years.

23. What is usually shown on the vertical axis of a line graph?
    Answer: The vertical axis shows the quantity being measured. The scale helps readers estimate its values.
24. What do the lines in a line graph connect?
    Answer: The lines connect the plotted data points. They help show how the data changes between points.
25. What does an upward line segment usually show?
    Answer: An upward segment shows an increase in the data. Its steepness indicates how large the change is.
26. What does a downward line segment usually show?
    Answer: A downward segment shows a decrease in the data. Its steepness indicates how large the change is.
27. Why should you check the scale when reading a graph?
    Answer: The scale shows the values represented by the intervals. Checking it helps prevent incorrect estimates.
28. What is an infographic?
    Answer: An infographic presents information using visual elements and data. It can make information easier to understand.
29. What does a colour scale explain in an infographic?
    Answer: It shows what different colours or shades represent. Readers use it to interpret the displayed data.
30. How did Manoj represent activities during a full day?
    Answer: He used an activity strip divided into 48 boxes. Each box represented 30 minutes.

5.8. Two-mark questions with Answers of HOTS Type: (30 Questions)

TWO-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – HOTS TYPE:

1. A data set has 6 values and a mean of 10; what is the new mean after adding 16?
   Answer: The original total is $6 \times 10 = 60$. The new mean is $(60 + 16) \div 7$, or approximately 10.86.
2. A set of 4 values has a mean of 12; what is the new mean after adding 4?
   Answer: The original total is $4 \times 12 = 48$. The new mean is $(48 + 4) \div 5$, or 10.4.
3. A set of 7 values has a mean of 9; what is the mean after removing a value of 16?
   Answer: The original total is $7 \times 9 = 63$. The new mean is $(63 - 16) \div 6$, or approximately 7.83.
4. A data set has a mean of 14; what happens to the mean if values 10 and 18 are added?
   Answer: The two added values have a mean of 14. Therefore, the overall mean remains 14.
5. The mean of a data set is 8; what is the new mean if every value is multiplied by 3?
   Answer: Multiplying every value by 3 also multiplies the mean by 3. The new mean is 24.
6. The mean of a data set is 6; what is the new mean if 2 is added to every value?
   Answer: Adding 2 to every value increases the mean by 2. The new mean is 8.
7. Five values have a mean of 20; four of the values add up to 78; what is the fifth value?
   Answer: The total of all five values is $5 \times 20 = 100$. The fifth value is $100 - 78 = 22$.
8. The mean of 12 recorded values is 25; one value was recorded 6 too high; what is the corrected mean?

Answer: The recorded total is 12 × 25 = 300, so the corrected total is 300 − 6 = 294. The corrected mean is 294 ÷ 12 = 24.5.

9. The ordered data are 3, 5, 7, 9, and 11; what is the median after adding 15?
   Answer: The six values in order are 3, 5, 7, 9, 11, and 15. The median is (7 + 9) ÷ 2 = 8.
10. The ordered data are 3, 5, 7, 9, and 11; what is the median after adding 1?
    Answer: The six values in order are 1, 3, 5, 7, 9, and 11. The median is (5 + 7) ÷ 2 = 6.
11. The data are 2, 4, 6, 8, and 10; what is the median after removing 2?
    Answer: The remaining ordered values are 4, 6, 8, and 10. The median is (6 + 8) ÷ 2 = 7.
12. Values 2, 4, and 6 have frequencies 2, 3, and 1; what is their mean?
    Answer: The weighted total is (2 × 2) + (4 × 3) + (6 × 1) = 22. The total frequency is 6, so the mean is 22 ÷ 6, or approximately 3.67.
13. Values 3, 5, and 7 have frequencies 2, 4, and 2; what is the median?
    Answer: There are 8 values, so the middle positions are the 4th and 5th. Both positions contain 5, so the median is 5.
14. A class mean is 150 cm; a student measuring 160 cm joins the class; what happens to the mean?
    Answer: The new student's height is greater than the original mean. The class mean increases.
15. A class mean is 150 cm; a student measuring 140 cm joins the class; what happens to the mean?
    Answer: The new student's height is less than the original mean. The class mean decreases.
16. Two values have a mean of 8, and one value is 5; what is the other value?
    Answer: The sum of the two values is 2 × 8 = 16. The other value is 16 − 5 = 11.
17. The average of 15 tree harvest counts is 25.6; one recorded count was 3 too high; what is the corrected average?
    Answer: Correcting the total reduces it by 3 coconuts. The mean decreases by 3 ÷ 15 = 0.2, giving a corrected average of 25.4.
18. A data set contains 10 values with a mean of 12; what is its mean if 5 is added to every value?
    Answer: Adding 5 to every value increases the mean by 5. The new mean is 17.
19. A data set contains 10 values with a mean of 12; what is its mean if every value is doubled?
    Answer: Doubling every value doubles the mean. The new mean is 24.
20. A line graph rises steadily from January to April and then falls until June; during which month does the data reach its highest point?
    Answer: The graph rises up to April, so the value is highest at that point. The highest month is April.
21. A line graph is flat from March to May; what does this indicate about the measured values?
    Answer: A flat segment shows no change between the plotted points. The measured values remained the same over that interval.
22. Two line segments cover the same time interval, but one is steeper; what does the steeper segment indicate?
    Answer: The steeper segment shows a larger change in the measured value. Its direction indicates whether the value increased or decreased.

23. A graph shows a city's rainfall peaking in November; what can be concluded about November?
    Answer: November has the highest plotted rainfall value for that city. It is the peak rainfall month shown.
24. A line graph shows temperature changing little throughout the year; what kind of pattern does this suggest?
    Answer: The temperature is relatively stable across the year. There is little variation between the monthly values.
25. A spreadsheet lists a student's marks in cells B3:G3; which formula would calculate the total?
    Answer: The cell range B3:G3 contains the student's marks. The formula =SUM(B3:G3) calculates their total.
26. A spreadsheet lists marks in cells B7:D7; which formula would calculate their average?
    Answer: The cell range B7:D7 contains the marks to be averaged. The formula =AVERAGE(B7:D7) calculates their average.
27. A graph shows data for three countries, but their values do not add up to the worldwide total; what is a reasonable explanation?
    Answer: The graph may show only selected countries. The worldwide total can include other countries' data too.
28. A line graph has many yearly data points; why might it be clearer than a clustered column graph for the same information?
    Answer: A clustered column graph would require many bars. A line graph makes the overall trend easier to follow.
29. Manoj's activity strip contains 48 boxes, each representing 30 minutes; how many hours does the strip represent?
    Answer: The strip represents 48 × 30 = 1,440 minutes. This is 24 hours.
30. A student's activity strip shows 14 boxes for sleep, with each box representing 30 minutes; how long did the student sleep?
    Answer: The sleep time is 14 × 30 = 420 minutes. This equals 7 hours.

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

THREE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – LOTS TYPE:

1. Find the mean of 4, 6, and 8.
   Answer:
   Step 1: Add the values: 4 + 6 + 8 = 18.
   Step 2: Count the values: there are 3.
   Step 3: Divide the sum by the count: 18 ÷ 3 = 6.
2. Find the median of 3, 9, and 5.
   Answer:
   Step 1: Arrange the values in order: 3, 5, 9.
   Step 2: Identify the middle value.
   Step 3: The median is 5.
3. Find the median of 2, 4, 8, and 10.
   Answer:
   Step 1: The values are already in order.
   Step 2: The middle values are 4 and 8.
   Step 3: Their average is (4 + 8) ÷ 2 = 6, so the median is 6.

4. Find the sum of 5 values whose mean is 12.
   Answer:
   Step 1: Note the mean, which is 12.
   Step 2: Note the number of values, which is 5.
   Step 3: Multiply: $12 \times 5 = 60$.
5. Find the missing value in 4, 6, and x if their mean is 6.
   Answer:
   Step 1: The required total is $6 \times 3 = 18$.
   Step 2: The known values add up to $4 + 6 = 10$.
   Step 3: The missing value is $18 - 10 = 8$.
6. The mean of 4 values is 10; find the new mean after adding 14.
   Answer:
   Step 1: The original total is $4 \times 10 = 40$.
   Step 2: The new total is $40 + 14 = 54$, and there are now 5 values.
   Step 3: The new mean is $54 \div 5 = 10.8$.
7. What happens to the mean if 3 is added to every value in a set whose mean is 8?
   Answer:
   Step 1: The original mean is 8.
   Step 2: Every value increases by 3.
   Step 3: The new mean is $8 + 3 = 11$.
8. What happens to the mean if each value in a set with mean 7 is doubled?
   Answer:
   Step 1: The original mean is 7.
   Step 2: Every value is multiplied by 2.
   Step 3: The new mean is $7 \times 2 = 14$.
9. Values 2 and 4 occur 3 and 1 times respectively; find the mean.
   Answer:
   Step 1: Multiply each value by its frequency: $(2 \times 3) + (4 \times 1) = 10$.
   Step 2: Add the frequencies: $3 + 1 = 4$.
   Step 3: Divide 10 by 4; the mean is 2.5.
10. Find the total number of values in a frequency table with frequencies 5, 8, and 3.
    Answer:
    Step 1: Note the frequencies: 5, 8, and 3.
    Step 2: Add them: $5 + 8 + 3 = 16$.
    Step 3: The table represents 16 values.
11. Find the median of the ordered values 1, 3, 5, 7, and 9.
    Answer:
    Step 1: Count the values; there are 5.
    Step 2: Identify the middle, or third, position.
    Step 3: The median is 5.
12. Find the median of the ordered values 4, 6, 8, and 12.
    Answer:
    Step 1: The two middle values are 6 and 8.
    Step 2: Add them: $6 + 8 = 14$.
    Step 3: Divide by 2; the median is 7.
13. Explain how to find the mean from a frequency table.
    Answer:
    Step 1: Multiply each value by its frequency.
    Step 2: Add the products and add the frequencies.
    Step 3: Divide the sum of the products by the total frequency.

14. Explain how to use cumulative frequency to find a median.
    Answer:
    Step 1: Arrange the data values from smallest to largest.
    Step 2: Add the frequencies successively to locate the middle position or positions.
    Step 3: Identify the value or values at those positions to find the median.
15. Describe how rows, columns, and cells are identified in a spreadsheet.
    Answer:
    Step 1: Spreadsheet columns are labelled with letters.
    Step 2: Spreadsheet rows are labelled with numbers.
    Step 3: Each box at a row and column intersection is a cell.
16. Give the spreadsheet formulas for finding a total and an average.
    Answer:
    Step 1: Use =SUM(start_cell:end_cell) to add a range of values.
    Step 2: Use =AVERAGE(start_cell:end_cell) to calculate the mean of a range.
    Step 3: Replace the range with the required cell references.
17. Describe the main parts of a line graph.
    Answer:
    Step 1: The horizontal axis commonly shows time.
    Step 2: The vertical axis shows the quantity being measured.
    Step 3: Line segments connect the plotted data points.
18. State three steps for interpreting a line graph.
    Answer:
    Step 1: Read the graph title and identify what the axes represent.
    Step 2: Check the scale and read the plotted values.
    Step 3: Describe the pattern or change shown by the line.
19. Explain what rising, falling, and flat line segments show.
    Answer:
    Step 1: A rising segment shows an increase in the data.
    Step 2: A falling segment shows a decrease in the data.
    Step 3: A flat segment shows that the value remains unchanged.
20. Describe how Manoj represented activities during a full day.
    Answer:
    Step 1: He divided a strip into 48 boxes.
    Step 2: Each box represented 30 minutes.
    Step 3: The complete strip represented 24 hours.

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

THREE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – HOTS TYPE:

1. A data set has 5 values with a mean of 12; find the new mean after adding 18.
   Answer:
   Step 1: The original sum is $5 \times 12 = 60$.
   Step 2: The new sum is $60 + 18 = 78$, and there are 6 values.
   Step 3: The new mean is $78 \div 6 = 13$.
2. A data set has a mean of 14; explain what happens to the mean when 10 and 18 are added.
   Answer:
   Step 1: The mean of the two added values is $(10 + 18) \div 2 = 14$.
   Step 2: Their mean matches the original mean.
   Step 3: Therefore, the overall mean remains 14.

3. Six values have a mean of 9; find the new mean if a value of 15 is removed.
   Answer:
   Step 1: The original sum is $6 \times 9 = 54$.
   Step 2: After removing 15, the sum is 39 and 5 values remain.
   Step 3: The new mean is $39 \div 5 = 7.8$.
4. Twenty-four students' average height is 150.2 cm, but their shoes added 1 cm to every measurement; find the corrected mean height.
   Answer:
   Step 1: Every recorded height is 1 cm greater than the actual height.
   Step 2: The mean must also be reduced by 1 cm.
   Step 3: The corrected mean is $150.2 - 1 = 149.2$ cm.
5. An average harvest of 25.6 coconuts was recorded for 15 trees, but one tree's count was 3 too high; find the corrected average.
   Answer:
   Step 1: The recorded total is $25.6 \times 15 = 384$ coconuts.
   Step 2: The corrected total is $384 - 3 = 381$ coconuts.
   Step 3: The corrected average is $381 \div 15 = 25.4$ coconuts per tree.
6. The ordered data are 2, 4, 6, 8, and 10; find the new median after adding 14.
   Answer:
   Step 1: The new ordered data are 2, 4, 6, 8, 10, and 14.
   Step 2: The two middle values are 6 and 8.
   Step 3: The new median is $(6 + 8) \div 2 = 7$.
7. The ordered data are 2, 4, 6, 8, and 10; find the new median after adding 1.
   Answer:
   Step 1: The new ordered data are 1, 2, 4, 6, 8, and 10.
   Step 2: The two middle values are 4 and 6.
   Step 3: The new median is $(4 + 6) \div 2 = 5$.
8. Values 3, 5, and 7 have frequencies 2, 4, and 2; find the mean.
   Answer:
   Step 1: The weighted sum is $(3 \times 2) + (5 \times 4) + (7 \times 2) = 40$.
   Step 2: The total frequency is $2 + 4 + 2 = 8$.
   Step 3: The mean is $40 \div 8 = 5$.
9. Values 2, 4, and 6 have frequencies 1, 4, and 3; find the median.
   Answer:
   Step 1: There are 8 values, so the middle positions are the 4th and 5th.
   Step 2: Both positions contain the value 4.
   Step 3: The median is 4.
10. A class mean height is 150.2 cm; two new students are 149 cm and 152 cm tall; determine whether the class mean rises or falls.
    Answer:
    Step 1: The mean of the two new heights is $(149 + 152) \div 2 = 150.5$ cm.
    Step 2: This is greater than the original class mean of 150.2 cm.
    Step 3: Adding them will increase the class mean.
11. A line graph rises from January to April, stays level until June, and then falls; describe the pattern.
    Answer:
    Step 1: The data increases from January to April.
    Step 2: It remains unchanged from April to June.
    Step 3: It decreases after June.

12. Two line segments cover the same time interval, but one is steeper; what can you conclude?
    Answer:
    Step 1: The steeper segment represents a larger change.
    Step 2: The direction of the segment shows whether the value increased or decreased.
    Step 3: Therefore, the steeper segment shows the faster change over that interval.
13. A monthly rainfall graph has its highest point in November; what can you infer?
    Answer:
    Step 1: November has the greatest plotted rainfall value.
    Step 2: It is the peak rainfall month shown on the graph.
    Step 3: The graph does not by itself explain why rainfall peaks then.
14. A line graph shows nearly constant temperatures in one state but large seasonal changes in another; compare the patterns.
    Answer:
    Step 1: The nearly flat line indicates little temperature variation.
    Step 2: The line with larger rises and falls indicates greater variation.
    Step 3: The second state has a wider seasonal temperature range.
15. A graph shows that kerosene use declined over time; can we conclude that there were no power cuts?
    Answer:
    Step 1: The graph provides information about kerosene use.
    Step 2: It does not directly show whether power cuts occurred.
    Step 3: Therefore, the conclusion about power cuts is not supported by that graph alone.
16. An infographic assigns a value of +100 to a state's rice preference; what does this mean?
    Answer:
    Step 1: The value represents the strongest relative preference for rice on the infographic's scale.
    Step 2: It compares per-capita rice and wheat consumption.
    Step 3: It does not mean that the state consumes no wheat.
17. A graph's selected country totals do not add up to its worldwide total; what is a reasonable explanation?
    Answer:
    Step 1: The graph may display only selected countries.
    Step 2: The worldwide total may include other countries.
    Step 3: Therefore, the selected totals need not equal the worldwide total.
18. A clustered column graph would require many bars to show monthly data across several years; why might a line graph be clearer?
    Answer:
    Step 1: A column graph could become crowded with many bars.
    Step 2: A line graph connects the values in time order.
    Step 3: This makes trends and changes easier to follow.
19. A student's activity strip has 18 boxes marked for sleep, with each box representing 30 minutes; find the sleep duration.
    Answer:
    Step 1: Multiply 18 boxes by 30 minutes per box.
    Step 2: The total is 540 minutes.
    Step 3: The student slept for 9 hours.

20. A data set has a mean of 10; every value is increased by 4 and then doubled; find the resulting mean.
    Answer:
    Step 1: Adding 4 changes the mean to 14.
    Step 2: Doubling every value doubles the mean.
    Step 3: The resulting mean is 14 × 2 = 28.

5.11 Five-mark questions with Answers of LOTS Type: (15 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – LOTS TYPE:

1. Find the mean of 6, 8, 10, 12, and 14.
   Answer:
   Step 1: Add the first two values: 6 + 8 = 14.
   Step 2: Add the remaining values: 10 + 12 + 14 = 36.
   Step 3: Find the total: 14 + 36 = 50.
   Step 4: Count the values: there are 5.
   Step 5: Divide 50 by 5; the mean is 10.
2. Find the median of 3, 7, 9, 11, 15, and 17.
   Answer:
   Step 1: Arrange the values in numerical order.
   Step 2: There are 6 values, so the data set has an even number of values.
   Step 3: Identify the two middle positions: the 3rd and 4th.
   Step 4: The values in those positions are 9 and 11.
   Step 5: Their average is 10, so the median is 10.
3. Find the missing value in 6, 8, 10, and x if their mean is 9.
   Answer:
   Step 1: There are 4 values.
   Step 2: The required total is 9 × 4 = 36.
   Step 3: Add the known values: 6 + 8 + 10 = 24.
   Step 4: Subtract the known total from the required total: 36 − 24 = 12.
   Step 5: The missing value is 12.
4. A data set has 6 values and a mean of 15; find the new mean after adding 10.
   Answer:
   Step 1: Find the original total: 6 × 15 = 90.
   Step 2: Add the new value: 90 + 10 = 100.
   Step 3: Count the new number of values: 7.
   Step 4: Divide the new total by 7.
   Step 5: The new mean is 100 ÷ 7, or approximately 14.29.
5. A data set has a mean of 8; find the new mean if 3 is added to every value and then each value is doubled.
   Answer:
   Step 1: The original mean is 8.
   Step 2: Adding 3 to every value changes the mean to 11.
   Step 3: Doubling every value also doubles the mean.
   Step 4: Calculate 11 × 2 = 22.
   Step 5: The resulting mean is 22.
6. Values 2, 4, and 6 have frequencies 2, 3, and 1 respectively; find the mean.
   Answer:
   Step 1: Multiply 2 by its frequency: 2 × 2 = 4.
   Step 2: Multiply 4 by its frequency: 4 × 3 = 12.

Step 3: Multiply 6 by its frequency: 6 × 1 = 6.
Step 4: The weighted sum is 22 and the total frequency is 6.
Step 5: The mean is 22 ÷ 6, or approximately 3.67.

7. Values 2, 4, and 6 have frequencies 2, 5, and 3; find the median.
   Answer:
   Step 1: Add the frequencies: 2 + 5 + 3 = 10 values.
   Step 2: The middle positions are the 5th and 6th.
   Step 3: The first 2 positions contain the value 2.
   Step 4: Positions 3 through 7 contain the value 4.
   Step 5: Both middle values are 4, so the median is 4.
8. The mean of 15 recorded marks is 24; one mark was recorded 6 too high; find the corrected mean.
   Answer:
   Step 1: Find the recorded total: 15 × 24 = 360.
   Step 2: Correct the total by subtracting 6: 360 − 6 = 354.
   Step 3: The number of marks remains 15.
   Step 4: Divide the corrected total by 15.
   Step 5: The corrected mean is 354 ÷ 15 = 23.6.
9. The mean of 5 values is 12; two values, 10 and 14, are added; find the new mean.
   Answer:
   Step 1: The original total is 5 × 12 = 60.
   Step 2: Add the two new values: 10 + 14 = 24.
   Step 3: The new total is 60 + 24 = 84.
   Step 4: There are now 7 values.
   Step 5: The new mean is 84 ÷ 7 = 12.
10. A team of 10 players has an average weight of 39.2 kg; nine players weigh 349 kg altogether; find the tenth player's weight.
    Answer:
    Step 1: Calculate the total weight of the team: 10 × 39.2 = 392 kg.
    Step 2: The nine known players weigh 349 kg altogether.
    Step 3: Subtract 349 from 392.
    Step 4: Calculate 392 − 349 = 43.
    Step 5: The tenth player weighs 43 kg.
11. Explain how to calculate a student's total marks and a subject average in a spreadsheet.
    Answer:
    Step 1: Enter the marks in the appropriate spreadsheet cells.
    Step 2: Identify the cell range for the student's marks.
    Step 3: Use a SUM formula, such as =SUM(B3:G3), to find a total.
    Step 4: Identify the cells containing the subject marks.
    Step 5: Use an AVERAGE formula for that range to find the subject average.
12. Describe how to read a line graph showing a city's monthly temperature.
    Answer:
    Step 1: Read the graph title to identify the information shown.
    Step 2: Check that the horizontal axis shows the months.
    Step 3: Check that the vertical axis shows temperature and its scale.
    Step 4: Read the plotted points and connected line.
    Step 5: Describe when the temperature rises, falls, or stays steady.
13. Compare the temperature patterns for Punjab and Kerala described in the chapter.
    Answer:

Step 1: Punjab's monthly maximum temperature rises from January towards June.
Step 2: Punjab's temperature then generally falls towards December.
Step 3: Kerala's temperature remains fairly steady through the year.
Step 4: Kerala reaches a high around April and a low around July.
Step 5: Punjab shows greater yearly temperature variation than Kerala.

14. Explain how monthly average rainfall data can be prepared and shown in a line graph.
    Answer:
    Step 1: Collect rainfall data for each month over several years.
    Step 2: Group together the readings for the same month.
    Step 3: Calculate the average for each month.
    Step 4: Plot the months on the horizontal axis and rainfall on the vertical axis.
    Step 5: Connect the monthly points to show the pattern.
15. Manoj's activity strip has 48 boxes for a full day; each box represents 30 minutes; find the total time shown and the time represented by 12 boxes.
    Answer:
    Step 1: Multiply 48 boxes by 30 minutes to find the full duration.
    Step 2: The full duration is 1,440 minutes.
    Step 3: Convert 1,440 minutes to hours by dividing by 60.
    Step 4: The strip represents 24 hours, and 12 boxes represent $12 \times 30 = 360$ minutes.
    Step 5: The 12 boxes represent 6 hours.

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

FIVE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – HOTS TYPE:

1. The mean of 8 recorded values is 14, but one value was recorded 3 too high; find the corrected mean.
   Answer:
   Step 1: Find the recorded total: $8 \times 14 = 112$.
   Step 2: Reduce the total by 3 to correct the error.
   Step 3: The corrected total is $112 - 3 = 109$.
   Step 4: The number of values remains 8.
   Step 5: The corrected mean is $109 \div 8 = 13.625$.
2. A group of 12 values has a mean of 25; two values, 20 and 30, are added; find the new mean.
   Answer:
   Step 1: The original total is $12 \times 25 = 300$.
   Step 2: The sum of the added values is $20 + 30 = 50$.
   Step 3: The new total is $300 + 50 = 350$.
   Step 4: There are now 14 values.
   Step 5: The new mean is $350 \div 14 = 25$.
3. The mean of 7 values is 18, and six values add up to 105; find the missing value.
   Answer:
   Step 1: The required total of all 7 values is $7 \times 18 = 126$.
   Step 2: The six known values have a total of 105.
   Step 3: Subtract the known total from the required total.
   Step 4: The missing value is $126 - 105 = 21$.
   Step 5: The value 21 makes the mean equal to 18.
4. A data set has a mean of 10; each value is increased by 4 and then every new value is doubled; find the resulting mean.
   Answer:

Step 1: The original mean is 10.
Step 2: Increasing every value by 4 changes the mean to 14.
Step 3: Doubling every value also doubles the mean.
Step 4: Calculate $14 \times 2 = 28$.
Step 5: The resulting mean is 28.

5. Values 3, 4, and 5 have frequencies 2, 3, and 5 respectively; find the mean.
   Answer:
   Step 1: Multiply 3 by its frequency: $3 \times 2 = 6$.
   Step 2: Multiply 4 by its frequency: $4 \times 3 = 12$.
   Step 3: Multiply 5 by its frequency: $5 \times 5 = 25$.
   Step 4: The weighted total is 43 and the total frequency is 10.
   Step 5: The mean is $43 \div 10 = 4.3$.
6. The ordered data are 3, 5, 7, 9, 11, 13, and 15; find the new median after adding 20.
   Answer:
   Step 1: There are 7 original values, and their median is 9.
   Step 2: Add 20 and keep the data in order.
   Step 3: The new data set has 8 values.
   Step 4: The two middle values are 9 and 11.
   Step 5: The new median is $(9 + 11) \div 2 = 10$.
7. A class has an average height of 150 cm; two new students are 148 cm and 156 cm tall; determine whether the class mean rises or falls.
   Answer:
   Step 1: Find the mean height of the two new students: $(148 + 156) \div 2 = 152$ cm.
   Step 2: Compare 152 cm with the class mean of 150 cm.
   Step 3: The two new students' mean is greater than the class mean.
   Step 4: Adding values above the current mean increases the overall mean.
   Step 5: Therefore, the class mean rises.
8. A line graph shows a state's monthly maximum temperature rising from about 19°C in January to 38°C in June, then falling to about 23°C in December; describe the pattern.
   Answer:
   Step 1: January is the lowest point at about 19°C.
   Step 2: The temperature rises from January to June.
   Step 3: June is the highest point at about 38°C.
   Step 4: The temperature generally falls from June to December.
   Step 5: December ends at about 23°C.
9. Punjab's maximum temperature varies more during the year than Kerala's; explain how a line graph can show this difference.
   Answer:
   Step 1: Identify the temperature scale on the vertical axis.
   Step 2: Observe the distance between the high and low points for each state.
   Step 3: Punjab's line has a wider range between its high and low points.
   Step 4: Kerala's line stays more nearly level through the year.
   Step 5: The graph therefore shows greater annual temperature variation in Punjab.
10. Rainfall graphs show Udupi, Mumbai, and Kovalam peaking from June to August, while Rameswaram peaks from October to December; state what the data suggests.
    Answer:
    Step 1: Identify the months with the highest rainfall for each city.
    Step 2: Udupi, Mumbai, and Kovalam have peaks from June to August.
    Step 3: Rameswaram has its peak from October to December.

Step 4: The cities show different seasonal rainfall patterns.
Step 5: The graph suggests that rainfall timing varies by location.

11. A sleep graph shows about 9.5 hours for 6-year-olds, about 8 hours for adults aged 30–50, and about 8.5 hours after age 50; describe the trend.
    Answer:
    Step 1: The graph begins at about 9.5 hours for 6-year-olds.
    Step 2: Sleep duration decreases as people grow through the teenage years.
    Step 3: It reaches about 8 hours for adults aged 30–50.
    Step 4: It increases to about 8.5 hours after age 50.
    Step 5: The overall trend is a decline followed by a later increase.
12. A spreadsheet stores one student's six subject marks in cells B3:G3; show how to calculate the total and average.
    Answer:
    Step 1: The range B3:G3 contains the six subject marks.
    Step 2: Enter =SUM(B3:G3) to calculate the total.
    Step 3: Enter =AVERAGE(B3:G3) to calculate the average.
    Step 4: The spreadsheet uses the same cells for both calculations.
    Step 5: The formulas update the results when the marks change.
13. A data set contains 70 closely spaced values over time; explain why a line graph may be clearer than a column graph.
    Answer:
    Step 1: A column graph would need a separate column for each value.
    Step 2: Seventy columns could make the display crowded.
    Step 3: A line graph connects the values in time order.
    Step 4: The connected line makes overall patterns easier to see.
    Step 5: Therefore, the line graph is a clearer choice for showing the trend.
14. An activity strip uses 48 boxes for a full day, with each box representing 30 minutes; a student marks 16 boxes for sleep; calculate the sleep duration.
    Answer:
    Step 1: Each box represents 30 minutes.
    Step 2: Multiply 16 boxes by 30 minutes.
    Step 3: The sleep duration is 480 minutes.
    Step 4: Divide 480 by 60 to convert the duration into hours.
    Step 5: The student slept for 8 hours.
15. A graph shows that kerosene use declined over time; explain why this alone cannot prove that power cuts stopped.
    Answer:
    Step 1: The graph provides data about kerosene use.
    Step 2: It does not directly provide data about power cuts.
    Step 3: A decline in kerosene use may have more than one explanation.
    Step 4: The graph does not establish the cause of the decline.
    Step 5: More information is needed to conclude whether power cuts stopped.

5.13 Five-mark questions with Answers of Applied Type: (15 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS WITH ANSWERS – APPLIED TYPE:

1. A student studies for 4, 6, 8, 10, and 12 hours over five days. Find the mean study time per day.
   Answer:
   Step 1: Add the study hours: 4 + 6 + 8 + 10 + 12 = 40.

Step 2: Count the days: there are 5.
Step 3: Use the formula Mean = Sum of values ÷ Number of values.
Step 4: Divide 40 by 5.
Step 5: The mean study time is 8 hours per day.

2. In a class survey, 2 families have 3 members, 4 families have 4 members, and 4 families have 5 members. Find the mean family size.
   Answer:
   Step 1: Calculate the members in the first group: 2 × 3 = 6.
   Step 2: Calculate the members in the second group: 4 × 4 = 16.
   Step 3: Calculate the members in the third group: 4 × 5 = 20.
   Step 4: The total is 42 members across 10 families.
   Step 5: The mean family size is 42 ÷ 10 = 4.2 members.
3. A farmer records harvest counts of 20, 24, 25, 26, and 30 coconuts from five trees. Find the mean harvest per tree.
   Answer:
   Step 1: Add the harvest counts: 20 + 24 + 25 + 26 + 30 = 125.
   Step 2: Count the trees: there are 5.
   Step 3: Divide the total harvest by the number of trees.
   Step 4: Calculate 125 ÷ 5 = 25.
   Step 5: The mean harvest is 25 coconuts per tree.
4. A coach records the weights of 10 players and finds their mean is 39.2 kg. Nine weights total 349 kg; find the missing weight.
   Answer:
   Step 1: Calculate the total weight of all 10 players: 39.2 × 10 = 392 kg.
   Step 2: The nine known weights total 349 kg.
   Step 3: Subtract the known total from the full total.
   Step 4: Calculate 392 − 349 = 43 kg.
   Step 5: The missing player's weight is 43 kg.
5. A class of 20 students has a mean height of 150 cm. Two new students join, with heights of 149 cm and 155 cm; find the new mean height.
   Answer:
   Step 1: The original total height is 20 × 150 = 3,000 cm.
   Step 2: The two new heights total 149 + 155 = 304 cm.
   Step 3: The new total height is 3,000 + 304 = 3,304 cm.
   Step 4: There are now 22 students.
   Step 5: The new mean height is 3,304 ÷ 22 ≈ 150.18 cm.
6. A delivery service records delivery times of 18, 20, 22, 25, 30, and 35 minutes. Find the median delivery time.
   Answer:
   Step 1: Arrange the delivery times in order; they are already ordered.
   Step 2: There are 6 values, so the two middle positions are the 3rd and 4th.
   Step 3: The middle values are 22 and 25 minutes.
   Step 4: Find their average: (22 + 25) ÷ 2 = 23.5.
   Step 5: The median delivery time is 23.5 minutes.
7. A thermometer at each weather station reads 2°C higher than the actual temperature. If the reported mean is 28°C, find the corrected mean.
   Answer:
   Step 1: Every station reading is 2°C too high.
   Step 2: The mean is also 2°C too high.
   Step 3: Subtract 2°C from the reported mean.

Step 4: Calculate 28 − 2 = 26°C.
Step 5: The corrected mean temperature is 26°C.

8. A teacher enters a student's six subject marks in cells B3:G3. Write spreadsheet formulas to find the total and average marks.
   Answer:
   Step 1: Identify the range containing the six marks: B3:G3.
   Step 2: Select the cell where the total will appear.
   Step 3: Enter =SUM(B3:G3) to calculate the total.
   Step 4: Select the cell where the average will appear.
   Step 5: Enter =AVERAGE(B3:G3) to calculate the average.
9. A shop records the number of customers visiting each day: Monday 16, Tuesday 19, Wednesday 10, Thursday 14, Friday 20, Saturday 22, and Sunday 35. Describe how to show the data in a line graph.
   Answer:
   Step 1: Write the days of the week along the horizontal axis.
   Step 2: Label the vertical axis "Number of customers" and choose a suitable scale.
   Step 3: Plot each day's customer count as a point.
   Step 4: Connect the points in weekday order.
   Step 5: Use the line to identify daily increases, decreases, and the busiest day.
10. A town's monthly rainfall is highest in July and August and lowest in January and February. What can a line graph help residents understand?
    Answer:
    Step 1: Put the months on the horizontal axis.
    Step 2: Put rainfall amounts on the vertical axis.
    Step 3: Plot and connect each month's rainfall value.
    Step 4: Observe the peak in July and August and the low values in January and February.
    Step 5: The graph helps residents see the seasonal rainfall pattern.
11. A student uses 14 boxes on a 30-minute-per-box activity strip to record sleep. Calculate the sleep duration.
    Answer:
    Step 1: Each box represents 30 minutes.
    Step 2: Multiply 14 boxes by 30 minutes.
    Step 3: The total sleep time is 420 minutes.
    Step 4: Divide 420 by 60 to convert minutes to hours.
    Step 5: The student recorded 7 hours of sleep.
12. A test average for 25 students is reported as 68, but one student's mark was recorded 5 points too low. Find the corrected class average.
    Answer:
    Step 1: The reported total is 25 × 68 = 1,700 marks.
    Step 2: Add back the 5 points that were missed.
    Step 3: The corrected total is 1,700 + 5 = 1,705 marks.
    Step 4: Divide the corrected total by 25 students.
    Step 5: The corrected average is 1,705 ÷ 25 = 68.2 marks.
13. A school records the daily maximum temperatures for a month and wants to compare the pattern with the previous month. How should it use a line graph?
    Answer:
    Step 1: Put the dates on the horizontal axis.
    Step 2: Put temperature in degrees Celsius on the vertical axis.
    Step 3: Plot and connect the daily temperatures for each month.

Step 4: Use different colours or markers to distinguish the months.
Step 5: Compare the lines to identify warmer periods and changes over time.

14. An infographic shows a state with a rice-preference score of +100 on a scale comparing rice and wheat consumption. How should a student interpret it?
Answer:
Step 1: Read the infographic's colour scale and explanation.
Step 2: Understand that +100 indicates the strongest relative preference for rice on that scale.
Step 3: Remember that the score compares per-capita rice and wheat consumption.
Step 4: Do not interpret +100 as meaning that the state consumes no wheat.
Step 5: Describe it as a strong relative preference for rice.
15. A teacher lists the number of books read by 10 students as 1, 2, 2, 3, 3, 3, 4, 4, 5, and 8. Find the mean and median.
Answer:
Step 1: Add the values: the total is 35 books.
Step 2: Divide by 10 students to find the mean: 35 ÷ 10 = 3.5 books.
Step 3: The data is already arranged in order.
Step 4: The middle values are the 5th and 6th values, both 3.
Step 5: The median is 3 books.

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

MULTIPLE-CHOICE QUESTIONS – OLYMPIAD TYPE:

1. What is the mean of 2, 4, 6, and 8?
A. 4 B. 5 C. 6 D. 8
Answer: B. 5
2. Two numbers have a mean of 15. If one number is 11, what is the other?
A. 17 B. 18 C. 19 D. 20
Answer: C. 19
3. A set of 7 values has a mean of 12. What is the sum of the values?
A. 72 B. 78 C. 84 D. 96
Answer: C. 84
4. The mean of 5 numbers is 14. Four of the numbers add up to 50. What is the fifth number?
A. 15 B. 18 C. 20 D. 24
Answer: C. 20
5. A set of 6 values has a mean of 8. What is the new mean after adding 20?
A. 9 B. 9 5/7 C. 10 D. 11
Answer: B. 9 5/7
6. The mean of a data set is 20. If 5 is added to every value, what is the new mean?
A. 15 B. 20 C. 25 D. 100
Answer: C. 25
7. The mean of a data set is 12. If every value is doubled, what is the new mean?
A. 6 B. 14 C. 24 D. 36
Answer: C. 24
8. Four values have a mean of 10. If 16 is removed, what is the mean of the remaining values?
A. 6 B. 8 C. 10 D. 12
Answer: B. 8

9. A data set has 3 values with a mean of 7. Which pair can be added without changing the mean?
   A. 4 and 8 B. 5 and 9 C. 6 and 10 D. 7 and 9
   Answer: B. 5 and 9
10. The mean of 8 values is 15. One value was recorded 4 too high. What is the corrected mean?
   A. 14.5 B. 14.75 C. 15.25 D. 15.5
   Answer: B. 14.5?
   Correction: Original total = 120; corrected total = 116; mean = 14.5.
   Answer: A. 14.5
11. What is the median of 3, 7, 9, 11, and 15?
   A. 7 B. 9 C. 10 D. 11
   Answer: B. 9
12. What is the median of 2, 6, 8, and 12?
   A. 6 B. 7 C. 8 D. 9
   Answer: B. 7
13. The data are 2, 4, 6, 8, and 10. What is the median after adding 20?
   A. 6 B. 7 C. 8 D. 9
   Answer: B. 7
14. The ordered data are 1, 3, 5, 7, and 9. What is the median after adding 11?
   A. 5 B. 6 C. 7 D. 8
   Answer: B. 6
15. What is the median of 4, 4, 6, 8, and 10?
   A. 4 B. 6 C. 7 D. 8
   Answer: B. 6
16. The ordered data are 2, 5, 8, 10, 12, and 15. What is the median?
   A. 8 B. 9 C. 10 D. 11
   Answer: B. 9
17. Values 2, 4, and 6 have frequencies 2, 3, and 1. What is their mean?
   A. 3 B. 3 2/3 C. 4 D. 4 1/3
   Answer: B. 3 2/3
18. Values 3, 5, and 7 have frequencies 2, 4, and 2. What is their mean?
   A. 4 B. 5 C. 5.5 D. 6
   Answer: B. 5
19. Values 2, 4, and 6 have frequencies 1, 4, and 3. What is their median?
   A. 4 B. 4.5 C. 5 D. 6
   Answer: A. 4
20. A frequency table has frequencies 3, 5, 4, and 2. How many observations does it represent?
   A. 12 B. 13 C. 14 D. 15
   Answer: C. 14
21. The mean of 5 values is 10. Which added value would increase the mean the least?
   A. 11 B. 15 C. 20 D. 50
   Answer: A. 11
22. The mean of a data set is 18. Which value can be added without changing the mean?
   A. 16 B. 17 C. 18 D. 19
   Answer: C. 18
23. A set of 4 values has a mean of 9. If each value is increased by 2 and then doubled, what is the new mean?
   A. 20 B. 22 C. 24 D. 26

Answer: D. 22?
Calculation: $(9 + 2) \times 2 = 22$.
Answer: B. 22

24. The mean of 10 numbers is 6. What is the mean if 3 is subtracted from every number?
A. 2 B. 3 C. 6 D. 9
Answer: B. 3
25. A data set has 5 values with mean 12. A new value equal to 12 is added. What is the new mean?
A. 10 B. 12 C. 14 D. 24
Answer: B. 12
26. A mean of 25 is calculated from 20 observations. If one value was recorded 10 too low, what is the corrected mean?
A. 24.5 B. 25 C. 25.5 D. 35
Answer: C. 25.5
27. A mean of 30 is calculated from 10 values. One value of 50 is removed. What is the mean of the remaining values?
A. 27 7/9 B. 28 C. 30 D. 32
Answer: A. 27 7/9
28. The mean of 6 numbers is 14. Five numbers add up to 65. What is the sixth number?
A. 15 B. 17 C. 19 D. 21
Answer: B. 19
29. If every value in a data set is increased by 4, what happens to the median?
A. It increases by 2 B. It increases by 4 C. It doubles D. It stays the same
Answer: B. It increases by 4
30. If every value in a data set is multiplied by 3, what happens to the median?
A. It increases by 3 B. It is multiplied by 3 C. It decreases by 3 D. It stays the same
Answer: B. It is multiplied by 3
31. Which graph is generally best for showing how a quantity changes over time?
A. Line graph B. Pictograph C. Venn diagram D. Tally chart
Answer: A. Line graph
32. In a time-based line graph, what is usually shown on the horizontal axis?
A. The scale B. Time C. The title D. The average
Answer: B. Time
33. On a temperature line graph, what does a steep upward segment indicate?
A. A small decrease B. No change C. A large increase D. A constant value
Answer: C. A large increase
34. A graph line is horizontal between two months. What does this show?
A. The value doubled B. The value stayed the same C. The value decreased D. The scale changed
Answer: B. The value stayed the same
35. A line graph rises to its highest point in June and then falls. When is the measured value greatest?
A. January B. March C. June D. December
Answer: C. June
36. Why might a line graph be preferred over a column graph when there are many data points across time?
A. It hides the scale B. It shows trends clearly without many bars C. It removes the data values D. It always gives the mean
Answer: B. It shows trends clearly without many bars

37. A graph shows selected countries' launch counts and a worldwide total. The selected counts do not add up to the worldwide total. What is a reasonable inference?
A. The worldwide total is incorrect B. Other countries are included in the worldwide count C. Every country launched the same number D. No launches occurred elsewhere
Answer: B. Other countries are included in the worldwide count
38. What does a value of +100 on the chapter's rice-and-wheat infographic represent?
A. No wheat is consumed B. The strongest relative preference for rice on the scale
C. Equal rice and wheat consumption D. The total population of the state
Answer: B. The strongest relative preference for rice on the scale
39. Manoj's activity strip has 48 boxes, each representing 30 minutes. How many hours does the full strip represent?
A. 12 B. 18 C. 24 D. 48
Answer: C. 24
40. A student's activity strip has 10 boxes for sleep, each representing 30 minutes. How long did the student sleep?
A. 3 hours B. 4 hours C. 5 hours D. 10 hours
Answer: C. 5 hours
41. Which formula finds the total of the values in spreadsheet cells B3 through G3?
A. =SUM(B3:G3) B. =AVERAGE(B3:G3) C. =COUNT(B3:G3) D. =MEDIAN(B3:G3)
Answer: A. =SUM(B3:G3)
42. Which formula finds the average of values in cells B7 through D7?
A. =SUM(B7:D7) B. =AVERAGE(B7:D7) C. =TOTAL(B7:D7) D. =MEAN(B7:D7)
Answer: B. =AVERAGE(B7:D7)
43. In a spreadsheet, what does the reference E5 identify?
A. Column 5, row E B. Column E, row 5 C. The fifth worksheet D. Five cells in column E
Answer: B. Column E, row 5
44. In a frequency table, the cumulative frequency up to a value is 14, and the next cumulative frequency is 23. Which positions contain the next value?
A. 1st to 14th B. 14th to 23rd C. 15th to 23rd D. 23rd to 36th
Answer: C. 15th to 23rd
45. There are 36 observations. Which two positions determine the median?
A. 17th and 18th B. 18th and 19th C. 18th and 20th D. 19th and 20th
Answer: B. 18th and 19th
46. A frequency table has 36 values; cumulative frequency reaches 14 at value 4 and 23 at value 5. What is the median?
A. 4 B. 4.5 C. 5 D. 6
Answer: C. 5
47. The mean of 5 values is 16. Two values, 12 and 20, are added. What is the new mean?
A. 15 B. 16 C. 17 D. 18
Answer: B. 16
48. The mean of 4 values is 10. If one value equal to 10 is removed, what is the mean of the remaining values?
A. 8 B. 9 C. 10 D. 12
Answer: C. 10
49. A line graph shows average sleep decreasing from childhood to adulthood and rising after age 50. Which statement best describes the pattern?

A. Sleep rises at every age B. Sleep falls and then rises C. Sleep never changes
D. Sleep falls only after age 50
Answer: B. Sleep falls and then rises

50. What should be checked before concluding that one category is larger than another in an infographic?
A. The colour scale or key B. The font size C. The page number D. The order of the labels
Answer: A. The colour scale or key

5.15 Best Practices Opportunity List from the Chapter: (14 Ideas)

BEST PRACTICES FOR TEACHING "TALES BY DOTS AND LINES":

(1) Begin with Familiar Data
Ask students to collect simple data, such as the number of books they read or hours they sleep. Use their examples to introduce mean, median, and data patterns.

(2) Use Physical Objects to Explain the Mean
Give groups counters or paper slips with different numbers. Let students redistribute them equally to see the mean as a fair share and balance point.

(3) Use Number Lines and Dot Plots
Plot values on a number line to help students see the position of the mean and median. Invite them to explain what happens when a value is added or removed.

(4) Compare Mean and Median
Give students data sets with and without an unusually high or low value. Ask them to calculate both measures and discuss which one changes more.

(5) Teach Frequency Tables Before Introducing Formulas
Have students tally repeated values from a class survey. Guide them to use the frequencies to find the total number of observations, mean, and median.

(6) Model Missing-Value Problems Step by Step
Start with a known mean and number of values, calculate the required total, and then find the missing value. Ask students to check their answer by recalculating the mean.

(7) Use Spreadsheets for Real Class Data
Let students enter marks or survey responses into a spreadsheet. Practise cell references and use SUM and AVERAGE formulas to calculate totals and averages.

(8) Connect Line Graphs to Local or School Data
Use information such as daily temperature, rainfall, attendance, or customer visits. Have students label the axes, choose a suitable scale, plot points, and connect them in order.

(9) Teach Graph Reading in Two Stages
First ask students to identify the title, axes, units, and scale. Then ask them to describe trends and support each conclusion with information from the graph.

(10) Compare Graph Types for Suitability
Present a time-based data set and ask students whether a line graph or column graph would communicate it more clearly. Discuss how many values and the purpose of the display affect the choice.

(11) Use Infographics to Practise Careful Interpretation
Ask students to read the key or colour scale before interpreting an infographic. Discuss why a value on a scale may show relative preference rather than complete absence of another item.

(12) Create Daily Activity Strips
Have students record a typical day using equal time intervals, then calculate time

spent on activities such as sleep, study, and leisure. Encourage respectful comparisons between different routines.

(13) Encourage Students to Explain Their Reasoning
Ask students to show how they calculated an answer or reached a conclusion. Use pair discussions so they can compare methods and correct misunderstandings.

(14) Use Exit Tickets for Quick Assessment
At the end of a lesson, ask students to solve one short mean, median, frequency-table, or graph-reading problem. Review responses to identify topics that need more practice.

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

INNOVATIONS IN TEACHING AND LEARNING "TALES BY DOTS AND LINES":

(1) Mean-Balance Challenge:
Give each group number cards and ask them to arrange the values around a proposed mean. Students explain how the values balance on either side.

(2) Data Detectives: Find the Missing Value:
Present a fictional class survey with one missing entry and a known mean. Students work backwards to identify the missing value and explain their method.

(3) Classroom Data Wall:
Collect anonymous class data, such as daily reading time or number of books read. Display the values as a dot plot, frequency table, and line graph, then compare what each representation shows.

(4) "Mean or Median?" Case Files:
Give groups short real-life scenarios containing an unusually high or low value. Students decide whether mean or median better describes the data and justify their choice.

(5) Spreadsheet Formula Race:
Provide a small marks table and a set of tasks, such as calculating subject averages or student totals. Students enter spreadsheet formulas and check one another's results.

(6) Living Line Graph:
Give each student a time-based data value on a card. Students stand in order along a floor number line to form a human line graph and describe the trend.

(7) Graph Detective Mystery:
Show students a graph with an unusual rise, fall, or flat section. They identify the pattern, suggest possible explanations, and distinguish what the graph shows from what it cannot prove.

(8) Rainfall and Temperature Data Story:
Assign groups different Indian cities and give them monthly weather data. Each group creates a line graph and presents a short story about the seasonal pattern.

(9) Infographic Redesign Studio:
Students select a small data set and make an infographic with a clear title, labels, scale, and key. Classmates review whether the visuals represent the values accurately.

(10) Activity-Strip Time Audit:
Students create a 24-hour strip using equal time intervals and record everyday activities. They calculate time spent in chosen categories and present a respectful comparison of patterns.

(11) "What If?" Data Transformation Lab:
Groups explore how a data set changes when a value is added, removed, increased, or

multiplied. They record how the mean and median respond and share a rule supported by their examples.

(12) Peer-Designed Data Quiz:
Students create short questions using a data set, frequency table, or graph they have made. Groups exchange quizzes, solve them, and explain the reasoning behind their answers.

5.17: Practicing Questions/Question Bank:

QUESTION BANK – "TALES BY DOTS AND LINES":

A. Fill in the Blanks:

1. The sum of all values divided by the number of values is the _____.
   Answer: mean
2. The middle value of data arranged in order is the _____.
   Answer: median
3. In a frequency table, the number of times a value occurs is its _____.
   Answer: frequency
4. Spreadsheet columns are labelled with _____.
   Answer: letters
5. In Manoj's activity strip, each of the 48 boxes represents _____ minutes.
   Answer: 30

B. One-Mark Descriptive Questions:

1. What does the mean represent in a data set?
   Answer: The mean represents the balance point of the data.
2. How do you find the median of an even number of ordered values?
   Answer: Find the average of the two middle values.
3. What happens to the mean when a value equal to it is added?
   Answer: The mean remains unchanged.
4. What does a line graph help us observe?
   Answer: It helps us observe how data changes over time.
5. What does the formula =SUM(B3:G3) calculate?
   Answer: It calculates the sum of the values in cells B3 through G3.

C. Two-Mark Descriptive Questions:

1. **Find the mean of 5, 7, and 9.**
   Answer:

- Their sum is 5 + 7 + 9 = 21.
- The mean is 21 ÷ 3 = 7.

2. **Find the median of 3, 6, 8, and 11.**
   Answer:

- The two middle values are 6 and 8.

- The median is (6 + 8) ÷ 2 = 7.

3. **How does adding 4 to every value affect a data set with a mean of 10?**
   Answer:

- The mean increases by 4.
- The new mean is 14.

4. **What does a flat section of a line graph show?**
   Answer:

- The measured value does not change during that interval.
- The plotted line remains at the same level.

5. **How does a frequency table help calculate the mean?**
   Answer:

- It shows how many times each value occurs.
- Multiply each value by its frequency before finding the mean.

D. Three-Mark Descriptive Questions

1. **Find the mean of 4, 6, 8, and 10.**
   Answer:

- Add the values: 4 + 6 + 8 + 10 = 28.
- There are 4 values.
- The mean is 28 ÷ 4 = 7.

2. **Find the missing value in 5, 7, and x if their mean is 8.**
   Answer:

- The required total is 8 × 3 = 24.
- The known values add up to 5 + 7 = 12.
- The missing value is 24 − 12 = 12.

3. **What happens to the mean if every value in a data set is doubled?**
   Answer:

- Each value is multiplied by 2.
- The total is also multiplied by 2.
- Therefore, the mean is doubled.

4. **State three things to check before interpreting a line graph.**
   Answer:

- Read the graph title.
- Identify what the horizontal and vertical axes represent.
- Check the scale used on the axes.

5. **A line graph rises and then falls. What information does this give?**
Answer:

- The rising section shows an increase.
- The highest point shows the maximum value.
- The falling section shows a decrease.

E. Five-Mark Descriptive Questions

1. **Find the mean of 6, 8, 10, 12, and 14.**
Answer:

- Add the values: 6 + 8 + 10 + 12 + 14 = 50.
- Count the values: there are 5.
- Use Mean = Sum ÷ Number of values.
- Divide 50 by 5.
- The mean is 10.

2. **Find the missing value in 4, 8, 10, and x if the mean is 9.**
Answer:

- There are 4 values.
- The required total is 9 × 4 = 36.
- The known values total 4 + 8 + 10 = 22.
- Subtract 22 from 36.
- The missing value is 14.

3. **Values 2, 4, and 6 have frequencies 2, 3, and 1 respectively; find the mean.**
Answer:

- Calculate 2 × 2 = 4.
- Calculate 4 × 3 = 12.
- Calculate 6 × 1 = 6.
- The weighted total is 22, and the total frequency is 6.
- The mean is 22 ÷ 6, or approximately 3.67.

4. **Explain how to calculate a student's total marks and average marks using a spreadsheet.**
Answer:

- Enter the student's marks in the spreadsheet cells.
- Identify the range containing the marks.
- Use =SUM(start_cell:end_cell) to calculate the total.
- Use =AVERAGE(start_cell:end_cell) to calculate the average.

- Check that the formulas refer to the correct cells.

5. **Describe how to create and interpret a line graph for monthly rainfall.**
   Answer:

- Write the months along the horizontal axis.
- Label the vertical axis with rainfall and choose a suitable scale.
- Plot each month's rainfall value.
- Connect the plotted points in month order.
- Identify the months with the highest, lowest, rising, or falling rainfall.

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8th Standard Maths Part 2 Book Chapter 6

Chapter 6: ALGEBRA PLAY

6.1 Summary of the Chapter:

Chapter 6: Algebra Play — Summary:

(1) **Algebra explains number tricks:** A number chosen in a "Think of a Number" trick can be represented by a letter such as x. Writing each step as an algebraic expression shows why the trick gives the same result for any starting number.

(2) **Date tricks can be decoded:** A person's chosen month and day can be represented by M and D. Following the steps in the trick produces 100M + 165 + D; subtracting 165 from the final answer helps reveal the date.

(3) **Number pyramids follow a simple rule:** Each number in a pyramid is the sum of the two numbers directly below it. When some numbers are missing, letters and equations can help find them.

(4) **Algebra reveals patterns in pyramids:** For a pyramid with three bottom numbers a, b, and c, the top number is a + 2b + c. This expression shows how the bottom row determines the top.

(5) **Pyramids connect to number sequences:** The chapter explores what happens when Virahāṅka-Fibonacci numbers are placed in the bottom row of a pyramid. The pyramid's rules can reveal patterns in the numbers above.

(6) **Calendar grids have predictable sums:** In a calendar, the four numbers in a 2 × 2 square can be written as a, a+1, a+7, and a+8. Their total is 4a+16, which can be used to find the numbers if the sum is known.

(7) **Algebra can solve grid puzzles:** Shapes in a grid can represent unknown numbers. By using the row sums and forming equations, the values of the shapes can be worked out.

(8) **Digits can be arranged to make a largest product:** When three different digits are used to form a two-digit number multiplied by a one-digit number, the largest digit should be the multiplier. The other two digits should be arranged in decreasing order to form the two-digit number.

(9) **Reversing two-digit numbers creates multiples of 9:** The difference between a two-digit number and the number formed by reversing its digits is divisible by 9. Algebra shows this difference is 9 times the difference between the digits.

(10) **Other digit patterns lead to divisibility rules:** Adding a two-digit number to its reverse gives a multiple of 11. The chapter also examines cyclic arrangements of three-digit numbers and repeated-digit numbers to explore divisibility by 37 and by 7, 11, and 13.

(11) **Algebra helps solve everyday puzzles:** The chapter applies equations and reasoning to situations involving animals' heads and legs, ages, numbers of cows, business costs and profits, and other practical problems.

(12) **Algebra is a tool for explaining and justifying:** By representing unknown quantities with letters, we can identify patterns, test mathematical tricks, and explain why a result is always true.

6.2 Important Formulas:

IMPORTANT FORMULAS: CHAPTER 6 – ALGEBRA PLAY:

1. **"THINK OF A NUMBER" TRICK:**

Let the starting number be x.
Double it, add 4, divide by 2, and subtract the starting number:
$[(2x + 4) / 2] - x = 2$

The result is always 2.

2. DATE TRICK:

Let M = month number and D = day of the month.
Final answer = 100M + 165 + D
To decode the date:
100M + D = Final answer - 165

3. NUMBER PYRAMIDS:

Each number above is the sum of the two numbers directly below it:
Number above = Left number below + Right number below
For three numbers in the bottom row, a, b, and c:
Top number = a + 2b + c
For four numbers in the bottom row, a, b, c, and d:
Top number = a + 3b + 3c + d

4. CALENDAR GRID: 2 × 2 BLOCK:

If the top-left number is a, the four numbers are:
a, a + 1, a + 7, a + 8
Sum of the four numbers:
S = 4a + 16
To find the top-left number:
a = (S - 16) / 4

5. GRID SUMS:

For a row containing unknown values x, y, and z, with total T:
x + y + z = T
Use the totals from different rows to form equations and find the unknown values.

6. LARGEST PRODUCT USING THREE DIFFERENT DIGITS:

Let the digits be p, q, and r, where $p < q < r$.
Largest product = (10q + p) × r
Arrange the two smaller digits in decreasing order to form the two-digit number. Use the largest digit as the multiplier.

7. REVERSING A TWO-DIGIT NUMBER: DIFFERENCE:

A two-digit number with digits a and b = 10a + b
The reversed number = 10b + a
Difference between the reversed number and the original number:
(10b + a) - (10a + b) = 9(b - a)
The difference is divisible by 9.

8. REVERSING A TWO-DIGIT NUMBER: SUM:

Sum of a two-digit number and its reverse:
(10a + b) + (10b + a) = 11(a + b)
The sum is divisible by 11.

9. CYCLIC ARRANGEMENTS OF A THREE-DIGIT NUMBER:

For digits a, b, and c, the three numbers are:
100a + 10b + c
100b + 10c + a
100c + 10a + b
Their sum is:
111(a + b + c) = 37 × 3(a + b + c)
The sum is divisible by 37 and by 3.

10. REPEATING A THREE-DIGIT NUMBER

Let N = 100a + 10b + c.
Repeating the number gives:

abcabc = 1001 × N
Since 1001 = 7 × 11 × 13, the repeated number is divisible by 7, 11, and 13.

11. HORSES AND HENS:

Let h = number of horses and n = number of hens.
Number of heads:
h + n = Total number of heads
Number of legs:
4h + 2n = Total number of legs

12. AGE PROBLEM:

Let d = daughter's present age.
Mother's present age = 5d
If, in six years, the mother will be three times the daughter's age:
5d + 6 = 3(d + 6)

13. COWS PROBLEM:

Let g = number of cows Gauri has and n = number of cows Naina has.
Naina has twice as many cows as Gauri:
n = 2g
After Naina gives three cows to Gauri, they have equal numbers:
n - 3 = g + 3

14. DOSA CART: PROFIT:

Let q = number of dosas sold and p = selling price per dosa.
Making cost per dosa = Rs. 10
Daily rent = Rs. 5,000
Profit = Revenue - Total expenses
Profit = pq - (10q + 5000)
Equivalently:
Profit = (p - 10)q - 5000
For a target profit P:
(p - 10)q - 5000 = P

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

FILL IN THE BLANKS – LOTS TYPE:

1. In algebra, an unknown number can be represented by a _____.
   Answer: letter
2. If the number chosen in a trick is represented by x, doubling it gives _____.
   Answer: 2x
3. Adding 4 to 2x gives _____.
   Answer: 2x + 4
4. Dividing 2x + 4 by 2 gives _____.
   Answer: x + 2
5. In the chapter's "Think of a Number" trick, the final answer is always _____.
   Answer: 2
6. In the date trick, M represents the _____.
   Answer: month number
7. In the date trick, D represents the _____.
   Answer: day of the month
8. The final answer in the date trick is represented by the expression _____.
   Answer: 100M + 165 + D
9. To decode the date trick, subtract _____ from the final answer.
   Answer: 165

10. In a number pyramid, each number is the sum of the two numbers directly _____ it.
    Answer: below
11. If the two numbers directly below a pyramid box are 6 and 2, the number in the box is _____.
    Answer: 8
12. If the bottom row of a three-row pyramid is a, b, and c, the top number is _____.
    Answer: a + 2b + c
13. In a three-row number pyramid, the middle bottom number is counted _____ times in the top number.
    Answer: two
14. If the bottom row of a four-row pyramid is a, b, c, and d, the top number is _____.
    Answer: a + 3b + 3c + d
15. In a calendar, numbers in the same column are usually _____ apart.
    Answer: 7
16. In a calendar, numbers next to each other in the same row are _____ apart.
    Answer: 1
17. If the top-left number in a 2 × 2 calendar grid is a, the number to its right is _____.
    Answer: a + 1
18. If the top-left number in a 2 × 2 calendar grid is a, the number below it is _____.
    Answer: a + 7
19. The sum of the four numbers in a 2 × 2 calendar grid beginning with a is _____.
    Answer: 4a + 16
20. If the sum of a 2 × 2 calendar grid is S, its top-left number is _____.
    Answer: (S - 16) / 4
21. In an algebra grid, shapes can represent _____ numbers.
    Answer: unknown
22. The values of shapes in a grid can be found by forming and solving _____.
    Answer: equations
23. When making the largest product using three different digits, the largest digit is used as the _____.
    Answer: multiplier
24. The two smaller digits are arranged in _____ order to form the two-digit number.
    Answer: decreasing
25. A two-digit number with digits a and b can be written as _____.
    Answer: 10a + b
26. The number formed by reversing the digits of 10a + b is _____.
    Answer: 10b + a
27. The difference between a two-digit number and its reverse is divisible by _____.
    Answer: 9
28. The difference between 10b + a and 10a + b simplifies to _____.
    Answer: 9(b - a)
29. The sum of a two-digit number and its reverse is divisible by _____.
    Answer: 11
30. The sum of 10a + b and 10b + a simplifies to _____.
    Answer: 11(a + b)
31. The sum of a three-digit number and its two cyclic arrangements is divisible by _____.
    Answer: 37

32. The sum of a three-digit number and its two cyclic arrangements is also divisible by _____.
Answer: 3
33. The number formed by repeating a three-digit number is that number multiplied by _____.
Answer: 1001
34. The number 1001 is the product of _____, _____, and _____.
Answer: 7, 11, and 13
35. Therefore, a number formed by repeating a three-digit number is divisible by _____, _____, and _____.
Answer: 7, 11, and 13
36. A problem involving horses and hens can be solved using the total number of _____ and legs.
Answer: heads
37. A horse has _____ legs.
Answer: 4
38. A hen has _____ legs.
Answer: 2
39. Profit is calculated by subtracting total expenses from total _____.
Answer: revenue
40. In the dosa cart problem, the daily rent is Rs. _____.
Answer: 5,000

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

FILL IN THE BLANKS – HOTS TYPE:

1. In the number trick, a number x is doubled, 10 is added, the result is divided by 2, and x is subtracted. The final answer is _____.
Answer: 5
2. In the date trick, if the final answer is 1390, subtracting 165 gives _____.
Answer: 1225
3. The date represented by 1225 in the date trick is _____.
Answer: 25 December
4. If the final answer in the date trick is 1269, the date represented is _____.
Answer: 4 November
5. If the final answer in the date trick is 394, the date represented is _____.
Answer: 29 February
6. If the final answer in the date trick is 296, the date represented is _____.
Answer: 31 January
7. A number pyramid has 12 and 8 at the ends of its bottom row, an unknown number c between them, and 60 at the top. Using 20 + 2c = 60, c equals _____.
Answer: 20
8. In the pyramid in Question 7, the two numbers in the row above the bottom row are _____ and _____.
Answer: 32 and 28
9. The top number of a pyramid with bottom row 4, 7, 2 is _____.
Answer: 20
10. The top number of a pyramid with bottom row 3, 5, 8, 2 is _____.
Answer: 38
11. A 2 × 2 calendar grid has a total of 68. Its top-left number is _____.
Answer: 13

12. In the calendar grid in Question 11, the four numbers are _____, _____, _____, and _____.
Answer: 13, 14, 20, and 21
13. The total of a 2 × 2 calendar grid with top-left number 17 is _____.
Answer: 84
14. If the total of a 2 × 2 calendar grid is 100, its top-left number is _____.
Answer: 21
15. The difference between 83 and its reverse, 38, is _____.
Answer: 45
16. When the difference in Question 15 is divided by 9, the quotient is _____.
Answer: 5
17. For the numbers 83 and 38, the quotient in Question 16 equals the difference between the digits _____ and _____.
Answer: 8 and 3
18. The sum of 28 and its reverse, 82, is _____, which is divisible by _____.
Answer: 110; 11
19. The cyclic arrangements of the digits 1, 2, and 3 are 123, 231, and 312. Their sum is _____.
Answer: 666
20. The sum in Question 19 is divisible by 37 because 666 = 37 × _____.
Answer: 18
21. Repeating the number 247 gives 247247. Dividing it by 1001 gives _____.
Answer: 247
22. The largest product using the digits 2, 3, and 5 once each is _____.
Answer: 32 × 5 = 160
23. The largest product using the digits 1, 3, and 7 once each is _____.
Answer: 31 × 7 = 217
24. The largest product using the digits 3, 5, and 9 once each is _____.
Answer: 53 × 9 = 477
25. If a farm has 55 animals, all hens would have _____ legs.
Answer: 110
26. A farm has 55 horses and hens altogether, with 150 legs. The number of horses is _____.
Answer: 20
27. The farm in Question 26 has _____ hens.
Answer: 35
28. A mother is five times her daughter's present age. If in six years she will be three times her daughter's age, the daughter is now _____ years old.
Answer: 6
29. The mother in Question 28 is now _____ years old.
Answer: 30
30. Naina has twice as many cows as Gauri. If Naina gives Gauri three cows and they then have equal numbers, Gauri originally had _____ cows.
Answer: 6
31. Naina in Question 30 originally had _____ cows.
Answer: 12
32. A dosa seller sells 100 dosas. Each dosa costs Rs. 10 to make, rent is Rs. 5,000, and the target profit is Rs. 2,000. The selling price per dosa should be Rs. _____.
Answer: 80

33. If dosas sell for Rs. 50 each, the seller must sell _____ dosas to make a profit of Rs. 2,000.
    Answer: 175
34. In the magical ponds puzzle, a person starts with 7 flowers. After each pond doubles the flowers, the person places 8 flowers at each shrine. The number placed at each shrine is _____.
    Answer: 8
35. In the genie puzzle, Karim's coins double and he gives the genie 8 coins after each round. If he has 8 coins after the third round, he started with _____ coins.
    Answer: 8
36. If the bottom row of a three-row number pyramid is 6, 4, and 9, the top number is _____.
    Answer: 23
37. If the top-left number of a 2 × 2 calendar grid is 9, the bottom-right number is _____.
    Answer: 17
38. The difference between a two-digit number and its reverse is 36. The difference between its digits is _____.
    Answer: 4
39. The sum of a two-digit number and its reverse is 99. The sum of its digits is _____.
    Answer: 9
40. A 2 × 2 calendar grid has top-left number a and total S. If S = 4a + 16 and the total is 52, then a = _____.
    Answer: 9

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

ONE-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. **How can an unknown number be represented in algebra?**
   Answer: An unknown number can be represented by a letter such as x.
2. **What is the result of doubling x and adding 4?**
   Answer: The result is 2x + 4.
3. **What is the final answer in the chapter's first "Think of a Number" trick?**
   Answer: The final answer is 2.
4. **In the date trick, what does M represent?**
   Answer: M represents the number of the month.
5. **In the date trick, what does D represent?**
   Answer: D represents the day of the month.
6. **What number is subtracted from the final answer to decode the date trick?**
   Answer: The number 165 is subtracted.
7. **What is the rule for filling a number pyramid?**
   Answer: Each number is the sum of the two numbers directly below it.
8. **What number belongs above 4 and 7 in a number pyramid?**
   Answer: The number above them is 11.
9. **What is the top number of a three-row pyramid with bottom row 2, 5, and 3?**
   Answer: The top number is 15.
10. **What expression gives the top number when a, b, and c are in the bottom row of a three-row pyramid?**
    Answer: The top number is a + 2b + c.

11. **What is the top number of a three-row pyramid with bottom row 4, 1, and 6?**
    Answer: The top number is 12.
12. **How many numbers are in a 2 × 2 calendar grid?**
    Answer: A 2 × 2 calendar grid contains four numbers.
13. **How much does a calendar number increase when moving one day to the right?**
    Answer: The number increases by 1.
14. **How much does a calendar number increase when moving one week down in the same column?**
    Answer: The number increases by 7.
15. **If the top-left number of a 2 × 2 calendar grid is 5, what are the other three numbers?**
    Answer: The other numbers are 6, 12, and 13.
16. **What is the sum of the numbers 5, 6, 12, and 13 in a calendar grid?**
    Answer: Their sum is 36.
17. **What can shapes represent in an algebra grid?**
    Answer: Shapes can represent unknown numbers.
18. **How can the value of an unknown shape in a grid be found?**
    Answer: Its value can be found by using the row totals to form equations.
19. **Which digit should be used as the multiplier to make the largest product from three different digits?**
    Answer: The largest of the three digits should be used as the multiplier.
20. **How should the other two digits be arranged to make the largest product?**
    Answer: They should be arranged in decreasing order to form the two-digit number.
21. **What is the largest product that can be made using the digits 2, 3, and 5 once each?**
    Answer: The largest product is 32 × 5, which equals 160.
22. **What is the reverse of the number 47?**
    Answer: The reverse of 47 is 74.
23. **What is the difference between 74 and 47?**
    Answer: The difference is 27.
24. **What is the result of dividing 27 by 9?**
    Answer: The result is 3.
25. **What is the difference between a two-digit number and its reverse always divisible by?**
    Answer: The difference is always divisible by 9.
26. **What is the sum of a two-digit number and its reverse always divisible by?**
    Answer: The sum is always divisible by 11.
27. **What is the sum of 31 and its reverse, 13?**
    Answer: The sum is 44.
28. **What is the sum of the three cyclic arrangements of a three-digit number always divisible by?**
    Answer: The sum is always divisible by 37.
29. **Is the sum of the three cyclic arrangements also divisible by 3?**
    Answer: Yes, the sum is also divisible by 3.
30. **What number is formed by repeating the three-digit number 123?**
    Answer: The repeated number is 123123.
31. **Which three numbers divide a repeated three-digit number of the form abcabc?**
    Answer: It is divisible by 7, 11, and 13.
32. **How many legs does a horse have?**
    Answer: A horse has four legs.

33. **How many legs does a hen have?**
    Answer: A hen has two legs.
34. **How many equations are needed to represent the heads and legs in a horses-and-hens problem?**
    Answer: Two equations are used: one for heads and one for legs.
35. **What is the relationship between a mother's and daughter's ages in the chapter's age problem?**
    Answer: The mother is five times her daughter's present age.
36. **What is the cost of making one dosa in the chapter's dosa-cart problem?**
    Answer: The cost of making one dosa is Rs. 10.
37. **What is the daily rent in the dosa-cart problem?**
    Answer: The daily rent is Rs. 5,000.
38. **How is profit calculated?**
    Answer: Profit is calculated by subtracting total expenses from total revenue.
39. **What happens to the number of flowers after they are dipped in one magical pond?**
    Answer: The number of flowers doubles.
40. **What mathematical tool does the chapter use to explain why number tricks work?**
    Answer: The chapter uses algebra to explain why number tricks work.

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

ONE-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. **A number x is doubled, 8 is added, and the result is divided by 2; then x is subtracted. What is the final answer?**
   Answer: The final answer is 4.
2. **What steps could be used in a "Think of a Number" trick to make the final answer 3?**
   Answer: Double the number, add 6, divide by 2, and subtract the original number.
3. **The final answer in the date trick is 1269; what date was chosen?**
   Answer: The date was 4 November.
4. **The final answer in the date trick is 394; what date was chosen?**
   Answer: The date was 29 February.
5. **A date trick gives the final answer 296; what date does it represent?**
   Answer: It represents 31 January.
6. **A date trick gives the final answer 1168; what date does it represent?**
   Answer: It represents 3 October.
7. **A number pyramid has bottom row 5, 2, and 7; what number will be at the top?**
   Answer: The top number will be 16.
8. **A three-row pyramid has bottom row 8, 3, and 4; what is its top number?**
   Answer: Its top number is 18.
9. **A four-row pyramid has bottom row 2, 4, 1, and 3; what is its top number?**
   Answer: Its top number is 20.
10. **In a pyramid, the bottom row is 12, c, and 8, and the top number is 60; what is c?**
    Answer: The value of c is 20.
11. **A 2 × 2 calendar grid has a total of 80; what is its top-left number?**
    Answer: Its top-left number is 16.

12. **If a 2 × 2 calendar grid starts with 16 in the top-left corner, what is its bottom-right number?**
    Answer: Its bottom-right number is 24.
13. **A 2 × 2 calendar grid has a top-left number of 23; what is the sum of its four numbers?**
    Answer: The sum is 108.
14. **The total of a 2 × 2 calendar grid is 64; what are the four numbers?**
    Answer: The four numbers are 12, 13, 19, and 20.
15. **In an algebra grid, a shape added to itself and then increased by 9 gives a total of 25; what is the value of the shape?**
    Answer: The value of the shape is 8.
16. **A row contains three equal shapes with a total of 27; what is the value of each shape?**
    Answer: Each shape is worth 9.
17. **Which product is larger: 32 × 5 or 52 × 3?**
    Answer: 32 × 5 is larger because it equals 160, while 52 × 3 equals 156.
18. **What is the largest product that can be made using the digits 2, 4, and 7 once each?**
    Answer: The largest product is 42 × 7, which equals 294.
19. **What is the largest product that can be made using the digits 1, 6, and 8 once each?**
    Answer: The largest product is 61 × 8, which equals 488.
20. **The number 63 is reversed to make 36; what is their difference divided by 9?**
    Answer: The quotient is 3.
21. **A two-digit number and its reverse differ by 45; what is the difference between their digits?**
    Answer: The difference between their digits is 5.
22. **The sum of a two-digit number and its reverse is 110; what is the sum of its digits?**
    Answer: The sum of its digits is 10.
23. **What is the sum of the cyclic arrangements 123, 231, and 312, and is it divisible by 37?**
    Answer: Their sum is 666, which is divisible by 37.
24. **The number 456 is repeated to form 456456; what is the result of dividing it by 1001?**
    Answer: The result is 456.
25. **How many horses and hens are on a farm with 32 heads and 90 legs?**
    Answer: There are 13 horses and 19 hens.
26. **A mother is four times her daughter's age, and in eight years she will be twice her daughter's age; how old is the daughter now?**
    Answer: The daughter is 4 years old.
27. **Naina has three times as many cows as Gauri, and after giving Gauri four cows they have equal numbers; how many cows did Gauri originally have?**
    Answer: Gauri originally had 4 cows.
28. **A dosa seller sells 100 dosas at Rs. 70 each, with a making cost of Rs. 10 per dosa and daily rent of Rs. 5,000; what is the profit?**
    Answer: The profit is Rs. 1,000.
29. **A dosa seller earns Rs. 50 per dosa, spends Rs. 10 to make each dosa, and pays Rs. 5,000 rent; how many dosas must be sold to make Rs. 2,000 profit?**
    Answer: The seller must sell 175 dosas.

30. **A person starts with 7 flowers and places 8 flowers at each of three shrines after using the magical ponds; how many flowers remain after the first pond and offering?**
    Answer: Six flowers remain.
31. **In the magical ponds puzzle, how many flowers does the person start with if 8 flowers are placed at each shrine?**
    Answer: The person starts with 7 flowers.
32. **Karim gives the genie 8 coins after each round and has 8 coins after three rounds; how many coins did he start with?**
    Answer: Karim started with 8 coins.
33. **If Karim starts with 10 coins and gives the genie 8 coins after each doubling, how many coins does he have after one round?**
    Answer: He has 12 coins after one round.
34. **If a number pyramid's bottom row is 3, 6, and 2, what number is at the top?**
    Answer: The top number is 17.
35. **A calendar block has top-left number 10; what is the total of its four numbers?**
    Answer: The total is 56.
36. **A number and its reverse are 52 and 25; what is their difference divided by 9?**
    Answer: The quotient is 3.
37. **A number and its reverse add to 88; what is the sum of the two digits?**
    Answer: The sum of the digits is 8.
38. **If the final answer in the date trick is 1390, what month number and day are represented?**
    Answer: They are month 12 and day 25.
39. **A 2 × 2 calendar grid has top-left number 7; what is its bottom-left number?**
    Answer: Its bottom-left number is 14.
40. **A three-row number pyramid has bottom row 9, 1, and 5; what is the top number?**
    Answer: The top number is 16.

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

TWO-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. **A number x is doubled, 4 is added, and the result is divided by 2. What expression is obtained, and what is it equal to?**
   Answer:
   1. The expression is (2x + 4) / 2.
   2. It simplifies to x + 2.
2. **In the "Think of a Number" trick, why is the final answer always 2?**
   Answer:
   1. If the chosen number is x, the steps give x + 2 - x.
   2. The x terms cancel, leaving 2.
3. **In the date trick, what expression represents the final answer for month M and day D?**
   Answer:
   1. The steps produce 100M + 165 + D.
   2. Subtracting 165 gives 100M + D.
4. **A number pyramid has 6 and 2 in two boxes directly below an empty box. What number belongs in the empty box, and why?**
   Answer:

1. The pyramid rule says to add the two numbers directly below.
2. The missing number is 6 + 2 = 8.

5. **Find the top number of a pyramid with bottom row 2, 5, and 3.**
   Answer:
   1. The top-number expression is a + 2b + c.
   2. Substituting the values gives 2 + 10 + 3 = 15.
6. **Find the top number of a pyramid with bottom row 4, 1, and 6.**
   Answer:
   1. The top-number expression is a + 2b + c.
   2. Substituting the values gives 4 + 2 + 6 = 12.
7. **In a pyramid, the bottom row is 12, c, and 8, and the top number is 60. Find c.**
   Answer:
   1. The top number is 12 + 2c + 8, so 20 + 2c = 60.
   2. Therefore, c = 20.
8. **Find the top number of a four-row pyramid with bottom row 1, 2, 3, and 4.**
   Answer:
   1. The top-number expression is a + 3b + 3c + d.
   2. Substituting the values gives 1 + 6 + 9 + 4 = 20.
9. **A 2 × 2 calendar grid begins with 5 in the top-left corner. What are the other three numbers?**
   Answer:
   1. The numbers to the right and below are 6 and 12.
   2. The bottom-right number is 13.
10. **Find the sum of a 2 × 2 calendar grid whose top-left number is 5.**
    Answer:
    1. The four numbers are 5, 6, 12, and 13.
    2. Their sum is 36.
11. **A 2 × 2 calendar grid has a total of 36. Find its top-left number.**
    Answer:
    1. The total is given by S = 4a + 16.
    2. Substituting 36 gives 4a + 16 = 36, so a = 5.
12. **In an algebra grid, three identical shapes have a total of 27. Find the value of each shape.**
    Answer:
    1. Let the value of each shape be x, so 3x = 27.
    2. Dividing by 3 gives x = 9.
13. **In an algebra grid, two identical shapes and a value of 9 have a total of 19. Find the value of each shape.**
    Answer:
    1. Let each shape be x, so 2x + 9 = 19.
    2. Therefore, x = 5.
14. **Which arrangement gives the largest product using the digits 2, 3, and 5 once each?**
    Answer:
    1. Arrange 3 and 2 as 32 and use 5 as the multiplier.
    2. The largest product is 32 × 5 = 160.
15. **Find the reverse of 47 and the difference between the two numbers.**
    Answer:
    1. The reverse of 47 is 74.
    2. Their difference is 74 - 47 = 27.

16. **When 74 - 47 is divided by 9, what is the quotient? What is the difference between the digits of 47?**
    Answer:
    1. The quotient is 27 / 9 = 3.
    2. The digit difference is 7 - 4 = 3.
17. **Find the sum of 28 and its reverse, 82.**
    Answer:
    1. Add the numbers: 28 + 82 = 110.
    2. The sum is divisible by 11.
18. **Add the cyclic arrangements 123, 231, and 312.**
    Answer:
    1. Their sum is 123 + 231 + 312 = 666.
    2. The sum is divisible by 37 and by 3.
19. **Write 123123 as a product involving 1001.**
    Answer:
    1. Repeating 123 gives 123123 = 1001 × 123.
    2. Since 1001 = 7 × 11 × 13, 123123 is divisible by 7, 11, and 13.
20. **A farm has 20 horses and 15 hens. Find the total number of heads and legs.**
    Answer:
    1. The total number of heads is 20 + 15 = 35.
    2. The total number of legs is 20 × 4 + 15 × 2 = 110.
21. **A mother is five times her daughter's present age. In six years, she will be three times her daughter's age. Find the daughter's present age.**
    Answer:
    1. Let the daughter's age be d; then 5d + 6 = 3(d + 6).
    2. Solving gives d = 6 years.
22. **Naina has twice as many cows as Gauri. If she gives Gauri three cows, they have equal numbers. Find their original numbers.**
    Answer:
    1. Let Gauri have g cows, so Naina has 2g; after the transfer, 2g - 3 = g + 3.
    2. Thus, Gauri had 6 cows and Naina had 12 cows.
23. **A dosa seller sells 100 dosas at Rs. 80 each. Each dosa costs Rs. 10 to make, and daily rent is Rs. 5,000. Find the profit.**
    Answer:
    1. Revenue is 100 × Rs. 80 = Rs. 8,000, and total expenses are Rs. 1,000 + Rs. 5,000 = Rs. 6,000.
    2. The profit is Rs. 8,000 - Rs. 6,000 = Rs. 2,000.
24. **A dosa seller charges Rs. 50 per dosa and wants a profit of Rs. 2,000. Rent is Rs. 5,000 and the making cost is Rs. 10 per dosa. How many dosas must be sold?**
    Answer:
    1. Profit is 50q - (10q + 5,000), so 40q - 5,000 = 2,000.
    2. Solving gives q = 175 dosas.
25. **A person starts with 7 flowers, and each magical pond doubles the flowers. If 8 flowers are placed at each shrine, how many remain after the first offering?**
    Answer:
    1. The first pond doubles 7 flowers to 14.
    2. After placing 8 flowers, 6 remain.
26. **Karim starts with 8 coins, and his coins double before he gives 8 coins to the genie. How many coins does he have after one round?**
    Answer:

1. His 8 coins double to 16.
2. After giving away 8 coins, he has 8 coins left.

27. **What expression represents the difference between a two-digit number ab and its reverse ba?**
Answer:
    1. The numbers are 10a + b and 10b + a.
    2. Their difference, in absolute value, is 9 times the difference between the digits.
28. **What expression represents the sum of a two-digit number ab and its reverse ba?**
Answer:
    1. The numbers are 10a + b and 10b + a.
    2. Their sum is 11(a + b).
29. **A two-digit number is 31. Find its reverse and the sum of the two numbers.**
Answer:
    1. The reverse of 31 is 13.
    2. Their sum is 31 + 13 = 44.
30. **How can algebra help explain why a number trick always gives the same result?**
Answer:
    1. Represent the starting number with a letter and write each step as an expression.
    2. Simplify the expression to show that the starting number cancels out.

6.8. Two-mark questions with Answers of HOTS Type: (30 Questions)

TWO-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. **A number is doubled, 10 is added, and the result is divided by 2; the original number is then subtracted. What is the result, and why?**
Answer:
    1. If the number is x, the expression is (2x + 10) / 2 - x.
    2. It simplifies to 5, whatever value x has.
2. **A number is tripled, 12 is added, and the result is divided by 3; the original number is then subtracted. What is the result?**
Answer:
    1. If the number is x, the expression is (3x + 12) / 3 - x.
    2. It simplifies to 4.
3. **In the date trick, what date is represented by the final answer 874?**
Answer:
    1. Subtracting 165 from 874 gives 709.
    2. The date is 9 July.
4. **In the date trick, what date is represented by the final answer 393?**
Answer:
    1. Subtracting 165 from 393 gives 228.
    2. The date is 28 February.
5. **A number pyramid has bottom row 7, 2, and 5. Find its top number.**
Answer:
    1. The top number is 7 + 2 × 2 + 5.
    2. The top number is 16.
6. **A three-row number pyramid has bottom row 10, c, and 8, with 50 at the top. Find c.**
Answer:
    1. The top number is 10 + 2c + 8, so 18 + 2c = 50.

2. Therefore, c = 16.

7. **Find the top number of a four-row pyramid with bottom row 1, 3, 5, and 2.**
   Answer:
   1. The top number is 1 + 3 × 3 + 3 × 5 + 2.
   2. The top number is 27.
8. **A 2 × 2 calendar grid has a total of 92. Find its top-left number and the other three numbers.**
   Answer:
   1. Using S = 4a + 16, the top-left number is a = 19.
   2. The four numbers are 19, 20, 26, and 27.
9. **A calendar grid begins with 24 in its top-left corner. Find the sum of its four numbers.**
   Answer:
   1. The four numbers are 24, 25, 31, and 32.
   2. Their sum is 112.
10. **In an algebra grid, three identical shapes total 36, and two of those shapes plus a circle total 30. Find the value of each shape and the circle.**
    Answer:
    1. Each shape is 12 because 36 divided by 3 is 12.
    2. The circle is 6 because 12 + 12 + 6 = 30.
11. **Which arrangement gives the larger product using 4, 6, and 9 once each: 64 × 9 or 94 × 6?**
    Answer:
    1. 64 × 9 = 576.
    2. 94 × 6 = 564, so 64 × 9 is larger.
12. **Find the largest product that can be formed using 2, 7, and 8 once each.**
    Answer:
    1. Arrange the smaller digits as 72 and use 8 as the multiplier.
    2. The largest product is 72 × 8 = 576.
13. **The number 62 is reversed to make 26. Find their difference and the quotient when the difference is divided by 9.**
    Answer:
    1. Their difference is 62 - 26 = 36.
    2. Dividing 36 by 9 gives 4, the difference between the digits.
14. **The number 57 is added to its reverse, 75. Explain the result using the digit sum.**
    Answer:
    1. The sum of the numbers is 57 + 75 = 132.
    2. The digit sum is 12, and 132 = 11 × 12.
15. **Add the cyclic arrangements 258, 582, and 825; show how the sum relates to 37.**
    Answer:
    1. Their sum is 258 + 582 + 825 = 1665.
    2. Since 1665 = 37 × 45, the sum is divisible by 37.
16. **The three-digit number 314 is repeated to form 314314. Find the quotient when it is divided by 1001.**
    Answer:
    1. A repeated three-digit number is 1001 times the original number.
    2. Therefore, 314314 divided by 1001 equals 314.
17. **A farm has 40 horses and hens altogether and 112 legs. Find the number of horses and hens.**
    Answer:

1. If all 40 animals were hens, there would be 80 legs, so the extra 32 legs represent 16 horses.
2. Therefore, there are 16 horses and 24 hens.

18. **A mother is three times her daughter's age, and in ten years she will be twice her daughter's age. Find the daughter's present age.**
Answer:
1. If the daughter's age is d, then 3d + 10 = 2(d + 10).
2. Solving gives d = 10 years.

19. **Naina has three times as many cows as Gauri; after giving Gauri four cows, they have equal numbers. Find their original numbers.**
Answer:
1. If Gauri has g cows, then 3g - 4 = g + 4.
2. Gauri had 4 cows and Naina had 12 cows.

20. **A dosa seller sells 100 dosas and wants a profit of Rs. 1,000; rent is Rs. 5,000 and making each dosa costs Rs. 10. What selling price per dosa is needed?**
Answer:
1. Total expenses are Rs. 6,000, so the required revenue is Rs. 7,000.
2. The selling price must be Rs. 70 per dosa.

21. **A dosa seller charges Rs. 60 per dosa, spends Rs. 10 to make each one, and pays Rs. 5,000 rent. How many dosas must be sold to earn a profit of Rs. 2,500?**
Answer:
1. The profit equation is (60 - 10)q - 5,000 = 2,500.
2. Solving gives q = 150 dosas.

22. **A person starts with 7 flowers; each magical pond doubles the flowers, and 8 flowers are placed at the shrine after the first pond. How many remain after that offering?**
Answer:
1. The first pond doubles 7 flowers to 14.
2. After placing 8 flowers, 6 remain.

23. **Karim starts with 10 coins and gives the genie 8 coins after his coins double. How many coins does he have after one round?**
Answer:
1. His 10 coins double to 20.
2. After giving away 8 coins, he has 12 coins.

24. **In a two-digit number, the difference between the digits is 6. What is the difference between the number and its reverse?**
Answer:
1. The difference between a two-digit number and its reverse is 9 times the difference between its digits.
2. The difference is 9 × 6 = 54.

25. **The digits of a two-digit number add to 9. What is the sum of the number and its reverse?**
Answer:
1. The sum of a two-digit number and its reverse is 11 times the sum of its digits.
2. The sum is 11 × 9 = 99.

26. **A 2 × 2 calendar grid has top-left number 18. Find the other numbers and their total.**
Answer:
1. The other numbers are 19, 25, and 26.
2. The total is 18 + 19 + 25 + 26 = 88.

27. **A three-row pyramid has bottom row 6, 4, and 9. Find the top number and explain how the middle number contributes.**
    Answer:
    1. The top number is 6 + 2 × 4 + 9 = 23.
    2. The middle number contributes twice because it appears in both sums directly above it.
28. **The sum of three cyclic arrangements of a three-digit number is 999. Is the sum divisible by 37 and by 3?**
    Answer:
    1. 999 = 37 × 27, so it is divisible by 37.
    2. 999 is also divisible by 3 because its digits add to 27.
29. **A 2 × 2 calendar grid has a total of 76. Find its top-left number and bottom-right number.**
    Answer:
    1. Using 76 = 4a + 16 gives a = 15.
    2. The bottom-right number is 15 + 8 = 23.
30. **A number is doubled, 6 is added, and the result is divided by 2; then 3 is subtracted. What is the final result in terms of the starting number?**
    Answer:
    1. If the starting number is x, the expression is [(2x + 6) / 2] - 3.
    2. It simplifies to x, so the final result is the original number.

6.9. Three-mark questions with Answers of LOTS Type: (27 Questions)

THREE-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. **Explain how the "Think of a Number" trick gives the answer 2.**
   Answer:
   1. Let the chosen number be x.
   2. Doubling it, adding 4, and dividing by 2 gives x + 2.
   3. Subtracting the original number leaves 2.
2. **Change the "Think of a Number" trick so that its final answer is always 5.**
   Answer:
   1. Let the chosen number be x and double it to get 2x.
   2. Add 10 and divide by 2 to get x + 5.
   3. Subtract x to get 5.
3. **Use the date trick to find the date represented by the final answer 291.**
   Answer:
   1. Subtract 165 from 291 to get 126.
   2. Read 126 as month 1 and day 26.
   3. The date is 26 January.
4. **Use the date trick to find the date represented by the final answer 1390.**
   Answer:
   1. Subtract 165 from 1390 to get 1225.
   2. Read 1225 as month 12 and day 25.
   3. The date is 25 December.
5. **Complete a number pyramid with bottom row 1, 9, and 4.**
   Answer:
   1. Add 1 and 9 to get 10.
   2. Add 9 and 4 to get 13.
   3. Add 10 and 13 to get the top number 23.

6. **Find the top number of a number pyramid with bottom row 5, 2, and 3.**
   Answer:
   1. The top number is found using a + 2b + c.
   2. Substitute 5, 2, and 3 to get 5 + 4 + 3.
   3. The top number is 12.
7. **Find the top number of a four-row pyramid with bottom row 2, 1, 3, and 4.**
   Answer:
   1. The top-number expression is a + 3b + 3c + d.
   2. Substitute the numbers to get 2 + 3 + 9 + 4.
   3. The top number is 18.
8. **In a pyramid, the bottom row is 12, c, and 8, and the top number is 60; find all the missing numbers.**
   Answer:
   1. The top number gives the equation 12 + 2c + 8 = 60.
   2. Solving gives c = 20.
   3. The row above the bottom is 32 and 28.
9. **Write the expression for the top number of a three-row pyramid with bottom row a, b, and c, and explain the coefficient of b.**
   Answer:
   1. The top number is a + 2b + c.
   2. The middle number b contributes to both numbers in the row above.
   3. Therefore, b is counted twice.
10. **Find the four numbers and their sum in a 2 × 2 calendar grid with 10 in the top-left corner.**
    Answer:
    1. The number to the right is 11, and the number below is 17.
    2. The bottom-right number is 18.
    3. The sum is 10 + 11 + 17 + 18 = 56.
11. **A 2 × 2 calendar grid has a total of 40; find its top-left number.**
    Answer:
    1. The grid sum is given by S = 4a + 16.
    2. Substitute 40 to get 40 = 4a + 16.
    3. The top-left number is a = 6.
12. **A 2 × 2 calendar grid has a total of 52; find all four numbers.**
    Answer:
    1. Solve 52 = 4a + 16 to get a = 9.
    2. The numbers to the right and below are 10 and 16.
    3. The bottom-right number is 17, so the grid is 9, 10, 16, and 17.
13. **In an algebra grid, three identical triangles total 27, and two squares plus one triangle total 19; find the value of each shape.**
    Answer:
    1. Each triangle is 27 ÷ 3 = 9.
    2. Two squares and a triangle total 19, so the two squares total 10.
    3. Each square is 5.
14. **Find the largest product that can be made using the digits 2, 3, and 5 once each.**
    Answer:
    1. Arrange the two smaller digits in decreasing order to make 32.
    2. Use the largest digit, 5, as the multiplier.
    3. The largest product is 32 × 5 = 160.

15. **Find the largest product that can be made using the digits 1, 3, and 7 once each.**
    Answer:
    1. Arrange the two smaller digits in decreasing order to make 31.
    2. Use 7 as the multiplier.
    3. The largest product is $31 \times 7 = 217$.
16. **Reverse 47 and find the difference, the quotient after dividing by 9, and the difference between its digits.**
    Answer:
    1. The reverse of 47 is 74, and their difference is 27.
    2. The quotient $27 \div 9$ is 3.
    3. The digit difference is $7 - 4 = 3$.
17. **Add 31 and its reverse, and show the result is divisible by 11.**
    Answer:
    1. The reverse of 31 is 13.
    2. Their sum is $31 + 13 = 44$.
    3. Since $44 = 11 \times 4$, it is divisible by 11.
18. **Add the cyclic arrangements 123, 231, and 312, and show that their sum is divisible by 37.**
    Answer:
    1. Their sum is $123 + 231 + 312 = 666$.
    2. Divide 666 by 37 to get 18.
    3. Therefore, the sum is divisible by 37.
19. **Explain why 123123 is divisible by 7, 11, and 13.**
    Answer:
    1. Repeating 123 gives $123123 = 1001 \times 123$.
    2. The number 1001 equals $7 \times 11 \times 13$.
    3. Therefore, 123123 is divisible by 7, 11, and 13.
20. **A farm has 55 horses and hens altogether and 150 legs; find the number of each animal.**
    Answer:
    1. If all 55 animals were hens, there would be 110 legs.
    2. The extra 40 legs represent 20 horses because each horse adds two legs over a hen.
    3. The farm has 20 horses and 35 hens.
21. **A mother is five times her daughter's age, and in six years she will be three times as old; find their present ages.**
    Answer:
    1. Let the daughter's age be d, so the mother's age is 5d.
    2. The condition gives $5d + 6 = 3(d + 6)$, which gives $d = 6$.
    3. The daughter is 6 years old and the mother is 30 years old.
22. **Naina has twice as many cows as Gauri; after giving Gauri three cows, they have equal numbers; find their original numbers.**
    Answer:
    1. Let Gauri have g cows, so Naina has 2g cows.
    2. The transfer gives $2g - 3 = g + 3$, so $g = 6$.
    3. Gauri had 6 cows and Naina had 12 cows.
23. **A dosa seller sells 100 dosas and wants to earn Rs. 2,000 profit; rent is Rs. 5,000 and each dosa costs Rs. 10 to make; find the required selling price.**
    Answer:
    1. The making cost for 100 dosas is Rs. 1,000.

2. Total expenses are Rs. 1,000 + Rs. 5,000 = Rs. 6,000, so required revenue is Rs. 8,000.
3. The selling price must be Rs. 80 per dosa.

24. **A dosa seller charges Rs. 50 per dosa and wants to make Rs. 2,000 profit; rent is Rs. 5,000 and each dosa costs Rs. 10 to make; find how many dosas must be sold.**
Answer:
    1. The profit equation is (50 - 10)q - 5,000 = 2,000.
    2. This gives 40q = 7,000.
    3. The seller must sell 175 dosas.
25. **A person starts with 7 flowers, and each magical pond doubles the flowers; if 8 flowers are placed after each pond, how many remain after the first two offerings?**
Answer:
    1. After the first pond, 7 flowers double to 14, and 8 are placed, leaving 6.
    2. The second pond doubles 6 to 12, and 8 are placed, leaving 4.
    3. Four flowers remain after the second offering.
26. **Karim has 8 coins and gives the genie 8 coins after his coins double; show how many coins he has after two rounds.**
Answer:
    1. After the first round, 8 doubles to 16 and Karim gives away 8, leaving 8.
    2. After the second round, 8 again doubles to 16 and he gives away 8.
    3. He still has 8 coins.
27. **A two-digit number and its reverse differ by 36; what is the difference between its digits, and why?**
Answer:
    1. The difference between a two-digit number and its reverse is 9 times the difference between its digits.
    2. Since 36 ÷ 9 = 4, the digit difference is 4.
    3. The digits differ by 4.

6.10. Three-mark questions with Answers of HOTS Type: (25 Questions)

THREE-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. **A number is multiplied by 3, 15 is added, and the result is divided by 3; then the original number is subtracted. Find the final answer and explain why it does not depend on the chosen number.**
Answer:
    1. Let the chosen number be x, so the expression is [(3x + 15) / 3] - x.
    2. Simplifying gives x + 5 - x.
    3. The final answer is 5 for every starting number.
2. **A number is multiplied by 5, 20 is added, and the result is divided by 5; then the original number is subtracted. Find the result.**
Answer:
    1. Let the number be x, giving [(5x + 20) / 5] - x.
    2. The expression simplifies to x + 4 - x.
    3. The result is 4.
3. **In the date trick, what date is represented by the final answer 1396?**
Answer:
    1. Subtract 165 from 1396 to get 1231.
    2. Read 1231 as month 12 and day 31.

3. The date is 31 December.

4. **In the date trick, what date is represented by the final answer 982?**
   Answer:
   1. Subtract 165 from 982 to get 817.
   2. Read 817 as month 8 and day 17.
   3. The date is 17 August.
5. **Find the top number of a pyramid whose bottom row is 9, 4, and 7.**
   Answer:
   1. The top number is a + 2b + c.
   2. Substitute 9, 4, and 7 to get 9 + 8 + 7.
   3. The top number is 24.
6. **Find the top number of a four-row pyramid whose bottom row is 3, 8, 2, and 5.**
   Answer:
   1. The top-number expression is a + 3b + 3c + d.
   2. Substituting gives 3 + 24 + 6 + 5.
   3. The top number is 38.
7. **A three-row pyramid has bottom row 10, c, and 6, and its top number is 48; find c and the two numbers above the bottom row.**
   Answer:
   1. The top-number equation is 10 + 2c + 6 = 48, so c = 16.
   2. The left number above the bottom row is 10 + 16 = 26.
   3. The right number is 16 + 6 = 22.
8. **Find the top number of a four-row pyramid with bottom row 2, 4, 6, and 8.**
   Answer:
   1. The top number is a + 3b + 3c + d.
   2. Substituting gives 2 + 12 + 18 + 8.
   3. The top number is 40.
9. **A 2 × 2 calendar grid starts with 14 in its top-left corner; find all four numbers and their sum.**
   Answer:
   1. The top row is 14 and 15.
   2. The bottom row is 21 and 22.
   3. Their total is 72.
10. **A 2 × 2 calendar grid has a total of 100; find its four numbers.**
    Answer:
    1. Use 100 = 4a + 16 to find the top-left number a = 21.
    2. The top row is 21 and 22.
    3. The bottom row is 28 and 29.
11. **In an algebra grid, three identical stars total 24, and one star plus two circles totals 18; find each shape's value.**
    Answer:
    1. Each star is 24 ÷ 3 = 8.
    2. The two circles together are 18 - 8 = 10.
    3. Each circle is 5.
12. **Three identical triangles and 4 more make a total of 31; find the value of one triangle.**
    Answer:
    1. Let the value of one triangle be x, so 3x + 4 = 31.
    2. Subtract 4 to get 3x = 27.
    3. Each triangle is worth 9.

13. **Find the largest product that can be made using the digits 2, 6, and 9 once each.**
    Answer:
    1. Arrange the smaller digits in decreasing order to make 62.
    2. Use the largest digit, 9, as the multiplier.
    3. The largest product is $62 \times 9 = 558$.
14. **Find the largest product that can be made using the digits 1, 4, and 8 once each.**
    Answer:
    1. Arrange the two smaller digits to make 41.
    2. Use 8 as the multiplier.
    3. The largest product is $41 \times 8 = 328$.
15. **Reverse 86 to make 68; find their difference and the quotient when it is divided by 9.**
    Answer:
    1. The difference is $86 - 68 = 18$.
    2. Divide 18 by 9 to get 2.
    3. The quotient equals the difference between the digits 8 and 6.
16. **Add 39 and its reverse; show how the digit sum helps explain the result.**
    Answer:
    1. The reverse of 39 is 93, and their sum is 132.
    2. The digits of 39 add to 12.
    3. The result is 11×12, so it is divisible by 11.
17. **Add the cyclic arrangements 321, 213, and 132, and show how the sum relates to 37.**
    Answer:
    1. Their sum is $321 + 213 + 132 = 666$.
    2. Divide 666 by 37 to get 18.
    3. Therefore, the sum is divisible by 37.
18. **The number 507 is repeated to form 507507; find the quotient when it is divided by 1001 and state what this shows.**
    Answer:
    1. $507507 = 1001 \times 507$.
    2. Dividing by 1001 gives 507.
    3. The repeated number is divisible by 7, 11, and 13 because $1001 = 7 \times 11 \times 13$.
19. **A farm has 48 horses and hens altogether and 136 legs; find the number of each animal.**
    Answer:
    1. If all 48 animals were hens, there would be 96 legs.
    2. The extra 40 legs represent 20 horses.
    3. There are 20 horses and 28 hens.
20. **A mother is four times her daughter's age, and in 12 years she will be twice her daughter's age; find their present ages.**
    Answer:
    1. Let the daughter's age be d, so the mother's age is 4d.
    2. The condition gives $4d + 12 = 2(d + 12)$, so $d = 6$.
    3. The daughter is 6 years old and the mother is 24 years old.
21. **Naina has four times as many cows as Gauri; after giving Gauri five cows, they have equal numbers; find their original numbers.**
    Answer:
    1. Let Gauri have g cows, so Naina has 4g cows.
    2. The transfer gives $4g - 5 = g + 5$, so $g = 10$.

3. Gauri had 10 cows and Naina had 40 cows.

22. **A dosa seller charges Rs. 60 per dosa, spends Rs. 10 to make each dosa, and pays Rs. 5,000 rent; how many dosas must be sold to earn Rs. 2,500 profit?**
Answer:
    1. Profit is (60 - 10)q - 5,000.
    2. Set the profit to Rs. 2,500 to get 50q = 7,500.
    3. The seller must sell 150 dosas.
23. **A dosa seller sells 80 dosas, spends Rs. 10 to make each one, pays Rs. 5,000 rent, and wants a profit of Rs. 3,000; find the selling price per dosa.**
Answer:
    1. Total expenses are 80 × Rs. 10 + Rs. 5,000 = Rs. 5,800.
    2. The required revenue is Rs. 5,800 + Rs. 3,000 = Rs. 8,800.
    3. The selling price must be Rs. 110 per dosa.
24. **A person starts with 7 flowers, and each pond doubles the flowers; after placing 8 flowers at each of the first two shrines, how many remain?**
Answer:
    1. After the first pond and offering, 14 - 8 = 6 flowers remain.
    2. The second pond doubles 6 to 12, and 12 - 8 = 4.
    3. Four flowers remain after the second offering.
25. **Karim starts with 10 coins and gives the genie 6 coins after each doubling; find how many coins he has after three rounds.**
Answer:
    1. After the first round, he has 2 × 10 - 6 = 14 coins.
    2. After the second round, he has 2 × 14 - 6 = 22 coins.
    3. After the third round, he has 2 × 22 - 6 = 38 coins.

6.11 Five-mark questions with Answers of LOTS Type: (17 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. **Explain why the "Think of a Number" trick always gives 2.**
Answer:
    1. Let the chosen number be x.
    2. Doubling it gives 2x.
    3. Adding 4 gives 2x + 4.
    4. Dividing by 2 gives x + 2.
    5. Subtracting the original number gives x + 2 - x = 2.
2. **Use the date trick to find the date represented by the final answer 291.**
Answer:
    1. Subtract 165 from 291.
    2. The result is 126.
    3. The last two digits, 26, give the day.
    4. The remaining digit, 1, gives the month.
    5. The date is 26 January.
3. **Complete a number pyramid with bottom row 1, 9, and 4.**
Answer:
    1. Add 1 and 9 to find the number above them.
    2. The left number in the middle row is 10.
    3. Add 9 and 4 to find the right number in the middle row.
    4. The right number in the middle row is 13.
    5. Add 10 and 13 to get the top number, 23.

4. **A pyramid has bottom row 12, c, and 8, and its top number is 60. Find all the missing numbers.**
   Answer:
   1. The number above 12 and c is 12 + c.
   2. The number above c and 8 is c + 8.
   3. Their sum is 60, so 12 + c + c + 8 = 60.
   4. Solving 20 + 2c = 60 gives c = 20.
   5. The two middle-row numbers are 32 and 28.
5. **Find the four numbers and their sum in a 2 × 2 calendar grid with 5 in the top-left corner.**
   Answer:
   1. The number to the right of 5 is 6.
   2. The number below 5 is 12.
   3. The bottom-right number is 13.
   4. The grid contains 5, 6, 12, and 13.
   5. Their sum is 36.
6. **A 2 × 2 calendar grid has a total of 72. Find its four numbers.**
   Answer:
   1. The grid total is 4a + 16, where a is the top-left number.
   2. Set 4a + 16 equal to 72.
   3. Subtracting 16 gives 4a = 56.
   4. Dividing by 4 gives a = 14.
   5. The grid numbers are 14, 15, 21, and 22.
7. **In an algebra grid, three identical shapes total 27, and two of those shapes plus a circle total 19. Find the value of each shape.**
   Answer:
   1. Divide 27 by 3 to find the value of one shape.
   2. Each shape is worth 9.
   3. Two shapes together are worth 18.
   4. Subtract 18 from 19 to find the circle's value.
   5. The circle is worth 1.
8. **Find the largest product that can be made using the digits 2, 3, and 5 once each.**
   Answer:
   1. The largest digit is 5.
   2. Use 5 as the one-digit multiplier.
   3. Arrange the other digits in decreasing order to form 32.
   4. Multiply 32 by 5.
   5. The largest product is 160.
9. **Reverse 47 and compare the difference with the difference between its digits.**
   Answer:
   1. Reversing 47 gives 74.
   2. Subtract 47 from 74 to get 27.
   3. Divide 27 by 9 to get 3.
   4. Subtract the digits, 7 - 4, to get 3.
   5. The quotient equals the difference between the digits.
10. **Add 28 and its reverse, and show that the sum is divisible by 11.**
    Answer:
    1. The reverse of 28 is 82.
    2. Add 28 and 82 to get 110.
    3. The digits of 28 add to 10.

4. Multiply 10 by 11 to get 110.
5. Therefore, the sum is divisible by 11.

11. **Add the cyclic arrangements 123, 231, and 312, and show that the sum is divisible by 37 and 3.**
    Answer:
    1. Add 123 and 231 to get 354.
    2. Add 312 to get a total of 666.
    3. Divide 666 by 37 to get 18.
    4. The digits of 666 add to 18, which is divisible by 3.
    5. Therefore, 666 is divisible by both 37 and 3.
12. **Explain why 123123 is divisible by 7, 11, and 13.**
    Answer:
    1. The number 123123 is formed by repeating 123.
    2. It can be written as 1001×123.
    3. The number 1001 equals $7 \times 11 \times 13$.
    4. Therefore, 123123 contains 7, 11, and 13 as factors.
    5. So 123123 is divisible by all three numbers.
13. **A farm has 55 horses and hens altogether and 150 legs. Find the number of each animal.**
    Answer:
    1. Assume all 55 animals are hens.
    2. They would have $55 \times 2 = 110$ legs.
    3. The farm has $150 - 110 = 40$ additional legs.
    4. Each horse has two more legs than a hen, so there are $40 \div 2 = 20$ horses.
    5. There are $55 - 20 = 35$ hens.
14. **A mother is five times her daughter's age, and in six years she will be three times her daughter's age. Find their present ages.**
    Answer:
    1. Let the daughter's age be d years.
    2. The mother's age is 5d years.
    3. In six years, their ages will be $d + 6$ and $5d + 6$.
    4. Use the equation $5d + 6 = 3(d + 6)$ to get $d = 6$.
    5. The daughter is 6 and the mother is 30.
15. **Naina has twice as many cows as Gauri; after giving Gauri three cows, they have equal numbers. Find their original numbers.**
    Answer:
    1. Let Gauri have g cows.
    2. Naina then has 2g cows.
    3. After the transfer, Naina has $2g - 3$ and Gauri has $g + 3$.
    4. Set $2g - 3$ equal to $g + 3$ to get $g = 6$.
    5. Gauri had 6 cows and Naina had 12.
16. **A dosa seller sells 100 dosas and wants a profit of Rs. 2,000; rent is Rs. 5,000 and each dosa costs Rs. 10 to make. Find the required selling price per dosa.**
    Answer:
    1. The cost of making 100 dosas is $100 \times$ Rs. 10 = Rs. 1,000.
    2. Add the Rs. 5,000 rent to get total expenses of Rs. 6,000.
    3. Add the target profit of Rs. 2,000 to get required revenue of Rs. 8,000.
    4. Divide Rs. 8,000 by 100 dosas.
    5. The required price is Rs. 80 per dosa.

17. **A person starts with 7 flowers and uses three magical ponds, which each double the flowers; after each pond, the person places 8 flowers at a shrine. Show how many flowers are placed at each shrine.**
    Answer:
    1. The first pond doubles 7 flowers to 14.
    2. After placing 8 flowers at the first shrine, 6 remain.
    3. The second pond doubles 6 to 12, leaving 4 after the offering.
    4. The third pond doubles 4 to 8.
    5. The person places 8 flowers at each shrine.

6.12 Five-mark questions with Answers of HOTS Type: (18 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. **A number is multiplied by 3, then 18 is added; the result is divided by 3, and the original number is subtracted. Prove that the final answer is always 6.**
   Answer:
   1. Let the chosen number be x.
   2. Multiplying it by 3 gives 3x.
   3. Adding 18 and dividing by 3 gives (3x + 18) / 3 = x + 6.
   4. Subtracting the original number gives x + 6 - x.
   5. The final answer is always 6.
2. **Design a "Think of a Number" trick that always gives 7, and show why it works.**
   Answer:
   1. Ask a person to think of a number x.
   2. Ask them to double it, giving 2x.
   3. Ask them to add 14, giving 2x + 14.
   4. Ask them to divide by 2 and subtract the original number.
   5. The result is (2x + 14) / 2 - x = 7.
3. **Use the date trick to decode the final answer 1269, and show the calculation.**
   Answer:
   1. The date trick's final answer is 100M + 165 + D.
   2. Subtract 165 from 1269 to get 1104.
   3. The last two digits, 04, give the day.
   4. The remaining digits, 11, give the month.
   5. The date is 4 November.
4. **Find the top number of a four-row pyramid with bottom row 3, 5, 2, and 4, and explain how you used the pyramid pattern.**
   Answer:
   1. The two numbers above 3 and 5 are 8.
   2. The numbers above 5 and 2, and above 2 and 4, are 7 and 6.
   3. The next row contains 15 and 13.
   4. Add 15 and 13 to find the top number.
   5. The top number is 28.
5. **A three-row pyramid has bottom row 12, c, and 8, and top number 60; find the missing numbers and check your result.**
   Answer:
   1. The top number is 12 + 2c + 8.
   2. Set 20 + 2c equal to 60 to get c = 20.
   3. The number above 12 and 20 is 32.
   4. The number above 20 and 8 is 28.

5. Since 32 + 28 = 60, the pyramid is correct.

6. **A 2 × 2 calendar grid has a total of 84; find its four numbers and verify the total.**
   Answer:
   1. Let a be the top-left number, so 4a + 16 = 84.
   2. Subtract 16 to get 4a = 68.
   3. Divide by 4 to get a = 17.
   4. The four numbers are 17, 18, 24, and 25.
   5. Their sum is 84.

7. **In an algebra grid, three identical stars total 30, and one star plus two identical circles total 22; find the value of each shape.**
   Answer:
   1. Let the value of one star be s, so 3s = 30.
   2. Divide by 3 to get s = 10.
   3. Substitute 10 into the second equation to get 10 + 2c = 22.
   4. Subtract 10 to get 2c = 12.
   5. Each circle is worth 6.

8. **Explain why 53 × 9 is the largest product that can be made using the digits 3, 5, and 9 once each.**
   Answer:
   1. The six possible products are 35 × 9, 39 × 5, 53 × 9, 59 × 3, 93 × 5, and 95 × 3.
   2. Their values are 315, 195, 477, 177, 465, and 285.
   3. The two largest results are 477 and 465.
   4. The product 53 × 9 is greater than 93 × 5.
   5. Therefore, 53 × 9 = 477 is the largest product.

9. **Use algebra to explain why the difference between a two-digit number and its reverse is divisible by 9.**
   Answer:
   1. Represent the two-digit number as 10a + b.
   2. Its reverse is 10b + a.
   3. Their difference is (10a + b) - (10b + a).
   4. Simplifying gives 9(a - b).
   5. Since the difference is a multiple of 9, it is divisible by 9.

10. **Use algebra to explain why the sum of a two-digit number and its reverse is divisible by 11.**
    Answer:
    1. Represent the number as 10a + b.
    2. Its reverse is 10b + a.
    3. Add them to get 10a + b + 10b + a.
    4. Simplifying gives 11(a + b).
    5. Therefore, the sum is divisible by 11.

11. **Use algebra to show that the sum of the three cyclic arrangements of any three digits is divisible by 37 and by 3.**
    Answer:
    1. Represent the digits' arrangements as 100a + 10b + c, 100b + 10c + a, and 100c + 10a + b.
    2. Add the three expressions to get 111a + 111b + 111c.
    3. Factor the sum to get 111(a + b + c).
    4. Since 111 = 3 × 37, the sum is divisible by both 3 and 37.
    5. This divisibility holds for any digits a, b, and c.

12. **Explain why repeating any three-digit number makes a number divisible by 7, 11, and 13.**
    Answer:
    1. Let the original three-digit number be N.
    2. Repeating it gives 1000N + N.
    3. This simplifies to 1001N.
    4. Since 1001 = 7 × 11 × 13, it contains all three factors.
    5. Therefore, the repeated number is divisible by 7, 11, and 13.
13. **A farm has 48 horses and hens altogether and 136 legs; find the number of each animal using the all-hens method.**
    Answer:
    1. If all 48 animals were hens, they would have 48 × 2 = 96 legs.
    2. The actual total is 136 legs, which is 40 more.
    3. Each horse has two more legs than a hen.
    4. Therefore, there are 40 ÷ 2 = 20 horses.
    5. The farm has 28 hens.
14. **A mother is five times her daughter's present age, and in six years she will be three times her daughter's age; find both present ages and verify the condition.**
    Answer:
    1. Let the daughter's age be d years, so the mother's age is 5d years.
    2. The condition gives 5d + 6 = 3(d + 6).
    3. Solving gives d = 6.
    4. The mother's present age is 5 × 6 = 30 years.
    5. In six years their ages will be 36 and 12, and 36 is three times 12.
15. **Naina has twice as many cows as Gauri; after giving Gauri three cows, they have equal numbers; find their original numbers and verify.**
    Answer:
    1. Let Gauri have g cows, so Naina has 2g cows.
    2. After the transfer, Naina has 2g - 3 cows and Gauri has g + 3 cows.
    3. Set these amounts equal to get 2g - 3 = g + 3.
    4. Solving gives g = 6, so Naina has 12 cows.
    5. After the transfer, each has 9 cows.
16. **A dosa seller sells 100 dosas and wants a profit of Rs. 2,000; rent is Rs. 5,000 and each dosa costs Rs. 10 to make; find and verify the selling price.**
    Answer:
    1. The cost of making 100 dosas is Rs. 1,000.
    2. Total expenses, including rent, are Rs. 6,000.
    3. To earn Rs. 2,000 profit, the required revenue is Rs. 8,000.
    4. Divide Rs. 8,000 by 100 to get a price of Rs. 80 per dosa.
    5. At that price, revenue is Rs. 8,000 and profit is Rs. 2,000.
17. **A person starts with 7 flowers, and each magical pond doubles the flowers; after each pond the person places 8 flowers at a shrine; show how many are placed at each shrine.**
    Answer:
    1. The first pond doubles 7 flowers to 14, leaving 6 after the first offering.
    2. The second pond doubles 6 flowers to 12, leaving 4 after the second offering.
    3. The third pond doubles 4 flowers to 8.
    4. The person places all 8 flowers at the third shrine.
    5. Each shrine receives 8 flowers.

18. **Karim has 8 coins and gives the genie 8 coins after his coins double; show why he still has 8 coins after three rounds.**
Answer:
    1. In the first round, 8 coins double to 16, and giving away 8 leaves 8.
    2. In the second round, 8 doubles to 16, and giving away 8 again leaves 8.
    3. In the third round, the same doubling gives 16 coins.
    4. Karim gives the genie 8 coins again.
    5. He is left with 8 coins after all three rounds.

6.13 Five-mark questions with Answers of Applied Type: (16 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS – APPLIED TYPE:

1. **A teacher wants a number trick that always gives 9. Write the steps and show why the trick works for any number.**
Answer:
    1. Ask a student to think of a number x.
    2. Ask the student to double it, giving 2x.
    3. Ask the student to add 18, giving 2x + 18.
    4. Ask the student to divide by 2 and subtract the original number.
    5. The result is (2x + 18) / 2 - x = 9.
2. **A student uses the chapter's date trick and gets 982 as the final answer. Find the date the student chose.**
Answer:
    1. Subtract 165 from 982.
    2. The result is 817.
    3. The last two digits, 17, give the day.
    4. The remaining digit, 8, gives the month.
    5. The student chose 17 August.
3. **A student chooses a 2 × 2 calendar grid whose numbers add to 124. Find the four numbers in the grid.**
Answer:
    1. Let the top-left number be a.
    2. The grid total is 4a + 16, so 4a + 16 = 124.
    3. Solving gives a = 27.
    4. The other numbers are 28, 34, and 35.
    5. The grid is 27, 28, 34, and 35.
4. **A display is made by placing numbered cards in a pyramid, with each card equal to the sum of the two cards directly below it. If the bottom row is 8, 5, and 3, find the top number.**
Answer:
    1. Add 8 and 5 to get 13.
    2. Add 5 and 3 to get 8.
    3. These are the two numbers in the row above.
    4. Add 13 and 8.
    5. The top card is 21.
5. **A number pyramid display has 90 at the top and 20 and 10 at the ends of the bottom row, with an unknown number c between them. Find the missing numbers.**
Answer:
    1. The two numbers above the bottom row are 20 + c and c + 10.

2. Their sum is 90, so 30 + 2c = 90.
3. Solving gives c = 30.
4. The middle-row numbers are 50 and 40.
5. Since 50 + 40 = 90, the pyramid is complete.

6. **At a school stall, three identical notebooks cost Rs. 150 altogether. Two notebooks and a pen cost Rs. 130. Find the cost of one notebook and one pen.**
   Answer:
   1. Let the cost of one notebook be n rupees.
   2. Since three notebooks cost Rs. 150, n = Rs. 50.
   3. Two notebooks cost Rs. 100.
   4. The pen costs Rs. 130 - Rs. 100 = Rs. 30.
   5. One notebook costs Rs. 50 and one pen costs Rs. 30.
7. **A student must use the digits 2, 3, and 5 once each to make a two-digit number multiplied by a one-digit number. Find the arrangement that gives the largest product.**
   Answer:
   1. The largest digit, 5, is used as the multiplier.
   2. The remaining digits are 2 and 3.
   3. Arrange them in decreasing order to make 32.
   4. Multiply 32 by 5.
   5. The largest product is 160.
8. **A puzzle asks a student to reverse the digits of 64 and find the difference between the two numbers. Show the calculation and the result when the difference is divided by 9.**
   Answer:
   1. Reverse 64 to get 46.
   2. Find the difference: 64 - 46 = 18.
   3. Divide 18 by 9.
   4. The quotient is 2.
   5. This equals the difference between the digits, 6 - 4.
9. **A puzzle asks for the sum of a two-digit number and its reverse. Use the number 37 to solve the puzzle and check divisibility by 11.**
   Answer:
   1. Reverse 37 to get 73.
   2. Add the two numbers: 37 + 73 = 110.
   3. The digits of 37 add to 10.
   4. Multiply 10 by 11 to get 110.
   5. The sum is divisible by 11.
10. **In a number puzzle, the digits 2, 4, and 6 are arranged in all three cyclic orders. Find the sum of the resulting numbers and check divisibility by 37.**
    Answer:
    1. The three numbers are 246, 462, and 624.
    2. Add them to get 1,332.
    3. Divide 1,332 by 37 to get 36.
    4. The sum is also divisible by 3 because its digits add to 9.
    5. The sum is divisible by both 37 and 3.
11. **A club creates a six-digit code by repeating the three-digit number 246. Explain how to check that the code is divisible by 7, 11, and 13.**
    Answer:
    1. Repeating 246 creates the code 246246.

2. Write the code as 1001 × 246.
3. Factor 1001 as 7 × 11 × 13.
4. The code therefore has 7, 11, and 13 as factors.
5. So 246246 is divisible by all three numbers.

12. **A farm has 65 horses and hens altogether and 180 legs. Find how many horses and hens are on the farm.**
Answer:
    1. If all 65 animals were hens, there would be 130 legs.
    2. The actual total is 50 legs more than that.
    3. Each horse has two more legs than a hen.
    4. Therefore, there are 50 ÷ 2 = 25 horses.
    5. The farm has 40 hens.
13. **A mother is four times her daughter's age. In 8 years, the mother will be twice her daughter's age. Find their present ages.**
Answer:
    1. Let the daughter's present age be d years.
    2. The mother's age is 4d years.
    3. In 8 years, their ages will be d + 8 and 4d + 8.
    4. Solve 4d + 8 = 2(d + 8) to get d = 4.
    5. The daughter is 4 and the mother is 16.
14. **Naina has three times as many cows as Gauri. If Naina gives Gauri four cows, they will have equal numbers. Find their original numbers.**
Answer:
    1. Let Gauri have g cows, so Naina has 3g cows.
    2. After the transfer, Naina has 3g - 4 cows.
    3. Gauri then has g + 4 cows.
    4. Set 3g - 4 = g + 4 to find g = 4.
    5. Gauri had 4 cows and Naina had 12 cows.
15. **A dosa seller wants to earn Rs. 2,000 profit by selling 100 dosas. The daily rent is Rs. 5,000, and making each dosa costs Rs. 10. Find the required selling price per dosa.**
Answer:
    1. Making 100 dosas costs 100 × Rs. 10 = Rs. 1,000.
    2. Total expenses are Rs. 1,000 + Rs. 5,000 = Rs. 6,000.
    3. Add the target profit to find the required revenue: Rs. 6,000 + Rs. 2,000 = Rs. 8,000.
    4. Divide Rs. 8,000 by 100 dosas.
    5. The seller should charge Rs. 80 per dosa.
16. **A person starts with 7 flowers and visits three magical ponds, each of which doubles the flowers. The person places 8 flowers at each shrine after visiting a pond. Show how many flowers are placed at each shrine.**
Answer:
    1. At the first pond, 7 flowers double to 14, and 8 are placed at the first shrine.
    2. Six flowers remain after the first offering.
    3. At the second pond, 6 flowers double to 12, and 8 are placed at the second shrine.
    4. Four flowers remain and double to 8 at the third pond.
    5. The person places 8 flowers at the third shrine.

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

OLYMPIAD-STYLE MULTIPLE-CHOICE QUESTIONS:

1. In a "Think of a Number" trick, a number is doubled, 4 is added, the result is divided by 2, and the original number is subtracted. What is the final answer?
   A. 1
   B. 2
   C. 4
   D. The starting number
   Answer: B. 2
2. A number x is multiplied by 5, 15 is added, and the result is divided by 5; then x is subtracted. What is the result?
   A. 2
   B. 3
   C. 5
   D. x + 3
   Answer: B. 3
3. In the date trick, the final answer is 874. Which date was chosen?
   A. 7 April
   B. 9 July
   C. 17 August
   D. 26 January
   Answer: B. 9 July
4. In the date trick, the final answer is 1390. Which date was chosen?
   A. 25 December
   B. 12 May
   C. 15 September
   D. 25 November
   Answer: A. 25 December
5. In the date trick, the final answer is 1269. Which date was chosen?
   A. 4 November
   B. 11 April
   C. 26 September
   D. 9 December
   Answer: A. 4 November
6. A number pyramid has bottom row 4, 7, and 2. What is the top number?
   A. 17
   B. 18
   C. 20
   D. 24
   Answer: C. 20
7. A number pyramid has bottom row 6, 1, and 8. What is the top number?
   A. 15
   B. 16
   C. 17
   D. 18
   Answer: B. 16
8. A four-row pyramid has bottom row 1, 2, 3, and 4. What is the top number?
   A. 18
   B. 19
   C. 20

D. 21
Answer: C. 20

9. A three-row pyramid has bottom row 8, c, and 4, and the top number is 40. What is c?
   A. 12
   B. 13
   C. 14
   D. 15
   Answer: C. 14
10. A three-row pyramid has bottom row 3, 6, and 9. What is the top number?
   A. 21
   B. 24
   C. 27
   D. 30
   Answer: B. 24
11. A 2 × 2 calendar grid has 14 in the top-left corner. What is the sum of its four numbers?
   A. 68
   B. 70
   C. 72
   D. 74
   Answer: C. 72
12. The four numbers in a 2 × 2 calendar grid add to 92. What is the top-left number?
   A. 17
   B. 18
   C. 19
   D. 20
   Answer: C. 19
13. The four numbers in a 2 × 2 calendar grid add to 68. Which set of numbers is in the grid?
   A. 12, 13, 19, 20
   B. 13, 14, 20, 21
   C. 14, 15, 21, 22
   D. 15, 16, 22, 23
   Answer: B. 13, 14, 20, 21
14. Three identical shapes in an algebra grid have a total value of 27. What is the value of one shape?
   A. 7
   B. 8
   C. 9
   D. 10
   Answer: C. 9
15. In a grid, each star is worth 9, and two stars plus a circle total 23. What is the value of the circle?
   A. 3
   B. 5
   C. 7
   D. 9
   Answer: B. 5
16. What is the largest product that can be made using 2, 3, and 5 once each as a two-digit number multiplied by a one-digit number?

A. 23 × 5
B. 32 × 5
C. 52 × 3
D. 53 × 2
Answer: B. 32 × 5

17. What is the largest product that can be made using 1, 3, and 7 once each?
A. 13 × 7
B. 31 × 7
C. 37 × 1
D. 73 × 1
Answer: B. 31 × 7

18. What is the largest product that can be made using 3, 5, and 9 once each?
A. 35 × 9
B. 53 × 9
C. 59 × 3
D. 95 × 3
Answer: B. 53 × 9

19. The number 62 is reversed to make 26. What is their difference divided by 9?
A. 2
B. 3
C. 4
D. 5
Answer: C. 4

20. What is the sum of 47 and its reverse?
A. 111
B. 121
C. 131
D. 141
Answer: B. 121

21. A two-digit number has digits that add to 9. What is the sum of the number and its reverse?
A. 90
B. 99
C. 108
D. 110
Answer: B. 99

22. The number 83 is reversed to make 38. What is the difference divided by 9?
A. 3
B. 4
C. 5
D. 6
Answer: C. 5

23. What is the sum of the cyclic arrangements 123, 231, and 312?
A. 555
B. 666
C. 777
D. 888
Answer: B. 666

24. The cyclic arrangements of 258 are 258, 582, and 825. Their sum divided by 37 is:
A. 35

B. 40
C. 45
D. 50
Answer: C. 45

25. Which factorisation of 1001 explains why a repeated three-digit number is divisible by these numbers?
A. 7 × 11 × 13
B. 7 × 10 × 13
C. 9 × 11 × 13
D. 7 × 11 × 15
Answer: A. 7 × 11 × 13

26. Dividing 246246 by 1001 gives:
A. 24
B. 246
C. 2462
D. 24624
Answer: B. 246

27. A farm has 30 horses and hens altogether and 84 legs. How many horses are there?
A. 10
B. 12
C. 15
D. 18
Answer: B. 12

28. A farm has 55 horses and hens altogether and 150 legs. How many hens are there?
A. 20
B. 30
C. 35
D. 40
Answer: C. 35

29. A mother is five times her daughter's age. In six years, she will be three times her daughter's age. How old is the daughter now?
A. 5 years
B. 6 years
C. 8 years
D. 10 years
Answer: B. 6 years

30. A mother is four times her daughter's age. In eight years, she will be twice her daughter's age. How old is the daughter now?
A. 3 years
B. 4 years
C. 6 years
D. 8 years
Answer: B. 4 years

31. Naina has twice as many cows as Gauri. After Naina gives Gauri three cows, they have equal numbers. How many cows did Gauri have originally?
A. 3
B. 6
C. 9
D. 12
Answer: B. 6

32. Naina has three times as many cows as Gauri. If she gives Gauri four cows, they have equal numbers. How many cows did Naina have originally?
    A. 8
    B. 10
    C. 12
    D. 16
    Answer: C. 12
33. A dosa seller sells 100 dosas. Each costs Rs. 10 to make, the rent is Rs. 5,000, and the target profit is Rs. 2,000. What selling price per dosa is needed?
    A. Rs. 60
    B. Rs. 70
    C. Rs. 80
    D. Rs. 90
    Answer: C. Rs. 80
34. A dosa seller charges Rs. 50 per dosa, spends Rs. 10 to make each one, and pays Rs. 5,000 rent. How many dosas must be sold to make Rs. 2,000 profit?
    A. 150
    B. 160
    C. 175
    D. 200
    Answer: C. 175
35. A dosa seller charges Rs. 60 per dosa, spends Rs. 10 to make each one, and pays Rs. 5,000 rent. How many dosas must be sold to make Rs. 2,500 profit?
    A. 100
    B. 125
    C. 150
    D. 175
    Answer: C. 150
36. A person starts with 7 flowers. Each pond doubles the flowers, and 8 flowers are placed at each shrine. How many flowers remain after the first pond and offering?
    A. 4
    B. 6
    C. 8
    D. 14
    Answer: B. 6
37. In the magical ponds puzzle, a person starts with 7 flowers and places 8 flowers at each of three shrines. How many flowers are placed at the third shrine?
    A. 4
    B. 6
    C. 8
    D. 16
    Answer: C. 8
38. Karim starts with 8 coins. His coins double and he gives the genie 8 coins after each round. How many coins does he have after three rounds?
    A. 0
    B. 4
    C. 8
    D. 16
    Answer: C. 8

39. In a four-row number pyramid, the bottom row is a, b, c, and d. Which expression gives the top number?
    A. a + b + c + d
    B. a + 2b + 2c + d
    C. a + 3b + 3c + d
    D. 3a + b + c + 3d
    Answer: C. a + 3b + 3c + d
40. A four-row pyramid has bottom row 2, 5, 1, and 3. What is the top number?
    A. 20
    B. 21
    C. 22
    D. 23
    Answer: D. 23

6.15 Best Practices Opportunity List from the Chapter: (14 Ideas)

BEST PRACTICES FOR TEACHING "ALGEBRA PLAY":

(1) **Begin with familiar number tricks:** Invite students to try a "Think of a Number" trick with several starting numbers before introducing algebraic explanations.
(2) **Ask students to predict first:** Before completing a trick or puzzle, ask students to predict the result and explain what they expect to happen.
(3) **Connect each step to an expression:** Write a letter such as x for the starting number and translate each instruction into an algebraic expression.
(4) **Use a clear think-aloud demonstration:** Model how to simplify an expression step by step, explaining why the starting number cancels in a number trick.
(5) **Use counters or cards for number pyramids:** Let students build pyramids with number cards and check that each box equals the sum of the two boxes below it.
(6) **Teach calendar grids with a real calendar:** Ask students to choose 2 × 2 blocks, identify how the numbers change across rows and columns, and calculate the block totals.
(7) **Use a concrete-to-symbolic approach:** Begin with numbers, diagrams, or physical cards, then guide students to describe the same pattern using letters and equations.
(8) **Encourage more than one solution method:** Invite students to solve a missing-number pyramid or grid puzzle using either logical reasoning or algebraic equations, then compare the methods.
(9) **Organise pair explanations:** Have students solve a puzzle in pairs and take turns explaining each step to one another using mathematical language.
(10) **Check understanding with short tasks:** Use quick exit questions on pyramid rules, calendar grids, or digit-reversal tricks to identify concepts that need review.
(11) **Address common errors directly:** Discuss mistakes such as subtracting the wrong number in the date trick or forgetting that calendar numbers increase by 7 when moving down one row.
(12) **Use everyday contexts for equations:** Relate the chapter's age, animals, and dosa-cart problems to familiar situations so students can identify unknown quantities and form equations.
(13) **Promote clear mathematical communication:** Ask students to show the expression or equation behind an answer, rather than giving only the final number.
(14) **Provide varied levels of practice:** Offer simple completion problems first, followed by puzzles with missing values and problems that require students to explain why a pattern works.

6.16 Innovations Opportunity List from the Chapter: (14 Ideas)

INNOVATIONS IN TEACHING AND LEARNING "ALGEBRA PLAY":

(1) **Create a Number-Trick Challenge:** Students design a "Think of a Number" trick, test it with classmates, and use algebra to explain why it works.
(2) **Build a Calendar Puzzle Generator:** Use a spreadsheet to display calendar grids and calculate their totals, then ask students to work backwards from a total to find the grid.
(3) **Set Up a Pyramid Puzzle Station:** Provide sets of number cards that students arrange into pyramids, including puzzles with missing bottom, middle, or top numbers.
(4) **Make an Algebra Escape Challenge:** Create a sequence of short puzzles on number tricks, pyramids, and divisibility; students solve each one to reveal a code for the next task.
(5) **Use Digital Whiteboards for Group Reasoning:** Let groups build number pyramids or algebra grids on a shared digital board and annotate how they found the missing values.
(6) **Record a "Maths Trick Explained" Video:** Students demonstrate a number trick and add captions showing the algebra behind each step.
(7) **Introduce a Simple Coding Activity:** Use a beginner-friendly coding tool or spreadsheet formula to run a number trick for different starting values and observe the repeated result.
(8) **Create a Divisibility Investigation Wall:** Students post examples of two-digit numbers and their reverses, record differences and sums, and use the collected results to identify patterns.
(9) **Design a Classroom "Maths Magic" Show:** Students present a date trick, calendar puzzle, or digit-reversal trick and invite the audience to work out how it functions.
(10) **Use QR-Coded Puzzle Cards:** Place QR codes around the classroom that link to short clues or questions; each correct answer directs students to the next puzzle.
(11) **Connect Algebra to a Mini Business Simulation:** Run a dosa-cart activity where students vary selling price and number sold to calculate expenses, revenue, and profit.
(12) **Create Student-Made Puzzle Cards:** Ask each student to make a puzzle based on the chapter, include its solution on the back, and exchange cards for peer solving.
(13) **Use a Virtual Manipulative for Pyramids:** Students move digital number tiles into pyramid boxes and receive prompts when a box does not match the sum rule.
(14) **Build a Class Pattern Gallery:** Display student explanations of calendar grids, number pyramids, and divisibility tricks, including diagrams, equations, and worked examples.

6.17: Practicing Questions/Question Bank:

QUESTION BANK: CHAPTER 6 – ALGEBRA PLAY:

A. Fill in the Blanks:

1. In a number pyramid, each number is the _____ of the two numbers directly below it.
   Answer: Sum

2. In the first "Think of a Number" trick, the final answer is always _____.
   Answer: 2

3. In the date trick, D represents the _____.
   Answer: Day of the month

4. In a calendar, numbers in the same column increase by _____ when moving down one week.
   Answer: 7
5. The sum of the numbers in a 2 × 2 calendar grid with top-left number a is _____.
   Answer: 4a + 16
6. The difference between a two-digit number and its reverse is divisible by _____.
   Answer: 9
7. The sum of a two-digit number and its reverse is divisible by _____.
   Answer: 11
8. A number formed by repeating a three-digit number is 1001 times the original number.
   Answer: 1001

B. One-Mark Descriptive Questions:

1. **What is the rule for filling a number pyramid?**
   Answer: Add the two numbers directly below each empty box.
2. **What is the reverse of 47?**
   Answer: The reverse of 47 is 74.
3. **What is the sum of 31 and its reverse?**
   Answer: The sum is 31 + 13 = 44.
4. **Which digit should be used as the multiplier to make the largest product from three different digits?**
   Answer: Use the largest digit as the multiplier.

C. Two-Mark Descriptive Questions:

1. **A 2 × 2 calendar grid has 5 as its top-left number. Find the other three numbers and the total.**
   Answer:
   1. The other numbers are 6, 12, and 13.
   2. The total is 5 + 6 + 12 + 13 = 36.
2. **Find the top number of a pyramid with bottom row 3, 4, and 2.**
   Answer:
   1. The top number is 3 + 2 × 4 + 2.
   2. The top number is 13.
3. **In the date trick, the final answer is 1390. Find the date.**
   Answer:
   1. Subtract 165 from 1390 to get 1225.
   2. The date is 25 December.
4. **Reverse 62 and divide the difference between the two numbers by 9.**
   Answer:
   1. The reverse of 62 is 26, and their difference is 36.

2. The quotient is $36 \div 9 = 4$.

D. Three-Mark Descriptive Questions:

1. **Complete a pyramid with bottom row 1, 9, and 4.**
   Answer:
   1. Add 1 and 9 to get 10.
   2. Add 9 and 4 to get 13.
   3. Add 10 and 13 to get the top number, 23.
2. **Explain why the "Think of a Number" trick always gives 2.**
   Answer:
   1. Let the chosen number be x.
   2. The steps give x + 2 before subtracting the original number.
   3. Subtracting x leaves 2.
3. **A 2 × 2 calendar grid has a total of 52. Find its four numbers.**
   Answer:
   1. Use $52 = 4a + 16$ to find $a = 9$.
   2. The numbers to the right and below are 10 and 16.
   3. The bottom-right number is 17, so the grid is 9, 10, 16, and 17.
4. **Find the largest product using the digits 2, 3, and 5 once each.**
   Answer:
   1. Use the largest digit, 5, as the multiplier.
   2. Arrange the other digits in decreasing order to make 32.
   3. The largest product is $32 \times 5 = 160$.

E. Five-Mark Descriptive Questions:

1. **Use the date trick to find the date represented by the final answer 291.**
   Answer:
   1. Subtract 165 from 291.
   2. The result is 126.
   3. The last two digits, 26, give the day.
   4. The remaining digit, 1, gives the month.
   5. The date is 26 January.
2. **A farm has 55 horses and hens altogether and 150 legs. Find the number of each animal.**
   Answer:
   1. If all 55 animals were hens, they would have 110 legs.
   2. The farm has 40 more legs than this.

3. Each horse has two more legs than a hen.
4. Therefore, the number of horses is 40 ÷ 2 = 20.
5. The farm has 35 hens.

3. **A mother is five times her daughter's age. In six years, she will be three times her daughter's age. Find their present ages.**
   Answer:
   1. Let the daughter's age be d years.
   2. The mother's age is 5d years.
   3. In six years, their ages will be d + 6 and 5d + 6.
   4. Solve 5d + 6 = 3(d + 6) to get d = 6.
   5. The daughter is 6 years old and the mother is 30 years old.
4. **A dosa seller sells 100 dosas and wants a profit of Rs. 2,000. The rent is Rs. 5,000 and each dosa costs Rs. 10 to make. Find the selling price per dosa.**
   Answer:
   1. The cost of making 100 dosas is Rs. 1,000.
   2. Total expenses, including rent, are Rs. 6,000.
   3. The required revenue is Rs. 6,000 + Rs. 2,000 = Rs. 8,000.
   4. Divide Rs. 8,000 by 100 dosas.
   5. The selling price should be Rs. 80 per dosa.

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8th Standard Maths Part 2 Book Chapter 7

Chapter 7: AREA

7.1 Summary of the Chapter:

AREA – CHAPTER SUMMARY:

(1) Area measures the surface covered by a two-dimensional shape. It is found by counting the unit squares that fit within the shape.

(2) The area of a rectangle is calculated by multiplying its length by its width: Area = length × width. Area is expressed in square units, such as cm^2 or m^2.

(3) A rectangle's diagonal divides it into two congruent triangles. Each triangle has half the area of the rectangle.

(4) Perimeter and area measure different properties. Shapes with the same perimeter can have different areas, and a shape with a greater perimeter may have a smaller area.

(5) The area of a triangle is half the product of its base and corresponding height: Area = ½ × base × height. This formula applies to all types of triangles.

(6) Triangles on the same base and between the same parallel lines have equal areas. A line joining a triangle's vertex to the midpoint of the opposite side divides it into two equal-area triangles.

(7) A polygon can be divided into triangles. Its area can therefore be found by calculating the areas of the triangles and adding them together.

(8) A parallelogram can be cut and rearranged into a rectangle of equal area. Its area is the product of a base and its corresponding height: Area = base × height.

(9) A rhombus's area can be found using its diagonals: Area = ½ × diagonal 1 × diagonal 2.

(10) A trapezium's area is half the product of its height and the sum of its parallel sides: Area = ½ × height × (parallel side 1 + parallel side 2).

(11) Dissection is the process of cutting a shape into pieces and rearranging them to form another shape with the same area.

(12) The chapter connects area problems with practical and historical contexts, including paths around parks, rangoli, shortest routes, and geometric methods described in the Śulba-Sūtras.

7.2 Important Formulas:

IMPORTANT FORMULAS – CHAPTER 7: AREA:

(1) Area of a rectangle = length × width
$A = l \times w$

(2) Area of a square = side × side
$A = s^2$

(3) Area of a triangle = ½ × base × corresponding height
$A = \frac{1}{2} \times b \times h$

(4) Area of a parallelogram = base × corresponding height
$A = b \times h$

(5) Area of a rhombus = ½ × product of its diagonals
$A = \frac{1}{2} \times d_1 \times d_2$

(6) Area of a trapezium = ½ × height × sum of the parallel sides
$A = \frac{1}{2} \times h \times (a + b)$

(7) Area of a polygon = sum of the areas of the triangles into which it is divided
$A = A_1 + A_2 + A_3 + \ldots$

(8) Area of a path or border around a shape = area of the outer shape − area of the inner shape
A_path = A_outer − A_inner

(9) Area of a cross-shaped path can be found by adding the areas of its rectangular strips and subtracting any overlapping area
A_path = $A_1 + A_2 - A_{overlap}$

(10) Area of each of the two triangles formed by a rectangle's diagonal = ½ × area of the rectangle
A_triangle = ½ × (l × w)

(11) If two triangles have equal bases and the same height, their areas are equal
$A_1 = ½ \times b \times h$; $A_2 = ½ \times b \times h$; therefore, $A_1 = A_2$

(12) If a triangle is divided by a line from a vertex to the midpoint of the opposite side, the two resulting triangles have equal areas
$A_1 = A_2 = ½ \times$ area of the original triangle

Note: In triangle and parallelogram formulas, the height must be perpendicular to the chosen base. Area is written in square units, such as cm^2 or m^2.

7.3 Fill-Up the Blank LOTS type questions with Answers: (45 Questions)

FILL IN THE BLANKS – LOTS TYPE:

1. The amount of surface covered by a two-dimensional region is called its _____.
   Answer: area
2. Area is measured by counting the number of _____ squares that cover a region.
   Answer: unit
3. A square with a side length of 1 cm has an area of 1 _____.
   Answer: cm^2
4. The area of a rectangle is found by multiplying its length by its _____.
   Answer: width
5. The formula for the area of a rectangle is _____ × width.
   Answer: length
6. A rectangle that is 7 cm long and 4 cm wide has an area of _____ cm^2.
   Answer: 28
7. A rectangle that is 8 cm long and 3 cm wide has an area of _____ cm^2.
   Answer: 24
8. The area of a rectangle with sides 5 cm and 6 cm is _____ cm^2.
   Answer: 30
9. The area of a rectangle with sides 9 m and 2 m is _____ m^2.
   Answer: 18
10. Area is expressed in _____ units.
    Answer: square
11. The diagonal of a rectangle divides it into two _____ triangles.
    Answer: congruent
12. Each triangle formed by a diagonal of a rectangle has _____ the area of the rectangle.
    Answer: half
13. The area of a triangle is half the product of its base and corresponding _____.
    Answer: height
14. The formula for the area of a triangle is _____ × base × height.
    Answer: ½
15. In a triangle, the height must be _____ to the chosen base.
    Answer: perpendicular

16. A triangle with base 8 cm and height 5 cm has an area of _____ cm².
    Answer: 20
17. A triangle with base 10 m and height 6 m has an area of _____ m².
    Answer: 30
18. The area of a triangle with base 12 cm and height 4 cm is _____ cm².
    Answer: 24
19. A line joining a vertex of a triangle to the midpoint of the opposite side divides it into two triangles of _____ areas.
    Answer: equal
20. Triangles with equal bases and the same height have _____ areas.
    Answer: equal
21. Triangles on the same base and between the same parallel lines have _____ areas.
    Answer: equal
22. Any polygon can be divided into _____.
    Answer: triangles
23. The area of a polygon can be found by adding the areas of its _____.
    Answer: triangles
24. The process of cutting a shape into pieces and rearranging them to form another shape of equal area is called _____.
    Answer: dissection
25. A parallelogram can be rearranged into a _____ of equal area.
    Answer: rectangle
26. The area of a parallelogram is equal to its base multiplied by its corresponding _____.
    Answer: height
27. The area of a parallelogram with base 7 cm and height 4 cm is _____ cm².
    Answer: 28
28. The height of a parallelogram is measured at a _____ angle to its base.
    Answer: right
29. A rhombus is a special type of _____.
    Answer: parallelogram
30. The area of a rhombus is half the product of its _____.
    Answer: diagonals
31. The formula for the area of a rhombus is ½ × diagonal 1 × _____.
    Answer: diagonal 2
32. A rhombus with diagonals 10 cm and 8 cm has an area of _____ cm².
    Answer: 40
33. The diagonals of a rhombus intersect at _____ angles.
    Answer: right
34. A trapezium has one pair of _____ sides.
    Answer: parallel
35. The area of a trapezium is half the product of its height and the _____ of its parallel sides.
    Answer: sum
36. The formula for the area of a trapezium is ½ × height × (a + _____).
    Answer: b
37. A trapezium has parallel sides of 6 cm and 10 cm and height 4 cm. Its area is _____ cm².
    Answer: 32

38. A trapezium has parallel sides of 8 m and 12 m and height 5 m. Its area is _____ m².
    Answer: 50
39. To find the area of a path around a rectangular park, subtract the area of the _____ rectangle from the area of the outer rectangle.
    Answer: inner
40. Two regions with the same perimeter may have _____ areas.
    Answer: different
41. Perimeter measures the length of a region's _____.
    Answer: boundary
42. The area of a rectangle measuring 4 cm by 3 cm is _____ cm².
    Answer: 12
43. A rectangle measuring 20 m by 5 m has an area of _____ m².
    Answer: 100
44. If the area of a rectangle is 35 cm² and its length is 7 cm, its width is _____ cm.
    Answer: 5
45. The ancient Indian geometric texts called the Śulba-Sūtras discuss methods for transforming shapes into other shapes of the same _____.
    Answer: area

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

FILL IN THE BLANKS – HOTS TYPE:

1. A square has a side of 4 cm. If its side is doubled, its new area is _____ cm².
   Answer: 64
2. When the side of a square is doubled, its area becomes _____ times the original area.
   Answer: 4
3. A rectangle measures 12 cm by 5 cm. A triangle with base 12 cm and height 5 cm has an area that is _____ the rectangle's area.
   Answer: half
4. Two triangles have the same base and equal heights. Their areas are _____.
   Answer: equal
5. Two triangles lie between the same parallel lines and share a common base. Their areas are _____.
   Answer: equal
6. A triangle has a base of 10 cm and a height of 6 cm. If the height is doubled while the base stays the same, the new area is _____ cm².
   Answer: 60
7. A triangle has an area of 24 cm² and a base of 8 cm. Its corresponding height is _____ cm.
   Answer: 6
8. A triangle has an area of 30 cm² and a height of 5 cm. Its base is _____ cm.
   Answer: 12
9. A line from a triangle's vertex meets the midpoint of the opposite side. The two triangles formed have _____ areas.
   Answer: equal
10. A rectangle has an area of 72 cm². Its diagonal divides it into two triangles, each with an area of _____ cm².
    Answer: 36

11. A rectangle measures 9 m by 4 m. One of its diagonals forms a triangle with area _____ m^2.
    Answer: 18
12. A parallelogram has a base of 8 cm and a height of 5 cm. A rectangle with the same base and height has an area _____ to that of the parallelogram.
    Answer: equal
13. A parallelogram has an area of 48 cm^2 and a base of 12 cm. Its corresponding height is _____ cm.
    Answer: 4
14. A parallelogram's base remains unchanged while its height is halved. Its new area is _____ the original area.
    Answer: half
15. A parallelogram has a base of 10 cm and a perpendicular height of 6 cm. Its area is _____ cm^2.
    Answer: 60
16. A rhombus has diagonals of 16 cm and 10 cm. Its area is _____ cm^2.
    Answer: 80
17. A rhombus has an area of 54 cm^2 and one diagonal of 9 cm. The other diagonal is _____ cm.
    Answer: 12
18. A rhombus has diagonals of 12 cm and 8 cm. If the shorter diagonal is doubled, its new area is _____ cm^2.
    Answer: 96
19. A trapezium has parallel sides of 7 cm and 13 cm and a height of 5 cm. Its area is _____ cm^2.
    Answer: 50
20. A trapezium has parallel sides of 8 cm and 14 cm. If its height is doubled from 3 cm to 6 cm, its new area is _____ cm^2.
    Answer: 66
21. A trapezium has an area of 60 cm^2, parallel sides of 8 cm and 12 cm, and an unknown height. Its height is _____ cm.
    Answer: 6
22. Two trapeziums have the same height and the same sum of parallel sides. Their areas are _____.
    Answer: equal
23. A rectangular park measures 20 m by 12 m. A path surrounds it, and the outer rectangle measures 24 m by 16 m. The path's area is _____ m^2.
    Answer: 144
24. An outer rectangular region has an area of 300 m^2, and the inner park has an area of 224 m^2. The surrounding path has an area of _____ m^2.
    Answer: 76
25. A rectangular path around a park is part of an outer rectangle measuring 18 m by 14 m. The park measures 14 m by 10 m. The path's area is _____ m^2.
    Answer: 112
26. A rectangle has a perimeter of 20 cm and dimensions 2 cm by 8 cm. Its area is _____ cm^2.
    Answer: 16
27. A square has the same perimeter as the 2 cm by 8 cm rectangle in Question 26. Its side is 5 cm, and its area is _____ cm^2.
    Answer: 25

28. The two shapes in Questions 26 and 27 have equal perimeters, but the square's area is _____ cm^2 greater.
    Answer: 9
29. A polygon is divided into three triangles with areas of 12 cm^2, 15 cm^2, and 18 cm^2. The polygon's total area is _____ cm^2.
    Answer: 45
30. A quadrilateral is divided by a diagonal into two triangles with areas of 24 cm^2 and 31 cm^2. Its area is _____ cm^2.
    Answer: 55
31. A rectangle is 10 cm long and 6 cm wide. It is divided into two equal-area triangles by a diagonal. Each triangle has an area of _____ cm^2.
    Answer: 30
32. Four triangles formed by the diagonals of a rectangle have _____ areas, even though they need not be congruent.
    Answer: equal
33. Two triangles have equal bases of 8 cm. Their heights are 5 cm and 7 cm. The difference between their areas is _____ cm^2.
    Answer: 8
34. Two parallelograms have equal bases of 9 cm and heights of 4 cm and 6 cm. The difference between their areas is _____ cm^2.
    Answer: 18
35. A rectangle measures 7 cm by 4 cm, while another measures 8 cm by 3 cm. The first rectangle has an area _____ cm^2 greater than the second.
    Answer: 4
36. A square is divided into four regions of equal area. If the square's area is 100 cm^2, each region has an area of _____ cm^2.
    Answer: 25
37. A triangle and a parallelogram have the same base and height. The triangle's area is _____ the parallelogram's area.
    Answer: half
38. A trapezium has parallel sides of 10 cm and 18 cm and a height of 7 cm. A triangle with base 14 cm and height 7 cm has an area _____ cm^2 less than the trapezium.
    Answer: 28
39. A rhombus has diagonals of 14 cm and 6 cm. A rectangle of equal area has dimensions 7 cm by _____ cm.
    Answer: 6
40. A region's area is found by counting unit squares, while its perimeter measures the length of its _____.
    Answer: boundary

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

ONE-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. What is area?
   Answer: Area is the measure of the surface covered by a two-dimensional region.
2. How can the area of a region be measured?
   Answer: It can be measured by counting the unit squares that cover the region.
3. What is the formula for the area of a rectangle?
   Answer: Area of a rectangle = length × width.
4. What is the area of a rectangle that is 6 cm long and 4 cm wide?
   Answer: Its area is 24 cm^2.

5. What is the area of a rectangle that is 9 m long and 3 m wide?
   Answer: Its area is 27 m².
6. What unit is used to express the area of a surface?
   Answer: Area is expressed in square units.
7. What is the area of a square with a side of 5 cm?
   Answer: Its area is 25 cm².
8. What does the diagonal of a rectangle do to its area?
   Answer: It divides the rectangle into two triangles of equal area.
9. What fraction of a rectangle's area is the area of each triangle formed by its diagonal?
   Answer: Each triangle has half the area of the rectangle.
10. What is the formula for the area of a triangle?
    Answer: Area of a triangle = ½ × base × corresponding height.
11. Find the area of a triangle with base 8 cm and height 5 cm.
    Answer: Its area is 20 cm².
12. Find the area of a triangle with base 12 m and height 3 m.
    Answer: Its area is 18 m².
13. What must be the direction of a triangle's height in relation to its base?
    Answer: The height must be perpendicular to the base.
14. What is the area of a triangle with base 10 cm and height 4 cm?
    Answer: Its area is 20 cm².
15. What kind of line divides a triangle into two equal-area triangles when drawn from a vertex?
    Answer: A line joining a vertex to the midpoint of the opposite side divides it into two equal-area triangles.
16. What can be said about triangles on the same base and between the same parallel lines?
    Answer: They have equal areas.
17. What is the area of a parallelogram with base 7 cm and height 4 cm?
    Answer: Its area is 28 cm².
18. What is the formula for the area of a parallelogram?
    Answer: Area of a parallelogram = base × corresponding height.
19. What is the height of a parallelogram called when it is measured at right angles to its base?
    Answer: It is the perpendicular height.
20. What process involves cutting a shape into pieces and rearranging them to form another shape of equal area?
    Answer: This process is called dissection.
21. Into what shape can a parallelogram be rearranged by dissection to find its area?
    Answer: It can be rearranged into a rectangle of equal area.
22. What type of quadrilateral is a rhombus?
    Answer: A rhombus is a parallelogram with all sides equal.
23. What is the formula for the area of a rhombus using its diagonals?
    Answer: Area of a rhombus = ½ × diagonal 1 × diagonal 2.
24. Find the area of a rhombus with diagonals 10 cm and 8 cm.
    Answer: Its area is 40 cm².
25. What is the relationship between the diagonals of a rhombus?
    Answer: The diagonals of a rhombus bisect each other at right angles.
26. What is the formula for the area of a trapezium?
    Answer: Area of a trapezium = ½ × height × sum of the parallel sides.

27. Find the area of a trapezium with parallel sides 6 cm and 10 cm and height 4 cm.
    Answer: Its area is 32 cm^2.
28. What is the height of a trapezium?
    Answer: It is the perpendicular distance between its parallel sides.
29. How can the area of a quadrilateral be found by using a diagonal?
    Answer: Divide it into two triangles, find their areas, and add them.
30. How can the area of any polygon be found?
    Answer: Divide the polygon into triangles and add their areas.
31. What is the area of a polygon divided into triangles of areas 10 cm^2 and 15 cm^2?
    Answer: Its area is 25 cm^2.
32. What formula can be used to find the area of a path around a rectangular park?
    Answer: Area of the path = area of the outer rectangle − area of the inner rectangle.
33. What is the area of a rectangle measuring 8 cm by 5 cm?
    Answer: Its area is 40 cm^2.
34. What is the area of a rectangle measuring 7 m by 6 m?
    Answer: Its area is 42 m^2.
35. What does the perimeter of a region measure?
    Answer: Perimeter measures the length of the region's boundary.
36. Can two regions with the same perimeter have different areas?
    Answer: Yes, two regions with the same perimeter can have different areas.
37. Is the area of a region determined by its perimeter alone?
    Answer: No, perimeter alone does not determine the area of a region.
38. What happens to the area of a square if its side length is doubled?
    Answer: Its area becomes four times the original area.
39. What are the areas of triangles 1, 2, 3, and 4 formed by the diagonals of a rectangle?
    Answer: The four triangles have equal areas.
40. Which ancient Indian texts discussed geometric constructions involving areas?
    Answer: The Śulba-Sūtras discussed geometric constructions involving areas.

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

ONE-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. A triangle's base stays the same while its height is doubled; how does its area change?
   Answer: Its area doubles.
2. A triangle's base is doubled while its height is halved; how does its area change?
   Answer: Its area remains unchanged.
3. A square has a side of 3 cm; what is the increase in its area when its side is doubled?
   Answer: Its area increases by 27 cm^2, from 9 cm^2 to 36 cm^2.
4. A square has an area of 25 cm^2; what is its new area if its side is doubled?
   Answer: Its new area is 100 cm^2.
5. A parallelogram has a base of 12 cm and a height of 5 cm; what height corresponds to a base of 10 cm if the area stays the same?
   Answer: The corresponding height is 6 cm.
6. A rhombus has diagonals of 10 cm and 8 cm; what is its area if the 8 cm diagonal is doubled?
   Answer: Its area becomes 80 cm^2.
7. A trapezium has parallel sides of 8 cm and 12 cm and a height of 5 cm; what is its area?
   Answer: Its area is 50 cm^2.

8. A rectangular path surrounds a park measuring 20 m by 14 m, and the outer rectangle measures 24 m by 18 m; what is the path's area?
   Answer: The path's area is 152 m^2.
9. Two rectangles measure 4 cm by 8 cm and 6 cm by 6 cm; which has the greater area and by how much?
   Answer: The 6 cm by 6 cm rectangle has 4 cm^2 more area.
10. A pentagon is divided into triangles with areas of 12 cm^2, 18 cm^2, and 20 cm^2; what is its total area?
    Answer: Its total area is 50 cm^2.
11. A parallelogram and a triangle have the same base and height; what fraction of the parallelogram's area is the triangle's area?
    Answer: The triangle's area is half the parallelogram's area.
12. Two triangles have equal areas and equal heights; what can be said about their bases?
    Answer: Their bases are equal.
13. A trapezium has parallel sides of 7 cm and 13 cm and an area of 60 cm^2; what is its height?
    Answer: Its height is 6 cm.
14. A trapezium has an area of 45 cm^2, a height of 5 cm, and one parallel side of 8 cm; what is the other parallel side?
    Answer: The other parallel side is 10 cm.
15. A rectangle has an area of 84 cm^2 and a width of 7 cm; what is its length?
    Answer: Its length is 12 cm.
16. A triangle has the same base and height as a 10 cm by 6 cm rectangle; what is the triangle's area?
    Answer: The triangle's area is 30 cm^2.
17. A parallelogram has a base of 9 cm and a height of 4 cm; what is its area?
    Answer: Its area is 36 cm^2.
18. A rhombus has diagonals of 14 cm and 6 cm; what is its area?
    Answer: Its area is 42 cm^2.
19. A square's side is tripled; how many times its original area does its new area become?
    Answer: Its new area becomes nine times the original area.
20. A rectangle's length is doubled and its width stays the same; how does its area change?
    Answer: Its area doubles.
21. A rectangle's length and width are both doubled; how does its area change?
    Answer: Its area becomes four times as large.
22. A rectangle measuring 7 cm by 4 cm and one measuring 8 cm by 3 cm have what difference in area?
    Answer: The first rectangle has 4 cm^2 more area.
23. A rectangle's area is 48 cm^2 and its length is 8 cm; what is its width?
    Answer: Its width is 6 cm.
24. A triangle has a base of 15 cm and an area of 60 cm^2; what is its height?
    Answer: Its height is 8 cm.
25. Two triangles share a base and have their third vertices on the same line parallel to that base; how do their areas compare?
    Answer: Their areas are equal.
26. A rectangle has an area of 96 cm^2; what is the area of each triangle formed by one diagonal?
    Answer: Each triangle has an area of 48 cm^2.

27. A quadrilateral is divided by a diagonal into triangles of areas 24 cm² and 31 cm²; what is the quadrilateral's area?
    Answer: Its area is 55 cm².
28. An outer rectangle has an area of 360 m² and an inner park has an area of 252 m²; what is the area of the path between them?
    Answer: The path's area is 108 m².
29. A rectangle has dimensions 2 cm by 8 cm, and a square has the same perimeter; which shape has the larger area?
    Answer: The square has the larger area.
30. The square in Question 29 has an area of 25 cm²; what is the area of the rectangle?
    Answer: The rectangle's area is 16 cm².
31. A triangle is divided into two parts by a line from one vertex to the midpoint of the opposite side; what fraction of the original area is each part?
    Answer: Each part is half of the original area.
32. A parallelogram's height is reduced to one-third while its base stays the same; what fraction of its original area remains?
    Answer: One-third of its original area remains.
33. A rhombus has an area of 48 cm² and one diagonal is 12 cm; what is the other diagonal?
    Answer: The other diagonal is 8 cm.
34. A trapezium has parallel sides of 9 cm and 15 cm; what is its area if its height is 4 cm?
    Answer: Its area is 48 cm².
35. A rectangular region is divided into four equal-area parts; what fraction of the rectangle's area does each part have?
    Answer: Each part has one-fourth of the rectangle's area.
36. A parallelogram and rectangle have equal bases and equal heights; how do their areas compare?
    Answer: Their areas are equal.
37. Two regions have the same perimeter but different shapes; can their areas be assumed to be equal?
    Answer: No, equal perimeters do not guarantee equal areas.
38. A polygon is divided into four triangles of areas 8 cm², 10 cm², 12 cm², and 15 cm²; what is its area?
    Answer: Its area is 45 cm².
39. A triangle's base is tripled while its height stays the same; how does its area change?
    Answer: Its area becomes three times as large.
40. The area of a trapezium is 70 cm², its parallel sides are 9 cm and 11 cm, and its height is unknown; what is its height?
    Answer: Its height is 7 cm.

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

TWO-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. Define area and state how it is measured.
   Answer:

- Area is the measure of the surface covered by a two-dimensional region.
- It is measured by counting unit squares.

2. Find the area of a rectangle that is 14 cm long and 5 cm wide.
   Answer:

- Area = length × width = 14 × 5.

- The area is 70 cm².

3. A rectangle has an area of 96 cm² and a length of 12 cm; find its width.
   Answer:
- Width = area ÷ length = 96 ÷ 12.
- The width is 8 cm.

4. Find the area of a square with a side of 9 cm.
   Answer:
- Area = side × side = 9 × 9.
- The area is 81 cm².

5. State the formula for the area of a triangle and find the area when its base is 14 cm and height is 6 cm.
   Answer:
- Area of a triangle = ½ × base × height = ½ × 14 × 6.
- The area is 42 cm².

6. A triangle has an area of 45 cm² and a base of 15 cm; find its height.
   Answer:
- Height = 2 × area ÷ base = 90 ÷ 15.
- The height is 6 cm.

7. Find the area of a parallelogram with a base of 11 cm and a corresponding height of 5 cm.
   Answer:
- Area = base × height = 11 × 5.
- The area is 55 cm².

8. A parallelogram has an area of 72 cm² and a base of 9 cm; find its corresponding height.
   Answer:
- Height = area ÷ base = 72 ÷ 9.
- The height is 8 cm.

9. Find the area of a rhombus whose diagonals are 18 cm and 10 cm.
   Answer:
- Area = ½ × diagonal 1 × diagonal 2 = ½ × 18 × 10.
- The area is 90 cm².

10. A rhombus has an area of 84 cm² and one diagonal of 14 cm; find the other diagonal.
    Answer:
- Other diagonal = 2 × area ÷ given diagonal = 168 ÷ 14.
- The other diagonal is 12 cm.

11. Find the area of a trapezium with parallel sides of 8 cm and 12 cm and a height of 5 cm.
    Answer:
- Area = ½ × height × sum of parallel sides = ½ × 5 × (8 + 12).
- The area is 50 cm².

12. A trapezium has an area of 72 cm² and a height of 8 cm; the sum of its parallel sides is 18 cm; verify the area.
    Answer:
- Area = ½ × 8 × 18 = 72.
- The calculated area is 72 cm².

13. A polygon is divided into triangles with areas of 12 cm², 18 cm², and 20 cm²; find its area.
    Answer:

- Add the areas of the triangles: 12 + 18 + 20 = 50.
- The polygon's area is 50 cm².

14. A rectangular park measures 16 m by 12 m, and the outer rectangle measures 20 m by 16 m; find the area of the path.
    Answer:
- Outer area = 20 × 16 = 320 m², and park area = 16 × 12 = 192 m².
- Path area = 320 − 192 = 128 m².

15. Find the area of each triangle formed by a diagonal in a rectangle measuring 10 cm by 8 cm.
    Answer:
- Rectangle area = 10 × 8 = 80 cm².
- Each triangle has half the rectangle's area, which is 40 cm².

16. A triangle has an area of 60 cm²; find the area of each half when it is divided by a line from a vertex to the midpoint of the opposite side.
    Answer:
- The line divides the triangle into two equal-area triangles.
- Each smaller triangle has an area of 30 cm².

17. State what can be said about triangles on the same base and between the same parallel lines.
    Answer:
- Such triangles have the same base and the same height.
- Their areas are equal.

18. Find the area of a rectangle that is 9 m long and 7 m wide.
    Answer:
- Area = length × width = 9 × 7.
- The area is 63 m².

19. A parallelogram has an area of 120 cm² and a base of 15 cm; find its corresponding height.
    Answer:
- Height = area ÷ base = 120 ÷ 15.
- The height is 8 cm.

20. Find the area of a rhombus with diagonals of 12 cm and 9 cm.
    Answer:
- Area = ½ × 12 × 9.
- The area is 54 cm².

21. Find the area of a trapezium with parallel sides of 6 cm and 14 cm and a height of 3 cm.
    Answer:
- Area = ½ × 3 × (6 + 14).
- The area is 30 cm².

22. A rectangle is divided into two triangles by a diagonal; describe the areas of the two triangles.
    Answer:
- The diagonal divides the rectangle into two congruent triangles.
- The triangles have equal areas.

23. State how the area of a polygon can be found by using triangles.
    Answer:
- Divide the polygon into triangles.
- Add the areas of all the triangles.

24. State the formula for the area of a parallelogram and identify the measurements required.
    Answer:
- Area = base × corresponding height.
- The base and its perpendicular height are required.

25. State the formula for the area of a trapezium and identify the measurements required.
    Answer:
- Area = ½ × height × sum of the parallel sides.
- The height and lengths of both parallel sides are required.

26. What is dissection in geometry?
    Answer:
- Dissection means cutting a shape into pieces.
- The pieces are rearranged to form another shape of equal area.

27. Explain why perimeter cannot be used as a measure of area.
    Answer:
- Perimeter measures the length of a region's boundary.
- Regions with the same perimeter can have different areas.

28. A rectangle has a length of 18 cm and a width of 4 cm; find its area.
    Answer:
- Area = 18 × 4.
- The area is 72 cm².

29. A triangle has a base of 12 m and a height of 7 m; find its area.
    Answer:
- Area = ½ × 12 × 7.
- The area is 42 m².

30. A square is divided into four equal-area regions and has a total area of 100 cm²; find the area of each region.
    Answer:
- Divide the total area by 4: 100 ÷ 4 = 25.
- Each region has an area of 25 cm².

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

TWO-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. A rectangle measures 12 cm by 5 cm. If its length is doubled and its width stays the same, what is its new area and how does it compare with the original area?
   Answer:
   (i) Original area = 12 × 5 = 60 cm².
   (ii) New area = 24 × 5 = 120 cm², which is double the original area.
2. A triangle has a base of 12 cm and a height of 5 cm. If its base is halved and its height is doubled, what is its new area?
   Answer:
   (i) Original area = ½ × 12 × 5 = 30 cm².
   (ii) New area = ½ × 6 × 10 = 30 cm², so the area is unchanged.
3. A square has a side of 6 cm. Find the increase in its area when its side is doubled.
   Answer:
   (i) Original area = 6 × 6 = 36 cm²; new area = 12 × 12 = 144 cm².
   (ii) The area increases by 144 − 36 = 108 cm².

4. A triangle and a parallelogram have the same base of 10 cm and height of 6 cm. Compare their areas.
   Answer:
   (i) Triangle area = ½ × 10 × 6 = 30 cm².
   (ii) Parallelogram area = 10 × 6 = 60 cm², which is twice the triangle's area.
5. A rhombus has diagonals of 16 cm and 12 cm. Find its area and the area if the 12 cm diagonal is halved.
   Answer:
   (i) Original area = ½ × 16 × 12 = 96 cm².
   (ii) New area = ½ × 16 × 6 = 48 cm².
6. A trapezium has parallel sides of 8 cm and 14 cm and a height of 5 cm. Find its area.
   Answer:
   (i) Add the parallel sides: 8 + 14 = 22 cm.
   (ii) Area = ½ × 5 × 22 = 55 cm².
7. A rectangular park measures 24 m by 16 m, and the surrounding outer rectangle measures 30 m by 22 m. Find the area of the path.
   Answer:
   (i) Outer area = 30 × 22 = 660 m²; park area = 24 × 16 = 384 m².
   (ii) Path area = 660 − 384 = 276 m².
8. A rectangle measures 2 cm by 10 cm. A square has the same perimeter as the rectangle and a side of 6 cm. Compare their areas.
   Answer:
   (i) Rectangle area = 2 × 10 = 20 cm²; square area = 6 × 6 = 36 cm².
   (ii) The square's area is 16 cm² greater.
9. Two triangles have the same base of 14 cm and heights of 4 cm and 7 cm. Find the difference between their areas.
   Answer:
   (i) Their areas are ½ × 14 × 4 = 28 cm² and ½ × 14 × 7 = 49 cm².
   (ii) The difference between their areas is 49 − 28 = 21 cm².
10. A trapezium has an area of 48 cm², a height of 6 cm, and one parallel side of 8 cm. Find the other parallel side.
    Answer:
    (i) The sum of the parallel sides is 2 × 48 ÷ 6 = 16 cm.
    (ii) The other parallel side is 16 − 8 = 8 cm.
11. One parallelogram has a base of 12 cm and height of 7 cm. Another has a base of 7 cm and height of 12 cm. Compare their areas.
    Answer:
    (i) First area = 12 × 7 = 84 cm².
    (ii) Second area = 7 × 12 = 84 cm², so their areas are equal.
12. A triangle has an area of 72 cm² and is divided by a line from a vertex to the midpoint of the opposite side. Find the area of each smaller triangle.
    Answer:
    (i) The line divides the triangle into two equal-area triangles.
    (ii) Each smaller triangle has an area of 72 ÷ 2 = 36 cm².
13. A polygon is divided into four triangles with areas of 8 cm², 12 cm², 15 cm², and 20 cm². Find the polygon's area.
    Answer:
    (i) Add the triangle areas: 8 + 12 + 15 + 20 = 55 cm².
    (ii) The polygon's area is 55 cm².

14. Two triangles share the same base and have their third vertices on a line parallel to the base. How do their areas compare?
    Answer:
    (i) Both triangles have the same base and the same height.
    (ii) Their areas are equal.
15. A triangle has an area of 48 cm² and a base of 12 cm. Find its height, then find the height needed if its base is reduced to 8 cm while its area stays the same.
    Answer:
    (i) Original height = 2 × 48 ÷ 12 = 8 cm.
    (ii) New height = 2 × 48 ÷ 8 = 12 cm.
16. A rectangle measures 14 cm by 8 cm and is divided by a diagonal. Find the area of each resulting triangle.
    Answer:
    (i) Rectangle area = 14 × 8 = 112 cm².
    (ii) Each triangle has an area of 112 ÷ 2 = 56 cm².
17. A rectangle measuring 4 cm by 8 cm and a square with side 6 cm have the same perimeter. Compare their areas.
    Answer:
    (i) Rectangle area = 4 × 8 = 32 cm²; square area = 6 × 6 = 36 cm².
    (ii) The square has 4 cm² more area despite having the same perimeter.
18. An outer rectangle has an area of 500 m², and the rectangular park inside it has an area of 320 m². Find the area of the surrounding path.
    Answer:
    (i) Path area = outer area − park area.
    (ii) Path area = 500 − 320 = 180 m².
19. A rectangle measures 12 cm by 8 cm. A parallelogram has the same base of 12 cm but a height of 7 cm. Compare their areas.
    Answer:
    (i) Rectangle area = 12 × 8 = 96 cm²; parallelogram area = 12 × 7 = 84 cm².
    (ii) The rectangle's area is 12 cm² greater.
20. A rhombus has diagonals of 10 cm and 12 cm. A rectangle has a base of 10 cm and a height of 6 cm. Compare their areas.
    Answer:
    (i) Rhombus area = ½ × 10 × 12 = 60 cm².
    (ii) Rectangle area = 10 × 6 = 60 cm², so the areas are equal.
21. A square's side is tripled. State how its area changes and give the area ratio.
    Answer:
    (i) The new area is 3 × 3 = 9 times the original area.
    (ii) The ratio of the new area to the original area is 9:1.
22. A trapezium has an area of 90 cm² and parallel sides of 12 cm and 18 cm. Find its height.
    Answer:
    (i) The sum of the parallel sides is 12 + 18 = 30 cm.
    (ii) Height = 2 × 90 ÷ 30 = 6 cm.
23. A quadrilateral is divided into two triangles with areas of 35 cm² and 42 cm². Find its total area.
    Answer:
    (i) Add the areas of the two triangles: 35 + 42 = 77 cm².
    (ii) The quadrilateral's area is 77 cm².

24. Two triangles have the same base; one has twice the height of the other. How do their areas compare?
    Answer:
    (i) The area of a triangle is proportional to its height when the base is fixed.
    (ii) The triangle with twice the height has twice the area.
25. A rectangle is divided into four equal-area regions. If its total area is 144 cm², find the area of each region.
    Answer:
    (i) Divide the total area by the number of equal regions: 144 ÷ 4 = 36.
    (ii) Each region has an area of 36 cm².

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

THREE-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. Find the area of a rectangle that is 15 cm long and 8 cm wide.
   Answer:
   (i) Formula: Area = length × width.
   (ii) Substitute the values: Area = 15 × 8.
   (iii) The area is 120 cm².
2. A rectangle has an area of 96 cm² and a length of 12 cm; find its width.
   Answer:
   (i) Formula: Width = area ÷ length.
   (ii) Substitute the values: Width = 96 ÷ 12.
   (iii) The width is 8 cm.
3. Find the area of a square with a side of 11 cm.
   Answer:
   (i) Formula: Area = side × side.
   (ii) Substitute the value: Area = 11 × 11.
   (iii) The area is 121 cm².
4. Find the area of a triangle with a base of 16 cm and a height of 7 cm.
   Answer:
   (i) Formula: Area = ½ × base × height.
   (ii) Substitute the values: Area = ½ × 16 × 7.
   (iii) The area is 56 cm².
5. A triangle has an area of 54 cm² and a base of 12 cm; find its height.
   Answer:
   (i) Formula: Height = 2 × area ÷ base.
   (ii) Substitute the values: Height = 2 × 54 ÷ 12 = 9.
   (iii) The height is 9 cm.
6. Find the area of a parallelogram with a base of 13 cm and a corresponding height of 6 cm.
   Answer:
   (i) Formula: Area = base × height.
   (ii) Substitute the values: Area = 13 × 6.
   (iii) The area is 78 cm².
7. A parallelogram has an area of 108 cm² and a base of 12 cm; find its height.
   Answer:
   (i) Formula: Height = area ÷ base.
   (ii) Substitute the values: Height = 108 ÷ 12.
   (iii) The height is 9 cm.

8. Find the area of a rhombus whose diagonals are 18 cm and 14 cm.
   Answer:
   (i) Formula: Area = ½ × diagonal 1 × diagonal 2.
   (ii) Substitute the values: Area = ½ × 18 × 14.
   (iii) The area is 126 cm².
9. A rhombus has an area of 80 cm² and one diagonal is 16 cm; find the other diagonal.
   Answer:
   (i) Formula: Other diagonal = 2 × area ÷ given diagonal.
   (ii) Substitute the values: Other diagonal = 2 × 80 ÷ 16 = 10.
   (iii) The other diagonal is 10 cm.
10. Find the area of a trapezium with parallel sides of 9 cm and 15 cm and a height of 8 cm.
    Answer:
    (i) Formula: Area = ½ × height × sum of parallel sides.
    (ii) Substitute the values: Area = ½ × 8 × (9 + 15).
    (iii) The area is 96 cm².
11. A trapezium has an area of 60 cm², a height of 6 cm, and one parallel side of 8 cm; find the other parallel side.
    Answer:
    (i) The sum of the parallel sides is 2 × area ÷ height = 120 ÷ 6 = 20 cm.
    (ii) Subtract the known parallel side: 20 − 8 = 12 cm.
    (iii) The other parallel side is 12 cm.
12. Find the area of a rectangle measuring 18 m by 7 m.
    Answer:
    (i) Formula: Area = length × width.
    (ii) Substitute the values: Area = 18 × 7.
    (iii) The area is 126 m².
13. A rectangular park measures 25 m by 16 m; find its area.
    Answer:
    (i) Formula: Area = length × width.
    (ii) Substitute the values: Area = 25 × 16.
    (iii) The park's area is 400 m².
14. A path surrounds a rectangular park measuring 18 m by 12 m; the outer rectangle measures 24 m by 18 m; find the path's area.
    Answer:
    (i) Outer area = 24 × 18 = 432 m².
    (ii) Park area = 18 × 12 = 216 m².
    (iii) Path area = 432 − 216 = 216 m².
15. A rectangle measures 12 cm by 10 cm and is divided by a diagonal; find the area of each triangle formed.
    Answer:
    (i) Rectangle area = 12 × 10 = 120 cm².
    (ii) The diagonal divides the rectangle into two equal-area triangles.
    (iii) Each triangle has an area of 120 ÷ 2 = 60 cm².
16. A polygon is divided into triangles with areas of 24 cm², 30 cm², and 36 cm²; find the polygon's area.
    Answer:
    (i) Add the area of the first two triangles: 24 + 30 = 54 cm².
    (ii) Add the area of the third triangle: 54 + 36 = 90 cm².
    (iii) The polygon's area is 90 cm².

17. A triangle has a base of 20 cm and an area of 70 cm²; find its height.
    Answer:
    (i) Formula: Height = 2 × area ÷ base.
    (ii) Substitute the values: Height = 2 × 70 ÷ 20 = 7.
    (iii) The height is 7 cm.
18. A square is divided into four equal-area parts; if its total area is 196 cm², find the area of each part.
    Answer:
    (i) There are four equal parts.
    (ii) Divide the total area by 4: 196 ÷ 4 = 49.
    (iii) Each part has an area of 49 cm².
19. Explain how to find the area of a quadrilateral by drawing a diagonal.
    Answer:
    (i) Draw a diagonal to divide the quadrilateral into two triangles.
    (ii) Find the area of each triangle using ½ × base × height.
    (iii) Add the two triangle areas to get the quadrilateral's area.
20. State how the area of a parallelogram is found and identify the height used.
    Answer:
    (i) Multiply the base by its corresponding height.
    (ii) The height is the perpendicular distance to the chosen base.
    (iii) The formula is Area = base × height.

7.10. Three-mark questions with Answers of HOTS Type: (22 Questions)

THREE-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. A triangle has a base of 18 cm and a height of 10 cm. If its base is reduced to 12 cm without changing its area, what must its new height be?
   Answer:
   (i) The original area is ½ × 18 × 10 = 90 cm².
   (ii) For the same area, ½ × 12 × height = 90.
   (iii) The new height must be 15 cm.
2. A rhombus has diagonals of 20 cm and 12 cm. A parallelogram has a base of 12 cm and a height of 10 cm. Compare their areas.
   Answer:
   (i) Rhombus area = ½ × 20 × 12 = 120 cm².
   (ii) Parallelogram area = 12 × 10 = 120 cm².
   (iii) The two shapes have equal areas.
3. A trapezium has parallel sides of 9 cm and 15 cm and an area of 96 cm². Find its height.
   Answer:
   (i) The sum of its parallel sides is 9 + 15 = 24 cm.
   (ii) Using 96 = ½ × height × 24, the height is 96 ÷ 12.
   (iii) The trapezium's height is 8 cm.
4. A 20 cm by 16 cm rectangle has a 10 cm by 6 cm rectangular piece removed from one corner. Find the area of the remaining shape.
   Answer:
   (i) The original rectangle's area is 20 × 16 = 320 cm².
   (ii) The removed rectangle's area is 10 × 6 = 60 cm².
   (iii) The remaining area is 320 − 60 = 260 cm².

5. A path surrounds a rectangular park measuring 24 m by 14 m; the outer rectangle measures 30 m by 20 m. Find the area of the path.
   Answer:
   (i) The outer rectangle's area is $30 \times 20 = 600$ m².
   (ii) The park's area is $24 \times 14 = 336$ m².
   (iii) The path's area is $600 - 336 = 264$ m².
6. Two rectangles have the same perimeter: one measures 4 cm by 8 cm, and the other measures 6 cm by 6 cm. Compare their areas.
   Answer:
   (i) The first rectangle's area is $4 \times 8 = 32$ cm².
   (ii) The second rectangle's area is $6 \times 6 = 36$ cm².
   (iii) The square-shaped rectangle has 4 cm² more area.
7. Two triangles have equal bases of 12 cm and heights of 5 cm and 9 cm. Find the difference between their areas.
   Answer:
   (i) The first triangle's area is $\frac{1}{2} \times 12 \times 5 = 30$ cm².
   (ii) The second triangle's area is $\frac{1}{2} \times 12 \times 9 = 54$ cm².
   (iii) The difference between their areas is 24 cm².
8. A square has a side of 7 cm. Find its area after its side is doubled and the increase in area.
   Answer:
   (i) The original area is $7 \times 7 = 49$ cm².
   (ii) The new side is 14 cm, so the new area is $14 \times 14 = 196$ cm².
   (iii) The area increases by $196 - 49 = 147$ cm².
9. A rectangular lawn measures 20 m by 14 m and has two crossing paths through its centre, each 2 m wide and parallel to the sides. Find the area covered by the paths.
   Answer:
   (i) The path along the 20 m side covers $20 \times 2 = 40$ m².
   (ii) The path along the 14 m side covers $14 \times 2 = 28$ m², and their 2×2 overlap is 4 m².
   (iii) The total path area is $40 + 28 - 4 = 64$ m².
10. A parallelogram has a base of 15 cm and a height of 8 cm. Another side is 10 cm long; find the height corresponding to this side if it is used as the base.
    Answer:
    (i) The parallelogram's area is $15 \times 8 = 120$ cm².
    (ii) The same area equals $10 \times$ the new height.
    (iii) The height corresponding to the 10 cm base is 12 cm.
11. A rectangle measures 14 cm by 8 cm. A triangle has the same base and height as the rectangle. Compare their areas.
    Answer:
    (i) The rectangle's area is $14 \times 8 = 112$ cm².
    (ii) The triangle's area is $\frac{1}{2} \times 14 \times 8 = 56$ cm².
    (iii) The triangle's area is half the rectangle's area.
12. A polygon is divided into four triangles with areas of 18 cm², 24 cm², 27 cm², and 31 cm². Find its total area.
    Answer:
    (i) The first two triangles have a combined area of $18 + 24 = 42$ cm².
    (ii) The remaining two triangles have a combined area of $27 + 31 = 58$ cm².
    (iii) The polygon's total area is $42 + 58 = 100$ cm².

13. Two identical trapeziums are joined to form a parallelogram with parallel sides of 8 cm and 14 cm and a height of 6 cm. Find the area of one trapezium.
    Answer:
    (i) The parallelogram's area is ½? No; its base is the sum of the trapezium's parallel sides, so its area is (8 + 14) × 6 = 132 cm².
    (ii) The parallelogram is made from two identical trapeziums.
    (iii) The area of one trapezium is 132 ÷ 2 = 66 cm².
14. A triangle has an area of 84 cm² and is divided by a median. Find the area of each smaller triangle.
    Answer:
    (i) A median joins a vertex to the midpoint of the opposite side.
    (ii) It divides the triangle into two triangles of equal area.
    (iii) Each smaller triangle has an area of 84 ÷ 2 = 42 cm².
15. A rhombus has an area of 90 cm² and one diagonal is 15 cm. Find the other diagonal.
    Answer:
    (i) The product of the diagonals is 2 × 90 = 180 cm².
    (ii) Divide the product by the known diagonal: 180 ÷ 15 = 12.
    (iii) The other diagonal is 12 cm.
16. A rectangular path of uniform width 3 m surrounds a park measuring 24 m by 14 m. Find the area of the path.
    Answer:
    (i) The outer dimensions are 24 + 6 = 30 m and 14 + 6 = 20 m.
    (ii) The outer area is 30 × 20 = 600 m², while the park area is 24 × 14 = 336 m².
    (iii) The path's area is 600 − 336 = 264 m².
17. A triangle's base increases from 12 cm to 18 cm while its height stays at 8 cm. Find the increase in its area.
    Answer:
    (i) The original area is ½ × 12 × 8 = 48 cm².
    (ii) The new area is ½ × 18 × 8 = 72 cm².
    (iii) The area increases by 72 − 48 = 24 cm².
18. Two parallelograms have the same base of 10 cm and heights of 7 cm and 11 cm. Find the difference between their areas.
    Answer:
    (i) The first parallelogram's area is 10 × 7 = 70 cm².
    (ii) The second parallelogram's area is 10 × 11 = 110 cm².
    (iii) The difference between their areas is 40 cm².
19. A trapezium has an area of 105 cm² and parallel sides of 12 cm and 18 cm. Find its height.
    Answer:
    (i) The sum of its parallel sides is 12 + 18 = 30 cm.
    (ii) Using 105 = ½ × height × 30, the height is 105 ÷ 15.
    (iii) The height is 7 cm.
20. Two triangles have equal heights of 8 cm and bases of 5 cm and 10 cm. Compare their areas.
    Answer:
    (i) The first triangle's area is ½ × 5 × 8 = 20 cm².
    (ii) The second triangle's area is ½ × 10 × 8 = 40 cm².
    (iii) The second triangle's area is twice the first triangle's area.
21. A rectangle measures 18 cm by 10 cm and is divided by a diagonal. Find the area of each triangle and explain why the areas are equal.

Answer:
(i) The rectangle's area is 18 × 10 = 180 cm².
(ii) Each triangle has half the rectangle's area, so each area is 90 cm².
(iii) The diagonal divides the rectangle into two congruent triangles.

22. A rectangular outer region has an area of 480 m², and the enclosed rectangular park has an area of 315 m². Find the area of the surrounding path.
Answer:
(i) The path's area equals the outer area minus the park's area.
(ii) Subtract: 480 − 315 = 165.
(iii) The path's area is 165 m².

7.11 Five-mark questions with Answers of LOTS Type: (15 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS – LOTS TYPE:

1. Find the area of a rectangle that is 18 cm long and 12 cm wide.
Answer:
(i) The formula for the area of a rectangle is length × width.
(ii) The length is 18 cm.
(iii) The width is 12 cm.
(iv) Area = 18 × 12 = 216.
(v) The rectangle's area is 216 cm².
2. Find the area of a square with a side of 14 cm.
Answer:
(i) The formula for the area of a square is side × side.
(ii) The side length is 14 cm.
(iii) Substitute the side length: Area = 14 × 14.
(iv) Calculate: 14 × 14 = 196.
(v) The square's area is 196 cm².
3. Find the area of a triangle with a base of 18 cm and a height of 8 cm.
Answer:
(i) The formula for the area of a triangle is ½ × base × height.
(ii) The base is 18 cm.
(iii) The height is 8 cm.
(iv) Area = ½ × 18 × 8 = 72.
(v) The triangle's area is 72 cm².
4. A triangle has an area of 90 cm² and a base of 15 cm; find its height.
Answer:
(i) The formula for the area of a triangle is ½ × base × height.
(ii) Substitute the known values: 90 = ½ × 15 × height.
(iii) Multiply both sides by 2: 180 = 15 × height.
(iv) Divide by 15: height = 180 ÷ 15 = 12.
(v) The triangle's height is 12 cm.
5. Find the area of a parallelogram with a base of 16 cm and a corresponding height of 7 cm.
Answer:
(i) The formula for the area of a parallelogram is base × height.
(ii) The base is 16 cm.
(iii) The corresponding height is 7 cm.
(iv) Area = 16 × 7 = 112.
(v) The parallelogram's area is 112 cm².

6. A parallelogram has an area of 180 cm² and a base of 15 cm; find its corresponding height.
   Answer:
   (i) The formula for the area of a parallelogram is base × height.
   (ii) Substitute the known values: 180 = 15 × height.
   (iii) Divide both sides by 15.
   (iv) Height = 180 ÷ 15 = 12.
   (v) The corresponding height is 12 cm.
7. Find the area of a rhombus whose diagonals are 20 cm and 14 cm.
   Answer:
   (i) The formula for the area of a rhombus is ½ × diagonal 1 × diagonal 2.
   (ii) The first diagonal is 20 cm.
   (iii) The second diagonal is 14 cm.
   (iv) Area = ½ × 20 × 14 = 140.
   (v) The rhombus's area is 140 cm².
8. A rhombus has an area of 96 cm² and one diagonal is 16 cm; find the other diagonal.
   Answer:
   (i) The area formula is Area = ½ × diagonal 1 × diagonal 2.
   (ii) Substitute the known values: 96 = ½ × 16 × the other diagonal.
   (iii) Simplify: 96 = 8 × the other diagonal.
   (iv) Divide by 8: the other diagonal = 96 ÷ 8 = 12.
   (v) The other diagonal is 12 cm.
9. Find the area of a trapezium with parallel sides of 10 cm and 18 cm and a height of 6 cm.
   Answer:
   (i) The formula for the area of a trapezium is ½ × height × sum of the parallel sides.
   (ii) The parallel sides are 10 cm and 18 cm.
   (iii) Their sum is 10 + 18 = 28 cm.
   (iv) Area = ½ × 6 × 28 = 84.
   (v) The trapezium's area is 84 cm².
10. A trapezium has an area of 120 cm², and the sum of its parallel sides is 30 cm; find its height.
    Answer:
    (i) The formula is Area = ½ × height × sum of the parallel sides.
    (ii) Substitute the known values: 120 = ½ × height × 30.
    (iii) Simplify: 120 = 15 × height.
    (iv) Divide by 15: height = 120 ÷ 15 = 8.
    (v) The trapezium's height is 8 cm.
11. A polygon is divided into three triangles with areas of 24 cm², 36 cm², and 40 cm²; find the polygon's area.
    Answer:
    (i) The polygon's area is the sum of the areas of its triangles.
    (ii) The first triangle's area is 24 cm².
    (iii) The second triangle's area is 36 cm², and the third triangle's area is 40 cm².
    (iv) Total area = 24 + 36 + 40 = 100.
    (v) The polygon's area is 100 cm².
12. A path surrounds a rectangular park measuring 22 m by 14 m; the outer rectangle measures 28 m by 20 m; find the path's area.
    Answer:
    (i) The area of the outer rectangle is 28 × 20 = 560 m².

(ii) The park's area is 22 × 14 = 308 m².
(iii) The path's area equals the outer area minus the park's area.
(iv) Path area = 560 − 308 = 252.
(v) The path's area is 252 m².

13. A rectangle measures 15 cm by 8 cm and is divided by a diagonal; find the area of each triangle formed.
Answer:
(i) The rectangle's area is length × width.
(ii) Rectangle area = 15 × 8 = 120 cm².
(iii) The diagonal divides the rectangle into two equal-area triangles.
(iv) Each triangle's area is 120 ÷ 2 = 60 cm².
(v) Each triangle has an area of 60 cm².
14. A rectangle has an area of 144 cm² and a length of 16 cm; find its width.
Answer:
(i) The formula for the area of a rectangle is length × width.
(ii) Substitute the known values: 144 = 16 × width.
(iii) Divide both sides by 16.
(iv) Width = 144 ÷ 16 = 9.
(v) The rectangle's width is 9 cm.
15. A square with a total area of 256 cm² is divided into four equal-area regions; find the area of each region.
Answer:
(i) The square's total area is 256 cm².
(ii) It is divided into four equal regions.
(iii) Divide the total area by 4.
(iv) Area of each region = 256 ÷ 4 = 64.
(v) Each region has an area of 64 cm².

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

FIVE-MARK DESCRIPTIVE QUESTIONS – HOTS TYPE:

1. A 3 m wide path surrounds a rectangular park measuring 24 m by 14 m. Find the area of the path.
Answer:
(i) The path is 3 m wide on every side, so the outer length is 24 + 3 + 3 = 30 m.
(ii) The outer width is 14 + 3 + 3 = 20 m.
(iii) The outer rectangle's area is 30 × 20 = 600 m².
(iv) The park's area is 24 × 14 = 336 m².
(v) The path's area is 600 − 336 = 264 m².
2. A rectangle measures 15 cm by 10 cm. Find the height of a triangle with a base of 20 cm that has the same area as the rectangle.
Answer:
(i) The rectangle's area is 15 × 10 = 150 cm².
(ii) The triangle must also have an area of 150 cm².
(iii) Use the triangle formula: 150 = ½ × 20 × height.
(iv) Simplify: 150 = 10 × height.
(v) The triangle's height is 15 cm.
3. A trapezium has an area of 126 cm², a height of 7 cm, and one parallel side of 12 cm. Find its other parallel side.
Answer:

(i) Use the formula: Area = ½ × height × sum of parallel sides.
(ii) Substitute the known values: 126 = ½ × 7 × (12 + other side).
(iii) Since 126 ÷ 3.5 = 36, the sum of the parallel sides is 36 cm.
(iv) Subtract the known side: 36 − 12 = 24 cm.
(v) The other parallel side is 24 cm.

4. A rhombus has diagonals of 18 cm and 10 cm. Find its area after the 10 cm diagonal is doubled.
   Answer:
   (i) The original area is ½ × 18 × 10 = 90 cm².
   (ii) The doubled diagonal is 20 cm.
   (iii) The new area is ½ × 18 × 20.
   (iv) The new area is 180 cm².
   (v) Doubling one diagonal doubles the rhombus's area.
5. Two rectangular paths cross at right angles through the centre of a 24 m by 16 m field. Each path is 2 m wide. Find the combined area of the paths.
   Answer:
   (i) The path along the 24 m side has an area of 24 × 2 = 48 m².
   (ii) The path along the 16 m side has an area of 16 × 2 = 32 m².
   (iii) The overlapping square is 2 × 2 = 4 m².
   (iv) Subtract the overlap once to avoid counting it twice.
   (v) The combined path area is 48 + 32 − 4 = 76 m².
6. A polygon is divided into triangles with areas of 18 cm², 25 cm², 32 cm², and 45 cm². Find its total area and state the method used.
   Answer:
   (i) A polygon can be divided into triangles to find its area.
   (ii) Add the first two triangle areas: 18 + 25 = 43 cm².
   (iii) Add the remaining two: 32 + 45 = 77 cm².
   (iv) Add the subtotals: 43 + 77 = 120 cm².
   (v) The polygon's total area is 120 cm².
7. A rectangle measures 10 cm by 8 cm. A parallelogram has a base of 10 cm and a corresponding height of 6 cm. Compare their areas.
   Answer:
   (i) The rectangle's area is 10 × 8 = 80 cm².
   (ii) The parallelogram's area is 10 × 6 = 60 cm².
   (iii) The parallelogram's height is less than the rectangle's width.
   (iv) The rectangle's area is 80 − 60 = 20 cm² greater.
   (v) Equal base lengths alone do not make the areas equal; the corresponding heights matter.
8. Triangle A has a base of 12 cm and a height of 8 cm. Triangle B has a base of 16 cm and a height of 6 cm. Compare their areas.
   Answer:
   (i) Triangle A's area is ½ × 12 × 8 = 48 cm².
   (ii) Triangle B's area is ½ × 16 × 6 = 48 cm².
   (iii) Both triangles have the same area.
   (iv) Their bases and heights are different.
   (v) Different base-height pairs can give equal triangle areas.
9. A square has a side of 5 cm. Its side length is increased by 3 cm. Find the increase in its area.
   Answer:
   (i) The original side is 5 cm, so its area is 5 × 5 = 25 cm².

(ii) The new side is 5 + 3 = 8 cm.
(iii) The new area is 8 × 8 = 64 cm².
(iv) Find the increase by subtracting the original area: 64 − 25 = 39 cm².
(v) The square's area increases by 39 cm².

10. A quadrilateral is divided by a diagonal into two triangles with areas of 42 cm² and 58 cm². Find the quadrilateral's area and explain why the areas are added.
Answer:
(i) The diagonal divides the quadrilateral into two triangles.
(ii) The first triangle has an area of 42 cm².
(iii) The second triangle has an area of 58 cm².
(iv) The triangles together make up the entire quadrilateral without overlapping.
(v) The quadrilateral's area is 42 + 58 = 100 cm².
11. A rectangular garden measures 18 m by 12 m. A diagonal divides it into two equal-area triangles. Find each triangle's area and verify the total.
Answer:
(i) The garden's area is 18 × 12 = 216 m².
(ii) Its diagonal divides it into two triangles of equal area.
(iii) Each triangle's area is 216 ÷ 2 = 108 m².
(iv) The two triangle areas add to 108 + 108 = 216 m².
(v) Their total matches the garden's area.
12. Several triangles have a common base of 14 cm, and their third vertices lie on a line parallel to the base at a perpendicular distance of 9 cm. Find their area and compare them.
Answer:
(i) Each triangle has a base of 14 cm.
(ii) Each triangle has a height of 9 cm because its vertex lies on the same parallel line.
(iii) Each area is ½ × 14 × 9 = 63 cm².
(iv) The triangles can have different shapes.
(v) Their areas are equal because they have the same base and height.
13. A rectangular plot has an area of 96 m². Give two possible whole-number pairs of side lengths and show that both rectangles have the same area.
Answer:
(i) One possible pair of side lengths is 12 m and 8 m.
(ii) Its area is 12 × 8 = 96 m².
(iii) Another possible pair is 16 m and 6 m.
(iv) Its area is 16 × 6 = 96 m².
(v) Both rectangles have the same area but different side lengths.
14. A 3 m wide path surrounds a rectangular park measuring 30 m by 18 m. Find the area of the path.
Answer:
(i) The outer length is 30 + 3 + 3 = 36 m.
(ii) The outer width is 18 + 3 + 3 = 24 m.
(iii) The outer area is 36 × 24 = 864 m².
(iv) The park's area is 30 × 18 = 540 m².
(v) The path's area is 864 − 540 = 324 m².
15. Two identical trapeziums are joined to form a parallelogram with a base of 22 cm and a height of 6 cm. Find the area of one trapezium.
Answer:
(i) The parallelogram's area is 22 × 6 = 132 cm².
(ii) It is formed from two identical trapeziums.

(iii) Each trapezium has half the parallelogram's area.
(iv) Divide 132 by 2 to get 66 cm².
(v) The area of one trapezium is 66 cm².

7.13 Five-mark questions with Answers of Applied Type: (15 Questions)

FIVE-MARK DESCRIPTIVE QUESTIONS – APPLIED TYPE:

1. A classroom floor is 12 m long and 8 m wide. It will be covered with square tiles measuring 0.5 m on each side. How many tiles are needed?
   Answer:
   (i) Floor area = 12 × 8 = 96 m².
   (ii) Area of one tile = 0.5 × 0.5 = 0.25 m².
   (iii) Number of tiles = floor area ÷ area of one tile.
   (iv) Number of tiles = 96 ÷ 0.25 = 384.
   (v) The classroom requires 384 tiles.
2. A rectangular rangoli measures 7 m by 4 m. If 50 g of coloured powder is needed for each square metre, how much powder is required?
   Answer:
   (i) Rangoli area = 7 × 4 = 28 m².
   (ii) Powder needed per square metre = 50 g.
   (iii) Total powder = 28 × 50 = 1,400 g.
   (iv) Convert grams to kilograms: 1,400 g = 1.4 kg.
   (v) The rangoli requires 1.4 kg of powder.
3. A triangular field has a base of 80 m and a perpendicular height of 45 m. Fertiliser is applied at 2 kg per 100 m². How much fertiliser is needed?
   Answer:
   (i) Field area = ½ × 80 × 45 = 1,800 m².
   (ii) The field contains 1,800 ÷ 100 = 18 groups of 100 m².
   (iii) Each group needs 2 kg of fertiliser.
   (iv) Fertiliser required = 18 × 2 = 36 kg.
   (v) The field requires 36 kg of fertiliser.
4. A trapezium-shaped flowerbed has parallel sides of 8 m and 12 m, with a perpendicular distance of 5 m between them. Find its area.
   Answer:
   (i) Add the parallel sides: 8 + 12 = 20 m.
   (ii) Use the formula: Area = ½ × height × sum of parallel sides.
   (iii) Substitute the measurements: Area = ½ × 5 × 20.
   (iv) Calculate: Area = 50 m².
   (v) The flowerbed covers 50 m².
5. A kite is made from cloth in the shape of a rhombus. Its diagonals are 1.2 m and 0.8 m. Find the area of cloth used.
   Answer:
   (i) Area of a rhombus = ½ × diagonal 1 × diagonal 2.
   (ii) The diagonals are 1.2 m and 0.8 m.
   (iii) Area = ½ × 1.2 × 0.8.
   (iv) Area = 0.48 m².
   (v) The kite uses 0.48 m² of cloth.
6. A room is 8 m long, 5 m wide, and 3 m high. It has two windows, each 2 m by 1.5 m, and one door measuring 1 m by 2 m. One litre of paint covers 10 m² for one coat. How much paint is needed to apply two coats to the four walls?

Answer:
(i) Area of the four walls = 2 × (8 + 5) × 3 = 78 m².
(ii) Total window area = 2 × (2 × 1.5) = 6 m².
(iii) Door area = 1 × 2 = 2 m², so the paintable area is 78 − 6 − 2 = 70 m².
(iv) Two coats require paint for 70 × 2 = 140 m².
(v) Paint needed = 140 ÷ 10 = 14 litres.

7. Two 2 m wide paths cross at right angles through the centre of a 40 m by 30 m rectangular field. Find the area covered by the paths.
Answer:
(i) The path along the 40 m side covers 40 × 2 = 80 m².
(ii) The path along the 30 m side covers 30 × 2 = 60 m².
(iii) Their shared square is 2 × 2 = 4 m².
(iv) Subtract the overlap once: 80 + 60 − 4 = 136 m².
(v) The paths cover 136 m².
8. A 2 m wide path is built outside a rectangular garden measuring 24 m by 16 m. Find the area of the path.
Answer:
(i) The outer length is 24 + 2 + 2 = 28 m.
(ii) The outer width is 16 + 2 + 2 = 20 m.
(iii) The outer area is 28 × 20 = 560 m².
(iv) The garden area is 24 × 16 = 384 m².
(v) The path area is 560 − 384 = 176 m².
9. A parallelogram-shaped farm has a base of 45 m and a corresponding height of 28 m. If the crop produces 3 kg for every 10 m², how much crop is produced?
Answer:
(i) Farm area = base × height = 45 × 28 = 1,260 m².
(ii) The farm contains 1,260 ÷ 10 = 126 groups of 10 m².
(iii) Each group produces 3 kg.
(iv) Total crop = 126 × 3 = 378 kg.
(v) The farm produces 378 kg of crop.
10. A plot is divided into three triangles with areas of 120 m², 95 m², and 85 m². Find the total area of the plot.
Answer:
(i) The first triangular section has an area of 120 m².
(ii) The second triangular section has an area of 95 m².
(iii) The third triangular section has an area of 85 m².
(iv) Total area = 120 + 95 + 85 = 300 m².
(v) The plot covers 300 m².
11. A triangular banner has a base of 3.6 m and a perpendicular height of 2.4 m. If the fabric costs ₹250 per square metre, find the cost of the fabric.
Answer:
(i) Banner area = ½ × 3.6 × 2.4 = 4.32 m².
(ii) The fabric costs ₹250 per square metre.
(iii) Fabric cost = 4.32 × 250.
(iv) The total cost is ₹1,080.
(v) The fabric for the banner costs ₹1,080.
12. A square courtyard has a side of 18 m. A square fountain with a side of 6 m is built in its centre. Find the area left for paving.
Answer:
(i) Courtyard area = 18 × 18 = 324 m².

(ii) Fountain area = 6 × 6 = 36 m².
(iii) The paving area is the courtyard area minus the fountain area.
(iv) Paving area = 324 − 36 = 288 m².
(v) The area left for paving is 288 m².

13. A trapezium-shaped roof section has parallel sides of 12 m and 20 m, with a perpendicular height of 8 m. If each solar panel covers 2 m², how many panels can cover the section?
Answer:
(i) Roof area = ½ × 8 × (12 + 20).
(ii) The sum of the parallel sides is 32 m.
(iii) Roof area = ½ × 8 × 32 = 128 m².
(iv) Number of panels = 128 ÷ 2 = 64.
(v) Sixty-four panels are needed to cover the roof section.
14. A rectangular noticeboard measures 3 m by 2 m. A rectangular poster measuring 2 m by 1.2 m is placed on it. Find the area of the board that remains uncovered.
Answer:
(i) Noticeboard area = 3 × 2 = 6 m².
(ii) Poster area = 2 × 1.2 = 2.4 m².
(iii) Uncovered area = noticeboard area − poster area.
(iv) Uncovered area = 6 − 2.4 = 3.6 m².
(v) The uncovered part of the board is 3.6 m².
15. A triangular sail has a base of 5 m and a perpendicular height of 4 m. If waterproofing material costs ₹180 per square metre, find the total cost.
Answer:
(i) Sail area = ½ × base × height.
(ii) Sail area = ½ × 5 × 4 = 10 m².
(iii) Waterproofing costs ₹180 per square metre.
(iv) Total cost = 10 × 180 = ₹1,800.
(v) Waterproofing the sail costs ₹1,800.

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

OLYMPIAD-STYLE MULTIPLE-CHOICE QUESTIONS:

1. How many 1 cm² unit squares cover a rectangle measuring 9 cm by 7 cm?
A. 16
B. 56
C. 63
D. 72
Answer: C. 63
2. A rectangle has an area of 96 cm² and a width of 8 cm. What is its length?
A. 10 cm
B. 12 cm
C. 14 cm
D. 16 cm
Answer: B. 12 cm
3. A diagonal divides a rectangle measuring 15 cm by 10 cm into two triangles. What is the area of each triangle?
A. 50 cm²
B. 65 cm²
C. 75 cm²

D. 150 cm²
Answer: C. 75 cm²

4. What is the area of a triangle with base 14 cm and perpendicular height 9 cm?
   A. 46 cm²
   B. 63 cm²
   C. 126 cm²
   D. 252 cm²
   Answer: B. 63 cm²
5. A triangle has an area of 48 cm² and a base of 12 cm. What is its height?
   A. 4 cm
   B. 6 cm
   C. 8 cm
   D. 12 cm
   Answer: C. 8 cm
6. Which triangle has an area of 60 cm²?
   A. Base 10 cm, height 6 cm
   B. Base 12 cm, height 12 cm
   C. Base 15 cm, height 10 cm
   D. Base 20 cm, height 8 cm
   Answer: A. Base 10 cm, height 6 cm
7. Two triangles have the same base. The height of Triangle P is twice the height of Triangle Q. What is the ratio of their areas, P:Q?
   A. 1:2
   B. 2:1
   C. 1:4
   D. 4:1
   Answer: B. 2:1
8. A triangle's base is doubled and its height is halved. How does its area change?
   A. It doubles.
   B. It is halved.
   C. It remains the same.
   D. It becomes four times as large.
   Answer: C. It remains the same.
9. A triangle has an area of 84 cm². A line from a vertex to the midpoint of the opposite side divides it into two triangles. What is the area of each smaller triangle?
   A. 21 cm²
   B. 42 cm²
   C. 56 cm²
   D. 84 cm²
   Answer: B. 42 cm²
10. Two triangles share a base and their third vertices lie on a line parallel to that base. Which statement is always true?
    A. The triangles have equal areas.
    B. The triangles have equal perimeters.
    C. The triangles are congruent.
    D. The triangles have equal side lengths.
    Answer: A. The triangles have equal areas.
11. A parallelogram has a base of 13 cm and a corresponding height of 7 cm. What is its area?
    A. 40 cm²

B. 91 cm²
C. 182 cm²
D. 273 cm²
Answer: B. 91 cm²

12. A parallelogram has an area of 144 cm² and a base of 16 cm. What is its corresponding height?
A. 7 cm
B. 8 cm
C. 9 cm
D. 10 cm
Answer: C. 9 cm
13. A parallelogram has a base of 12 cm and height of 8 cm. If a different side of length 16 cm is used as the base, what is the corresponding height?
A. 4 cm
B. 6 cm
C. 8 cm
D. 12 cm
Answer: B. 6 cm
14. A rhombus has diagonals of 18 cm and 10 cm. What is its area?
A. 28 cm²
B. 90 cm²
C. 180 cm²
D. 280 cm²
Answer: B. 90 cm²
15. A rhombus has an area of 120 cm² and one diagonal is 15 cm. What is the other diagonal?
A. 8 cm
B. 12 cm
C. 16 cm
D. 18 cm
Answer: C. 16 cm
16. Which information is sufficient to find the area of a rhombus using its diagonals?
A. The lengths of two adjacent sides
B. The length of one side and one angle
C. The lengths of both diagonals
D. The perimeter and one side
Answer: C. The lengths of both diagonals
17. A trapezium has parallel sides of 10 cm and 18 cm and a height of 7 cm. What is its area?
A. 98 cm²
B. 196 cm²
C. 126 cm²
D. 70 cm²
Answer: A. 98 cm²
18. A trapezium has parallel sides of 8 cm and 16 cm and an area of 84 cm². What is its height?
A. 3.5 cm
B. 6 cm
C. 7 cm

D. 10.5 cm
Answer: C. 7 cm

19. A trapezium has an area of 60 cm², a height of 6 cm, and one parallel side of 12 cm. What is the other parallel side?
A. 6 cm
B. 8 cm
C. 10 cm
D. 12 cm
Answer: B. 8 cm
20. A square has a side of 9 cm. What is the area of a square whose side is twice as long?
A. 162 cm²
B. 243 cm²
C. 324 cm²
D. 648 cm²
Answer: C. 324 cm²
21. If the side length of a square is multiplied by 3, by what factor is its area multiplied?
A. 3
B. 6
C. 9
D. 12
Answer: C. 9
22. A rectangular garden is 24 m by 16 m. It is surrounded by an outer rectangular path, making the outer dimensions 28 m by 20 m. What is the area of the path?
A. 112 m²
B. 176 m²
C. 384 m²
D. 560 m²
Answer: B. 176 m²
23. A garden measuring 20 m by 12 m is surrounded by a uniform 3 m wide path. What is the area of the path?
A. 180 m²
B. 216 m²
C. 228 m²
D. 468 m²
Answer: C. 228 m²
24. Two paths cross at right angles through the centre of a 30 m by 20 m rectangular field. One path is 2 m wide and runs along the 30 m side; the other is 2 m wide and runs along the 20 m side. What is their combined area?
A. 96 m²
B. 100 m²
C. 104 m²
D. 120 m²
Answer: A. 96 m²
25. A polygon is divided into three triangles with areas 15 cm², 20 cm², and 25 cm². What is the area of the polygon?
A. 45 cm²
B. 50 cm²
C. 60 cm²
D. 75 cm²
Answer: C. 60 cm²

26. A quadrilateral is divided by a diagonal into two triangles with areas of 36 cm² and 49 cm². What is the area of the quadrilateral?
    A. 13 cm²
    B. 72 cm²
    C. 85 cm²
    D. 1764 cm²
    Answer: C. 85 cm²
27. A rectangle measuring 3 cm by 9 cm and a square have the same perimeter. Which has the greater area, and by how much?
    A. The rectangle, by 9 cm²
    B. The square, by 9 cm²
    C. The rectangle, by 36 cm²
    D. They have equal areas.
    Answer: B. The square, by 9 cm²
28. Among all rectangles with the same perimeter, which one has the greatest area?
    A. The one with the longest length
    B. The one with the shortest width
    C. The square
    D. They all have the same area.
    Answer: C. The square
29. A square with an area of 144 cm² is divided into four equal-area regions. What is the area of each region?
    A. 24 cm²
    B. 36 cm²
    C. 48 cm²
    D. 72 cm²
    Answer: B. 36 cm²
30. A rectangle measures 6 cm by 4 cm. A parallelogram has a base of 6 cm and a perpendicular height of 3 cm. How much greater is the rectangle's area?
    A. 3 cm²
    B. 6 cm²
    C. 12 cm²
    D. 24 cm²
    Answer: B. 6 cm²
31. A triangle has a base of 10 cm and a height of 5 cm. What must the height be for a triangle with a base of 5 cm to have the same area?
    A. 5 cm
    B. 10 cm
    C. 15 cm
    D. 20 cm
    Answer: B. 10 cm
32. Two identical trapeziums are joined to form a parallelogram with a base of 22 cm and height of 6 cm. What is the area of each trapezium?
    A. 33 cm²
    B. 66 cm²
    C. 132 cm²
    D. 264 cm²
    Answer: B. 66 cm²
33. A square has an area of 100 cm². What is its perimeter?
    A. 20 cm

B. 30 cm
C. 40 cm
D. 100 cm
Answer: C. 40 cm

34. A triangle has the same area as a square with a side of 5 cm. If the triangle's base is 10 cm, what is its height?
A. 2.5 cm
B. 5 cm
C. 10 cm
D. 25 cm
Answer: B. 5 cm

35. A trapezium has parallel sides of 6 cm and 14 cm. A rectangle has the same height and an area equal to the trapezium's area. What should the rectangle's length be compared with the trapezium's height?
A. Equal to the shorter parallel side
B. Equal to the longer parallel side
C. Equal to the average of the parallel sides
D. Equal to the sum of the parallel sides
Answer: C. Equal to the average of the parallel sides

36. A quadrilateral is divided into two triangles. One triangle has a base of 12 cm and height of 8 cm; the other has a base of 10 cm and height of 9 cm. What is the quadrilateral's area?
A. 48 cm^2
B. 93 cm^2
C. 96 cm^2
D. 186 cm^2
Answer: B. 93 cm^2

37. A rectangular park has an area of 300 m^2. A path outside it is part of an outer rectangle with an area of 420 m^2. What is the path's area?
A. 120 m^2
B. 300 m^2
C. 420 m^2
D. 720 m^2
Answer: A. 120 m^2

38. A rectangle's length is increased by 50% while its width stays unchanged. What happens to its area?
A. It increases by 25%.
B. It increases by 50%.
C. It doubles.
D. It increases by 150%.
Answer: B. It increases by 50%.

39. A rhombus has diagonals of 24 cm and 10 cm. A rectangle has an area equal to the rhombus and a length of 15 cm. What is the rectangle's width?
A. 6 cm
B. 8 cm
C. 12 cm
D. 16 cm
Answer: B. 8 cm

40. Two regions have equal perimeters. Which conclusion about their areas is always correct?

A. Their areas are equal.
B. The region with the longer sides has greater area.
C. Their areas may be different.
D. The region with more sides has greater area.
Answer: C. Their areas may be different.

7.15 Best Practices Opportunity List from the Chapter: (14 Ideas)

BEST PRACTICES FOR TEACHING "AREA" – GRADE 8:

(1) Begin with familiar examples. Ask students to compare the surface covered by notebooks, desks, floor tiles, or rangoli designs before introducing area formulas.
(2) Use unit squares to build the meaning of area. Let students cover paper shapes with square grid units and record the number of units used.
(3) Connect formulas to visual models. Show how a rectangle's rows and columns lead to length × width, and how a diagonal divides a rectangle into two equal-area triangles.
(4) Teach the triangle formula using cut-outs. Have students cut and rearrange two identical triangles to form a parallelogram, then connect the result to Area = ½ × base × height.
(5) Emphasize perpendicular height. Use rulers, set squares, and diagrams to help students distinguish a triangle's or parallelogram's height from a slanted side.
(6) Use grid paper for parallelograms and trapeziums. Ask students to divide, rearrange, or compare shapes to understand how the area formulas work.
(7) Include hands-on dissection activities. Let students cut and rearrange paper shapes to explore how a parallelogram or rhombus can be transformed into a rectangle of equal area.
(8) Teach composite areas by decomposition. Encourage students to divide polygons into familiar shapes, find each area, and combine the results.
(9) Relate area to local surroundings. Use examples such as school gardens, classroom floors, rangoli patterns, paths around parks, fields, and roof sections.
(10) Contrast area and perimeter explicitly. Give pairs of shapes with the same perimeter but different areas, and ask students to explain why the measures are not interchangeable.
(11) Ask students to estimate before calculating. Have them predict which shape covers more space, then use measurements or unit squares to check their reasoning.
(12) Check understanding through short formative tasks. Use exit slips, quick sketches, mini-whiteboard answers, or partner explanations to identify errors with units, formulas, and corresponding heights.
(13) Encourage students to explain each calculation. Ask them to label the base, height, and units, and to show how the measurements fit the selected formula.
(14) Provide practice at different levels. Begin with direct formula questions, then offer missing-measurement problems and real-life applications for students ready for additional challenge.

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

INNOVATIONS IN TEACHING-LEARNING "AREA" – GRADE 8:

(1) Area Investigation Walk
Ask student teams to measure selected areas around the school, such as a garden bed, noticeboard, or classroom floor. They can sketch each shape, record measurements, and calculate its area.
(2) Rangoli Design Challenge
Have students create a rangoli design on grid paper, divide it into familiar shapes, and calculate the total area covered by each colour.

(3) Design a Park
Students design a rectangular park with a surrounding path, play area, and garden beds. They calculate the area of each part and explain how they found the usable space.

(4) Shape Dissection Lab
Provide paper parallelograms, rhombuses, and trapeziums for students to cut and rearrange. Students use their rearrangements to develop and explain the area formulas.

(5) Digital Grid Exploration
Use a digital whiteboard or geometry app to change the dimensions of rectangles and triangles. Students observe how changing a base or height affects area.

(6) Area Formula Puzzle Cards
Prepare cards showing shapes, measurements, formulas, and answers. Students match each shape to the correct formula and solve the problems collaboratively.

(7) "Same Area, Different Shape" Gallery
Ask students to draw several different polygons with the same area on grid paper. Display the designs and invite students to explain how they checked their areas.

(8) Cross-Path Planning Activity
Give teams a rectangular field and ask them to plan two intersecting paths. Students calculate the combined area while accounting for the overlapping section.

(9) Area Estimation Contest
Show students objects or floor plans and ask them to estimate the area before measuring. Teams compare estimates with calculated results and discuss what helped improve accuracy.

(10) Student-Created Video Lessons
In small groups, students record a brief explanation of one area formula using a diagram, demonstration, or real-life example. Classmates can review the explanations and ask questions.

(11) Polygon Decomposition Challenge
Give students an irregular polygon and challenge them to find its area in two different ways by dividing it into familiar shapes. They compare their methods and check whether the totals agree.

(12) Shortest-Route Mirror Model
Use a classroom map and a reflective-line diagram to explore how a reflection can help identify a short route from a house to a river and then to a water tank. Connect the activity to the chapter's geometric reasoning.

7.17: Practicing Questions/Question Bank:

QUESTION BANK – CHAPTER 7: AREA:

A. FILL IN THE BLANKS:

1. The area of a rectangle is length × _____.
   Answer: width

2. The area of a triangle is ½ × base × corresponding _____.
   Answer: height

3. The area of a parallelogram is base × corresponding _____.
   Answer: height

4. The area of a rhombus is half the product of its _____.
   Answer: diagonals

5. The area of a trapezium is ½ × height × the sum of its _____ sides.
   Answer: parallel

B. ONE-MARK DESCRIPTIVE QUESTIONS:

1. What does area measure?
   Answer: Area measures the surface covered by a two-dimensional region.

2. Find the area of a square with a side of 6 cm.
   Answer: The area is 36 cm².

3. What fraction of a rectangle's area is the area of each triangle formed by its diagonal?
   Answer: Each triangle has half the area of the rectangle.

4. Find the area of a triangle with a base of 10 cm and a height of 4 cm.
   Answer: The area is 20 cm².

5. What is dissection in geometry?
   Answer: Dissection is cutting a shape into pieces and rearranging them to make another shape of equal area.

C. TWO-MARK DESCRIPTIVE QUESTIONS:

1. Find the area of a trapezium with parallel sides of 8 cm and 12 cm and a height of 5 cm.
   Answer:
   (i) Area = ½ × height × sum of parallel sides = ½ × 5 × (8 + 12).
   (ii) The area is 50 cm².

2. A rectangle has an area of 72 cm² and a length of 9 cm; find its width.
   Answer:
   (i) Width = area ÷ length = 72 ÷ 9.
   (ii) The width is 8 cm.

3. A rectangle measuring 12 cm by 8 cm is divided by a diagonal; find the area of each triangle.
   Answer:
   (i) Rectangle area = 12 × 8 = 96 cm².
   (ii) Each triangle has half the rectangle's area, or 48 cm².

4. State how to find the area of a polygon by dividing it into triangles.
   Answer:
   (i) Divide the polygon into triangles.
   (ii) Add the areas of all the triangles.

5. An outer rectangle measures 18 m by 14 m, and an inner park measures 12 m by 8 m; find the area between them.
   Answer:
   (i) Outer area = 18 × 14 = 252 m², and park area = 12 × 8 = 96 m².
   (ii) Area between them = 252 − 96 = 156 m².

D. THREE-MARK DESCRIPTIVE QUESTIONS:

1. Find the area of a rhombus whose diagonals are 16 cm and 12 cm.
   Answer:
   (i) Area = ½ × diagonal 1 × diagonal 2.
   (ii) Area = ½ × 16 × 12 = 96.
   (iii) The rhombus's area is 96 cm².

2. A quadrilateral is divided by a diagonal into triangles with areas of 25 cm² and 34 cm²; find its area.
   Answer:
   (i) The diagonal divides the quadrilateral into two triangles.
   (ii) Add their areas: 25 + 34 = 59.
   (iii) The quadrilateral's area is 59 cm².

3. Find the area of a triangle with a base of 14 cm and a height of 9 cm.
   Answer:
   (i) Area = ½ × base × height.
   (ii) Area = ½ × 14 × 9 = 63.
   (iii) The triangle's area is 63 cm².

4. A rectangle has an area of 105 cm² and a width of 7 cm; find its length.
   Answer:
   (i) Length = area ÷ width.
   (ii) Length = 105 ÷ 7 = 15.
   (iii) The rectangle's length is 15 cm.

5. A triangle has an area of 48 cm² and a base of 12 cm; find its height.
   Answer:
   (i) Height = 2 × area ÷ base.
   (ii) Height = 2 × 48 ÷ 12 = 8.
   (iii) The triangle's height is 8 cm.

E. FIVE-MARK DESCRIPTIVE QUESTIONS:

1. A 3 m wide path surrounds a rectangular garden measuring 20 m by 12 m. Find the area of the path.
   Answer:
   (i) The outer length is 20 + 3 + 3 = 26 m.
   (ii) The outer width is 12 + 3 + 3 = 18 m.
   (iii) The outer area is 26 × 18 = 468 m².
   (iv) The garden area is 20 × 12 = 240 m².
   (v) The path area is 468 − 240 = 228 m².

2. A rectangle measures 16 cm by 10 cm. Find the height of a triangle with a base of 20 cm that has the same area.
   Answer:
   (i) Rectangle area = 16 × 10 = 160 cm².
   (ii) The triangle must have an area of 160 cm².
   (iii) Use the formula: 160 = ½ × 20 × height.
   (iv) Simplify: 160 = 10 × height.
   (v) The triangle's height is 16 cm.

3. A polygon is divided into four triangles with areas of 20 cm², 24 cm², 30 cm², and 36 cm²; find its total area.
   Answer:
   (i) Add the first two areas: 20 + 24 = 44 cm².
   (ii) Add the other two areas: 30 + 36 = 66 cm².
   (iii) Combine the subtotals: 44 + 66 = 110 cm².
   (iv) The polygon's area is the sum of the areas of its triangles.
   (v) The total area is 110 cm².

4. A parallelogram has an area of 135 cm² and a base of 15 cm; find its corresponding height.
   Answer:
   (i) Area of a parallelogram = base × height.
   (ii) Substitute the known values: 135 = 15 × height.
   (iii) Divide both sides by 15.
   (iv) Height = 135 ÷ 15 = 9 cm.
   (v) The corresponding height is 9 cm.

5. A trapezium has an area of 112 cm² and parallel sides of 12 cm and 16 cm; find its height.
   Answer:
   (i) Add the parallel sides: 12 + 16 = 28 cm.
   (ii) Use the formula: Area = ½ × height × sum of parallel sides.
   (iii) Substitute: 112 = ½ × height × 28.
   (iv) Simplify: 112 = 14 × height, so height = 112 ÷ 14 = 8 cm.
   (v) The trapezium's height is 8 cm.

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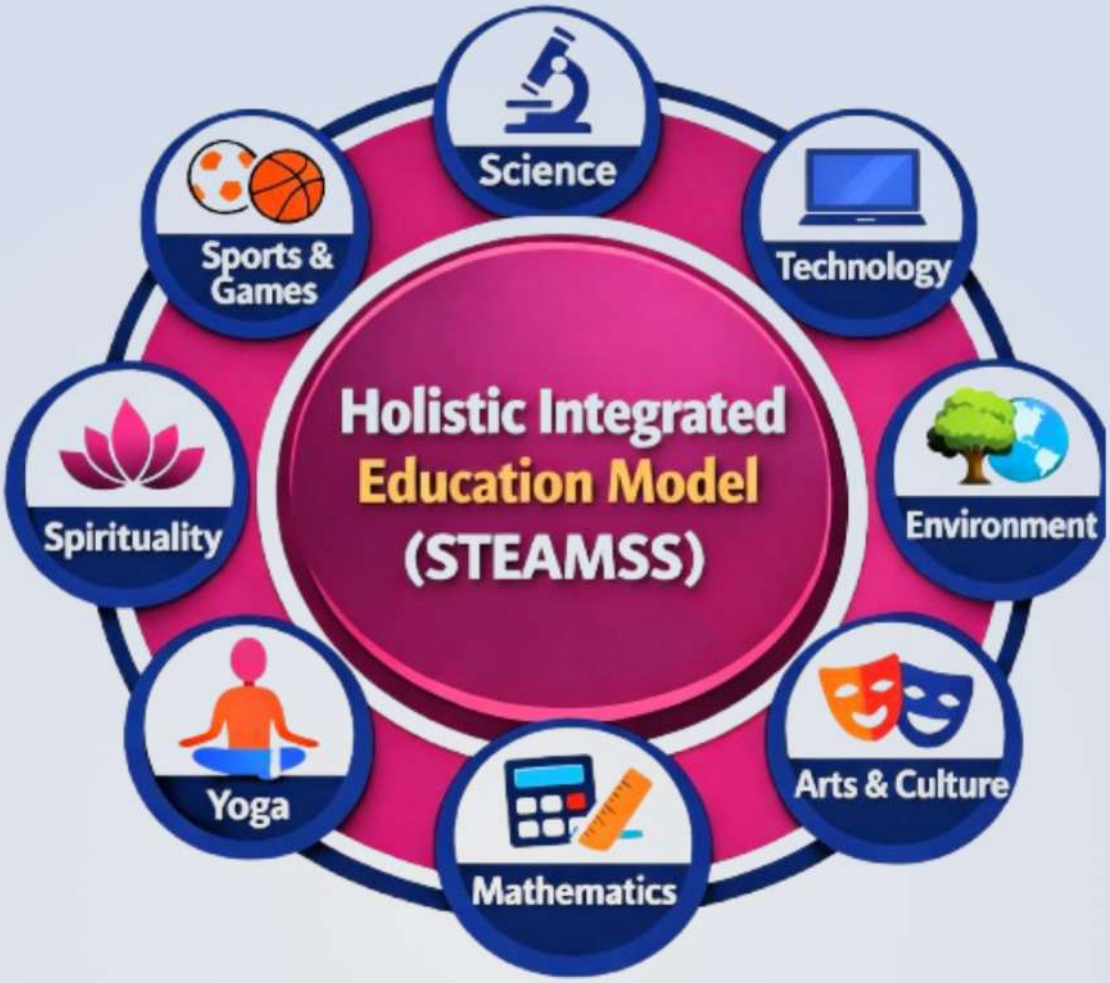
ALEVOOR POORNAPRAJNA PUBLIC SCHOOL

(Proposed CBSE Tech School)



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