MATHEMATICS

Class 8 (Based on NCERT 2025)

ANSWER KEY WITH DETAILED SOLUTIONS

Chapters 1 to 13

Note: This key gives step-by-step working for every question in the exercises covered in the sample pages, arranged chapter-wise and exercise-wise for quick reference.

Chapter 1 — Rational Numbers

Exercise 1.1

Q1.

Name the property under multiplication used in each part:

(i) $-4/5 \times 1 = 1 \times (-4/5) = -4/5$ → Existence of multiplicative identity (multiplying any rational number by 1 leaves it unchanged).

(ii) $-13/17 \times (-2/7) = -2/7 \times (-13/17)$ → Commutativity of multiplication (order of the two numbers can be swapped).

(iii) $-19/29 \times 29/(-19) = 1$ → Existence of multiplicative inverse (the two numbers are reciprocals of each other, and their product is 1).

Q2.

Computing $1/3 \times (6 \times 4/3)$ as $(1/3 \times 6) \times 4/3$ uses the Associative property of multiplication — the way the numbers are grouped in a product can be changed without affecting the result.

Q3.

The product of two rational numbers is always a rational number.

(This illustrates the Closure property of rational numbers under multiplication.)

Chapter 2 — Linear Equations in One Variable

Exercise 2.1

Q1.

3x = 2x + 18 □ 3x − 2x = 18 □ x = 18.
Check: LHS = 3(18) = 54; RHS = 2(18)+18 = 36+18 = 54. LHS = RHS ✓

Q2.

5t − 3 = 3t − 5 □ 5t − 3t = −5 + 3 □ 2t = −2 □ t = −1.
Check: LHS = 5(−1) − 3 = −8; RHS = 3(−1) − 5 = −8. ✓

Q3.

5x + 9 = 5 + 3x □ 5x − 3x = 5 − 9 □ 2x = −4 □ x = −2.
Check: LHS = 5(−2)+9 = −1; RHS = 5+3(−2) = −1. ✓

Q4.

4z + 3 = 6 + 2z □ 4z − 2z = 6 − 3 □ 2z = 3 □ z = 3/2.
Check: LHS = 4(3/2)+3 = 6+3 = 9; RHS = 6+2(3/2) = 6+3 = 9. ✓

Q5.

2x − 1 = 14 − x □ 2x + x = 14 + 1 □ 3x = 15 □ x = 5.
Check: LHS = 2(5) − 1 = 9; RHS = 14 − 5 = 9. ✓

Q6.

8x + 4 = 3(x − 1) + 7 □ 8x+4 = 3x−3+7 □ 8x+4 = 3x+4 □ 5x = 0 □ x = 0.
Check: LHS = 8(0)+4 = 4; RHS = 3(0 − 1)+7 = −3+7 = 4. ✓

Q7.

x = 4/5(x+10) □ 5x = 4(x+10) □ 5x = 4x+40 □ x = 40.
Check: LHS = 40; RHS = 4/5(40+10) = 4/5×50 = 40. ✓

Q8.

2x/3 + 1 = 7x/15 + 3. Multiply throughout by 15 (LCM of 3,15): 10x + 15 = 7x + 45.
10x − 7x = 45 − 15 □ 3x = 30 □ x = 10.
Check: LHS = 2(10)/3+1 = 23/3; RHS = 7(10)/15+3 = 14/3+9/3 = 23/3. ✓

Q9.

2y + 5/3 = 26/3 − y. Multiply throughout by 3: 6y + 5 = 26 − 3y.
6y + 3y = 26 − 5 □ 9y = 21 □ y = 7/3.
Check: LHS = 2(7/3)+5/3 = 19/3; RHS = 26/3 − 7/3 = 19/3. ✓

Q10.

3m = 5m − 8/5 □ 3m − 5m = −8/5 □ −2m = −8/5 □ m = 4/5.
Check: LHS = 3(4/5) = 12/5; RHS = 5(4/5) − 8/5 = 4 − 8/5 = 12/5. ✓

Exercise 2.2

Q1.

x/2 − 1/5 = x/3 + 1/4. Multiply throughout by 60 (LCM of 2,5,3,4): 30x − 12 = 20x + 15.
30x − 20x = 15 + 12 □ 10x = 27 □ x = 27/10 = 2.7.

Q2.

n/2 − 3n/4 + 5n/6 = 21. Multiply throughout by 12 (LCM of 2,4,6): 6n − 9n + 10n = 252.
7n = 252 □ n = 36.

Q3.

x + 7 − 8x/3 = 17/6 − 5x/2. Multiply throughout by 6: 6x + 42 − 16x = 17 − 15x.

$-10x + 42 = 17 - 15x \Rightarrow -10x + 15x = 17 - 42 \Rightarrow 5x = -25 \Rightarrow x = -5.$

Q4.

$(x-5)/3 = (x-3)/5$. Cross-multiplying: $5(x-5) = 3(x-3)$.

$5x - 25 = 3x - 9 \Rightarrow 2x = 16 \Rightarrow x = 8.$

Q5.

$(3t-2)/4 - (2t+3)/3 = 2/3 - t$. Multiply throughout by 12: $3(3t-2) - 4(2t+3) = 8 - 12t$.

$9t - 6 - 8t - 12 = 8 - 12t \Rightarrow t - 18 = 8 - 12t \Rightarrow 13t = 26 \Rightarrow t = 2.$

Q6.

$m - (m-1)/2 = 1 - (m-2)/3$. Multiply throughout by 6: $6m - 3(m-1) = 6 - 2(m-2)$.

$6m - 3m + 3 = 6 - 2m + 4 \Rightarrow 3m + 3 = 10 - 2m \Rightarrow 5m = 7 \Rightarrow m = 7/5 = 1.4.$

Q7.

$3(t-3) = 5(2t+1) \Rightarrow 3t - 9 = 10t + 5 \Rightarrow -9 - 5 = 10t - 3t \Rightarrow -14 = 7t \Rightarrow t = -2.$

Q8.

$15(y-4) - 2(y-9) + 5(y+6) = 0 \Rightarrow 15y - 60 - 2y + 18 + 5y + 30 = 0.$

$18y - 12 = 0 \Rightarrow y = 12/18 = 2/3.$

Q9.

$3(5z-7) - 2(9z-11) = 4(8z - 13) - 17 \Rightarrow 15z - 21 - 18z + 22 = 32z - 52 - 17.$

$-3z + 1 = 32z - 69 \Rightarrow 1 + 69 = 32z + 3z \Rightarrow 70 = 35z \Rightarrow z = 2.$

Q10.

$0.25(4f-3) = 0.05(10f-9)$. Multiply both sides by 100: $25(4f-3) = 5(10f-9)$.

$100f - 75 = 50f - 45 \Rightarrow 50f = 30 \Rightarrow f = 30/50 = 3/5 = 0.6.$

Chapter 3 — Understanding Quadrilaterals

Exercise 3.1

Q1.

This question asks you to classify figures (a)–(h) shown in the textbook under five headings: simple curve, simple closed curve, polygon, convex polygon, concave polygon.

Method: A simple curve does not cross itself. A simple closed curve is a simple curve whose end points meet. A polygon is a simple closed curve made up entirely of straight line segments. A convex polygon has no interior angle greater than 180° (no side 'bends inward'); a concave polygon has at least one interior angle greater than 180° (it has an 'indentation').

NOTE: The exact classification of each individual figure (a) through (h) depends on the specific shapes printed in this edition, which could not be verified with full confidence from the scanned image. Please cross-check each labelled figure against the definitions above, or share a clear photo/description of figures (a)–(h) and I will complete the exact matching.

Q2.

A regular polygon is a polygon that is both equilateral (all sides equal in length) and equiangular (all angles equal in measure).

(a) Regular polygon of 3 sides = Equilateral triangle.

(b) Regular polygon of 4 sides = Square.

(c) Regular polygon of 6 sides = Regular hexagon.

Exercise 3.2

Q1.

Method: For any polygon, the sum of all exterior angles (taken in order, one at each vertex) is always 360°. To find the unknown x, subtract the sum of the known exterior angles from 360°.

NOTE: The exact given angle values in figures (a) and (b) of this edition could not be read with full confidence from the scan. Using the general rule: if figure (a) is a quadrilateral with known exterior angles adding to 255° (e.g. 125°, 60°, 70°), then $x = 360^\circ - 255^\circ = 105^\circ$. Please confirm the printed angle values in your copy so the exact figure-specific answer can be finalised; the method above applies regardless of the specific numbers.

Q2.

Exterior angle of a regular polygon = $360^\circ \div$ number of sides.

(a) 9 sides: $360^\circ \div 9 = 40^\circ$.

(b) 15 sides: $360^\circ \div 15 = 24^\circ$.

Q3.

Number of sides = $360^\circ \div$ exterior angle = $360^\circ \div 24^\circ = 15$ sides.

Q4.

Interior angle = 165° □ Exterior angle = $180^\circ - 165^\circ = 15^\circ$.

Number of sides = $360^\circ \div 15^\circ = 24$ sides.

Q5.

(a) For a regular polygon, number of sides $n = 360^\circ \div$ exterior angle must be a whole number.

$n = 360^\circ \div 22^\circ = 16.36\ldots$, which is not a whole number, so it is NOT possible to have a regular polygon with each exterior angle 22°.

(b) No — 22° cannot be an interior angle of a regular polygon either, since the smallest possible interior angle of any regular polygon is 60° (that of an equilateral triangle); 22° is smaller than this minimum, so no regular polygon can have it as an interior angle.

Q6.

(a) The minimum interior angle possible for a regular polygon is 60°. This occurs for the regular polygon with the fewest sides, the equilateral triangle (n=3); as the number of sides increases, the interior angle increases, so 60° is the smallest possible value.

(b) The maximum exterior angle possible is 120° (corresponding to the equilateral triangle), since interior + exterior = 180°, and the minimum interior angle is 60°.

Exercise 3.3

Q1.

Complete each statement using the definition/property of a parallelogram:

(a) AD = BC — Property used: opposite sides of a parallelogram are equal.

(b) $\angle DCB = \angle DAB$— Property used: opposite angles of a parallelogram are equal.

(c) OC = OA — Property used: the diagonals of a parallelogram bisect each other (O is the point of intersection of the diagonals).

(d) $m\angle DAB + m\angle CDA = 180^\circ$— Property used: adjacent (co-interior) angles of a parallelogram, formed by a transversal (here AD) cutting the parallel sides AB and DC, are supplementary.

Q2.

This question shows five parallelograms (a)–(e), each with one angle given, asking you to find x, y and z in each using parallelogram properties.

Method for every part: (i) Opposite angles of a parallelogram are equal. (ii) Adjacent (co-interior) angles are supplementary (add up to 180°). (iii) If a diagonal is drawn, alternate interior angles are equal wherever it crosses a pair of parallel sides (angle sum of the resulting triangle = 180°).

NOTE: The exact angle values given in figures (a)–(e) of this edition could not be read with full confidence from the scan. Please confirm the printed angle in each part and I will work out the exact values of x, y, z for each — the three properties above are all that is needed once the given angle is known.

Exercise 3.3 (continued)

Q3.

(a) $\angle D + \angle B = 180^\circ$ only tells us ONE pair of opposite angles is supplementary; it does not confirm the other pair, and equal opposite angles are also required. So this alone is not enough — ABCD need not be a parallelogram.

(b) In a parallelogram, both pairs of opposite sides must be equal. Here AD = 4 cm and BC = 4.4 cm are unequal, so ABCD cannot be a parallelogram.

(c) In a parallelogram, opposite angles must be equal. Here $\angle A = 70^\circ$ and $\angle C = 65^\circ$ are unequal, so ABCD cannot be a parallelogram.

Q4.

A kite is a suitable example: it has exactly one pair of opposite angles equal (the angles between the unequal sides), but it is not a parallelogram since its sides are not parallel.

Q5.

Adjacent angles of a parallelogram are supplementary (co-interior angles), so 3x + 2x = 180°.

5x = 180° □ x = 36°.

Angles = 3x = 108° and 2x = 72°.

Answer: The angles of the parallelogram are 108°, 72°, 108°, 72°.

Q6.

Let each adjacent angle = x. Since adjacent angles are supplementary: x + x = 180°.

2x = 180° □ x = 90°.

Answer: Each angle of the parallelogram = 90° (it is a rectangle).

Q7.

Since HOPE is a parallelogram (order H, O, P, E), $\angle O$ and $\angle E$ are opposite angles, so $\angle E = \angle O$ □x = 70°.

Diagonal HP is drawn. Since HO ∥ EP, HP is a transversal, soalternate interior angles are equal: ∠OHP = ∠HPE □z = y.

In triangle HOP, angle sum = 180°: ∠OHP (z) + ∠HOP (70°) + ∠OPH = 180°. Also ∠OPH = ∠EHP = 40° (alternate angles, since EH ∥ OP with transversal HP).

So z + 70° + 40° = 180° □ z = 70°, and hence y = z = 70°.

Answer: x = 70°, y = 70°, z = 70°.

Properties used: opposite angles of a parallelogram are equal; alternate interior angles formed by a transversal with parallel lines are equal; angle sum property of a triangle.

Q8.

(a) In parallelogram GUNS (order G,U,N,S), opposite sides are equal: GU = NS and UN = SG.

GU = NS □ 3y − 1 = 26 □ 3y = 27 □ y = 9.

UN = SG □ 18 = 3x □ x = 6.

Answer: x = 6 cm, y = 9 cm.

(b) In parallelogram RUNS, the diagonals bisect each other, so each diagonal is divided into two equal halves at the point of intersection.

16 = y + 7 □ y = 9.

20 = x + y □ x = 20 − 9 = 11.

Answer: x = 11 cm, y = 9 cm.

Q9.

Since ∠K = 120° in parallelogram RISK, the adjacent interior angle (co-interior, supplementary) = 180° − 120° = 60°.

Since ∠L = 70° in parallelogram CLUE, the corresponding adjacent angle on the same straight line stays as 70°.

Points I, S/C lie on a straight line, so the three angles on that line add up to 180°: 60° + x + 70° = 180°.

x = 180° − 130° = 50°.

Answer: x = 50°.

Q10.

∠M + ∠L = 100° + 80° = 180°.

These are co-interior (allied) angles formed by transversal ML cutting sides MN and LK. Since they are supplementary, MN ∥ LK.

Answer: NM and KL are the parallel sides, so the figure is a trapezium (exactly one pair of parallel sides, NK and ML being the non-parallel legs).

Q11.

Given AB ∥ DC and ∠B = 120°. BC acts as a transversal cutting the parallel lines AB and DC, so ∠B and ∠C are co-interior angles and are supplementary.

∠B + ∠C = 180° □ ∠C = 180° − 120° = 60°.

Answer: m∠C = 60°.

Q12.

Given SP ∥ RQ in quadrilateral SRQP with ∠R = 90° and ∠Q = 130°.

SR is a transversal cutting SP ∥ RQ, so ∠S and ∠R are co-interior (supplementary): ∠S + 90° = 180° □ ∠S = 90°.

PQ is a transversal cutting SP ∥ RQ, so ∠P and ∠Q are co-interior (supplementary): ∠P + 130° = 180° □ ∠P = 50°.

Answer: ∠S = 90°, ∠P = 50°.

Yes — ∠P can also be found using the angle-sum property of a quadrilateral (360°): ∠S + ∠R + ∠Q + ∠P = 360° □ 90° + 90° + 130° + □P = 360° □ □P = 50°, confirming the same answer by a second method.

Exercise 3.4

Q1.

(a) False — only a rectangle with all sides equal is a square; not every rectangle has equal sides.

(b) True — a rhombus has both pairs of opposite sides parallel, so it satisfies the definition of a parallelogram.

(c) True — a square has all sides equal (rhombus property) and all angles 90° (rectangle property).

(d) False — every square is in fact a parallelogram (opposite sides are equal and parallel).

(e) False — a kite generally has two pairs of adjacent (not opposite) sides equal, and is a rhombus only in the special case when all four sides are equal.

(f) True — since a rhombus has two pairs of adjacent equal sides (all four sides equal), it fits the definition of a kite.

(g) True — a parallelogram has (at least) one pair of parallel sides, so it satisfies the trapezium condition.

(h) True — a square has a pair of parallel sides, so it is also a trapezium.

Q2.

(a) Quadrilaterals with all four sides equal: Rhombus and Square.

(b) Quadrilaterals with four right angles: Rectangle and Square.

Q3.

(a) A square is a quadrilateral because it is a closed figure with four sides and four angles.

(b) A square is a parallelogram because its opposite sides are equal and parallel.

(c) A square is a rhombus because all four of its sides are equal in length.

(d) A square is a rectangle because all four of its angles measure 90°.

Q4.

(a) Diagonals bisect each other: parallelogram, rhombus, rectangle, square.

(b) Diagonals are perpendicular bisectors of each other: rhombus, square.

(c) Diagonals are equal: rectangle, square.

Q5.

A rectangle is a convex quadrilateral because each of its interior angles measures 90°, which is less than 180°, and both diagonals lie completely inside the figure (no vertex points inward).

Q6.

O is the midpoint of the hypotenuse BC (the side opposite the right angle at A). Completing the rectangle ABDC (by drawing AD parallel to BC and reflecting), the diagonals of this rectangle are AD and BC.

Diagonals of a rectangle bisect each other and are equal in length, so O (the common midpoint) is equidistant from all four corners, in particular from A, B, C.

Hence OA = OB = OC, i.e., O is equidistant from A, B and C.

Chapter 4 — Data Handling

Exercise 4.1

Q1.

(a) Classical music = 10% corresponds to 20 people, so 10% of total = 20 □ total surveyed = 20 ÷ 0.10 = 200 people.

(b) The largest sector is Light music (40%), so it is liked by the maximum number of people.

(c) For 1000 CDs: Semi Classical = 20% of 1000 = 200; Classical = 10% of 1000 = 100; Light = 40% of 1000 = 400; Folk = 30% of 1000 = 300.

Q2.

(a) Winter received the most votes (150 out of 360).

(b) Central angle = (votes ÷ total) × 360°.

Summer: (90 ÷ 360) × 360° = 90°.

Rainy: (120 ÷ 360) × 360° = 120°.

Winter: (150 ÷ 360) × 360° = 150°.

(c) Draw a circle and mark three sectors of 90°, 120° and 150° for Summer, Rainy and Winter respectively, using a protractor.

Q3.

Total people = 36. Central angle = (number ÷ 36) × 360°.

Blue: 18/36 = 1/2 → 180°. Green: 9/36 = 1/4 → 90°.

Red: 6/36 = 1/6 → 60°. Yellow: 3/36 = 1/12 → 30°.

Draw a circle and mark sectors of 180°, 90°, 60° and 30° for Blue, Green, Red and Yellow respectively (sum = 360°).

Q4.

Total marks = 540, corresponding to 360°, so 1° represents 540 ÷ 360 = 1.5 marks.

(a) 105 marks corresponds to a central angle of 105 ÷ 1.5 = 70°, which matches the Hindi sector (70°). So the student scored 105 marks in Hindi.

(b) Mathematics marks = 90° × 1.5 = 135; Hindi marks = 70° × 1.5 = 105. Difference = 135 − 105 = 30 marks.

(c) Social Science + Mathematics angles = 65° + 90° = 155°; Science + Hindi angles = 80° + 70° = 150°. Since 155° > 150°, the sum of marks in Social Science and Mathematics (232.5) is indeed more than the sum in Science and Hindi (225).

Q5.

Total students = 72. Central angle = (number ÷ 72) × 360°.

Hindi: 40/72 × 360° = 200°. English: 12/72 × 360° = 60°.

Marathi: 9/72 × 360° = 45°. Tamil: 7/72 × 360° = 35°. Bengali: 4/72 × 360° = 20°.

(Check: 200+60+45+35+20 = 360° ✓)

Draw a circle and mark these five sectors using a protractor to complete the pie chart.

Exercise 4.2

Q1.

(a) Spinning the wheel (5 sectors shown): possible outcomes = A, B, C, D (A occurs on two sectors but is still one outcome-type).

(b) Tossing two coins together: possible outcomes = HH, HT, TH, TT.

Q2.

(a)(i) Prime numbers on a die: 2, 3, 5.

(a)(ii) Not a prime number: 1, 4, 6.

(b)(i) Greater than 5: 6.

(b)(ii) Not greater than 5: 1, 2, 3, 4, 5.

Q3.

(a) The wheel has 5 equal sectors (A, A, B, C, D); D occurs on 1 sector. P(D) = 1/5.

(b) A deck of 52 cards has 4 aces. P(ace) = 4/52 = 1/13.

(c) From the figure there are 7 apples in all — 3 marked G (green) and 4 marked R (red). P(red apple) = 4/7.

Q4.

Total slips = 10 (numbers 1 to 10), each equally likely.

(a) P(6) = 1/10.

(b) Numbers less than 6: 1,2,3,4,5 → P = 5/10 = 1/2.

(c) Numbers greater than 6: 7,8,9,10 → P = 4/10 = 2/5.

(d) 1-digit numbers: 1,2,3,4,5,6,7,8,9 (nine numbers) → P = 9/10.

Q5.

Total sectors = 3 + 1 + 1 = 5.

P(green) = 3/5.

P(non-blue) = P(green) + P(red) = (3+1)/5 = 4/5.

Q6.

Using Q2 (die has 6 equally likely faces):

(a)(i) P(prime) = 3/6 = 1/2. (ii) P(not prime) = 3/6 = 1/2.

(b)(i) P(greater than 5) = 1/6. (ii) P(not greater than 5) = 5/6.

Chapter 5 — Squares and Square Roots

Exercise 5.1

Q1.

The unit digit of a square depends only on the unit digit of the number.

(a) 81 → $1^2 = 1$ (b) 272 → $2^2 = 4$ (c) 799 → $9^2 = 81$ → 1 (d) 3853 → $3^2 = 9$ (e) 1234 → $4^2 = 16$ → 6 (f) 26387 → $7^2 = 49$ → 9 (g) 52698 → $8^2 = 64$ → 4 (h) 99880 → $0^2 = 0$ (i) 12796 → $6^2 = 36$ → 6 (j) 55555 → $5^2 = 25$ → 5

Q2.

A number cannot be a perfect square if it ends in 2, 3, 7 or 8, or ends in an odd number of zeros.

(a) 1057 ends in 7 — not a perfect square. (b) 23453 ends in 3 — not a perfect square.

(c) 7928 ends in 8 — not a perfect square. (d) 222222 ends in 2 — not a perfect square.

(e) 64000 ends in 3 zeros (odd number of zeros) — not a perfect square. (f) 89722 ends in 2 — not a perfect square.

(g) 222000 ends in 3 zeros — not a perfect square. (h) 505050 ends in 1 zero and in 0 preceded by an odd digit pattern — not a perfect square (odd number of zeros).

Q3.

The square of an odd number is always odd.

(a) 431 is odd → its square is odd. (b) 2826 is even → its square is even.

(c) 7779 is odd → its square is odd. (d) 82004 is even → its square is even.

Q4.

Following the pattern $11^2=121$, $101^2=10201$, $1001^2=1002001$:

100001^2 = 1 00002 00001 → written as 10000200001.

10000001^2 = 100000020000001.

Q5.

Following the pattern 11^2=1 2 1, 101^2=1 0 2 0 1, 10101^2=1 0 2 0 3 0 2 0 1:

1010101^2 = 1 02 03 04 03 02 01 → 1020304030201.

The number whose square is 10203040504030201 is 101010101.

Q6.

Pattern: the third number = 1 × 2 × ... relation — actually the third number is obtained as (n × (n+1)) where n is the first number, and the fourth number is (third number + 1).

$1^2 + 2^2 + 2^2 = 3^2$ (given) $2^2 + 3^2 + 6^2 = 7^2$ (given)

$4^2 + 5^2 + 20^2 = 21^2$ → missing number = 20.

$5^2 + 6^2 + 30^2 = 31^2$ → missing number = 6.

$6^2 + 7^2 + 42^2 = 43^2$ → missing numbers = 42 and 43.

Q7.

Sum of first n odd numbers = n^2.

(a) 1+3+5+7+9 (5 odd numbers) = 5^2 = 25.

(b) 1+3+…+19 (10 odd numbers) = 10^2 = 100.

(c) 1+3+…+23 (12 odd numbers) = 12^2 = 144.

Q8.

(a) 49 = 7^2 = sum of first 7 odd numbers = 1+3+5+7+9+11+13.

(b) 121 = 11^2 = sum of first 11 odd numbers = 1+3+5+7+9+11+13+15+17+19+21.

Q9.

Between n^2 and $(n+1)^2$, there are exactly 2n non-square numbers.

(a) Between 12^2 and 13^2: 2×12 = 24 numbers.

(b) Between 25^2 and 26^2: 2×25 = 50 numbers.

(c) Between 99^2 and 100^2: $2\times99 = 198$ numbers.

Exercise 5.2

Q1.

(a) $32^2 = 1024$ (b) $35^2 = 1225$ (c) $86^2 = 7396$
(d) $93^2 = 8649$ (e) $71^2 = 5041$ (f) $46^2 = 2116$

Q2.

Using the pattern for even m: $2m$, m^2-1, m^2+1 form a Pythagorean triplet.
(a) One member = 6 → m = 3: triplet = 6, 8, 10.
(b) One member = 14 → m = 7: triplet = 14, 48, 50.
(c) One member = 16 → m = 8: triplet = 16, 63, 65.
(d) One member = 18 → m = 9: triplet = 18, 80, 82.

Exercise 5.3

Q1.

The possible unit digit of the square root depends on the unit digit of the number (pairs: 1↔1,9; 4↔2,8; 5↔5; 6↔4,6; 9↔3,7; 0↔0).
(a) 9801 ends in 1 → possible unit digits of √: 1 or 9.
(b) 99856 ends in 6 → possible unit digits: 4 or 6.
(c) 998001 ends in 1 → possible unit digits: 1 or 9.
(d) 657666025 ends in 5 → possible unit digit: 5.

Q2.

Numbers ending in 2, 3, 7 or 8 are surely not perfect squares.
(a) 153 ends in 3 — not a perfect square. (b) 257 ends in 7 — not a perfect square.
(c) 408 ends in 8 — not a perfect square. (d) 441 ends in 1 — cannot be ruled out this way (and in fact $441 = 21^2$ is a perfect square).

Q3.

By repeated subtraction of consecutive odd numbers (1,3,5,7,...) until reaching 0; the count of subtractions gives the square root.
$100 - 1 - 3 - 5 - 7 - 9 - 11 - 13 - 15 - 17 - 19 = 0$ in 10 steps → $\sqrt{100} = 10$.
$169 - 1 - 3 - 5 - 7 - 9 - 11 - 13 - 15 - 17 - 19 - 21 - 23 = 0$ in 13 steps → $\sqrt{169} = 13$.

Q4.

Using the Prime Factorisation Method (pair up equal prime factors and take one from each pair):
(a) $729 = 3^6 \rightarrow \sqrt{729} = 3^3 = 27$
(b) $400 = 2^4 \times 5^2 \rightarrow \sqrt{400} = 2^2\times5 = 20$
(c) $1764 = 2^2\times3^2\times7^2 \rightarrow \sqrt{1764} = 2\times3\times7 = 42$
(d) $4096 = 2^{12} \rightarrow \sqrt{4096} = 2^6 = 64$
(e) $7744 = 2^6\times11^2 \rightarrow \sqrt{7744} = 2^3\times11 = 88$
(f) $9604 = 2^2\times7^4 \rightarrow \sqrt{9604} = 2\times7^2 = 98$
(g) $5929 = 7^2\times11^2 \rightarrow \sqrt{5929} = 7\times11 = 77$
(h) $9216 = 2^{1\square}\times3^2 \rightarrow \sqrt{9216} = 2^{\square}\times3 = 96$
(i) $529 = 23^2 \rightarrow \sqrt{529} = 23$
(j) $8100 = 2^2\times3^4 \times5^2 \rightarrow \sqrt{8100} = 2\times3^2\times5 = 90$

Q5.

Factorise each number; the prime(s) with an odd power must be multiplied once more to make every power even.
(a) $252 = 2^2\times3^2\times7$ → multiply by 7 → $1764 = 42^2$
(b) $180 = 2^2\times3^2\times5$ → multiply by 5 → $900 = 30^2$

(c) $1008 = 2^4 \times 3^2 \times 7$ → multiply by 7 → $7056 = 84^2$
(d) $2028 = 2^2 \times 3 \times 13^2$ → multiply by 3 → $6084 = 78^2$
(e) $1458 = 2 \times 3^6$ → multiply by 2 → $2916 = 54^2$
(f) $768 = 2^8 \times 3$ → multiply by 3 → $2304 = 48^2$

Q6.

Factorise each number; divide out the prime(s) with an odd power.
(a) $252 = 2^2 \times 3^2 \times 7$ → divide by 7 → $36 = 6^2$
(b) $2925 = 3^2 \times 5^2 \times 13$ → divide by 13 → $225 = 15^2$
(c) $396 = 2^2 \times 3^2 \times 11$ → divide by 11 → $36 = 6^2$
(d) $2645 = 5 \times 23^2$ → divide by 5 → $529 = 23^2$
(e) $2800 = 2^4 \times 5^2 \times 7$ → divide by 7 → $400 = 20^2$
(f) $1620 = 2^2 \times 3^4 \times 5$ → divide by 5 → $324 = 18^2$

Q7.

Let the number of students = x. Each donated □x, total donation = x^2.
$x^2 = 2401$ □ $x = \sqrt{2401} = 49$.
Answer: There were 49 students in the class.

Q8.

Let the number of rows = number of plants in each row = x, so $x^2 = 2025$.
$x = \sqrt{2025} = 45$.
Answer: Number of rows = 45, number of plants in each row = 45.

Q9.

We need the LCM of 4, 9, 10, then make every prime's power even.
LCM(4, 9, 10) = $180 = 2^2 \times 3^2 \times 5$. The power of 5 is odd, so multiply by 5.
Smallest square number = $180 \times 5 = 900$.

Q10.

LCM(8, 15, 20) = $120 = 2^3 \times 3 \times 5$. Powers of 2, 3 and 5 are all odd, so multiply by $2 \times 3 \times 5 = 30$.
Smallest square number = $120 \times 30 = 3600$.

Exercise 5.4

Q1.

Square roots found by the Long Division Method:
(a) $\sqrt{2304} = 48$ (b) $\sqrt{4489} = 67$ (c) $\sqrt{3481} = 59$ (d) $\sqrt{529} = 23$ (e) $\sqrt{3249} = 57$
(f) $\sqrt{1369} = 37$ (g) $\sqrt{5776} = 76$ (h) $\sqrt{7921} = 89$ (i) $\sqrt{576} = 24$ (j) $\sqrt{1024} = 32$
(k) $\sqrt{3136} = 56$ (l) $\sqrt{900} = 30$

Q2.

Rule: if a number has n digits, its square root has n/2 digits (n even) or (n+1)/2 digits (n odd).
(a) 64 has 2 digits → $\sqrt{64}$ has 1 digit ($\sqrt{64} = 8$).
(b) 144 has 3 digits → $\sqrt{144}$ has 2 digits ($\sqrt{144} = 12$).
(c) 4489 has 4 digits → $\sqrt{4489}$ has 2 digits ($\sqrt{4489} = 67$).
(d) 27225 has 5 digits → $\sqrt{27225}$ has 3 digits ($\sqrt{27225} = 165$).
(e) 390625 has 6 digits → $\sqrt{390625}$ has 3 digits ($\sqrt{390625} = 625$).

Q3.

Square roots of decimals (mark off pairs of digits from the decimal point in both directions):
(a) $\sqrt{2.56} = 1.6$ (b) $\sqrt{7.29} = 2.7$ (c) $\sqrt{51.84} = 7.2$ (d) $\sqrt{42.25} = 6.5$ (e) $\sqrt{31.36} = 5.6$

Q4.

Find the square root by division method; the remainder is the number to be subtracted.
(a) 402: nearest lower perfect square is 400 (20^2); subtract 2 → $\sqrt{400} = 20$.

(b) 1989: nearest lower perfect square is 1936 (44^2); subtract 53 → $\sqrt{1936} = 44$.
(c) 3250: nearest lower perfect square is 3249 (57^2); subtract 1 → $\sqrt{3249} = 57$.
(d) 825: nearest lower perfect square is 784 (28^2); subtract 41 → $\sqrt{784} = 28$.
(e) 4000: nearest lower perfect square is 3969 (63^2); subtract 31 → $\sqrt{3969} = 63$.

Q5.

Find the next perfect square above the number; the difference is the number to be added.
(a) 525: next perfect square is 529 (23^2); add 4 → $\sqrt{529} = 23$.
(b) 1750: next perfect square is 1764 (42^2); add 14 → $\sqrt{1764} = 42$.
(c) 252: next perfect square is 256 (16^2); add 4 → $\sqrt{256} = 16$.
(d) 1825: next perfect square is 1849 (43^2); add 24 → $\sqrt{1849} = 43$.
(e) 6412: next perfect square is 6561 (81^2); add 149 → $\sqrt{6561} = 81$.

Q6.

Area of square = $(\text{side})^2$, so side = $\sqrt{\text{Area}} = \sqrt{441} = 21$ m.

Q7.

By Pythagoras' theorem, in right triangle ABC with $\angle B = 90^\circ$: $AC^2 = AB^2 + BC^2$.
(a) AB=6, BC=8 → $AC = \sqrt{6^2+8^2} = \sqrt{36+64} = \sqrt{100} = 10$ cm.
(b) AC=13, BC=5 → $AB = \sqrt{13^2-5^2} = \sqrt{169-25} = \sqrt{144} = 12$ cm.

Q8.

Let the number of rows = number of columns = x, so $x^2 \geq 1000$.
$\sqrt{1000} \approx 31.6$, so the next perfect square is $32^2 = 1024$.
Extra plants needed = 1024 − 1000 = 24.
Answer: He needs 24 more plants (to arrange 32 rows of 32).

Q9.

Let rows = columns = x, so $x^2 \leq 500$.
$\sqrt{500} \approx 22.36$, so the largest perfect square ≤ 500 is $22^2 = 484$.
Children left out = 500 − 484 = 16.
Answer: 16 children would be left out.

Chapter 6 — Cubes and Cube Roots

Exercise 6.1

Q1.

(a) $216 = 6^3$ — perfect cube. (b) $128 = 2^7$ (power not a multiple of 3) — not a perfect cube.

(c) $1000 = 10^3$ — perfect cube. (d) $100 = 2^2\times5^2$ — not a perfect cube. (e) $46656 = 36^3$ — perfect cube.

Answer: 128 and 100 are NOT perfect cubes.

Q2.

Factorise and group prime factors in triples; multiply by primes needed to complete any incomplete triple.

(a) $243 = 3^5 \rightarrow$ multiply by $3 \rightarrow 3^6 = 729 = 9^3$

(b) $256 = 2^8 \rightarrow$ multiply by $2 \rightarrow 2^9 = 512 = 8^3$

(c) $72 = 2^3\times3^2 \rightarrow$ multiply by $3 \rightarrow 2^3\times3^3 = 216 = 6^3$

(d) $675 = 3^3\times5^2 \rightarrow$ multiply by $5 \rightarrow 3^3\times5^3 = 3375 = 15^3$

(e) $100 = 2^2\times5^2 \rightarrow$ multiply by $10 \rightarrow 2^3\times5^3 = 1000 = 10^3$

Q3.

Factorise and divide out primes whose power is not a multiple of 3.

(a) $81 = 3^4 \rightarrow$ divide by $3 \rightarrow 3^3 = 27 = 3^3$

(b) $128 = 2^7 \rightarrow$ divide by $2 \rightarrow 2^6 = 64 = 4^3$

(c) $135 = 3^3\times5 \rightarrow$ divide by $5 \rightarrow 3^3 = 27 = 3^3$

(d) $192 = 2^6\times3 \rightarrow$ divide by $3 \rightarrow 2^6 = 64 = 4^3$

(e) $704 = 2^6\times11 \rightarrow$ divide by $11 \rightarrow 2^6 = 64 = 4^3$

Q4.

Volume of each cuboid = $5\times2\times5 = 50$ cm^3 = 2×5^2.

To make a cube, we need every prime's power to be a multiple of 3, so multiply by $2^2\times5 = 20$.

New volume = $50\times20 = 1000$ cm^3 = 10^3.

Answer: Parikshit needs 20 such cuboids.

Exercise 6.2

Q1.

Cube roots by prime factorisation (group factors in triples):

(a) $\sqrt[3]{64} = 4$ (b) $\sqrt[3]{512} = 8$ (c) $\sqrt[3]{10648} = 22$ (d) $\sqrt[3]{27000} = 30$ (e) $\sqrt[3]{15625} = 25$

(f) $\sqrt[3]{13824} = 24$ (g) $\sqrt[3]{110592} = 48$ (h) $\sqrt[3]{46656} = 36$ (i) $\sqrt[3]{175616} = 56$ (j) $\sqrt[3]{91125} = 45$

Q2.

(a) False — the cube of an odd number is always odd.

(b) True — a perfect cube never ends with exactly two zeros (the number of trailing zeros in a perfect cube must be a multiple of 3).

(c) True — e.g., $15^2 = 225$ (ends in 5), $15^3 = 3375$ (ends in 25); if a number ends in 5, its square ends in 25, and its cube also ends in 25.

(d) False — e.g., $12^3 = 1728$, which ends in 8.

(e) False — the smallest two-digit number is 10, and $10^3 = 1000$, which already has 4 digits; so no two-digit number's cube can have only 3 digits.

(f) False — the largest two-digit number is 99, and $99^3 = 970299$, which has only 6 digits; so a two-digit number's cube never reaches 7 digits.

(g) True — e.g., $2^3 = 8$, a single digit number.

Chapter 7 — Comparing Quantities

Exercise 7.1

Q1.

(a) Speed ratio = 15 km/h : 30 km/h = 15:30 = 1:2.
(b) 5 m : 10 km = 5 m : 10000 m = 5:10000 = 1:2000.
(c) 50 paise : □5 = 50 paise : 500 paise = 50:500 = 1:10.

Q2.

(a) 3:4 = 3/4 × 100% = 75%.
(b) 2:3 = 2/3 × 100% = 200/3 % = 66⅔%.

Q3.

Students good in mathematics = 72% of 25 = 0.72 × 25 = 18.
Students not good in mathematics = 25 − 18 = 7.

Q4.

Let total matches = x. Win % = 40, so 40% of x = 10.
0.40x = 10 □ x = 25.
Answer: The team played 25 matches in all.

Q5.

Chameli spent 75%, so the □600 left represents the remaining 25%.
25% of total = 600 □ total = 600 ÷ 0.25 = □2400.
Answer: Chameli had □2400 in the beginning.

Q6.

Percentage liking other games = 100% − 60% − 30% = 10%.
Total people = 50,00,000.
Cricket = 60% of 50,00,000 = 30,00,000.
Football = 30% of 50,00,000 = 15,00,000.
Other games = 10% of 50,00,000 = 5,00,000.

Exercise 7.2

Q1.

Price after 10% discount = Marked Price × (1 − 10%) = Marked Price × 0.9.
Jeans: □1450 × 0.9 = □1305.
Two shirts: 2 × □850 × 0.9 = □1530.
Total payable = □1305 + □1530 = □2835.

Q2.

Amount payable = Price × (1 + Sales Tax%) = □13,000 × 1.12 = □14,560.

Q3.

Let Marked Price = M. After 20% discount, amount paid = M × 0.8.
M × 0.8 = 1600 □ M = 1600 ÷ 0.8 = □2000.
Answer: The marked price is □2000.

Q4.

Let price before VAT = P. Price including 8% VAT = P × 1.08 = □5400.
P = 5400 ÷ 1.08 = □5000.
Answer: The price before VAT was □5000.

Q5.

Let price before GST = P. Price including 18% GST = P × 1.18 = □1239.

P = 1239 ÷ 1.18 = □1050.
Answer: The price before GST was □1050.

Exercise 7.3

Q1.

Using $A = P(1 + R/100)^n$, with growth rate 5% per annum.
(a) Population in 2003 = Population in 2001 × $(1.05)^2$.
54000 = P × 1.1025 □ P = 54000 ÷ 1.1025 ≈ 48,980.
(b) Population in 2005 = 54000 × $(1.05)^2$ = 54000 × 1.1025 = 59,535.

Q2.

Count after 2 hours = Initial count × $(1 + 2.5\%)^2$ = 5,06,000 × $(1.025)^2$.
= 5,06,000 × 1.050625 ≈ 5,31,616.

Q3.

Depreciated value after 1 year = Cost × (1 ***− 8%) = □42,000 ×0.92 = □38,640.***

Chapter 8 — Algebraic Expressions and Identities

Exercise 8.1

Q1.

Add like terms (terms with the same variables and powers):

(a) $(ab-bc) + (bc-ca) + (ca-ab) = ab-bc+bc-ca+ca-ab = 0$.

(b) $(a-b+ab) + (b-c+bc) + (c-a+ac) = ab+bc+ac$.

(c) $(2p^2q^2-3pq+4) + (5+7pq-3p^2q^2) = -p^2q^2 + 4pq + 9$.

(d) $(l^2+m^2) + (m^2+n^2) + (n^2+l^2) + (2lm+2mn+2nl) = 2l^2+2m^2+2n^2+2lm+2mn+2nl$.

Q2.

(a) $(12a-9ab+5b-3) - (4a-7ab+3b+12) = 8a - 2ab + 2b - 15$.

(b) $(5xy-2yz-2zx+10xyz) - (3xy+5yz-7zx) = 2xy - 7yz + 5zx + 10xyz$.

(c) $(18-3p-11q+5pq-2p^2q+5p^2q) - (4p^2q-3pq+5pq^2-8p+7q-10) = 5p - p^2q - 5pq^2 + 8pq - 18q + 28$.

Exercise 8.2

Q1.

Multiply the monomials (coefficients × coefficients, variables × variables):

(a) $4 \times 7p = 28p$

(b) $-4p \times 7p = -28p^2$

(c) $-4p \times 7pq = -28p^2q$

(d) $4p^3 \times (-3p) = -12p^4$

(e) $4p \times 0 = 0$

Q2.

Area = length × breadth:

$(p, q) \rightarrow pq$

$(10m, 5n) \rightarrow 50mn$

$(20x^2, 5y^2) \rightarrow 100x^2y^2$

$(4x, 3x^2) \rightarrow 12x^3$

$(3mn, 4np) \rightarrow 12mn^2p$

Q3.

Complete the multiplication table (each entry = row monomial × column monomial):

Row $2x$: $4x^2, -10xy, 6x^3, -8x^2y, 14x^3y, -18x^3y^2$

Row $-5y$: $-10xy, 25y^2, -15x^2y, 20xy^2, -35x^2y^2, 45x^2y^3$

Row $3x^2$: $6x^3, -15x^2y, 9x^4, -12x^3y, 21x^4y, -27x^4y^2$

Row $-4xy$: $-8x^2y, 20xy^2, -12x^3y, 16x^2y^2, -28x^3y^2, 36x^3y^3$

Row $7x^2y$: $14x^3y, -35x^2y^2, 21x^4y, -28x^3y^2, 49x^4y^2, -63x^4y^3$

Row $-9x^2y^2$: $-18x^3y^2, 45x^2y^3, -27x^4y^2, 36x^3y^3, -63x^4y^3, 81x^4y^4$

Q4.

Volume = length × breadth × height:

(a) $5a, 3a^2, 7a^4 \rightarrow 105a^7$

(b) $2p, 4q, 8r \rightarrow 64pqr$

(c) $xy, 2x^2y, 2xy^2 \rightarrow 4x^4y^3$

(d) $a, 2b, 3c \rightarrow 6abc$

Q5.

(a) $xy \times yz \times zx = x^2y^2z^2$

(b) $a \times (-a^2) \times a^3 = -a^6$

(c) $2 \times 4y \times 8y^2 \times 16y^3 = 1024y^6$

(d) $a \times 2b \times 3c \times 6abc = 36a^2b^2c^2$
(e) $m \times (-mn) \times mnp = -m^3n^2p$

Exercise 8.3

Q1.

Multiply each term of the monomial by every term of the binomial/expression (distributive law):
(a) $4p \times (q+r) = 4pq + 4pr$
(b) $ab \times (a-b) = a^2b - ab^2$
(c) $(a+b) \times 7a^2b^2 = 7a^3b^2 + 7a^2b^3$
(d) $(a^2-9) \times 4a = 4a^3 - 36a$
(e) $(pq+qr+rp) \times 0 = 0$

Q2.

Complete the table (Product = First expression × Second expression):
(a) $a \times (b+c+d) = ab+ac+ad$
(b) $(x+y-5) \times 5xy = 5x^2y + 5xy^2 - 25xy$
(c) $p \times (6p^2-7p+5) = 6p^3 - 7p^2 + 5p$
(d) $4p^2q^2 \times (p^2 - q^2) = 4p^{4}\ \ q^2 - 4p^2q^4$
(e) $(a+b+c) \times abc = a^2bc + ab^2c + abc^2$

Q3.

(a) $(a^2) \times (2a^{22}) \times (4a^{26}) = 8a^{5\ 0}$
(b) $(2/3\ xy) \times (-9/10\ x^2y^2) = -3x^3y^3/5$
(c) $(-10/3\ pq^3) \times (6/5\ p^3q) = -4p^4\ \ q^4$
(d) $x \times x^2 \times x^3 \times x^4 = x^1$ □

Q4.

(a) $3x(4x-5)+3 = 12x^2-15x+3$.
At $x=3$: $12(9)-15(3)+3 = 108-45+3 = 66$.
At $x=1/2$: $12(1/4)-15(1/2)+3 = 3-7.5+3 = -1.5$.
(b) $a(a^2+a+1)+5 = a^3+a^2+a+5$.
At $a=0$: $0+0+0+5 = 5$. At $a=1$: $1+1+1+5 = 8$. At $a=-1$: $-1+1-1+5 = 4$.

Q5.

(a) $p(p-q) + q(q-r) + r(r-p) = p^2 - pq - pr + q^2 - qr + r^2$.
(b) $2x(z-x-y) + 2y(z-y-x) = -2x^2 - 4xy + 2xz - 2y^2 + 2yz$.
(c) $4l(10n-3m+2l) - 3l(l-4m+5n) = 5l^2 + 25ln$.
(d) $4c(-a+b+c) - [3a(a+b+c) - 2b(a-b+c)] = -3a^2 - ab - 7ac - 2b^2 + 6bc + 4c^2$.

Exercise 8.4

Q1.

Multiply the binomials using the distributive law (FOIL):
(a) $(2x+5)(4x-3) = 8x^2 + 14x - 15$
(b) $(y-8)(3y-4) = 3y^2 - 28y + 32$
(c) $(2.5l-0.5m)(2.5l+0.5m) = 6.25l^2 - 0.25m^2$ ($= 25l^2/4 - m^2/4$)
(d) $(a+3b)(x+5) = ax + 5a + 3bx + 15b$
(e) $(2pq+3q^2)(3pq - 2q^2) = 6p^2q^2 + 5pq^3 - 6q^4$
(f) $(3/4\ a^2+3b^2) \times 4(a^2 - 2/3\ b^2) = 3a^{4} + 10a^2b^2 - 8b^4$

Q2.

(a) $(5-2x)(3+x) = -2x^2 - x + 15$
(b) $(x+7y)(7x-y) = 7x^2 + 48xy - 7y^2$
(c) $(a^2+b)(a+b^2) = a^3 + a^2b^2 + ab + b^3$

(d) $(p^2-q^2)(2p+q) = 2p^3 + p^2q - 2pq^2 - q^3$

Q3.

(a) $(x^2-5)(x+5)+25 = x^3+5x^2-5x-25+25 = x^3+5x^2-5x$.
(b) $(a^2+5)(b^3+3)+5 = a^2b^3+3a^2+5b^3+15+5 = a^2b^3+3a^2+5b^3+20$.
(c) $(t+s^2)(t^2-s) = t^3 - ts + s^2t^2 - s^3$.
(d) $(a+b)(c-d) + (a-b)(c+d) + 2(ac+bd) = 4ac$.
(e) $(x+y)(2x+y) + (x+2y)(x-y) = 3x^2 + 4xy - y^2$.
(f) $(x+y)(x^2-xy+y^2) = x^3 + y^3$ (sum-of-cubes identity).
(g) $(1.5x-4y)(1.5x+4y+3) - 4.5x + 12y = 2.25x^2 - 16y^2$.
(h) $(a+b+c)(a+b-c) = a^2 + 2ab + b^2 - c^2$ (using $[(a+b)+c][(a+b)-c] = (a+b)^2-c^2$).

Chapter 9 — Mensuration

Exercise 9.1

Q1.

Area of trapezium = ½ × (sum of parallel sides) × height.

= ½ × (1 + 1.2) × 0.8 = ½ × 2.2 × 0.8 = 0.88 m².

Q2.

34 = ½ × (10 + b) × 4 □ 34 = 2 × (10+b) □ 17 = 10+b □ b = 7 cm.

Answer: The other parallel side = 7 cm.

Q3.

Perimeter = AB + BC + CD + AD = 120 m. Given BC=48, CD=17, AD=40.

AB = 120 − 48 − 17 − 40 = 15 m.

Since AB ⊥ AD and AB ⊥BC, AB is the height between the parallel sides AD and BC.

Area = ½ × (AD+BC) × AB = ½ × (40+48) × 15 = ½ × 88 × 15 = 660 m².

Q4.

Area of quadrilateral = ½ × diagonal × (sum of the two offsets/perpendiculars).

= ½ × 24 × (8+13) = ½ × 24 × 21 = 252 m².

Q5.

Area of rhombus = ½ × d_1 × d_2 = ½ × 7.5 × 12 = 45 cm².

Q6.

Area of rhombus = side × altitude = 5 × 4.8 = 24 cm².

Also Area = ½ × d_1 × d_2 □ 24 = ½ × 8 × d_2 □ d_2 = 48/8 = 6 cm.

Q7.

Area of one tile = ½ × 45 × 30 = 675 cm² = 0.0675 m².

Area of 3000 tiles = 3000 × 0.0675 = 202.5 m².

Total cost = 202.5 × □4 = □810.

Q8.

Let the side along the road = r, so side along the river = 2r.

Area = ½ × (r + 2r) × 100 = 150r.

10500 = 150r □ r = 70 m.

Answer: The side along the river = 2 × 70 = 140 m.

Q9.

Divide the octagon into a middle rectangle (11m × 5m) and two trapeziums (top and bottom), each with parallel sides 11m and 5m and height 4m.

Area of rectangle = 11 × 5 = 55 m².

Area of each trapezium = ½ × (11+5) × 4 = 32 m²; for two trapeziums = 64 m².

Total area = 55 + 64 = 119 m².

Q10.

Jyoti's method: split the pentagon into a square (15m × 15m) and a triangle (base 15m, height 15m).

Area = (15×15) + (½×15×15) = 225 + 112.5 = 337.5 m².

Kavita's method: split the pentagon differently (e.g., a trapezium plus a triangle, or a rectangle plus a triangle using the same overall dimensions); the total works out to the same value.

Area = 337.5 m² (same by both methods, confirming that area does not depend on how the figure is divided).

Other approaches are possible too — e.g. dividing the pentagon into two congruent trapeziums — all give the same total area of 337.5 m².

Q11.

Outer dimensions 24 cm × 28 cm, inner dimensions 16 cm × 20 cm; border width = (24−16)/2 = 4 cm = (28−20)/2, confirming uniform width 4 cm.

Sections I and II (left and right) are trapeziums with parallel sides 28 cm and 20 cm, height 4 cm:

Area (each) = ½ × (28+20) × 4 = 96 cm².

Sections III and IV (top and bottom) are trapeziums with parallel sides 24 cm and 16 cm, height 4 cm:

Area (each) = ½ × (24+16) × 4 = 80 cm².

Check: 2(96) + 2(80) = 352 cm², which equals (24×28) − (16×20) = 672 − 320 = 352 cm². ✓

Exercise 9.2

Q1.

Total Surface Area of a cuboid = 2(lb+bh+hl).

Box (a) 60×40×50: TSA = 2(60×40 + 40×50 + 50×60) = 2(2400+2000+3000) = 2×7400 = 14800 cm².

Box (b) 50×50×50 (cube): TSA = 6×50² = 15000 cm².

Answer: Box (a) needs less material (14800 cm² < 15000 cm²).

Q2.

Surface area of one suitcase = 2(80×48 + 48×24 + 24×80) = 2(3840+1152+1920) = 2×6912 = 13824 cm².

Total area for 100 suitcases = 13824 × 100 = 13,82,400 cm².

Length of tarpaulin = Total area ÷ width = 13,82,400 ÷ 96 = 14400 cm = 144 m.

Q3.

Surface area of cube = 6 × side² = 600.

side² = 100 □ side = 10 cm.

Q4.

Cabinet: length=2m, breadth=1m, height=1.5m. Painted area = total surface area − area of the bottom.

Total SA = 2(lb+bh+hl) = 2(2×1 + 1×1.5 + 1.5×2) = 2(2+1.5+3) = 2×6.5 = 13 m².

Bottom area = l×b = 2×1 = 2 m².

Painted area = 13 − 2 = 11 m².

Q5.

Area of 4 walls + ceiling = 2(l+b)h + lb, with l=15, b=10, h=7.

Walls = 2(15+10)×7 = 2×25×7 = 350 m². Ceiling = 15×10 = 150 m².

Total = 350+150 = 500 m².

Cans needed = 500 ÷ 100 = 5 cans.

Q6.

Both figures are a cylinder and a cube, each with the same dimension (7 cm) — the cylinder's diameter and height both equal 7 cm, matching the cube's edge (7 cm).

They are alike in overall size but different in shape: the cylinder has curved surfaces plus two circular ends, while the cube has six flat square faces.

Lateral surface area of cylinder = 2πrh = 2×(22/7)×3.5×7 = 154 cm².

Lateral surface area of cube (4 side faces) = 4×7² = 196 cm².

Answer: The cube has the larger lateral surface area.

Q7.

Total surface area of a closed cylinder = 2πr(r+h).

= 2×(22/7)×7×(7+3) = 2×22×10 = 440 m².

Q8.

When cut along its height, the hollow cylinder unfolds into a rectangle whose sides are the height (33 cm) and the circumference of the base.

Circumference = LSA ÷ height = 4224 ÷ 33 = 128 cm.

Perimeter of the rectangular sheet = 2(length+breadth) = 2(128+33) = 2×161 = 322 cm.

Q9.

Area covered in one revolution = curved surface area = $2\pi rl$ (l = length of roller = 1 m, r = 0.42 m).

= $2\times(22/7)\times0.42\times1 = 2.64\ m^2$.

Area of road for 750 revolutions = $2.64 \times 750 = 1980\ m^2$.

Q10.

Label height = total height − 2cm (top) − 2cm (bottom) = 20 − 4 = 16 cm.

Circumference = $2\pi r = 2\times(22/7)\times7 = 44$ cm.

Area of label = circumference × label height = $44 \times 16 = 704\ cm^2$.

Exercise 9.3

Q1.

(a) To find how much a cylindrical tank can hold, we find its volume (capacity).

(b) To find the number of cement bags needed to plaster it, we find its surface area.

(c) To find the number of smaller tanks that can be filled from it, we again use volume (capacity).

Q2.

Cylinder A: r=3.5cm, h=14cm. Volume = $\pi r^2 h = (22/7)\times3.5^2\times14 = 539\ cm^3$.

Cylinder B: r=7cm, h=7cm. Volume = $(22/7)\times7^2\times7 = 1078\ cm^3$.

Cylinder B has double the volume of A, even though both have the same total 'material' (πdh product is the same) — volume depends on r^2 so the fatter, shorter cylinder (B) holds more.

Checking surface area: SA of A = $2\pi r(r+h) = 2\times(22/7)\times3.5\times17.5 = 385\ cm^2$. SA of B = $2\times(22/7)\times7\times14 = 616\ cm^2$.

Answer: Cylinder B has both the greater volume (1078 > 539) and the greater surface area (616 > 385).

Q3.

Height = Volume ÷ Base area = 900 ÷ 180 = 5 cm.

Q4.

Number of small cubes = $(60\div6) \times (54\div6) \times (30\div6) = 10 \times 9 \times 5 = 450$.

Q5.

Radius = 140÷2 = 70 cm = 0.7 m. Volume = $\pi r^2 h$.

$1.54 = (22/7) \times 0.7^2 \times h$ □ $1.54 = 1.54 \times h$ □ $h = 1$ m.

Q6.

Volume = $\pi r^2 h = (22/7) \times 1.5^2 \times 7 = 49.5\ m^3$.

$1\ m^3$ = 1000 litres, so quantity of milk = 49.5 × 1000 = 49,500 litres.

Q7.

If edge = a, Surface area = $6a^2$, Volume = a^3.

Doubling the edge to 2a: New SA = $6(2a)^2 = 24a^2 = 4 \times (6a^2)$ → surface area becomes 4 times.

New Volume = $(2a)^3 = 8a^3$ → volume becomes 8 times.

Q8.

Volume of reservoir = $108\ m^3$ = 1,08,000 litres.

Time = Volume ÷ rate = 1,08,000 ÷ 60 = 1800 minutes = 1800÷60 = 30 hours.

Chapter 10 — Exponents and Powers

Exercise 10.1

Q1.

Using $a^{-n} = 1/a^n$:

(a) $3^{-2} = 1/9$

(b) $(-4)^{-2} = 1/16$

(c) $(1/2)^{-5} = 2^5 = 32$

Q2.

(a) $(-4)^5 \div (-4)^8 = (-4)^{5-8} = (-4)^{-3} = -1/64$

(b) $(1/2^3)^2 = 1/2^6 = 1/64$

(c) $(-3)^4 \times (5/3)^4 = 81 \times 625/81 = 625$

(d) $(3^{-7} \div 3^{-10}) \times 3^{-5} = 3^3 \times 3^{-5} = 3^{-2} = 1/9$

(e) $2^{-3} \times (-7)^{-3} = (2\times(-7))^{-3} = (-14)^{-3} = -1/2744$

Q3.

(a) $(3^{\square}+4^{\square 1})\times 2^2 = (1 + 1/4) \times 4 = (5/4) \times 4 = 5$

(b) $(2^{-1}\times 4^{-1})\div 2^{-2} = (1/2 \times 1/4) \div 1/4 = 1/8 \times 4 = 1/2$

(c) $(1/2)^{-2}+(1/3)^{-2}+(1/4)^{-2} = 4+9+16 = 29$

(d) $(3^{-1}+4^{-1}+5^{-1})^0 = 1$ (anything non -zero raised to power 0 is 1)

(e) $\{(-2/3)^{-2}\}^2 = (9/4)^2 = 81/16$

Q4.

(a) $8^{-1}\times 5^3/2^{-4} = (1/8 \times 125) \times 16 = (125/8) \times 16 = 250$

(b) $(5^{-1}\times 2^{-1})\times 6^{-1} = (1/5\times 1/2)\times 1/6 = 1/60$

Q5.

5□ ÷ 5□³ = 5□ □ 5^(m−(−3)) = 5□ □ m+3 = 5 □ m = 2.

Q6.

(a) $\{(1/3)^{-1} - (1/4)^{-1}\}^{-1} = (3-4)^{-1} = (-1)^{-1} = -1$

(b) $(5/8)^{-7} \times (8/5)^{-4} = (8/5)^7 \times (5/8)^4 = (8/5)^{(7-4)} = (8/5)^3 = 512/125$

Q7.

(a) $[25\times t^{-4}] \div [5^{-3}\times 10\times t^{-8}] = (25\div 10) \times 5^3 \times t^{(-4+8)} = (5/2) \times 125 \times t^4 = (625/2)\, t^4 \quad (t\neq 0)$

(b) $[3^{-5}\times 10^{-5}\times 125] \div [5^{-7}\times 6^{-5}]$: writing $10=2\times 5$ and $6=2\times 3$ and $125=5^3$, and simplifying the powers of 2, 3 and 5 separately gives $5^5 = 3125$.

Exercise 10.2

Q1.

Standard form: move the decimal point so only one non-zero digit remains before it, and count the places moved for the power of 10.

(a) $0.0000000000000085 = 8.5 \times 10^{-15}$

(b) $0.00000000000000942 = 9.42 \times 10^{-15}$

(c) $6020000000000000 = 6.02 \times 10^{15}$

(d) $0.00000000837 = 8.37 \times 10^{-9}$

(e) 31860000000 = 3.186 × 10¹□

Q2.

Convert back to usual (decimal) form:

(a) $3.02 \times 10^{-6} = 0.00000302$

(b) $4.5 \times 10^4 = 45000$

(c) $3 \times 10^{-8} = 0.00000003$

(d) $1.0001 \times 10^9 = 1000100000$

(e) $5.8 \times 10^{12} = 5800000000000$

(f) $3.61492 \times 10^6 = 3614920$

Q3.

(a) 1 micron = 1/1000000 m = 1×10^{-6} m.

(b) Charge of an electron = 0.000000000000000000 16 C = 1.6×10^{-19} C.

(c) Size of a bacteria = 0.0000005 m = 5×10^{-7} m.

(d) Size of a plant cell = 0.00001275 m = 1.275×10^{-5} m.

(e) Thickness of paper = 0.07 mm = 7×10^{-2} mm.

Q4.

Thickness of 5 books = 5 × 20 mm = 100 mm.

Thickness of 5 paper sheets = 5 × 0.016 mm = 0.08 mm.

Total thickness = 100 + 0.08 = 100.08 mm.

Chapter 11 — Direct and Inverse Proportions

Exercise 11.1

Q1.

For direct proportion, charge ÷ time should be constant.
4hr→60 (ratio 15), 8hr→100 (ratio 12.5), 12hr→140 (ratio ≈11.67), 24hr→180 (ratio 7.5).
Since the ratio is not constant, the parking charges are NOT in direct proportion to the parking time.

Q2.

Ratio of red pigment to base = 1:8, so base = 8 × (parts of red pigment).
4→32, 7→56, 12→96, 20→160.

Q3.

1 part of red pigment needs 75 mL of base, so parts of pigment = base(mL) ÷ 75.
For 1800 mL of base: 1800 ÷ 75 = 24 parts of red pigment.

Q4.

Bottles per hour = 840 ÷ 6 = 140. In 5 hours: 140 × 5 = 700 bottles.

Q5.

Actual length = Photograph length ÷ magnification = 5 cm ÷ 50000 = 0.0001 cm = 1 micrometre (1 μm).
At 20000× magnification: enlarged length = actual length × 20000 = 0.0001 × 20000 = 2 cm.

Q6.

Ratio (model mast : actual mast) = 9 cm : 1200 cm (12 m = 1200 cm) = 3:400.
Model ship length = Actual length × (3/400) = 2800 cm × 3/400 = 21 cm = 0.21 m.

Q7.

Crystals per kg = $9\times10^6 \div 2 = 4.5\times10^6$.
(a) In 5 kg: $4.5\times10^6 \times 5 = 2.25\times10^7$ crystals.
(b) In 1.2 kg: $4.5\times10^6 \times 1.2 = 5.4\times10^6$ crystals.

Q8.

Map distance = Actual distance ÷ scale = 72 km ÷ 18 km/cm = 4 cm.

Q9.

Ratio of shadow to height = 3.2 m ÷ 5.6 m = 4/7.
(a) Shadow of a 10.5 m pole = 10.5 × 4/7 = 6 m.
(b) Height of pole with 5 m shadow: height = 5 ÷ (4/7) = 5 × 7/4 = 8.75 m = 8 m 75 cm.

Q10.

Speed = 14 km ÷ 25 min. In 5 hours (300 minutes):
Distance = (14/25) × 300 = 168 km.

Exercise 11.2

Q1.

(a) Workers and time to complete a job — inverse proportion (more workers, less time).
(b) Time for a journey and distance travelled at uniform speed — direct proportion (not inverse).
(c) Area of cultivated land and crop harvested — direct proportion (not inverse).
(d) Time for a fixed journey and speed of the vehicle — inverse proportion.
(e) Population of a country and area of land per person — inverse proportion.

Q2.

Since total prize money is fixed (□1,00,000), prize per winner = 1,00,000 ÷ number of winners (inverse proportion).

1→1,00,000, 2→50,000, 4→25,000, 5→20,000, 8→12,500, 10→10,000, 20→5,000.

As the number of winners increases, the prize per winner decreases proportionally — this is inverse proportion.

Q3.

Since the spokes divide the wheel (360°) equally, angle = 360° ÷ number of spokes (inverse proportion).

4→90°, 6→60°, 8→45°, 10→36°, 12→30°.

(a) Yes, the number of spokes and the angle between consecutive spokes are in inverse proportion.

(b) For 15 spokes: angle = 360÷15 = 24°.

(c) For an angle of 40°: spokes = 360÷40 = 9 spokes.

Q4.

Total sweets = 24 × 5 = 120. If children reduced by 4 → 20 children: sweets each = 120 ÷ 20 = 6.

Q5.

Total animal-days of food = 20 × 6 = 120. With 30 animals (20+10): days = 120 ÷ 30 = 4 days.

Q6.

Total person-days = 3 × 4 = 12. With 4 persons: days = 12 ÷ 4 = 3 days.

Q7.

Total bottles = 25 × 12 = 300. With 20 bottles per box: boxes = 300 ÷ 20 = 15 boxes.

Q8.

Total machine-days = 42 × 63 = 2646. For 54 days: machines = 2646 ÷ 54 = 49 machines.

Q9.

Total distance = 60 × 2 = 120 km. At 80 km/h: time = 120 ÷ 80 = 1.5 hours.

Q10.

Total person-days of work = 2 × 3 = 6.

(a) With 1 person: days = 6 ÷ 1 = 6 days.

(b) Persons needed to finish in 1 day = 6 ÷ 1 = 6 persons.

Q11.

Total school-minutes = 8 × 45 = 360 minutes. With 9 periods: minutes per period = 360 ÷ 9 = 40 minutes.

Chapter 12 — Factorisation

Exercise 12.1

Q1.

Common factor = HCF of the coefficients × common variables (lowest power).

(a) $12x$, $36 \rightarrow 12$

(b) $2y$, $22xy \rightarrow 2y$

(c) $14pq$, $28p^2q^2 \rightarrow 14pq$

(d) $2x$, $3x^2$, $4 \rightarrow 1$

(e) $6abc$, $24ab^2$, $12a^2b \rightarrow 6ab$

(f) $16x^3$, $-4x^2$, $32x \rightarrow 4x$

(g) $10pq$, $20qr$, $30rp \rightarrow 10$

(h) $3x^2y^3$, $10x^3y^2$, $6x^2y^2z \rightarrow x^2y^2$

Q2.

Take out the common factor:

(a) $7x-42 = 7(x-6)$

(b) $6p-12q = 6(p-2q)$

(c) $7a^2+14a = 7a(a+2)$

(d) $-16z+20z^3 = 4z(5z^2-4)$

(e) $20l^2m+30alm = 10lm(2l+3a)$

(f) $5x^2y-15xy^2 = 5xy(x-3y)$

(g) $10a^2-15b^2+20c^2 = 5(2a^2-3b^2+4c^2)$

(h) $-4a^2+4ab-4ca = -4a(a-b+c)$

(i) $x^2yz+xy^2z+xyz^2 = xyz(x+y+z)$

(j) $ax^2y+bxy^2+cxyz = xy(ax+by+cz)$

Q3.

Factorise by grouping terms in pairs with a common factor:

(a) $x^2+xy+8x+8y = x(x+y)+8(x+y) = (x+y)(x+8)$

(b) $15xy-6x+5y-2 = 3x(5y-2)+1(5y-2) = (5y-2)(3x+1)$

(c) $ax+bx-ay-by = x(a+b)-y(a+b) = (a+b)(x-y)$

(d) $15pq+15+9q+25p = 5p(3q+5)+3(3q+5) = (3q+5)(5p+3)$

(e) $z-7+7xy-xyz = (z-7)-xy(z-7) = (z-7)(1-xy)$

Exercise 12.2

Q1.

Use the identities $(a+b)^2 = a^2+2ab+b^2$ and $(a-b)^2 = a^2-2ab+b^2$:

(a) $a^2+8a+16 = (a+4)^2$

(b) $p^2-10p+25 = (p-5)^2$

(c) $25m^2+30m+9 = (5m+3)^2$

(d) $49y^2+84yz+36z^2 = (7y+6z)^2$

(e) $4x^2-8x+4 = 4(x-1)^2$

(f) $121b^2-88bc+16c^2 = (11b-4c)^2$

(g) $(l+m)^2-4lm = l^2+2lm+m^2-4lm = l^2-2lm+m^2 = (l-m)^2$

(h) $a^4+2a^2b^2+b^4 = (a^2+b^2)^2$

Q2.

Use the identity $a^2-b^2 = (a-b)(a+b)$:

(a) $4p^2-9q^2 = (2p-3q)(2p+3q)$

(b) $63a^2-112b^2 = 7(9a^2-16b^2) = 7(3a-4b)(3a+4b)$

(c) $49x^2-36 = (7x-6)(7x+6)$
(d) $16x^5 - 144x^3 = 16x^3(x^2-9) = 16x^3(x-3)(x+3)$
(e) $(l+m)^2-(l-m)^2 = [(l+m)+(l-m)][(l+m)-(l-m)] = (2l)(2m) = 4lm$
(f) $9x^2y^2-16 = (3xy-4)(3xy+4)$
(g) $(x^2-2xy+y^2)-z^2 = (x-y)^2-z^2 = (x-y-z)(x-y+z)$
(h) $25a^2-4b^2+28bc-49c^2 = 25a^2-(4b^2-28bc+49c^2) = 25a^2-(2b-7c)^2 = (5a-2b+7c)(5a+2b-7c)$

Q3.

(a) $ax^2+bx = x(ax+b)$
(b) $7p^2+21q^2 = 7(p^2+3q^2)$
(c) $2x^3+2xy^2+2xz^2 = 2x(x^2+y^2+z^2)$
(d) $am^2+bm^2+bn^2+an^2 = m^2(a+b)+n^2(a+b) = (a+b)(m^2+n^2)$
(e) $(lm+l)+m+1 = l(m+1)+1(m+1) = (m+1)(l+1)$
(f) $y(y+z)+9(y+z) = (y+z)(y+9)$
(g) $5y^2-20y-8z+2yz = 5y(y-4)+2z(y-4) = (y-4)(5y+2z)$
(h) $10ab+4a+5b+2 = 2a(5b+2)+1(5b+2) = (5b+2)(2a+1)$
(i) $6xy-4y+6-9x = 2y(3x-2)-3(3x-2) = (3x-2)(2y-3)$

Q4.

(a) $a^4 - b^4 = (a^2-b^2)(a^2+b^2) = (a-b)(a+b)(a^2+b^2)$
(b) $p^4 - 81 = (p^2-9)(p^2+9) = (p-3)(p+3)(p^2+9)$
(c) $x^4 - (y+z)^4 = [x^2-(y+z)^2][x^2+(y+z)^2] = [x-(y+z)][x+(y+z)][x^2+(y+z)^2] =$
$(x-y-z)(x+y+z)(x^2+y^2+2yz+z^2)$
(d) $x^4 - (x-z)^4 = [x^2-(x-z)^2][x^2+(x-z)^2] = [x-(x-z)][x+(x-z)][x^2+(x-z)^2] = z(2x-z)(2x^2-2xz+z^2)$
(e) $a^4 - 2a^2b^2+b^4 = (a^2-b^2)^2 = (a-b)^2(a+b)^2$

Q5.

Factorise the trinomials of the form $x^2+(\text{sum})x+(\text{product})$, finding two numbers with that sum and product:
(a) p^2+6p+8: numbers 2 and 4 (sum 6, product 8) → $(p+2)(p+4)$
(b) $q^2-10q+21$: numbers −3 and −7 (sum −10, product 21) → $(q-3)(q-7)$
(c) $p^2+6p-16$: numbers 8 and −2 (sum 6, product −16) → $(p-2)(p+8)$

Exercise 12.3

Q1.

Divide coefficients and subtract powers of the same variable:
(a) $28x^4 \div 56x = x^3/2$
(b) $-36y^3 \div 9y^2 = -4y$
(c) $66pq^2r^3 \div 11qr^2 = 6pqr$
(d) $34x^3y^3z \div 51xy^2z = 2x^2y/3$
(e) $12a^8b^8 \div (-6a^6b^4) = -2a^2b^4$

Q2.

Divide each term of the polynomial by the monomial:
(a) $(5x^2-6x) \div 3x = 5x/3 - 2$
(b) $(3y^8 - 4y^6 + 5y^4) \div y^4 = 3y^4 - 4y^2+5$
(c) $8(x^3y^2z^2+x^2y^3z^2+x^2y^2z^3) \div 4x^2y^2z^2 = 2x+2y+2z$
(d) $(x^3+2x^2+3x) \div 2x = x^2/2 + x + 3/2$
(e) $(p^3q^6 - p^6q^3) \div p^3q^3 = q^3 - p^3$

Q3.

(a) $(10x-25) \div 5 = 2x-5$
(b) $(10x-25) \div (2x-5)$: factor $10x-25 = 5(2x-5)$, so quotient $= 5(2x-5)\div(2x-5) = 5$
(c) $10y(6y+21) \div 5(2y+7)$: $6y+21=3(2y+7)$, so $= 10y\times3(2y+7) \div 5(2y+7) = 30y/5 = 6y$

(d) $9x^2y^2(3z-24) \div 27xy(z-8)$: $3z-24=3(z-8)$, so $= 9x^2y^2\times3(z-8) \div 27xy(z-8) = 27x^2y^2/27xy = xy$

(e) $96abc(3a-12)(5b-30) \div 144(a-4)(b-6)$: $3a-12=3(a-4)$, $5b-30=5(b-6)$, so numerator$=96abc\times3\times5\times(a-4)(b-6)=1440abc(a-4)(b-6)$; quotient $= 1440abc/144 = 10abc$

Q4.

(a) $5(2x+1)(3x+5) \div (2x+1) = 5(3x+5) = 15x+25$

(b) $26xy(x+5)(y-4) \div 13x(y-4) = 2y(x+5)$

(c) $52pqr(p+q)(q+r)(r+p) \div 104pq(q+r)(r+p) = r(p+q)/2$

(d) $20(y+4)(y^2+5y+3) \div 5(y+4) = 4(y^2+5y+3) = 4y^2+20y+12$

(e) $x(x+1)(x+2)(x+3) \div x(x+1) = (x+2)(x+3)$

Q5.

First factorise the numerator, then cancel the common factor with the divisor:

(a) $y^2+7y+10 = (y+2)(y+5)$; $\div(y+5) = (y+2)$

(b) $m^2-14m-32 = (m-16)(m+2)$; $\div(m+2) = (m-16)$

(c) $5p^2-25p+20 = 5(p^2-5p+4) = 5(p-1)(p-4)$; $\div(p-1) = 5(p-4) = 5p-20$

(d) $4yz(z^2+6z-16) = 4yz(z-2)(z+8)$; $\div2y(z+8) = 2z(z-2) = 2z^2-4z$

(e) $5pq(p^2-q^2) = 5pq(p-q)(p+q)$; $\div2p(p+q) = 5q(p-q)/2$

(f) $12xy(9x^2-16y^2) = 12xy(3x-4y)(3x+4y)$; $\div4xy(3x+4y) = 3(3x-4y) = 9x-12y$

(g) $39y^3(50y^2-98) = 39y^3\times2(25y^2-49) = 78y^3(5y-7)(5y+7)$; $\div26y^2(5y+7) = 3y(5y-7) = 15y^2-21y$

Chapter 13 — Introduction to Graphs

Exercise 13.1

Q1.

Read the values directly from the temperature-time graph (9 a.m. to 3 p.m.).

(a) At 1 p.m., the patient's temperature = 36.5°C.

(b) The temperature was 38.5°C at 12 noon.

(c) The temperature was the same (36.5°C) at 1 p.m. and 2 p.m.

(d) At 1:30 p.m., the temperature was 36.5°C — since the graph is a flat (horizontal) line between 1 p.m. and 2 p.m. (both readings are 36.5°C), the value in between must also be 36.5°C.

(e) The temperature showed an upward trend during 9 a.m.–11 a.m. and again during 2 p.m.–3 p.m.

Q2.

Read values from the sales line graph (in □ crores).

(a)(i) Sales in 2002 = □4 crore. (ii) Sales in 2006 = □8 crore.

(b)(i) Sales in 2003 = □7 crore. (ii) Sales in 2005 = □10 crore.

(c) Difference between sales in 2002 and 2006 = 8 ***−4 = □4 crore.***

(d) Year-on-year changes: 2002→2003: +3; 2003→2004: −1; 2004→2005: +4; 2005→2006: −2. The greatest difference from the previous year was in 2005 (an increase of □4 crore over 2004).

Q3.

Reading heights from the graph (Plant A dashed, Plant B solid):

(a) Plant A: (i) after 2 weeks = 7 cm, (ii) after 3 weeks = 9 cm.

(b) Plant B: (i) after 2 weeks = 7 cm, (ii) after 3 weeks = 10 cm.

(c) Growth of Plant A during the 3rd week = 9−7 = 2 cm.

(d) Growth of Plant B from end of 2nd to end of 3rd week = 10−7 = 3 cm.

(e) Plant A's growth by week: week1 ≈ 2cm, week2 ≈ 5cm, week3 ≈ 2cm — it grew most during the 2nd week.

(f) Plant B's growth by week: week1 ≈ 1cm, week2 ≈ 6cm, week3 ≈ 3cm — it grew least during the 1st week.

(g) Yes — at the end of the 2nd week, both plants were the same height (7 cm).

Q4.

Reading forecast (dashed) and actual (solid) temperatures from the graph, day by day:

(a) The forecast and actual temperatures coincided on the days where the two lines meet on the graph (from the figure, this occurs around Tuesday and Friday).

(b) The maximum forecast temperature during the week, read from the highest point of the dashed line, is 25°C.

(c) The minimum actual temperature during the week, read from the lowest point of the solid line, is 15°C.

(d) The day with the largest vertical gap between the two lines shows the greatest difference between actual and forecast temperature — from the graph this is Thursday.

(Note: since this reads values off a printed graph, students should confirm exact figures against the specific grid in their copy of the book.)

Q5.

(a) Plot Year (x-axis) against Days of snow (y-axis) using the points (2003,8), (2004,10), (2005,5), (2006,12), and join them with straight line segments — this gives a line graph (not necessarily a single straight line, since the trend is not uniform).

(b) Plot Year (x-axis) against Population in thousands (y-axis) for both Men and Women as two separate line graphs on the same axes, using the given data points for each year 2003–2007.

Q6.

(a) Reading the graph, each division on the time-axis represents 1 hour (marked at 8 a.m., 9 a.m., 10 a.m., 11 a.m., 12 noon).

(b) Total time taken for the travel = from 8 a.m. to 12 noon = 4 hours.

(c) The merchant's place is 22 km from the town (the final, highest point on the graph).

(d) Yes, the person stopped on the way — between 10 a.m. and 11 a.m. the distance stayed at 16 km (the graph is flat/horizontal in that interval), showing no distance was covered, i.e., the courier had halted.

(e) The courier rode fastest between 8 a.m. and 9 a.m., covering 10 km in the first hour — this is the steepest part of the graph, steeper than the 6 km covered in each of the other travelling hours.

Q7.

(a) A straight line rising from the origin: Yes, this is possible — it represents temperature increasing steadily and uniformly with time (e.g., water being heated at a constant rate).

(b) A straight line falling from left to right: Yes, this is possible — it represents temperature decreasing steadily and uniformly with time (e.g., a hot object cooling at a constant rate).

(c) A vertical line: No, this is not possible — a vertical line would mean many different temperatures at the very same instant of time, which cannot happen; time must always move forward.

(d) A horizontal line: Yes, this is possible — it represents temperature staying constant while time passes (e.g., temperature held steady, such as during a phase change, or a thermostatically controlled room).

Exercise 13.2

Q1.

(a) Cost of apples: plot Number of apples (x-axis) against Cost in □ (y-axis) using (1,5),(2,10),(3,15),(4,20),(5,25). Since cost = 5 × number of apples, this is a straight line through the origin (direct proportion).

(b) Distance travelled by car: plot Time (x-axis) against Distance in km (y-axis) using (6,40),(7,80),(8,120),(9,160).

(i) Since the car covers 40 km every hour at a steady rate, from 7:30 a.m. to 8 a.m. (half an hour) it covers half of 40 km = 20 km.

(ii) The distance was 100 km midway between 80 km (7 a.m.) and 120 km (8 a.m.), i.e. at 7:30 a.m.

(c) Interest on deposits: plot Deposit (x-axis) against Simple Interest (y-axis) using (1000,80),(2000,160),(3000,240),(4000,320),(5000,400).

(i) Yes, the graph passes through the origin (□0 deposit gives □0 interest).

(ii) Rate of interest = 80/1000 = 8%. Interest on □2500 = 2500 × 8% = □200.

(iii) For interest of □280: deposit = 280 ÷ 8% = □3500.

Q2.

(a) Side (2,3,3.5,5,6) vs Perimeter (8,12,14,20,24): since Perimeter = 4 × Side, the graph is a straight line through the origin. Yes, this is a linear graph.

(b) Side (2,3,4,5,6) vs Area (4,9,16,25,36): since Area = Side^2, the plotted points lie on a curve, not a straight line. No, this is NOT a linear graph.