CBSE Class 10 Mathematics: Sample Paper 1: Marking Scheme and Solutions

Based on NCERT · the board's 2024 to 2026 pattern | Time: 3 hours · **Maximum marks: 80**

Section A (20 × 1 mark)

1. The line drawn from the eye of an observer to the point of the object being viewed is called the [1]

(a) horizontal (b) vertical
(c) line of sight (d) angle of elevation

Answer: (c) By definition this line is the line of sight; the angles of the chapter are measured between it and the horizontal.

2. Assertion (A): $5x^2 - 3 = 0$ is a quadratic equation. Reason (R): $ax^2 + bx + c = 0$ is a quadratic equation whenever $a \neq 0$, even if $b = 0$. [1]

(a) Both A and R are true, and R is the correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false. (d) A is false, but R is true.

Answer: (a) Here $a = 5$, $b = 0$, $c = -3$. Only $a = 0$ would destroy the x^2 term, so R is exactly why A holds.

3. To draw the line $3x - 2y = 0$, a suitable pair of points is [1]

(a) (2, 0) and (0, 3) (b) (0, 0) and (3, 2)
(c) (0, 0) and (0, 0) (d) (0, 0) and (2, 3)

Answer: (d) $c = 0$, so $x = 0$ and $y = 0$ give the same point (0, 0) twice. Another value is needed: $x = 2$ gives $6 - 2y = 0$, $y = 3$, so (2, 3). (3, 2) gives $9 - 4 = 5 \neq 0$.

4. Two angles of a triangle are 48° and 67°. A triangle similar to it has angles [1]

(a) 67°, 67°, 46° (b) 67°, 56°, 57°
(c) 48°, 66°, 66° (d) 65°, 48°, 67°

Answer: (d) The third angle is 180° − 48° − 67° = 65°. A similar triangle is equiangular with it: 48°, 67°, 65° in any order.

5. In a right triangle one acute angle is 45° and the hypotenuse is $10\sqrt{2}$ cm. The length of each of the other two sides is [1]

(a) $5\sqrt{2}$ cm (b) $10\sqrt{2}$ cm
(c) 20 cm (d) 10 cm

Answer: (d) The other acute angle is also 45°, so the legs are equal. Each leg = hypotenuse × sin 45° = $10\sqrt{2} \times 1/\sqrt{2} = 10$ cm.

6. Which term of the AP 8, 14, 20, . . . is 176? [1]

(a) 30th (b) 28th
(c) 29th (d) 31st

Answer: (c) $176 = 8 + (n - 1) \times 6$ gives $n - 1 = 28$, so $n = 29$. (28 forgets to add 1.)

7. For a grouped distribution, $\Sigma f_i = 40$ and $\Sigma f_i x_i = 1260$. The mean is [1]

(a) 31.5 (b) 32
(c) 3.15 (d) 30

Answer: (a) $\bar{x} = \Sigma f_i x_i \div \Sigma f_i = 1260 \div 40 = 31.5$.

8. From a point on level ground 18 m from the foot of a water tower, the angle of elevation of its top is 45°. The height of the water tower is [1]

(a) 18 m (b) $18\sqrt{3}$ m

(c) $6\sqrt{3}$ m (d) 9 m

Answer: (a) tan 45° = height / 18 and tan 45° = 1, so the height is 18 m. ($18\sqrt{3}$ m comes from wrongly using tan 60°, $6\sqrt{3}$ m from tan 30°.)

9. The probability that the morning bus from Bhopal reaches Indore late is 0.37. The probability that it is not late is [1]

(a) 0.37 (b) 0.63

(c) 1.37 (d) 0.73

Answer: (b) P(not late) = 1 − P(late) = 1 − 0.37 = 0.63. 1.37 adds instead of subtracting; 0.73 reverses the digits.

10. If $2^a \times 3^b = 432$, where a and b are natural numbers, then (a, b) is [1]

(a) (3, 4) (b) (4, 3)

(c) (2, 4) (d) (4, 2)

Answer: (b) $432 = 2 \times 216 = 2 \times 2^3 \times 27 = 2^4 \times 3^3$. The factorisation is unique, so a = 4 and b = 3.

11. ΔABC and ΔDEF are equiangular, with A, B, C matching D, E, F. AB = 4 cm, BC = 6 cm and DE = 10 cm. Then EF is [1]

(a) 2.4 cm (b) 12 cm

(c) 15 cm (d) 4 cm

Answer: (c) In equiangular triangles corresponding sides are in one ratio: EF/BC = DE/AB = 10/4, so EF = 6 × 2.5 = 15 cm. (12 cm adds 6 instead of multiplying.)

12. In the triangle with vertices A(2, 3), B(6, 6) and C(−1, 7), the right angle is at [1]

(a) A (b) B

(c) C (d) no vertex: the triangle has no right angle

Answer: (a) $AB^2 = 16 + 9 = 25$, $AC^2 = 9 + 16 = 25$, $BC^2 = 49 + 1 = 50$. $AB^2 + AC^2 = BC^2$, so by the converse of Pythagoras the angle opposite BC, that is $\angle A$, is 90°.

13. A circular mirror with centre O and radius 28 cm has a strip cut off along a straight line AB, where $\angle AOB = 60°$. The area of the strip cut off is. Take $\pi = 22/7$. [1]

(a) $(\frac{1232}{3} + 196\sqrt{3})$ cm² (b) $(\frac{1232}{3} - 196\sqrt{3})$ cm²

(c) $(\frac{2464}{3} - 196\sqrt{3})$ cm² (d) $(\frac{1232}{3} - 392\sqrt{3})$ cm²

Answer: (b) Sector = (60/360) × (22/7) × 28^2 = 1232/3 cm²; triangle (equilateral, side 28) = ($\sqrt{3}/4$) × 784 = $196\sqrt{3}$ cm²; segment = sector − triangle.

14. Which of the following is a zero of $x^2 + 2x - 15$? [1]

(a) 3 (b) 5

(c) −3 (d) 15

Answer: (a) p(3) = 9 + 6 − 15 = 0, so 3 is a zero. p(5) = 20, p(−3) = −12, p(15) = 240. ($x^2 + 2x - 15 = (x + 5)(x - 3)$.)

15. After simplifying, the equation $(x + 3)^2 = x(x - 2) + 5$ is [1]

(a) a quadratic equation (b) an equation with no x in it

(c) a cubic equation (d) a linear equation

Answer: (d) $x^2 + 6x + 9 = x^2 - 2x + 5$. The x^2 terms cancel, leaving 8x + 4 = 0, which is linear.

16. In practice at a court in Kochi, a basketball player attempts 80 free throws and scores on 52 of them. The empirical probability that she scores on a free throw is [1]

(a) $\frac{7}{20}$ (b) $\frac{13}{20}$

(c) 0.52 (d) $\frac{20}{13}$

Answer: (b) Empirical probability = 52/80 = 13/20. 7/20 is the misses; 0.52 treats 52 as a percentage; 20/13 exceeds 1 and is upside down.

17. To factorise $6x^2 + 7x - 3$ by splitting the middle term, 7x is written as [1]

(a) $9x - 2x$ (b) $6x + x$

(c) $-9x + 2x$ (d) $3x + 4x$

Answer: (a) ac = 6 × (−3) = −18 and b = 7. Since ac < 0 the parts have opposite signs: 9 × (−2) = −18 and 9 + (−2) = 7.

18. A solid cone has base radius 3 cm and height 7 cm. Take π = 22/7. Its volume is [1]

(a) 198 cm^3 (b) 66 cm^3

(c) 22 cm^3 (d) 132 cm^3

Answer: (b) $V = (1/3)\pi r^2 h = (1/3) \times (22/7) \times 9 \times 7 = 66\ cm^3$. 198 cm^3 forgets the 1/3.

19. A line l is at a distance of 7 cm from the centre of a circle of radius 6.5 cm. Then l is [1]

(a) a tangent to the circle (b) a secant of the circle

(c) a line that does not meet the circle (d) a line through the centre

Answer: (c) The distance 7 cm is greater than the radius 6.5 cm, so every point of l lies outside the circle: l and the circle have no common point.

20. Assertion (A): A line drawn parallel to one side of a triangle, meeting the other two sides at distinct points, divides them in the same ratio. Reason (R): Any line meeting two sides of a triangle divides them in the same ratio. [1]

(a) Both A and R are true, and R is the correct explanation of A.

(b) Both A and R are true, but R is not the correct explanation of A.

(c) A is true, but R is false.

(d) A is false, but R is true.

Answer: (c) A is the Basic Proportionality Theorem. R is false: only a line parallel to the third side does this; a slanting line generally cuts the sides in different ratios.

Section B (5 × 2 marks)

21. A circle touches all four sides of a quadrilateral PQRS in which PQ = (2x + 3) cm, QR = 3x cm, RS = 9 cm and SP = 10 cm. Find x and the side QR. [2]

For a quadrilateral whose sides touch a circle, PQ + RS = QR + SP: 2x + 3 + 9 = 3x + 10, so x = 2 and QR = 6 cm.

- PQ + RS = QR + SP written (1)
- x = 2, QR = 6 cm (1)

22. If $\tan 2\theta = \sqrt{3}$, where $0° < 2\theta < 90°$, find θ. Hence show that tan 2θ is not equal to 2 tan θ. [2]

$\tan 2\theta = \sqrt{3} = \tan 60°$. As 2θ is acute, where tan takes each value only once, $2\theta = 60°$ and $\theta = 30°$. Then $2 \tan \theta = 2 \tan 30° = 2/\sqrt{3}$, while $\tan 2\theta = \tan 60° = \sqrt{3} = 3/\sqrt{3}$. Since $2/\sqrt{3} \neq 3/\sqrt{3}$, $\tan 2\theta \neq 2 \tan \theta$.

- $2\theta = 60°$, so $\theta = 30°$ (1)
- $2 \tan 30° = 2/\sqrt{3}$ against $\tan 60° = \sqrt{3}$, so they differ (1)

23. A storage tank is a cylinder 10 m long with a hemisphere of radius 7 m at each end. Take π = 22/7. Find the outer surface area of the tank. [2]

Or *A boiler is a cylinder 6 m long with a hemisphere of radius 3.5 m at each end. Take π = 22/7. Find the outer surface area of the boiler.*

Surface = CSA of cylinder + CSA of two hemispheres = $2\pi rh + 4\pi r^2 = 440 + 616 = 1056$ m^2.

- uses $2\pi rh + 2 \times 2\pi r^2$, with no flat faces (1)
- gets 1056 m^2 (1)

Or:

Surface = $2\pi rh + 4\pi r^2 = 2(22/7)(3.5)(6) + 4(22/7)(12.25) = 132 + 154 = 286$ m^2.

- uses $2\pi rh + 2 \times 2\pi r^2$, with no flat faces (1)
- gets 286 m^2 (1)

24. An AP has first term −12, common difference 5 and last term 108. Find the number of terms and its middle term. [2]

$108 = -12 + (n - 1) \times 5$ gives $n - 1 = 24$, $n = 25$. The middle term is the 13th: $a_{13} = -12 + 12 \times 5 = 48$.

- n = 25 (1)
- middle (13th) term = 48 (1)

25. In a grouped distribution with class size 5, the modal class is 25-30 with frequency 18. The class before it has frequency 12 and the class after it has frequency 9. Find the mode. [2]

$l = 25$, $f_1 = 18$, $f_0 = 12$, $f_2 = 9$, $h = 5$. Mode $= 25 + ((18 - 12) \div (36 - 12 - 9)) \times 5 = 25 + (6 \div 15) \times 5 = 27$.

- substitutes l, f_1, f_0, f_2, h correctly (1)
- mode = 27 (1)

Section C (6 × 3 marks)

26. A card is drawn from a well-shuffled deck of 52 cards. Find the probability that it is (i) a black card that is not a face card, (ii) a number card (2 to 10) of hearts, (iii) neither a club nor a king. [3]

(i) 26 black cards less 6 black face cards = 20: P = 20/52 = 5/13. (ii) 9 cards: P = 9/52. (iii) Clubs 13 and kings of the other three suits 3 give 16, so P(club or king) = 16/52 and P(neither) = 1 − 16/52 = 36/52 = 9/13.

- P(black non-face) = 5/13 (1)
- P(number card of hearts) = 9/52 (1)
- P(neither) = 9/13 (1)

27. α and β are the zeroes of $ax^2 + bx + c$, $a \neq 0$. Starting from $ax^2 + bx + c = k(x - \alpha)(x - \beta)$, show that $\alpha + \beta = -\frac{b}{a}$ and $\alpha\beta = \frac{c}{a}$. [3]

Since α and β are zeroes, $x - \alpha$ and $x - \beta$ are factors, so $ax^2 + bx + c = k(x - \alpha)(x - \beta) = kx^2 - k(\alpha + \beta)x + k\alpha\beta$. Comparing coefficients: $a = k$, $b = -k(\alpha + \beta)$, $c = k\alpha\beta$. Hence $\alpha + \beta = -\frac{b}{k} = -\frac{b}{a}$ and $\alpha\beta = \frac{c}{k} = \frac{c}{a}$.

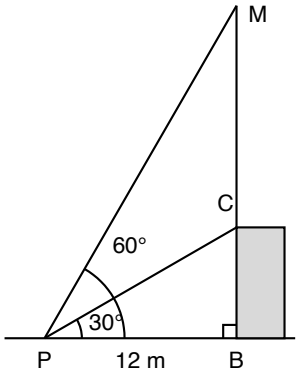
- expands $k(x - \alpha)(x - \beta) = kx^2 - k(\alpha + \beta)x + k\alpha\beta$ (1)
- compares coefficients: $a = k$, $b = -k(\alpha + \beta)$, $c = k\alpha\beta$ (1)
- concludes $\alpha + \beta = -\frac{b}{a}$, $\alpha\beta = \frac{c}{a}$ (1)

28. A circular window with centre O and radius 30 cm has a straight wooden bar AB fixed across it, where $\angle AOB = 120°$. Find the length of the bar and the area of the smaller glass pane. (Take $\pi = 3.14$ and $\sqrt{3} = 1.73$.) [3]

Sector = $(120/360) \times 3.14 \times 900 = 942$ cm^2. Draw OM $\perp$ AB; $\angle AOM = 60°$, so OM = 30 cos 60° = 15 cm and AM = 30 sin 60° = $15\sqrt{3}$ cm, so the bar AB = $30\sqrt{3} = 51.9$ cm. Triangle = $\frac{1}{2} \times 30\sqrt{3} \times 15 = 225\sqrt{3} = 389.25$ cm^2. Smaller pane = minor segment = $942 - 389.25 = 552.75$ cm^2.

- OM = 15 cm and bar AB = $30\sqrt{3} = 51.9$ cm (1)
- sector 942 cm^2 and triangle 389.25 cm^2 (1)
- pane 552.75 cm^2 (1)

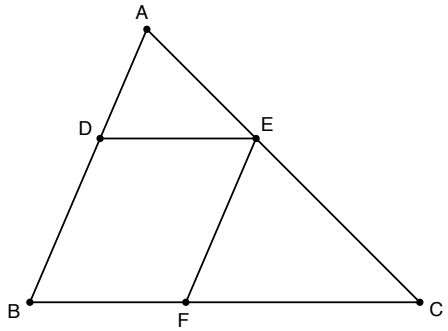
29. A mobile mast CM stands on the flat roof of a building BC. From a point P on the ground 12 m from the foot B of the building, the angles of elevation of the foot C and the top M of the mast are 30° and 60°. Find the height of the building and the height of the mast. (Use $\sqrt{3} \approx 1.73$.) [3]



In right ΔPBC, BC = 12 tan 30° = $12/\sqrt{3} = 4\sqrt{3}$ m ≈ 6.92 m. In right ΔPBM, BM = 12 tan 60° = $12\sqrt{3}$ m. Mast CM = BM − BC = $12\sqrt{3} - 4\sqrt{3} = 8\sqrt{3}$ m ≈ 13.84 m.

- building BC = 12 tan 30° = $4\sqrt{3} \approx 6.92$ m (1)
- BM = 12 tan 60° = $12\sqrt{3}$ m (1)
- mast = $8\sqrt{3} \approx 13.84$ m (1)

30. In ΔABC, D is a point on AB. The line through D parallel to BC meets AC at E, and the line through E parallel to AB meets BC at F, as in the figure. Prove that $\frac{AD}{DB} = \frac{BF}{FC}$. [3]



In ΔABC, DE $\parallel$ BC, so by BPT AD/DB = AE/EC ...(1). In ΔCAB, EF $\parallel$ AB with E on CA and F on CB, so by BPT CE/EA = CF/FB, that is AE/EC = BF/FC ...(2). From (1) and (2), AD/DB = BF/FC.

- AD/DB = AE/EC from DE $\parallel$ BC (1)
- CE/EA = CF/FB from EF $\parallel$ AB (1)
- combines to AD/DB = BF/FC (1)

31. Solve graphically: $x + y = 5$ and $2x - y = 4$. [3]

$x + y = 5$: (0, 5), (5, 0), (2, 3). $2x - y = 4$: (0, −4), (2, 0), (3, 2). Plot and join each set. The lines cross at (3, 2), so $x = 3$, $y = 2$. Check: $3 + 2 = 5$, $6 - 2 = 4$.

- table of at least two points for each line (1)
- both lines drawn correctly (1)
- reads the crossing point $x = 3$, $y = 2$ (1)

Section D (4 × 5 marks)

32. The daily earnings of 50 vegetable vendors at a market in Mumbai are given below. (a) Find the mean by the step deviation method. (b) Find the mode. (c) Compare the two. [5]

Earnings (₹)	Number of vendors
200-300	4
300-400	8
400-500	14
500-600	12
600-700	8
700-800	4

Or *The lengths of 40 fish in a catch landed at Kochi harbour are given below. (a) Find the mean by the step deviation method. (b) Find the mode. (c) Compare the two.*

Length (mm)	Number of fish
100-120	3
120-140	6
140-160	12
160-180	10
180-200	5
200-220	4

(a) $a = 450$, $h = 100$; $u_i = -2, -1, 0, 1, 2, 3$; $f_iu_i = -8, -8, 0, 12, 16, 12$; $\Sigma f_iu_i = 24$, $\Sigma f_i = 50$. $\bar{x} = 450 + (24 \div 50) \times 100 = ₹498$. (b) Modal class 400-500: $l = 400$, $f_1 = 14$, $f_0 = 8$, $f_2 = 12$. Mode $= 400 + ((14 - 8) \div (28 - 8 - 12)) \times 100 = ₹475$. (c) The mean is greater than the mode; the two are different measures and the mode need not equal the mean.

- u_i and f_iu_i columns, $\Sigma f_iu_i = 24$ (1)
- mean = 498 (1)
- modal class 400-500 with l, f_1, f_0, f_2 (1)
- mode = 475 (1)
- compares: the mean and the mode differ, either may be larger (1)

Or:

(a) $a = 150$, $h = 20$; $u_i = -2, -1, 0, 1, 2, 3$; $f_iu_i = -6, -6, 0, 10, 10, 12$; $\Sigma f_iu_i = 20$, $\Sigma f_i = 40$. $\bar{x} = 150 + (20 \div 40) \times 20 = 160$ mm. (b) Modal class 140-160: $l = 140$, $f_1 = 12$, $f_0 = 6$, $f_2 = 10$. Mode $= 140 + ((12 - 6) \div (24 - 6 - 10)) \times 20 = 155$ mm. (c) The mean is greater than the mode; the two are different measures and the mode need not equal the mean.

- u_i and f_iu_i columns, $\Sigma f_iu_i = 20$ (1)
- mean = 160 mm (1)
- modal class 140-160 with l, f_1, f_0, f_2 (1)
- mode = 155 mm (1)
- compares: the mean and the mode differ, either may be larger (1)

33. (a) Prove that the lengths of the two tangents drawn from an external point to a circle are equal. [5] (b) Show also that the line joining the external point to the centre bisects the angle between the tangents. (c) For a circle of radius 33 cm whose centre O is 65 cm from the external point P, find the length of each tangent and the distance from P to the nearest point of the circle.

Or *(a) PA and PB are tangents from P to a circle with centre O. Prove that the centre lies on the bisector of ∠APB. (b) Deduce that PA = PB. (c) If the radius is 11 cm and PA = 60 cm, find OP and the distance from P to the nearest point of the circle.*

(a) Let PA, PB be the tangents and O the centre. Join OA, OB, OP. ∠OAP = ∠OBP = 90°, OA = OB and OP is common, so ΔOAP ≅ ΔOBP (RHS) and PA = PB (CPCT). (b) From the same congruence, ∠APO = ∠BPO. (c) PA = PB = $\sqrt{(65^2 - 33^2)} = \sqrt{3136} = 56$ cm. The nearest point C lies on PO: PC = 65 − 33 = 32 cm.

- joins OA, OB, OP; ∠OAP = ∠OBP = 90° (1)
- ΔOAP ≅ ΔOBP (RHS), PA = PB (1)
- ∠APO = ∠BPO (CPCT) (1)
- PA = 56 cm (1)
- PC = 32 cm (1)

Or:

(a) Join OA, OB, OP. ∠OAP = ∠OBP = 90°, OA = OB, OP common, so ΔOAP ≅ ΔOBP (RHS). Then ∠APO = ∠BPO, so O lies on the bisector of ∠APB. (b) From the same congruence, PA = PB (CPCT). (c) OP = $\sqrt{(60^2 + 11^2)} = \sqrt{3721} = 61$ cm. The nearest point lies on PO: 61 − 11 = 50 cm.

- joins OA, OB, OP; right angles at A and B (1)
- ΔOAP ≅ ΔOBP, ∠APO = ∠BPO (1)
- PA = PB (1)
- OP = 61 cm (1)
- nearest distance 50 cm (1)

34. A science museum in Kolkata sells adult and student tickets. On Saturday, 40 adult and 60 student tickets brought in ₹5,200. On Sunday, 50 adult and 90 student tickets brought in ₹7,100. (a) Form the pair of equations. (b) Find the price of each ticket. (c) Find what a group of 12 adults and 30 students pays. [5]

Or *At a plant nursery in Pune, 5 rose plants and 8 tulsi plants cost ₹490, while 3 rose plants and 10 tulsi plants cost ₹450. (a) Form the pair of equations. (b) Find the price of each plant. (c) Find the cost of 4 rose and 6 tulsi plants.*

(a) 40x + 60y = 5200 and 50x + 90y = 7100, i.e. 2x + 3y = 260 and 5x + 9y = 710. (b) Multiply the first by 3: 6x + 9y = 780. Subtract the second: x = 70, then 3y = 260 − 140, y = 40. Adult ₹70, student ₹40. Check: 2800 + 2400 = 5200, 3500 + 3600 = 7100. (c) 12 × 70 + 30 × 40 = 840 + 1200 = ₹2,040.

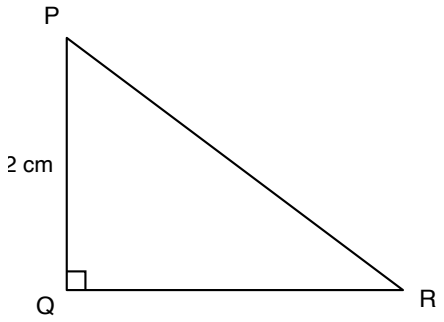
- both equations formed (1)
- simplified and coefficients matched (1)
- adult ticket ₹70 (1)
- student ticket ₹40, checked against both days (1)
- group pays ₹2,040 (1)

Or:

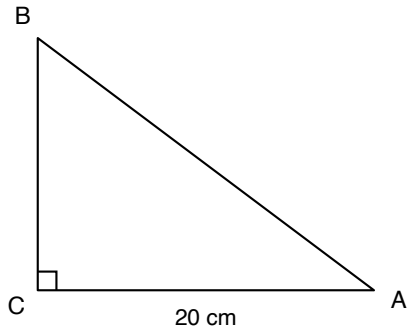
(a) 5x + 8y = 490 and 3x + 10y = 450. (b) Multiply by 3 and 5: 15x + 24y = 1470, 15x + 50y = 2250. Subtract: 26y = 780, y = 30; 5x = 490 − 240, x = 50. Rose ₹50, tulsi ₹30. Check: 150 + 300 = 450. (c) 4 × 50 + 6 × 30 = 200 + 180 = ₹380.

- both equations formed (1)
- x-coefficients matched and subtracted (1)
- tulsi ₹30 (1)
- rose ₹50, checked against the second purchase (1)
- cost ₹380 (1)

35. In ΔPQR, right-angled at Q, PQ = 12 cm and sin R = $\frac{3}{5}$ (see the figure). (a) Find PR and QR. (b) Find cos P and tan P. (c) Verify that $1 + \tan^2 R = \sec^2 R$. [5]



Or *In ΔABC, right-angled at C, AC = 20 cm and cos A = $\frac{4}{5}$ (see the figure). (a) Find AB and BC. (b) Find sin B and tan B. (c) Verify that $\cot^2 A + 1 = \text{cosec}^2 A$.*



(a) sin R = PQ/PR = 3/5, so PR = 12 × 5/3 = 20 cm. QR = $\sqrt{(20^2 - 12^2)} = \sqrt{256} = 16$ cm. (b) For angle P the adjacent side is PQ and the opposite side is QR: cos P = 12/20 = 3/5, tan P = 16/12 = 4/3. (c) tan R = PQ/QR = 12/16 = 3/4 and sec R = PR/QR = 20/16 = 5/4. $1 + \tan^2 R = 1 + 9/16 = 25/16 = (5/4)^2 = \sec^2 R$.

- PR = 20 cm (1)
- QR = 16 cm (1)
- cos P = 3/5 and tan P = 4/3 (1)
- tan R = 3/4 and sec R = 5/4 (1)
- both sides equal 25/16 (1)

Or:

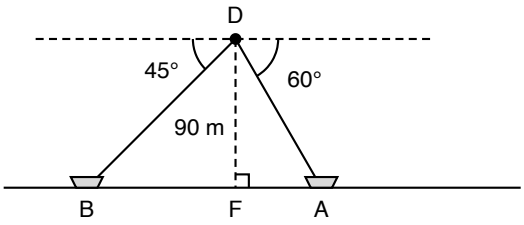
(a) cos A = AC/AB = 4/5, so AB = 20 × 5/4 = 25 cm. BC = $\sqrt{(25^2 - 20^2)} = \sqrt{225} = 15$ cm. (b) For angle B the opposite side is AC and the adjacent side is BC: sin B = 20/25 = 4/5, tan B = 20/15 = 4/3. (c) cot A = AC/BC = 20/15 = 4/3 and cosec A = AB/BC = 25/15 = 5/3. $\cot^2 A + 1 = 16/9 + 1 = 25/9 = (5/3)^2 = \text{cosec}^2 A$.

- AB = 25 cm (1)
- BC = 15 cm (1)
- sin B = 4/5 and tan B = 4/3 (1)
- cot A = 4/3 and cosec A = 5/3 (1)
- both sides equal 25/9 (1)

Section E (3 × 4 marks)

36. Read the passage and answer the questions that follow. [4]

A coastguard drone D hovers 90 m above the sea, directly above the point F on the water. Its camera picks up a fishing boat A on one side at an angle of depression of 60°, and a second boat B on the other side, in the same straight line with F, at an angle of depression of 45°, as in the figure. The crew on the boats use these readings to fix their positions. (Use $\sqrt{3} \approx 1.73$.)



(a) The angle of elevation of the drone, as seen from boat A, is [1]

(a) 30° (b) 45°
(c) 60° (d) 90°

Answer: (c) Angle FDA = 90° − 60° = 30°, so angle DAF = 180° − 90° − 30° = 60°; it equals the depression (alternate angles).

(b) The distance FA is [1]

(a) $90\sqrt{3}$ m (b) $30\sqrt{3}$ m
(c) 45 m (d) 90 m

Answer: (b) $\tan 60° = 90/FA$, so $FA = 90/\sqrt{3} = 30\sqrt{3}$ m.

(c) Find the distance between the boats A and B. [2]

Or *A third boat C, on the same side of F as A and in line with it, is seen at an angle of depression of 30°. Find the distance AC.*

FB = 90 cot 45° = 90 m. F lies between the boats, so AB = FA + FB = $30\sqrt{3}$ + 90 m ≈ 51.9 + 90 = 141.9 m.

- FB = 90 m (1)
- adds, since F is between: AB = 90 + $30\sqrt{3}$ ≈ 141.9 m (1)

Or:

FC = 90 cot 30° = $90\sqrt{3}$ m. A and C are on the same side, so AC = FC − FA = $90\sqrt{3} - 30\sqrt{3} = 60\sqrt{3}$ m ≈ 103.8 m.

- FC = $90\sqrt{3}$ m (1)
- subtracts: AC = $60\sqrt{3}$ ≈ 103.8 m (1)

37. Read the passage and answer the questions that follow. [4]

A gram panchayat near Hassan is fencing a rectangular plot for a community vegetable garden. The surveyor notes that the length of the plot is 6 m more than its breadth and that its area is 160 m^2. The panchayat needs the dimensions to order the fencing wire and to plan the beds. Let the breadth of the plot be x metres.

(a) The quadratic equation satisfied by x is [1]

(a) $x^2 + 6x - 160 = 0$ (b) $x^2 - 6x - 160 = 0$

(c) $x^2 + 6x + 160 = 0$ (d) $2x + 6 = 160$

Answer: (a) Length x + 6, area $x(x + 6) = 160$, so $x^2 + 6x - 160 = 0$.

(b) The discriminant of this equation is [1]

(a) 676 (b) 604

(c) 26 (d) −604

Answer: (a) $D = 6^2 - 4 \times 1 \times (-160) = 36 + 640 = 676$.

(c) Find the length and breadth of the plot. [2]

Or *Find the length of wire needed to fence the plot once around.*

$x = (-6 \pm \sqrt{676})/2 = (-6 \pm 26)/2$, so x = 10 or x = −16. A breadth cannot be negative, so the breadth is 10 m and the length is 16 m.

- solves to x = 10 or −16 (1)
- rejects −16; breadth 10 m, length 16 m (1)

Or:

$x^2 + 6x - 160 = 0$ gives $(x + 16)(x - 10) = 0$; breadth 10 m (−16 rejected), length 16 m. Perimeter = 2(16 + 10) = 52 m.

- finds breadth 10 m, length 16 m, rejecting −16 (1)
- perimeter 52 m (1)

38. Read the passage and answer the questions that follow. [4]

A printing unit in Surat makes a triangular logo ABC for a cooperative dairy and a large banner PQR of exactly the same shape. The banner's longest side RP had not been measured when the order sheet below was written. A third piece, a sticker XYZ, was cut by a new worker from his own measurements.

Item	Sides
Logo ABC	AB = 4 cm, BC = 6 cm, CA = 7 cm
Banner PQR	QR = 12 cm, PQ = 18 cm, RP = ?
Sticker XYZ	XY = 8 cm, YZ = 12 cm, ZX = 13 cm

(a) The scale factor of the banner to the logo is [1]

(a) 3 (b) $\frac{1}{3}$

(c) 2 (d) $\frac{3}{2}$

Answer: (a) Matching by size, QR ↔ AB and PQ ↔ BC: 12/4 = 18/6 = 3.

(b) The length of RP is [1]

(a) 21 cm (b) 28 cm

(c) 18 cm (d) 14 cm

Answer: (a) RP matches the longest side CA: RP = 3 × 7 = 21 cm.

(c) Write the similarity between the logo and the banner with the vertices in the correct order, and name the criterion. [2]

Or *Is the sticker XYZ similar to the logo ABC? Justify.*

AB/QR = BC/PQ = CA/RP = 1/3, so the triangles are similar by SSS. B lies on AB and BC, matching Q on QR and PQ; A matches R and C matches P. So ΔABC ~ ΔRQP.

- three equal ratios, SSS (1)
- ΔABC ~ ΔRQP (1)

Or:

Match by size: XY/AB = 8/4 = 2 and YZ/BC = 12/6 = 2, but ZX/CA = 13/7 ≠ 2. The sides are not in one ratio, so the sticker is not similar to the logo.

- computes the three ratios (1)
- 13/7 ≠ 2, so not similar (1)