CBSE Class 10 Mathematics: Sample Paper 2: 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. In ΔXYZ, right-angled at Y, XY = 7 cm, YZ = 24 cm and XZ = 25 cm. The value of tan Z is [1]

(a) $\frac{24}{7}$ (b) $\frac{7}{25}$

(c) $\frac{7}{24}$ (d) $\frac{24}{25}$

Answer: (c) For angle Z the opposite side is XY = 7 cm and the adjacent side is YZ = 24 cm, so tan Z = 7/24.

2. The weights of 36 sacks of rice at a godown in Raipur are grouped below. The modal class is [1]

Weight (kg)	Number of sacks
45-50	5
50-55	9
55-60	12
60-65	7
65-70	3

(a) 50-55 (b) 55-60

(c) 60-65 (d) 45-50

Answer: (b) The modal class is the class with the largest frequency, 12, which is 55-60.

3. The distance between the points A(1, −2) and B(7, 6) is [1]

(a) 10 units (b) 14 units

(c) $4\sqrt{5}$ units (d) 2 units

Answer: (a) $AB = \sqrt{[(7-1)^2 + (6-(-2))^2]} = \sqrt{(36+64)} = \sqrt{100} = 10$. (14 adds the gaps 6 + 8; $4\sqrt{5}$ comes from adding the coordinates instead of subtracting them.)

4. A cone has base radius 6 cm and height 8 cm. Take π = 3.14. Its curved surface area is [1]

(a) 188.4 cm^2 (b) 150.72 cm^2

(c) 301.44 cm^2 (d) 113.04 cm^2

Answer: (a) $l = \sqrt{(6^2 + 8^2)} = 10$ cm. CSA = $\pi rl = 3.14 \times 6 \times 10 = 188.4$ cm^2. Using the height for l gives 150.72 cm^2; adding the base gives 301.44 cm^2.

5. ΔABC ~ ΔDEF and ΔDEF ~ ΔPQR. Which of these must be true? [1]

(a) ΔABC ≅ ΔPQR (b) ΔABC ~ ΔPQR

(c) ΔABC ~ ΔQPR (d) ΔABC and ΔPQR are similar only if they are congruent

Answer: (b) Similarity is transitive: the angles and side ratios carry through ΔDEF, with the vertices in the same order.

6. A box at a sweet shop in Mathura holds 40 laddoos, of which 15 are kesar laddoos and the rest are plain. One laddoo is taken out at random. The probability that it is a kesar laddoo is [1]

(a) $\frac{5}{8}$ (b) $\frac{3}{8}$

(c) $\frac{3}{5}$ (d) $\frac{1}{4}$

Answer: (b) P(kesar) = 15/40 = 3/8. 5/8 is the plain laddoos; 3/5 divides kesar by plain instead of by all 40; 1/4 would need only 10 kesar laddoos.

7. The lines $x = 4$ and $y = -1$ meet at [1]

(a) (0, 0) (b) (−1, 4)

(c) (4, −1) (d) no point, as they are parallel

Answer: (c) $x = 4$ is a vertical line and $y = -1$ a horizontal one; they always meet, at the point (4, −1).

8. The sum of the first 20 terms of the AP 3, 7, 11, . . . is [1]

(a) 820 (b) 780

(c) 860 (d) 410

Answer: (a) $S_{20} = 20/2\ [2 \times 3 + 19 \times 4] = 10 \times 82 = 820$.

9. Assertion (A): The values of a scooter that loses 10% of its value every year, recorded at the end of each year, form an AP. Reason (R): In an AP each term after the first is obtained by adding a fixed number to the preceding term. [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: (d) R is the definition of an AP and is true. A is false: losing 10% of the value each time multiplies by 0.9, so the yearly fall shrinks (for ₹50,000: ₹5,000, then ₹4,500, . . .) and the differences are not fixed.

10. Assertion (A): From a point 17 cm from the centre of a circle of radius 8 cm, each of the two tangents is 15 cm long. Reason (R): A circle has infinitely many tangents. [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: (b) A is true: $\sqrt{(17^2 - 8^2)} = 15$. R is true, but the count of all tangents says nothing about the length 15 cm.

11. The length of the tangent from a point 17 cm from the centre of a circle of radius 8 cm is [1]

(a) 15 cm (b) 9 cm

(c) 25 cm (d) $\sqrt{353}$ cm

Answer: (a) The right angle is at the point of contact, so the tangent length is $\sqrt{(17^2 - 8^2)} = \sqrt{225} = 15$ cm.

12. Which of the following is a quadratic equation? [1]

(a) $2x + 3 = 0$ (b) $x^3 + 2x = 1$

(c) $3x^2 = 0$ (d) $(x + 1)^2 = x^2 + 4$

Answer: (c) $3x^2 = 0$ is $ax^2 + bx + c = 0$ with $a = 3$, $b = 0$, $c = 0$; only a must be non-zero. $(x + 1)^2 = x^2 + 4$ simplifies to $2x - 3 = 0$, which is linear.

13. Which of the following lists is an AP? [1]

(a) 2, 6, 18, 54 (b) 5, 9, 14, 20

(c) 1, 4, 9, 16 (d) −7, −2, 3, 8

Answer: (d) For −7, −2, 3, 8 the differences are 5, 5, 5. The others: 4, 12, 36; 4, 5, 6; 3, 5, 7 are not fixed.

14. Which of the following statements is true? [1]

(a) A circle has exactly two tangents.

(b) A circle has infinitely many tangents, but only two of them pass through a given point outside it.

(c) From a point inside a circle exactly one tangent can be drawn.

(d) A circle has infinitely many tangents, and infinitely many pass through a given point outside it.

Answer: (b) There is one tangent at every point of the circle, so infinitely many in all; through a point outside the circle exactly two of them pass, and through a point inside, none.

15. A polynomial p(x) has degree 5. The greatest number of points at which the graph of y = p(x) can meet the x-axis is [1]

(a) infinitely many (b) 4

(c) 6 (d) 5

Answer: (d) A polynomial of degree n has at most n zeroes, so its graph meets the x-axis at most n times: here at most 5.

16. In the step deviation method, the assumed mean is 55 and the class size is 10. For the class with class mark 75, u_i is [1]

(a) 2 (b) 20

(c) −2 (d) 7.5

Answer: (a) $u_i = (x_i - a) \div h = (75 - 55) \div 10 = 2$. 20 is d_i, not u_i.

17. The value of $2 \sin 30° + \sqrt{3} \cos 30°$ is [1]

(a) $\frac{3}{2}$ (b) $\frac{5}{2}$

(c) 2 (d) $1 + \sqrt{3}$

Answer: (b) $2 \sin 30° = 2 \times 1/2 = 1$ and $\sqrt{3} \cos 30° = \sqrt{3} \times \sqrt{3}/2 = 3/2$, so the value is $1 + 3/2 = 5/2$.

18. The prime factorisation of 180 is [1]

(a) $2^2 \times 3 \times 15$ (b) $4 \times 9 \times 5$

(c) $2^2 \times 3^2 \times 5$ (d) $2^3 \times 3^2 \times 5$

Answer: (c) $180 = 2 \times 90 = 2 \times 2 \times 45 = 2 \times 2 \times 3 \times 15 = 2 \times 2 \times 3 \times 3 \times 5 = 2^2 \times 3^2 \times 5$. $4 \times 9 \times 5$ and $2^2 \times 3 \times 15$ multiply to 180 but contain non-primes (4, 9, 15); $2^3 \times 3^2 \times 5$ is 360.

19. The part of a circular region enclosed between a chord and the arc it cuts off is called [1]

(a) a sector (b) a quadrant

(c) a segment (d) an arc

Answer: (c) A chord and its arc enclose a segment. A sector is bounded by two radii and an arc, a quadrant is a 90° sector, and an arc is a curve, not a region.

20. From the top of a cliff, the angle of depression of a boat at sea is 30°. The angle of elevation of the top of the cliff, seen from the boat, is [1]

(a) 60° (b) 30°

(c) 90° (d) 45°

Answer: (b) In the right triangle formed by the cliff, the sea and the line of sight, the angle at the cliff-top is 90° − 30° = 60°, so the angle at the boat is 180° − 90° − 60° = 30°. The depression and the elevation are alternate angles, hence equal.

Section B (5 × 2 marks)

21. The area of a circle is 616 cm^2 and a sector of it has area 154 cm^2. Find the angle of the sector and the length of its arc. Take π = 22/7. [2]

Or *The circumference of a circle is 264 cm and an arc of it is 88 cm long. Find the angle the arc subtends at the centre and the area of the corresponding sector. Take π = 22/7.*

The sector is 154/616 = 1/4 of the circle, so θ = 360°/4 = 90°. $\pi r^2 = 616$ gives $r^2 = 196$, r = 14 cm. Arc = (1/4) × 2 × (22/7) × 14 = 22 cm.

- angle 90° (1)
- radius 14 cm and arc 22 cm (1)

Or:

The arc is 88/264 = 1/3 of the circumference, so θ = 120°. 2πr = 264 gives r = 42 cm. Sector = (1/3) × (22/7) × 42^2 = 1848 cm^2.

- angle 120° (1)
- radius 42 cm and sector 1848 cm^2 (1)

22. Explain why equal corresponding angles are enough to show that two triangles are similar, but not enough for two quadrilaterals. Give an example for quadrilaterals. [2]

For triangles, Theorem 6.3 (AAA) shows that equal corresponding angles force the corresponding sides into the same ratio, so the second condition follows. For quadrilaterals it does not: a 2 cm × 3 cm rectangle and a 2 cm × 5 cm rectangle have all angles 90°, but 2/2 ≠ 3/5, so they are not similar.

- triangles: AAA makes the sides proportional (1)
- a correct quadrilateral counter-example (1)

23. The zeroes of $x^2 + (k - 4)x - 9$ are negatives of each other. Find k and the zeroes. [2]

Zeroes α and −α have sum 0, so −(k − 4) = 0 and k = 4. The polynomial is $x^2 - 9 = (x - 3)(x + 3)$, with zeroes 3 and −3.

- sum 0 gives k = 4 (1)
- zeroes 3 and −3 (1)

24. A bag has 10 tokens marked with a star and some plain tokens. A token is drawn at random, and the probability that it is plain is $\frac{1}{3}$. Find the number of plain tokens. [2]

Let the plain tokens be p. Then p/(10 + p) = 1/3, so 3p = 10 + p, 2p = 10, p = 5. Check: 5/15 = 1/3.

- forms p/(10 + p) = 1/3 (1)
- p = 5 (1)

25. A boy whose eyes are 1.35 m above the ground sees the top of a 21.35 m tall flag-mast at an angle of elevation of 45°. How far from the mast is he standing? [2]

The triangle runs from his eye, so its vertical side is 21.35 − 1.35 = 20 m. tan 45° = 20/d gives d = 20 m.

- trims the eye height: vertical side = 20 m (1)
- tan 45° = 20/d, d = 20 m (1)

Section C (6 × 3 marks)

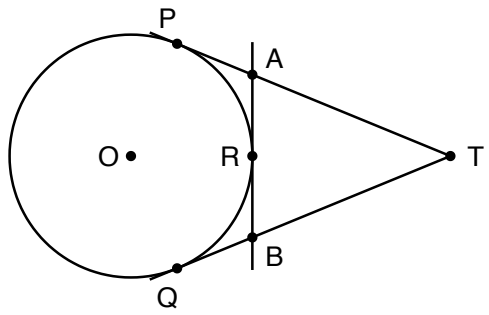
26. The total rainfall in July (in mm) at 50 weather stations in Assam is given below. Find the mean rainfall by the step deviation method. [3]

Rainfall (mm)	Number of stations
100-150	4
150-200	9
200-250	16
250-300	13
300-350	8

Class marks 125, 175, 225, 275, 325; a = 225, h = 50. $u_i = -2, -1, 0, 1, 2$; $f_iu_i = -8, -9, 0, 13, 16$; $\Sigma f_iu_i = 12$. $\bar{x} = 225 + (12 \div 50) \times 50 = 237$ mm.

- u_i column with a = 225, h = 50 (1)
- $\Sigma f_iu_i = 12$ (1)
- mean = 237 mm (1)

27. TP and TQ are tangents from T to a circle. A third tangent touches the circle at R on the minor arc PQ and meets TP at A and TQ at B, as in the figure. Prove that the perimeter of ΔTAB equals 2TP. Find the perimeter when TP = 12 cm. [3]



Tangents from A: AR = AP; from B: BR = BQ. Perimeter = TA + AB + BT = TA + AR + RB + BT = (TA + AP) + (BQ + TB) = TP + TQ. TP = TQ, so the perimeter is 2TP = 24 cm.

- AR = AP and BR = BQ (1)
- perimeter = TP + TQ = 2TP (1)
- 24 cm (1)

28. If $5 \tan\theta = 12$, where θ is acute, find the value of $\frac{2\sin\theta - \cos\theta}{\sin\theta + 3\cos\theta}$. [3]

$\tan\theta = 12/5$. Take opposite side 12k and adjacent side 5k; hypotenuse = $\sqrt{(144k^2 + 25k^2)} = 13k$. So $\sin\theta = 12/13$ and $\cos\theta = 5/13$. Value = $(24/13 - 5/13)/(12/13 + 15/13) = (19/13)/(27/13) = 19/27$. (Or divide above and below by $\cos\theta$: $(2\tan\theta - 1)/(\tan\theta + 3) = (24/5 - 1)/(12/5 + 3) = 19/27$.)

- hypotenuse 13k, or divides through by $\cos\theta$ (1)
- $\sin\theta = 12/13$ and $\cos\theta = 5/13$ (or the expression in $\tan\theta$) (1)
- value = 19/27 (1)

29. Solve $3x + 2y = 12$ and $5x - 3y = 1$ by elimination, and hence find m for which $y = mx - 1$. [3]

Multiply by 3 and 2: $9x + 6y = 36$, $10x - 6y = 2$. Add: $19x = 38$, $x = 2$; then $2y = 12 - 6$, $y = 3$. Substituting into $y = mx - 1$: $3 = 2m - 1$, $m = 2$.

- makes the y-coefficients equal and adds (1)
- x = 2, y = 3 (1)
- m = 2 (1)

30. Find the values of k for which $(k + 1)x^2 - 2(k - 1)x + 1 = 0$ has two equal roots. Find the roots for the positive value of k. [3]

Or *Find the value of k for which $x^2 - 2(k + 1)x + k^2 = 0$ has two equal roots, and find those roots.*

$D = 4(k - 1)^2 - 4(k + 1) = 4(k^2 - 3k) = 4k(k - 3)$. $D = 0$ gives $k = 0$ or $k = 3$ (neither makes $k + 1$ zero). For $k = 3$: $4x^2 - 4x + 1 = 0$, so $x = -b/2a = 4/8 = 1/2$, i.e. roots 1/2, 1/2.

- writes $D = 4(k - 1)^2 - 4(k + 1)$ (1)
- sets $D = 0$ and gets $k = 0$ or 3 (1)
- for $k = 3$, roots 1/2, 1/2 (1)

Or:

$D = 4(k + 1)^2 - 4k^2 = 4(2k + 1)$. $D = 0$ gives $k = -1/2$. The equation becomes $x^2 - x + 1/4 = 0$, so $x = -b/2a = 1/2$; roots 1/2, 1/2.

- writes $D = 4(k + 1)^2 - 4k^2$ (1)
- sets $D = 0$ and gets $k = -1/2$ (1)
- roots 1/2, 1/2 (1)

31. A cylindrical flower vase has inner radius 2.1 cm and height 14 cm, but its base rises inside it as a hemisphere of radius 2.1 cm. Take $\pi = 22/7$. Find how much water the vase holds when full, and what percentage of its apparent capacity is lost to the raised base. [3]

Apparent capacity $= \pi r^2 h = (22/7)(4.41)(14) = 194.04$ cm^3. Hemisphere $= (2/3)\pi r^3 = (2/3)(22/7)(9.261) = 19.404$ cm^3. Water held $= 194.04 - 19.404 = 174.636$ cm^3. Loss $= 19.404/194.04 \times 100 = 10\%$.

- apparent capacity 194.04 cm^3 (1)
- hemisphere 19.404 cm^3 and water held 174.636 cm^3 (1)
- percentage lost 10% (1)

Section D (4 × 5 marks)

32. Ankit's mother is 24 years older than Ankit. Five years from now, the product of their ages (in years) will be 432. (a) Form a quadratic equation in Ankit's present age x. (b) Find the present ages of Ankit and his mother. [5]

Or *The sum of the present ages of two sisters, Riya and Tara, is 22 years. Three years ago, the product of their ages (in years) was 63. (a) Form a quadratic equation in Riya's present age x. (b) Find their present ages.*

(a) Five years from now: Ankit x + 5, mother x + 29. (x + 5)(x + 29) = 432 gives $x^2 + 34x + 145 = 432$, i.e. $x^2 + 34x - 287 = 0$. (b) (x + 41)(x − 7) = 0, so x = 7 or −41. An age cannot be negative, so x = 7. Ankit is 7 years and his mother 31 years. Check: 12 × 36 = 432.

- shifts both ages: x + 5 and x + 29 (1)
- forms $x^2 + 34x - 287 = 0$ (1)
- solves to x = 7 or −41 (1)
- rejects −41 with the reason (1)
- Ankit 7 years, mother 31 years (1)

Or:

(a) Tara is 22 − x. Three years ago: x − 3 and 19 − x. (x − 3)(19 − x) = 63 gives $-x^2 + 22x - 57 = 63$, i.e. $x^2 - 22x + 120 = 0$. (b) (x − 10)(x − 12) = 0, so x = 10 or 12. Either way the ages are 10 years and 12 years. Check: 7 × 9 = 63.

- shifts both ages: x − 3 and 19 − x (1)
- forms $x^2 - 22x + 120 = 0$ (1)
- solves to x = 10 or 12 (1)
- interprets both roots as the same pair of ages (1)
- ages 10 years and 12 years (1)

33. (a) State and prove the Basic Proportionality Theorem. (b) In ΔLMN, P lies on LM and Q on LN with PQ ∥ MN. If LP = 3.5 cm, PM = 6.5 cm and LQ = 4.2 cm, find LN. [5]

Or *(a) Prove that if in two triangles the corresponding angles are equal, then their corresponding sides are in the same ratio. (b) In ΔABC and ΔDEF, ∠A = ∠D and ∠B = ∠E. AB = 5 cm, BC = 7 cm, DE = 7.5 cm and DF = 9 cm. Find EF and AC.*

(a) Statement: a line drawn parallel to one side of a triangle, meeting the other two sides at distinct points, divides them in the same ratio. Given ΔABC with DE ∥ BC, D on AB, E on AC; to prove AD/DB = AE/EC. Join BE and CD; draw EN ⊥ AB and DM ⊥ AC. ar(ADE)/ar(BDE) = (½·AD·EN)/(½·DB·EN) = AD/DB, and ar(ADE)/ar(DEC) = (½·AE·DM)/(½·EC·DM) = AE/EC. ΔBDE and ΔDEC stand on the same base DE between the parallels DE and BC, so ar(BDE) = ar(DEC). Hence AD/DB = AE/EC. (b) By BPT LP/PM = LQ/QN, so QN = 4.2 × 6.5/3.5 = 7.8 cm and LN = 4.2 + 7.8 = 12 cm.

- statement, figure and construction (1)
- the two area ratios AD/DB and AE/EC (1)
- ar(BDE) = ar(DEC), conclusion (1)
- LP/PM = LQ/QN, QN = 7.8 cm (1)
- LN = 12 cm (1)

Or:

(a) Given ΔABC and ΔDEF with ∠A = ∠D, ∠B = ∠E, ∠C = ∠F (DE longer than AB). Cut DP = AB on DE and DQ = AC on DF and join PQ. ΔABC ≅ ΔDPQ (SAS), so ∠DPQ = ∠B = ∠E, and PQ ∥ EF (corresponding angles equal). By BPT, DP/PE = DQ/QF, so DP/DE = DQ/DF, that is AB/DE = AC/DF. In the same way AB/DE = BC/EF. So the sides are in the same ratio. (b) Two pairs of angles are equal, so the triangles are similar with ratio DE/AB = 7.5/5 = 1.5. EF = 1.5 × 7 = 10.5 cm and AC = 9/1.5 = 6 cm.

- construction DP = AB, DQ = AC and ΔABC ≅ ΔDPQ (1)
- ∠DPQ = ∠E so PQ ∥ EF (1)
- BPT gives AB/DE = AC/DF = BC/EF (1)
- ratio 1.5, EF = 10.5 cm (1)
- AC = 6 cm (1)

34. A straight level road runs away from the foot of a 120 m tall watchtower. A guard at the top sees a bus moving away along the road at uniform speed. Its angle of depression is 60° at first and 45° two minutes later. (a) Find the bus's distances from the foot at the two sightings. (b) Find its speed. (c) How many more minutes will it take for the angle of depression to become 30°? (Use √3 ≈ 1.73.) [5]

Or *A hot-air balloon rises vertically at a uniform speed from a point O on level ground. Rohan stands at P, 60 m from O. Eight seconds after it leaves O, he sees the balloon at an angle of elevation of 30°. (a) Find the balloon's speed. (b) After how many seconds from the start is its angle of elevation 45°? (c) After how many seconds is it 60°? (Use √3 ≈ 1.73.)*

(a) Distances: 120 cot 60° = 40√3 m ≈ 69.2 m and 120 cot 45° = 120 m. (b) In 2 minutes it covers 120 − 40√3 m, so speed = 60 − 20√3 = 20√3(√3 − 1) m/min ≈ 25.4 m/min. (c) At 30° the distance is 120 cot 30° = 120√3 m, so the remaining distance is 120√3 − 120 = 120(√3 − 1) m. Time = 120(√3 − 1) ÷ 20√3(√3 − 1) = 6/√3 = 2√3 minutes ≈ 3.46 minutes.

- distances 40√3 m and 120 m (1)
- distance covered is the difference, 120 − 40√3 m (1)
- speed = 60 − 20√3 ≈ 25.4 m/min (1)
- distance at 30° is 120√3 m; remaining 120(√3 − 1) m (1)
- time = 2√3 ≈ 3.46 min (1)

Or:

(a) At 8 s its height is 60 tan 30° = 20√3 m, so speed = 20√3/8 = 5√3/2 m/s ≈ 4.33 m/s. (b) At 45° the height is 60 tan 45° = 60 m; time = 60 ÷ (5√3/2) = 24/√3 = 8√3 s ≈ 13.84 s. (c) At 60° the height is 60√3 m; time = 60√3 ÷ (5√3/2) = 24 s.

- height at 8 s = 20√3 m (1)
- speed = 5√3/2 ≈ 4.33 m/s (1)
- height 60 m at 45° (1)
- time = 8√3 ≈ 13.84 s (1)
- height 60√3 m, time 24 s (1)

35. A toy shop in Chennai has a box of 40 balls, some red and the rest yellow. For a ball taken out at random, P(red) = $\frac{3}{8}$. (a) Find the number of red balls. (b) Find P(yellow). (c) If 10 more red balls are put into the original box, find the new P(red). (d) Starting again from the original box, how many yellow balls must be taken out so that P(red) becomes $\frac{3}{5}$? [5]

Or *A stationery shop in Bengaluru has a box of 36 pens, some blue and the rest black. For a pen taken out at random, P(blue) = $\frac{5}{12}$. (a) Find the number of blue pens. (b) Find P(black). (c) If 9 more blue pens are put into the original box, find the new P(blue). (d) Starting again from the original box, how many black pens must be taken out so that P(blue) becomes $\frac{3}{4}$?*

(a) Red = 40 × 3/8 = 15. (b) P(yellow) = 1 − 3/8 = 5/8 (25 yellow). (c) 25 red of 50: P = 1/2. (d) Let y yellow remain: 15/(15 + y) = 3/5, so 75 = 45 + 3y, y = 10. Take out 25 − 10 = 15 yellow balls.

- red = 15 (1)
- P(yellow) = 5/8 (1)
- new P(red) = 25/50 = 1/2 (1)
- forms 15/(15 + y) = 3/5, y = 10 (1)
- 15 yellow balls taken out (1)

Or:

(a) Blue = 36 × 5/12 = 15. (b) P(black) = 1 − 5/12 = 7/12 (21 black). (c) 24 blue of 45: P = 8/15. (d) Let b black remain: 15/(15 + b) = 3/4, so 60 = 45 + 3b, b = 5. Take out 21 − 5 = 16 black pens.

- blue = 15 (1)
- P(black) = 7/12 (1)
- new P(blue) = 24/45 = 8/15 (1)
- forms 15/(15 + b) = 3/4, b = 5 (1)
- 16 black pens taken out (1)

Section E (3 × 4 marks)

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

Kavya, a Class 10 student in Kochi, made a table of the sine and cosine of some standard angles for her revision notes. She wants to use it to find the other ratios, since tan A = sin A ÷ cos A, and to see how the values change as the angle grows from 0° to 90°.

A	0°	30°	45°	60°	90°
sin A	0	1/2	1/√2	√3/2	1
cos A	1	√3/2	1/√2	1/2	0

(a) As A increases from 0° to 90°, the table shows that [1]

(a) sin A and cos A both increase
(b) sin A increases and cos A decreases
(c) sin A decreases and cos A increases
(d) sin A and cos A both decrease

Answer: (b) The sin row runs 0, 1/2, 1/√2, √3/2, 1 (rising) and the cos row runs 1, √3/2, 1/√2, 1/2, 0 (falling).

(b) Using the table, the value of tan 60° is [1]

(a) √3
(b) $\frac{1}{\sqrt{3}}$
(c) $\frac{\sqrt{3}}{2}$
(d) 1

Answer: (a) tan 60° = sin 60° ÷ cos 60° = (√3/2) ÷ (1/2) = √3.

(c) Kavya tries to find tan 90° from her table. Explain why tan 90° is not defined, and name one other ratio that is not defined at 90°. [2]

Or *Kavya tries to find cot 0° from her table. Explain why cot 0° is not defined, and name one other ratio that is not defined at 0°.*

tan 90° = sin 90° ÷ cos 90° = 1 ÷ 0. Division by zero is not defined, so tan 90° is not defined. sec 90° = 1/cos 90° = 1/0 is also not defined.

- tan 90° = 1/0 and division by 0 is not defined (1)
- names sec 90°, with 1/cos 90° = 1/0 (1)

Or:

cot 0° = cos 0° ÷ sin 0° = 1 ÷ 0, which is not defined. cosec 0° = 1/sin 0° = 1/0 is also not defined.

- cot 0° = 1/0 and division by 0 is not defined (1)
- names cosec 0°, with 1/sin 0° = 1/0 (1)

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

A caterer at a wedding hall in Indore stacks identical plastic cups one inside another. A single cup stands 11 cm tall, and each cup added to the stack raises its height by 1.5 cm, so stacks of 1, 2, 3, . . . cups are 11 cm, 12.5 cm, 14 cm, . . . tall. The cups are stored on shelves, and the caterer wants to know how tall different stacks will be and how many cups fit in a given height.

(a) The height of a stack of 20 cups is [1]

(a) 39.5 cm (b) 41 cm
(c) 30 cm (d) 38 cm

Answer: (a) $a_{20} = 11 + 19 \times 1.5 = 39.5$ cm. (41 cm uses 20 steps of 1.5 cm.)

(b) The number of cups in a stack 50 cm tall is [1]

(a) 27 (b) 26
(c) 33 (d) 28

Answer: (a) $11 + (n - 1) \times 1.5 = 50$ gives $n - 1 = 26$, $n = 27$. (33 divides 50 by 1.5.)

(c) A shelf has 80 cm of clear height. Find the largest number of cups that can stand in one stack on it, and the height of that stack. [2]

Or *A second kind of cup stands 9 cm tall alone, and each added cup raises its stack by 2 cm. For what number of cups are the two kinds of stack equally tall, and what is that height?*

$11 + 1.5(n - 1) \le 80$ gives $n - 1 \le 46$, so $n \le 47$. The largest stack has 47 cups and is $11 + 46 \times 1.5 = 80$ cm tall, exactly filling the shelf.

- sets up $11 + 1.5(n - 1) \le 80$ (1)
- 47 cups, 80 cm (1)

Or:

$11 + 1.5(n - 1) = 9 + 2(n - 1)$ gives $2 = 0.5(n - 1)$, so $n - 1 = 4$ and $n = 5$. Height $= 11 + 4 \times 1.5 = 17$ cm (and $9 + 4 \times 2 = 17$ cm).

- equates the two nth terms (1)
- 5 cups, 17 cm (1)

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

A park in Jaipur has a circular flower bed with centre O and radius 28 m. From the park gate G, two straight paths GA and GB are laid so that each just touches the edge of the bed, at A and at B, as in the figure. The gate is 53 m from the centre of the bed. The gardener wants to know the lengths of the paths and the angles they make, so that he can order the paving stones and edge the paths with a hedge.

(a) The angle between the radius OA and the path GA is [1]

(a) 45° (b) 60°
(c) 90° (d) 180°

Answer: (c) The path touches the bed at A, so it is a tangent there, and the tangent is perpendicular to the radius OA.

(b) The length of the path GA is [1]

(a) 25 m (b) 45 m
(c) 53 m (d) 81 m

Answer: (b) GA = $\sqrt{(53^2 - 28^2)} = \sqrt{2025} = 45$ m, with the right angle at A.

(c) If ∠AOB is four times ∠AGB, find ∠AGB and ∠AOB. [2]

Or *Find the total length of hedge needed along both paths and the two radii OA and OB, that is, the perimeter of OAGB.*

∠AGB + ∠AOB = 180°, as ∠OAG = ∠OBG = 90° in quadrilateral OAGB. So ∠AGB + 4∠AGB = 180°: ∠AGB = 36° and ∠AOB = 144°.

- ∠AGB + ∠AOB = 180° (1)
- ∠AGB = 36°, ∠AOB = 144° (1)

Or:

GB = GA = 45 m (tangents from G). Perimeter = 28 + 45 + 45 + 28 = 146 m.

- GB = GA = 45 m (1)
- perimeter = 146 m (1)