Mathematics (Standard) – Code 041

CBSE Class 10 Board Examination 2027 – Practice Paper No. 2

Model Answer Paper

Time: 3 hours **Max. Marks: 80**

Model answers show one correct method; any other correct method gets full marks.

SECTION A This section comprises 18 multiple choice questions (Q.1 to Q.18) and 2 Assertion–Reason based questions (Q.19 and Q.20) of 1 mark each. **[20]**

1. If $396 = 2^x \times 3^y \times 11^z$, where x, y and z are natural numbers, then x + y + z is:

(A) 4 (B) 5

(C) 6 (D) 3

Answer (1 mark)

(B) 5

$396 = 2 \times 198 = 2 \times 2 \times 99 = 2 \times 2 \times 3 \times 3 \times 11 = 2^2 \times 3^2 \times 11$. So x = 2, y = 2, z = 1 and x + y + z = 5.

2. If one zero of the quadratic polynomial $3x^2 - 11x + k$ is 3, then its other zero is:

(A) 2/3 (B) −2/3

(C) 3/2 (D) 2

Answer (1 mark)

(A) 2/3

Sum of zeroes = −(−11)/3 = 11/3. Other zero = 11/3 − 3 = 2/3. (Check: p(3) = 27 − 33 + k = 0 gives k = 6, and product = 6/3 = 2 = 3 × 2/3 ✓.)

3. The lines represented by 4x − 6y = 10 and 6x + ky = 15 are coincident. The value of k is:

(A) 9 (B) 4

(C) −9 (D) −4

Answer (1 mark)

(C) −9

Coincident lines ⇒ $a_1/a_2 = b_1/b_2 = c_1/c_2$: 4/6 = −6/k = 10/15. From 2/3 = −6/k, k = −9.

4. Which of the following quadratic equations has two distinct real roots?

(A) $x^2 + x + 1 = 0$ (B) $4x^2 - 12x + 9 = 0$

(C) $2x^2 - 5x + 4 = 0$ (D) $3x^2 + 2x - 2 = 0$

Answer (1 mark)

(D) $3x^2 + 2x - 2 = 0$

Discriminants $b^2 - 4ac$: (A) 1 − 4 = −3 < 0; (B) 144 − 144 = 0 (equal roots); (C) 25 − 32 = −7 < 0; (D) 4 + 24 = 28 > 0, so only (D) has two distinct real roots.

5. The sum of the first n terms of an A.P. is given by $S_n = 3n^2 + 2n$. The 10th term of the A.P. is:

(A) 56 (B) 59

(C) 62 (D) 320

Answer (1 mark)
(B) 59
$a_{10} = S_{10} - S_9 = (300 + 20) - (243 + 18) = 320 - 261 = 59$.

6. If $\triangle ABC \sim \triangle QRP$, $\angle A = 50°$ and $\angle B = 60°$, then $\angle P$ is:

(A) 50° (B) 60°
(C) 70° (D) 80°

Answer (1 mark)
(C) 70°
The correspondence is A ↔ Q, B ↔ R, C ↔ P, so $\angle P = \angle C = 180° - 50° - 60° = 70°$.

7. If the distance between the points P(k, 3) and Q(4, −1) is 5 units, then the value(s) of k is/are:

(A) 1 or 7 (B) −1 or 7
(C) 1 or −7 (D) −1 or −7

Answer (1 mark)
(A) 1 or 7
$(k - 4)^2 + (3 + 1)^2 = 25 \Rightarrow (k - 4)^2 = 9 \Rightarrow k - 4 = \pm 3 \Rightarrow k = 7$ or $k = 1$.

8. If $40 \tan\theta = 9$, where θ is an acute angle, then the value of $(1 - \sin\theta)/\cos\theta$ is:

(A) 5/4 (B) 32/41
(C) 9/40 (D) 4/5

Answer (1 mark)
(D) 4/5
$\tan\theta = 9/40$: opposite 9k, adjacent 40k, hypotenuse $\sqrt{(81 + 1600)}\, k = 41k$. $\sin\theta = 9/41$, $\cos\theta = 40/41$. $(1 - 9/41)/(40/41) = (32/41) \times (41/40) = 4/5$.

9. A number x is chosen at random from the numbers 1, 2, 3, ..., 25. The probability that $x^2 < 60$ is:

(A) 6/25 (B) 7/25
(C) 8/25 (D) 1/5

Answer (1 mark)
(B) 7/25
$x^2 < 60$ for x = 1, 2, 3, 4, 5, 6, 7 (since $7^2 = 49$ and $8^2 = 64$). Favourable outcomes 7 out of 25, so P = 7/25.

10. A paper hand-fan opens out into a sector of a circle of radius 10.5 cm with a central angle of 120°. The area of the paper in the open fan is:

(A) 115.5 cm^2 (B) 231 cm^2
(C) 346.5 cm^2 (D) 57.75 cm^2

Answer (1 mark)
(A) 115.5 cm^2
Area of sector = $(120°/360°) \times \pi r^2 = (1/3) \times (22/7) \times 10.5 \times 10.5 = (1/3) \times 346.5 = 115.5\ cm^2$.

11. A toy is made by fixing a cone of base radius 3 cm and height 4 cm on a hemisphere of the same radius, with their circular faces together. The total surface area of the toy is:

(A) 24π cm^2 (B) 27π cm^2
(C) 33π cm^2 (D) 42π cm^2

Answer (1 mark)
(C) 33π cm^2
Slant height $l = \sqrt{(3^2 + 4^2)} = 5$ cm. TSA = CSA of cone + CSA of hemisphere = $\pi rl + 2\pi r^2 = 15\pi + 18\pi = 33\pi$ cm^2.

12. The mean of the following frequency distribution is 18. The value of p is:

Class	0–10	10–20	20–30	30–40
Frequency	4	p	6	2

(A) 6 (B) 10
(C) 12 (D) 8

Answer (1 mark)
(D) 8
Class marks 5, 15, 25, 35. Mean = $(4 \times 5 + 15p + 6 \times 25 + 2 \times 35)/(12 + p) = (240 + 15p)/(12 + p) = 18 \Rightarrow 240 + 15p = 216 + 18p \Rightarrow 3p = 24 \Rightarrow p = 8$.

13. A spinner has 8 equal sectors numbered 1 to 8. It is spun once. The probability that the pointer stops at a number which is a factor of 8 is:
(A) 1/4 (B) 3/8
(C) 5/8 (D) 1/2

Answer (1 mark)
(D) 1/2
Factors of 8 among 1 to 8: 1, 2, 4, 8 → 4 favourable outcomes out of 8. P = 4/8 = 1/2.

14. If the point (2, p) is the mid-point of the line segment joining A(−1, 5) and B(q, −3), then p + q is:
(A) 6 (B) 4
(C) 5 (D) 3

Answer (1 mark)
(A) 6
$(-1 + q)/2 = 2 \Rightarrow q = 5$; $p = (5 + (-3))/2 = 1$. So p + q = 6.

15. Two tangents PA and PB drawn from an external point P to a circle with centre O and radius 4 cm are perpendicular to each other. The length OP is:
(A) 4 cm (B) $4\sqrt{2}$ cm
(C) 8 cm (D) $2\sqrt{2}$ cm

Answer (1 mark)
(B) $4\sqrt{2}$ cm
$\angle OAP = \angle OBP = 90°$ (tangent $\perp$ radius) and $\angle APB = 90°$, so OAPB is a square of side 4 cm (OA = OB, PA = PB). OP is its diagonal = $4\sqrt{2}$ cm.

16. For a grouped frequency distribution with N = 60, the median class is 40–50, its frequency is 16 and the cumulative frequency of the class preceding it is 18. The median of the distribution is:
(A) 45 (B) 50
(C) 52.5 (D) 47.5

Answer (1 mark)
(D) 47.5
Median = $l + [(N/2 - cf)/f] \times h = 40 + [(30 - 18)/16] \times 10 = 40 + 7.5 = 47.5$.

17. From the top of a water tank 18 m high, the angle of depression of a point on the level ground is 60°. The distance of the point from the foot of the tank is:

(A) 6 m (B) $18\sqrt{3}$ m

(C) $6\sqrt{3}$ m (D) 9 m

Answer (1 mark)

(C) $6\sqrt{3}$ m

The angle of elevation of the top from the point equals the angle of depression, 60°. $\tan 60° = 18/d \Rightarrow d = 18/\sqrt{3} = 6\sqrt{3}$ m.

18. The perimeter of a sector of a circle of radius 7 cm with central angle 90° is:

(A) 25 cm (B) 11 cm

(C) 18 cm (D) 32 cm

Answer (1 mark)

(A) 25 cm

Arc length = $(90°/360°) \times 2 \times (22/7) \times 7 = 11$ cm. Perimeter = 7 + 7 + 11 = 25 cm.

19. **Assertion–Reason based questions.** Directions: In Question numbers 19 and 20, a statement of Assertion (A) is followed by a statement of Reason (R). Select the correct answer from the options (A), (B), (C) and (D) given below each question.

Assertion (A): In $\triangle ABC$, D and E are points on the sides AB and AC respectively such that DE ∥ BC. If AD = 2 cm and DB = 3 cm, then DE : BC = 2 : 3.

Reason (R): If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, the other two sides are divided in the same ratio.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true but Reason (R) is false.

(D) Assertion (A) is false but Reason (R) is true.

Answer (1 mark)

(D) Assertion (A) is false but Reason (R) is true.

R is the Basic Proportionality Theorem, so it is true. A is false: DE ∥ BC gives $\triangle ADE \sim \triangle ABC$ (AA), so DE/BC = AD/AB = 2/(2 + 3) = 2/5, not 2/3 (AD/DB = 2/3 is the ratio in which D divides AB, not the ratio of DE to BC).

20. **Assertion (A):** −150 is a term of the A.P. 12, 9, 6, 3, ...

Reason (R): Every negative integer is a term of the A.P. 12, 9, 6, 3, ...

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true but Reason (R) is false.

(D) Assertion (A) is false but Reason (R) is true.

Answer (1 mark)

(C) A is true but R is false.

a = 12, d = −3: $12 + (n - 1)(-3) = -150 \Rightarrow n - 1 = 54 \Rightarrow n = 55$, a natural number, so −150 is the 55th term. R is false: every term is a multiple of 3 (e.g. −1 is not a term, since $12 - 3(n - 1) = -1$ gives n = 16/3).

SECTION B This section comprises 5 very short answer (VSA) type questions of 2 marks each. **[10]**

21. Three electronic display boards at a railway station in Pune refresh their screens every 42 seconds, 56 seconds and 63 seconds respectively. If all three refresh together at 6:00:00 a.m., at what time will they next refresh together? Use prime factorisation.

Answer (2 marks)

$42 = 2 \times 3 \times 7$, $56 = 2^3 \times 7$, $63 = 3^2 \times 7$.

LCM $= 2^3 \times 3^2 \times 7 = 8 \times 9 \times 7 = 504$ seconds (product of the greatest powers of the prime factors).

504 s = 8 minutes 24 seconds.

They next refresh together at **6:08:24 a.m.**

Marking: Prime factorisation of all three numbers – 1 mark · LCM = 504 s – ½ mark · Time 6:08:24 a.m. – ½ mark

Examiner tip: Boards refreshing 'together again' needs the LCM, not the HCF. Convert 504 s into minutes and seconds before writing the time.

22. (A) In △ABC, D and E are points on the sides AB and AC respectively such that ∠ADE = ∠ABC. If AD = 4 cm, AB = 10 cm and BC = 7.5 cm, find DE.

OR

(B) In △PQR, L and M are points on the sides PQ and PR respectively such that PL = 2.4 cm, LQ = 4.8 cm, PM = 1.8 cm and MR = 3.6 cm. Is LM ∥ QR? Justify your answer. If ∠PLM = 72°, find ∠PQR.

Answer (2 marks)

(A) In △ADE and △ABC: ∠A = ∠A (common) and ∠ADE = ∠ABC (given).

So △ADE ~ △ABC (AA similarity criterion).

Hence DE/BC = AD/AB ⇒ DE/7.5 = 4/10 ⇒ DE = 3 cm.

OR

(B) PL/LQ = 2.4/4.8 = 1/2 and PM/MR = 1.8/3.6 = 1/2.

Since PL/LQ = PM/MR, the line LM divides the two sides in the same ratio, so **LM ∥ QR** (converse of the Basic Proportionality Theorem).

LM ∥ QR with transversal PQ ⇒ ∠PQR = ∠PLM (corresponding angles) = **72°**.

Marking: (A) △ADE ~ △ABC by AA with reasons – 1 mark · DE = 3 cm – 1 mark · (B) Both ratios equal to 1/2 – ½ mark · LM ∥ QR by converse of BPT – ½ mark · ∠PQR = 72° (corresponding angles) – 1 mark

Examiner tip: In (A), write the triangles in matching order (A ↔ A, D ↔ B, E ↔ C) before writing the ratio. In (B), name the converse of BPT as the reason.

23. If $2\cos^2\theta - 3\cos\theta + 1 = 0$, where $0° < \theta < 90°$, find θ. Hence find the value of $\sin^2\theta + \tan^2\theta$.

Answer (2 marks)

$2\cos^2\theta - 3\cos\theta + 1 = 0 \Rightarrow (2\cos\theta - 1)(\cos\theta - 1) = 0 \Rightarrow \cos\theta = 1/2$ or $\cos\theta = 1$.

$\cos\theta = 1$ gives $\theta = 0°$, which is not allowed ($0° < \theta < 90°$). So $\cos\theta = 1/2 \Rightarrow$ **$\theta = 60°$**.

$\sin^2 60° + \tan^2 60° = (\sqrt{3}/2)^2 + (\sqrt{3})^2 = 3/4 + 3 =$ **15/4**.

Marking: Factorising $(2\cos\theta - 1)(\cos\theta - 1)$ – ½ mark · Rejecting $\cos\theta = 1$ – ½ mark · $\theta = 60°$ – ½ mark · Value 15/4 – ½ mark

Examiner tip: Treat $\cos\theta$ as the variable and factorise. Give the reason for rejecting $\cos\theta = 1$.

24. (A) A lawn sprinkler in a garden in Nashik waters a region in the shape of a sector of a circle of radius 42 m, turning through an angle of 30°. Find the area of the region watered and the length of its curved edge.

OR

(B) A flower bed in a park is in the shape of a sector of a circle of radius 21 m. A fence of total length 97 m runs exactly once along its whole boundary (the two radii and the arc). Find the angle of the sector and the area of the flower bed.

Answer (2 marks)

(A) $r = 42$ m, $\theta = 30°$.

Area $= (\theta/360°) \times \pi r^2 = (30/360) \times (22/7) \times 42 \times 42 = (1/12) \times 5544 =$ **462 m^2**.

Length of arc $= (\theta/360°) \times 2\pi r = (1/12) \times 2 \times (22/7) \times 42 =$ **22 m**.

OR

(B) Perimeter of sector $= 2r +$ arc length $\Rightarrow 97 = 2 \times 21 +$ arc $\Rightarrow$ arc length $= 55$ m.

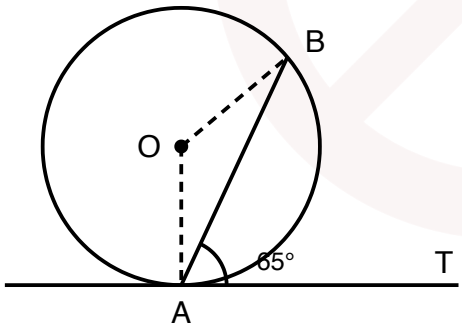
Arc length $= (\theta/360°) \times 2\pi r \Rightarrow 55 = (\theta/360°) \times 2 \times (22/7) \times 21 = (\theta/360°) \times 132 \Rightarrow$ **$\theta = 150°$**.

Area of sector $= (\theta/360°) \times \pi r^2 = (150/360) \times (22/7) \times 21 \times 21 = (5/12) \times 1386 =$ **577.5 m^2**. (Check: $\tfrac{1}{2} \times$ arc $\times r = \tfrac{1}{2} \times 55 \times 21 = 577.5$.)

Marking: (A) Area 462 m^2 – 1 mark · Arc length 22 m – 1 mark · (B) Arc length 55 m and $\theta = 150°$ – 1 mark · Area of flower bed 577.5 m^2 – 1 mark

Examiner tip: Write the formula with $\theta/360°$ first. In (B), the perimeter of a sector is arc + 2r – students often forget the two radii.

25. In the given figure, AB is a chord of a circle with centre O and AT is the tangent to the circle at A. If $\angle BAT = 65°$, find $\angle OAB$ and $\angle AOB$.



Answer (2 marks)

$\angle OAT = 90°$ (the tangent at A is perpendicular to the radius OA).

$\angle OAB = \angle OAT - \angle BAT = 90° - 65° =$ **25°**.

OA = OB (radii), so $\angle OBA = \angle OAB = 25°$.

In $\triangle OAB$, $\angle AOB = 180° - 25° - 25° =$ **130°**.

Marking: $\angle OAT = 90°$ with reason – ½ mark · $\angle OAB = 25°$ – ½ mark · $\angle OBA = 25°$ (OA = OB) – ½ mark · $\angle AOB = 130°$ – ½ mark

Examiner tip: State the reason 'tangent ⊥ radius' and 'radii are equal' at each step; unexplained angles lose marks.

SECTION C This section comprises 6 short answer (SA) type questions of 3 marks each. **[18]**

26. Given that $\sqrt{5}$ is an irrational number, prove that $1/(\sqrt{5}-2)$ is an irrational number.

Answer (3 marks)

$1/(\sqrt{5}-2) = (\sqrt{5}+2)/[(\sqrt{5}-2)(\sqrt{5}+2)] = (\sqrt{5}+2)/(5-4) = \sqrt{5}+2$.

So it is enough to prove that $\sqrt{5}+2$ is irrational.

Suppose, to the contrary, that $\sqrt{5}+2$ is rational. Then $\sqrt{5}+2 = a/b$, where a and b are integers, $b \neq 0$.

$\Rightarrow \sqrt{5} = a/b - 2 = (a-2b)/b$.

Since a and b are integers, $(a-2b)/b$ is rational, so $\sqrt{5}$ would be rational.

This contradicts the given fact that $\sqrt{5}$ is irrational. So our assumption is wrong.

Hence $\sqrt{5}+2$, that is $1/(\sqrt{5}-2)$, is irrational.

Marking: Rationalising to get $\sqrt{5}+2$ – 1 mark · Assuming rational and expressing $\sqrt{5} = (a-2b)/b$ – 1 mark · Contradiction and conclusion – 1 mark

Examiner tip: Rationalise first. In the contradiction step, say clearly why $(a-2b)/b$ is rational and which given fact it contradicts.

27. If α and β are the zeroes of the quadratic polynomial $p(x) = 2x^2 - 11x + k$ such that $\alpha - \beta = 3/2$, find the value of k and the zeroes of p(x).

Answer (3 marks)

$\alpha + \beta = -(-11)/2 = 11/2$ and $\alpha\beta = k/2$.

$(\alpha-\beta)^2 = (\alpha+\beta)^2 - 4\alpha\beta$

$\Rightarrow 9/4 = 121/4 - 4(k/2) = 121/4 - 2k$

$\Rightarrow 2k = 112/4 = 28 \Rightarrow$ **k = 14**.

Now $\alpha + \beta = 11/2$ and $\alpha - \beta = 3/2 \Rightarrow 2\alpha = 7 \Rightarrow \alpha = 7/2$ and $\beta = 2$.

Zeroes: **7/2 and 2**. (Check: $2x^2 - 11x + 14 = (2x-7)(x-2)$.)

Marking: Sum 11/2 and product k/2 – ½ mark · Using $(\alpha-\beta)^2 = (\alpha+\beta)^2 - 4\alpha\beta$ – 1 mark · k = 14 – ½ mark · Zeroes 7/2 and 2 – 1 mark

Examiner tip: Product of zeroes is c/a = k/2, not k. Check the zeroes by factorising the polynomial.

28. (A) A gym in Aurangabad charges a one-time admission fee and a fixed fee for every month. Riya paid ₹4,600 in all for 6 months and Kunal paid ₹7,000 in all for 10 months. Find the admission fee and the monthly fee. How much will a person pay in all for 12 months?

OR

(B) The first term of an A.P. is 21 and the sum of its first 15 terms is zero. Find the common difference, the 10th term and the sum of the first 10 terms of the A.P.

Answer (3 marks)

(A) Let the admission fee be ₹x and the monthly fee be ₹y.

$x + 6y = 4600$ ...(1)

$x + 10y = 7000$ ...(2)

Subtracting (1) from (2): $4y = 2400 \Rightarrow y = 600$. Then $x = 4600 - 3600 = 1000$.

Admission fee = **₹1,000**; monthly fee = **₹600**.

For 12 months: $1000 + 12 \times 600 =$ **₹8,200**.

OR

(B) $a = 21$, $S_{15} = 0$.

$S_{15} = (15/2)[2a + 14d] = 0 \Rightarrow 42 + 14d = 0 \Rightarrow$ **d = −3**.

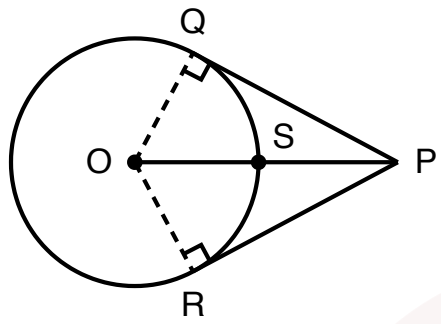
$a_{10} = a + 9d = 21 - 27 = \mathbf{-6}$.

$S_{10} = (10/2)[2a + 9d] = 5(42 - 27) = 5 \times 15 = \mathbf{75}$.

Marking: (A) Forming both equations – 1 mark · Solving: y = 600 and x = 1000 – 1 mark · Total for 12 months ₹8,200 – 1 mark · (B) $S_{15} = 0 \Rightarrow 2a + 14d = 0$ – 1 mark · d = −3 – ½ mark · $a_{10} = -6$ – ½ mark · $S_{10} = 75$ – 1 mark

Examiner tip: In (A), the admission fee is paid only once, so it is not multiplied by the number of months. In (B), use $S_n = (n/2)[2a + (n - 1)d]$ with n − 1 = 14.

29. In the given figure, PQ and PR are tangents drawn from an external point P to a circle with centre O, touching it at Q and R. The line segment OP meets the circle at S. If PQ = 15 cm and PS = 9 cm, find (i) the radius of the circle, (ii) the area of the quadrilateral OQPR, and (iii) the length of the chord QR.



Answer (3 marks)

(i) Let the radius be r cm. Then OQ = OS = r and OP = r + 9.

∠OQP = 90° (tangent ⊥ radius), so in right △OQP:

$OP^2 = OQ^2 + PQ^2 \Rightarrow (r + 9)^2 = r^2 + 225 \Rightarrow 18r + 81 = 225 \Rightarrow$ **r = 8 cm**, and OP = 17 cm.

(ii) PR = PQ = 15 cm (tangents from an external point) and △OQP ≅ △ORP.

ar(OQPR) = 2 × ar(△OQP) = 2 × ½ × 8 × 15 = **120 cm^2**.

(iii) OQ = OR and PQ = PR, so both O and P are equidistant from Q and R; hence OP is the perpendicular bisector of QR, i.e. the diagonals OP and QR are perpendicular.

Area of a quadrilateral with perpendicular diagonals = ½ × OP × QR ⇒ 120 = ½ × 17 × QR ⇒ **QR = 240/17 cm ≈ 14.1 cm**.

(Alternatively, if OP meets QR at M, QM = OQ × PQ/OP = 120/17, so QR = 240/17 cm.)

Marking: ∠OQP = 90° and $(r + 9)^2 = r^2 + 15^2$ – ½ mark · r = 8 cm – ½ mark · Area of OQPR = 120 cm^2 – ½ mark · OP ⊥ QR with reason – ½ mark · QR = 240/17 cm – 1 mark

Examiner tip: OP is not equal to PS: OP = OS + SP = r + 9. For QR, first justify that OP ⊥ QR.

30. (A) Prove that $(1 + \cos\theta - \sin^2\theta) / [\sin\theta (1 + \cos\theta)] = \cot\theta$, where $0° < \theta < 90°$.

OR

(B) If $\sec\theta + \tan\theta = 5/2$, where θ is an acute angle, find the value of $\sec\theta - \tan\theta$. Hence find sin θ and cos θ.

Answer (3 marks)

(A) LHS = $(1 - \sin^2\theta + \cos\theta) / [\sin\theta (1 + \cos\theta)]$

= $(\cos^2\theta + \cos\theta) / [\sin\theta (1 + \cos\theta)]$ (since $1 - \sin^2\theta = \cos^2\theta$)

= $\cos\theta (\cos\theta + 1) / [\sin\theta (1 + \cos\theta)]$

= $\cos\theta / \sin\theta = \cot\theta$ = RHS. Hence proved.

OR

(B) $\sec^2\theta - \tan^2\theta = 1 \Rightarrow (\sec\theta + \tan\theta)(\sec\theta - \tan\theta) = 1 \Rightarrow$ **$\sec\theta - \tan\theta = 2/5$**.
Adding: $2\sec\theta = 5/2 + 2/5 = 29/10 \Rightarrow \sec\theta = 29/20$. Subtracting: $2\tan\theta = 5/2 - 2/5 = 21/10 \Rightarrow \tan\theta = 21/20$.
$\cos\theta = 1/\sec\theta = 20/29$; **$\sin\theta = \tan\theta \times \cos\theta = (21/20) \times (20/29) = 21/29$**.
(Check: $(21/29)^2 + (20/29)^2 = (441 + 400)/841 = 1$ ✓.)

Marking: (A) Replacing $1 - \sin^2\theta$ by $\cos^2\theta$ – 1 mark · Taking $\cos\theta$ common in the numerator – 1 mark · Cancelling $(1 + \cos\theta)$ and getting $\cot\theta$ – 1 mark · (B) $\sec\theta - \tan\theta = 2/5$ using the identity – 1 mark · $\sec\theta = 29/20$ and $\tan\theta = 21/20$ – 1 mark · $\cos\theta = 20/29$ and $\sin\theta = 21/29$ – 1 mark

Examiner tip: In (A), work on one side only and end with '= RHS'. In (B), use the identity $\sec^2\theta - \tan^2\theta = 1$ as a difference of squares.

31. The distance travelled in a day by 50 food-delivery riders in Nashik is given below. Find the modal distance travelled.

Distance (km)	0–10	10–20	20–30	30–40	40–50	50–60
Number of riders	2	7	16	10	8	7

Answer (3 marks)
The maximum class frequency is 16, for the class 20–30. So the modal class is 20–30.
$l = 20$, $h = 10$, $f_1 = 16$, $f_0 = 7$ (preceding class), $f_2 = 10$ (succeeding class).
Mode $= l + [(f_1 - f_0)/(2f_1 - f_0 - f_2)] \times h$
$= 20 + [(16 - 7)/(32 - 7 - 10)] \times 10$
$= 20 + (9/15) \times 10 = 20 + 6 =$ **26 km**.
So the modal distance travelled is 26 km.

Marking: Modal class 20–30 – ½ mark · Values of l, h, f_1, f_0, f_2 – ½ mark · Correct formula and substitution – 1½ marks · Mode = 26 km – ½ mark

Examiner tip: Students often take f_0 and f_2 from the wrong classes, or write $2f_1 - f_0 + f_2$ in the denominator. Write l, h, f_1, f_0, f_2 first.

SECTION D This section comprises 4 long answer (LA) type questions of 5 marks each. **[20]**

32. (A) The gram panchayat of a village near Solapur owns a corner plot in the shape of a right-angled triangle ABC, right-angled at B. The side BC is 23 m longer than the side AB, and the side AC is 2 m longer than the side BC. Form a quadratic equation and find the lengths of the three sides of the plot. Also find the cost of fencing the plot all around at ₹125 per metre.

OR

(B) Meera's grandmother is 52 years older than Meera. Six years from now, the product of their ages (in years) will be 1088. Form a quadratic equation and find their present ages. Also find how many years ago the grandmother's age was 14 times Meera's age.

Answer (5 marks)
(A) Let AB = x m. Then BC = (x + 23) m and AC = (x + 25) m.
$\angle B = 90°$, so by Pythagoras theorem, $AC^2 = AB^2 + BC^2$:
$(x + 25)^2 = x^2 + (x + 23)^2$
$\Rightarrow x^2 + 50x + 625 = 2x^2 + 46x + 529$
$\Rightarrow$ **$x^2 - 4x - 96 = 0$**
$\Rightarrow (x - 12)(x + 8) = 0 \Rightarrow x = 12$ or $x = -8$.
$x = -8$ is not possible, since a length cannot be negative. So $x = 12$.
AB = **12 m**, BC = **35 m**, AC = **37 m**. (Check: $12^2 + 35^2 = 144 + 1225 = 1369 = 37^2$ ✓.)
Perimeter = 12 + 35 + 37 = 84 m. Cost of fencing = 84 × ₹125 = **₹10,500**.

OR

(B) Let Meera's present age be x years. Then her grandmother's present age = (x + 52) years.
Six years from now their ages will be (x + 6) and (x + 58) years.
$(x + 6)(x + 58) = 1088 \Rightarrow x^2 + 64x + 348 = 1088$
$\Rightarrow \mathbf{x^2 + 64x - 740 = 0} \Rightarrow (x + 74)(x - 10) = 0 \Rightarrow x = 10$ or $x = -74$.
$x = -74$ is not possible, since age cannot be negative. So x = 10.
Meera's present age = **10 years**; grandmother's present age = **62 years**. (Check: 16 × 68 = 1088 ✓.)
Let t years ago the grandmother's age be 14 times Meera's: $62 - t = 14(10 - t) \Rightarrow 62 - t = 140 - 14t \Rightarrow 13t = 78 \Rightarrow \mathbf{t = 6}$.
So **6 years ago** (Meera 4 years, grandmother 56 years; 56 = 14 × 4 ✓).

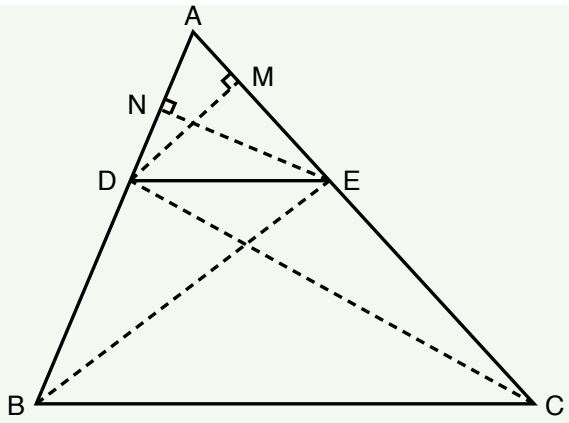
Marking: (A) Sides x, x + 23, x + 25 and Pythagoras equation – 1 mark · Quadratic $x^2 - 4x - 96 = 0$ – 1 mark · Solving and rejecting x = −8 with reason – 1 mark · Sides 12 m, 35 m, 37 m – 1 mark · Perimeter 84 m and cost ₹10,500 – 1 mark · (B) Ages six years from now and the equation (x + 6)(x + 58) = 1088 – 1 mark · Quadratic $x^2 + 64x - 740 = 0$ – 1 mark · Solving and rejecting x = −74 with reason – 1 mark · Present ages 10 years and 62 years – 1 mark · 6 years ago – 1 mark

Examiner tip: Always give the reason for rejecting a root (here a negative length or a negative age); a bare 'rejected' can lose ½ mark. In (A), the longest side AC is the hypotenuse because it is opposite the right angle at B.

33. Prove that if a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, the other two sides are divided in the same ratio.
Using the above result, solve the following: In △ABC, D and E are points on the sides AB and AC respectively such that DE ∥ BC. If AD = (x + 1) cm, DB = (3x − 1) cm, AE = (x + 3) cm and EC = (3x + 4) cm, find the value of x and the lengths of AB and AC.

Answer (5 marks)
Given: In △ABC, a line DE ∥ BC meets AB at D and AC at E.
To prove: AD/DB = AE/EC.
Construction: Join BE and CD. Draw EN ⊥ AB and DM ⊥ AC.
Proof: ar(△ADE) = ½ × AD × EN and ar(△BDE) = ½ × DB × EN.
So ar(△ADE)/ar(△BDE) = AD/DB ...(1)
Similarly, ar(△ADE) = ½ × AE × DM and ar(△DEC) = ½ × EC × DM.
So ar(△ADE)/ar(△DEC) = AE/EC ...(2)
△BDE and △DEC are on the same base DE and between the same parallels DE and BC, so ar(△BDE) = ar(△DEC) ...(3)
From (1), (2) and (3): AD/DB = AE/EC. Hence proved.

Application: Since DE ∥ BC, AD/DB = AE/EC
$\Rightarrow (x + 1)/(3x - 1) = (x + 3)/(3x + 4)$
$\Rightarrow (x + 1)(3x + 4) = (x + 3)(3x - 1)$
$\Rightarrow 3x^2 + 7x + 4 = 3x^2 + 8x - 3 \Rightarrow \mathbf{x = 7}$.
Then AD = 8 cm, DB = 20 cm, AE = 10 cm, EC = 25 cm (check: 8/20 = 10/25 = 2/5 ✓).
AB = 8 + 20 = **28 cm**; AC = 10 + 25 = **35 cm**.



Marking: Given, to prove, construction and figure – 1 mark · Area ratios (1) and (2) – 1 mark · ar(△BDE) = ar(△DEC) and conclusion – 1 mark · Correct proportion and equation – 1 mark · x = 7 – ½ mark · AB = 28 cm and AC = 35 cm – ½ mark

Examiner tip: Draw the figure and write Given, To prove and Construction before the proof. In the application, cross-multiply and expand carefully; the x^2 terms cancel.

34. (A) A concrete planter for a tulsi plant (tulsi vrindavan) is made from a solid cuboid of length 35 cm, breadth 35 cm and height 20 cm. A cylindrical cavity of radius 14 cm and depth 15 cm is hollowed out from the middle of its top face to hold soil. Find (i) the volume of concrete in the planter, and (ii) the total surface area of the planter, including the inside of the cavity.

OR

(B) A wooden model of a temple is made of a solid cube of edge 14 cm surmounted by a solid cone. The base of the cone is the largest circle that can be drawn on the top face of the cube, and the height of the cone is 24 cm. Find (i) the total surface area of the model, and (ii) its volume.

Answer (5 marks)

(A) Cuboid: 35 cm × 35 cm × 20 cm. Cavity (cylinder): r = 14 cm, h = 15 cm.

(i) Volume of cuboid = 35 × 35 × 20 = 24500 cm^3.

Volume of cavity = $\pi r^2 h$ = (22/7) × 14 × 14 × 15 = 9240 cm^3.

Volume of concrete = 24500 − 9240 = **15260 cm^3**.

(ii) TSA of cuboid = 2(lb + bh + hl) = 2(1225 + 700 + 700) = 5250 cm^2.

The circular opening (area πr^2) is removed from the top face, but the bottom of the cavity (also πr^2) is added, so these cancel. The curved surface of the cavity is added:

$2\pi rh$ = 2 × (22/7) × 14 × 15 = 1320 cm^2.

Total surface area = 5250 − 616 + 616 + 1320 = **6570 cm^2**.

OR

(B) Cube: a = 14 cm. Cone: r = 7 cm (the largest circle on a face of side 14 cm), h = 24 cm.

Slant height $l = \sqrt{(7^2 + 24^2)} = \sqrt{625} = 25$ cm.

(i) TSA = (TSA of cube − base of cone) + CSA of cone

= 6 × 14 × 14 − (22/7) × 7 × 7 + (22/7) × 7 × 25

= 1176 − 154 + 550 = **1572 cm^2**.

(ii) Volume = $a^3 + (1/3)\pi r^2 h$ = 2744 + (1/3) × (22/7) × 7 × 7 × 24 = 2744 + 1232 = **3976 cm^3**.

Marking: (A) Volume of cuboid – 1 mark · Volume of cavity – 1 mark · Volume of concrete 15260 cm^3 – ½ mark · TSA of cuboid 5250 cm^2 – 1 mark · Adding curved surface of cavity (opening and cavity bottom cancel) – 1 mark · TSA 6570 cm^2 – ½ mark · (B) Slant height 25 cm – ½ mark · TSA of cube minus base of cone – 1 mark · CSA of cone 550 cm^2 – 1 mark · TSA 1572 cm^2 – ½ mark · Volume of cube – ½ mark · Volume of cone 1232 cm^3 – 1 mark · Total volume 3976 cm^3 – ½ mark

Examiner tip: Think about which surfaces can actually be touched. In (A), the cavity adds a curved surface; in (B), the part of the top face covered by the cone must be subtracted.

35. Ramesh lives in an apartment building in Nagpur. From a point at the foot of his building, the angle of elevation of the top of a mobile tower standing on the same level ground is 60°. From the terrace of the building, 24 m above the ground, the angle of elevation of the top of the tower is 30°. Draw a neat figure and find (i) the distance between the building and the tower, (ii) the height of the tower, and (iii) the length of a cable stretched straight from the terrace to the top of the tower. (Use $\sqrt{3} = 1.73$)

Answer (5 marks)

Let AB = 24 m be the building (A = terrace, B = foot) and CD the tower (D = top, C = foot). Let BC = d m and CD = H m. Draw AE ⊥ CD, so AE = BC = d and EC = AB = 24 m, DE = H − 24.

In right △DCB: $\tan 60° = CD/BC \Rightarrow \sqrt{3} = H/d \Rightarrow H = \sqrt{3}\,d$ …(1)

In right △DEA: $\tan 30° = DE/AE \Rightarrow 1/\sqrt{3} = (H - 24)/d \Rightarrow H - 24 = d/\sqrt{3}$ …(2)

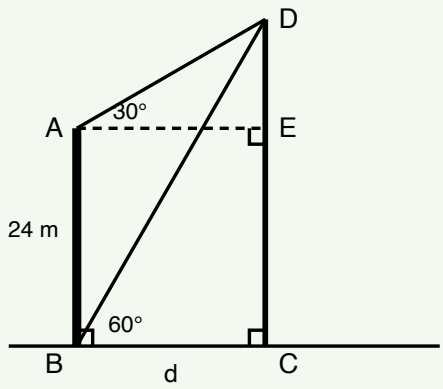
From (1) and (2): $\sqrt{3}\,d - d/\sqrt{3} = 24 \Rightarrow (3d - d)/\sqrt{3} = 24 \Rightarrow 2d = 24\sqrt{3} \Rightarrow d = 12\sqrt{3}$.

(i) Distance between building and tower = $12\sqrt{3} = 12 \times 1.73 =$ **20.76 m**.

(ii) Height of tower H = $\sqrt{3} \times 12\sqrt{3} =$ **36 m**.

(iii) Cable AD: $\cos 30° = AE/AD \Rightarrow AD = 12\sqrt{3} \div (\sqrt{3}/2) =$ **24 m**.

(Check: $AD^2 = AE^2 + DE^2 = 432 + 144 = 576$.)



Marking: Correct figure – 1 mark · Equations from the two right triangles – 1 mark · d = $12\sqrt{3}$ = 20.76 m – 1 mark · Height of tower 36 m – 1 mark · Cable length 24 m – 1 mark

Examiner tip: The 30° angle is at the terrace, measured from the horizontal line AE, so use DE = H − 24, not H. Keep $\sqrt{3}$ till the end and substitute 1.73 only in the final step.

SECTION E This section comprises 3 case study based questions of 4 marks each. Each case study has three sub-parts (i), (ii) and (iii) of 1, 1 and 2 marks respectively. **[12]**

36. To promote healthy eating, the eco-club of a school in Sangli is setting up a rectangular kitchen garden of area 300 m^2. The length of the garden is 5 m more than its breadth. Let the breadth of the garden be x m.

Based on the above information, answer the following questions:

(i) Form a quadratic equation in x representing the area of the garden. (1 mark)

(ii) Find the discriminant of the equation formed in (i) and state the nature of its roots. (1 mark)

(iii) (A) Find the length and the breadth of the garden. (2 marks)

OR

(iii) (B) The students plant 270 vegetable saplings in the garden in rows such that the number of rows is 3 less than the number of saplings in each row. Find the number of saplings in each row and the number of rows. (2 marks)

Answer (4 marks)

(i) Length = (x + 5) m. Area: $x(x + 5) = 300 \Rightarrow \mathbf{x^2 + 5x - 300 = 0}$.

(ii) $D = b^2 - 4ac = 25 + 1200 = \mathbf{1225} > 0$, so the equation has **two distinct real roots**.

(iii) (A) $x = (-5 \pm \sqrt{1225})/2 = (-5 \pm 35)/2 \Rightarrow x = 15$ or $x = -20$.

Breadth cannot be negative, so breadth = **15 m** and length = **20 m**. (Check: 15 × 20 = 300 ✓.)

OR

(iii) (B) Let the number of saplings in each row be y. Number of rows = y − 3.

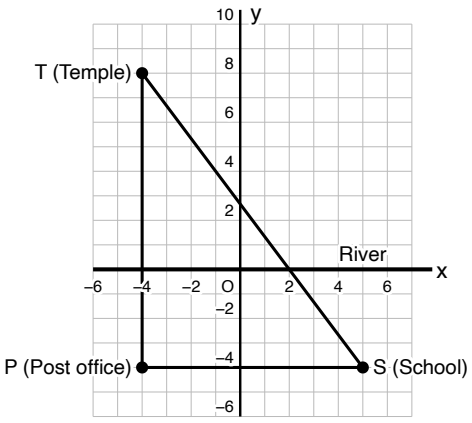
$y(y - 3) = 270 \Rightarrow y^2 - 3y - 270 = 0 \Rightarrow (y - 18)(y + 15) = 0 \Rightarrow y = 18$ ($y = -15$ is rejected).

Saplings in each row = **18**; number of rows = **15**. (Check: 18 × 15 = 270 ✓.)

Marking: (i) $x^2 + 5x - 300 = 0$ – 1 mark · (ii) D = 1225 and two distinct real roots – 1 mark · (iii)(A) Solving the quadratic – 1 mark · Breadth 15 m and length 20 m (rejecting −20) – 1 mark · (iii)(B) Equation $y^2 - 3y - 270 = 0$ – 1 mark · 18 saplings per row, 15 rows – 1 mark

Examiner tip: Write the equation in the standard form $ax^2 + bx + c = 0$ before finding the discriminant. Always reject a negative length or count with a reason.

37. The map of a village near Wardha is drawn on a coordinate plane, with 1 unit = 100 m. A straight river flows along the x-axis. The temple is at T(−4, 8), the school is at S(5, −4) and the post office is at P(−4, −4). A straight road joins the temple and the school, and straight roads join the temple to the post office and the post office to the school (see figure).



Based on the above information, answer the following questions:
(i) Find the distance between the temple and the school. (1 mark)
(ii) Amit goes from the temple to the post office and then to the school along the straight roads TP and PS. How many metres more does he travel than he would along the straight road TS? (1 mark)
(iii) (A) The road TS crosses the river at a bridge B. Find the ratio in which B divides TS, and the coordinates of B. (2 marks)

OR

(iii) (B) A water tank W is to be built on the road TS such that TW : WS = 1 : 2. Find the coordinates of W. (2 marks)

Answer (4 marks)

(i) TS = $\sqrt{[(5 + 4)^2 + (-4 - 8)^2]} = \sqrt{(81 + 144)} = \sqrt{225}$ = **15 units** (1500 m).

(ii) TP = $\sqrt{[0^2 + (-4 - 8)^2]}$ = 12 units; PS = $\sqrt{[(5 + 4)^2 + 0^2]}$ = 9 units.

TP + PS = 21 units, so Amit travels 21 − 15 = 6 units = **600 m** more.

(iii) (A) Let B divide TS in the ratio k : 1. Then the y-coordinate of B = $(k \times (-4) + 1 \times 8)/(k + 1) = 0$ (B lies on the x-axis)

$\Rightarrow -4k + 8 = 0 \Rightarrow k = 2$. Ratio = **2 : 1**.

x-coordinate = $(2 \times 5 + 1 \times (-4))/(2 + 1) = 6/3 = 2$. So **B(2, 0)**.

OR

(iii) (B) W divides TS in the ratio 1 : 2 ($m_1 = 1$, $m_2 = 2$).

W = $((1 \times 5 + 2 \times (-4))/3, (1 \times (-4) + 2 \times 8)/3) = (-3/3, 12/3)$ = **(−1, 4)**.

Marking: (i) TS = 15 units – 1 mark · (ii) TP = 12, PS = 9 and extra distance 600 m – 1 mark · (iii)(A) Ratio 2 : 1 using y = 0 – 1 mark · B(2, 0) – 1 mark · (iii)(B) Correct use of the section formula – 1 mark · W(−1, 4) – 1 mark

Examiner tip: A point on the x-axis has y-coordinate 0 — use this to find the ratio first. In the section formula, m_1 goes with the second point's coordinates.

38. At the Maths Mela of a school in Pune, a game stall has a box of 40 identical cards: 20 red cards numbered 1 to 20 and 20 green cards numbered 1 to 20. A player draws one card at random from the well-shuffled box.

Based on the above information, answer the following questions:
(i) Find the probability that the card drawn is a red card bearing an even number. (1 mark)
(ii) Find the probability that the card drawn bears the number 15. (1 mark)
(iii) (A) Find the probability that the card drawn is (a) a green card bearing a prime number, (b) a card bearing a multiple of 6. (2 marks)

OR

(iii) (B) All the red cards bearing numbers less than 6 are removed from the box. A card is now drawn at random from the remaining cards. Find the probability that it is (a) a red card, (b) a card bearing the number 4. (2 marks)

Answer (4 marks)

Total outcomes = 40.

(i) Red even cards: 2, 4, ..., 20 → 10 cards. P = 10/40 = **1/4**.

(ii) Number 15 is on one red and one green card → 2 cards. P = 2/40 = **1/20**.

(iii) (A) (a) Primes from 1 to 20: 2, 3, 5, 7, 11, 13, 17, 19 → 8 green cards. P = 8/40 = **1/5**.

(b) Multiples of 6: 6, 12, 18 → 3 of each colour = 6 cards. P = 6/40 = **3/20**.

OR

(iii) (B) Red cards 1, 2, 3, 4, 5 are removed, leaving 35 cards (15 red, 20 green).

(a) P(red) = 15/35 = **3/7**.

(b) Only the green card numbered 4 remains with the number 4. P = **1/35**.

Marking: (i) 1/4 – 1 mark · (ii) 1/20 – 1 mark · (iii)(A)(a) 1/5 – 1 mark · (iii)(A)(b) 3/20 – 1 mark · (iii)(B)(a) 3/7 – 1 mark · (iii)(B)(b) 1/35 – 1 mark

Examiner tip: Each number appears on two cards (one red, one green) — count both. In (iii)(B), the total number of outcomes changes to 35 after the cards are removed; 1 is not a prime number.

All the best for your exam!