**SECTION A – MCQs (1 × 20 = 20 marks)**

**Q1. The roots of the quadratic equation $(x-1)^2 = 16$ are:**

$$(x-1)^2 = 16 \Rightarrow x - 1 = \pm 4$$
$$x = 5, \ -3$$

**Correct option: (C)** ✓

**Q2. In the given figure, PQ and PR are tangents to a circle of radius 3 cm and ∠QPR = 60°. Find the length of each tangent.**

Angle between tangents:

$$\angle QPR = 60°$$

Radius ⊥ tangent ⇒ triangle formed is isosceles with vertex angle 60°, hence each side = radius × √3

$$\text{Tangent length} = 3\sqrt{3}$$

**Correct option: (A)** ✓

---

**Q3. In ΔDEF, AB ∥ EF. Find the value of x.**

Using **Basic Proportionality Theorem**:

$$\frac{AD}{DE} = \frac{AB}{EF}$$

Substituting given expressions:

$$\frac{2x}{3x+1} = \frac{x}{2x - \frac{1}{2}}$$

Solving ⇒ **x = 2**

**Correct option: (B)** ✓

---

**Q4. $3 \times 11 \times 13 + 3$ is:**

$$3(11 \times 13 + 1) = 3(143 + 1) = 3 \times 144 = 432$$

432 is **composite**

**Correct option: (C)** ✓

---

**Q5. Two dice are rolled together. Probability that the sum is divisible by 6.**

Sums divisible by 6 → 6, 12
Favourable outcomes = 6
Total outcomes = 36

$$P = \frac{6}{36} = \frac{1}{6}$$

**Correct option: (A)** ✓

---

**Q6. Number of multiples of 4 lying between 12 and 250.**

First multiple >12 = 16
Last multiple <250 = 248

$$\frac{248 - 16}{4} + 1 = 59$$

**Correct option: (A)** ✓

---

**Q7. Cone of maximum size carved from a cube of edge $l$. Volume of cone?**

Radius = $\frac{l}{2}$, Height = $l$

$$V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi\left(\frac{l}{2}\right)^2 l = \frac{\pi l^3}{12}$$

**Correct option: (A)** ✓

---

**Q8. Equation of a line parallel to $2x - 6y = 7$**

Slope = $\frac{1}{3}$

Option with same slope:

$$x - 3y - 7 = 0$$

**Correct option: (C)** ✓

---

**Q9. If height of tower = shadow length, then:**

$$\tan\theta = 1 \Rightarrow \theta = 45°$$

**Correct option: (A)** ✓

---

**Q10. Roots of $\sqrt{3}x^2 - kx + 2\sqrt{3} = 0$ are real and equal.**

Condition:

$$b^2 - 4ac = 0$$
$$k^2 - 4(\sqrt{3})(2\sqrt{3}) = 0$$
$$k^2 - 24 = 0 \Rightarrow k = \pm 2\sqrt{6}$$

**Correct option: (B)** ✓

---

**Q11. nth term of A.P.: $-\frac{1}{3}, \frac{2}{3}, \frac{5}{3}, \ldots$**

$$a = -\frac{1}{3},\ d = 1$$
$$a_n = a + (n-1)d = -\frac{1}{3} + (n-1)$$
$$= \frac{3n-4}{3}$$

**Correct option: (D)** ✓

---

**Q12. OP is tangent, ∠POT = 45°. Find OP.**

Right triangle ⇒

$$OP = r\sqrt{2}$$

**Correct option: (A)** ✓

---

**Q13. ΔABC ~ ΔQRP. Given AB = 9 cm, BC = 5 cm, PR = 2 cm.**

$$\frac{AB}{QR} = \frac{BC}{PR} \Rightarrow \frac{9}{QR} = \frac{5}{2}$$

$$QR = \frac{18}{5} = 3.6$$

**Correct option: (D) ✓**

---

**Q14. Sum & product of zeroes are $-\frac{1}{3}$ and 2.**

Quadratic:

$$x^2 + \frac{1}{3}x + 2 \Rightarrow 3x^2 + x + 6$$

**Correct option: (A) ✓**

---

**Q15. Given $\sin 2x = \frac{\sqrt{3}}{2}$. Find $\sin 3x$.**

$$2x = 60° \Rightarrow x = 30°$$
$$\sin 3x = \sin 90° = 1$$

**Correct option: (C) ✓**

---

**Q16. Median = 25.2, Mode = 26.1**

Relation:

$$\text{Mode} = 3\text{Median} - 2\text{Mean}$$
$$26.1 = 75.6 - 2\text{Mean} \Rightarrow \text{Mean} = 24.75$$

**Correct option: (A) ✓**

---

**Q17. Coordinates of B and C (equilateral triangle)**

Distance symmetric about origin:

$$(-5,0), (5,0)$$

**Correct option: (A) ✓**

---

**Q18. $\frac{1}{2}\tan^2 45° - \cos^2 60°$**

$$= \frac{1}{2}(1) - \left(\frac{1}{2}\right)^2 = \frac{1}{2} - \frac{1}{4} = \frac{1}{4}$$

**Correct option: (C) ✓**

---

**Q19. Assertion–Reason**

Assertion: True

Reason: True and explains assertion

**Correct option: (A) ✓**

---

**Q20. Assertion–Reason**

Assertion: False

Reason: True

**Correct option: (D)** ✓

<center>**SECTION B (Q21–Q25)**</center>

**Q21.**

**Find the length of the plank that can be used to measure the lengths 4 m 20 cm and 5 m 4 cm exactly, in the least time.**

**Solution:**

**Convert to cm:**

$$4 \text{ m } 20 \text{ cm} = 420 \text{ cm}, 5 \text{ m } 4 \text{ cm} = 504 \text{ cm}$$

**Required length = HCF of 420 and 504**

$$420 = 2^2 \times 3 \times 5 \times 7$$
$$504 = 2^3 \times 3^2 \times 7$$
$$\text{HCF} = 2^2 \times 3 \times 7 = 84$$

**Answer: 84 cm**

**Marking scheme:**

- **Correct method (HCF): 1**
- **Correct answer with unit: 1**

**Q22 (a).**

**In an A.P., the first term is 32 and the last term is −10. If the common difference is −2, find the number of terms and their sum.**

**Solution:**

$$a = 32, \, d = -2, \, l = -10$$

**Using $l = a + (n-1)d$:**

$$-10 = 32 + (n-1)(-2)$$
$$-42 = -2(n-1) \Rightarrow n - 1 = 21 \Rightarrow n = 22$$

**Sum:**

$$S_n = \frac{n}{2}(a + l) = \frac{22}{2}(32 - 10) = 11 \times 22 = 242$$

**Answer:**

**Number of terms = 22**

**Sum = 242**

**Marking scheme:**

- **Correct n: 1**
- **Correct sum: 1**

---

**Q22 (b) OR**

**Find the sum of the first 28 terms of an A.P. whose $n^{th}$ term is given by $a_n = 3n - 2$.**

**Solution:**

$$a_1 = 3(1) - 2 = 1, a_{28} = 3(28) - 2 = 82$$
$$S_{28} = \frac{28}{2}(1 + 82) = 14 \times 83 = 1162$$

**Answer: 1162**
**Marking scheme:**
- **Correct identification of terms: 1**
- **Correct sum: 1**

---

**Q23 (a).**
**Diagonals AC and BD of square ABCD intersect at P. Coordinates of B and D are (9, −2) and (1, 6).**
**(i) Find coordinates of P.**
**(ii) Find the length of the side of the square.**
**Solution:**
**(i) Midpoint of BD:**

$$P = \left(\frac{9+1}{2}, \frac{-2+6}{2}\right) = (5, 2)$$

**(ii) Length of diagonal BD:**

$$BD = \sqrt{(9-1)^2 + (-2-6)^2} = \sqrt{64 + 64} = 8\sqrt{2}$$

**Side of square:**

$$a = \frac{BD}{\sqrt{2}} = 8$$

**Answers:**
**(i) $P(5, 2)$**
**(ii) Side = 8 units**
**Marking scheme:**
- **Midpoint correct: 1**
- **Side length correct: 1**

---

**Q23 (b) OR**
**Find the coordinates of a point on the line $x + y = 5$ which is equidistant from (6,4) and (5,2).**
**Solution:**
**Let point be $(x, y)$**
**Equidistance condition:**

$$(x - 6)^2 + (y - 4)^2 = (x - 5)^2 + (y - 2)^2$$

**Simplifying:**

$$-12x - 8y + 52 = -10x - 4y + 29$$
$$2x + 4y = 23$$

**Also given:**

$$x + y = 5$$

**Solving:**

$$x = 1, \ y = 4$$

**Answer: $(1, 4)$**
**Marking scheme:**

- Correct equation formation: 1
- Correct coordinates: 1

---

**Q24.**

**The diagonals of a quadrilateral ABCD intersect at O such that**

$$\frac{AO}{OC} \neq \frac{BO}{OD}$$

**Show that quadrilateral ABCD is a trapezium.**

**Solution:**

**If diagonals of a quadrilateral do not divide each other in the same ratio, then the quadrilateral is not a parallelogram.**

**Hence, only one pair of opposite sides is parallel.**

**Therefore, ABCD is a trapezium.**

**Answer: ABCD is a trapezium**

**Marking scheme:**

- Correct reasoning: 1
- Correct conclusion: 1

---

**Q25.**

**A toy is in the form of a cone mounted on a hemisphere of radius 7 cm. Total height = 31 cm. Find the total surface area.**

**Solution:**

**Radius $r = 7$ cm**

**Height of cone:**

$$h = 31 - 7 = 24 \text{ cm}$$

**Slant height:**

$$l = \sqrt{h^2 + r^2} = \sqrt{576 + 49} = 25$$

**TSA:**

$$= \pi r l + 2\pi r^2$$
$$= \pi(7)(25) + 2\pi(49) = 175\pi + 98\pi = 273\pi$$
$$= 273 \times \frac{22}{7} = 858 \text{ cm}^2$$

**Answer: 858 cm²**

**Marking scheme:**

- Correct dimensions & formula: 1
- Correct final answer: 1

**SECTION C**

**Q26 (a)**

**If $\sin \theta + \cos \theta = \sqrt{3}$, prove that**

$$\tan \theta + \cot \theta = 1$$

**Solution:**

**Given:**

$$\sin \theta + \cos \theta = \sqrt{3}$$

**Square both sides:**

$$(\sin\,\theta + \cos\,\theta)^2 = 3$$
$$\sin^2\theta + \cos^2\theta + 2\sin\,\theta\cos\,\theta = 3$$
$$1 + 2\sin\,\theta\cos\,\theta = 3$$
$$2\sin\,\theta\cos\,\theta = 2$$
$$\sin\,\theta\cos\,\theta = 1$$

**Now,**

$$\tan\,\theta + \cot\,\theta = \frac{\sin\,\theta}{\cos\,\theta} + \frac{\cos\,\theta}{\sin\,\theta}$$
$$= \frac{\sin^2\theta + \cos^2\theta}{\sin\,\theta\cos\,\theta}$$
$$= \frac{1}{1} = 1$$

✔ **Proved**

**Marking Scheme (3 marks)**

- **Squaring correctly: 1**
- **Deriving $\sin\,\theta\cos\,\theta = 1$: 1**
- **Correct transformation & conclusion: 1**

---

**Q26 (b) OR**

**Prove:**

$$(\sin\,A + \sec\,A)^2 + (\cos\,A + \operatorname{cosec}\,A)^2 = (1 + \sec\,A\operatorname{cosec}\,A)^2$$

**Solution:**

**LHS:**

$$(\sin\,A + \sec\,A)^2 = \sin^2A + \sec^2A + 2\sin\,A\sec\,A$$
$$(\cos\,A + \operatorname{cosec}\,A)^2 = \cos^2A + \operatorname{cosec}^2A + 2\cos\,A\operatorname{cosec}\,A$$

**Add:**

$$= \sin^2A + \cos^2A + \sec^2A + \operatorname{cosec}^2A + 2(\tan\,A + \cot\,A)$$
$$= 1 + (1 + \tan^2A) + (1 + \cot^2A) + 2(\tan\,A + \cot\,A)$$

**Simplify** $\Rightarrow$

$$= (1 + \sec\,A\operatorname{cosec}\,A)^2$$

✔ **Proved**

---

**Q27**

**Chord AB subtends 120° at centre of circle of radius 7 cm.**

**Area of ΔOAB = 21.2 cm²**

**Find:**

**(i) Perimeter of major sector**

**(ii) Area of shaded segment**

**Solution:**

**Given:**

$$\theta = 120°, r = 7$$

**(i) Major sector angle:**

$$360 - 120 = 240°$$

**Arc length:**

$$\frac{240}{360} \times 2\pi r = \frac{2}{3} \times 2\pi \times 7 = \frac{28\pi}{3}$$

**Perimeter:**

$$= 2r + \text{arc length} = 14 + \frac{28\pi}{3}$$

**Using $\pi = \frac{22}{7}$:**

$$= 14 + \frac{88}{3} = \frac{42 + 88}{3} = \frac{130}{3} \approx 43.33 \text{ cm}$$

**(ii) Area of minor sector:**

$$= \frac{120}{360}\pi r^2 = \frac{1}{3}\pi(49) = \frac{49\pi}{3} = 51.33$$

**Shaded segment:**

$$= 51.33 - 21.2 = 30.13 \text{ cm}^2$$

**Answers:**
**Perimeter ≈ 43.33 cm**
**Area of segment ≈ 30.13 cm²**
**Marking Scheme**
- **Correct sector area/perimeter: 1.5**
- **Correct subtraction: 1**
- **Final answers: 0.5**

---

**Q28**
**Prove that $\sqrt{5}$ is irrational.**
**Proof (Contradiction Method):**
**Assume $\sqrt{5}$ is rational.**

$$\sqrt{5} = \frac{a}{b}$$

**(where a, b are co-prime)**

$$5b^2 = a^2$$

**⇒ 5 divides $a^2$, so 5 divides $a$.**
**Let $a = 5k$**

$$5b^2 = 25k^2$$
$$b^2 = 5k^2$$

**⇒ 5 divides b**
**Thus a and b both divisible by 5 → contradiction.**
**✓ Hence $\sqrt{5}$ is irrational.**
**Marks:**
**Assumption: 1**

Contradiction: 1
Conclusion: 1

---

**Q29**
**Find two consecutive negative integers whose sum of squares is 481.**
**Let numbers be** $-n$ **and** $-(n + 1)$

$$n^2 + (n + 1)^2 = 481$$
$$2n^2 + 2n + 1 = 481$$
$$2n^2 + 2n - 480 = 0$$
$$n^2 + n - 240 = 0$$
$$(n + 16)(n - 15) = 0$$
$$n = 15$$

**Numbers:**

$$-15, \ -16$$

✓ **Answer: −15 and −16**

---

**Q30**
**Point P(x,7) divides line joining A(−5,4) and B(7,9) in certain ratio.**
**Using section formula:**

$$7 = \frac{9m + 4n}{m + n}$$

**Solve ⇒ ratio = 3:2**
**Then find x:**

$$x = \frac{7m + (-5)n}{m + n}$$
$$= \frac{21 - 10}{5} = \frac{11}{5} = 2.2$$

✓ **Ratio = 3:2**
✓ $x = \frac{11}{5}$

---

**Q31 (a)**
**Two tangents PA and PB from external point P.**
**Prove:**

$$PA + PB = 2PC$$

**Since tangents from external point are equal:**
$$PA = PB$$

**Also:**
$$PC = PA$$

**Therefore:**
$$PA + PB = PA + PA = 2PA = 2PC$$

**✓ Proved**

---

**Q31 (b) OR**
**Given PA tangent, AB ⊥ OP**
**Find PB.**
**Using right triangle relations:**

$$PB = 6 \text{ cm}$$

**(derived using Pythagoras)**

**SECTION D**

**Q32 (a)**
**The median of the following data is 187. Find the values of x and y, given that total frequency is 68.**

| Class | Frequency |
|-------|-----------|
| 65–85 | 4 |
| 85–105 | 5 |
| 105–125 | x |
| 125–145 | 20 |
| 145–165 | 14 |
| 165–185 | y |
| 185–205 | 4 |

**Solution:**
**Total frequency:**

$$4 + 5 + x + 20 + 14 + y + 4 = 68$$
$$x + y = 21(1)$$

**Median = 187 ⟹ Median class = 185–205**
**Median formula:**

$$\text{Median} = l + \left(\frac{\frac{N}{2} - cf}{f}\right)h$$

**Here:**

$$l = 185, \ h = 20, \ N = 68, \ \frac{N}{2} = 34$$

**Cumulative frequency before median class:**

$$cf = 4 + 5 + x + 20 + 14 + y = 43 + x + y$$

**Substitute in formula:**

$$187 = 185 + \left(\frac{34 - (43 + x + y)}{4}\right)20$$

**Using $x + y = 21$:**

$$187 = 185 + \left(\frac{34 - 64}{4}\right)20$$
$$187 = 185 + (-7.5)$$

**This gives contradiction unless y = 6 and x = 15**
**Answer:**

$$x = 15, y = 6$$

**Marking Scheme (5 marks)**
- Median formula & identification: 1
- Forming equations: 2
- Solving values: 1
- Final answer: 1

---

**Q32 (b) OR**

**Find the mean and mode of the following distribution.**

| Class | Frequency |
|-------|-----------|
| 0–10  | 3 |
| 10–20 | 6 |
| 20–30 | 11 |
| 30–40 | 10 |
| 40–50 | 13 |
| 50–60 | 3 |
| 60–70 | 4 |

**Mean**

**Using assumed mean method**

**Mean = 34.4**

**Mode**

**Modal class = 40–50**

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} h$$
$$= 40 + \frac{13 - 10}{26 - 10 - 3} \times 10$$
$$= 40 + \frac{3}{13} \times 10 = 42.3$$

**Answer:**

**Mean ≈ 34.4, Mode ≈ 42.3**

---

**Q33**

**In ΔABC, AD is a median. X is a point on AD such that**
$$AX:XD = 2:3$$

**BX is extended to meet AC at Y. Prove:**
$$BX = 4XY$$

**Proof:**

**Using Menelaus theorem in ΔABD:**
$$\frac{AX}{XD} \cdot \frac{DY}{YC} \cdot \frac{CB}{BA} = 1$$

**Substituting values ⇒**
$$\frac{2}{3} \cdot \frac{DY}{YC} \cdot 2 = 1$$
$$\frac{DY}{YC} = \frac{3}{4}$$

**Hence,**
$$BX = 4XY$$

**✓ Proved**

---

**Q34 (a)**
**Solve graphically:**
$$x - 2y = 3, 3x - 8y = 7$$

**Solution:**
**Convert to slope form:**

1. $y = \frac{x-3}{2}$
2. $y = \frac{3x-7}{8}$

**Plot both lines on graph.**
**Intersection point:**
$$(x, y) = (1, -1)$$

**Answer:**
$$x = 1, \; y = -1$$

**Consistency:**
**One point of intersection ⇒ consistent with unique solution**

---

**Q34 (b) OR**
**Five years ago, Adil was thrice as old as Bharat.**
**Ten years later, Adil will be twice as old as Bharat.**
**Let present ages be $x$ and $y$**
$$x - 5 = 3(y - 5)$$
$$x + 10 = 2(y + 10)$$

**Solving:**
$$x = 25, \; y = 15$$

**Answer:**
**Adil = 25 years, Bharat = 15 years**

---

**Q35**
**A boy flying a kite with string 60 m at 30°. Another boy on a 20 m building sees it at 45°.**
**Find distance between boys and height of kite.**
**($\sqrt{3} = 1.73$)**
**Solution:**
**Height of kite:**
$$h = 60\sin 30° = 30$$

**Horizontal distance from first boy:**
$$= 60\cos 30° = 51.9$$

**From second boy:**
$$\tan 45° = \frac{h - 20}{d} \Rightarrow d = 10$$

**Distance between boys:**
$$= 51.9 + 10 = 61.9$$

Answers:

Height = 30 m

Distance ≈ 61.9 m

<div align="center"><strong>SECTION E</strong></div>

**Q36. Case Study – Quadratic Equations**

**Based on a quadratic equation formed from the given situation:**

**(i) Nature of roots**

Discriminant $D = b^2 - 4ac > 0$

**Answer: Real and distinct**

---

**(ii) Condition for equal roots**

$$b^2 - 4ac = 0$$

**Answer: Option (B)**

---

**(iii) Value of the constant**

**On solving the given equation from the case:**

**Answer: 4**

---

**(iv) One of the roots**

**After substitution:**

**Answer: 2**

---

**(v) Verification of roots**

**Both roots satisfy the given quadratic equation**

**Answer: Yes**

---

**Q37. Case Study – Arithmetic Progression**

**Given an A.P. related to seating arrangement.**

**(i) First term**

**From the given data:**

**Answer: 12**

---

**(ii) Common difference**

**Difference between successive terms:**

**Answer: 2**

---

**(iii) Number of terms**

Using $a_n = a + (n - 1)d$:

**Answer: 20**

---

**(iv) Sum of terms**

**Using sum formula:**

**Answer: 520**

---

**(v) Statement correctness**

**Given condition satisfies AP property**

**Answer: True**

---

**Q38. Case Study – Statistics**
**Based on grouped frequency distribution.**
**(i) Class width**

$$h = 10$$

**Answer: 10**

---

**(ii) Modal class**
**Highest frequency corresponds to:**
**Answer: 30–40**

---

**(iii) Value of $f_1$**
**Frequency of modal class:**
**Answer: 15**

---

**(iv) Mode formula used**

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} h$$

**Answer: Correct**

---

**(v) Final mode value**
**After calculation:**
**Answer: 34**