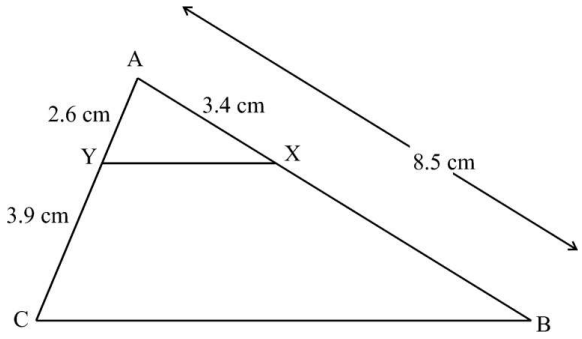
Class- X
Post Mid Term Examination, 2024-25
Subject- Mathematics
Set : B1/ B2 Solutions

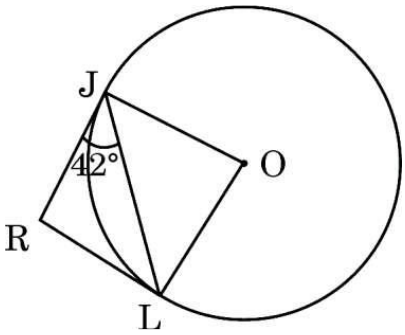
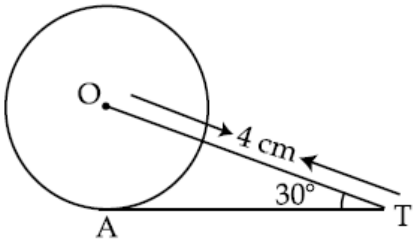
Time Allowed: 3 Hours **Maximum Marks: 80**

General Instructions:

1. This question paper contains 38 questions.
2. This Question Paper is divided into 5 Sections A, B, C, D and E.
3. In Section A, Questions no. 1-18 are multiple choice questions (MCQs) and questions no. 19 and 20 are Assertion- Reason based questions of 1 mark each.
4. In Section B, Questions no. 21-25 are very short answer (VSA) type questions, carrying 02 marks each.
5. In Section C, Questions no. 26-31 are short answer (SA) type questions, carrying 03 marks each.
6. In Section D, Questions no. 32-35 are long answer (LA) type questions, carrying 05 marks each.
7. In Section E, Questions no. 36-38 are case study based questions carrying 4 marks each with sub parts of the values of 1, 1 and 2 marks each respectively.
8. All Questions are compulsory. However, an internal choice in 2 Question of Section B, 2 Questions of Section C and 2 Questions of Section D has been provided. An internal choice has been provided in all the 2 marks questions of Section E.
9. Draw neat and clean figures wherever required.
10. Take π =22/7 wherever required if not stated.
11. Use of calculators is not allowed.

B1	B2	Expected Answers	Marks
		SECTION A **Section A consists of 20 questions of 1 mark each.**	
1	**10**	The centre of a circle is at (2, 0). If one end of a diameter is at (6, 0), then the other end is at: (A) (0,0) (B) (4,0) (C) $(-2,0)$ (D) $(-6,0)$ Correct Answer: **Option (C)**	**1**
2	**1**	The number of zeroes of a polynomial whose graph is either touching or intersecting the axes only at the points (–3, 0), (0, 2) & (3, 0) are (A) 1 (B) 2 (C) 3 (D) 0 Correct Answer: **Option (B)**	**1**
3	**2**	If the zeroes of the polynomial $p(x) = 2x^2 + 13x + k$ are reciprocal of each other, then the value of k is : (A) – 2 (B) 2 (C) $\frac{13}{2}$ (D) $\frac{2}{13}$	**1**

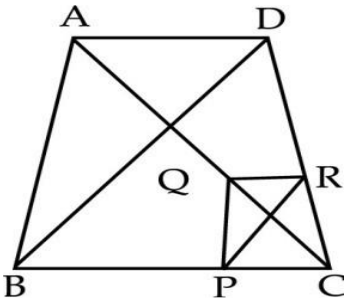
		Correct Answer: **Option (B)**	
4	**3**	The value of $'p'$ for which the pair of linear equations $(3p+5)x+2y-7=0$ and $10x-2y+7=0$ has infinitely many solutions is: (A) -5 (B) 5 (C) $\frac{5}{3}$ (D) $\frac{3}{5}$ Correct Answer: **Option (A)**	**1**
5	**4**	The quadratic equation $2x^2-\sqrt{5}x-1=0$ has (A) two distinct real roots (B) two equal real roots (C) no real roots (D) more than 2 real roots Correct Answer: **Option (A)**	**1**
6	**5**	Cards with numbers 2 to 101 are placed in a box. A card is selected at random. The probability that the card has an odd number is (A) $\frac{1}{2}$ (B) $\frac{49}{99}$ (C) $\frac{49}{100}$ (D) $\frac{50}{99}$ Correct Answer: **Option (A)**	**1**
7	**6**	If $4\ sec\ \theta - 5 = 0$, then the value of $cot\ \theta$ is : (A) $\frac{3}{4}$ (B) $\frac{4}{5}$ (C) $\frac{5}{3}$ (D) $\frac{4}{3}$ Correct Answer: **Option (D)**	**1**
8	**7**	A hollow vessel is in the shape of a cylinder standing on a hemisphere with both their radii being equal to 1 cm and the height of the cylinder is equal to its radius. The inner surface area of the vessel (in sq cm) is (A) 2π (B) π (C) 4π (D) 3π Correct Answer: **Option (C)**	**1**
9	**8**	In the figure, X and Y are two points on the sides AB and AC respectively in ΔABC, such that AX = 3.4 cm, AB = 8.5 cm, AY = 2.6 cm and YC = 3.9 cm. Which of the following relations is correct ?  (A) BC = 2XY (B) 3BC = 2XY (C) 2BC = 5XY (D) BC =3 XY Correct Answer: **Option (C)**	**1**

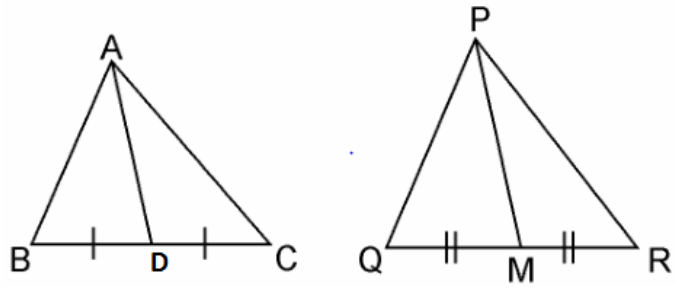
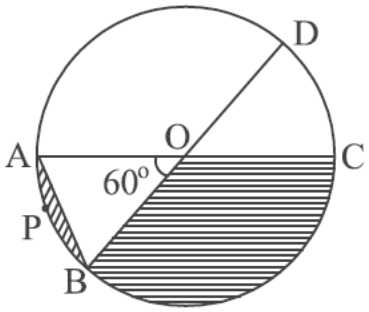
10	**9**	In the given figure, RJ and RL are two tangents to the circle. If $\angle RJL = 42°$, then the measure of $\angle JOL$ is :  (A) 42° (B) 84° (C) 96° (D) 138° Correct Answer: **Option (B)**	**1**
11	**18**	In the given figure, AT is a tangent to the circle with centre O such that OT = 4 cm and ∠OTA = 30°. Then AT is equal to  (A) 4 cm (B) 2 cm (C) $2\sqrt{3}$ cm (D) $4\sqrt{3}$ cm Correct Answer: **Option (C)**	**1**
12	**11**	For the following distribution, Class: 0-5 | 5-10 | 10-15 | 15-20 | 20-25 Frequency: 10 | 15 | 12 | 20 | 9 the sum of the lower limits of the median and modal class is (A) 15 (B) 25 (C) 30 (D) 35 Correct Answer: **Option (B)**	**1**
13	**12**	Two coins are tossed together. The probability of getting at least one head is : (A) $\frac{1}{4}$ (B) $\frac{1}{2}$ (C) $\frac{3}{4}$ (D) 1 Correct Answer: **Option (C)**	**1**
14	**13**	If the distance between the points (4, p) and (1, 0) is 5, then the value of p is (A) 4 only (B) ± 4 (C) – 4 only (D) 0 Correct Answer: **Option (B)**	**1**
15	**14**	The volume of the largest right circular cone that can be carved out from a solid cube of edge 2 cm is:	**1**

		(A) $\frac{4\pi}{3}$ cu cm (B) $\frac{5\pi}{3}$ cu cm (C) $\frac{8\pi}{3}$ cu cm (D) $\frac{2\pi}{3}$ cu cm Correct Answer: **Option (D)**	
16	**15**	Using the empirical relationship between measures of central tendency, the mode is equal to (A) 2 Median − 3 Mean (B) 3 Median − 2 Mean (C) 3 Median + 2 Mean (D) 2 Median + 3 Mean Correct Answer: **Option (B)**	**1**
17	**16**	Which term of the AP: $-29, -26, -23, \ldots\ldots, 61$ is the first positive term? (A) 11^{th} (B) 10^{th} (C) 16^{th} (D) 31^{st} Correct Answer: **Option (A)**	**1**
18	**17**	$\frac{(1-\tan^2 30^0)}{(1+\tan^2 30^0)}$ is equal to : (A) sin 60° (B) cos 60° (C) tan 60° (D) cot 30° Correct Answer: **Option (B)**	**1**
		Direction for questions 19 & 20: In question numbers 19 and 20, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option. (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 and 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.	
19	**20**	**Statement A (Assertion):** HCF and LCM of two natural numbers are 25 and 815 respectively. **Statement R(Reason) :** LCM of two natural numbers is always divisible by their HCF**.** Correct Answer: **Option (D)**	**1**
20	**19**	**Statement A (Assertion):** If three sectors whose sector angles are 35°, 65° and 80° are cut from a circle, then the sum of their sector areas is half of the area of the circle. **Statement R (Reason)**: If θ is the angle (in degrees) of a sector of a circle of radius *r*, then area of the sector is $\frac{\theta}{360^\circ}\ \pi r^2$. Correct Answer: **Option (A)**	**1**
		SECTION B	

		Section B consists of 5 questions of 2 marks each.	
21	**22**	(a) Prove that $3 + 2\sqrt{5}$ is irrational, given that $\sqrt{5}$ is irrational. Sol. Let us assume, to the contrary, that $3 + 2\sqrt{5}$ is rational. So, $3 + 2\sqrt{5} = \frac{a}{b}$, where a and b are coprime ($b \neq 0$) Rearranging, we get $\sqrt{5} = \frac{a - 3b}{2b}$ Since 3, 2, a and b are integers, $\frac{a-3b}{2b}$ is rational, and so $\sqrt{5}$ is rational. But this contradicts the fact that $\sqrt{5}$ is irrational. This contradiction has arisen due to our wrong assumption that $3+ 2\sqrt{5}$ is rational. So, $3 + 2\sqrt{5}$ is irrational. **OR** (b) The traffic lights at three different road crossings change after every 48 seconds, 60 seconds and 72 seconds respectively. If they change simultaneously at 7 A.M., at what time will they change simultaneously again ? Sol. LCM (48, 72, 60) $48 = 2^4 \times 3$ $60 = 2^2 \times 3 \times 5$ $72 = 2^3 \times 3^2$ LCM = $2^4 \times 3^2 \times 5$ = 720 seconds = 12 min So, time will be 7:12 AM	½ **1** ½ **1 ½** ½
22	**25**	(a) Two dice are thrown at the same time and the product of the numbers appearing on top is noted. Find the probability that (i) the product of the numbers lies between 8 and 13 (ii) the product of the numbers is 6 Sol. Total no. of outcomes = 36 (i) Favourable outcomes = {(3,3), (2,5), (5,2), (3,4), (4,3), (2,6), (6,2)} P(E) = $\frac{7}{36}$ (ii) Favourable outcomes = {(2,3), (3,2), (1,6), (6,1)} P(E) = $\frac{4}{36} = \frac{1}{9}$ **OR** (b) Find the probability that a leap year chosen at random has (i) 53 Sundays	**1** **1**

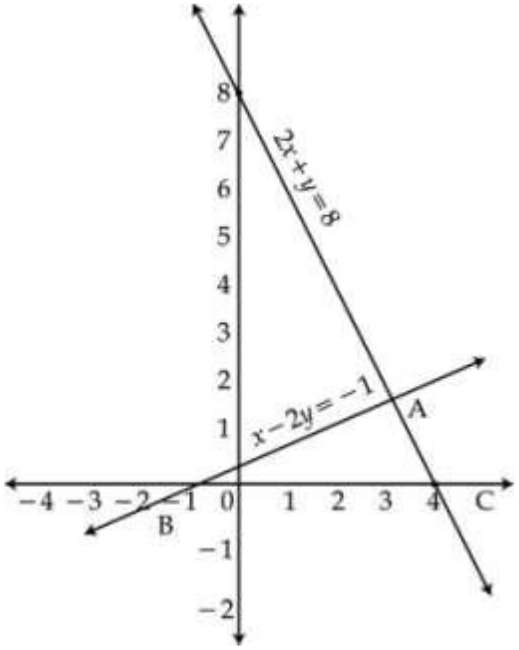
		(ii) 52 Sundays Sol. A leap year has 366 days i.e. 52 weeks and 2 days. These two days may be (Sun, Mon), (Mon, Tue), (Tue, Wed), (Wed, Thu), (Thu, Fri), (Fri, Sat) and (Sat, Sun). (i) Of the 7 possible outcomes, two i.e., (Sun, Mon) (Sat, Sun) are the favourable outcomes P(53 Sundays) = 2/7 (ii) P(52 Sundays) = $1-\frac{2}{7}=\frac{5}{7}$	**1** **1**
23	**23**	**B1** - Find the ratio in which the point $(-1, k)$ divides the line segment joining the points $(-3, 10)$ and $(6, -8)$. Hence, find the value of k. Sol. For x - coordinate $-1=\frac{-3m_2+6m_1}{m_1+m_2}$ $-m_1-m_2=-3m_2+6m_1$ $2m_2=7m_1$ $m_1:m_2=2:7$ is the required ratio. Now, for y-coordinate $k=\frac{10(7)+(-8)(2)}{2+7}=\frac{54}{9}=6$ **B2 -** Find the ratio in which the *y*-axis divides the line segment joining the points (5, – 6) and (–1, – 4). Also find the point of intersection. Sol. This point lies on the *y*-axis, so the abscissa is 0. $0=\frac{5m_2-m_1}{m_1+m_2}$ $m_1=5m_2$ $m_1:m_2=5:1$ is the required ratio. Now, $y=\frac{-6(1)-4(5)}{5+1}=-\frac{26}{6}=-\frac{13}{3}$ So, the point of intersection is $(0, -\frac{13}{3})$	**1** **1** **1** **1**
24	**24**	**B1** - Find a relation between x and y such that the point (x, y) is equidistant from the points (7, 1) and $(-3, 5)$. **Solution :** Let P(x, y) be equidistant from the points A(7, 1) and B$(-3, 5)$. Given that AP = BP. So, $AP^2=BP^2$ i.e., $(x-7)^2+(y-1)^2=(x+3)^2+(y-5)^2$ i.e., $x^2-14x+49+y^2-2y+1=x^2+6x+9+y^2-10y+25$	**1**

		i.e., $-20x + 8y = -16$ or $5x - 2y = 4$ which is the required relation. **B2-** Find a relation between x and y such that the point (x, y) is equidistant from the points (7, −1) and (3, 5). **Solution :** Let P(x, y) be equidistant from the points A(7, −1) and B(3, 5). Given that AP = BP. So, $AP^2 = BP^2$ i.e., $(x - 7)^2 + (y + 1)^2 = (x - 3)^2 + (y - 5)^2$ i.e., $x^2 - 14x + 49 + y^2 + 2y + 1 = x^2 - 6x + 9 + y^2 - 10y + 25$ i.e., $-8x + 12y = -16$ or $2x - 3y = 4$ which is the required relation.	**1** **1** **1**
25	**21**	Find the value of x if $3\ tan^2 60° - x\ sin^2 45° + \frac{3}{4} sec^2 30° = 2$ Sol. $3\ tan^2 60° - x\ sin^2 45° + \frac{3}{4} sec^2 30° = 2$ $3(\sqrt{3})^2 - x\left(\frac{1}{\sqrt{2}}\right)^2 + \frac{3}{4}\left(\frac{2}{\sqrt{3}}\right)^2 = 2$ $9 - \frac{x}{2} + 1 = 2$ $x = 16$	**1 ½** **½**
		SECTION C **Section C consists of 6 questions of 3 marks each.**	
26	**31**	(a) In the given figure, two triangles ABC and DBC lie on same side of BC such that PQ | | BA and PR| |BD. Prove that QR| |AD.  Sol. PQ || BA So, $\frac{CP}{PB} = \frac{CQ}{QA}$ (1) (BPT) PR|| BD	**1**

		So, $\frac{CP}{PB} = \frac{CR}{RD}$ (2) (BPT)	**1**
		From (1) and (2) ,	
		$\frac{CR}{RD} = \frac{CQ}{QA}$	½
		So, QR ‖AD (Converse of BPT)	½
		OR	
		(b) If AD and PM are medians of triangles ABC and PQR, respectively where Δ ABC ~ Δ PQR, prove that $\frac{AB}{PQ} = \frac{AD}{PM}$.	
		Sol. Figure – ½	
			
		Given, ΔABC ~ ΔPQR	
		$\therefore \frac{AB}{PQ} = \frac{BC}{QR}$	
		So, $\frac{AB}{PQ} = \frac{2BD}{2QM} = \frac{BD}{QM}$ (1)	**1**
		In ΔABD and ΔPQM,	
		From equation (ii), we have	
		∠B = ∠Q	
		$\frac{AB}{PQ} = \frac{BD}{QM}$	
		∴ ΔABD ~ ΔPQM (SAS similarity criterion)	**1**
		$\Rightarrow \frac{AB}{PQ} = \frac{AD}{PM}$	½
27	**26**	(a) In the given figure, diameters AC and BD of the circle intersect at O. If ∠AOB = 60° and OA = 10 cm, then :	
			
		(i) find the length of the chord AB.	
		(ii) find the area of shaded region. (Take π = 3.14 and √3 = 1.73)	
		Sol. Since OA = OB	
		Each angle of ΔAOB is 60°	
		So, ΔAOB is an equilateral triangle.	½

		So, length of chord AB = 10 cm Area of $\Delta AOB = \frac{\sqrt{3}}{4} \times (10)^2 = \frac{173}{4} = 43.25\ sq\ cm$ Area of semicircle = $\frac{1}{2} \times 3.14 \times (10)^2 = 157$ sq cm Shaded area = $157 - 43.25 = 113.75$ sq cm **OR** (b) A chord of a circle of radius 20 cm subtends an angle of 90° at the centre. Find the area of the corresponding major segment of the circle. (Use $\pi = 3.14$). Sol. Angle of the major sector = 360° – 90° = 270° So, area of the major sector = $\frac{270}{360} \times 3 \cdot 14 \times (20)^2$ =942 sq cm Area of right triangle = $\frac{1}{2} \times 20 \times 20 = 200$ sq cm Are of major segment = 942 + 200 = 1142 sq cm	½ ½ ½ **1** ½ **1** ½ **1**
28	**27**	Prove that $\frac{\cos\theta - \sin\theta + 1}{\cos\theta + \sin\theta + 1} = sec\ \theta - \tan\theta$ Sol. Divide numerator and denominator of LHS by $\cos\theta$ $\text{LHS} = \frac{1 + \sec\theta - \tan\theta}{1 + \sec\theta + \tan\theta}$ $= \frac{(\sec^2\theta - \tan^2\theta) + (\sec\theta - \tan\theta)}{1 + \sec\theta + \tan\theta} \quad [\because \sec^2\theta - \tan^2\theta = 1]$ $= \frac{(\sec\theta - \tan\theta)(\sec\theta + \tan\theta) + (\sec\theta - \tan\theta)}{1 + \sec\theta + \tan\theta}$ $= \frac{(\sec\theta - \tan\theta)[(\sec\theta + \tan\theta) + 1]}{1 + \sec\theta + \tan\theta}$ $= \sec\theta - \tan\theta$	**1** ½ ½ ½ **1/2**
29	**28**	National Art convention got registrations from students from all parts of the country, of which 60 are interested in music, 84 are interested in dance and 108 students are interested in handicrafts. The organisers wish to keep them in minimum number of groups such that each group consists of students interested in the same artform and the number of students in each group is the same. Find the number of students in each group. Find the number of groups in each art form. Sol. $60 = 2^2 \times 3 \times 5$ $84 = 2^2 \times 3 \times 7$	

		$108 = 2^2 \times 3^3$ HCF (60,84,108) = $2^2 \times 3 = 12$ Number of students in each group = 12 Number of groups in Music = $\frac{60}{12}$ = 5 Number of groups in Dance = $\frac{84}{12}$ = 7 Number of groups in Handicrafts = $\frac{108}{12}$ = 9	**1 ½** **½** **1**
30	**30**	**B1** - If α and β are zeroes of the polynomial $3x^2 - 4x - 4$ then form a quadratic polynomial whose zeroes are α^2 and β^2. Sol. $\alpha + \beta = \frac{4}{3}, \alpha\beta = -\frac{4}{3}$ Now $a^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$ $= \left(\frac{4}{3}\right)^2 - 2\left(-\frac{4}{3}\right) = \frac{16}{9} + \frac{8}{3} = \frac{40}{9}$ $a^2.\beta^2 = \left(-\frac{4}{3}\right)^2 = \frac{16}{9}$ Required polynomial = $k\left[x^2 - \frac{40}{9}x + \frac{16}{9}\right]$ Or $9x^2 - 40x + 16$ **B2** - If α and β are the zeros of the polynomial $3y^2 - 5y + 2$, find a quadratic polynomial whose zeros are α^2 and β^2. Sol. $\alpha + \beta = \frac{5}{3}, \alpha\beta = \frac{2}{3}$ Now $a^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$ $= \left(\frac{5}{3}\right)^2 - 2\left(\frac{2}{3}\right) = \frac{25}{9} - \frac{4}{3} = \frac{13}{9}$ $a^2.\beta^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$ Required polynomial = $k\left[x^2 - \frac{13}{9}x + \frac{4}{9}\right]$ Or $9x^2 - 13x + 4$	**1** **1** **1** **1** **1**
31	**29**	In a class test, the sum of Arun's marks in Mathematics and English is 30. Had he got 3 marks more in Mathematics and 2 marks less in English, the product of their marks would have been 240. Find his marks in the two subjects. Sol. Let the marks in Maths be x. Then, the marks in English will be 30 – x. As per the given question, $(x + 3)(30 - x - 2) = 240$	

		$(x + 3)(28 - x) = 240$ $\Rightarrow x^2 - 25x + 156 = 0$ $\Rightarrow x^2 - 12x - 13x + 156 = 0$ $\Rightarrow x(x - 12) - 13(x - 12) = 0$ $\Rightarrow (x - 12)(x - 13) = 0$ $\Rightarrow x = 12, 13$ Therefore, if the marks in Maths are 12, then marks in English will be 30 – 12 = 18, and if the marks in Maths are 13, then marks in English will be 30 – 13 = 17**.**	**1 ½** **1** **1/2**
		SECTION D **Section D consists of 4 questions of 5 marks each.**	
32	**35**	(a) Solve graphically the pair of linear equations: $2x + y = 8\,;\, x + 1 = 2y.$ Also, determine the coordinates of the vertices of the triangle formed by these lines and the *x*-axis. Sol. Plotting correct Graph  Solution of pair is $x = 3$, $y = 2$ Coordinates of triangle are A(3, 2), B(−1, 0), C(4, 0) **OR** (b) The area of a rectangle gets reduced by 9 square units, if its length is reduced by 5 units and breadth is increased by 3 units. If we increase the length by 3 units and the breadth by 2 units, the area increases by 67 square units. Find the dimensions of the rectangle. Sol. Let length and breadth be x and y respectively.	**3** **½** **1 ½**

So, Area = xy

Ist Condition:

$$(x-5)(y+3) = xy - 9 \quad \Rightarrow xy + 3x - 5y - 15 = xy - 9$$

$$\Rightarrow \quad 3x - 5y - 15 = -9$$

$$\Rightarrow \quad 3x - 5y = 6$$ **1 ½**

2nd Condition:

$$(x+3)(y+2) = xy + 67 \quad \Rightarrow xy + 2x + 3y + 6 = xy + 67$$

$$\Rightarrow \quad 2x + 3y + 6 = 67$$

$$\Rightarrow \quad 2x + 3y = 61$$ **1 ½**

Solving (1) and (2)

$x = 17, y = 9$

So, length and breadth are 17 and 9 units respectively. **2**

33 **34** (a) The median of the distribution given below is 35. Find the values of x and y, if sum of all frequencies is 170.

Class Interval	Frequency
0 – 10	10
10 – 20	20
20 – 30	x
30 – 40	40
40 – 50	y
50 – 60	25
60 - 70	15

Sol.

Class	f	cf
0 - 10	10	10
10 - 20	20	30
20 - 30	x	$30 + x$
30 - 40	40	$70 + x$
40 - 50	y	$70 + x + y$
50 - 60	25	$95 + x + y$
60 - 70	15	$110 + x + y$

1 ½

Since median is 35, 30-40 is the median class. **½**

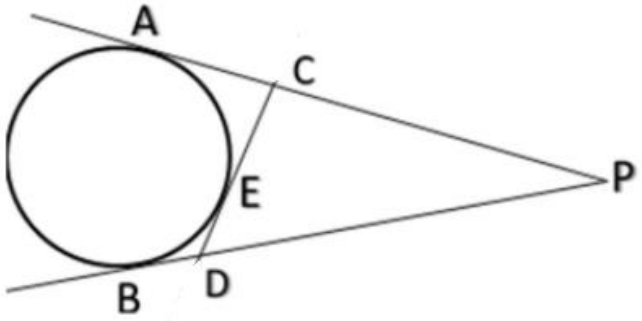
$n = 170, l = 30, f = 40, cf = 30 + x, h = 10$

Median = $l + \left(\frac{n/2 - cf}{f}\right) \times h$

		$35 = 30 + \frac{(85 - 30 - x)}{40} \times 10$ $5 \times 4 = 55 - x$ $x = 35$ Now, $110 + x + y = 170$ So, $y = 25$ **OR** (b) Calculate the mean and mode of the following frequency distribution : Sol. The Continuous frequency distribution is as follows Modal Class is 70-90 Mode = $70 + \left(\frac{20-12}{40-12-3}\right) \times 20 = 76.4$ $\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i}$ $= \frac{3280}{50}$ $= 65.6$	**1** **1** **1** **2 ½** **½** **1** **1**
34	**33**	Prove that the lengths of tangents drawn from an external point to a circle are equal. From an external point P, two tangents, PA and PB are drawn to a circle. At a point E on the circle, a tangent is drawn to intersect PA and PB at C and D, respectively. Prove that PA = $\frac{1}{2}$ Perimeter of ΔPCD.	

Class :	Below 30	Below 50	Below 70	Below 90	Below 110	Below 130
Frequency :	5	13	25	45	48	50

Classes	Class mark (X)	Frequency (f_i)	$f_i\ x_i$
10-30	20	5	100
30-50	40	8	320
50-70	60	12	720
70-90	80	20	1600
90-110	100	3	300
110-130	120	2	240



Sol.

		Correct given, to prove, construction, figure	**1**
		Correct proof	**2**
		PA = PB; CA = CE; DE = DB [Tangents to a circle]	**1**
		Perimeter of ΔPCD = PC + CD + PD = PC + CE + ED + PD = PC + CA + BD + PD = PA + PB	**1**
		Perimeter of ΔPCD = PA + PA = 2PA Or PA = $\frac{1}{2}$ Perimeter of ΔPCD	
35	**32**	At a given instance, the angle of elevation of a jet plane from a point on the ground is 60°. After a flight of 15 seconds, it is observed that the angle of elevation changes to 30°. The height of the plane remains constantly as 1500√3 m. What is the speed of the plane in km/hr?	

SoL.

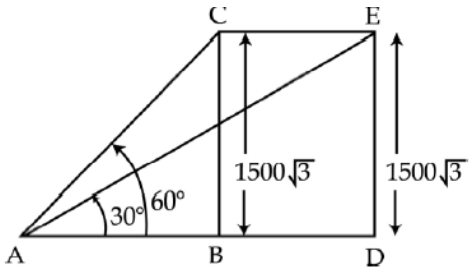


Fig - 1

C and E are the two positions of the plane flying at a height of 1500√3m. A is the point of observation.

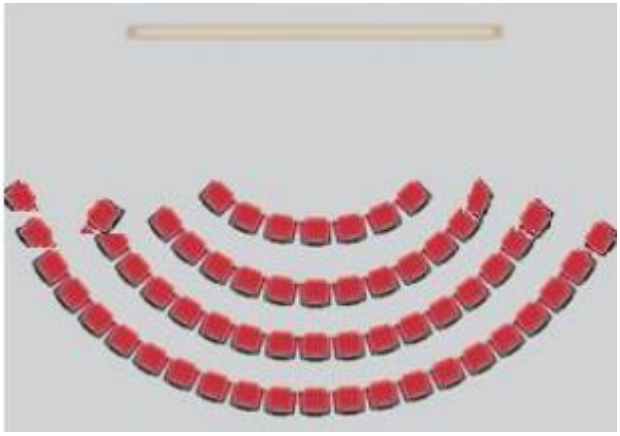
(ii) Also BC = DE = 1500 $\sqrt{3}$

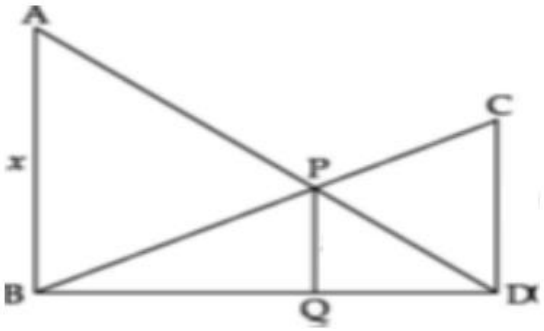
$$\frac{BC}{AB} = \tan 60°$$

$$\frac{1500\sqrt{3}}{AB} = \sqrt{3}$$

$$\Rightarrow \quad \boxed{AB = 1500}$$ **1**

		$\frac{DE}{AD} = \tan 30°$ $\frac{1500\sqrt{3}}{AD} = \frac{1}{\sqrt{3}}$ $AD = 4500\ m$ Now distance covered by jet plane in 15 seconds = $AD - AB$ $=4500 - 1500 = 3000$ m Speed = 3000/ 15 = 200 m/s = 200 × 3600/1000 = 720 km/hr	**1** **1** **1**
		SECTION E **Case study based questions are compulsory.**	
36	**36**	**Case Study 1** India has a rich legacy in toy-making. Historically Indian toys date back to 5000 years. The Thanjavur doll is a type of traditional Indian bobblehead toy made of terracotta material. These toys are traditionally handmade, finished with detailed, painted exteriors. A solid toy, made of wood, is in the form of a cone of radius 3.5 cm mounted on a hemisphere of same radius. The total height of the toy is 15.5 cm. Rahul wants to pack the toy in a cylindrical box, which circumscribes the toy. Use the above information to answer the questions that follow- (i) Determine the slant height of the conical part of the toy. (ii) Find the total surface area of the toy. **OR** Find the volume of wood in the toy. (iii) Find the area of the cardboard required for packing. Sol. (i) Height of conical part = 15.5−3.5 = 12 cm Slant height of conical part the toy $= \sqrt{3.5^2 + 12^2} = 12.5\ cm$ (ii) Total surface area of the toy = CSA of hemisphere + CSA of cone $= \pi rl + 2\pi r^2 = \pi r(l + 2r)$ $= \frac{22}{7} \times 3.5 \times (12.5 + 7)$	**1** **2**

		$= 11 \times 19.5 = 214.5$ cm^2 **OR** Volume of the toy = Volume of cone +vol. of hemisphere $= \frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3$ $= \frac{1}{3}\pi r^2(h + 2r) = \frac{1}{3} \times \frac{22}{7} \times 3.5 \times 3.5 \times 19$ $= \frac{731.5}{3}$ cm^3 (iii) Area of cardboard = TSA of cylinder = $2\pi r(H + r)$ $= 2 \times \frac{22}{7} \times 3.5 \times 19$ $= 418\ sq\ cm$	**1**
37	**37**	**Case Study 2** A school auditorium has to be constructed. The chairs in the auditorium are arranged in a concave shape facing towards the stage in such a way that each succeeding row has 5 seats more than the previous one. Due to shortage of funds, only 25 rows were constructed in the beginning.  (i) If the first row has 15 seats, then how many seats will be there in 12th row? (ii) What is the total number of seats in the auditorium? (iii) If total 1250 guests were there in the auditorium for a particular event, then how many rows were occupied? **OR** Suppose 5 more rows of seats are built later, how many additional seats will the auditorium have? Sol (i) a = 15, d = 5 a_{12} = 15 + 11 × 5 = 70	**1** **1**

		(ii) $S_{25} = \frac{25}{2}\{2(15) + 5(24)\} = 1875$ (iii) $S_n = \frac{n}{2}(2a + (n-1)d)$ $1250 = \frac{n}{2}(2 \times 15 + 5(n-1))$ $n^2 + 5n - 500 = 0$ $n^2 + 25n - 20n - 500 = 0$ *$(n + 25)(n - 20) = 0 \Longrightarrow n = 20$* *$\therefore$ Number of rows occupied = 20* **OR** The expanded auditorium will have 25+5= 30 rows of seats. The *total* number of seats in the expanded hall is: $S_{30} = \frac{30}{2}[2(15) + 29(5)] = 2625$ The number of *additional* seats is = $2625 - 1875 = 750$.	**2**
38	**38**	**Case Study 3** A girl observes three poles AB, PQ and CD at an instant as shown in figure. It is being given that AB = x m, PQ = 3.6 m, CD = 5.4 m and BD = 24 m.  Based on the above information, solve the following questions: (i) Prove that $\Delta BPQ \sim \Delta BCD$. (ii) Find the distance BQ. (iii) Find the height of the pole AB. **OR** Prove that $\frac{1}{AB} + \frac{1}{CD} = \frac{1}{PQ}$. Solution: (i) $\angle BQP = \angle BDC$ (Each 90°) $\angle$ PBQ = $\angle$ CBD (Common) Bv AA similarity criterion, $\Delta BPQ \sim \Delta BCD$ (ii) $\frac{BQ}{BD} = \frac{PQ}{CD}$	**1**

		$\frac{BQ}{24} = \frac{3.6}{5.4}$ $BQ = \frac{2}{3} \times 24 = 16$ m (iii) $\angle DQP = \angle DBA$ (Each 90°) $\angle$ PDQ = $\angle$ ADB (Common) Bv AA similarity criterion, $\Delta PDQ \sim \Delta ADB$ $\frac{DQ}{BD} = \frac{PQ}{AB}$ $\frac{24-16}{24} = \frac{3.6}{x}$ $x = \frac{3.6 \times 24}{8} = 3.6 \times 3 = 10.8$ m **OR** Bv AA similarity criterion, $\Delta PDQ \sim \Delta ADB$ $\frac{DQ}{BD} = \frac{PQ}{AB}$ (1) Also, $\frac{BQ}{BD} = \frac{PQ}{CD}$ (2) Adding (1) and (2) $\frac{BQ+DQ}{BD} = \frac{PQ}{AB} + \frac{PQ}{CD}$ $\frac{BD}{BD} = PQ\,(\frac{1}{AB} + \frac{1}{CD})$ $\frac{1}{PQ} = \frac{1}{AB} + \frac{1}{CD}$	**1** **2**