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

	Section A	
1	(c) a^3b^2	1
2	(c) 13 km/hours	1
3	(b) -10	1
4	(b) Parallel.	1
5	(c) k = 4	1
6	(b) 12	1
7	(c) $\angle B = \angle D$	1
8	(b) 5 : 1	1
9	(a) 25°	1
10	(a) $\frac{\sqrt{3}}{2}$	1
11	(c) $\sqrt{3}$	1
12	(b) 0	1
13	(b) 14 : 11	1
14	(c) 16 : 9	1
15	(d) 147π cm^2	1
16	(c) 20	1
17	(b) 8	1
18	(a) $\frac{3}{26}$	1
19	(d) Assertion (A) is false but Reason (R) is true.	1

20	(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).	1
	Section B	
21	For a pair of linear equations to have infinitely many solutions : $\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} = \dfrac{c_1}{c_2} \Rightarrow \dfrac{k}{12} = \dfrac{3}{k} = \dfrac{k-3}{k}$ $\dfrac{k}{12} = \dfrac{3}{k} \Rightarrow k^2 = 36 \Rightarrow k = \pm 6$ Also, $\dfrac{3}{k} = \dfrac{k-3}{k} \Rightarrow k^2 - 6k = 0 \Rightarrow k = 0, 6.$ Therefore, the value of k, that satisfies both the conditions, is k = 6.	½ ½ ½ ½
22	 	(i) In ΔABD and ΔCBE ∠ADB = ∠CEB = 90º ∠ABD = ∠CBE (Common angle) ⇒ ΔABD ~ ΔCBE (AA criterion) (ii) In ΔPDC and ΔBEC ∠PDC = ∠BEC = 90º ∠PCD = ∠BCE (Common angle) ⇒ ΔPDC ~ ΔBEC (AA criterion) **[OR]** In ΔABC, DE ‖ AC BD/AD = BE/EC ....(i) (Using BPT) In ΔABE, DF ‖ AE BD/AD = BF/FE ....(ii) (Using BPT) From (i) and (ii) BD/AD = BE/EC = BF/FE Thus, $\dfrac{BF}{FE} = \dfrac{BE}{EC}$	½ ½ ½ ½ ½ ½ ½ ½
23		Let O be the centre of the concentric circle of radii 5 cm and 3 cm respectively. Let AB be a chord of the larger circle touching the smaller circle at P Then AP = PB and OP⊥AB Applying Pythagoras theorem in ΔOPA, we have $OA^2 = OP^2 + AP^2 \Rightarrow 25 = 9 + AP^2$ $\Rightarrow AP^2 = 16 \Rightarrow AP = 4$ cm ∴ AB = 2AP = 8 cm	½ ½ ½ ½
24	Now, $\dfrac{(1+\sin\theta)(1-\sin\theta)}{(1+\cos\theta)(1-\cos\theta)} = \dfrac{(1-\sin^2\theta)}{(1-\cos^2\theta)}$ $\qquad\qquad = \dfrac{\cos^2\theta}{\sin^2\theta} = \left(\dfrac{\cos\theta}{\sin\theta}\right)^2$ $\qquad\qquad = \cot^2\theta$ $\qquad\qquad = \left(\dfrac{7}{8}\right)^2 = \dfrac{49}{64}$	½ ½ ½ ½
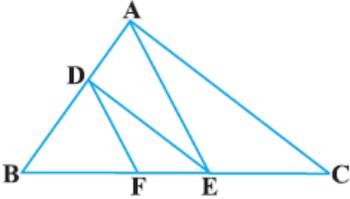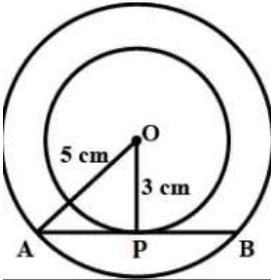
25	Perimeter of quadrant = $2r + \frac{1}{4} \times 2\pi r$	½
	$\Rightarrow$ Perimeter = $2 \times 14 + \frac{1}{2} \times \frac{22}{7} \times 14$	½
	$\Rightarrow$ Perimeter = 28 + 22 =28+22 = 50 cm	1
	[OR]	
	Area of the circle = Area of first circle + Area of second circle	
	$\Rightarrow \pi R^2 = \pi (r_1)^2 + \pi (r_1)^2$	½
	$\Rightarrow \pi R^2 = \pi (24)^2 + \pi (7)^2 \Rightarrow \pi R^2 = 576\pi + 49\pi$	½
	$\Rightarrow \pi R^2 = 625\pi \Rightarrow R^2 = 625 \Rightarrow R = 25$ Thus, diameter of the circle = 2R = 50 cm.	1

	Section C	
26	Let us assume to the contrary, that $\sqrt{5}$ is rational. Then we can find a and b ($\neq 0$) such that $\sqrt{5} = \frac{a}{b}$ (assuming that a and b are co-primes).	1
	So, a = $\sqrt{5}$ b $\Rightarrow a^2 = 5b^2$ Here 5 is a prime number that divides a^2 then 5 divides a also (Using the theorem, if a is a prime number and if a divides p^2, then a divides p, where a is a positive integer) Thus 5 is a factor of a	½
	Since 5 is a factor of a, we can write a = 5c (where c is a constant). Substituting a = 5c We get $(5c)^2 = 5b^2 \Rightarrow 5c^2 = b^2$	½
	This means 5 divides b^2 so 5 divides b also (Using the theorem, if a is a prime number and if a divides p^2, then a divides p, where a is a positive integer). Hence a and b have at least 5 as a common factor.	½
	But this contradicts the fact that a and b are coprime. This is the contradiction to our assumption that p and q are co-primes.	
	So, $\sqrt{5}$ is not a rational number. Therefore, the $\sqrt{5}$ is irrational.	½
27	$6x^2 - 7x - 3 = 0 \Rightarrow 6x^2 - 9x + 2x - 3 = 0$ $\Rightarrow 3x(2x - 3) + 1(2x - 3) = 0 \Rightarrow (2x - 3)(3x + 1) = 0$ $\Rightarrow 2x - 3 = 0$ & $3x + 1 = 0$	½
	x = 3/2 & x = -1/3 Hence, the zeros of the quadratic polynomials are 3/2 and -1/3.	½
	For verification	
	Sum of zeros = $\frac{-\text{coefficient of x}}{\text{coefficient of x}^2} \Rightarrow 3/2 + (-1/3) = -(-7)/6 \Rightarrow 7/6 = 7/6$	1
	Product of roots = $\frac{\text{constant}}{\text{coefficient of x}^2} \Rightarrow 3/2 \times (-1/3) = (-3)/6 \Rightarrow -1/2 = -1/2$ Therefore, the relationship between zeros and their coefficients is verified.	1
28	Let the fixed charge by Rs x and additional charge by Rs y per day Number of days for Latika = 6 = 2 + 4 Hence, Charge x + 4y = 22 x = 22 – 4y ………(1) Number of days for Anand = 4 = 2 + 2 Hence, Charge x + 2y = 16	½
	x = 16 – 2y ……. (2) On comparing equation (1) and (2), we get,	½

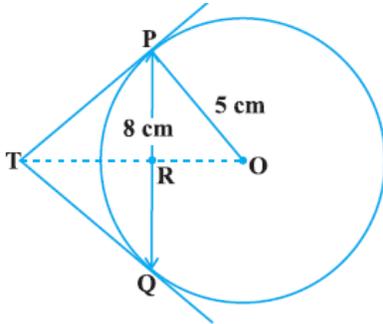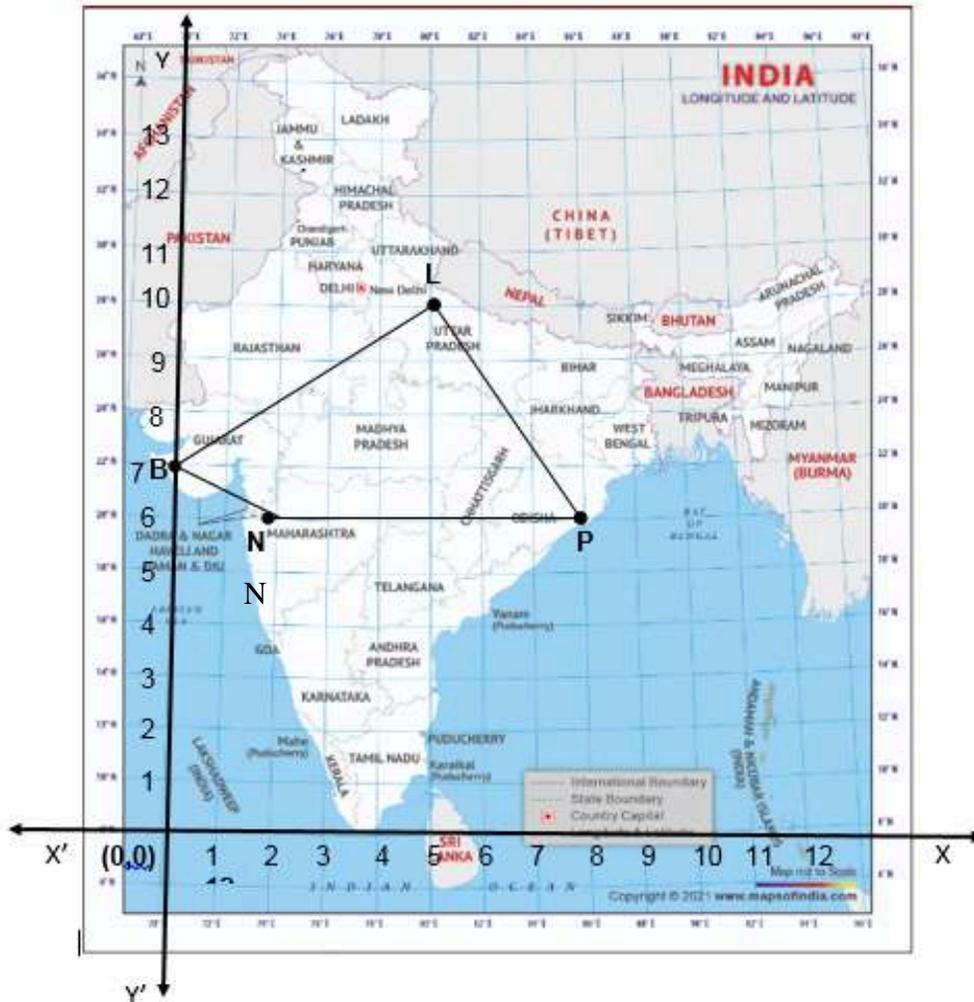|		
	22 − 4y = 16 − 2y ⇒ 2y = 6 ⇒ y = 3 Substituting y = 3 in equation (1), we get, x = 22 − 4 (3) ⇒ x = 22 − 12 ⇒ x = 10	1
	Therefore, fixed charge = Rs 10 and additional charge = Rs 3 per day	1
	[OR]	
	 AB = 100 km. We know that, Distance = Speed × Time. AP − BP = 100 ⇒ 5x − 5y = 100 ⇒ x−y=20.....(i) AQ + BQ = 100 ⇒ x + y = 100….(ii) Adding equations (i) and (ii), we get, x − y + x + y = 20 +100 ⇒ 2x = 120 ⇒ x = 60 Substituting x = 60 in equation (ii), we get, 60 + y = 100 ⇒ y = 40 Therefore, the speed of the first car is 60 km/hr and the speed of the second car is 40 km/hr.	½ ½ 1 1
29	Since OT is perpendicular bisector of PQ. Therefore, PR=RQ=4 cm Now, OR = $\sqrt{OP^2 - PR^2} = \sqrt{5^2 - 4^2}$ =3cm Now, ∠TPR + ∠RPO = 90° (∵TPO=90°) & ∠TPR + ∠PTR = 90° (∵TRP=90∘) So, ∠RPO = ∠PTR So, $\triangle$TRP ∼ $\triangle$PRO [By A-A Rule of similar triangles] So, $\frac{TP}{PO} = \frac{RP}{RG}$ ⇒ $\frac{TP}{5} = \frac{4}{3}$ ⇒ TP = $\frac{20}{3}$ cm	½ ½ ½ ½ ½ ½
30	$$LHS = \frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta} = \frac{\tan\theta}{1-\frac{1}{\tan\theta}} + \frac{\frac{1}{\tan\theta}}{1-\tan\theta}$$ $$= \frac{\tan^2\theta}{\tan\theta-1} + \frac{1}{\tan\theta\,(1-\tan\theta)}$$ $$= \frac{\tan^3\theta-1}{\tan\theta\,(\tan\theta-1)}$$ $$= \frac{(\tan\theta-1)\,(\tan^3\theta + \tan\theta+1)}{\tan\theta\,(\tan\theta-1)}$$ $$= \frac{(\tan^3\theta + \tan\theta+1)}{\tan\theta}$$ $$= \tan\theta + 1 + \sec = 1 + \tan\theta + \sec\theta$$ $$= 1 + \frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta}$$ $$= 1 + \frac{\sin^2\theta + \cos^2\theta}{\sin\theta\,\cos\theta}$$	½ ½ ½ ½ ½ ½
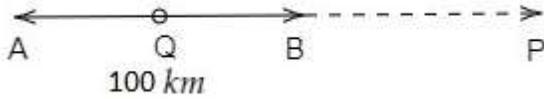
$$= 1 + \frac{1}{\sin\theta\cos\theta} = 1 + \sec\theta\,\csc\theta$$

[OR]

$\sin\theta + \cos\theta = \sqrt{3} \Rightarrow (\sin\theta + \cos\theta)^2 = 3$

$\Rightarrow \sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta = 3$

$\Rightarrow 1 + 2\sin\theta\cos\theta = 3 \Rightarrow 1\,\sin\theta\cos\theta = 1$

Now $\tan\theta + \cot\theta = \dfrac{\sin\theta}{\cos\theta} + \dfrac{\cos\theta}{\text{isn}\,\theta}$

$$= \frac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta}$$

$$= \frac{1}{\sin\theta\cos\theta} = \frac{1}{1} = 1$$

½
½
½
½
½
½
½

31

(i) $P(8) = \dfrac{5}{36}$

(ii) $P(13) = \dfrac{0}{36} = 0$

(iii) P(less than or equal to 12) = 1

1
1
1

Section D

32

Let the average speed of passenger train = x km/h.

and the average speed of express train = $(x + 11)$ km/h

As per given data, time taken by the express train to cover 132 km is 1 hour less than the passenger train to cover the same distance. Therefore,

$\dfrac{132}{x} - \dfrac{132}{x+11} = 1$

$\Rightarrow \dfrac{132\,(x+11-x)}{x\,(x+11)} = 1 \Rightarrow \dfrac{132\; x\; 11}{x\,(x+11)} = 1$

$\Rightarrow 132 \times 11 = x(x + 11) \Rightarrow x^2 + 11x - 1452 = 0$

$\Rightarrow x^2 + 44x - 33x - 1452 = 0$

$\Rightarrow x\,(x + 44) - 33(x + 44) = 0 \Rightarrow (x + 44)(x - 33) = 0$

$\Rightarrow x = -44, 33$

As the speed cannot be negative, the speed of the passenger train will be 33 km/h and the speed of the express train will be 33 + 11 = 44 km/h.

[OR]

Let the speed of the stream be x km/hr
So, the speed of the boat in upstream = (18 - x) km/hr
& the speed of the boat in downstream = (18 + x) km/hr

ATQ, $\dfrac{\text{distance}}{\text{upstream speed}} - \dfrac{\text{distance}}{\text{downstream speed}} = 1$

$\Rightarrow \dfrac{24}{18 - x} - \dfrac{24}{18 + x} = 1$

½
1
½
1
1
½
½
½
½
1

	$\Rightarrow 24\left[\dfrac{1}{18-x}-\dfrac{1}{18+x}\right]=1 \Rightarrow 24\left[\dfrac{18+x-(18-x)}{(18-x).(18+x)}\right]=1$	1
	$\Rightarrow 24\left[\dfrac{2x}{(18-x).(18+x)}\right]=1 \Rightarrow 24\left[\dfrac{2x}{(18-x).(18+x)}\right]=1$	
	$\Rightarrow 48x = 324 - x^2 \Rightarrow x^2 + 48x - 324 = 0$	1
	$\Rightarrow (x + 54)(x - 6) = 0 \Rightarrow x = -54$ or 6	½
	As speed to stream can never be negative, the speed of the stream is 6 km/hr.	½
33	Figure	½
	Given, To prove, constructions	1½
	Proof	2
	Application ----	1
34	Volume of one conical depression $= \frac{1}{3} \times \pi\, r^2\, h$	½
	$= \frac{1}{3} \times \frac{22}{7} \times 0.5^2 \times 1.4$ cm^3 $= 0.366$ cm^3	1½
	Volume of 4 conical depression $= 4 \times 0.366$ cm^3	
	$= 1.464$ cm^3	½
	Volume of cuboidal box $= L \times B \times H$	½
	$= 15 \times 10 \times 3.5$ cm$^3 = 525$ cm^3	1½
	Remaining volume of box = Volume of cuboidal box – Volume of 4 conical depressions	
	$= 525$ cm$^3 - 1.464$ cm$^3 = 523.5$ cm^3	½
		1
	[OR]	
	Let h be height of the cylinder, and r the common radius of the cylinder and hemisphere.	
	Then, the total surface area = CSA of cylinder + CSA of hemisphere	½
	$= 2\pi rh + 2\pi r^2 = 2\pi\, r\,(h + r)$	2
	$= 2 \times \frac{22}{7} \times 30\,(145 + 30)$ cm^2	1
	$= 2 \times \frac{22}{7} \times 30 \times 175$ cm^2	½
	$= 33000$ cm$^2 = 3.3$ m^2	1

35	Class Interval	Number of policy holders (f)	Cumulative Frequency (cf)		
	Below 20	2	2		
	20-25	4	6		
	25-30	18	24		
	30-35	21	45		
	35-40	33	78		
	40-45	11	89		
	45-50	3	92		
	50-55	6	98		
	55-60	2	100		1

		n = 100 ⇒ n/2 = 50, Therefore, median class = 35 – 40, Class size, h = 5, Lower limit of median class, l = 35, frequency f = 33, cumulative frequency cf = 45 ⇒Median = l + $\left[\dfrac{\frac{n}{2} - cf}{f}\right]$ × h ⇒Median = 35 + $\left[\dfrac{50 - 45}{33}\right]$ × 5 = 35 + $\dfrac{25}{33}$ = 35 + 0.76 = 35.76 Therefore, median age is 35.76 years		½ 1½ 1 1

<table>
<tr><td colspan="5" align="center">Section E</td></tr>
<tr>
<td rowspan="4">36</td>
<td>1</td>
<td>Since the production increases uniformly by a fixed number every year, the number of Cars manufactured in 1st, 2nd, 3rd, . . .,years will form an AP.
So, a + 3d = 1800 & a + 7d = 2600
So d = 200 & a = 1200</td>
<td>½
½</td>
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</tr>
<tr>
<td>2</td>
<td>$t_{12} = a + 11d \Rightarrow t_{30} = 1200 + 11 \times 200$
$\Rightarrow t_{12} = 3400$</td>
<td>½
½</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$S_n = \frac{n}{2}[2a + (n-1)d] \Rightarrow S_{10} = \frac{10}{2}[2 \times 1200 + (10-1)\,200]$

$\Rightarrow S_{10} = \frac{13}{2}[2 \times 1200 + 9 \times 200]$

$\Rightarrow S_{10} = 5 \times [2400 + 1800]$
$\Rightarrow S_{10} = 5 \times 4200 = 21000$
<div align="center">[OR]</div>Let in n years the production will reach to 31200
$S_n = \frac{n}{2}[2a + (n-1)d] = 31200 \Rightarrow \frac{n}{2}[2 \times 1200 + (n-1)200] = 31200$

$\Rightarrow \frac{n}{2}[2 \times 1200 + (n-1)200] = 31200 \Rightarrow n\,[12 + (n-1)] = 312$
$\Rightarrow n^2 + 11n - 312 = 0$
$\Rightarrow n^2 + 24n - 13n - 312 = 0$
$\Rightarrow (n+24)(n-13) = 0$
$\Rightarrow n = 13$ or -24. As n can't be negative. So n = 13</td>
<td>½

½
½
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½

½

½</td>
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<td>37</td>
<td colspan="4">Case Study – 2</td>
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</table>

1	$LB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \Rightarrow LB = \sqrt{(0 - 5)^2 + (7 - 10)^2}$	½
	$LB = \sqrt{(5)^2 + (3)^2} \Rightarrow LB = \sqrt{25 + 9} \quad LB = \sqrt{34}$	
	Hence the distance is $150\sqrt{34}$ km	½
2	Coordinate of Kota (K) is $\left(\dfrac{3 \times 5 + 2 \times 0}{3 + 2}, \dfrac{3 \times 7 + 2 \times 10}{3 + 2}\right)$	½
	$= \left(\dfrac{15+0}{5}, \dfrac{21+20}{5}\right) = \left(3, \dfrac{41}{5}\right)$	½
3	L(5, 10), N(2,6), P(8,6)	½
	$LN = \sqrt{(2 - 5)^2 + (6 - 10)^2} = \sqrt{(3)^2 + (4)^2} = \sqrt{9 + 16} = \sqrt{25} = 5$	½
	$NP = \sqrt{(8 - 2)^2 + (6 - 6)^2} = \sqrt{(4)^2 + (0)^2} = 4$	½
	$PL = \sqrt{(8 - 5)^2 + (6 - 10)^2} = \sqrt{(3)^2 + (4)^2} \Rightarrow LB = \sqrt{9 + 16} = \sqrt{25} = 5$	½
	as LN = PL ≠ NP, so Δ LNP is an isosceles triangle.	½
	[OR]	

		Let A (0, b) be a point on the y – axis then AL = AP	
		$\Rightarrow \sqrt{(5-0)^2 + (10-b)^2} = \sqrt{(8-0)^2 + (6-b)^2}$	½
		$\Rightarrow (5)^2 + (10-b)^2 = (8)^2 + (6-b)^2$	½
		$\Rightarrow 25 + 100 - 20b + b^2 = 64 + 36 - 12b + b^2 \Rightarrow 8b = 25 \Rightarrow b = \frac{25}{8}$	½
		So, the coordinate on y axis is $\left(0, \frac{25}{8}\right)$	½

Case Study – 3

38

1	$\sin 60° = \dfrac{PC}{PA}$	½
	$\Rightarrow \dfrac{\sqrt{3}}{2} = \dfrac{18}{PA} \Rightarrow PA = 12\sqrt{3}$ m	½
2	$\sin 30° = \dfrac{PC}{PB}$	½
	$\Rightarrow \dfrac{1}{2} = \dfrac{18}{PB} \Rightarrow PB = 36$ m	½
3	$\tan 60° = \dfrac{PC}{AC} \Rightarrow \sqrt{3} = \dfrac{18}{AC} \Rightarrow AC = 6\sqrt{3}$ m	1
	$\tan 30° = \dfrac{PC}{CB} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{18}{CB} \Rightarrow CB = 18\sqrt{3}$ m	½
	Width AB = AC + CB = $6\sqrt{3} + 18\sqrt{3} = 24\sqrt{3}$ m	½
	[OR]	
	RB = PC =18 m & PR = CB = $18\sqrt{3}$ m	½
	$\tan 30° = \dfrac{QR}{PR} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{QR}{18\sqrt{3}} \Rightarrow QR = 18$ m	1
	QB = QR + RB = 18 + 18 = 36m. Hence height BQ is 36m	½