COMMON PRE-BOARD EXAMINATION 2025-26

MATHEMATICS -CODE NO. 041

CLASS-XII-(2025-26)

SET: 2 ANSWER KEY

SECTION-A [1 × 20 = 20]

(This section comprises of multiple-choice questions (MCQs) of 1 mark each.)

Select the correct option (Question 1 - Question 20)

1.	(a) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$	11.	(d) any point on the line segment joining the points$(0,2)$ and $(3,0)$.	
2.	(c) 25	12.	(b) $\frac{1}{\pi}$ unit	
3.	(b) a^9	13.	(d) -3	
4.	(c) 4	14.	(b) -1	
5.	(d) 300	15.	(c) $\frac{3}{2}$	
6.	(d) $12\sqrt{3}$	16.	(c) 0	
7.	(b) $\frac{x^{2x}}{2}+C$	17.	(b) $\frac{2}{3}\sin^{-1}\left(\frac{x^{3/2}}{a^{3/2}}\right)+C$	
8.	(d) $\frac{\pi}{6}$	18.	(a) $3p=q$	
9.	(b) $12,-2$	19.	(c) A is true but R is false	
10.	(a) $\frac{5}{8}$	20.	(c)A is true but R is false	

SECTION B [2 × 5 = 10]

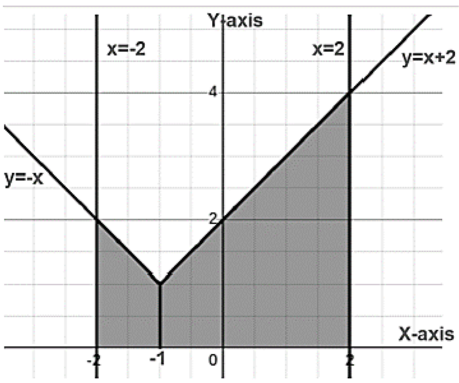
(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21.	$\sqrt{x}+\sqrt{y}=1$ Differentiating both sides w.r.t x $\frac{1}{2\sqrt{x}}+\frac{1}{2\sqrt{y}}\frac{dy}{dx}=0$ $\Rightarrow \frac{dy}{dx}=-\frac{\sqrt{y}}{\sqrt{x}}$ $\frac{dy}{dx}$ at $\left(\frac{1}{9},\frac{1}{9}\right)$ is -1.	1 0.5 0.5

22.	$x = a\left(cos\theta + logtan\frac{\theta}{2}\right)$ $y = asin\theta$ Differentiating x w.r.t θ Differentiating y w.r.t θ $\frac{dx}{d\theta} = a\left(-sin\theta + \frac{1}{tan\frac{\theta}{2}} \times sec^2\frac{\theta}{2} \times \frac{1}{2}\right)$ $\frac{dy}{d\theta} = acos\theta$	1
	$\frac{dx}{d\theta} = a\left(-sin\theta + \frac{1}{2sin\frac{\theta}{2}cos\frac{\theta}{2}}\right)$ $= a\left(-sin\theta + \frac{1}{sin\theta}\right)$ $= a\left(\frac{-sin^2\theta+1}{sin\theta}\right)$	
	$= a\left(\frac{cos^2\theta}{sin\theta}\right)$	0.5
	$\frac{dy}{dx} = \frac{dy}{d\theta} \Big/ \frac{dx}{d\theta} = \frac{acos\theta}{a\left(\frac{cos^2\theta}{sin\theta}\right)} = tan\theta$	0.5
23.	$\|\vec{a}\| = \|\vec{b}\| = 1$ $\|\sqrt{2}\vec{a} - \vec{b}\| = 1$ $\Rightarrow \|\sqrt{2}\vec{a} - \vec{b}\|^2 = 1$	0.5
	$\Rightarrow (\sqrt{2}\vec{a} - \vec{b}).(\sqrt{2}\vec{a} - \vec{b}) = 1$	0.5
	$\Rightarrow 2\|\vec{a}\|^2 + \|\vec{b}\|^2 - 2\sqrt{2}\vec{a}.\vec{b} = 1$ $\Rightarrow 3 - 2\sqrt{2}\|\vec{a}\|\|\vec{b}\|cos\theta = 1$	
	$\Rightarrow cos\theta = {}^{1}\!/\!_{\sqrt{2}}$	0.5
	$\Rightarrow \theta = \frac{\pi}{4}$	0.5

24.	$tan^{-1}\left[2sin\left(2cos^{-1}\frac{\sqrt{3}}{2}\right)\right]$ $= tan^{-1}\left[2sin\left(2\left(\frac{\pi}{6}\right)\right)\right]$ $= tan^{-1}\left[2sin\left(\frac{\pi}{3}\right)\right]$ $= tan^{-1}\left[2\left(\frac{\sqrt{3}}{2}\right)\right]$ $= tan^{-1}[\sqrt{3}] = \frac{\pi}{3}$ **OR** $\tan^{-1}(1) + \cos^{-1}\left(\frac{-1}{2}\right) + \sin^{-1}\left(\frac{-1}{2}\right)$ $= \frac{\pi}{4} + \pi - \frac{\pi}{3} - \frac{\pi}{6}$ $= \frac{3\pi+12\pi-4\pi-2\pi}{12}$ $= \frac{9\pi}{12} = \frac{3\pi}{4}$	0.5 0.5 0.5 0.5 1 0.5 0.5
25.	$I = \int_{-2}^{2}\frac{x^2}{1+5^x}\,dx$ ……… (1) By applying the property $\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$ $I = \int_{-2}^{2}\frac{(-x)^2}{1+5^{-x}}\,dx$ ……… (2) (1) + (2) $\Longrightarrow 2I = \int_{-2}^{2}\left[\frac{x^2}{1+5^x} + \frac{(-x)^2}{1+5^{-x}}\right]dx$ $= \int_{-2}^{2}\left[\frac{x^2}{1+5^x} + \frac{5^x x^2}{1+5^x}\right]dx = \int_{-2}^{2}x^2\,dx$ $= \left[\frac{x^3}{3}\right]_{-2}^{2} = \frac{16}{3}$ $\therefore I = \frac{8}{3}$ **OR**	0.5 0.5 0.5 0.5

	$\int_0^{\frac{\pi}{4}} \sqrt{1+sin2x}dx$	1
	$= \int_0^{\frac{\pi}{4}} \sqrt{(sinx+cosx)^2}dx$	
	$= \int_0^{\frac{\pi}{4}} (sinx+cosx)dx$	0.5
	$= [-cosx+sinx]_0^{\frac{\pi}{4}}$	0.5
	$= -\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}} - (-1+0) = 1$	
	SECTION C **[3 × 6 =18]** **(This section comprises of 6 short answer (SA) type questions of 3 marks each.)**	
26.	E_1: 2 balls are white E_2: 3 balls are white E_3: 4 balls are white A : Two balls are white	
	$P(E_1) = P(E_2) = P(E_3) = \frac{1}{3}$	0.5
	$P\left({}^{A}/_{E_1}\right) = \frac{1}{6}, P\left({}^{A}/_{E_2}\right) = \frac{1}{2}, P\left({}^{A}/_{E_3}\right) = 1$	0.5
	$P\left({}^{E_3}/_{A}\right) = \frac{P(E_3)\, P\left({}^{A}/_{E_3}\right)}{P(E_1)P\left({}^{A}/_{E_1}\right) + P(E_2)P\left({}^{A}/_{E_2}\right) + P(E_3)P\left({}^{A}/_{E_3}\right)}$	
	$= \frac{\frac{1}{3}\times 1}{\frac{1}{3}\times\frac{1}{6}+\frac{1}{3}\times\frac{1}{2}+\frac{1}{3}\times 1} = \frac{6}{10} = \frac{3}{5}$	2

27.	$y=\sin(m\sin^{-1}x)\Rightarrow \frac{dy}{dx}=\cos(m\sin^{-1}x)\cdot\frac{m}{\sqrt{1-x^2}}$ $\Rightarrow \sqrt{1-x^2}\frac{dy}{dx}=m\cos(m\sin^{-1}x)$ Again diff.w.r.t. $x, \sqrt{1-x^2}\frac{d^2y}{dx^2}+\frac{dy}{dx}\left(\frac{-2x}{\sqrt{1-x^2}}\right)=-m\sin(m\sin^{-1}x)\frac{m}{\sqrt{1-x^2}}$ $\Rightarrow (1-x^2)\frac{d^2y}{dx^2}-x\frac{dy}{dx}=-m^2\sin(m\sin^{-1}x)=-m^2y$ $\Rightarrow (1-x^2)\frac{d^2y}{dx^2}-x\frac{dy}{dx}+m^2y=0$ **OR** $y=(\log x)^x+x^{\log x}=e^{\log\{(\log x)^x\}}+e^{\log\{x^{\log x}\}}$ $=e^{x\log\{(\log x)\}}+e^{\log x\cdot\log x}$ $\frac{dy}{dx}\cdot= e^{x\log\{(\log x)\}}\left[x\cdot\frac{1}{\log x}\cdot\frac{1}{x}+\log(\log x)\cdot 1\right]+e^{\log x\cdot\log x}\left[\frac{\log x}{x}+\frac{\log x}{x}\right]$ $=(\log x)^x\left[\frac{1}{\log x}+\log(\log x)\right]+x^{\log x}\left[\frac{2\log x}{x}\right]$	1 1 0.5 0.5 0.5 2 0.5
28.	 $y=1+\lvert x+1\rvert=\begin{cases}1-x-1, & x<-1\\ 1+x+1, & x\geq -1\end{cases}$ $y=\begin{cases}-x, & x<-1\\ x+2, & x\geq -1\end{cases}$ RA = Area under $y=x$ +Area under $y=(x+2)$ $=\int_{-3}^{-1}-x\,dx+\int_{-1}^{3}x+2\,dx$ $=-\left(\frac{x^2}{2}\right)_{-3}^{-1}+\left(\frac{x^2}{2}+2x\right)_{-1}^{3}$ $=-\left(\frac{1}{2}-\frac{9}{2}\right)+\left[\frac{9}{2}+6-\left(\frac{1}{2}-2\right)\right]$ = 16 squnits	0.5 0.5 1 1

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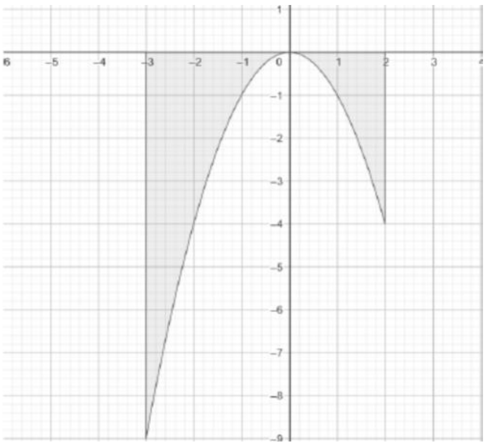

RA $=\left|\int_{-3}^{2} -x^2\,dx\right|$

$=\left|-\left(\frac{x^3}{3}\right)_{-3}^{2}\right| = \left|\frac{-1}{3}(8-(-27))\right| = \frac{35}{3}$sq units

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$5x-3=15y+7=3-10z$

Equation of the line is $\frac{x-\frac{3}{5}}{\frac{1}{5}}=\frac{y+\frac{7}{15}}{\frac{1}{15}}=\frac{z-\frac{3}{10}}{\frac{-1}{10}}$

The dr's are $\langle\frac{1}{5},\frac{1}{15},\frac{-1}{10}\rangle$ or $\langle 6,2,-3\rangle$

The dc's are $\langle\frac{6}{7},\frac{2}{7},\frac{-3}{7}\rangle$

The point at which it passes is $\left(\frac{3}{5},\frac{-7}{15},\frac{3}{10}\right)$

OR

The vector equation of the line passing through $(1,2,-4)$is

$\vec{r}=\hat{\imath}+2\hat{\jmath}+6\hat{k}+\lambda(2\hat{\imath}+3\hat{\jmath}+6\hat{k})$

Cartesian Equation is $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-6}{1}$

Equation of the line passing through the points A$(3,3,-5\ )$ and B$(1,0,-11)$ is

$\vec{r}=3\hat{\imath}+3\hat{\jmath}-5\hat{k}+\mu(2\hat{\imath}+3\hat{\jmath}+6\hat{k})$

Distance between the parallel lines is $d=\left|\frac{(\overrightarrow{a_2}-\overrightarrow{a_1})\times\vec{b}}{|\vec{b}\,|}\right|=\left|\frac{(2\hat{\imath}+\hat{\jmath}-\hat{k})\times(2\hat{\imath}+3\hat{\jmath}+6\hat{k})}{|2\hat{\imath}+3\hat{\jmath}+6\hat{k}|}\right|$

$=\left|\frac{9\hat{\imath}-14\hat{\jmath}+4\hat{k}}{7}\right|=\frac{\sqrt{293}}{7}\ units$

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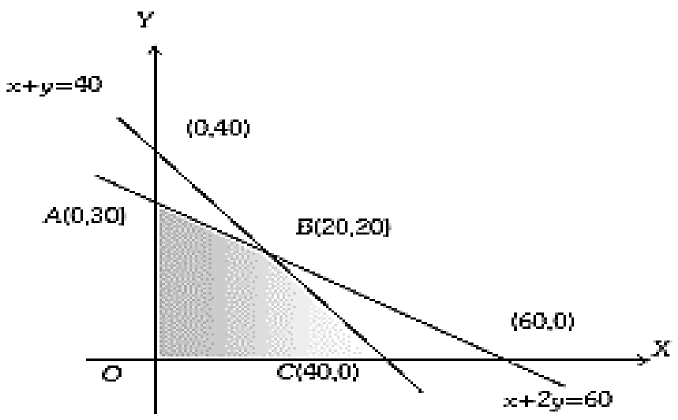

1.5

Corner points	Z = 3x + 4y
$A(0,30)$	120
$B(20,20)$	140
$C(40,0)$	120
$O(0,0)$	0

1

0.5

Maximum is at $B(20,20)$ and maximum value is 140.

31.

$$y = \frac{4\sin\ \theta}{(2+\cos\ \theta)} - \theta$$

$$\frac{\text{dy}}{\text{d}\theta} = \frac{(2+\cos\theta)4\cos\theta - 4\sin\ \theta(-sin\theta)}{(2+\cos\ \theta)^2} - 1$$

1.5

0.5

$$\frac{\text{dy}}{\text{d}\theta} = \frac{8\cos\theta + 4cos^2\theta + 4\sin^2\theta - 4 - 4cos\theta - cos^2\theta}{(2+\cos\theta)^2}$$

0.5

$$= \frac{4cos\theta - cos^2\theta}{(2+\cos\theta)^2} = \frac{cos\theta(4-cos\theta)}{(2+\cos\theta)^2}$$

For $\theta\epsilon\left[0,\frac{\pi}{2}\right], cos\theta \geq 0, 4 - cos\theta > 0\ and\ (2+\cos\theta)^2 > 0$

0.5

$$\Rightarrow \frac{cos\theta(4-cos\theta)}{(2+\cos\theta)^2} \geq 0$$

$\therefore y$ is an increasing function

SECTION D **[5 × 4 = 20]**

(This section comprises of 4 long answer (LA) type questions of 5 marks each)

32.	A = $\begin{bmatrix}1 & 1 & 1\\0 & 1 & 3\\1 & -2 & 1\end{bmatrix}$ $B = \begin{bmatrix}7 & -3 & 2\\3 & 0 & -3\\-1 & 3 & 1\end{bmatrix}$ AB = $\begin{bmatrix}9 & 0 & 0\\0 & 9 & 0\\0 & 0 & 9\end{bmatrix}$ $\Rightarrow AB = 9I_3$ $\Rightarrow A^{-1} = \frac{1}{9}B$ For the given system of linear equations A = $\begin{bmatrix}1 & 1 & 1\\0 & 1 & 3\\1 & -2 & 1\end{bmatrix}, X = \begin{bmatrix}x\\y\\z\end{bmatrix}, C = \begin{bmatrix}6\\11\\0\end{bmatrix}$ $X = A^{-1}C$ $\begin{bmatrix}x\\y\\z\end{bmatrix} = \frac{1}{9}BC$ $\begin{bmatrix}x\\y\\z\end{bmatrix} = \frac{1}{9}\begin{bmatrix}7 & -3 & 2\\3 & 0 & -3\\-1 & 3 & 1\end{bmatrix}\begin{bmatrix}6\\11\\0\end{bmatrix}$ $\begin{bmatrix}x\\y\\z\end{bmatrix} = \frac{1}{9}\begin{bmatrix}9\\18\\27\end{bmatrix}$ $x = 1, y = 2, z = 3$	2 0.5 0.5 1 0.5 0.5
33.	$2ye^{\frac{x}{y}}dx + \left(y - 2xe^{\frac{x}{y}}\right)dy = 0$ $\Rightarrow \frac{dx}{dy} = \frac{2xe^{x/y} - y}{2y \cdot e^{x/y}}$ Let $F(x, y) = \frac{2xe^{x/y} - y}{2y \cdot e^{x/y}}$ $F(\lambda x, \lambda y) = \frac{2\lambda xe^{\lambda x/\lambda y} - \lambda y}{2\lambda y \cdot e^{\lambda x/\lambda y}} = \lambda^0\left(\frac{2xe^{x/y} - y}{2y \cdot e^{x/y}}\right) = \lambda^0 F(x, y)$	0.5

	∴ given Diff.Eq. is homogeneous. Let $x = vy \Rightarrow \frac{dx}{dy} = v + x\frac{dv}{dy}$ $\Rightarrow v + x\frac{dv}{dy} = \frac{2vye^{vy/y} - y}{2y \cdot e^{vy/y}} = \frac{2ve^{v} - 1}{2.e^{v}}$ $\Rightarrow x\frac{dv}{dy} = \frac{2ve^{v} - 1}{2.e^{v}} - v = \frac{2ve^{v} - 1 - 2ve^{v}}{2.e^{v}} = -\frac{1}{2.e^{v}}$ $2\int e^{v}dv = -\int \frac{dy}{y} \Rightarrow 2e^{v} + \log\ y\| = C \Rightarrow 2e^{x/y} + \log\|y\| = C$ ∵ $y = 1$ when $x = 0 \Rightarrow C = 2$ ∴ required sol is $\mathbf{2e^{x/y} + logy\ \| = C}$ **OR** Let $y = vx \Rightarrow \frac{dy}{dx} = v + x\frac{dv}{dx}$ $\therefore v + x\frac{dv}{dx} = \frac{v^2 - 3xvx}{x^2 + xvx} = \frac{v^2x^2 - 3xvx}{x^2 + xvx} = \frac{v^2 - 3v}{1 + v}$ $\therefore x\frac{dv}{dx} = \frac{v^2 - 3v}{1 + v} - v = \frac{v^2 - 3v - v - v^2}{1 + v} = \frac{-4v}{1 + v}$ $\therefore \int \left(\frac{1 + v}{v}\right) dv = -4\int \frac{dx}{x} \Rightarrow \int \left(\frac{1}{v}\right) dv + \int dv = -4\int \frac{dx}{x}$ $\Rightarrow \log\ v + v + 4\log\ x = C \Rightarrow \log\frac{y}{x} \cdot x^4 + \frac{y}{x} = C$ $\Rightarrow \mathbf{x\log(x^3y) = Cx}$	0.5 1.5 1 1 0.5 0.5 2 1 1 0.5
34.	$I = \int_0^{\frac{\pi}{4}} \frac{sinx + cosx}{9 + 16sin2x}\ dx$ $= \int_0^{\frac{\pi}{4}} \frac{sinx+cosx}{25-16(1-sin2x)}\ dx$ $= \int_0^{\frac{\pi}{4}} \frac{sinx+cosx}{25-16(sinx-cosx)^2}\ dx$ Let $sinx - cosx = t \Longrightarrow (cosx + sinx)dx = dt$ When $x = 0, t = -1\ and\ x = \frac{\pi}{4}\ t = 0$ $= \int_{-1}^{0} \frac{t}{25 - 16t^2}\ dt$	1 1 0.5

	$= \frac{1}{16}\int_{-1}^{0} \frac{t}{\frac{25}{16} - t^2}\ dt = \frac{1}{4} \times \frac{1}{10}\left[log\left[\frac{5+4t}{5-4t}\right]\right]_{-1}^{0}$	1.5
	$= \frac{1}{40}\left[log1 - log\frac{1}{9}\right] = \frac{1}{40}log9 = \frac{1}{20}log3$	1
	OR	
	$\int x^2 \tan^{-1} x \cdot dx = \tan^{-1} x \int x^2 \cdot dx - \int \left[\left(\int x^2 \cdot dx\right)\frac{d}{dx}(\tan^{-1} x)\right] dx$	1.5
	$= \tan^{-1} x \cdot \frac{x^3}{3} - \int \frac{x^3}{3} \cdot \frac{1}{1+x^2} \cdot dx = \tan^{-1} x \cdot \frac{x^3}{3} - \frac{1}{3}\int \frac{x^3}{1+x^2} \cdot dx$	1.5
	$= \tan^{-1} x \cdot \frac{x^3}{3} - \frac{1}{3}\int \frac{x^3 + x - x}{1+x^2} \cdot dx$	1
	$= \tan^{-1} x \cdot \frac{x^3}{3} - \frac{1}{3}\int \frac{x(x^2+1) - x}{1+x^2} \cdot dx$	0.5
	$= \tan^{-1} x \cdot \frac{x^3}{3} - \frac{1}{3}\int x \cdot dx + \frac{1}{6}\int \frac{2x}{1+x^2} \cdot dx$	0.5
	$= \frac{x^3}{3}\tan^{-1} x - \frac{1}{6}x^2 + \frac{1}{6}\log(x^2+1) + C$	
35.	Equation of the line is $\frac{x+2}{3} = \frac{y+1}{2} = \frac{z-3}{2}$	
	General point on the line is $(3\lambda - 2, 2\lambda - 1, 2\lambda + 3)$	1
	Distance from the point $A(1,2,3)$ is $3\sqrt{2}$	1
	$\Rightarrow (3\lambda - 2 - 1)^2 + (2\lambda - 1 - 2)^2 + (2\lambda + 3 - 3)^2 = \left(3\sqrt{2}\right)^2$	1
	$\Rightarrow (3\lambda - 3)^2 + (2\lambda - 3)^2 + (2\lambda)^2 = 18$	
	$\Rightarrow 17\lambda^2 - 30\lambda = 0$	
	$\Rightarrow \lambda = 0\ or\ \lambda = \frac{30}{17}$	1
	$\therefore$ Point is $(-2, -1, 3)$ or $\left(\frac{56}{17}, \frac{43}{17}, \frac{111}{17}\right)$	1
	SECTION- E **[4 × 3= 12]** **(This section comprises of 3 case-study/passage-based questions of 4 marks each with sub parts. The first two case study questions have three sub parts (a), (b), (c) of marks 1, 1, 2 respectively. The third case study question has two sub parts of 2 marks each)**	

36.	a) $P(E/A_1) + P(E/A_2) + P(E/A_3) = \frac{45}{100} + \frac{60}{100} + \frac{35}{100} = \frac{14}{10}$	2
	b) $P(E) = P(A_1)\,P(E/A_1) + P(A_2)P(E/A_2) + P(A_3)P(E/A_3)$ $= \frac{4}{10} \times \frac{45}{100} + \frac{4}{10} \times \frac{60}{100} + \frac{2}{10} \times \frac{35}{100} = \frac{490}{1000} = 49\%$ **OR** $P\left({}^{A_2}/_{E'}\right) = \frac{P(A_2)\,P(E'/A_2)}{P(A_1)P(E'/A_1) + P(A_2)\,P(E'/A_2) + P(A_3)\,P(E'/A_3)}$ $= \frac{\frac{4}{10} \times \frac{40}{100}}{\frac{4}{10} \times \frac{55}{100} + \frac{4}{10} \times \frac{40}{100} + \frac{2}{10} \times \frac{65}{100}} = \frac{16}{51}$	2
37.	a) Area $A = \frac{12x}{5}\sqrt{25 - x^2}$	1
	b) $\frac{dA}{dx} = 0 \Rightarrow \frac{12}{5} \times \frac{(25-2x^2)}{\sqrt{25-x^2}} = 0 \Rightarrow x = \frac{5}{\sqrt{2}}$	1
	c) For values of $x < \frac{5}{\sqrt{2}}$, $\frac{dA}{dx} > 0$ and for values of $x > \frac{5}{\sqrt{2}}$, $\frac{dA}{dx} < 0$ Hence, by the first derivative test, local maximum is at the critical point $= \frac{5}{\sqrt{2}}$. For maximum area ,length $= 5\sqrt{2}\,units$ and breadth= $3\sqrt{2}\,units$ **OR** Area $A = \frac{12x}{5}\sqrt{25 - x^2}$ Let $Z = A^2 = \frac{144x^2}{25}(25 - x^2)$ Diff Z w.r.t. x $\frac{dZ}{dx} = \frac{144}{25}(50x - 4x^3)$ $\frac{dZ}{dx} = 0 \Rightarrow x = \frac{5}{\sqrt{2}}$ Diff $again$ w.r.t. x	2

	$\frac{d^2Z}{dx^2} = \frac{144}{25}(50 - 12x^2)$ $\left[\frac{d^2Z}{dx^2}\right]_{x=\frac{5}{\sqrt{2}}} < 0$ Hence, by the second derivative test, local maximum value of Z is at the critical point $x = \frac{5}{\sqrt{2}}$ Area A is maximum at the critical point $x = \frac{5}{\sqrt{2}}$. Area A is maximum when length $= 5\sqrt{2}\,units$ and breadth$= 3\sqrt{2}\,units$	
38.	a) R_1	1
	b) R_4	1
	c) $\{(1,1), (2,2), (3,3), (2,1), (3,1), (2,3)\}$	2