BANGALORE SAHODAYA SCHOOLS COMPLEX ASSOCIATION (BSSCA)

Class XII

MARKING SCHEME MATHEMATICS (CODE-041)

SET B

SECTION:A (MULTPLE CHOICE QUESTIONS- 1 MARK EACH)

Question No	Hints/Solution	Answer
1.	$A^2 = \lambda A$ $\begin{bmatrix} 18 & -18 \\ -18 & 18 \end{bmatrix} = \lambda \begin{bmatrix} 3 & -3 \\ -3 & 3 \end{bmatrix} \Rightarrow \lambda = 6$	a
2.	$A = A'$ $\begin{bmatrix} 0 & 2b & -2 \\ 3 & 1 & 3 \\ 3a & 3 & -1 \end{bmatrix} = \begin{bmatrix} 0 & 3 & 3a \\ 2b & 1 & 3 \\ -2 & 3 & -1 \end{bmatrix}$ On comparing 2b = 3 , 3a = -2 $b = \frac{3}{2}$, $a = \frac{-2}{3}$ $\therefore$ a + b =b + a = $\frac{3}{2} - \frac{2}{3} = \frac{5}{6}$	b
3.	$det(A^{-1}) = (detA)^k$ $\frac{1}{\lvert A\rvert} = \lvert A\rvert^k \Rightarrow 1 = \lvert A\rvert^{k+1}$, $\Rightarrow \lvert A\rvert^0 = \lvert A\rvert^{k+1}$, $\Rightarrow$ k+1=0, $\Rightarrow$ k = - 1	d
4.	A(adjA) = $\lvert A\rvert I$,But A is a singular matrix,$\therefore$ $\lvert A\rvert$=0, $\therefore$A(adjA)=0	a
5.	$\lvert A\rvert = \lambda^2 - 4$, and $\lvert A^3\rvert = 125$, $\therefore \lvert A\rvert^3 = 125, \therefore \lvert A\rvert = 5$ $\therefore 5 = \lambda^2 - 4, \Rightarrow \lambda = \pm 3$.	b
6.	$(\vec{a}+\lambda\vec{b}).\vec{c} = 0, \therefore (2-\lambda)3 + (2+2\lambda) = 0, \therefore \lambda = 8$	b
7.	Median is $2i + 2k$.And its length is $\lvert 2i + 2k\rvert = 2\sqrt{2}$.	c
8.	Area=$\frac{1}{2}\lvert\vec{d_1} \times \vec{d_2}\rvert = \frac{1}{2}\lvert -2i - 14j - 10k\rvert = \frac{\sqrt{300}}{2} = 5\sqrt{3}$	a
9.	Line is $\frac{x-b}{a} = \frac{y}{1} = \frac{z-d}{c}$ .The direction ratios are a , 1 , c.	b
10.	The probability that both the tickets will show even numbers is $\frac{12}{25} \times \frac{11}{24} = \frac{11}{50}$	a
11.	Order=2 and degree=2.The sum of order and degree=4	c
12.	Integrating factor is $e^{\int\left(\frac{1}{x}+cotx\right)dx} = e^{logx\,sinx} = x\,sinx$	b
13.	I=$\int_0^{\frac{\pi}{2}} \log(tanx)\,dx$.Also I=$\int_0^{\frac{\pi}{2}} \log(\tan[\frac{\pi}{2} - x]dx$ $\therefore 2I = \int_0^{\frac{\pi}{2}} log1 = 0$	b
14.	On integrating $f(x) = \frac{x^2}{2} + \frac{1}{x} + C$,and $f(1) = \frac{1}{2} + 1 + C$, $C = -1$. $\therefore f(x) = \frac{x^2}{2} + \frac{1}{x} - 1$	a
15.	$\lim_{x\to 4^-} f(x) = \lim_{x\to 4^-} (-1 + a) = -1 + a$ $\lim_{x\to 4^+} f(x) = \lim_{x\to 4^+} (1 + b) = 1 + b$	b

	$f(x) = a + b$ $,\therefore a + b = a - 1 and\ a + b = 1 + b, \Rightarrow a = 1, b = -1$	
16.	$y' = \frac{\cos(logx)}{x}\ , y'' = \frac{-sin(logx) - \cos(logx)}{x^2},$ $\therefore x^2 y'' + xy' = -y$	b
17.	Minimum value is at (4,3)=24	d
18.	Minimum value is at (0,8)=-24	c
19.	Both A and R are true and R is the correct explanation of A. $i.e\ -1 \leq 2x - 1 \leq 1$ $0 \leq 2x \leq 2$ $0 \leq x \leq 1 \Rightarrow x\epsilon[0,1]$	a
20.	Both A and R are true and R is the correct explanation of A. i.e $\cos\theta = \left\| \frac{\sqrt{3} - 1 - \sqrt{3} - 1 + 8}{\sqrt{1+1+4}\ \sqrt{3 + 1 - 2\sqrt{3} + 3 + 1 + 2\sqrt{3} + 16}} \right\| = \frac{1}{2}$ $\theta = \frac{\pi}{3}$	a

SECTION B

This section comprises of VSA of 2 marks each

21.	$\tan^{-1}\left(\frac{-1}{\sqrt{3}}\right) + \tan^{-1}(-\sqrt{3}) + \tan^{-1}\left(\sin\left(\frac{-\pi}{2}\right)\right)$ $-\tan^{-1}\left(\frac{1}{\sqrt{3}}\right) - \tan^{-1}(\sqrt{3}) + \tan^{-1}(-1)$ $\frac{-\pi}{6} - \frac{\pi}{3} - \frac{\pi}{4} = \frac{-3\pi}{4}$	1 1
21.(or)	For one-one: Let $x_1, x_2 \in A$, $f(x_1) = f(x_2) \Rightarrow \frac{x_1 - 2}{x_1 - 3} = \frac{x_2 - 2}{x_2 - 3}$ $x_1x_2 - 3x_1 - 2x_2 + 6 = x_1x_2 - 3x_2 - 2x_1 + 6$ $x_1 = x_2$. Hence, function is one-one. For onto: Let for $y\epsilon B$,there exist $x \in A$such that $y = f(x) \Rightarrow y = \frac{x-2}{x-3} \Rightarrow xy - 3y = x - 2$ $x(y-1) = 3y - 2$ $x = \frac{3y-2}{y-1}\epsilon A$ Hence, function is onto. Therefore, f is 1-1 and onto.	1 1

22.	Given:$\frac{dA}{dt}=k$ $A=\pi r^2 \Rightarrow \frac{dA}{dt}=2\pi r\frac{dr}{dt} \Rightarrow \frac{k}{2\pi r}=\frac{dr}{dt}$ ....(1) Now, $P=2\pi r \Rightarrow \frac{dP}{dt}=2\pi\frac{dr}{dt} \Rightarrow \frac{dP}{dt}=2\pi\times\frac{k}{2\pi r}=\frac{dP}{dt}=\frac{k}{r}$ $\frac{dP}{dt}\propto\frac{1}{r}$	1 1
23.	$\frac{x+2}{3}=\frac{y+1}{2}=\frac{z-3}{2}=\lambda$, is the equation of the line General point, $(x=3\lambda-2; y=2\lambda-1\ ; z=2\lambda+3)$ The distance between the point on the line and given point P(1,3,3) is 5 units, then $\sqrt{(3\lambda-2-1)^2+(2\lambda-1-3)^2+(2\lambda+3-3)^2}=5$ On solving , $\lambda=0,2$ When $\lambda=0$, the point is (-2,-1,3); $\lambda=2$, the point is (4,3,7).	1 1
23. (or)	Let $\vec{r}=x\hat{\imath}+y\hat{\jmath}+z\hat{k}$, Given, $\vec{r}.\vec{a}=0 \Rightarrow (x\hat{\imath}+y\hat{\jmath}+z\hat{k}).(2\hat{\imath}+\hat{k})=0 \Rightarrow 2x+z=0 \ldots.(1)$ Given, $\vec{r}\times\vec{b}=\vec{c}\times\vec{b} \Rightarrow \begin{vmatrix} i & j & k \\ x & y & z \\ 1 & 1 & 1 \end{vmatrix}=\begin{vmatrix} i & j & k \\ 4 & -3 & 7 \\ 1 & 1 & 1 \end{vmatrix}$ $(y-z)i+(z-x)j+(x-y)k=-10i+3j+7k$ $y-z=-10;\ z-x=3;\ x-y=7$........(2) On solving (1) and (2) $x=-1\ , y=-8\ , z=2$, therefore; $\vec{r}=-\hat{\imath}-8\hat{\jmath}+2\hat{k}$	½ 1 ½
24.	$\log y=a\ \tan^{-1}x$ $\frac{1}{y}\frac{dy}{dx}=\frac{a}{1+x^2} \Rightarrow (1+x^2)\frac{dy}{dx}=ay$ Again differentiate, $(1+x^2)\frac{d^2y}{dx^2}+2x\frac{dy}{dx}=a\frac{dy}{dx} \Rightarrow (1+x^2)\frac{d^2y}{dx^2}+(2x-a)\frac{dy}{dx}=0$	1 1
25.	$\vec{a}-\vec{b}=(\hat{\imath}+2\hat{\jmath}+\hat{k})-(2\hat{\imath}+\hat{\jmath})=-\hat{\imath}+\hat{\jmath}+\hat{k}$ $\vec{c}-\vec{b}=(3\hat{\imath}-4\hat{\jmath}-5\hat{k})-(2\hat{\imath}+\hat{\jmath})=\hat{\imath}-5\hat{\jmath}-5\hat{k}$ Unit vector perpendicular to both $\vec{a}-\vec{b}$ and $\vec{c}-\vec{b}$ $\Rightarrow \frac{(\vec{a}-\vec{b})\times(\overrightarrow{\vec{c}-b})}{\lvert(\vec{a}-\vec{b})\times(\overrightarrow{\vec{c}-b})\rvert}$ $(\vec{a}-\vec{b})\times(\overrightarrow{\vec{c}-b})=\begin{vmatrix} i & j & k \\ -1 & 1 & 1 \\ 1 & -5 & -5 \end{vmatrix}$ $=\left((-5+5)\hat{\imath}-(5-1)\hat{\jmath}+(5-1)\hat{k}\right)$ =- $4j+4k$ $\lvert(\vec{a}-\vec{b})\times(\overrightarrow{\vec{c}-b})\rvert=\sqrt{16+16}=4\sqrt{2}$	½ ½ ½ ½

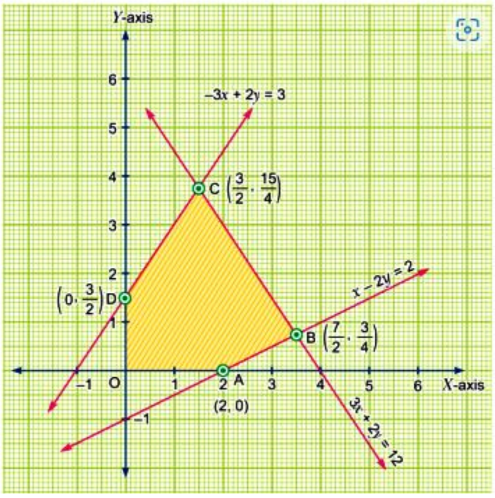
SECTION C (Short Answer Questions of 3 Marks each)

26.	$\int \frac{\cos(x+a)}{\sin(x+b)}dx = \int \frac{\cos\{(x+b)+(a-b)\}}{\sin(x+b)}dx$ $=\int \frac{\cos(x+b)\cos(a-b)-\sin(x+b)\sin(a-b)}{\sin(x+b)}dx$ $= \cos(a-b)\int \cot(x+b)\,dx - \sin(a-b)\int 1\,dx$ $= \cos(a-b)\,.\,log\lvert\sin(x+b)\rvert - \sin(a-b)\,x + c$	1 1 1
27.	Group of 50 people , 20 believe in non-violence X; Number of Persons who are non-violent X: 0,1,2 <table><tr><td>X</td><td>P(X)</td></tr><tr><td>0</td><td>$P(0) = \frac{30_{C_2} \times 20_{C_0}}{50_{C_2}} = \frac{30 \times 29}{50 \times 49}$ $P(0) = \frac{87}{245}$</td></tr><tr><td>1</td><td>$P(1) = \frac{30_{C_1} \times 20_{C_1}}{50_{C_2}}$ $= \frac{30 \times 20 \times 2}{50 \times 49}$ $P(1) = \frac{120}{245}$</td></tr><tr><td>2</td><td>$P(2) = \frac{30_{C_0} \times 20_{C_2}}{50_{C_2}} = \frac{20 \times 19}{50 \times 49}$ $P(2) = \frac{38}{245}$</td></tr></table>Mean =$\sum X.P(X) = 0 \times P(0) + 1 \times P(1) + 2P(2) = \frac{196}{245}$	½ 1 ½ 1
27.OR	X: Bolts produced by Machine X ;P(X)=1/6 Y: Bolts produced by Machine Y; P(Y)=2/6=1/3 Z: Bolts produced by Machine Z; P(X)=3/6=1/2 E: defective bolts produced i. P(E/Y) $= \frac{1.5}{100} = \frac{3}{200} = 0.015$ ii. P(defective by Z)= $P(Z) \times P(E/Z) = \frac{3000}{6000} \times \frac{2}{100} = 0.01$ iii. $P(E) = \frac{1}{6} \times \frac{1}{100} + \frac{1}{3} \times \frac{1.5}{100} + \frac{1}{2} \times \frac{2}{100} = \frac{1}{60}$	1 1 1
28.	$\int_1^4 (\lvert x-1\rvert + \lvert x-2\rvert + \lvert x-4\rvert)\,dx =$ $\int_1^4 (x-1)dx + \int_1^2 (2-x)\,dx + \int_2^4 (x-2)dx + \int_1^4 (4-x)dx$ $=\left[\frac{x^2}{2} - x\right]_1^4 + \left[2x - \frac{x^2}{2}\right]_1^2 + \left[\frac{x^2}{2} - 2x\right]_2^4 + \left[4x - \frac{x^2}{2}\right]_1^4 = \frac{23}{2}$	1 ½ 1 ½

28.(or)	$Let\ I = \int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} \frac{x\ sinx}{e^x+1} dx \ldots\ldots\ldots(i)$ $Also, I = \int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} \frac{\left(\frac{-\pi}{2}+\frac{\pi}{2}-x\right) sin\left(\frac{-\pi}{2}+\frac{\pi}{2}-x\right)}{e^{\left(\frac{-\pi}{2}+\frac{\pi}{2}-x\right)}+1} dx$ $I = \int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} \frac{-x\sin(-x)}{e^{-x}+1} dx,\ \ I = \int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} \frac{x\ sinx\ e^x}{e^x+1} dx \ldots\ldots\ldots(ii)$ Adding (i) and (ii),we obtain 2I=$\int_{\frac{-\pi}{2}}^{\frac{\pi}{2}}\left(\frac{x\ sinx}{e^x+1}+\frac{x\ sinx\ e^x}{e^x+1}\right)dx$ 2I=$\int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} x\ sinx\ dx$, $2I = [-x\ cosx]_{\frac{-\pi}{2}}^{\frac{\pi}{2}} + \int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} cosx\ dx$ $2I = [-x\ cosx]_{\frac{-\pi}{2}}^{\frac{\pi}{2}} + [sinx]_{\frac{-\pi}{2}}^{\frac{\pi}{2}}$ $2I = (0-0)+1-(-1),$ $\therefore 2I = 2\quad, I = 1$	 ½ ½ ½ 1 ½
Q29.	$(1+y^2)dx = (tan^{-1}y - x)dy,\quad y(0)=0$ $\Rightarrow \frac{dx}{dy} = \frac{tan^{-1}y-x}{1+y^2}$, $\Rightarrow \frac{dx}{dy}+\frac{x}{1+y^2} = \frac{tan^{-1}y}{1+y^2} \ldots\ldots(i)$,This is a linear differential equation with P=$\frac{1}{1+y^2}$ and Q=$\frac{tan^{-1}y}{1+y^2}$, $\therefore I.F = e^{\int\frac{1}{1+y^2}dy} = e^{tan^{-1}y}$ G.S $xe^{tan^{-1}y} = \int \frac{tan^{-1}y}{1+y^2} e^{tan^{-1}y} dy + C$ ⇒x$e^{tan^{-1}y} = \int te^t dt + C, where\ t = tan^{-1}y,$ ⇒x$e^{tan^{-1}y} = e^{tan^{-1}y}(tan^{-1}y-1)+C$............(ii) It is given that $y=0$ when x = 0 .From (ii),we get 0 = $e^0(0-1)+C$ ⇒C= 1 From (ii) we get x$e^{tan^{-1}y} = e^{tan^{-1}y}(tan^{-1}y-1)+1$ $\Rightarrow (x - tan^{-1}y + 1)e^{tan^{-1}y} = 1$, which is the required solution.	1 1 1
29.(or)	The given differential equation is $(x^2+xy)dy = (x^2+y^2)dx$ $\Rightarrow \frac{dy}{dx} = \frac{x^2+y^2}{x^2+xy} \ldots(i)$ Putting y = xv and $\frac{dy}{dx} = v + x\frac{dv}{dx}\ in\ (i),$ $we\ get\ v + x\frac{dv}{dx} = \frac{x^2+v^2x^2}{x^2+vx^2}, \Rightarrow v + x\frac{dv}{dx} = \frac{1+v^2}{1+v}$ $\Rightarrow x\frac{dv}{dx} = \frac{1+v^2-v-v^2}{1+v}$ $\Rightarrow x\frac{dv}{dx} = \frac{1-v}{1+v} \Rightarrow x(1+v)dv = (1-v)dx$ $\Rightarrow \frac{1+v}{1-v}dv = \frac{dx}{x} \Rightarrow \frac{2-(1-v)}{1-v}dv = \frac{dx}{x}$ .Integrating both sides we get $\int\left(\frac{2}{1-v}-1\right)dv = \int\frac{dx}{x} \Rightarrow \int\frac{2}{1-v}dv - \int 1.dv = \int\frac{dx}{x}$ $\Rightarrow -2log\|1-v\| - v = log\|x\| + logC$	 1 1

$\Rightarrow log|x| + logC + 2log|1-v| = -v$
$\Rightarrow \log\{C|x|(1-v)^2\} = -v \Rightarrow C|x|(1-v)^2 = e^{-v}$
$\Rightarrow C|x|\left(1-\frac{y}{x}\right)^2 = e^{-\frac{y}{x}}$
$\Rightarrow C(x-y)^2 = |x|e^{\frac{-y}{x}}$ ....(ii) ,It is given that when y=0, x=1,∴ — 1
$from\ (ii)$ we get
$C(1-0)^2 = e^0 \Rightarrow C = 1,$
$\therefore The\ particular\ solution\ is\ (x-y)^2 = |x|e^{\frac{-y}{x}}.$

30. Maximize and Minimize Z=5x+2y
Subject to constraints; $x - 2y \leq 2; 3x + 2y \leq 12; -3x + 2y \leq 3; x \geq 0; y \geq 0$



— 2

Corner Point	Z = 5x + 2y	
O (0, 0)	0	→ Minimum
A (2, 0)	10	
$B\left(\frac{7}{2}, \frac{3}{4}\right)$	19	→ Maximum
$C\left(\frac{3}{2}, \frac{15}{4}\right)$	15	
$D\left(0, \frac{3}{2}\right)$	3	

— 2

Hence, Z is minimum at x = 0, y = 0 and minimum value = 0

Z is maximum at x = $\frac{7}{2}$, y = $\frac{3}{4}$ and maximum value = 19 — 1

31. Let I = $\int \frac{\sqrt{x}}{\sqrt{x}-\sqrt[3]{x}} dx, \quad \therefore I = \int \frac{x^{\frac{1}{2}}}{x^{\frac{1}{2}}-x^{\frac{1}{3}}} dx, put\ x = t^6 and\ dx = 6t^5$dt, we get — ½

I=$\int \frac{t^3}{t^3-t^2} . 6t^5 dt = 6\int \frac{t^6}{t-1} dt = 6\int \frac{t^6-1+1}{t-1} dt = 6\int \frac{t^6-1^6}{t-1} + \frac{1}{t-1}\ dt$ — ½

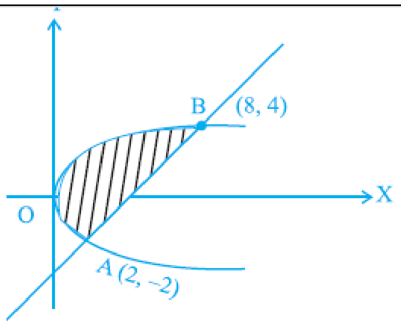
$I = 6\int t^5 + t^4 + t^3 + t^2 + t + 1 + \frac{1}{t-1}\ dt$ — ½

$I = 6\left\{\frac{t^6}{6} + \frac{t^5}{5} + \frac{t^4}{4} + \frac{t^3}{3} + \frac{t^2}{2} + t + log(t-1)\right\} + C$ — ½

I=$6\left\{\frac{x}{6} + \frac{x^{\frac{5}{6}}}{5} + \frac{x^{\frac{2}{3}}}{3} + \frac{x^{\frac{1}{2}}}{3} + \frac{x^{\frac{1}{3}}}{2} + x^{\frac{1}{6}} + log\left(x^{\frac{1}{6}} - 1\right)\right\} + C$ — 1

SECTION D

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

32.	 The intersecting points of the given curves are obtained by solving the equations x − y = 4 and $y^2 = 2x$ for x and y. We have $y^2 = 8 + 2y$ i.e., (y − 4) (y + 2) = 0 which gives y = 4, −2 and x = 8, 2. Thus, the points of intersection are (8, 4), (2, −2). Hence $\text{Area} = \int_{-2}^{4}\left(4 + y - \frac{1}{2}y^2\right)dy$ $= \left[4y + \frac{y^2}{2} - \frac{1}{6}y^3\right]_{-2}^{4} = 18$ sq units.	1 1 2 ½ ½
33.	Reflexive: Let $(a, b) \in N \times N$, then $a + b = b + a$ $\Longrightarrow (a, b)R(b, a)$ $\Longrightarrow\ R\ is\ reflexive$……………………….(1) Symmetric: Let $(a, b), (c, d) \in N \times N\ and\ (a, b)R(c, d)$ $a + d = b + c$ $b + c = a + d$ $c + b = d + a$ $(c, d)R(a, b)$ $\Longrightarrow R\ is\ symmetric$……………………..(2) Transitive: Let $(a, b), (c, d), (e, f) \in N \times N\ and\ Let\ \ (a, b)R(c, d), (c, d)R(e, f)$ $\Longrightarrow a + d = b + c\ ;\ c + f = d + e$ $a + d + c + f = b + c + d + e$ $a + f = b + e$ $(a, b)R(e, f)$ $\Longrightarrow R\ is\ transistive$……………………..(3) From (1),(2) and (3)	1 1 ½ 1 ½ ½ ½

	R is an equivalence Relation.	
33. (or)	Relation S is defined as S= $\{(a,b)\epsilon\ R\times R : 1+\ ab>0$ **Reflexive**: Let $a\in R$ $1+a.a>0$ $\Rightarrow 1+a^2>0, true\ for\ a\in R$ $\Rightarrow (a,a) is\ Reflexive.$ **Symmetric:** Let $a,b\ \epsilon\ R\ and\ (a,b)\in S$ $\Rightarrow 1+ab$ >0 $1+ba>0$ $\Rightarrow (b,a)\in S$ $\Rightarrow R\ is\ symmetric$ **Transitive**: Let $a,b,c\in R$ and $(a,b),(b,c)\in S$ $\Rightarrow 1+ab>0\ and\ 1+bc>0\ but\ this\ may\ not\ imply\ 1+ac>0.$ $i.e\ (a,c)\in S.$ For example, Let $a\ =1, b=\frac{1}{2}, c=-\frac{3}{2} then\ (a,b)\in S\ i.e(1,\frac{1}{2})\in S$ $\Rightarrow 1+1\times\frac{1}{2}>0$, true Now, $(b,c)\in S\ \ i.e\ \left(\frac{1}{2},-\frac{3}{2}\right)\in S$ $\Rightarrow 1+\frac{1}{2}\times-\frac{3}{2}>0\Rightarrow 1-\frac{3}{4}>0\Rightarrow\frac{1}{4}>0, true$ Now $for\ (a,c)\in S$ i.e $(1,-\frac{3}{2})\in S$ $\Rightarrow 1+1\times-\frac{3}{2}>0\Rightarrow-\frac{1}{2}$ $\Rightarrow-\frac{1}{2}\ngtr 0, hence\ false$ $\therefore (a,b)\epsilon\ S,(b,c)\epsilon\ S\ but\ (a,c)\notin S.$ $\Rightarrow S$ is not transitive Therefore, S is reflexive, symmetric and but not transitive. $\Rightarrow therefore, S\ is\ not\ an\ \ equivalence\ Relation.$	 1 1 1 ½ ½ ½ ½
34.	$L_1:\vec{r}=3\hat{\imath}+2\hat{\jmath}-4\hat{k}+\lambda(\hat{\imath}+2\hat{\jmath}+2\hat{k})$ $L_1:\vec{r}=5\hat{\imath}-2\hat{\jmath}+\mu(3\hat{\imath}+2\hat{\jmath}+6\hat{k})$ Any point on L_1, $P(3+\lambda,2+2\lambda,-4+2\lambda)$ Any point on L_2, $Q(5+3\mu,-2+2\mu,6\mu)$ If the $L_1 and\ L_2$ intersect then, they must have a common point on them, i.e. P and Q must coincide for some values of $\lambda\ and\ \mu$ now, $3+\lambda=5+3\mu$…………(1) similarly, $2+2\lambda=-2+2\mu$……..(2) Also,-4+2$\lambda=6\mu$ solving 1 and 2, we get $\lambda=-4$, $\mu=-2$ substitute the values in 3, $-4+2(-4)=6(-2)$ $-12=-12$ LHS=RHS Therefore the point of intersection(-1,-6,-12)	 1 ½ 1 1 1 ½

34.(or)	Shortest distance between lines with vector equations $\vec{r} = \vec{a_1} + \lambda\, \vec{b_1}$ and $\vec{r} = \vec{a_2} + \mu \vec{b_2}$ is $\left\| \frac{(\vec{b_1} \times \vec{b_2}).(\vec{a_2} - \vec{a_1})}{\|\vec{b_1} \times \vec{b_2}\|} \right\|$ $\vec{r} = (1 - t)\,\hat{\imath} + (t - 2)\hat{\jmath} + (3 - 2t)\,\hat{k}$ | $\vec{r} = (s+1)\,\hat{\imath} + (2s-1)\hat{\jmath} - (2s+1)\,\hat{k}$ $= 1\hat{\imath} - t\hat{\imath} + t\hat{\jmath} - 2\hat{\jmath} + 3\hat{k} - 2t\hat{k}$ | $= s\hat{\imath} + 1\hat{\imath} + 2s\hat{\jmath} - 1\hat{\jmath} - 2s\hat{k} - 1\hat{k}$ $= (1\hat{\imath} - 2\hat{\jmath} + 3\hat{k}) + t(-1\hat{\imath} + 1\hat{\jmath} - 2\hat{k})$ | $= (1\hat{\imath} - 1\hat{\jmath} - 1\hat{k}) + s(1\hat{\imath} + 2\hat{\jmath} - 2\hat{k})$ Comparing with $\vec{r} = \vec{a_1} + t\,\vec{b_1}$, | Comparing with $\vec{r} = \vec{a_2} + s\,\vec{b_2}$, $\vec{a_1} = 1\hat{\imath} - 2\hat{\jmath} + 3\hat{k}$ | $\vec{a_2} = 1\hat{\imath} - 1\hat{\jmath} - 1\hat{k}$ & $\vec{b_1} = -1\hat{\imath} + 1\hat{\jmath} - 2\hat{k}$ | & $\vec{b_2} = 1\hat{\imath} + 2\hat{\jmath} - 2\hat{k}$ Now, $(\vec{a_2} - \vec{a_1}) = (1\hat{\imath} - 1\hat{\jmath} - 1\hat{k}) - (1\hat{\imath} - 2j + 3\hat{k})$ $= (1-1)\,\hat{\imath} + (-1+2)\hat{\jmath} + (-1-3)\hat{k}$ $= \mathbf{0\hat{\imath} + 1\hat{\jmath} - 4\hat{k}}$ $(\vec{b_1} \times \vec{b_2}) = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ -1 & 1 & -2 \\ 1 & 2 & -2 \end{vmatrix}$ $= \hat{\imath}[(1 \times -2) - (2 \times -2)] - \hat{\jmath}[(-1 \times -2) - (1 \times -2)] + \hat{k}[(-1 \times 2) - (1 \times 1)]$ $= \hat{\imath}[-2+4] - \hat{\jmath}[2+2]$ A $+ \hat{k}[-2-1]$ $= \mathbf{2\hat{\imath} - 4\hat{\jmath} - 3\hat{k}}$ Magnitude of $(\vec{b_1} \times \vec{b_2}) = \sqrt{2^2 + (-4)^2 + (-3)^2}$ $\|\vec{b_1} \times \vec{b_2}\| = \sqrt{4 + 16 + 9} = \sqrt{\mathbf{29}}$ $d = \frac{8}{\sqrt{29}}\ units.$	1 1 ½ 1 1 ½
35.	$\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix} \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$ $= \begin{bmatrix} -4+4+8 & 4-8+4 & -4-8+12 \\ -7+1+6 & 7-2+3 & -7-2+9 \\ 5-3-2 & -5+6-1 & 5+6-3 \end{bmatrix}$ $= \begin{bmatrix} 8 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 8 \end{bmatrix} = 8I$ $If\ A = \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$ $A^{-1} = \begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}, X = A^{-1}B = \begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix} \begin{bmatrix} 4 \\ 9 \\ 1 \end{bmatrix}$ $X = \frac{1}{8} \begin{bmatrix} -16+36+4 \\ -28+9+3 \\ 20-27-1 \end{bmatrix} = \frac{1}{8} \begin{bmatrix} 24 \\ -16 \\ -8 \end{bmatrix} = \begin{bmatrix} 3 \\ -2 \\ -1 \end{bmatrix} \Rightarrow x = 3, y = -2, z = -1$	1 ½ 1½ 1 1

Section E : (Case studies/Passage based questions of 4 marks each)

36.	1. $y = 4x - \frac{1}{2}x^2$ $\frac{dy}{dx} = 4 - x$ When $\frac{dy}{dx} = 0 \Rightarrow 4 - x = 0 \Rightarrow x = 4$ 2. $x = 2\ cm,$ $y = 4x - \frac{1}{2}x^2 \Rightarrow y = 4 \times 2 - \frac{1}{2}2^2 = 6cm$ Height of the plant will be 6 cm 3. $f''(x) = -1 < 0 \Rightarrow f(x) attains\ maximum\ at\ x = 4,$ $f(4) = 4 \times 4 - \frac{1}{2}4^2 = 8cm$ Local minimum value : not defined Local maximum value $f(4) = 8cm$ now, In [0,5] $f(0) = 0cm$ $f(4) = 8cm$ $f(5) = 4 \times 5 - \frac{1}{2}5^2 = 20 - 12.5 = 7.5cm$ Therefore, Absolute Maxima is x=4 and Absolute Maximum value is 8cm Absolute minima is x=0 and Absolute Minimum value is 0cm. 3. Or Interval | Sign of f'(x) | Nature of the function $(-\infty, 4)$ | > 0 | $f(x) strictly\ increasing$ $(4, \infty)$ | > 0 | $f(x) strictly\ increasing$	1 1 1 1 2
37.	1. $P(x) = -5x^2 + 125x + 37500$ $P'(x) = -10x + 125, when\ P'(x) = 0, x = 12.5$ $P''(x) = -10 < 0$ Therefore, $at\ x = 12.5\ the\ profit\ is\ maximum$ 2. Maximum profit= $-5(12.5)^2 + 125 \times 12.5 + 37500 =$ ₹ 38281.25 3. $P(x) = 38250;\ -5x^2 + 125x + 37500 = 38250$ $x^2 - 25x + 150 = 0$ $x = 10, x = 15$ 3. or When $x = 2, P(2) = -5 \times 2^2 + 125(2) + 37500 =$ ₹37750	1 1 1 1 or 2
38.	Probability A will hit= $\frac{4}{5}$ Probability B will hit = $\frac{3}{4}$ Probability C will hit = $\frac{2}{3}$ i.. P(any two will hit)=P(A will not hit)*P(B will hit)*P(C will hit)+ P(A will	1

	hit)*P(B will not hit)*P(C will hit)+ P(A will hit)*P(B will hit)*P(C will not hit) $=\left(1-\frac{4}{5}\right)\times\frac{3}{4}\times\frac{2}{3} + \frac{4}{5}\times\left(1-\frac{3}{4}\right)\times\frac{2}{3}+ \frac{4}{5}\times\frac{3}{4}\times(1-\frac{2}{3})$ $=\frac{1}{10}+\frac{2}{15}+\frac{1}{5}=\frac{13}{30}$	1
	ii.. P(at least one will hit)=P(exactly one will hit)+P(exactly two will hit)+P(all will hit) $\text{P(exactly one will hit)} =$ P(A will hit)*P(B will not hit)*P(C will not hit)+ P(A will not hit)*P(B will hit)*P(C will not hit)+ P(A will not hit)*P(B will not hit)*P(C will hit)	1
	$=\frac{4}{5}\times\left(1-\frac{3}{4}\right)\times\left(1-\frac{2}{3}\right)+\left(1-\frac{4}{5}\right)\times\frac{3}{4}\times\left(1-\frac{2}{3}\right)+\left(1-\frac{4}{5}\right) \times\left(1-\frac{3}{4}\right)\times\frac{2}{3}$ $=\frac{1}{15}+\frac{1}{20}+\frac{1}{30}=\frac{9}{60}$ ....(1) P(exactly two will hit)= $\frac{13}{30}$...........(2) P(all will hit)= $\frac{2}{5}$.............(3) Therefore , P(at least one will hit)= $\frac{9}{60}+\frac{13}{30}+\frac{2}{5}=\frac{59}{60}$	1