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Class: XII Session: 2020-21

Subject: Mathematics

Marking Scheme (Theory)

Sr.No.	Objective type Question Section I	Marks
1	Let $f(x_1) = f(x_2)$ for $some\ x_1, x_2 \in R$ $\Rightarrow (x_1)^3 = (x_2)^3$ $\Rightarrow x_1 = x_2$, Hence $f(x)$ is one − one **OR** 2^6 reflexive relations	1 1
2	(1,2)	1
3	Since $\sqrt{a}$ is not defined for $a \in (-\infty, 0)$ $\therefore \sqrt{a} = b\ is\ not\ a\ function.$ **OR** $A_1 \cup A_2 \cup A_3 = A\ and\ A_1 \cap A_2 \cap A_3 = \phi$	1 1
4	3x5	1
5	$A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \Rightarrow A^2 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ OR $\lvert adj\ A\rvert = (-4)^{3-1} = 16$	1
6	0	1
7	$e^x(1 - \cot x)$ + C **OR** $\because f(x)$ is an odd function $\therefore \int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} x^2 \sin x\ dx = 0$	1 1
8	$A = 2\int_0^1 x^2\,dx = \frac{2}{3}[x^3]_0^1$ $= \frac{2}{3} sq\ unit$	1

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9	0 **OR** 3	1 1
10	$\hat{j}$	1
11	$\frac{1}{2}\lvert 2\hat{\imath}\times(-3\hat{j})\rvert = \frac{1}{2}\,\lvert -6\hat{k}\rvert = 3\ sq\ units$	1
12	$\lvert\hat{a}+\hat{b}\rvert^2 = 1$ $\Rightarrow\ \hat{a}^2+\hat{b}^2+2\,\hat{a}.\hat{b} = 1$ $\Rightarrow\ 2\,\hat{a}.\hat{b} = 1-1-1$ $\Rightarrow\ \hat{a}.\hat{b} = \frac{-1}{2} \Rightarrow \lvert\hat{a}\rvert\lvert\hat{b}\rvert\cos\theta = \frac{-1}{2} \Rightarrow \theta = \pi - \frac{\pi}{3}$ $\Rightarrow\ \theta = \frac{2\pi}{3}$	1
13	1,0,0	1
14	(0,0,0)	1
15	$1-\frac{2}{3}\times\frac{3}{4}=\frac{1}{2}$	1
16	$\left(\frac{1}{2}\right)^4\left(\frac{1}{2}\right)^3=\left(\frac{1}{2}\right)^7$	1
	Section II	
17(i)	(b)	1
17(ii)	(a)	1
17(iii)	(c)	1
17(iv)	(a)	1
17(v)	(d)	1
18(i)	(b)	1
18(ii)	(c)	1
18(iii)	(b)	1
18(iv)	(d)	1
18(v)	(d)	1
	Section III	
19	$tan^{-1}\left(\frac{cosx}{1-sinx}\right) = tan^{-1}\left[\frac{\sin\left(\frac{\pi}{2}-x\right)}{1-\cos\left(\frac{\pi}{2}-x\right)}\right]$ $tan^{-1}\left[\frac{2\sin\left(\frac{\pi}{4}-\frac{x}{2}\right)\cos\left(\frac{\pi}{4}-\frac{x}{2}\right)}{2\ sin^2\left(\frac{\pi}{4}-\frac{x}{2}\right)}\right]$	$\frac{1}{2}$

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	$tan^{-1}\left[cot\left(\frac{\pi}{4}-\frac{x}{2}\right)\right] = tan^{-1}\left[\tan\frac{\pi}{2}-\left(\frac{\pi}{4}-\frac{x}{2}\right)\right]$ $tan^{-1}\left[tan\left(\frac{\pi}{4}+\frac{x}{2}\right)\right] = \frac{\pi}{4}+\frac{x}{2}$	1 $\frac{1}{2}$
20	$A^2 = 2A$ $\Rightarrow \|AA\| = \|2A\|$ $\Rightarrow \|A\|\|A\| = 8\|A\| \quad (\because \|AB\| = \|A\|\,\|B\| \text{ and } \|2A\| = 2^3\|A\|)$ $\Rightarrow \|A\|\,(\|A\|-8) = 0$ $\Rightarrow \|A\| = 0 \text{ or } 8$ **OR** $A^2 = \begin{bmatrix}3 & 1\\-1 & 2\end{bmatrix}\begin{bmatrix}3 & 1\\-1 & 2\end{bmatrix} = \begin{bmatrix}8 & 5\\-5 & 3\end{bmatrix}$ $5A = \begin{bmatrix}15 & 5\\-5 & 10\end{bmatrix}, 7I = \begin{bmatrix}7 & 0\\0 & 7\end{bmatrix}$ $\Rightarrow A^2-5A+7I = \begin{bmatrix}0 & 0\\0 & 0\end{bmatrix} = O$ $\Rightarrow A^{-1}(A^2-5A+7I) = A^{-1}O$ $\Rightarrow A-5I+7A^{-1} = O$ $\Rightarrow 7A^{-1} = 5I-A$ $\Rightarrow A^{-1} = \frac{1}{7}\left(\begin{bmatrix}5 & 0\\0 & 5\end{bmatrix}-\begin{bmatrix}3 & 1\\-1 & 2\end{bmatrix}\right)$ $\Rightarrow A^{-1} = \frac{1}{7}\begin{bmatrix}2 & -1\\1 & 3\end{bmatrix}$	$\frac{1}{2}$ 1 $\frac{1}{2}$ 1 1
21	$\lim_{x\to 0}\frac{1-\cos kx}{x\sin x} = \lim_{x\to 0}\frac{2\,sin^2\left(\frac{kx}{2}\right)}{x\sin x}$ $= \lim_{x\to 0}\frac{\frac{2\,sin^2\left(\frac{kx}{2}\right)}{x^2}}{\frac{x\sin x}{x^2}}$ $= \frac{\lim_{x\to 0}\frac{2\,sin^2\left(\frac{kx}{2}\right)}{\left(\frac{kx}{2}\right)^2}\times\left(\frac{k}{2}\right)^2}{\lim_{x\to 0}\frac{\sin x}{x}} = \frac{2\times 1\times\frac{k^2}{4}}{1}$	$1\frac{1}{2}$

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	$\because f(x)$ *is continuous at* $x = 0$ $\therefore \lim_{x \to 0} f(x) = f(0)$ $\Rightarrow \frac{k^2}{2} = \frac{1}{2} \Rightarrow k^2 = 1 \Rightarrow k = \pm 1$	$\frac{1}{2}$
22	$y = x + \frac{1}{x} \Rightarrow \frac{dy}{dx} = 1 - \frac{1}{x^2}$ $\because$ *normal is perpendicular to* $3x - 4y = 7$, $\therefore$ tangent is parallel to it $1 - \frac{1}{x^2} = \frac{3}{4} \Rightarrow x^2 = 4 \quad \Rightarrow x = 2 \ (\because x > 0)$ *when* $x = 2$, $y = 2 + \frac{1}{2} = \frac{5}{2}$ $\therefore$ *Equation of Normal* : $y - \frac{5}{2} = -\frac{4}{3}(x - 2) \Rightarrow \quad 8x + 6y = 31$	1 1
23	$I = \int \frac{1}{cos^2x\,(1 - \tan x)^2} dx$ Put, $1 - \tan x = y$ So that, $-sec^2x\,dx = dy$ $= \int \frac{-1\,dy}{y^2} = -\int y^{-2} dy$ $= +\frac{1}{y} + c = \frac{1}{1 - \tan x} + c$ **OR** $I = \int_0^1 x\,(1 - x)^n dx$ $I = \int_0^1 (1 - x)[1 - (1 - x)]^n dx$ $I = \int_0^1 (1 - x)\,x^n\,dx = \int_0^1 (x^n - x^{n+1}) dx$ $I = \left[\frac{x^{n+1}}{n+1} - \frac{x^{n+2}}{n+2}\right]_0^1$ $I = \left[\left(\frac{1}{n+1} - \frac{1}{n+2}\right) - 0\right] = \frac{1}{(n+1)\,(n+2)}$	1 1 $\frac{1}{2}$ 1 $\frac{1}{2}$
24	$Area = 2\int_0^2 \sqrt{8x}\,dx$ $= 2 \times 2\sqrt{2} \int_0^2 x^{\frac{1}{2}} dx$	1

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	$= 4\sqrt{2}\left[\frac{2}{3}x^{\frac{3}{2}}\right]_0^2$ $= \frac{8}{3}\sqrt{2}\left[2^{\frac{3}{2}} - 0\right] = \frac{8\sqrt{2}}{3} \times 2\sqrt{2}$ $= \frac{32}{3}\ sq\ units$	$\frac{1}{2}$ $\frac{1}{2}$
25	$\frac{dy}{dx} = x^3 cosec\ y \quad ; \quad y(0) = 0$ $\int \frac{dy}{cosec\ y} = \int x^3 dx$ $\int \sin y\ dy = \int x^3 dx$ $-\cos y = \frac{x^4}{4} + c$ $-1 = c \quad (\because y = 0, when\ x = 0)$ $\cos y = 1 - \frac{x^4}{4}$	$\frac{1}{2}$ 1 $\frac{1}{2}$
26	Let $\vec{a} = \hat{\imath} - \hat{\jmath} + \hat{k}$ $\vec{d} = 4\,\hat{\imath} + 5\hat{k}$ $\because \vec{a} + \vec{b} = \vec{d} \therefore \vec{b} = \vec{d} - \vec{a} \qquad = 3\,\hat{\imath} + \hat{\jmath} + 4\,\hat{k}$ $\vec{a} \times \vec{b} = \begin{vmatrix} \hat{\imath} - & \hat{\jmath} + & \hat{k} \\ 1 & -1 & 1 \\ 3 & 1 & 4 \end{vmatrix} = -5\hat{\imath} - 1\hat{\jmath} + 4\,\hat{k}$ Area of parallelogram = $\lvert\vec{a} \times \vec{b}\rvert = \sqrt{25+1+16} = \sqrt{42}\ sq\ units$	$\frac{1}{2}$ 1 $\frac{1}{2}$
27	Let the normal vector to the plane be $\vec{n}$ Equation of the plane passing through (1,0,0), i.e., $\hat{\imath}$ is $(\vec{r} - \hat{\imath}) \cdot \vec{n} = 0$ ....(1) $\because$plane (1) contains the line $\vec{r} = \vec{o} + \lambda\,\hat{\jmath}$ $\therefore \hat{\imath} \cdot \vec{n} = 0$ and $\hat{\jmath} \cdot \vec{n} = 0 \quad \Rightarrow \vec{n} = \hat{k}$ Hence equation of the plane is $(\vec{r} - \hat{\imath}) \cdot \hat{k} = 0$ i.e., $\vec{r} \cdot \hat{k} = 0$	1 1
28	Let x denote the number of milk chocolates drawn <table><tr><td>X</td><td>P(x)</td></tr></table>	

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	<table><tr><td>0</td><td>$\frac{4}{6}\times\frac{3}{5}=\frac{12}{30}$</td></tr><tr><td>1</td><td>$\left(\frac{2}{6}\times\frac{4}{5}\right)\times 2=\frac{16}{30}$</td></tr><tr><td>2</td><td>$\frac{2}{6}$ x $\frac{1}{5}=\frac{2}{30}$</td></tr></table>	$1\frac{1}{2}$
	Most likely outcome is getting one chocolate of each type	$\frac{1}{2}$
	OR	
	P $(\bar{E} \mid \bar{F})$ = P $\frac{(\bar{E} \cap \bar{F})}{P(\bar{F})}$ = $\frac{(\overline{E \cup F})}{P(\bar{F})}=\frac{1-P(E \cup F)}{1-P(F)}$-----------(1)	1
	Now $P(E \cup F)$ = P (E) + P (F) - P (E ∩ F)	
	= 0.8+0.7-0.6=0.9	$\frac{1}{2}$
	Substituting value of $P(E \cup F)$ in (1)	
	P $(\bar{E} \mid \bar{F})$ = $\frac{1-0.9}{1-0.7}=\frac{0.1}{0.3}=\frac{1}{3}$	$\frac{1}{2}$
	Section IV	
29	(i) Reflexive : Since, a+a=2a which is even ∴ (a,a) ∈ R $\forall a$ ∈ Z Hence R is reflexive	$\frac{1}{2}$
	(ii) Symmetric: If (a,b) ∈R, then a+b = 2λ ⇒ b+a = 2 λ ⇒ (b,a) ∈R, Hence R is symmetric	1
	(iii) Transitive: If (a,b) ∈R and (b,c,) ∈R then a+b = 2 λ---(1) and b+c =2 μ ---- (2) Adding (1) and (2) we get a+2b+c=2(λ + μ) ⇒ a+c=2 (λ + $\mu - b$) ⇒ a+c=2k ,where $\lambda+\mu-b=k$ ⇒ (a,c) ∈R Hence R is transitive	1
	[0] = {...-4, -2, 0, 2, 4...}	$\frac{1}{2}$
30	Let u = $e^{x\sin^2 x}$and v = $(\sin x)^x$	$\frac{1}{2}$

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	so that y = u + v $\Rightarrow \frac{dy}{dx} = \frac{du}{dx} + \frac{dv}{dx}$----(1) Now, u = $e^{x\,sin^2 x}$, Differentiating both sides w.r.t. x, we get $\Rightarrow \frac{du}{dx} = e^{x\,sin^2 x}\,[x(sin2x) + sin^2 x]$ ----- (2) Also , v = $(\sin x)^x$ $\Rightarrow$ log v = x log $(\sin x)$ Differentiating both sides w.r.t. x, we get $\frac{1}{v}\frac{dv}{dx} = x \cot x + \log\ (sinx)$ $\frac{dv}{dx} = (\sin x)^x\ \ [x\,cotx + \log(sinx)]$ ------ (3) Substituting from $-(2), -(3)$ in $-(1)$ we get $\frac{dy}{dx} = e^{x\,sin^2 x}\,[xsin2x + sin^2 x] + (\sin x)^x\ \ [x\,cotx + \log(sinx)]$	1 1 $\frac{1}{2}$
31	RHD = $\underset{h\to 0}{Lt}\frac{f(1+h)-f(1)}{h} = \underset{h\to 0}{Lt}\frac{[1+h]-[1]}{h}$ $= \underset{h\to 0}{Lt}\frac{(1-1)}{h} = 0$ LHD = $\underset{h\to 0}{Lt}\frac{f(1-h)-f(1)}{-h} = \underset{h\to 0}{Lt}\frac{[1-h]-[1]}{-h} = \underset{h\to 0}{Lt}\frac{0-1}{-h}$ $= \underset{h\to 0}{Lt}\frac{1}{h} = \infty$ Since, RHD ≠LHD Therefore f(x) is not differentiable at x = 1 **OR** $y = b\tan\theta \Rightarrow \frac{dy}{d\theta} = b\,sec^2\theta \ldots (1)$ $x = a\sec\theta \Rightarrow \frac{dx}{d\theta} = a\sec\theta\tan\theta \ldots (2)$	1 1 1

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	$\frac{dy}{dx} = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}} = \frac{b\ sec^2\theta}{a \sec\theta \tan\theta} = \frac{b}{a} cosec\ \theta$	$1\frac{1}{2}$
	Differentiating both sides w.r.t. x, we get	
	$\frac{d^2y}{dx^2} = \frac{-b}{a} cosec\ \theta \cot\theta \times \frac{d\theta}{dx}$	
	$= \frac{-b}{a} cosec\ \theta \cot\theta \times \frac{1}{a \sec\theta \tan\theta}$ [using (2)]	
	$= \frac{-b}{a.a} cot^3\theta$	1
	$\left.\frac{d^2y}{dx^2}\right]_{\theta=\frac{\pi}{6}} = \frac{-b}{a}\left[\cot\frac{\pi}{6}\right]^3 = \frac{-b}{a}\left(\sqrt{3}\right)^3 = -\frac{3\sqrt{3}b}{a.a}$	$\frac{1}{2}$
32	$f\ (x) = \tan x - 4x$	
	$f'(x) = sec^2x - 4$	$\frac{1}{2}$
	a) For $f\ (x)$ to be strictly increasing	
	$f'(x) > 0$	
	$\Rightarrow\quad sec^2\ x - 4\ > 0$	
	$\Rightarrow\quad sec^2\ x\ > 4$	
	$\Rightarrow\quad cos^2\ x\ < \frac{1}{4} \Rightarrow cos^2\ x\ < \left(\frac{1}{2}\right)^2$	
	$\Rightarrow\quad -\frac{1}{2} < \cos x\ < \frac{1}{2} \Rightarrow \frac{\pi}{3} < x\ < \frac{\pi}{2}$	$1\frac{1}{2}$
	b) For $f\ (x)$ to be strictly decreasing	
	$f'(x) < 0$	
	$\Rightarrow\quad sec^2\ x - 4\ < 0$	
	$\Rightarrow\quad sec^2\ x\ < 4$	
	$\Rightarrow\quad cos^2\ x\ > \frac{1}{4}$	
	$\Rightarrow\quad cos^2\ x\ > \left(\frac{1}{2}\right)^2$	
	$\Rightarrow\quad \cos x\ > \frac{1}{2}\ \left[\because x \in \left(0, \frac{\pi}{2}\right)\right]$	
	$\Rightarrow\quad 0\ < x\ < \frac{\pi}{3}$	
		1

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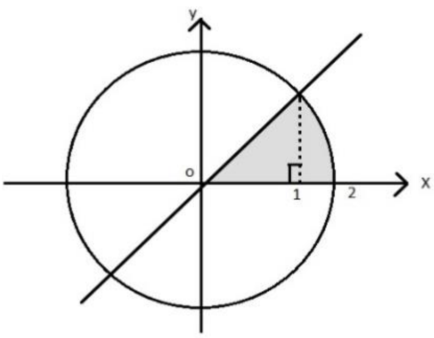
33	Put $x^2 = y \; to \; make \; partial \; fractions$ $\frac{x^2+1}{(x^2+2)(x^2+3)} = \frac{y+1}{(y+2)(y+3)} = \frac{A}{y+2} + \frac{B}{y+3}$ $\Rightarrow \quad y+1 = A(y+3) + B\,(y+2)$……………(1) Comparing coefficients of y and constant terms on both sides of (1) we get A+B = 1 and 3A + 2B = 1 Solving, we get A = −1, B = 2 $\int \frac{x^2+1}{(x^2+2)(x^2+3)} dx = \int \frac{-1}{x^2+2} dx + 2\int \frac{1}{x^2+3} dx$ $= -\frac{1}{\sqrt{2}} tan^{-1}\left(\frac{x}{\sqrt{2}}\right) + \frac{2}{\sqrt{3}} tan^{-1}\left(\frac{x}{\sqrt{3}}\right) + C$	$\frac{1}{2}$ $\frac{1}{2}$ 1 1
34	Solving $y = \sqrt{3}x \; and x^2 + y^2 = 4$ We get $x^2 + 3x^2 = 4$ $\Rightarrow x^2 = 1 \;\; \Rightarrow x = 1$  Required Area $= \sqrt{3}\int_0^1 x \; dx + \int_1^2 \sqrt{2^2 - x^2} \; dx$ $= \frac{\sqrt{3}}{2}[x^2]_0^1 + \left[\frac{x}{2}\sqrt{2^2-x^2} + 2\sin^{-1}\left(\frac{x}{2}\right)\right]_1^2$ $= \frac{\sqrt{3}}{2} + \left[2 \times \frac{\pi}{2} - \frac{\sqrt{3}}{2} - 2 \times \frac{\pi}{6}\right]$ $\frac{2\pi}{3} \, sq \; units$ **OR**	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 1 $\frac{1}{2}$

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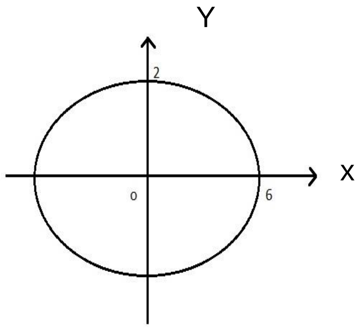
	Required Area $= \frac{4}{3}\int_0^6 \sqrt{6^2 - x^2}\, dx$  $= \frac{4}{3}\left[\frac{x}{2}\sqrt{6^2 - x^2} + 18\ sin^{-1}\left(\frac{x}{6}\right)\right]_0^6$ $= \frac{4}{3}\left[18 \times \frac{\pi}{2} - 0\right] = 12\pi\ sq\ units$	$\frac{1}{2}$ $\frac{1}{2}$ 1 1
35	The given differential equation can be written as $\frac{dy}{dx} = \frac{y + 2x^2}{x} \quad \Rightarrow \quad \frac{dy}{dx} - \frac{1}{x}y = 2x$ $Here \quad P = -\frac{1}{x},\ Q = 2x$ IF $= e^{\int P dx} = e^{-\int \frac{1}{x} dx} = e^{-\log x} = \frac{1}{x}$ The solutions is : $y \times \frac{1}{x} = \int \left(2x \times \frac{1}{x}\right) dx$ $\Rightarrow \frac{y}{x} = 2x + c$ $\Rightarrow y = 2x^2 + cx$	$\frac{1}{2}$ 1 1 $\frac{1}{2}$
36	$\|A\| = 1(-1-2) - 2(-2-0) = -3 + 4 = 1$ A is nonsingular, therefore A^{-1}exists $Adj\ A = \begin{bmatrix} -3 & -2 & -4 \\ 2 & 1 & 2 \\ 2 & 1 & 3 \end{bmatrix}$ $\Rightarrow A^{-1} = \frac{1}{\|A\|}(Adj\ A) = \begin{bmatrix} -3 & -2 & -4 \\ 2 & 1 & 2 \\ 2 & 1 & 3 \end{bmatrix}$	$\frac{1}{2}$ $1\frac{1}{2}$

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	The given equations can be written as: $\begin{bmatrix}1 & -2 & 0\\ 2 & -1 & -1\\ 0 & -2 & 1\end{bmatrix}\begin{bmatrix}x\\ y\\ z\end{bmatrix}=\begin{bmatrix}10\\ 8\\ 7\end{bmatrix}$	$\frac{1}{2}$
	Which is of the form $A'X = B$ $\Rightarrow\ X = (A')^{-1}B = (A^{-1})'B$	1
	$\Rightarrow \begin{bmatrix}x\\ y\\ z\end{bmatrix} = \begin{bmatrix}-3 & 2 & 2\\ -2 & 1 & 1\\ -4 & 2 & 3\end{bmatrix}\begin{bmatrix}10\\ 8\\ 7\end{bmatrix} = \begin{bmatrix}0\\ -5\\ -3\end{bmatrix}$ $\Rightarrow\ x = 0, \quad y = -5, \quad z = -3$	$1\frac{1}{2}$
	OR	
	$AB = \begin{bmatrix}1 & -1 & 0\\ 2 & 3 & 4\\ 0 & 1 & 2\end{bmatrix}\begin{bmatrix}2 & 2 & -4\\ -4 & 2 & -4\\ 2 & -1 & 5\end{bmatrix}$ $= \begin{bmatrix}6 & 0 & 0\\ 0 & 6 & 0\\ 0 & 0 & 6\end{bmatrix}$	$1\frac{1}{2}$
	$\Rightarrow AB = 6I$ $\Rightarrow A\left(\frac{1}{6}B\right) = I \ \Rightarrow A^{-1} = \frac{1}{6}(B)$	1
	The given equations can be written as $\begin{bmatrix}1 & -1 & 0\\ 2 & 3 & 4\\ 0 & 1 & 2\end{bmatrix}\begin{bmatrix}x\\ y\\ z\end{bmatrix} = \begin{bmatrix}3\\ 17\\ 7\end{bmatrix}$ $AX = D,\ where\ D = \begin{bmatrix}3\\ 17\\ 7\end{bmatrix}$ $\Rightarrow\ X = A^{-1}D$ $\Rightarrow\ \begin{bmatrix}x\\ y\\ z\end{bmatrix} = \frac{1}{6}\begin{bmatrix}2 & 2 & -4\\ -4 & 2 & -4\\ 2 & -1 & 5\end{bmatrix}\begin{bmatrix}3\\ 17\\ 7\end{bmatrix} = \frac{1}{6}\begin{bmatrix}12\\ -6\\ 24\end{bmatrix}$	1
	$\Rightarrow\ \begin{bmatrix}x\\ y\\ z\end{bmatrix} = \begin{bmatrix}2\\ -1\\ 4\end{bmatrix}$ $x = 2, \quad y = -1, \quad z = 4$	$1\frac{1}{2}$
37	We have $a_1 = 3\hat{i} + 2\hat{j} - 4\hat{k}$ $\qquad b_1 = \hat{i} + 2\hat{j} + 2\hat{k}$	

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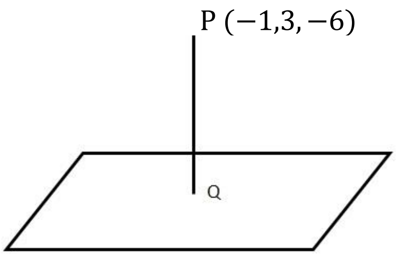
	$a_2 = 5i - 2j$ $\qquad\qquad\qquad$ $b_2 = 3\hat{\imath} + 2\hat{\jmath} + 6\hat{k}$	
	$\overrightarrow{a_2} - \overrightarrow{a_1} = 2\hat{\imath} - 4\hat{\jmath} + 4\hat{k}$	1
	$\overrightarrow{b_1} \times \overrightarrow{b_2} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 1 & 2 & 2 \\ 3 & 2 & 6 \end{vmatrix} = \hat{\imath}(12-4) - \hat{\jmath}(6-6) + \hat{k}\,(2-6)$	1
	$\overrightarrow{b1} \times \overrightarrow{b_2} = 8\hat{\imath} + 0\hat{\jmath} - 4\hat{k} = 8\hat{\imath} - 4\hat{k}$	
	$\because \left(\overrightarrow{b_1} \times \overrightarrow{b_2}\right).\left(\overrightarrow{a_2} - \overrightarrow{a_1}\right) = 16 - 16 = 0$	1
	$\therefore$ The lines are intersecting and the shortest distance between the lines is 0.	
	Now for point of intersection	
	$3\hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda(\hat{\imath} + 2\hat{\jmath} + 2\hat{k}) = 5\hat{\imath} - 2\hat{\jmath} + \mu(3\hat{\imath} + 2\hat{\jmath} + 6\hat{k})$ $\Longrightarrow 3 + \lambda = 5 + 3\mu \quad ---- \quad (1)$ $2 + 2\lambda = -2 + 2\mu \quad ---- \quad (2)$ $-4 + 2\lambda = 6\mu \quad ---- \quad (3)$	1
	Solving (1) ad (2) we get, $\mu = -2\ and\ \lambda = -4$ Substituting in equation of line we get $\vec{r} = 5i - 2j + (-2)\left(3\hat{\imath} + 2\hat{\jmath} - 6\hat{k}\right) = -\hat{\imath} - 6\hat{\jmath} - 12\hat{k}$ Point of intersection is $(-1, -6, -12)$	1
	OR	
	Let P be the given point and Q be the foot of the perpendicular.	
	Equation of PQ $\quad \frac{x+1}{2} = \frac{y-3}{1} = \frac{z+6}{-2} = \lambda$	$1\frac{1}{2}$
		
	Let coordinates of Q be $(2\lambda - 1, \lambda + 3, -2\lambda - 6)$ Since Q lies in the plane $2x + y - 2z + 5 = 0$	
	$\therefore 2(2\lambda - 1) + (\lambda + 3) - 2(-2\lambda - 6) + 5 = 0$	$\frac{1}{2}$
	$\Rightarrow 4\lambda - 2 + \lambda + 3 + 4\lambda + 12 + 5 = 0$	

$\Rightarrow 9\lambda + 18 = 0 \qquad \Rightarrow \lambda = -2$

$\therefore$ *coordinates of* Q *are* $(-5, \quad 1, -2)$

Length of the perpendicular = $\sqrt{(-5+1)^2 + (1-3)^2 + (-2+6)^2}$ 1

$= 6$ *units* 1

1

38 Max $Z = 3x + y$

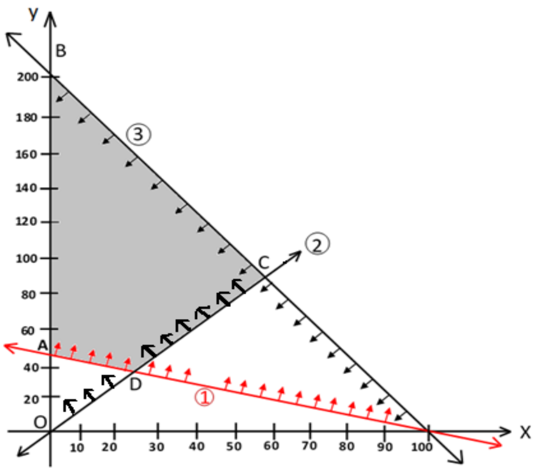
Subject to

$x + 2y \geq 100$ ----- (1)

$2x - y \leq 0$ ----- (2)

$2x + y \leq 200$ ----- (3)

$x \geq 0, \quad y \geq 0$



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Corner Points	$Z = 3x + y$
A (0, 50)	50
B (0, 200)	200
C (50, 100)	250
D (20, 40)	100

1

$Max\ z = 250 \quad at \quad x = 50, \qquad y = 100$

1

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OR

(i)

Corner points	$Z = 3x - 4y$
O(0,0)	0
A(0,8)	-32
B(4,10)	-28
C(6,8)	-14
D(6,5)	-2
E(4,0)	12

$Max \quad Z = 12 \; at \; E(4,0)$

$Min \quad Z = -32 \; at \; A(0,8)$

(ii) Since maximum value of Z occurs at B(4,10) and C(6, 8)

$\therefore 4p + 10q = 6p + 8q$

$\Rightarrow 2q = 2p$

$\Rightarrow p = q$

Number of optimal solution are infinite

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$1\frac{1}{2}$

1

2

$\frac{1}{2}$

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