SECOND YEAR HIGHER SECONDARY EXAMINATION, JUNE 2017
(Finalised Scheme of Valuation)

Subject: Mathematics (Commerce) **Code No: 7053**

Qn.No	Scoring Indicators	Split Score	Total Score
1 (i)	(a) Range of f = Codomain of 'f'	1	1
(ii)	$f(x) = x+1$, $g(x) = x^2$		
	$fog(x) = f[g(x)] = f[x^2] = x^2+1$	1	2
	$gof(x) = g[f(x)] = g[x+1] = (x+1)^2$	1	
(iii)	$f(x) = 3x+2$		
	Domain of f = Range of f = R		⑤
	$f(x_1) = f(x_2) \Rightarrow 3x_1+2 = 3x_2+2$	1	
	$\Rightarrow x_1 = x_2$		
	$\therefore$ f is 1-1		2
	Let $y = 3x+2$		
	$\Rightarrow x = \frac{y-2}{3}$	1	
	$\Rightarrow f(x) = f\left[\frac{y-2}{3}\right] = 3\left[\frac{y-2}{3}\right]+2$		
	$\Rightarrow f(x) = y$		
	$\therefore$ f is onto		
	Remarks:- (ii) $fog(x) = f[g(x)]$, $gof(x) = g[f(x)]$ give 1 mark (iii) If f is 1-1 & onto give 1 score.		
2	(i) (c) $\pi/6$	1	1
	(ii) $\tan^{-1}\left[\frac{2x+3x}{1-2x\cdot 3x}\right] = \pi/4$	1	

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Qn. No	Sub Qns	Answer Key / Value points	Score	Total
		$\frac{5x}{1-6x^2} = \tan\frac{\pi}{4} = 1$	1	
		$\Rightarrow 6x^2+5x-1=0$	½	
		$(6x-1)(x+1)=0 \Rightarrow x=\frac{1}{6}$ or $x=-1$	½	3
		$x=-1$ is not acceptable.		4
		$\therefore x=\frac{1}{6}$ is the solution	½	
3	(i)	(b) 5×7	1	1
	(ii)	$(A+2B)' = A'+2B'$ $= \begin{bmatrix}-2 & 3\\ 1 & 2\end{bmatrix} + 2\begin{bmatrix}-1 & 1\\ 0 & 2\end{bmatrix}$	1	2
		$= \begin{bmatrix}-2 & 3\\ 1 & 2\end{bmatrix} + \begin{bmatrix}-2 & 2\\ 0 & 4\end{bmatrix} = \begin{bmatrix}-4 & 5\\ 1 & 6\end{bmatrix}$	1	
		Remark: $A+2B = \begin{bmatrix}-4 & 3\\ 3 & 6\end{bmatrix}$ give full score.		5
	(iii)	$A = \begin{bmatrix}-2 & 1\\ 2 & 3\end{bmatrix}$, $\|A\| = -6-2=-8$	½	
		$A^{-1} = \frac{1}{\|A\|}\cdot(\text{adj } A)$	½	2
		$A^{-1} = \frac{1}{-8}\begin{bmatrix}3 & -1\\ -2 & -2\end{bmatrix}$	1	
		Remarks:- Any other method give full score		
4	(i)	(b) singular	1	1

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Qn. No	Sub Qns	Answer Key / Value points	Score	Total
	(ii)	$\begin{vmatrix} 2x+2y+2z & x & y \\ 2x+2y+2z & y+z+2x & y \\ 2x+2y+2z & x & z+x+2y \end{vmatrix}$ $C_1 \to C_1+C_2+C_3$	1	
		$=(2x+2y+2z)\begin{vmatrix} 1 & x & y \\ 1 & y+z+2x & y \\ 1 & x & z+x+2y \end{vmatrix}$	1	4
		$=2(x+y+z)\begin{vmatrix} 1 & x & y \\ 0 & y+z+x & 0 \\ 0 & 0 & z+x+y \end{vmatrix}$	½	3
		$(R_2 \to R_2 - R_1,\ R_3 \to R_3 - R_1)$		
		$= 2(x+y+z)\begin{vmatrix} y+z+x & 0 \\ 0 & z+x+y \end{vmatrix}$	½	
		$= 2(x+y+z)^3$	1	
5	(i)	(b) 1	1	1
	(ii)	$A=\begin{bmatrix} 2 & 3 & 3 \\ 1 & -2 & 1 \\ 3 & -1 & -2 \end{bmatrix}$ $X=\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ $B=\begin{bmatrix} 5 \\ -4 \\ 3 \end{bmatrix}$	½	
		$\lvert A\rvert = \begin{vmatrix} 2 & 3 & 3 \\ 1 & -2 & 1 \\ 3 & -1 & -2 \end{vmatrix} = 40 \neq 0$		
		$\text{adj } A = \begin{bmatrix} 5 & 3 & 9 \\ 5 & -13 & 1 \\ 5 & 11 & -7 \end{bmatrix}$	1	
		$A^{-1} = \frac{1}{\lvert A\rvert}\text{adj } A = \frac{1}{40}\begin{bmatrix} 5 & 3 & 9 \\ 5 & -13 & 1 \\ 5 & 11 & -7 \end{bmatrix}$	1	

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Qn. No	Sub Qns	Answer Key / Value points	Score	Total
		$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{40}\begin{bmatrix} 5 & 3 & 9 \\ 5 & -13 & 1 \\ 5 & 11 & -7 \end{bmatrix}\begin{bmatrix} 5 \\ -4 \\ 3 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$		4 (5)
		$x = 1,\ y = 2,\ z = -1$	$\frac{1}{2}$	
6	(i)	Not continuous	1	1
	(ii)	When $x^2 - 5x + 6 = 0 \Rightarrow x = \{2, 3\}$	1	2 (3)
		$f(x)$ is discontinuous at $x = 2$ and $x = 3$	1	
7	(i)	$y = e^{2x+\log x} = e^{2x}\cdot e^{\log x} = e^{2x}\cdot x.$	1	2
		$\frac{dy}{dx} = e^{2x}\cdot 1 + x\cdot e^{2x}\cdot 2$ $= e^{2x}[1 + 2x]$	1	
		Remarks:- Using chain rule $\frac{dy}{dx} = e^{2x+\log x}\cdot(2 + 1/x)$ OR use logarthmic differentiation give full score		
	(ii)	$x = at^2,\ y = 2at$		
		$\frac{dx}{dt} = 2at,\ \frac{dy}{dt} = 2a$	1	3
		$\frac{dy}{dx} = \frac{dy/dt}{dx/dt} = 1/t$	1	
		Diff w.r.t 'x'		

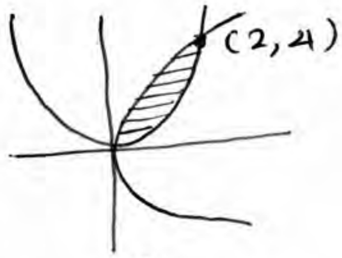
$$\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{1}{t}\right)\cdot\frac{dt}{dx} = \frac{-1}{t^2}\times\frac{1}{2at}$$

$$= -\frac{1}{2at^3} \qquad 1$$

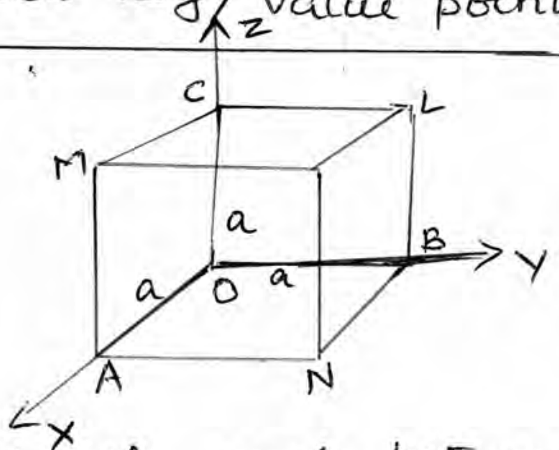
Remark: For formula give $\frac{1}{2}$ score

Qn no:	Sub Qns	Answer Key / Value points		
	iii	$f(x) = x(x-2) = x^2-2x$ $f'(x) = 2x-1 = 2(x-1)$ Since $f'(x)$ exist, f is differentiable on (1, 3), the conditions of MVT are satisfied	1	
		$f(a) = -1$, $f(b) = 3$	1	3
		$f'(c) = \frac{f(b)-f(c)}{b-c} = \frac{3+1}{2} \Rightarrow 2(c-1) = \frac{4}{2}$	½	
		$\Rightarrow c-1 = 1 \Rightarrow c = 2 \in (1, 3)$	½	8
		Mean value theorem is satisfied		
8	(i)	Cost function $= 1500+30\times5+5^2$ $= 1500+150+25 = 1675$	1	
	(ii)	Marginal cost function $\frac{dc}{dx} = 30+2x$	1	4
	(iii)	Marginal cost when $x = 20$ (MC) at $x = 20 = 30+2(20)$ $= 70$	2	
		OR		
	(i)	(b) decreasing	1	1
	(ii)	$y = x^3$ diff w.r.t x, $\frac{dy}{dx} = 3x^2$ At (1, 1) $\frac{dy}{dx} = 3\times1^2 = 3$	1	
		At (1,1), slope of the tangent = 3 Equation of the tangent at (1,1) is $y-1 = 3(x-1) \Rightarrow y = 3x-2$	1	

Qn no:	Sub Qns	Answer key / value points	Score	Total
	(iii)	At (1,1) Slope of the normal $= -\frac{1}{3}$ Equation of the normal at (1,1) $y-1 = -\frac{1}{3}(x-1)$ $\Rightarrow x+3y-4=0$ Remark:- For formulae give $\frac{1}{2}$ mark each	1	3 4
9	(i)	(b) $2\sqrt{x}+C$	1	1
	(ii)	$\int \sin^3 x = \int \sin^2 x \cdot \sin x \, dx$ $= \int (1-\cos^2 x)\sin x \, dx$ Put $\cos x = t \Rightarrow -dt = \sin x \, dx$ $= \int (1-t^2)(-dt) = \int (t^2-1)\,dt$ $= \left(\frac{t^3}{3} - t\right) + C$ $= \frac{\cos^3 x}{3} - \cos x + C$ Remark: for alternative method give full score	1 1	2 5
	(iii)	$\int x \log x \, dx = \int \log x \cdot x \, dx$ $= \log x \cdot \frac{x^2}{2} - \int \frac{1}{x} \cdot \frac{x^2}{2}$ $= \frac{x^2}{2}\log x - \frac{1}{2}\left(\frac{x^2}{2}\right) + C$ $= \frac{x^2}{2}\log x - \frac{x^2}{4} + C$	$\frac{1}{2}$ 1 $\frac{1}{2}$	2
		OR		
	(i)	(C) $e-1$	1	1
	(ii)	Let $I = \int_0^{\pi/2} \cos^2 x \, dx$ Also $I = \int_0^{\pi/2} \cos^2\left(\frac{\pi}{2}-x\right)dx = \int_0^{\pi/2} \sin^2 x \, dx$	1	

Qn No:	Sub Qns	Answer Key / Value points	Score	Total
		$2I = \int_0^{\pi/2} 1 \, dx = [x]_0^{\pi/2} = \pi/2$		2
		$I = \pi/4$	1	
				5
	(iii)	$\int_0^1 x \cdot e^x \, dx$	1	
		$\Rightarrow x \cdot e^x - \int 1 \cdot e^x \cdot dx$		2
		$\Rightarrow x \cdot e^x - e^x + C \Rightarrow e^x [x-1]_0^1$		
		$\Rightarrow [e(1-1) - e^0(0-1)] = 0+1 = 1$	1	
10	(i)	Solving $y = x^2$ and $y^2 = 8x$, $x(x^3 - 8) = 0 \Rightarrow x = 0, x = 2$ When $x = 0, y = 0$ $x = 2, y = 4$ Points of intersection are $(0,0), (2,4)$	1	1
	ii)			4
		Req. area $= \int_0^2 \sqrt{8x} \, dx - \int_0^2 x^2 \, dx$	1	
		$= \left[2\sqrt{2} \frac{x^{3/2}}{3/2} - \frac{x^3}{3} \right]_0^2$	1	3
		$= \left[\frac{4\sqrt{2}}{3} \cdot 2^{3/2} - \frac{8}{3} \right] = \frac{16}{3} - \frac{8}{3}$	½	
		$= 8/3$ sq. units	½	
		Remarks: For fig only give ½ score		

Qn no:	Sub Qns	Answer key/Value points	Score	Total
11	(i)	$\frac{dy}{dx}+\left(\frac{1}{x}\right)y=\log x$	1	1
	(ii)	Integrating factor, $e^{\int P dx}$		
		$P=1/x$, $Q=\log x$		④
		$I.F=e^{\log x}=x.$	1	1
	(iii)	Solution is $y(IF)=\int Q(IF)+c$	1	
		$\Rightarrow xy=\int x\log x\,dx$		2
		$\Rightarrow xy=\frac{1}{2}\left[x^2\log x-\frac{x^2}{2}\right]+c$	1	
		Remark:- For formulae give ½ score each		
12	(i)	$\vec{AB}=\vec{OB}-\vec{OA}$		
		$=(2\bar{i}-\bar{j}+3\bar{k})-(\bar{i}+2\bar{j}+4\bar{k})$	1	1
		$=(\bar{i}-3\bar{j}-\bar{k})$		
	(ii)	Unit vector along $\vec{AB}=\frac{\vec{AB}}{\lvert\vec{AB}\rvert}$	1	
				2
		$=\frac{\hat{i}-3\hat{j}-\hat{k}}{\sqrt{1^2+(-3)^2+(-1)^2}}=\frac{1}{\sqrt{11}}(\hat{i}-3\hat{j}-\hat{k})$	1	⑥
	(iii)	$\vec{a}\cdot(\vec{b}+\vec{c})\times(\vec{a}+\vec{b}+\vec{c})$		
		$=\vec{a}\cdot\{\vec{b}\times\vec{a}+\vec{b}\times\vec{b}+\vec{b}\times\vec{c}+\vec{c}\times\vec{a}+\vec{c}\times\vec{b}+\vec{c}\times\vec{c}\}$	1	
		$=\vec{a}\cdot\{\vec{b}\times\vec{a}+\vec{b}\times\vec{c}+\vec{c}\times\vec{a}+\vec{c}\times\vec{b}\}$		3
		$=\vec{a}\cdot(\vec{b}\times\vec{a})+\vec{a}\cdot(\vec{b}\times\vec{c})+\vec{a}\cdot(\vec{c}\times\vec{a})+\vec{a}\cdot(\vec{c}\times\vec{b})$	1	
		$=[\vec{a}\,\vec{b}\,\vec{a}]+[\vec{a}\,\vec{b}\,\vec{c}]+[\vec{a}\,\vec{c}\,\vec{a}]+[\vec{a}\,\vec{c}\,\vec{b}]$		
		$=[\vec{a}\,\vec{b}\,\vec{c}]-[\vec{a}\,\vec{b}\,\vec{c}]=0$	1	

Qn nos	Sub Qns	Answer key/Value points	Score	Total
13	(i)		1	
		Let θ be the angle between any two diagonals of the cube $\cos\theta = \left\|\frac{a_1a_2+b_1b_2+c_1c_2}{\sqrt{a_1^2+b_1^2+c_1^2}\sqrt{a_2^2+b_2^2+c_2^2}}\right\|$	1	3
		$= \left\|\frac{-\vec{a}\cdot\vec{a}+\vec{a}\cdot(-a)+a\cdot a}{\sqrt{3a^2}\ \sqrt{3a^2}}\right\| = \left\|\frac{-a^2}{3a^2}\right\| = \frac{1}{3}$	1	5
		$\therefore\ \theta = \cos^{-1}(1/3)$		
	(ii)	Equation of the plane in intercept form is $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$	1	2
		$\frac{x}{2}+\frac{y}{3}+\frac{z}{4}=1 \Rightarrow 6x+4y+3z=12$	1	
		OR		
	(i)	$\vec{a_1}=\hat{i}+2\hat{j}+\hat{k}$ $\quad \vec{b_1}=\hat{i}-\hat{j}+\hat{k}$ $\vec{a_2}=2\hat{i}-\hat{j}+\hat{k}$ $\quad \vec{b_2}=2\hat{i}+\hat{j}+2\hat{k}$	1	
		$\vec{a_2}-\vec{a_1}=\hat{i}-3\hat{j}$, $\vec{b_1}\times\vec{b_2}=-3\hat{i}+3\hat{k}$	1	3
		$\|\vec{b_1}\times\vec{b_2}\|=\sqrt{18}$ $S.D = \left\|\frac{(\vec{a_2}-\vec{a_1})\cdot(\vec{b_1}\times\vec{b_2})}{\|\vec{b_1}\times\vec{b_2}\|}\right\| = \left\|-3/\sqrt{18}\right\| = \frac{3}{\sqrt{18}}$	1	

Qn no:s	Sub Qns	Answer key / Value points	Score	Total
	(ii)	Given plane $2x-3y+4z=6$. The $\perp r$ distance from origin is $\frac{\lvert d\rvert}{\sqrt{a^2+b^2+c^2}} = \frac{\lvert 6\rvert}{\sqrt{2^2+(-3)^2+4^2}}$	1	2
		$= \ \ = \frac{6}{\sqrt{29}}$	1	⑤
14	(i)	Let the number of shirts be 'x' & pants be y		

Cloth	No: of Cl. pieces	Item req			Profit
		A	B	C	
Shirt	x	3	2	1	150
Pant	y	4	3	2	200

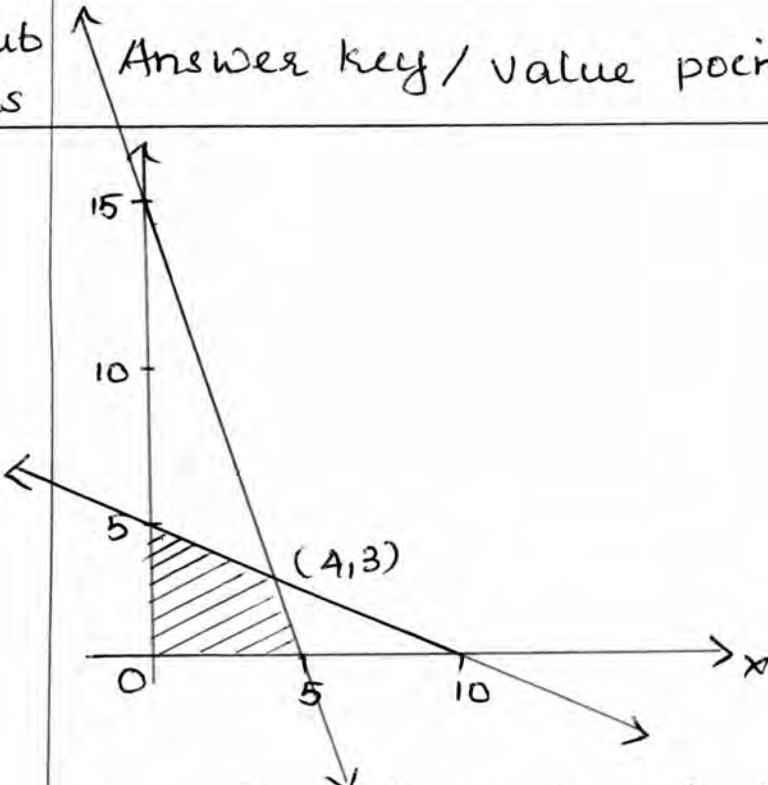
Qn no:s	Sub Qns	Answer key / Value points	Score	Total
	(i)	The objective function is $z = 150x+200y$	1	
	(ii)	Constraints are $3x+4y \le 12$, $2x+3y \ge 5$, $x+2y \le 12$, $x, y \ge 0$	3	④
15	(i)	$x+2y=10$ $3x+y=15$		

$x+2y=10$

x	0	10
y	5	0

$3x+y=15$

x	0	5
y	15	0

<table>
<tr><th>Qn no.s</th><th>Sub Qns</th><th>Answer key / value points</th><th>Score</th><th>Total</th></tr>
<tr><td></td><td></td><td>
</td><td>2</td><td>2</td></tr>
<tr><td></td><td>(ii)</td><td>The feasible region is the shaded region in the figure
<table>
<tr><th>Corner points</th><th>$z = 3x+2y$</th></tr>
<tr><td>A (5,0)</td><td>$z = 15$</td></tr>
<tr><td>B (4,3)</td><td>$z = 18$</td></tr>
<tr><td>C (0,5)</td><td>$z = 10$</td></tr>
</table>
Maximum value of z is 18 at (4,3)
Remark:- For axis ½ marks each. Any two correct two corner pts give 1 mark</td><td>1
1</td><td>4
2</td></tr>
<tr><td>16</td><td>(i)</td><td>$P(A') = 4/7$ $P(B') = 2/7$</td><td>1</td><td>1</td></tr>
<tr><td></td><td>(ii)</td><td>P[only one of them passing]
$= P(AB' \cup A'B)$
$= P(A) \cdot P(B') + P(A') \cdot P(B)$
$= \frac{3}{7} \times \frac{2}{7} + \frac{4}{7} \times \frac{5}{7} = \frac{26}{49}$</td><td>1
1</td><td>5
2</td></tr>
<tr><td></td><td>(iii)</td><td>P[both of them passing] $= P(A \cap B)$
$= P(A) \cdot P(B) = \frac{3}{7} \times \frac{5}{7} = \frac{15}{49}$</td><td>1
1</td><td>2</td></tr>
</table>

Qn nos	Sub Qns	Answer key / Value Points	Score	Total
17	(i)	$0+k+2k+3k+4k=1$		
		$\Rightarrow 10k=1 \Rightarrow k=1/10$	1	1
	(ii)	$P(X<3)=P(X=0)+P(X=1)+P(X=2)$	1	2
		$=0+k+2k=\frac{1}{10}+\frac{2}{10}=\frac{3}{10}$	1	
	(iii)	Mean of the random variable		5
		$E(X)=0+1\times\frac{1}{10}+2\times\frac{2}{10}+3\times\frac{3}{10}+4\times\frac{4}{10}$	1	2
		$=\frac{1}{10}[1+4+9+16]=\frac{30}{10}=3$	1	

1.	Beena Mathew Mar Basil HSS Kothamangalam Ernakulam (dist)	[signature]	
2.	Santhoshkumar. S DVMNNM HSS. Maranalloor Trivandrum Dist (Mob) 9447000141	Santhosh	
3	Jessymol Varghese Union HSS Mambra Thrissur (D)	Jessymol Varghese	