ANSWER KEY

Code No	SY 227 ~~527~~

SECOND YEAR HIGHER SECONDARY EXAMINATION MARCH 2023

PART-I/II/III

SUBJECT : MATHEMATICS – S60 (Science)

60 SCORES 2 HOURS

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
1	(i)	$f(x) = \{(1,2), (2,3), (3,4)\}$	1	
	(ii)	Different elements of A are mapped into different elements in B		
		f is one – one	1	3
		$5 \in B$ has no preimage under f		
		f is not onto	1	
		NB: (i) Alternate methods to (i) and (ii) Give full score (Using Arrow diagram) (ii) For the concept of one one and onto function give 1 Score		
2.		$X+Y = \begin{bmatrix} 7 & 0 \\ 2 & 5 \end{bmatrix}$ — ①		
		$X-Y = \begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}$ — ②		
		① + ② $\Rightarrow 2X = \begin{bmatrix} 10 & 0 \\ 2 & 8 \end{bmatrix}$	1	3
		$X = \begin{bmatrix} 5 & 0 \\ 1 & 4 \end{bmatrix}$	½	
		① – ② $\Rightarrow 2Y = \begin{bmatrix} 4 & 0 \\ 2 & 2 \end{bmatrix}$	1	
		$Y = \begin{bmatrix} 2 & 0 \\ 1 & 1 \end{bmatrix}$	½	
		NB: Alternate method to get Correct answer (With proper steps) give full score		

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3		$A(1,3)$ $B(0,0)$. Let $P(x_1,y)$ be any pt on line joining A and B Area of triangle is zero $\Delta = \frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$	1	3
		$\therefore \frac{1}{2}\begin{vmatrix} 0 & 0 & 1 \\ 1 & 3 & 1 \\ x & y & 1 \end{vmatrix} = 0$	1	
		$\Rightarrow \frac{1}{2}(y-3x)=0$	1	
		$\Rightarrow y-3x=0$ or $y=3x$		
4		$f(x)$ is cts. $\therefore$ It is cts at $x=3$ and $x=4$		
		$\therefore \lim_{x\to 3^+} f(x) = f(3) \Rightarrow 3a+b=10$ —①	1	
		$\lim_{x\to 4^-} f(x) = f(4) \Rightarrow 4a+b=20$ —②	1	3
		$\therefore a=10,\ b=20$	1	
		NB: (i) Give one score for idea of Continuity (ii) For direct answer give 1 score		
5		$f(x) = \sin x + \cos x,\ 0<x<\pi/2$		
		$f'(x) = \cos x - \sin x$	1/2	
		$f''(x) = -\sin x - \cos x$ $= -(\sin x + \cos x)$	1/2	
		$f'(x)=0 \Rightarrow \cos x - \sin x = 0$	1/2	

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		$\Rightarrow \cos x = \sin x \quad x \in (0, \pi/2)$ $\Rightarrow x = \frac{\pi}{4}$ $f''(\pi/4) = -\left(\sin\frac{\pi}{4} + \cos\frac{\pi}{4}\right) < 0$ $\therefore x = \pi/4$ is a point of local maxima $\therefore$ Local maximum $= \cos\frac{\pi}{4} + \sin\frac{\pi}{4}$ $= \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}} = \sqrt{2}$ NB: $f'(x) = 0$, give $\frac{1}{2}$ Score.	1/2 1/2 1/2	3
6.	(i)	$\bar{a} \cdot \bar{b} = a_1a_2 + b_1b_2 + c_1c_2$ $= 1\times3 + 2\times2 + 3\times1$ $= 10$	1	
	(ii)	Angle between $\bar{a}$ and $\bar{b}$ is given by $\cos\theta = \frac{\bar{a}\cdot\bar{b}}{\lvert\bar{a}\rvert\lvert\bar{b}\rvert}$ $= \frac{10}{\sqrt{1^2+2^2+3^2}\sqrt{3^2+2^2+1^2}}$ $= \frac{10}{14} = \frac{5}{7}$ $\therefore \theta = \cos^{-1}(5/7)$	1 1	3
7		$\bar{a} = \bar{i} + 2\bar{j} + 3\bar{k}$ $\bar{b} = 3\bar{i} + 2\bar{j} - 2\bar{k}$ Vector equation of line is $\bar{r} = \bar{a} + \lambda\bar{b}$ $\bar{r} = (\hat{i} + 2\hat{j} + 3\bar{k}) + \lambda(3\hat{i} + 2\hat{j} - 2\bar{k})$ Cartesian equation of line $\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c}$	1 1/2 1	

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		ii $\frac{x-1}{3} = \frac{y-2}{2} = \frac{z-3}{-2}$	1/2	3
		NB: Direct answer for vector and Cartesian equation give 1½ Score each		
8		$P(A) = \frac{1}{2}$ $P(B) = \frac{7}{12}$		
	(i)	$(A \cap B)' = A' \cup B'$		
		$P(A \cap B)' = P(A' \cup B') = \frac{1}{4}$		
		$\therefore P(A \cap B) = 1 - P(A \cap B') = 3/4$	2	
	(ii)	$P(A) \cdot P(B) = \frac{1}{2} \times \frac{7}{12} = \frac{7}{24}$		3
		$\therefore P(A) \cdot P(B) \neq P(A \cap B)$	1	
		$\therefore$ A and B are not independent		
		NB For analysing the problem give score 3.		
9	(i)	$A(2,4) \in R$	1	
	(ii)	2 divides $(a-a)$ $\forall a \in R$	1	
		$\therefore$ R is reflexive		
		$(a,b) \in R \Rightarrow a-b$ is even		
		$\Rightarrow b-a$ is also even		
		$\Rightarrow$ 2 divides $(b-a)$		
		$\therefore (b,a) \in R$; $\therefore$ R is symmetric	1	
		Let (a,b) And $(b,c) \in R$		
		$\Rightarrow$ 2 divides both $(a-b)$ and $(b-c)$		
		$\Rightarrow$ 2 divides $(a-b)+b-c$		
		$\Rightarrow$ 2 divides $(a-c)$		
		$\therefore (a,c) \in R$ $\therefore$ R is transitive	1	

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		R is reflexive, Symmetric and transitive. ∴ R is an equivalence relation NB: For the idea of an equivalence relation give 1 Score		4
10	(i)	$\frac{\pi}{6}$ or 30°	1	
	(ii)	$\tan^{-1}\left[2\cos\left(2\sin^{-1}\frac{1}{2}\right)\right] = \tan^{-1}\left[2\cos\frac{\pi}{3}\right]$	1	4
		$= \tan^{-1}\left(2\times\frac{1}{2}\right)$	1	
		$= \tan^{-1}1$	1	
		$= \frac{\pi}{4}$ or 45°		
		NB: For direct answer give 1 Score		
11	(i)	(c) $(AB)' = A'B'$	1	
	(ii)	$A = \begin{bmatrix} 1 & 5 \\ 6 & 7 \end{bmatrix}$ $A' = \begin{bmatrix} 1 & 6 \\ 5 & 7 \end{bmatrix}$		
		$A+A' = \begin{bmatrix} 2 & 11 \\ 11 & 14 \end{bmatrix}$	1	
		$(A+A')' = \begin{bmatrix} 2 & 11 \\ 11 & 14 \end{bmatrix} = (A+A')$	½	4
		∴ $A+A'$ is symmetric		
		$A-A' = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$	1	
		$(A-A')' = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} = -(A-A')$	½	
		∴ $(A-A')$ is skewsymmetric		
		NB: For finding A' give $\frac{1}{2}$ Score		

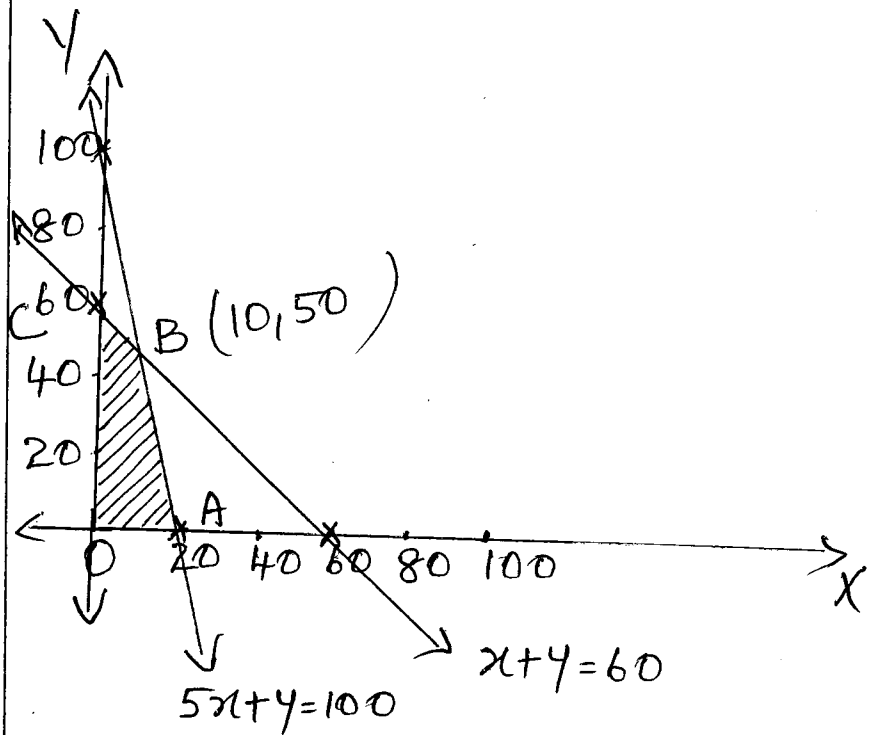
Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
12.		$\frac{x^2}{9}+\frac{y^2}{4}=1$ $\frac{y^2}{4}=1-\frac{x^2}{9} \Rightarrow y=\frac{2}{3}\sqrt{9-x^2}$ Required Area $=4\times\int_0^3 y\,dx$ $=4\cdot\int_0^3 \frac{2}{3}\sqrt{9-x^2}\,dx$ $=\frac{8}{3}\left[\frac{x}{2}\sqrt{9-x^2}+\frac{9}{2}\sin^{-1}\frac{x}{3}\right]_0^3$ $=\frac{8}{3}\left[\left(0+\frac{9}{2}\sin^{-1}1\right)-0\right]$ $=6\pi$ Sq. units NB: (i) For drawing figure only give 1 Score (ii) For $\int\sqrt{a^2-x^2}\,dx=\frac{x}{2}\sqrt{a^2-x^2}+\frac{a^2}{2}\sin^{-1}\frac{x}{a}$ only give 1 Score (iii) Area of ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is πab only give 1 Score	1 1 1 1 1	4
13	(i)	(C) 3	1	4
	(ii)	$\frac{dy}{dx}=(1+x^2)(1+y^2)$ $\frac{dy}{1+y^2}=(1+x^2)\,dx$ $\therefore\int\frac{dy}{1+y^2}=\int(1+x^2)\,dx$ $\tan^{-1}y=x+\frac{x^3}{3}+C$	1 1 1	
14	(i)	$\bar{a}=\bar{i}-7\bar{j}+7\bar{k}$ $\bar{b}=3\bar{i}-2\bar{j}+2\bar{k}$		

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		$\bar{a}\times\bar{b} = \begin{vmatrix} i & j & k \\ 1 & -7 & 7 \\ 3 & -2 & 2 \end{vmatrix}$	1	
		$= 0\hat{i}+19\hat{j}+19\hat{k}$	1	
	(ii)	Unit vector for to $\bar{a}$ and $\bar{b}$		
		$\hat{n} = \frac{\bar{a}\times\bar{b}}{\lvert\bar{a}\times\bar{b}\rvert}$ $\left(\text{or } \frac{-(\bar{a}\times\bar{b})}{\lvert\bar{a}\times\bar{b}\rvert}\right)$	½	
		$= \frac{19\hat{j}+19\hat{k}}{\sqrt{19^2+19^2}}$	½	4
		$= \frac{19\hat{j}+19\hat{k}}{19\sqrt{2}}$		
		$= \frac{\hat{j}+\hat{k}}{\sqrt{2}}$		
	(iii)	Area of parallelogram $= \lvert\bar{a}\times\bar{b}\rvert$	½	
		$= 19\sqrt{2}$ sq. units	½	
15		$\bar{a}_1 = i+2j+k \quad \bar{b}_1 = i+j+k$	1	
		$\bar{a}_2 = 2i-j+4k \quad \bar{b}_2 = 2i+j+2k$		
		$\bar{a}_2-\bar{a}_1 = \hat{i}-3\hat{j}+3\hat{k}$	½	
		$\bar{b}_1\times\bar{b}_2 = \begin{vmatrix} i & j & k \\ 1 & 1 & 1 \\ 2 & 1 & 2 \end{vmatrix}$	1	
		$= i-k$		4
		$(\bar{a}_2-\bar{a}_1)\cdot(\bar{b}_1\times\bar{b}_2) = 1+0-3 = -2$	½	
		$SD = \left\lvert\frac{(\bar{a}_2-\bar{a}_1)\cdot(\bar{b}_1\times\bar{b}_2)}{\lvert\bar{b}_1\times\bar{b}_2\rvert}\right\rvert$	1	
		$= \left\lvert\frac{-2}{\sqrt{1+1}}\right\rvert = \sqrt{2}$		

Qn No:	Sub Qns	Answer key / Value Point	Score	Total Score
		NB (i) Formula for SD, give 1 Score (ii) Using Cartesian equation } give Score 4 with proper steps and correct answer		
16		$P(E_1) = P(E_2) = \frac{1}{2}$	$\frac{1}{2}$	
		$P(A/E_1) = P(\text{drawing red ball from bag 1}) = \frac{3}{7}$	$\frac{1}{2}$	
		$P(A/E_2) = P(\text{drawing red ball from bag 2}) = \frac{5}{11}$	$\frac{1}{2}$	4
		$\therefore P(E_2/A) = \frac{P(E_2)\cdot P(A/E_2)}{P(E_1)P(A/E_1) + P(E_2)P(A/E_2)}$	1	
		$= \frac{\frac{1}{2} \times \frac{5}{11}}{\frac{1}{2}\times\frac{3}{7} + \frac{1}{2}\times\frac{5}{11}}$	1	
		$= \frac{5/22}{\frac{3}{14}+\frac{5}{22}} = \frac{35}{68}$	$\frac{1}{2}$	
17		$AX = B$		
		$A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & 1 \\ 2 & -1 & 1 \end{bmatrix}$ $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ $B = \begin{bmatrix} 3 \\ 4 \\ 2 \end{bmatrix}$	1	
		$\lvert A\rvert = 2 - 0 + -4 = -2 \neq 0$	$\frac{1}{2}$	
		$\therefore A^{-1}$ exists		
		$\text{Adj } A = \begin{bmatrix} 2 & -2 & 0 \\ 0 & -1 & 1 \\ -4 & 3 & -1 \end{bmatrix}$	2	

Qn No	Sub Qns	Answer key / Value Points	Score	Total Score
		$\bar{A}^1 = \frac{adj\ A}{\lvert A \rvert} = \frac{\begin{bmatrix} 2 & -2 & 0 \\ 0 & -1 & 1 \\ -4 & 3 & -1 \end{bmatrix}}{-2}$	$\frac{1}{2}$	
		$X = \bar{A}^1 . B$	$\frac{1}{2}$	
		$= \frac{-1}{2}\begin{bmatrix} 2 & -2 & 0 \\ 0 & -1 & 1 \\ -4 & 3 & -1 \end{bmatrix}\begin{bmatrix} 3 \\ 4 \\ 2 \end{bmatrix}$	$\frac{1}{2}$	
		$= \frac{-1}{2}\begin{bmatrix} -2 \\ -2 \\ -2 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$	1	6
		$x=1 \quad y=1 \quad z=1$		
		NB: (i) For any correct 6 Element of adj A give 1½ Score. (ii) Using this adj A and finding X, give 5½ Score		
18	(i)	$y = x^x$		
		$\log y = \log x^x = x \log x$	1	
		$\therefore \frac{1}{y}\frac{dy}{dx} = x \cdot \frac{1}{x} + \log x$	1	
		$\frac{dy}{dx} = x^x(1+\log x)$		
	(ii)	$x = at^2 \quad \frac{dx}{dt} = 2at$	1	
		$y = 2at \quad \frac{dy}{dt} = 2a$		
		$\frac{dy}{dx} = \frac{2a}{2at} = \frac{1}{t}$	1	

Qn No	Sub Qn	Answer key / Value Point	Score	Total Score
	(iii)	$\frac{dr}{dt} = 5$ cm/sec	$\frac{1}{2}$	
		$A = \pi r^2$	$\frac{1}{2}$	6
		$\frac{dA}{dt} = \pi \cdot 2r \frac{dr}{dt}$		
		$= 2\pi \times 8 \times 5$	1	
		$= 80\pi$ cm^2/sec		
19	(i)	$\int \frac{1}{x^2-a^2} dx = \frac{1}{2a} \log \left\lvert \frac{x-a}{x+a} \right\rvert + C$	1	
	(ii)	$\int \frac{1}{x^2+4x-5} dx = \int \frac{1}{(x^2+4x+4)-9} dx$	1	
		$= \int \frac{1}{(x+2)^2-3^2} dx$	1	
		$= \frac{1}{2\times 3} \log \left\lvert \frac{x+2-3}{x+2+3} \right\rvert + C$	1	6
		$= \frac{1}{6} \log \left\lvert \frac{x-1}{x+5} \right\rvert + C.$		
	(iii)	$\int_2^3 \frac{x}{1+x^2} dx = \frac{1}{2} \int_2^3 \frac{2x}{1+x^2} dx$		
		$= \frac{1}{2} \left[\log \lvert 1+x^2 \rvert \right]_2^3$	1	
		$= \frac{1}{2} (\log 10 - \log 5)$	1	
		$= \frac{1}{2} \log \frac{10}{5}$	1	
		$= \frac{1}{2} \log 2$		

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		give 3 score		
20		$x+y=60$ <table><tr><td>x</td><td>0</td><td>60</td></tr><tr><td>y</td><td>60</td><td>0</td></tr></table> $5x+y=100$ <table><tr><td>x</td><td>0</td><td>20</td></tr><tr><td>y</td><td>100</td><td>0</td></tr></table>	1	6
			2	
		<table><tr><td>Corner point</td><td>$Z=250x+75y$</td></tr><tr><td>O (0,0)</td><td>$Z=0$</td></tr><tr><td>A (20,0)</td><td>$Z=250\times20+0=5000$</td></tr><tr><td>B (10,50)</td><td>$Z=250\times10+75\times50$ $=6250$</td></tr><tr><td>C (0,60)</td><td>$Z=0+75\times60=4500$</td></tr></table> Z is maximum when $x=10$ and $y=50$ Maximum Value of $Z=6250$.	3	

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
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