

ANSWER KEY

Code No

SY 227
527SECOND YEAR HIGHER SECONDARY EXAMINATION MARCH 2023

PART-I/II/III

SUBJECT : MATHEMATICS — S60 (Science)60 SCORES2 HOURS

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
1	(i) $f(x) = \{(1,2), (2,3), (3,4)\}$ (ii) Different elements of A are mapped into different elements in B f is one-one $5 \in B$ has no preimage under f f is not onto 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	1 1 1 3		
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 $\Rightarrow 2X = \begin{bmatrix} 10 & 0 \\ 2 & 8 \end{bmatrix}$ $X = \begin{bmatrix} 5 & 0 \\ 1 & 4 \end{bmatrix}$ ① - ② $\Rightarrow 2Y = \begin{bmatrix} 4 & 0 \\ 2 & 2 \end{bmatrix}$ $Y = \begin{bmatrix} 2 & 0 \\ 1 & 1 \end{bmatrix}$ NB: Alternate method to get correct answer (With proper steps) give full score	1 $\frac{1}{2}$ 1 $\frac{1}{2}$ 3		

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
3		$A(1,3) \quad B(0,0)$. Let $P(x,y)$ be any pt on line joining A and B Area of triangle is zero $\Delta = \frac{1}{2} \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ $\therefore \frac{1}{2} \begin{vmatrix} 0 & 0 & 1 \\ 1 & 3 & 1 \\ x & y & 1 \end{vmatrix} = 0$ $\Rightarrow \frac{1}{2}(y-3x) = 0$ $\Rightarrow y-3x = 0 \text{ or } y = 3x$	1 1 1	3
4		$f(x)$ is ctn. $\therefore$ It is ctn at $x=3$ and $x=4$ $\therefore \lim_{x \rightarrow 3^+} f(x) = f(3) \Rightarrow 3a+b=10$ Outstanding Guidance for Youth — ① $\lim_{x \rightarrow 4^-} f(x) = f(4) \Rightarrow 4a+b=20$ ② $\therefore a=10, b=20$ NB: (i) Give one score for idea of continuity (ii) For direct answer give 1 score	1 1 1	3
5		$f(x) = \sin x + \cos x, 0 < x < \pi/2$ $f'(x) = \cos x - \sin x$ $f''(x) = -\sin x - \cos x$ $= -(\sin x + \cos x)$ $f'(x) = 0 \Rightarrow \cos x - \sin x = 0$	1/2 1/2 1/2	

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Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		$\Rightarrow \cos x = \sin x \quad x \in (0, \pi/2)$ $\Rightarrow x = \frac{\pi}{4}$ $f''(\pi/4) = -(\sin \frac{\pi}{4} + \cos \frac{\pi}{4}) < 0$ $\therefore x = \pi/4$ 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) $\vec{a} \cdot \vec{b} = a_1 a_2 + b_1 b_2 + c_1 c_2$ $= 1 \times 3 + 2 \times 2 + 3 \times 1$ $= 10$ (ii) Angle between $\vec{a}$ and $\vec{b}$ is given by $\cos \theta = \frac{\vec{a} \cdot \vec{b}}{ \vec{a} \vec{b} }$ $= \frac{10}{\sqrt{1^2 + 2^2 + 3^2} \sqrt{3^2 + 2^2 + 1^2}}$ $= \frac{10}{14} = \frac{5}{7}$ $\therefore \theta = \cos^{-1}(5/7)$	 1 1 1	3	
7	$\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$ $\vec{b} = 3\hat{i} + 2\hat{j} - 2\hat{k}$ vector equation of line is $\vec{r} = \vec{a} + \lambda \vec{b}$ $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda (3\hat{i} + 2\hat{j} - 2\hat{k})$ Cartesian equation of line $\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c}$	 1 1/2 1		

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Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		$\therefore \frac{x-1}{3} = \frac{4-2}{2} = \frac{2-3}{-2}$ NB: Direct answer for vector and Cartesian equation give 1/2 Score each	1/2	3
8		$P(A) = \frac{1}{2} \quad P(B) = \frac{7}{12}$ (i) $(A \cap B)' = A' \cup B'$ $P(A \cap B)' = P(A' \cup B') = \frac{1}{4}$ $\therefore P(A \cap B) = 1 - P(A \cap B)' = 3/4$ (ii) $P(A) \cdot P(B) = \frac{1}{2} \times \frac{7}{12} = \frac{7}{24}$ $\therefore P(A) \cdot P(B) \neq P(A \cap B)$ $\therefore A$ and B are not independent <u>NB</u> For analysing the problem give score 3.	2 1	3
9		(i) $A(2,4) \in R$ (ii) 2 divides $(a-a) \quad \forall a \in R$ $\therefore R$ 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 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 1 1	

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

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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 = $4 \times \int_0^3 y \, dx$ $= 4 \times \int_0^3 \frac{2}{3} \sqrt{9-x^2} \, dx$ $= \frac{8}{3} \left[\frac{x}{2} \sqrt{9-x^2} + \frac{9}{2} \sin^{-1} \frac{x}{3} \right]_0^3$ $= \frac{8}{3} \left[(0 + \frac{9}{2} \sin^{-1} 1) - 0 \right]$ $= 6\pi \text{ Sq. units}$ 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	4
13	(i) (c) 3 (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 1	4
14	(i) $\vec{a} = \vec{i} - 7\vec{j} + 7\vec{k}$ $\vec{b} = 3\vec{i} - 2\vec{j} + 2\vec{k}$			

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

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

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Qn No	Sub Qns	Answer key / Value Points	Score	Total Score
		$\bar{A} = \frac{\text{adj } A}{ A } = \frac{\begin{bmatrix} 2 & -2 & 0 \\ 0 & -1 & 1 \\ -4 & 3 & -1 \end{bmatrix}}{-2}$ $X = \bar{A} \cdot B$ $= -\frac{1}{2} \begin{bmatrix} 2 & -2 & 0 \\ 0 & -1 & 1 \\ -4 & 3 & -1 \end{bmatrix} \begin{bmatrix} 3 \\ 4 \\ 2 \end{bmatrix}$ $= -\frac{1}{2} \begin{bmatrix} -2 \\ -2 \\ -2 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ $x=1 \quad y=1 \quad z=1$ NB: (i) For any correct 6 elements of adj A give 1/2 score. (ii) Using this adj A and finding X, give 5/12 score	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 1	6
18	(i)	$y = x^x$ $\log y = \log x^x = x \log x$ $\therefore \frac{1}{y} \frac{dy}{dx} = x \cdot \frac{1}{x} + \log x$ $\frac{dy}{dx} = x(1 + \log x)$	1 1	
	(ii)	$x = at^2 \quad \frac{dx}{dt} = 2at$ $y = 2at - \frac{dy}{dt} = 2a$ $\frac{dy}{dx} = \frac{2a}{2at} = \frac{1}{t}$	1 1	

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

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

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		<u>NAME OF TEACHERS</u> 1. Geetha M <u>Geetha M</u> 2. V. P. GEETHA <u>Geetha</u> 3. L. JAYALAKSHMI 4. ASHRAF. U.T <u>Ashraf</u> 5. MARY CHRISTALDA.A 6. Sudheesh Kumar.S <u>Sudheesh</u> 7. FARISA. M		

