

ANSWER KEY

SECOND YEAR HIGHER SECONDARY EXAMINATION MARCH 2022

PART-I/II/III

SUBJECT: MATHEMATICS (S) 60

CODE NO: SY 27

VERSION: _____

60 SCORES

2 HOURS

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
1	A	Part I (a) $\{(1,1), (2,2), (3,3)\}$	1	
2		(a) $\frac{1}{2}$	1	
3		(b) $ A ^2$	1	
4		$P(E/F) = \frac{P(E \cap F)}{P(F)} = \frac{1}{2}$	$\frac{1}{2} + \frac{1}{2}$	
5		$\int_a^b y dx$ or $\int_0^2 x dx = 4$	$\frac{1}{2} + \frac{1}{2}$	
6		$\frac{dy}{dx} = 2x$, Slope = 4	$\frac{1}{2} + \frac{1}{2}$	
7		$\vec{AB} = \vec{OB} - \vec{OA}$, $\vec{AB} = 3\hat{i} - 3\hat{k}$	$\frac{1}{2} + \frac{1}{2}$	
8		(c) $(2, 1, 2)$	1	
9		1	1	
10	B	$\frac{\pi}{4}$ or 45°	1	
11		(b) 2	1	
12		$\frac{3}{\sqrt{38}}, \frac{-2}{\sqrt{38}}, \frac{5}{\sqrt{38}}$ Remark: direction ratios = $3, -2, 5$ give $\frac{1}{2}$ score 2. $ \vec{r} = \sqrt{38}$ give $\frac{1}{2}$ score 3. $\frac{a}{\sqrt{a^2+b^2+c^2}}, \frac{b}{\sqrt{a^2+b^2+c^2}}, \frac{c}{\sqrt{a^2+b^2+c^2}}$ give $\frac{1}{2}$ score	1	

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
13		$\frac{3x^2}{x^3}$ or $\frac{3}{x}$	1	4
14	A	Part II $x+y=5, 5+x=6$ $x=1, y=4$	$\frac{1}{2}+\frac{1}{2}$ $\frac{1}{2}+\frac{1}{2}$	2
15		$\frac{dx}{dt}=4, \frac{dy}{dt}=-5$ $A=xy$ $\frac{dA}{dt}=x \frac{dy}{dt} + y \frac{dx}{dt} = 10x - 5 + 5 \times 4$ $= -30$	$\frac{1}{2}+\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
16		$f'(x) = 3x^2 + 3$ $f'(x) > 0$ Therefore $f(x)$ is strictly increasing on $\mathbb{R}$	1 1	2
17		$y^2 dy = 2x dx$ $\int y^2 dy = \int 2x dx$ $\frac{y^3}{3} = x^2 + C$	1 $\frac{1}{2}$ $\frac{1}{2}$	2
18		$\begin{vmatrix} 1 & -1 & 1 \\ 3 & 1 & 2 \\ 1 & \lambda & -3 \end{vmatrix} = 0$ $1(-3-2\lambda) + 1(-9-2) + 1(3\lambda-1) = 0$ (Remark: $[\vec{a}, \vec{b}, \vec{c}] = 0$ give $\frac{1}{2}$ score) $\lambda = 15$	1 $\frac{1}{2}$ $\frac{1}{2}$	2
19		$\log y = \log(x^{\sin x})$ $\log y = \sin x \log x$ $\frac{1}{y} \frac{dy}{dx} = \frac{\sin x}{x} + \log x \cos x$ $\frac{dy}{dx} = x^{\sin x} \left[\frac{\sin x}{x} + \log x \cos x \right]$	1 1	2

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
20		$\frac{dy}{dx} - \frac{y}{x} = 2x$ $IF = e^{\int p dx}$ $= e^{-\log x}$ $= e^{\log(\frac{1}{x})} = \frac{1}{x}$	$\frac{1}{2}$ 1 $\frac{1}{2}$	2
21	A	PART-III $A' = \begin{bmatrix} 3 & -2 & -4 \\ 3 & -2 & -5 \\ -1 & 1 & 2 \end{bmatrix}$ $P = \frac{1}{2}(A + A') = \frac{1}{2} \begin{bmatrix} 6 & 1 & -5 \\ 1 & -4 & -4 \\ -5 & -4 & 4 \end{bmatrix}$ $Q = \frac{1}{2}(A - A') = \frac{1}{2} \begin{bmatrix} 0 & 5 & 3 \\ -5 & 0 & 6 \\ -3 & 6 & 0 \end{bmatrix}$ Therefore $A = P + Q$	$\frac{1}{2}$ 1 1 $\frac{1}{2}$	3
22		$x - x = 0$, integer $(x, x) \in R$, R is reflexive $x - y$ integer $\Rightarrow y - x$ integer $(x, y) \in R \Rightarrow (y, x) \in R$, Symmetric $x - y$ integer, $y - z$ integer $\Rightarrow x - z$ integer $(x, y) \in R, (y, z) \in R \Rightarrow (x, z) \in R$, transitive $\therefore R$ is an equivalence relation (Using example give 3 score)	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3
23		$P(E_1) = \frac{1}{2}, P(E_2) = \frac{1}{2}$ $P(A/E_1) = \frac{5}{8}, P(A/E_2) = \frac{3}{10}$ $P(E_2/A) = \frac{P(E_2) P(A/E_2)}{P(E_1) P(A/E_1) + P(E_2) P(A/E_2)}$	1 1 $\frac{1}{2}$	

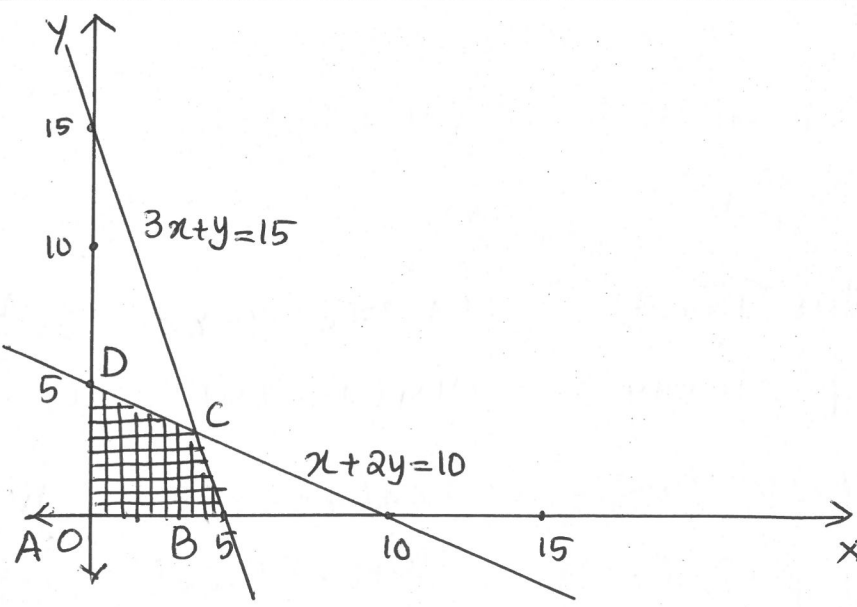
Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		$= \frac{\frac{1}{2} \times \frac{3}{10}}{\frac{1}{2} \times \frac{5}{8} + \frac{1}{2} \times \frac{3}{10}}$ $= \frac{12}{37}$	$\frac{1}{2}$	3
24	(a)	$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{vmatrix}$ $= \hat{i}(1-1) - \hat{j}(2-1) + \hat{k}(2-1)$ $= -\hat{j} + \hat{k}$	1 $\frac{1}{2}$ $\frac{1}{2}$	3
	(b)	$\text{Unit vector} = \frac{\vec{a} \times \vec{b}}{ \vec{a} \times \vec{b} } = \frac{-\hat{j} + \hat{k}}{\sqrt{2}}$ Remark 1 For any $\vec{a} \times \vec{b}$, correct unit vector give 1 score Remark 2 $\hat{a} = \frac{\vec{a}}{ \vec{a} }$ give $\frac{1}{2}$ score	$\frac{1}{2} + \frac{1}{2}$	
25	B	$A = I A$ $\begin{bmatrix} 1 & 3 \\ 2 & 7 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$ $\begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} A, R_2 \rightarrow R_2 - 2R_1$ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 7 & -3 \\ -2 & 1 \end{bmatrix} A, R_1 \rightarrow R_1 - 3R_2$ $A^{-1} = \begin{bmatrix} 7 & -3 \\ -2 & 1 \end{bmatrix}$ Remark Using the formula $A^{-1} = \frac{\text{Adj } A}{ A } = \begin{bmatrix} 7 & -3 \\ -2 & 1 \end{bmatrix}$ give 3 Score	1 $\frac{1}{2}$ 1 $\frac{1}{2}$	3

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
26	(a) (b)	$a \times e = a$ $\frac{ae}{3} = a, e = 3$ $3 \times b = e$ $\frac{3b}{3} = 3$ $b = 3$	$\frac{1}{2}$ $\frac{1}{2}$ 1 $\frac{1}{2}$ $\frac{1}{2}$	3
27		$f(x) = x^2, a = 0, b = 2, nh = 2$ $\int_a^b f(x) dx = \lim_{h \rightarrow 0} h [f(a) + f(a+h) + \dots + f(a+(n-1)h)]$ $\int_0^2 x^2 dx = \lim_{h \rightarrow 0} h [0 + h^2 + 2^2 h^2 + \dots + (n-1)^2 h^2]$ $= \lim_{h \rightarrow 0} h^3 \frac{n(n-1)(2n-1)}{6}$ $= \frac{8}{3}$ <u>Remark</u> $\int_0^2 x^2 dx = \left[\frac{x^3}{3} \right]_0^2 = \frac{8}{3}, \text{ give 2 Score}$	1 1 $\frac{1}{2}$ $\frac{1}{2}$	3
28	A	PART - IV $2 \tan^{-1} \left(\frac{1}{2} \right) = \tan^{-1} \left(\frac{2 \times \frac{1}{2}}{1 - \frac{1}{4}} \right) = \tan^{-1} \left(\frac{4}{3} \right)$ $2 \tan^{-1} \frac{1}{2} + \tan^{-1} \frac{1}{7} = \tan^{-1} \left(\frac{4}{3} \right) + \tan^{-1} \left(\frac{1}{7} \right)$ $= \tan^{-1} \left(\frac{\frac{4}{3} + \frac{1}{7}}{1 - \frac{4}{3} \times \frac{1}{7}} \right)$ $= \tan^{-1} \left(\frac{31}{17} \right)$ <u>Remark 1</u> For alternative method give 4 Score <u>Remark 2</u> $2 \tan^{-1} x = \tan^{-1} \left(\frac{2x}{1-x^2} \right)$ give $\frac{1}{2}$ score <u>Remark 3</u> $\tan^{-1} x + \tan^{-1} y = \tan^{-1} \left(\frac{x+y}{1-xy} \right) \rightarrow 1 \text{ Score}$	1 $\frac{1}{2}$ 2 $\frac{1}{2}$	4

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
29		$\text{Area} = \int_a^b y \, dx = \int_2^4 3\sqrt{x} \, dx$ $= 3 \left[\frac{x^{\frac{3}{2}}}{\frac{3}{2}} \right]_2^4$ $= \frac{6}{3} \left[4^{\frac{3}{2}} - 2^{\frac{3}{2}} \right]$ $= 2 [8 - 2\sqrt{2}]$ Remarks 1 Rough sketch of the region give 1 Score Remark 2 $\int_a^b y \, dx = \text{Area}$ give 1 Score	2 1 1	4
30	(a)	$\text{LHL} = \lim_{x \rightarrow 3^-} (3x+1) = 10$ $\text{RHL} = \lim_{x \rightarrow 3^+} (x^2+1) = 10$ $\text{LHL} = \text{RHL}, f(x) \text{ is continuous}$ Remark 1 Concept of continuity give 1 Score Remark 2 LHL = RHL give 1 Score	$\frac{1}{2} + \frac{1}{2}$ $\frac{1}{2} + \frac{1}{2}$	
	(b)	$f(x) \text{ is continuous in } [2, 4]$ $f(x) \text{ is differentiable in } (2, 4)$ $f(a) = f(c) = -15, f(b) = f(4) = -15$ $f'(c) = 0, 4c - 12 = 0,$ $c = 3 \in (2, 4)$ Remark: $f'(x) = 4x - 12$ give 1 Score	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	4
31	(a)	$\frac{x-x_1}{x_2-x_1} = \frac{y-y_1}{y_2-y_1} = \frac{z-z_1}{z_2-z_1} \text{ or } \frac{x-x_1}{a} = \frac{y-y_1}{b} = \frac{z-z_1}{c}$ $\frac{x-2}{2} = \frac{y-1}{3} = \frac{z}{3}$ Remark Vector method give 2 Score	1 1	
	(b)	$A(x-x_1) + B(y-y_1) + C(z-z_1) = 0$ $2(x-1) + 3(y-1) + 3(z-2) = 0$ $2x + 3y + 3z - 11 = 0 \text{ (vector method)}$	1 $\frac{1}{2}$ $\frac{1}{2}$	4

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score																								
32	B	<table border="1"><tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td></td></tr><tr><td>P(x)</td><td>$\frac{1}{6}$</td><td>$\frac{1}{6}$</td><td>$\frac{1}{6}$</td><td>$\frac{1}{6}$</td><td>$\frac{1}{6}$</td><td>$\frac{1}{6}$</td><td></td></tr><tr><td>x P(x)</td><td>$\frac{1}{6}$</td><td>$\frac{2}{6}$</td><td>$\frac{3}{6}$</td><td>$\frac{4}{6}$</td><td>$\frac{5}{6}$</td><td>$\frac{6}{6}$</td><td>$\Sigma = \frac{21}{6}$</td></tr></table> Mean = $\sum x P(x) = 1 \times \frac{1}{6} + 2 \times \frac{1}{6} + 3 \times \frac{1}{6} + 4 \times \frac{1}{6} + 5 \times \frac{1}{6} + 6 \times \frac{1}{6}$ $= \frac{21}{6}$ Remark 1 $S = \{1, 2, 3, 4, 5, 6\}$ give 1 score Remark 2 $P(E) = \frac{1}{6}$ give $\frac{1}{2}$ score	x	1	2	3	4	5	6		P(x)	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$		x P(x)	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$	$\frac{6}{6}$	$\Sigma = \frac{21}{6}$	3 1	4
x	1	2	3	4	5	6																						
P(x)	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$																						
x P(x)	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$	$\frac{6}{6}$	$\Sigma = \frac{21}{6}$																					
33	(a)	$a_1, b_1, c_1 = 3, -2, 1; a_2, b_2, c_2 = 2, 1, 2$ $\cos \theta = \frac{a_1 a_2 + b_1 b_2 + c_1 c_2}{\sqrt{a_1^2 + b_1^2 + c_1^2} \sqrt{a_2^2 + b_2^2 + c_2^2}}$ $= \frac{6}{3\sqrt{14} \sqrt{14}} = \frac{2}{14}$ Remark 1 $a_1, b_1, c_1 = 3, -2, 1$ and $a_2, b_2, c_2 = 2, 1, 2$ give 1 score Remark 2 Using vector formula give 2 score (b) $(3x - 2y + z + 6) + k(2x + y + 2z - 6) = 0$ $k = 1$ $5x - y + 3z = 0$ Remark: Using vector method give 2 score	1 1 1 $\frac{1}{2}$ $\frac{1}{2}$	4																								
34		PART V $A = \begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -3 \\ 3 & -2 & 4 \end{bmatrix}$ $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ $B = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$ $A = -1$ $\text{Adj } A = \begin{bmatrix} 2 & 0 & -1 \\ -9 & -2 & 3 \\ -6 & -1 & 2 \end{bmatrix}$ $A^{-1} = \frac{\text{Adj } A}{ A } = -1 \begin{bmatrix} 2 & 0 & -1 \\ -9 & -2 & 3 \\ -6 & -1 & 2 \end{bmatrix}$ $X = A^{-1} B$	1 1 2 $\frac{1}{2} + \frac{1}{2}$ $\frac{1}{2}$																									

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score																		
		$X = \begin{bmatrix} 0 \\ 5 \\ 3 \end{bmatrix}$ $x=0, y=5, z=3$	$\frac{1}{2}$	6																		
35	(a)	$\frac{x}{(x+1)(x+2)} = \frac{A}{x+1} + \frac{B}{x+2}$ $A = -1, B = 2$ $\int \frac{x}{(x+1)(x+2)} dx = \int \frac{-1}{x+1} dx + \int \frac{2}{x+2} dx$ $= -\log x+1 + 2\log x+2 + C$	1 $\frac{1}{2}$ $\frac{1}{2}$	6																		
	(b)	$I = \int_0^{\frac{\pi}{2}} \frac{\sin^4 x}{\sin^4 x + \cos^4 x} dx \quad \text{--- (1)}$ $= \int_0^{\frac{\pi}{2}} \frac{\sin^4(\frac{\pi}{2} - x)}{\sin^4(\frac{\pi}{2} - x) + \cos^4(\frac{\pi}{2} - x)} dx$ $I = \int_0^{\frac{\pi}{2}} \frac{\cos^4 x}{\cos^4 x + \sin^4 x} dx \quad \text{--- (2)}$ $2I = \int_0^{\frac{\pi}{2}} \frac{\sin^4 x + \cos^4 x}{\sin^4 x + \cos^4 x} dx$ $= \int_0^{\frac{\pi}{2}} 1 dx = \frac{\pi}{2}$ $I = \frac{\pi}{4}$	1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$																			
		Remark 1: $\int_0^a f(x) dx = \int_0^a f(a-x) dx$ give 1 score Remark 2: $\sin(\frac{\pi}{2} - x) = \cos x$ give $\frac{1}{2}$ score																				
36		<table><tr><td colspan="3">$x+2y=10$</td></tr><tr><td>x</td><td>0</td><td>10</td></tr><tr><td>y</td><td>5</td><td>0</td></tr></table> <table><tr><td colspan="3">$3x+y=15$</td></tr><tr><td>x</td><td>0</td><td>5</td></tr><tr><td>y</td><td>15</td><td>0</td></tr></table>	$x+2y=10$			x	0	10	y	5	0	$3x+y=15$			x	0	5	y	15	0	$\frac{1}{2} + \frac{1}{2}$	
$x+2y=10$																						
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		 Corner points $A(0,0)$, $B(5,0)$, $C(4,3)$, $D(0,5)$ Maximum value of $Z = 18$ Remark 1 Another feasible region give $\frac{1}{2}$ score Remark 2 Each correct line give 1 score Remark 3 Only drawing x, y axes give 1 score	3 1 1	6

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