Kerala Board

Answer Key

2024

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ANSWER KEY

7/12

SECOND YEAR HIGHER SECONDARY EXAMINATION ..March..... 20.24

PART ~~I/II~~/III

SUBJECT: MATHEMATICS (Science)

CODE NO: . SY 527 VERSION:..R....

60.... SCORES ..2.... HOURS

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
1	i	$R = \{(1,1),(2,3)(3,5)\}$	1	
		Domain $= \{1,2,3\}$ Range $= \{1,3,5\}$	(1/2+1/2)	
	ii	$(2,3) \in R$ but $(3,2) \notin R$ ∴ R is not Symmetric ∴ R is not an equivalence relation [not reflexive, not transitive] 1		3
		Any other method give full mark		
2.		$A^2 = A \times A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}\begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 8 & 5 \\ -5 & 3 \end{bmatrix}$	1	
		$5A = \begin{bmatrix} 15 & 5 \\ -5 & 10 \end{bmatrix}$ $7I = \begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix}$	1/2+1/2	3
		$A^2 - 5A + 7I = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$	1	
3	i	$\lim_{x \to 1} f(x) = \lim_{x \to 1} 2x+3 = 5$	1/2	
		$f(1) = 5$	1/2	
		∴ f is continuous at $x = 1$		
	ii)	$\lim_{x \to 5^+} f(x) = \lim_{x \to 5^-} f(x)$	1/2	3
		$\lim_{x \to 5} kx+1 = \lim_{x \to 5} 3x-5$	1	
		$5k+1 = 15-5$		
		$k = 9/5$	1/2	

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
4	i	$\frac{\pi}{6}$	1	
	ii	$\tan^{-1}\left[2\cos\left(2\times\frac{\pi}{6}\right)\right] = \tan^{-1}\left[2\cos\frac{\pi}{3}\right]$	1	3
		$= \tan^{-1}\left(2\times\frac{1}{2}\right) = \tan^{-1}(1) = \frac{\pi}{4}$	1/2+1/2	
5	i	(D) log x	1	
	ii	$f'(x) = 2x - 4$	1/2	
		$2x - 4 = 0$	1/2	3
		$x = 2$		
		$(-\infty, 2)$, $f'(x) < 0$ ∴ f(x) decreasing	1/2	
		$(2, \infty)$ $f'(x) > 0$ ∴ f(x) is increasing	1/2	
6	i	$\frac{\pi}{4}$	1	
	ii)	Projection of $\vec{a}$ on $\vec{b} = \frac{\vec{a}\cdot\vec{b}}{\lvert\vec{b}\rvert}$	1	3
		$= \frac{(i-j)\cdot(i+j)}{\sqrt{1^2+1^2}} = \frac{1-1}{\sqrt{2}}$	1	
		$= 0$		
		(If $\vec{a}\cdot\vec{b} = 0$ only give 1/2 score $\lvert\vec{b}\rvert = \sqrt{2}$ give 1/2 score)		

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
7		$P(A \cap B) = P(A)\ P(B) = 0.3 \times 0.4 = 0.12$	1/2 + 1/2	
		$P(A \cup B) = P(A) + P(B) - P(A \cap B)$		
		$= 0.3 + 0.4 - 0.12 = 0.58$	1	3
		$P(A/B) = \frac{P(A \cap B)}{P(B)} = \frac{0.12}{0.4} = 0.3$	1	
8		$x^5 + 1 = t$	1/2	
		$5x^4\,dx = dt$	1/2	
		When $x = -1$ $t = 0$ When $x = 1$, $t = 2$		3
		$\int_0^2 \sqrt{t}\,dt = \frac{2}{3}\left[t^{3/2}\right]_0^2 =$	1	
		$= \frac{2}{3}\left[2^{3/2} - 0\right] = \frac{2^{5/2}}{3}$	1	
9	i)	4	1	
	ii)	$\forall\ x_1, x_2 \in A$		
		$f(x_1) = f(x_2)$		
		$\frac{x_1 - 2}{x_1 - 3} = \frac{x_2 - 2}{x_2 - 3}$	1	
		$(x_1 - 2)(x_2 - 3) = (x_1 - 3)(x_2 - 2)$		
		$x_1x_2 - 3x_1 - 2x_2 + 6 = x_1x_2 - 2x_1 - 3x_2 + 6$		
		$-x_1 = -x_2$		
		$x_1 = x_2 \therefore f$ is 1-1	1/2	

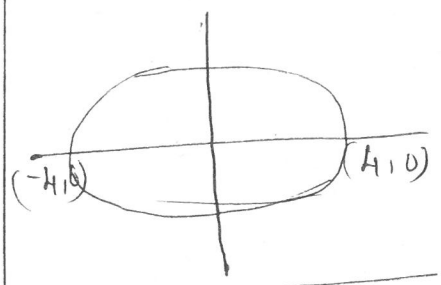
Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		Let $y = \frac{x-2}{x-3} \Rightarrow xy - 3y = x - 2$ $\Rightarrow xy - x = 3y - 2$ $x = \frac{3y-2}{y-1} \in A$ ∴ f is onto From the above clear that $\forall y$ except 1 i.e $\forall y \in B = R - \{1\} \exists x \in A$ s.t $f(x) = y$	$\frac{1}{2}+\frac{1}{2}$ $\frac{1}{2}$	4
10	i	$-A$	1	
	ii	$A^T = \begin{bmatrix} 2 & -1 & 1 \\ -2 & 3 & -2 \\ -4 & 4 & -3 \end{bmatrix}$	$\frac{1}{2}$	
		$P = \frac{A+A^T}{2} = \frac{1}{2}\begin{bmatrix} 4 & -3 & -3 \\ -3 & 6 & 2 \\ -3 & 2 & -6 \end{bmatrix}$, Which is symmetric	$\frac{1}{2}+\frac{1}{2}$	4
		$Q = \frac{A-A^T}{2} = \frac{1}{2}\begin{bmatrix} 0 & -1 & -5 \\ 1 & 0 & 6 \\ 5 & -6 & 0 \end{bmatrix}$	$\frac{1}{2}+\frac{1}{2}$	
		Which is skew symmetric $P + Q = A$	$\frac{1}{2}$	
11		Let x be the length of the square piece and $28-x$ be the length of circular piece	1	
		Perimeter of Square $= x$ $4a = x \quad a = \frac{x}{4}$	$\frac{1}{2}$	

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		Area of Square $= a^2 = \frac{x^2}{16}$	1/2	
		Circumference of circle $= 28 - x$		
		$2\pi r = 28 - x$		
		$r = \frac{28-x}{2\pi}$		
		Area of circle $= \pi r^2 = \pi \frac{(28-x)^2}{4\pi^2}$	1/2	
		$= \frac{(28-x)^2}{4\pi}$		
		Combained Area $A = \frac{x^2}{16} + \frac{(28-x)^2}{4\pi}$		
		$\frac{dA}{dx} = \frac{2x}{16} + \frac{2(28-x)}{4\pi} \times -1$	1/2	
		$= \frac{x}{8} - \frac{28-x}{2\pi}$		4
		$\frac{d^2A}{dx^2} = \frac{1}{8} - \frac{1}{2\pi} \times -1$ Which is +ve	1/2	
		So Area is minimum		
		$\frac{dA}{dx} = \frac{x}{8} - \frac{28-x}{2\pi} = 0$		
		$\frac{x - 4(28-x)}{8\pi} = 0$		
		$x = \frac{112}{\pi+4}$	1/2	
		Length of Square piece $= \frac{112}{\pi+4}$		
		Length of Other piece $= 28 - \frac{112}{\pi+4}$		
		$= \frac{28\pi}{\pi+4}$		

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
12	i	Order - 2 degree - not defined	1/2 1/2	
	ii	$\frac{dy}{dx} + \frac{2}{x} y = x$ $\quad P = 2/x$ $I.F = e^{\int P dx} = e^{\int \frac{2}{x} dx} =$ $= x^2$	1 1/2 1/2	4
	iii	Soln: $y \times x^2 = \int x \times x^2 dx$ $y x^2 = \frac{x^4}{4} + C$	1	
13	i	$\vec{a} + \vec{b} = 2i + 3j + 4k$ $\vec{a} - \vec{b} = 0i - j - 2k$	1/2 1/2	
	ii	$(\vec{a}+\vec{b}) \times (\vec{a}-\vec{b}) = \begin{vmatrix} i & j & k \\ 2 & 3 & 4 \\ 0 & -1 & -2 \end{vmatrix}$ $= i - 2i + 4j - 2k$ Unit vector $\perp^{lr}$ to $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$ is $= \frac{-2i + 4j - 2k}{\sqrt{4+16+4}}$ $= \frac{-2i + 4j - 2k}{2\sqrt{6}}$ OR USING formula $\frac{\vec{a} \times \vec{b}}{\lvert \vec{a} \times \vec{b} \rvert}$ give 3 score	2 1	4

+/12

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
14		$\vec{a_1} = \hat{i}+\hat{j}$ $\vec{b_1} = 2\hat{i}-\hat{j}+\vec{k}$ $\vec{a_2} = 2i+j-k$ $\vec{b_2} = 3i-5j+2k$	1	
		$\vec{b_1} \times \vec{b_2} = \begin{vmatrix} i & j & k \\ 2 & -1 & 1 \\ 3 & -5 & 2 \end{vmatrix} = 3i-j-7k$	1	
		$a_2 - a_1 = i-k$	1/2	4
		$\lvert \vec{b_1} \times \vec{b_2} \rvert = \sqrt{59}$		
		$S.D = \left\lvert \frac{(\vec{a_2}-\vec{a_1}) \cdot (\vec{b_1} \times \vec{b_2})}{\lvert \vec{b_1} \times \vec{b_2} \rvert} \right\rvert$	1	
		$= \left\lvert \frac{(i-k) \cdot (3i-j-7k)}{\sqrt{59}} \right\rvert$	1/2	
		$= \frac{10}{\sqrt{59}}$		
15		A : getting a defective bolt		
		E_1 - Choosing machine A		
		E_2 - Choosing machine B		
		E_3 : Choosing machine C	1	
		$P(E_1) = .25$ $P(E_2) = .35$ $P(E_3) = .45$	1	
		$P(A/E_1) = .05$ $P(A/E_2) = .04$ $P(A/E_3) = .02$	1	
		$P(E_2/A) = \frac{P(E_2)\,P(A/E_2)}{P(E_1)P(A/E_1) + P(E_2)P(A/E_2) + P(E_3)P(A/E_3)}$	1	4

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
16		 $y = \frac{3}{4}\sqrt{16-x^2}$	1½	
		$\therefore A = 4\left\lvert \int_0^4 y\,dx \right\rvert$	1	
		$= 4\left\lvert \frac{3}{4}\int_0^4 \sqrt{4^2-x^2}\,dx \right\rvert$		4
		$= 3\left[\frac{x}{2}\sqrt{4^2-x^2} + \frac{4^2}{2}\sin^{-1}\frac{x}{4}\right]_0^4$	1	
		$= 3\left[\sin^{-1}1 - 0\right] = 3\times\frac{8\pi}{2}$	1/2	
		Remark: $= 12\pi$ Sq. Unit Direct answer give 1 score		
17		$A = \begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix}$ $B = \begin{bmatrix} 11 \\ -5 \\ -3 \end{bmatrix}$	1	
		$X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$		
		$\lvert A\rvert = 2\times 0 + 3\times -2 + 5 = -1$	1	
		$\therefore A^{-1}$ exist		
		Cofactor matrix of $A = \begin{bmatrix} 0 & 2 & 1 \\ -1 & -9 & -5 \\ 2 & 23 & 13 \end{bmatrix}$	1	

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		$A^{-1} = \frac{adj\,A}{|A|} = \frac{\begin{bmatrix} 0 & -1 & 2 \\ 2 & -9 & 23 \\ 1 & -5 & 13 \end{bmatrix}}{-1}$	1	6
		$X = A^{-1}B = \frac{-1}{1}\begin{bmatrix} 0 & -1 & 2 \\ 2 & -9 & 23 \\ 1 & -5 & 13 \end{bmatrix}\begin{bmatrix} 11 \\ -5 \\ -3 \end{bmatrix}$	1	
		$= -\begin{bmatrix} -1 \\ -2 \\ -3 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$	1	
18	i	$\cos x - \sin y \frac{dy}{dx} = x\frac{dy}{dx} + y$	1	
		$\frac{dy}{dx} = \frac{\cos x - y}{x + \sin y}$	1	
	ii	$\frac{dx}{dt} = 3a\cos^2 t \, x - \sin t$	1/2	
		$\frac{dy}{dt} = 3a\sin^2 t \cos t$	1/2	
		$\frac{dy}{dx} = \frac{dy/dt}{dx/dt} = -\frac{3a\cos^2 t \sin t}{3a\sin^2 t \cos t}$	1	
		$= -\frac{\sin t}{\cos t} = -\tan t$		
	iii	$\frac{dy}{dx} = 2\sin^{-1}x \times \frac{1}{\sqrt{1-x^2}}$	1	
		$\sqrt{1-x^2}\frac{dy}{dx} = 2\sin^{-1}x$		

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		Deb; $\sqrt{1-x^2}\frac{d^2y}{dx^2} + \frac{dy}{dx} \times \frac{1}{2\sqrt{1-x^2}} \times -2x = 2 \times \frac{1}{\sqrt{1-x^2}}$	1	6
		$(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} = 2$		
19	i	$\frac{x-1}{(x-2)(x-3)} = \frac{A}{x-2} + \frac{B}{x-3}$	1	
		$x-1 = A(x-3) + B(x-2)$		
		$x=2,\ A=-1$	1	
		$x=3,\ B=2$		
		$\int \frac{x-1}{(x-2)(x-3)} = \int -\frac{1}{x-2}dx + \int \frac{2}{x-3}dx$	½	
		$= -\log\lvert x-2\rvert + 2\log\lvert x-3\rvert$	½	
	ii	$I = \int_0^{\frac{\pi}{4}} \log(1+\tan x)\,dx = \int_0^{\frac{\pi}{4}} \log\left(1+\tan\left(\frac{\pi}{4}-x\right)\right)dx$	1	
		$= \int_0^{\frac{\pi}{4}} \log\left(1 + \frac{\tan\frac{\pi}{4} - \tan x}{1+\tan\frac{\pi}{4}\tan x}\right)dx$		
		$= \int_0^{\frac{\pi}{4}} \log\left(\frac{1+\tan x + 1-\tan x}{1+\tan x}\right)dx$	½	

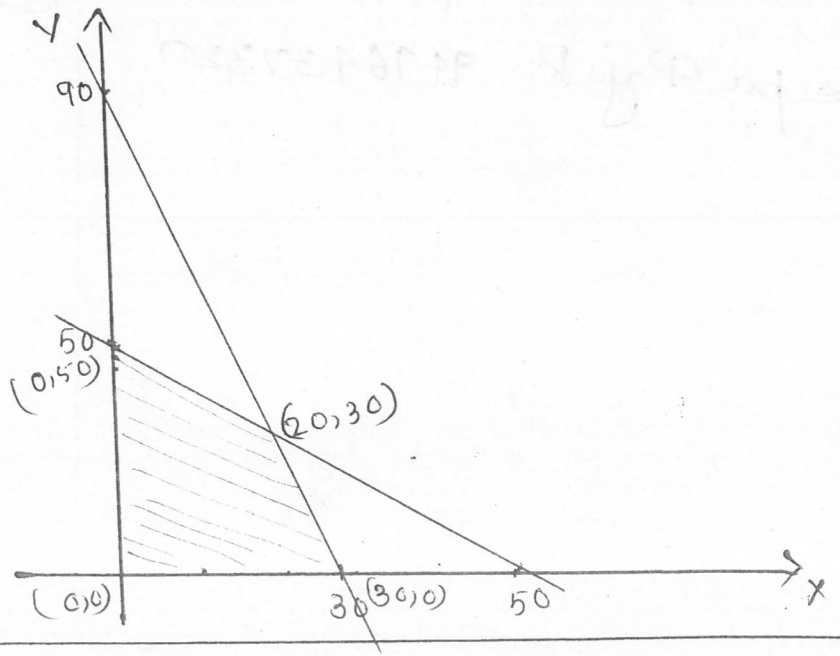
Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		$\int_0^{\frac{\pi}{4}} \log\left(\frac{2}{1+\tan x}\right) dx = \int_0^{\frac{\pi}{4}} (\log 2 - \log(1+\tan x)) dx$		
		$= \int_0^{\frac{\pi}{4}} \log 2 \, dx - \int_0^{\frac{\pi}{4}} \log(1+\tan x) \, dx$		
		$= \int_0^{\frac{\pi}{4}} \log 2 \, dx - I$	1	
		$2I = \int_0^{\frac{\pi}{4}} \log 2 \, dx = \frac{\pi}{4} \log 2$		6
		$I = \frac{\pi}{8} \log 2$	1/2	
		$\int_0^{\frac{\pi}{4}} \log(1+\tan x) \, dx = \frac{\pi}{8} \log 2$		
		Remark: Try to answer using the property give 3 score.		
20				
20.		$x+y \leq 50$		

x	0	50
y	50	0

$3x+y \leq 90$

x	0	30
y	90	0

1



3

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		$Z = 60x + 15y$ Corner points: (0,0), (30,0), (0,50), (20,30) $Z = 60x + 15y$: 0, 1800, 750, 1650 Maximum value occurs at (30,0) The solution is $Z = 1800$ at (30,0)	2	6

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