RUBRICS: HSSC ANNUAL EXAMINATION 2024
SUBJECT: MATHEMATICS HSSC-I (D)

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
$2(i)$	Simplifying z in the form of $a+ib$ and finding the value of $\|z\|$.	Correctly finding the product in numerator and denominator **AND** Correctly multiplying and dividing by the conjugate of denominator (2)	Correctly finding the product in numerator and denominator **OR** Correctly multiplying and dividing by the conjugate of denominator (1)	Partially correct response (0.5)	Wrong response (0)		
		Correctly simplifying z in the form of $a+ib$ **AND** Correctly finding $\|z\|$ (2)	Correctly simplifying z in the form of $a+ib$ **OR** Correctly finding $\|z\|$ (1)	Partially correct response (0.5)	Wrong response (0)		
$2(i)$	Solving for x.	Correctly stating $\|A\|=0$ **AND** Correctly expanding LHS (2)	Correctly stating $\|A\|=0$ **AND** Partially correct expanding LHS (1.5)	Correctly stating $\|A\|=0$ **OR** Partially correct expanding LHS (1)	Correctly stating $\|A\|=0$ **AND** Incorrect expanding LHS (0.5)	Wrong Answer (0)	
		Correctly simplifying and writing in quadratic equation (1)	Partially correct (0.5)	Wrong answer (0)			
		Correctly finding two values of x (1)	Any one correct value of x (0.5)	Wrong answer (0)			
$2(ii)$	Solving the system of linear equations.	Correctly multiplying eq(1) with $(1+i)$ and eq(2) with $(2+3i)$ **AND** Correctly simplifying (2)	Correctly multiplying eq(1) with $(1+i)$ and eq(2) with $(2+3i)$ **OR** Correctly simplifying (1)	Partially correct response (0.5)	Wrong response (0)		
		Correctly finding the values of x **AND** y. (2)	Correctly finding the values of x **OR** y. (1)	Partially correct response (0.5)	Wrong Answer (0)		
$2(ii)$	Finding the work done.	Correctly finding the sum of forces **AND** Correctly finding the distance from P to Q (2)	Correctly finding the sum of forces **OR** Correctly finding the distance from P to Q (1)	Partially correct response (0.5)	Wrong Answer (0)		

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		Correctly stating the work done formula **AND** Correctly finding the work done (2)	Correctly stating the work done formula **OR** Correctly finding the work done (1)	Partially correct response (0.5)	Wrong Answer (0)		
$2(iii)$	Showing that $(A - A^t)$ is skew-symmetric.	Correctly finding A^t **AND** Correctly finding $(A - A^t)$ (2)	Correctly finding A^t **OR** Correctly finding $(A - A^t)$ (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly finding $(A - A^t)^t$ **AND** Correctly showing the required result (2)	Correctly finding $(A - A^t)^t$ **OR** Correctly showing the required result (1)	Partially correct (0.5)	Wrong Answer (0)		
$2(iii)$	Finding number of different arrangements that can be made from the letters of word PARALLELOGRAM. How many of these begin with PE and end with OM?	Correctly stating the number of letters **AND** Correctly finding the total arrangements (2)	Correctly stating the number of letters **OR** Correctly finding the total arrangements (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly stating the number of letters by treating PE and OM as single **AND** Correctly finding the total arrangements (2)	Correctly stating the number of letters by treating PE and OM as single **OR** Correctly finding the total arrangements (1)	Partially correct (0.5)	Wrong Answer (0)		
$2(iv)$	Inserting four G.Ms between 7 and 1701.	Correctly stating GP **AND** finding the common ratio r (2)	Correctly stating GP **OR** finding the common ratio r (1)	Partially correct (0.5)	Wrong answer (0)		
		Correctly finding the four G.Ms. (2)	Any three correctly stated aspects (1.5)	Any two correctly stated aspects (1)	Any one correctly stated aspect (0.5)	Wrong answer (0)	
$2\ (iv)$	Finding the volume of parallelopiped with vertices	Correctly finding all three coterminous edge vectors (1.5)	Finding any two correctly stated aspects (1)	Finding any one correctly stated aspect (0.5)	Wrong Answer (0)		

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
	$A(0,1,2), B(1,2,1), C(5,5$ and $D(3,3,1)$	Correctly formulating the volume of parallelopiped **AND** Correctly finding the volume of parallelopiped (2.5)	Correctly formulating the volume of parallelopiped **AND** Finding partially correct volume of parallelopiped (2)	Correctly formulating the volume of parallelopiped **OR** Finding partially correct volume of parallelopiped (1.5)	Correctly formulating the volume of parallelopiped **AND** Finding incorrect volume of parallelopiped (1)	Wrong Formula (0)	
$2(v)$	Finding the sum of first 20 terms of an AP.	Correctly finding the value of first term (a_1) **AND** common difference (d). (2)	Correctly finding the values of first term (a_1) **OR** common difference (d). (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly stating general formula for sum of n-terms of an AP **AND** Correctly finding S_{20}. (2)	Correctly stating sum of first 20 terms of an AP **OR** Correctly finding S_{20}. (1)	Partially correct (0.5)	Wrong Answer (0)		
$2(v)$	Finding sum to n-terms of the series $1.2 + 2.3 + 3.4 + \cdots$	Correctly finding general term of the series **AND** Correctly applying the sigma notations (2)	Correctly finding nth term of the series **AND** Applying one correct sigma notation (1.5)	Correctly finding nth term of the series **AND** Applying wrong sigma notations (1)	Partially correct Response (0.5)	Wrong Answer (0)	
		Correctly substituting the values of sigma notations **AND** Correctly finding sum of the series in simplified form (2)	Correctly substituting the values of sigma notations **AND** Finding partially correct sum of the series (1.5)	Correctly substituting the values of sigma notations **AND** Finding incorrect sum of the series (1)	Partially correct Response (0.5)	Wrong Answer (0)	
$2(v\text{i})$	Verifying by using mathematical induction.	Correctly verifying $S(1)$ **AND** Correctly stating $S(k)$ (2)	Correctly verifying $S(1)$ **OR** Correctly stating $S(k)$ (1)	Partially correct (0.5)	Wrong Answer (0)		

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		Correctly adding $(4k+3)$ **AND** Correctly verifying the required result (2)	Correctly adding $(4k+3)$ **OR** Correctly verifying the required result (1)	Partially correct (0.5)	Wrong Answer (0)		
$2(vi)$	Finding the values of $'n'$ and $'r'$ from given permutation and combination.	Correctly stating permutation **AND** combination (2)	Correctly stating permutation **OR** combination (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly finding 'n' **AND** 'r' (2)	Correctly finding 'n' **OR** 'r' (1)	Partially correct (0.5)	Wrong Answer (0)		
$2(vii)$	Finding 35^{th} term of the HP.	Correctly expressing 8^{th} **AND** 17^{th} terms of HP in AP (2)	Correctly expressing 8^{th} **OR** 17^{th} terms of HP in AP (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly finding a_1 and d from AP **AND** Correctly finding 35^{th} term and expressing the result in HP (2)	Correctly finding a_1 and d from AP **OR** Correctly finding 35^{th} term and expressing the result in HP (1)	Partially correct (0.5)	Wrong Answer (0)		
$2(vii)$	For the given real-valued function, finding $f^{-1}(x)$ and determining its domain and range	Correctly expressing x in terms of y **AND** Correctly finding the value of $f^{-1}(x)$ (2)	Correctly expressing x in terms of y **AND** Finding incorrect value of $f^{-1}(x)$ (1)	Wrong expression of x in terms of y (0)			
		Correctly finding domain of f^{-1} **AND** Correctly finding range of f^{-1} (2)	Correctly finding domain of f^{-1} **OR** Correctly finding range of f^{-1} (1)	Partially Correct Response (0.5)	Wrong Findings (0)		
$2(viii)$	Finding $P(A \cup B)$.	Correctly writing the sample space. (1)	Wrong answer (0)				

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		Correctly finding $P(A)$, and $P(B)$. (2)	Any one correct aspect. (1)	Partially correct (0.5)	Wrong answer (0)		
		Correctly finding $P(A \cup B)$ (1)	Wrong answer (0)				
$2(viii)$	Guessing the graph of $y = \cos\frac{\theta}{6}$ (without drawing it) and finding the period, frequency, and amplitude of the function	Correctly stating the expanded graph as $\frac{1}{6}th$ cycle of $y = cos\theta$ (1)	Wrong answer (0)				
		Correctly finding the period, frequency, and amplitude of the function (3)	Any two correctly stated aspects (2)	Any one correctly stated aspect (1)	Stating all aspects wrong (0)		
$2(ix)$	If $Sec\alpha = \frac{5}{4}$, $Sec\beta = 13/5$, then finding the value of $\tan(\alpha + \beta)$.	Correctly converting $Sec\alpha$ and $Sec\beta$ into $Cos\alpha$ and $Cos\beta$ (1)	Partially Correct aspect (0.5)	Wrong Answer (0)			
		Correctly finding $Sin\alpha$ and $Sin\beta$ (2)	Correctly finding any one aspect (1)	Partially Correct aspect (0.5)	Wrong Answer (0)		
		Correctly finding $\tan(\alpha + \beta)$ (1)	Partially Correct aspect (0.5)	Wrong Answer (0)			
$2(ix)$	Solving triangle ABC with usual notations	Correctly stating the law of cosines **AND** law of sines (1)	Correctly stating the law of cosines **OR** law of sines (0.5)	Wrong answer (0)			
		Correctly finding the values of b, α and γ. (3)	Any two correct aspects (2)	Any one correct aspect (1)	Partially correct (0.5)	Wrong answer (0)	
$2(x)$	Verifying that $Cos3\theta + Cos5\theta + Cos7\theta + Cos9\theta = 4Cos\theta Cos2\theta Cos6\theta$.	Correctly expressing the sum $cos9\theta + cos3\theta$ as product **AND** Correctly expressing the sum $cos7\theta + cos5\theta$ as product (2)	Correctly expressing the sum $cos9\theta + cos3\theta$ as product **OR** Correctly expressing the sum $cos7\theta + cos5\theta$ as product (1)	Wrong Expressions (0)			

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		Correctly factoring the sum of products **AND** Correctly expressing the sum $cos3\theta + cos\theta$ as product (2)	Correctly factoring the sum of products **AND** Expressing the sum $cos3\theta + cos\theta$ incorrectly as product (1)	Incorrect Factoring (0.5)	Aspects stated wrongly (0)		
$2(x)$	Finding radii ('R' and 'r') of circumscribed and inscribed circles of triangle ABC with side measures.	Correctly finding 's' **AND** 'Δ' (2)	Correctly finding 's' **OR** 'Δ' (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly finding 'R' **AND** 'r' (2)	Correctly finding 'R' **OR** 'r' (1)	Partially correct (0.5)	Wrong Answer (0)		
$2(xi)$	Verifying that $2r = 8R\sin\frac{\alpha}{2}\sin\frac{\beta}{2}\sin\frac{\gamma}{2}$	Correctly substituting all four values of $R, \sin\frac{\alpha}{2}, \sin\frac{\beta}{2}$ and $\sin\frac{\gamma}{2}$ (2)	Any three correctly stated aspects (1.5)	Any two correctly stated aspects (1)	Any one correctly stated aspect (0.5)	Stating all aspects wrong (0)	
		Correctly verifying the result (2)	Partially correct (1)	Wrong Answer (0)			
$2(xi)$	Verifying $Sin^4\theta = \frac{1}{8}(3 + cos4\theta - 4cos2\theta)$	Correctly applying the Half-Angle Identity $\sin^2\theta = \frac{1-\cos 2\theta}{2}$ **AND** Correctly simplifying (2)	Correctly applying the Half-Angle Identity $\sin^2\theta = \frac{1-\cos 2\theta}{2}$ **AND** Simplifying incorrectly (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly applying the Half-Angle Identity $\cos^2 2\theta = \frac{1+\cos 4\theta}{2}$ **AND** Correctly simplifying (2)	Correctly applying the Half-Angle Identity $\cos^2 2\theta = \frac{1+\cos 4\theta}{2}$ **AND** Simplifying incorrectly (1)	Partially correct (0.5)	Wrong Answer (0)		

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
$2(xii)$	Verifying that $\left(\sin^{-1}\frac{1}{\sqrt{5}} + \sin^{-1}\frac{1}{\sqrt{10}}\right) + \left(\cos^{-1}\frac{2}{\sqrt{5}} + \cos^{-1}\frac{3}{\sqrt{10}}\right) = \frac{\pi}{2}$	Correctly converting sum of Sine inverse to single term of inverse Sine function **AND** Correctly converting sum of Cosine inverse to single term of inverse Cosine function (2)	Correctly converting sum of Sine inverse to single term of inverse Sine function **OR** Correctly converting sum of Cosine inverse to single term of inverse Cosine function (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly verifying the result (2)	Partially correct (1)	Wrong Answer (0)			
$2(xii)$	Finding the equation of parabola $y = ax^2 + bx + c$ that cuts $x-$axis at points $(-5,0), (4,0)$ and passes through a point $(1,18)$.	Correctly finding three simultaneous equations by substituting three points. (1)	Partially correct (0.5)	Wrong Answer (0)			
		Correctly finding the values of a, b, and c (3)	Correctly finding any two values (2)	Correctly finding any one value (1)	Wrong Answer (0)		
3	Finding inverse of the matrix.	Correctly appending the identity matrix (1)	Wrong appending (0)				
		Correctly applying the elementary row operations **AND** Correctly setting 1st column as $\begin{bmatrix}1\\0\\0\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}1\\0\\0\end{bmatrix}$ (1)	Wrong elementary row operations (0)			
		Correctly applying the row operations **AND** Correctly setting 2nd column as $\begin{bmatrix}0\\1\\0\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}0\\1\\0\end{bmatrix}$ (1)	Wrong elementary row operations (0)			

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		Correctly applying the row operations **AND** Correctly setting 3rd column as $\begin{bmatrix}0\\0\\1\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}0\\0\\1\end{bmatrix}$ (1)	Wrong elementary row operations (0)			
		Correctly stating the inverse matrix (1)	Stating incorrect inverse matrix (0)				
3	Finding a vector of magnitude 14 units orthogonal to vectors $\underline{a}$ and $\underline{b}$ both. Also find angle between the vectors $\underline{a}$ and $\underline{b}$.	Correctly stating $\underline{a} \times \underline{b}$ in determinate form **AND** Correctly finding $\underline{a} \times \underline{b}$. (2)	Correctly stating $\underline{a} \times \underline{b}$ in determinate form **OR** Correctly finding $\underline{a} \times \underline{b}$. (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly finding $\lvert\underline{a} \times \underline{b}\rvert$ **AND** Correctly finding unit vector orthogonal to $\underline{a}$ and $\underline{b}$ (2)	Correctly finding $\lvert\underline{a} \times \underline{b}\rvert$ **OR** Correctly finding unit vector orthogonal to $\underline{a}$ and $\underline{b}$ (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly finding the required vector of magnitude 14 units (2)	Partially correct (1)	Wrong Answer (0)			
		Correctly finding the angle between $\underline{a}$ and $\underline{b}$ (2)	Partially correct (1)	Wrong Answer (0)			
4	Solving the system of linear equations by Gauss Jordan method.	Correctly stating the augmented matrix (0.5)	Wrong statement (0)				
		Correctly applying the elementary row operations **AND** Correctly setting 1st column as $\begin{bmatrix}1\\0\\0\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}1\\0\\0\end{bmatrix}$ (1)	Wrong elementary row operations (0)			

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		Correctly applying the row operations **AND** Correctly setting 2nd column as $\begin{bmatrix}0\\1\\0\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}0\\1\\0\end{bmatrix}$ (1)	Wrong elementary row operations (0)			
		Correctly applying the row operations **AND** Correctly setting 3rd column as $\begin{bmatrix}0\\0\\1\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}0\\0\\1\end{bmatrix}$ (1)	Wrong elementary row operations (0)			
		Correctly finding the values of x, y and z (1.5)	Finding correct values of any two variables (1)	Finding correct values of any one variable (0.5)	Wrong answer (0)		
4	Finding the point of intersection graphically from the given equations.	Correctly tabulating $f(x) = -x + 4$ **AND** Correctly tabulating $g(x) = x^2 - 3x + 1$ (4)	Correctly tabulating $f(x) = -x + 4$ **AND** Partially correct tabulating $g(x) = x^2 - 3x + 1$ (3)	Correctly tabulating $f(x) = -x + 4$ **OR** Correctly tabulating $g(x) = x^2 - 3x + 1$ (2)	Partially correct (1)	Wrong Answer (0)	
		Correctly plotting the straight line **AND** Correctly plotting the parabola (2)	Correctly plotting the straight line **OR** Correctly plotting the parabola (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly finding the two points of intersection. (2)	Correctly finding any one point of intersection. (1)	Partially correct (0.5)	Wrong Answer (0)		
5	Proving that $3y^2 + 6y - 1 = 0$ from the given series.	Correctly adding 1 to both sides of the equation **AND** Correctly stating the binomial expansion (2)	Correctly adding 1 to both sides of the equation **OR** Correctly stating the binomial expansion (1)	Partially correct (0.5)	Wrong answer (0)		

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		Correctly finding the values of x **AND** n (4)	Correctly finding the values of x **OR** n (3)	Partially correct (2)	Some step correct (1)	Wrong answer (0)	
		Correctly stating $(1+x)^n = 1+y$ **AND** Correctly proving the required equation (2)	Correctly stating $(1+x)^n = 1+y$ **OR** Correctly proving the required equation (1)	Partially correct (0.5)	Wrong answer (0)		
5	Finding general solution of a trigonometric equation $Cos2x = Sinx$	Correctly applying $Cos2x = 1-2Sin^2x$ **AND** Correctly making quadratic equation (2)	Correctly applying $Cos2x = 1-2Sin^2x$ **OR** Correctly making quadratic equation (1)	Partially correct (0.5)	Wrong answer (0)		
		Correctly finding two values of $Sinx$ (2)	Correctly finding any one value of $Sinx$ (1)	Partially correct (0.5)	Wrong answer (0)		
		Correctly finding the angles (2)	Partially correct (1)	Wrong answer (0)			
		Correctly finding the general solution (2)	Partially correct (1)	Wrong answer (0)			
6	Finding extreme values of the objective function subject to the given constraints	Correctly finding x-intercepts **AND** y-intercepts (1)	Correctly finding x-intercepts **OR** y-intercepts (0.5)	Wrong Findings of Intercepts (0)			
		Correctly sketching the three straight lines (3)	Correctly sketching the two straight lines (2)	Correctly sketching any one straight line (1)	Incorrect Sketching of straight lines (0)		
		Correctly shading the feasible region **AND** Correctly stating corner points (2)	Correctly shading the feasible region **AND** Stating partially correct corner points (1.5)	Correctly shading the feasible region **AND** Stating incorrect corner points (1)	Incorrect feasible region (0)		

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		Correctly finding maximum value of the function **AND** Correctly finding minimum value of the function (2)	Correctly finding maximum value of the function **OR** Correctly finding minimum value of the function (1)	Wrong Findings (0)			
6	Sketching the graph of $y = \sin\frac{\theta}{2}$	Correctly tabulating five values of $y = \sin\frac{\theta}{2}$ (5)	Correctly tabulating any four values (4)	Correctly tabulating any three values (3)	Correctly tabulating any two values (2)	Correctly tabulating any one value (1)	Wrong Answer (0)
		Correctly sketching the graph (03)	Partially correct sketch (02)	Wrong Answer (0)			

RUBRICS: HSSC 1st ANNUAL EXAMINATION 2024
SUBJECT: MATHEMATICS HSSC-I (B)

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
$2(i)$	Simplifying $z = \frac{(3+i)^3}{3-i}$ in the form $a + ib$ and finding the value of $\|z\|$	Correctly simplifying the numerator **AND** Correctly rationalizing the denominator (2)	Correctly simplifying the numerator **AND** Rationalizing incorrectly the denominator (1)	Wrong Simplification (0)			
		Correctly reducing z in the form of $a + ib$ **AND** Correctly finding the value of $\|z\|$ (2)	Correctly reducing z in the form of $a + ib$ **AND** Finding incorrect value of $\|z\|$ (1)	Wrong Responses (0)			
$2(i)$	Finding row rank of the given matrix	Correctly setting each leading non zero entry 1 (2)	Partially Correct Response (0.5)	Wrong Entries (0)			
		Correctly setting 0 below each non zero entry 1 (1.5)	Partially Correct Response (1)	Wrong Entries (0)			
		Correctly stating rank of the matrix (0.5)	Wrong Answer (0)				
$2(ii)$	Solving the system of linear equations	Correctly finding the value of x (2)	Partially Correct Response (1)	Wrong Answer (0)			
		Correctly finding the value of y (2)	Partially Correct Response (1)	Wrong Answer (0)			
$2(ii)$	Finding the 23rd term of a HP when its 4th and 10th terms are given	Correctly stating the 4th term of AP **AND** Correctly stating the 10th term of AP (1)	Correctly stating the 4th term in AP **OR** Correctly stating the 10th term of AP (0.5)	Wrong Statements (0)			
		Correctly finding the first term of AP **AND** Correctly finding the common	Correctly finding the first term of AP **OR** Correctly finding the common	Wrong Findings (0)			

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		difference of AP (2)	difference of AP (1)				
		Correctly finding the 23rd term of AP **AND** Correctly finding the 23rd term of HP (1)	Correctly finding the 23rd term of AP **OR** Correctly finding the 23rd term of HP (0.5)	Wrong Findings (0)			
$2(iii)$	Showing that $(A + A^t)$ is symmetric	Correctly finding A^t **AND** Correctly finding $(A + A^t)$ (2)	Correctly finding A^t **AND** Finding incorrect $(A + A^t)$ (1)	Partially correct (0.5)	Wrong Answer (0)		
		Correctly finding $(A + A^t)^t$ **AND** Correctly showing the required result (2)	Correctly finding $(A + A^t)^t$ **AND** Showing incorrect result (1)	Partially correct (0.5)	Wrong Answer (0)		
$2(iii)$	Finding the value of p when given vectors are mutually perpendicular	Correctly finding the dot product of the given vectors **AND** Correctly applying the condition of perpendicularity of vectors (2)	Correctly finding the dot product of the given vectors **OR** Correctly applying the condition of perpendicularity of vectors (1)	Correctly stated aspects are wrong (0)			
		Correctly finding two values of p (2)	Finding one correct value of p (1)	Wrong Findings (0)			
$2(iv)$	Finding the volume of tetrahedron with vertices $A(1,2,2), B(2,1,1), C(3,3,4)$, and $D(0,1,5)$	Correctly finding all three coterminous edge vectors (2)	Finding any two correctly stated aspects (1.5)	Finding any one correctly stated aspect (1)	Wrong Answer (0)		
		Correctly formulating the volume of tetrahedron **AND** Correctly finding the volume of tetrahedron (2)	Correctly formulating the volume of tetrahedron **AND** Finding partially correct volume of tetrahedron (1.5)	Correctly formulating the volume of tetrahedron **AND** Finding incorrect volume of tetrahedron (1)	Wrong Formula (0)		
$2(iv)$	Inserting four AMs between 5	Correctly finding the common	Partially correct	Wrong answer			

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	and 25	difference d (1)	(0.5)	(0)			
		Correctly finding the four A.Ms. (3)	Any three correctly stated aspects (2)	Any two correctly stated aspects (1)	Any one correctly stated aspect (0.5)	Wrong answer (0)	
$2(v)$	Finding the 16th term of a GP when its 2nd and 6th terms are given	Correctly stating the 2nd term of GP **AND** Correctly stating the 6th term of GP (1)	Correctly stating the 2nd term of GP **OR** Correctly stating the 6th term of GP (0.5)	Wrong Statements (0)			
		Correctly finding the common ratio of GP **AND** Correctly finding the first term of GP (2)	Correctly finding the common ratio of GP **AND** Finding incorrect first term of GP (1)	Wrong Findings (0)			
		Correctly finding the 16th term of GP (1)	Wrong Findings (0)				
$2(v)$	Finding sum to n-terms of the series $1.5 + 2.6 + 3.7 + 4.8 + \cdots$	Correctly finding general term of the series **AND** Correctly applying the sigma notations (2)	Correctly finding nth term of the series **AND** Applying one correct sigma notation (1.5)	Correctly finding nth term of the series **AND** Applying wrong sigma notations (1)	Partially correct Response (0.5)	Wrong Answer (0)	
		Correctly substituting the values of sigma notations **AND** Correctly finding sum of the series in simplified form (2)	Correctly substituting the values of sigma notations **AND** Finding partially correct sum of the series (1.5)	Correctly substituting the values of sigma notations **AND** Finding incorrect sum of the series (1)	Partially correct Response (0.5)	Wrong Answer (0)	
$2(vi)$	Finding number of 7-digit numbers (using all) from the given digits and finding numbers	Correctly formulating the alike permutations **AND** Correctly finding the number of 7-	Correctly formulating the alike permutations **AND** Finding incorrect number of 7-	Wrong Formulation (0)			

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
	greater than 9,950,000	digit numbers (2)	digit numbers (1)				
		Correctly formulating the 7-digit numbers greater than 9950000 **AND** Correctly finding the 7-digit numbers greater than 9950000 (2)	Correctly formulating the 7-digit numbers greater than 9950000 **AND** Finding incorrect result (1)	Wrong Formulation (0			
$2(vi)$	Proving the given series by using the Mathematical Induction method	Correctly stating $S(n)$ is true for $n = 1$ (1)	Wrong Statement (0)				
		Correctly proposing $S(n)$ is true for $n = k \in Z^+$ (1)	Wrong Proposition (0)				
		Correctly stating the truth for $n = k$ implies its truth for $n = k + 1$ **AND** Justifying $S(n)$ is true for Z^+ (2)	Correctly stating the truth for $n = k$ implies its truth for $n = k + 1$ **AND** Not justifying $S(n)$ true for Z^+ (1)	Wrong Statement (0)			
$2(vii)$	For the given real valued function, finding $f^{-1}(x)$ and determining its domain and range	Correctly expressing x in terms of y **AND** Correctly finding the value of $f^{-1}(x)$ (2)	Correctly expressing x in terms of y **AND** Finding incorrect value of $f^{-1}(x)$ (1)	Wrong expression of x in terms of y (0)			
		Correctly finding domain of f^{-1} **AND** Correctly finding range of f^{-1} (2)	Correctly finding domain of f^{-1} **OR** Correctly finding range of f^{-1} (1)	Partially Correct Response (0.5)	Wrong Findings (0)		
$2(vii)$	Finding the value of $\sin(\alpha + \beta)$	Correctly finding the value of $sin\alpha$ **AND** Correctly finding the value of $cos\beta$ (2)	Correctly finding the value of $sin\alpha$ **OR** Correctly finding the value of $cos\beta$ (1)	Wrong findings (0)			

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		Correctly formulating $\sin(\alpha+\beta)$ **AND** Correctly finding the value of $\sin(\alpha+\beta)$ (2)	Correctly formulating $\sin(\alpha+\beta)$ **AND** Finding incorrect value of $\sin(\alpha+\beta)$ (1)	Wrong Formulating (0.5)			
$2(viii)$	Stating number of diagonals of n-sided polygon and finding number of diagonals of 9-sided polygon	Correctly formulating the number of diagonals of n-sided polygon (1)	Wrong statement of the formula (0)				
		Correctly formulating the number of diagonals of 9-sided polygon (1)	Wrong statement of the formula (0)				
		Correctly finding the number of diagonals of a 9-sided polygon (2)	Partially Correct Response (1)	Wrong Findings (0)			
$2(viii)$	Proving that $Sin2\theta + sin4\theta + sin6\theta + sin8\theta = 4sin5\theta cos2\theta cos\theta$	Correctly expressing the sum $sin8\theta + sin2\theta$ as product **AND** Correctly expressing the sum $sin6\theta + sin4\theta$ as product (2)	Correctly expressing the sum $sin8\theta + sin2\theta$ as product **OR** Correctly expressing the sum $sin6\theta + sin4\theta$ as product (1)	Wrong Expressions (0)			
		Correctly factoring the sum of products **AND** Correctly expressing the sum $cos3\theta + cos\theta$ as product (2)	Correctly factoring the sum of products **AND** Expressing the sum $cos3\theta + cos\theta$ incorrectly as product (1)	Incorrect Factoring (0)			
$2\ (ix)$	Finding equation of a parabola $y = ax^2 + bx + c$ that cuts x-axis at points $(-4,0)$ and $(4,0)$ and passes through a point $(0,8)$	Correctly stating the parabolic equation as $y = a(x+4)(x-4)$ (1)	Wrong Statement (0)				
		Correctly finding the value of a (2)	Partially Correct Response (1)	Wrong Answer (0)			
		Correctly finding the required parabolic equation	Wrong Equation (0)				

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		(1)					
$2(ix)$	Finding the probability of getting a sum of dots on tossing two fair dice greater than 9 of divisible by 5	Correctly stating the event that sum of dots is greater than 9 **AND** Correctly finding the probability (1)	Correctly stating the event that sum of dots is greater than 9 **AND** Finding incorrect probability (0.5)	Incorrect statement of the event (0)			
		Correctly stating the event that sum of dots is divisible by 5 **AND** Correctly finding the probability (1)	Correctly stating the event that sum of dots is divisible by 5 **AND** Finding incorrect probability (0.5)	Incorrect statement of the event (0)			
		Correctly stating the event that sum of dots is greater than 9 and divisible by 5 **AND** Correctly finding the probability (1)	Correctly stating the event that sum of dots is greater than 9 and divisible by 5 **AND** Finding incorrect probability (0.5)	Incorrect statement of the event (0)			
		Correctly applying the addition law of probability **AND** Correctly finding the probability (1)	Correctly applying the addition law of probability **AND** Finding incorrect probability (0.5)	Incorrect statement of the law (0)			
$2(x)$	Verifying that $\cos^4\theta = \frac{1}{8}(3 + 2cos2\theta + 4cos4\theta)$	Correctly applying the Half Angle Identity $\cos^2\theta = \frac{1+\cos 2\theta}{2}$ **AND** Correctly simplifying (2)	Correctly applying the Half Angle Identity $\cos^2\theta = \frac{1+\cos 2\theta}{2}$ **AND** Simplifying incorrectly (1)	Wrong application of identity (0)			
		Correctly applying the Half Angle Identity $\cos^2 2\theta = \frac{1+\cos 4\theta}{2}$ **AND** Correctly simplifying (2)	Correctly applying the Half Angle Identity $\cos^2 2\theta = \frac{1+\cos 4\theta}{2}$ **AND** Simplifying incorrectly (1)	Wrong application of identity (0)			
$2(x)$	Solving triangle ABC with usual	Correctly finding the value of γ	Wrong value of γ				

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
	notations	(1)	(0)				
		Correctly applying the Law of Sines **AND** Correctly finding the value of b (1.5)	Correctly applying Law of Sines **AND** Finding partially correct value of b (1)	Correctly applying Law of Sines **AND** Finding incorrect value of b (0.5)	Applying incorrect law (0)		
		Correctly applying the Law of Sines or the Law of Cosines **AND** Correctly finding the value of a (1.5)	Correctly applying the Law of Sines or the Law of Cosines **AND** Finding partially correct value of a (1)	Correctly applying the Law of Sines or the Law of Cosines **AND** Finding incorrect value of a (0.5)	Applying incorrect law (0)		
$2(xi)$	Finding radii of the escribed circles of triangle ABC opposite to the largest and smallest sides with given side measures $a = 13, b = 10, c = 7$	Correctly finding the value of s **AND** Correctly finding the value of ∆ (1)	Correctly finding the value of s **AND** Finding incorrect value of ∆ (0.5)	Finding incorrect value of s (0)			
		Correctly formulating the escribed radii r_1 **AND** Correctly finding the value of r_1 (1.5)	Correctly formulating the escribed radii r_1 **AND** Finding incorrect value of r_1 (1)	Wrong Formula (0)			
		Correctly formulating the escribed radii r_3 **AND** Correctly finding the value of r_3 (1.5)	Correctly formulating the escribed radii r_3 **AND** Finding incorrect value of r_3 (1)	Wrong Formula (0)			
$2(xi)$	Guessing the graph of $y = \sin\frac{\theta}{6}$ $(without\ drawing\ it)$ and finding period, frequency and amplitude of the function	Correctly stating the expanded graph as $\frac{1}{6}th$ cycle of $y = sin\theta$ (1)	Wrong answer (0)				
		Correctly finding the period, frequency and amplitude of the function (3)	Any two correctly stated aspects (2)	Any one correctly stated aspect (1)	Stating all aspects wrong (0)		

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
$2(xii)$	Verifying that $2s = 8R\cos\frac{\alpha}{2}\sin\frac{\beta}{2}\cos\frac{\gamma}{2}$	Correctly substituting all four values of $R, \cos\frac{\alpha}{2}, \sin\frac{\beta}{2}$ and $\cos\frac{\gamma}{2}$ (4)	Any three correctly stated aspects (3)	Any two correctly stated aspects (2)	Any one correctly stated aspect (1)	Stating all aspects wrong (0)	
$2(xii)$	Showing that $\tan^{-1}\left(\frac{3}{4}\right) - \tan^{-1}\left(\frac{4}{3}\right) + 2\tan^{-1}\left(\frac{1}{7}\right) = 0$	Correctly applying the trigonometric identity **AND** Correctly converting $2\tan^{-1}\left(\frac{1}{7}\right)$ to $\tan^{-1}\left(\frac{7}{24}\right)$ (1.5)	Correctly applying the trigonometric identity **AND** Incorrect conversion of $2\tan^{-1}\left(\frac{1}{7}\right)$ to $\tan^{-1}\left(\frac{7}{24}\right)$ (1)	Wrong answer (0)			
		Correctly applying the trigonometric identity **AND** Correctly converting $\tan^{-1}\left(\frac{3}{4}\right) - \tan^{-1}\left(\frac{4}{3}\right)$ to $\tan^{-1}\left(-\frac{7}{24}\right)$. (1.5)	Correctly applying the trigonometric identity **AND** Incorrect conversion of $\tan^{-1}\left(\frac{3}{4}\right) - \tan^{-1}\left(\frac{4}{3}\right)$ to $\tan^{-1}\left(-\frac{7}{24}\right)$. (1)	Wrong answer (0)			
		Correctly showing the result (1)	Wrong answer (0)				
3	Finding inverse of the matrix	Correctly appending the identity matrix (1)	Wrong appending (0)				
		Correctly applying the elementary row operations **AND** Correctly setting 1st column as $\begin{bmatrix}1\\0\\0\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}1\\0\\0\end{bmatrix}$ (1)	Wrong elementary row operations (0)			
		Correctly applying the row operations **AND** Correctly setting 2nd column as $\begin{bmatrix}0\\1\\0\end{bmatrix}$	Correctly applying the elementary row operations **AND** Setting 1st column other than	Wrong elementary row operations (0)			

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		(2)	$\begin{bmatrix}0\\1\\0\end{bmatrix}$ (1)				
		Correctly applying the row operations **AND** Correctly setting 3rd column as $\begin{bmatrix}0\\0\\1\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}0\\0\\1\end{bmatrix}$ (1)	Wrong elementary row operations (0)			
		Correctly stating the inverse matrix (1)	Stating incorrect inverse matrix (0)				
3	Finding a unit vector orthogonal to $\underline{a} \times \underline{b}$, where if $\underline{a} = -10i + 2j + 4k$ and $\underline{b} = i - j + 2k$ Finding angle between the vectors to $\underline{a}$ and $\underline{b}$	Correctly finding $\underline{a} \times \underline{b}$ **AND** Correctly finding the value of $\lvert\underline{a} \times \underline{b}\rvert$ (2)	Correctly finding $\underline{a} \times \underline{b}$ **AND** Finding incorrect value of $\lvert\underline{a} \times \underline{b}\rvert$ (1)	Finding incorrect value of $\underline{a} \times \underline{b}$ (0)			
		Correctly formulating a unit vector along $\underline{a} \times \underline{b}$ **AND** Correctly finding a unit vector along $\underline{a} \times \underline{b}$ (2)	Correctly formulating a unit vector along $\underline{a} \times \underline{b}$ **AND** Finding an incorrect unit vector along $\underline{a} \times \underline{b}$ (1)	Wrong Formula (0)			
		Correctly finding the values of $\lvert\underline{a}\rvert$ and $\lvert\underline{b}\rvert$ **AND** Correctly finding a unit vector $\hat{a}$ **OR** $\hat{b}$ orthogonal to $\underline{a} \times \underline{b}$ (2)	Correctly finding the values of $\lvert\underline{a}\rvert$ and $\lvert\underline{b}\rvert$ **AND** Finding an incorrect unit vector $\hat{a}$ **OR** $\hat{b}$ orthogonal to $\underline{a} \times \underline{b}$ (1)	Correctly finding the values of $\lvert\underline{a}\rvert$ **OR** $\lvert\underline{b}\rvert$ (0.5)	Wrong Findings (0)		
		Correctly formulating angle between two vectors **AND** Correctly finding angle between vectors $\underline{a}$ and $\underline{b}$ (2)	Correctly formulating angle between two vectors **AND** Finding incorrect angle between vectors $\underline{a}$ and $\underline{b}$ (1)	Wrong Formula (0)			

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
4	Using Gauss Jordan method to solve the given system of equations	Correctly stating the augmented matrix (0.5)	Wrong statement (0)				
		Correctly applying the elementary row operations **AND** Correctly setting 1st column as $\begin{bmatrix}1\\0\\0\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}1\\0\\0\end{bmatrix}$ (1)	Wrong elementary row operations (0)			
		Correctly applying the row operations **AND** Correctly setting 2nd column as $\begin{bmatrix}0\\1\\0\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}0\\1\\0\end{bmatrix}$ (1)	Wrong elementary row operations (0)			
		Correctly applying the row operations **AND** Correctly setting 3rd column as $\begin{bmatrix}0\\0\\1\end{bmatrix}$ (2)	Correctly applying the elementary row operations **AND** Setting 1st column other than $\begin{bmatrix}0\\0\\1\end{bmatrix}$ (1)	Wrong elementary row operations (0)			
		Correctly finding the values of x, y and z (1.5)	Finding correct values of any two variables (1)	Finding correct values of any one variable (0.5)	Wrong answer (0)		
4	Proving that $y^2 + 2y - 1 = 0$ from the given series	Correctly adding 1 to both sides of the equation **AND** Correctly stating the binomial expansion (2)	Correctly adding 1 to both sides of the equation **OR** Correctly stating the binomial expansion (1)	Partially correct (0.5)	Wrong answer (0)		
		Correctly finding the values of x **AND** n	Correctly finding the values of x **OR** n	Partially correct (1)	Wrong answer		

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		(4)	(2)		(0)		
		Correctly stating $(1+x)^n = 1+y$ **AND** Correctly proving the required equation (2)	Correctly stating $(1+x)^n = 1+y$ **OR** Correctly proving the required equation (1)	Partially correct (0.5)	Wrong answer (0)		
5	Finding point of intersection of the given functions graphically	Correctly tabulating three ordered pairs for the linear equation (1.5)	Correctly tabulating two ordered pairs for the linear equation (1)	Correctly tabulating one ordered pair for the linear equation (0.5)	Wrong Tabulation (0)		
		Correctly plotting three ordered pairs on the graph for the linear function (2)	Correctly plotting two ordered pairs on the graph (1)	Correctly plotting one ordered pair on the graph (0.5)	Wrong plotting (0)		
		Correctly tabulating four ordered pairs for the parabolic equation (1.5)	Correctly tabulating three or two ordered pairs for the parabolic equation (1)	Correctly tabulating one ordered pair for the parabolic equation (0.5)	Wrong Tabulation (0)		
		Correctly plotting the four ordered pairs on the graph for the parabolic function (2)	Correctly plotting three ordered pairs on the graph (1.5)	Correctly plotting two ordered pairs on the graph (1)	Correctly plotting one ordered pair on the graph (0.5)	Wrong plotting (0)	
		Correctly stating the point of intersection (1)					
5	Finding general solution of the given trigonometric equation	Correctly writing the equation quadratic in $cosx$ (2)	Partially Incorrect quadratic equation **(1)**	Incorrect quadratic equation (0)			
		Correctly factoring the quadratic equation (2)	Partially Factoring **(1)**	Wrong Factoring (0)			
		Correctly solving $2cosx + 1 = 0$ (2)	Partially correct roots (1)	Incorrect roots (0)			
		Correctly solving $cosx + 1 = 0$ (2)	Partially correct roots (1)	Incorrect roots (0)			
6	Finding extreme values of the objective function subject to the given constraints	Correctly finding x-intercepts **AND** y-intercepts (1)	Correctly finding x-intercepts **OR** y-intercepts (0.5)	Wrong Findings of Intercepts (0)			

Q.# /Part #	Criteria	Level 1 (Marks)	Level 2(Marks)	Level 3 (Marks)	Level 4 (Marks)	Level 5 (Marks)	Level 6 (Marks)
		Correctly sketching the three straight lines (3)	Correctly sketching the two straight lines (2)	Correctly sketching any one straight line (1)	Incorrect Sketching of straight lines (0)		
		Correctly shading the feasible region **AND** Correctly stating corner points (2)	Correctly shading the feasible region **AND** Stating partially correct corner points (1.5)	Correctly shading the feasible region **AND** Stating incorrect corner points (1)	Incorrect feasible region (0)		
		Correctly finding maximum value of the function **AND** Correctly finding minimum value of the function (2)	Correctly finding maximum value of the function **OR** Correctly finding minimum value of the function (1)	Wrong Findings (0)			
6	Sketching the graph of $y = 2\cos\frac{\theta}{2}\ ; -\pi \leq \theta \leq \pi$	Correctly tabulating five ordered pairs (4)	Correctly tabulating four ordered pairs (3)	Correctly tabulating three ordered pairs (2)	Correctly tabulating two ordered pairs (1)	Correctly tabulating one ordered pair (.5)	Wrong Tabulation (0)
		Correctly plotting five ordered pairs (4)	Correctly plotting four ordered pairs (3)	Correctly plotting three ordered pairs (2)	Correctly plotting two ordered pairs (1)	Correctly plotting one ordered pair (.5)	Wrong Plotting (0)