Roll No. | | | | | |

INDIAN SCHOOL SALALAH

FIRST TERM EXAMINATION – SEPTEMBER 2025

Class: XII **MATHEMATICS (041)** **Date: 22/09/2025**

Time: 3 hours **Maximum Marks: 80**

General Instructions:

a) This Question paper contains 38 questions. All questions are compulsory.

b) This Question paper is divided into five Sections - A, B, C, D and E.

c) In Section A, Questions no. 1 to 18 are multiple choice questions (MCQs) with only one correct option and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.

d) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.

e) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.

f) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.

g) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.

h) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.

i) Use of calculator is not allowed.

NO	SECTION A	MARKS
1	Let the relation R in the set $A = \{x \in Z: 0 \leq x \leq 12\}$, given by $R = \{(a, b): \lvert a - b \rvert$ is a multiple of $4\}$. Then [1], the equivalence class containing 1, is: (a) {1, 5, 9} (b) {0, 1, 2, 5} (c) ϕ (d) A	1
2	Let X = {1, 2, 3} and a relation R is defined in X as R = {(1, 3), (2, 2), (3, 2)}, then minimum ordered pairs which should be added in relation R to make it reflexive and symmetric are: (a) {(1, 1), (2, 3), (1, 2)} (b) {(3, 3), (3, 1), (1, 2)} (c) {(1, 1), (3, 3), (3, 1), (2, 3)} (d) {(1, 1), (3, 3), (3, 1), (1, 2)}	1

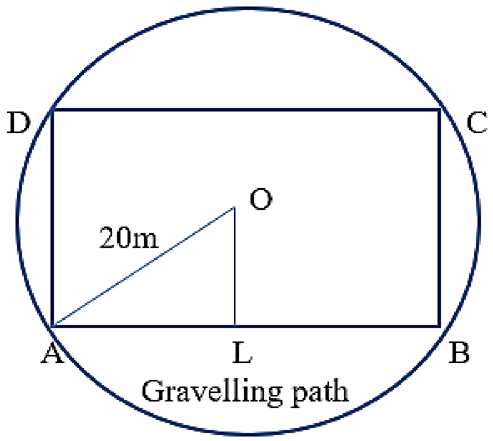
3	Let Z denote the set of integers, then the function $f: Z \to Z$ defined as $f(x) = x^3 - 1$ is: (a) both one-one and onto (b) one-one but not onto (c) onto but not one-one (d) neither one-one nor onto	1
4	What is the domain of $\cos^{-1}(2x-3)$? (a) $[-1, 1]$ (b) $(1, 2)$ (c) $(-1, 1)$ (d) $[1, 2]$	1
5	The value of $\sin^{-1}\left(\cos\frac{3\pi}{5}\right)$ is: (a) $\frac{\pi}{10}$ (b) $\frac{3\pi}{5}$ (c) $\frac{-\pi}{10}$ s(d) $\frac{-3\pi}{5}$	1
6	If A $= \begin{bmatrix} x & 0 \\ 1 & 1 \end{bmatrix}$ and B $= \begin{bmatrix} 4 & 0 \\ -1 & 1 \end{bmatrix}$, then value of x for which $A^2 = B$ is: (a) -2 (b) 2 (c) 2 or -2 (d) 4	1
7	The matrix $\begin{bmatrix} 0 & 5 & -7 \\ -5 & 0 & 11 \\ 7 & -11 & 0 \end{bmatrix}$ is: (a) A skew-symmetric matrix (b) A symmetric matrix (c) A diagonal matrix (d) An upper triangular matrix	1
8	If A is a skew symmetric matrix of order 3×3 and $\|A\| = x$ then $(2025)^x =$ a) $\frac{1}{2025}$ b) 2025 c) $(2025)^2$ d) 1	1
9	If A and B are matrices of order $3 \times m$ and $3 \times n$ respectively such that $m = n$, then order of 2A + 7B is (a) 3×3 (b) $m \times 3$ (c) $n \times 3$ (d) $3 \times m$	1
10	If A is a square matrix of order 3 × 3 such that $\|adjA\|$ = 25 then |A| is (a) 125 (b) 9 (c) ± 5 (d) 25	1
11	If $\begin{vmatrix} x+1 & x-1 \\ x-3 & x+2 \end{vmatrix} = \begin{vmatrix} 4 & -1 \\ 1 & 3 \end{vmatrix}$, then the value of x is: (a) 4 (b) 3 (c) 0 (d) 2	1
12	The function $f(x) = \|x\| + \|x-2\|$ is: (a) Continuous, but not differentiable at $x = 0$ and $x = 2$ (b) Differentiable but not continuous at $x = 0$ and $x = 2$ (c) Continuous but not differentiable at $x = 0$ only (d) Neither continuous nor differentiable at $x = 0$ and $x = 2$	1
13	The rate of change of area of a circle with respect to its radius at $r = 3cm$ is (a)3π (b) 4π (c) 6π (d) 12π	1

14	The local minimum value of $x^2 + \frac{250}{x}$ is: (a) 75 (b) 55 (c) 50 (d) 25	1
15	If $f(x) = a(x - \cos x)$ is strictly decreasing in R, then a belongs to: (a) $\{0\}$ (b) $(0, \infty)$ (c) $(-\infty, 0)$ (d) $(-\infty, \infty)$	1
16	$\int \frac{dx}{\sqrt{9-4x^2}}$ is equal to (a) $\frac{1}{6}\sin^{-1}\left(\frac{2x}{3}\right) + C$ (b) $\frac{1}{2}\sin^{-1}\left(\frac{2x}{3}\right) + C$ (c) $\sin^{-1}\left(\frac{2x}{3}\right) + C$ (d) $\frac{3}{2}\sin^{-1}\left(\frac{2x}{3}\right) + C$	1
17	$\int \frac{1}{\sin^2 x \cos^2 x} dx$ equals (a) $\tan x + \cot x + C$ (b) $\tan x - \cot x + C$ (c) $\tan x \cot x + C$ (d) $\tan x - \cot 2x + C$	1
18	If $\frac{d}{dx}[f(x)] = 2x + \frac{3}{x}$ and $f(1) = 1$, then $f(x)$ is equal to: (a) $x^2 + 3\log\|x\|$ (b) $x^2 + 3\log\|x\| + 1$ (b) $2 - \frac{3}{x^2}$ (d) $x^2 + 3\|x\| - 4$	1
	Question number 19 and 20 are Assertion and Reason based question. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answers from the codes A, B C and D as given below. (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true and R is false. (d) A is false and R is true.	
19	**Assertion(A)**: Principal value of $\tan^{-1}(-1) = \frac{\pi}{4}$ **Reasoning(R)**: The range of $\tan^{-1}x$ is $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$	1
20	**Assertion(A)**: If x is real, then the minimum value of $x^2 - 8x + 17$ is 1. **Reasoning(R)**: If f "(x) > 0 at a critical point, then the value of the function at the critical point will be the minimum value of the function.	1
	SECTION B	
21	Draw the graph of $y = \sin^{-1}x$ and hence find its domain and range. **OR**	2

	Solve: $\tan^{-1}\left(\frac{1-x}{1+x}\right) = \frac{1}{2}\tan^{-1}x$, $(x > 0)$	
22	Find the matrices X and Y if $2X + 3Y = \begin{bmatrix} 2 & 3 \\ 4 & 0 \end{bmatrix}$ and $3X + 2Y = \begin{bmatrix} 2 & -2 \\ -1 & 5 \end{bmatrix}$	2
23	Find values of k if area of triangle is 35 sq. units and vertices are (2, – 6), (5, 4) and (k, 4).	2
24	Find the values of k so that the function f(x) = $\begin{cases} \frac{k\cos x}{\pi-2x}, & if\ x \neq \frac{\pi}{2} \\ 3, & if\ x = \frac{\pi}{2} \end{cases}$ is continuous at $x = \frac{\pi}{2}$. **OR** If $\cos y = x\cos(a+y)$, with $\cos a \neq \pm 1$, prove that $\frac{dy}{dx} = \frac{\cos^2(a+y)}{\sin a}$.	2
25	Evaluate: $\int \log x\, dx$	2
	SECTION C	
26	Let $f: N \to N$ be defined by $f(n) = \begin{cases} \frac{n+1}{2}, & \text{if } n \text{ is odd} \\ \frac{n}{2}, & \text{if } n \text{ is even} \end{cases}$ for all $n \in$ N. State whether the function f is bijective. Justify your answer. **OR** Show that the relation S in the set R of real numbers, defined as S = {(a, b): a, $b \in R$ and $a \leq b^3$} is neither reflexive, nor symmetric, nor transitive.	3
27	Prove that $\tan^{-1}\left(\frac{\sqrt{1+x}-\sqrt{1-x}}{\sqrt{1+x}+\sqrt{1-x}}\right) = \frac{\pi}{4} - \frac{1}{2}\cos^{-1}x, -\frac{1}{\sqrt{2}} \leq x \leq 1$	3
28	If $A = \begin{bmatrix} 2 & 3 \\ 1 & -4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -2 \\ -1 & 3 \end{bmatrix}$, then verify $(AB)^{-1} = B^{-1}A^{-1}$. **OR** If $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$, show that $A^2 - 5A + 7I = O$. Hence find A^{-1}.	3
29	Find $\frac{dy}{dx}$ if $y = \sin^{-1}\left(\frac{2^{x+1}}{1+4^x}\right)$	3
30	Find local maximum and local minimum values of the function f given by $f(x) = 3x^4 + 4x^2 - 12x^2 + 12$	3

31	Find $\int \frac{(3\sin\theta-2)\cos\theta}{5-\cos^2\theta-4\sin\theta}\,d\theta$ **OR** Find $\int \frac{2x}{(x^2+1)(x^2+3)}\,dx$	3
	SECTION D	
32	Solve the system of equations by using matrix method: $\frac{2}{x}+\frac{3}{y}+\frac{10}{z}=\ 4\ ;\quad \frac{4}{x}-\frac{6}{y}+\frac{5}{z}=\ 1\ ;\quad \frac{6}{x}+\frac{9}{y}-\frac{20}{z}=2$ **OR** The sum of three numbers is 6. If we multiply third number by 3 and add second number to it, we get 11. By adding first and third numbers, we get double of the second number. Represent it algebraically and find the numbers using matrix method.	5
33	a) If $x\sqrt{1+y}+y\sqrt{1+x}=0$, for $-1<x<1$, prove that $\frac{dy}{dx}=-\frac{1}{(1+x)^2}$. b) Find $\frac{dy}{dx}$ if y = $x^{\sin x}$	5
34	Show that height of the cylinder of greatest volume which can be inscribed in a right circular cone of height h and semi vertical angle α is one-third that of the cone and the greatest volume of cylinder is $\frac{4}{27}\pi h^3\tan^2\alpha$. **OR** An open topped box is to be constructed by removing equal squares from each corner of a 3 metre by 8 metre rectangular sheet of aluminium and folding up the sides. Find the volume of the largest such box.	5
35	Evaluate: $\int \frac{(x^2+1)\,dx}{x^2-5x+6}\,dx$	5
	SECTION E	
36	**Case Study.1** Vijay visited the amusement park along with his family. The amusement park had a huge swing, which attracted many children. He found that the swing traced the path of a parabola as given by y = $3x^2$.	

		
	Answer the following questions using the above information.	
	a) If f: R→R be defined by $f(x) = 3x^2$, then check whether f is an injective function or not.	1
	b) Let f: N→N be defined by $(x) = 3x^2$. Check whether f is a bijective function or not.	1
	c) (i) Let $f: \{1, 2, 3, \ldots\} \rightarrow \{3, 12, 27, \ldots\}$ be defined by $f(x) = 3x^2$. Check whether the function f is bijective or not by giving suitable reason. **OR** c) (ii) Let f: N→R be defined by $f(x) = 3x^2$. Determine the range of the function f. Also find f (3).	2
37	**Case Study.2** A college canteen sells three types of food items – Sandwich, Burger, and Pizza. The sales record for two consecutive days is given below: 	

	- On **Day 1**, 20 sandwiches, 15 burgers, and 10 pizzas were sold. - On **Day 2**, 25 sandwiches, 18 burgers, and 12 pizzas were sold. This information is represented in the form of a matrix: $S = \begin{bmatrix} 20 & 15 & 10 \\ 25 & 18 & 12 \end{bmatrix}$ where the first row represents sales on Day 1 and the second row represents sales on Day 2. Answer the following questions using the above information. a) Write the order of the matrix S. b) Write the transpose of matrix S. c) (i) If $S^T S = (a_{ij})$, find $a_{21} + a_{32}$. **OR** c) (ii) If A and B are symmetric matrices, such that AB and BA are both defined, then prove that AB − BA is a skew-symmetric matrix.	 1 1 2
38	**Case Study.3** An architect designs a garden in a residential complex. The garden is in the shape of a rectangle inscribed in a large circle of radius 20 m as shown in the following figure. If the length and breadth of rectangle garden are $2x$ and $2y$ meters respectively.  Based on the above information answer the followings. a) Find the area A of the green grass of garden also find $\frac{dA}{dx}$. b) Find the maximum area of the garden.	 2 2

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