COMMON PRE-BOARD EXAMINATION

MATHEMATICS - Code No. 041

CLASS: XII (2025-26) – SET- 3

Time Allowed: 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.

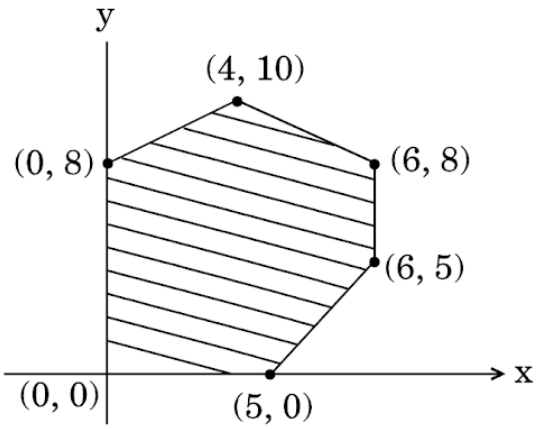
g) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.

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.

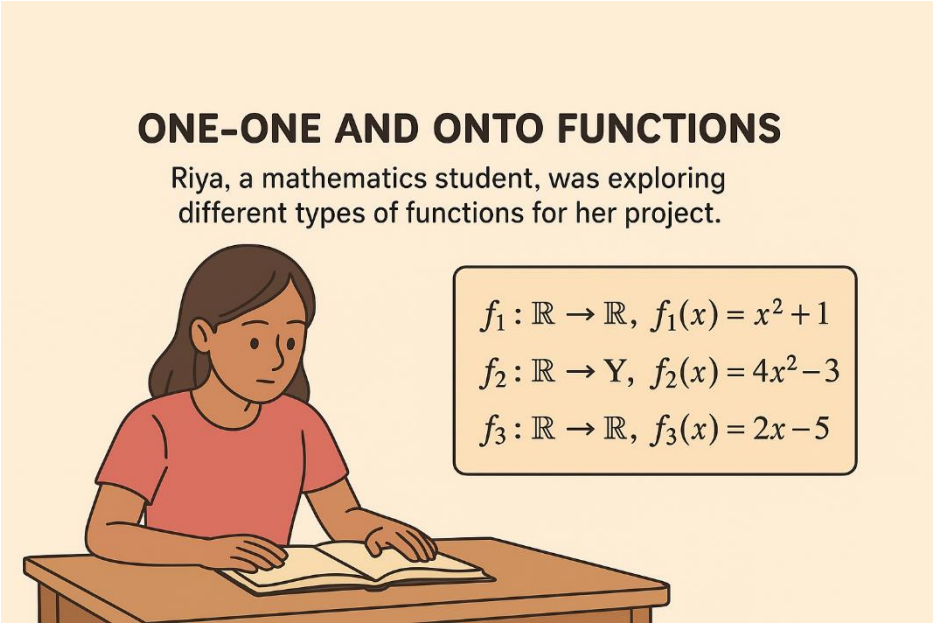
NO	SECTION A	MARKS
1	The diagonal of a square, of side $3\sqrt{2}$ cm, is increasing at a rate of 2 cm/sec. Which of the following is the rate at which its area is increasing? (a) $\sqrt{2}$ cm^2/sec (b) $6\sqrt{2}$ cm^2/sec (c) 12 cm^2/sec (d) 24 cm^2/sec	1
2	$\int e^{\log \sin x}\, dx$ is equal to: (a) sinx + C (b) cosx + C (c) –cosx + C (d) –sinx + C	1
3	The set of all points where the function $f(x) = x + \lvert x \rvert$ is differentiable, is (a) $(0, \infty)$ (b) $(-\infty, 0)$ (c) $(-\infty, 0) \cup (0, \infty)$ (d) $(-\infty, \infty)$	1
4	$\int e^{x}(\log \sin x + \cot x)\, dx$ is equal to: (a) $e^x \log \sin x$ + C (b) $e^x \cot x$ + C (c) $e^x \tan x$ + C (d) e^x (log cos$x$ - cot x) + C	1

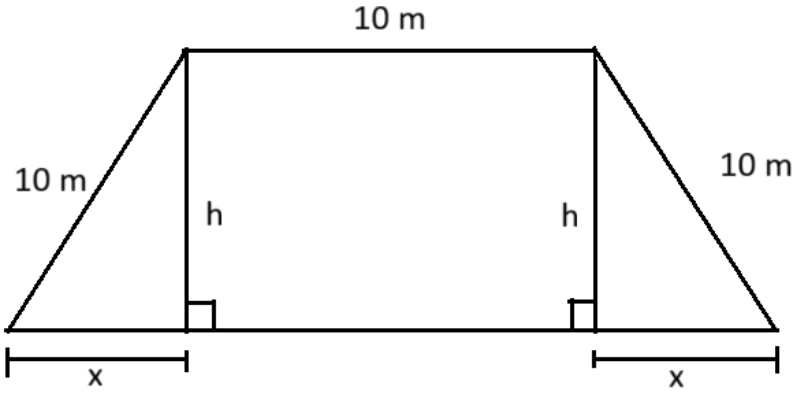
5	The lines $\frac{x-2}{1}=\frac{y-3}{1}=\frac{4-z}{k}$ and $\frac{x-1}{k}=\frac{y-4}{2}=\frac{z-5}{-2}$ are mutually perpendicular if the value of k is: (a) $\frac{-2}{3}$ (b) $\frac{2}{3}$ (c) -2 (d) 2	1
6	Let $A=\begin{bmatrix}1 & \sin\alpha & 1\\ -\sin\alpha & 1 & \sin\alpha\\ -1 & -\sin\alpha & 1\end{bmatrix}$, where $0 \le \alpha \le 2\pi$, then: (a) $\lvert A\rvert = 0$ (b) $\lvert A\rvert \in (2,\infty)$ (c) $\lvert A\rvert \in (2,4)$ (d) $\lvert A\rvert \in [2,4]$	1
7	If $\vec{a} = 2\hat{i}+\hat{j}+3\hat{k}$ and $\vec{b} = 3\hat{i}+5\hat{j}-2\hat{k}$,then $\lvert\vec{a}\times\vec{b}\rvert$ is: (a) $\sqrt{507}$ (b) 25 (c) 24 (d) $\sqrt{524}$	1
8	If $y = sin^{-1}x$, then $\frac{d^2y}{dx^2}$ is: (a) $\sec y$ (b) $\sec y \tan y$ (c) $\sec^2 y \tan y$ (d) $\tan^2 y \sec y$	1
9	Domain of the function $\sin^{-1}(3x-1)$ is: (a) [0,1] (b) $[-1,1]$ (c)$(-1,1)$ (d) $\left[0,\frac{2}{3}\right]$	1
10	If P(A) = 1/2, P(B) = 0, then P(A|B) is: (a) 0 (b) $\frac{1}{2}$ (c) not defined (d) 1	1
11	If A and B are symmetric matrices of same order, then AB – BA is a: (a) Skew symmetric matrix (b) Symmetric matrix (c) Zero matrix (d) Identity matrix	1
12	If matrix $\begin{bmatrix}2 & 3 & -1\\ x+4 & -1 & 2\\ 3x & 2 & -1\end{bmatrix}$ is a singular matrix, then the value of x is : (a) $\frac{-3}{16}$ (b) $\frac{3}{16}$ (c) $\frac{1}{8}$ (d) $\frac{8}{10}$	1
13	If A is a square matrix of order 3 and |A| = 5, then the value of $\lvert 2A'\rvert$ is (a) -10 (b) 10 (c) -40 (d) 40	1
14	For what value of 'a', the vectors $2\hat{i}-3\hat{j}+4\hat{k}$ and $a\hat{i}+6\hat{j}-8\hat{k}$ are collinear: (a) 3 (b) 4 (c) -4 (d) -3	1
15	If the area of a triangle with vertices (-3, 0), (3, 0) and (0, k) is 9 sq. units. Then the value of k will be: (a) 9 (b) 3 (c) -9 (d) 6	1
16	Solution set of the inequality 2x+ y > 5 is:	1

	(a) The half plane containing origin. (b) The open half plane not containing origin. (c) XY- plane excepts the points on the line 2x + y = 5 (d) None of these	
17	The feasible solution for a LPP is shown in Figure Let z = 3x – 4y be the objective function. Minimum of Z occurs at:  (a) (0, 0) (b) (0, 8) (c) (5, 0) (d) (4, 10)	1
18	Integrating factor of the differential equation, cos$x$ $\frac{dy}{dx}$+ y sin$x$ =1, is (a) sin$x$ b) sec$x$ (c) tan$x$ (d) cos$x$	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): The value of $\sin\left[\tan^{-1}\left(-\sqrt{3}\right)+\cos^{-1}\left(\frac{-\sqrt{3}}{2}\right)\right]$ is 1. Reason (R): $\tan^{-1}(\tan x)=x$ for $x\in\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$ and $\cos^{-1}(\cos x)=x$ for $x\in[0,\pi]$	1
20	Assertion (A): Lines $\frac{3-x}{2}=\frac{2y+4}{\lambda}=\frac{z-1}{5}$ and $\frac{x-2}{-1}=\frac{y+2}{4}=\frac{z-2}{2}$ are perpendicular if $\lambda=-4$.	1

	Reason (R): Two lines with direction ratios a_1, b_1, c_1 and a_2, b_2, c_2 are perpendicular if $a_1a_2 + b_1b_2 + c_1c_2 = 0$.	
	SECTION B	
21	If vectors $\vec{a}$ and $\vec{b}$ are such that $\|\vec{a}\| = \frac{1}{2}$, $\|\vec{b}\| = \frac{4}{\sqrt{3}}$ and $\left\|\vec{a} \times \vec{b}\right\| = \frac{1}{\sqrt{3}}$, then find $\left\|\vec{a}.\vec{b}\right\|$.	2
22	A) Find $\int \frac{2^{x+1}-5^{x-1}}{10^x}$ dx **OR** B) Find the area bounded by the curve $y = \sin x$ between $x = 0$ and $x = 2\pi$.	2
23	If $y = 5e^{7x} + 6e^{-7x}$, then show that $\frac{d^2y}{dx^2} = 49y$	2
24	Determine the value of 'k' so that the function $f(x) = \begin{cases} \frac{kx}{\|x\|}, \text{if } x < 0 \\ 3, if\ x \geq 0 \end{cases}$ is continuous at $x = 0$.	2
25	A) Evaluate: $3\sin^{-1}\left(\frac{1}{\sqrt{2}}\right) + 2\cos^{-1}\left(\frac{\sqrt{3}}{2}\right) + \cos^{-1}(0)$ **OR** B) Express $\tan^{-1}\left(\frac{\cos x}{1-\sin x}\right), -\frac{3\pi}{2} < x < \frac{\pi}{2}$ in simplest form.	2
	SECTION C	
26	A) Find the vector and the cartesian equations of a line that passes through the point $A(1,2,-1)$ and parallel to the line $5x - 25 = 14 - 7y = 35z$. **OR** B) Find the shortest distance between the line whose vector equations are: $\vec{r_1} = (\hat{\imath} + \hat{\jmath}) + \lambda(2\hat{\imath} - \hat{\jmath} + \hat{k})$ and $\vec{r_2} = (2\hat{\imath} + \hat{\jmath} - \hat{k}) + \mu(3\hat{\imath} - 5\hat{\jmath} + 2\hat{k})$	3
27	Find the absolute maximum and absolute minimum values of the function f given by $f(x) = \sin^2 x - \cos x, x \in [0, \pi]$	3
28	Solve the following linear programming problem graphically: Minimize: $z = 5x + 10y$ Subject to constraints: $x + 2y \leq 120$; $x + y \geq 60$; $x - 2y \geq 0, x, y \geq 0$	3

29	A) If $x = \cos t(3 - 2\cos^2 t)$ and $y = \sin t(3 - 2\sin^2 t)$, find the value of $\frac{dy}{dx}$ at $t = \frac{\pi}{4}$. **OR** B) Differentiate the following function with respect to x: $y = (\sin x)^x + \sin^{-1}\sqrt{x}$	3
30	A) Find $\int \frac{dx}{\sqrt{\sin^3 x \cos(x-a)}}$ **OR** B) Find the area of the region bounded by the curves $x^2 + y^2 = 4$, $x = \sqrt{3}y$ and x-axis in the first quadrant.	3
31	The probability that it rains today is 0.4. If it rains today, the probability that it will rain tomorrow is 0.8. If it does not rain today, the probability that it will rain tomorrow is 0.7. If $P1$: denotes the probability that it does not rain today. $P2$: denotes the probability that it will not rain tomorrow, if it rains today. $P3$: denotes the probability that it will rain tomorrow, if it does not rain today. $P4$: denotes the probability that it will not rain tomorrow, if it does not rain today. Find the value of $P_1 \times P_4 - P_2 \times P_3$ and calculate the probability of raining tomorrow.	3
	SECTION D	
32	A) Solve the differential equation $(x\,dy - y\,dx)y \sin\left(\frac{y}{x}\right) = (y\,dx + x\,dy)x \cos\left(\frac{y}{x}\right)$ **OR** B) Prove that $x^2 - y^2 = c\,(x^2 + y^2)^2$, is the general solution of differential equation $(x^3 - 3x\,y^2)dx = (y^3 - 3x^2 y)dy$, where c is a parameter.	5
33	A) Evaluate: $\int_0^{\pi} \frac{x \sin x}{1+\cos^2 x}\,dx$ **OR**	5

	B) Evaluate: $\int_{\pi/6}^{\pi/3} \frac{\sin x+\cos x}{\sqrt{\sin 2x}}$ dx	
34	Given A = $\begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ and B = $\begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$, verify that BA = 6I, use the result to solve the system $x - y = 3$, $2x + 3y + 4z = 17$, $y + 2z = 7$.	5
35	Find the vector and cartesian equations of the line through the point (1, 2, –4) and perpendicular to the two lines $\vec{r_1} = (8\hat{\imath} - 19\hat{\jmath} + 10\hat{k}) + \lambda(3\hat{\imath} - 16\hat{\jmath} + 7\hat{k})$, and $\vec{r_2} = (15\hat{\imath} + 29\hat{\jmath} + 5\hat{k}) + \mu(3\hat{\imath} + 8\hat{\jmath} - 5\hat{k})$.	5
	SECTION E	
36	**Case Study.1**  Her teacher asked her to identify whether these functions are one-one, onto, or bijective, and to justify her reasoning based on their domain and range. Based on above information, answer the following: (a) For the function $f_1(x) = x^2 + 1$, check whether the function is one-one or not. (b) If the function $f_2(x) = 4x^2 - 3$ is onto, find its codomain Y. (c) For the function $f_3(x) = 2x - 5$, check whether it is bijective. Justify your answer. **OR**	1 1 2

	(c) For the function $f_1(x) = x^2 + 1$, find its range and justify whether it is onto when codomain is $\mathbb{R}$.	
37	**Case Study.2** Read the following passage and answer the questions given below: The front gate of a building is in the shape of a trapezium as shown below. Its three sides other than base are 10m each. The height of the gate is h meter. On the basis of this information and figure given below answer the following questions:  Based on above information, answer the following: (a) Find area **A** of the gate expressed as a function of **x**. (b) Find value of $\frac{dA}{dx}$. (c) Find x and show that area is maximum **OR** (c) Find maximum area of trapezium.	1 1 2
38	**Case Study.3** Read the following passage and answer the questions given below: 	

	In an Office three employees Ram, Shyam and Sohan process a calculation in an excel form. Probability that Ram, Shyam and Sohan process the calculation respectively is 50%, 20% and 30%. Ram has a probability of making a mistake as 0.06, Shyam has probability 0.04 to make a mistake and Sohan has a probability 0.03. Based on the above information, answer the following questions. (a) Find the total probability of committing a mistake in processing the calculation. (b) The boss wants to do a good check. During check, he selects a calculation form at random from all the days. If the form selected at random has a mistake, find the probability that the form is not processed by Ram.	2 2

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