केन्द्रीय विद्यालय संगठन, कोलकाता संभाग

KENDRIYA VIDYALAYA SANGATHAN, KOLKATA REGION

द्वितीय प्री-बोर्ड परीक्षा / 2ND PRE-BOARD EXAMINATION 2025–26

कक्षा/CLASS :XII — **अधिकतम अंक/MAX. MARKS: 80**

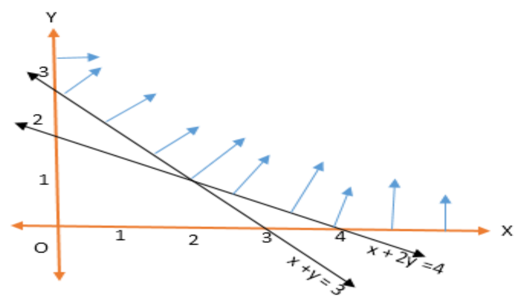
विषय/SUBJECT: MATHEMATICS — **समय/TIME: 3 HOURS**

General Instructions:

Read the following instructions very carefully and strictly follow them:

1. This Question paper contains 38 questions. All questions are compulsory.
2. This Question paper is divided into five Sections - A, B, C, D and E.
3. 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.
4. In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
5. In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
6. In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
7. In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
8. 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.
9. Use of calculator is not allowed.

Q.No	**Section A** This section comprises of multiple-choice questions (MCQs) of 1 mark each. Select the correct option (Question 1 - Question 18)	Marks
1.	The principal value of $\cos^{-1}\left(\frac{1}{2}\right) + \sin^{-1}(-1/\sqrt{2})$ is (a) $\pi/12$ b) π c) $\pi/3$ d) $\pi/6$	1
2.	If $\mathbf{a}, \mathbf{b}$ are positive integers such that $\mathbf{a} < \mathbf{b}$ and $[\mathbf{a} \quad \mathbf{b}]\begin{bmatrix}\mathbf{a}\\ \mathbf{b}\end{bmatrix} = [25]$, then $(\mathbf{a}, \mathbf{b}) =$ (a) (3,5) (b) (5,5) (c) (3,4) (d) (15,10)	1
3.	Let A be a skew-symmetric matrix of order 3. If $\lvert\mathbf{A}\rvert = \mathbf{x}$, then $(2023)^{\mathbf{x}}$ is: (a) 2023 (b) $\frac{1}{2023}$ (c) $(2023)^2$ (d) 1	1
4.	If A is an invertible matrix of order 2, then $\lvert\mathbf{A}\rvert^{-1} =$ (a) $\lvert\mathbf{A}\rvert$ (b) $\frac{1}{\lvert\mathbf{A}\rvert}$ (c) 1 (d) 0	1
5.	If $\mathbf{C_{ij}}$ is the cofactor of the element $\mathbf{a_{ij}}$ of the determinant $\begin{vmatrix}2 & -3 & 5\\ 6 & 0 & 4\\ 1 & 5 & -7\end{vmatrix}$, then the value of $\mathbf{a_{32}C_{32}}$: (a) 110 (b) 22 (c) -110 (d) -22	1
6.	Let A $= \begin{bmatrix}1 & \sin\theta & 1\\ -\sin\theta & 1 & \sin\theta\\ -1 & -\sin\theta & 1\end{bmatrix}$, where $0 \le \theta \le 2\pi$. Then (a) $\mathbf{Det}\ (\mathbf{A}) = 0$ (b) $\mathbf{Det}\ (\mathbf{A}) \in (2, \infty)$ (c) $\mathbf{Det}\ (\mathbf{A}) \in (2, 4)$ (d) $\mathbf{Det}\ (\mathbf{A}) \in [2, 4]$	1
7.	If y=log$\sqrt{\sec\sqrt{x}}$, then $\frac{dy}{dx}$ at x=$\frac{\pi^2}{16}$is: (a) $\frac{1}{\pi}$ (b) π (c) $\frac{1}{2}$ (d) $\frac{1}{4}$	1

8.	The value of k for which f(x)=$\begin{cases} 3x+5, x \geq 2 \\ kx^2, x < 2 \end{cases}$, is continuous, is (a) 11/4 (b) 4/11 (c) 1 (d) -11/4	1
9.	The function $f(x) = x^2 - 4x + 6$ is increasing in the interval (a)(0,2) (b) (-∞, 2] (c)[1,2] (d)[2, ∞)	1
10.	$\int \frac{\cos(x+a)}{\sin(x+b)}$ dx equals to (a) cos (a-b).log$\lvert\sin(x+b)\rvert$ -sin (a-b)x + C (b) cos (a+b).log$\lvert\sin(x+b)\rvert$-sin (a-b)x + C (c) cos (a-b).log$\lvert\sin(x+b)\rvert$-sin (a+b)x + C (d)- cos (a-b).log$\lvert\sin(x+b)\rvert$-sin (a-b)x + C	1
11.	The integrating factor of differential equation (x + 2y^3) $\frac{dy}{dx} = 2y$ is a) $e^{\frac{y^2}{2}}$ (b) $\frac{1}{\sqrt{y}}$ (c) $\frac{1}{y^2}$ (d) $e^{-\frac{1}{y^2}}$	1
12.	The value of λ for which the angle between the lines $\vec{r} = (\hat{i}+\hat{j}+\hat{k}) + p(2\hat{i}+\hat{j}+2\hat{k})$ and $\vec{r} = (1+q)\hat{i} + (1+q\lambda)\hat{j} + (1+q)\hat{k}$ is $\frac{\pi}{2}$ is a)4 b) -4 c) 2 d) -2	1
13.	If θ is the acute angle between any two vectors $\vec{a}$ and $\vec{b}$, when $\lvert\vec{a} \times \vec{b}\rvert = \lvert\vec{a}.\vec{b}\rvert$, then θ is equal to: a) 0 b) $\frac{\pi}{4}$ c) $\frac{\pi}{2}$ d) π	1
14.	If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + \hat{j} - \hat{k}$, then $\vec{a}$ and $\vec{b}$ are: a) Collinear vectors which are not parallel b) Parallel vectors c) Perpendicular vectors d) Unit vectors	1
15.	The feasible region of a LPP is shown in the fig. Which of the following are the possible constraints?  (a) $x + 2y \geq 4, x + y \leq 3, x \geq 0, y \geq 0$ (b) $x + 2y \leq 4, x + y \leq 3, x \geq 0, y \geq 0$ (c) $x + 2y \geq 4, x + y \geq 3, x \geq 0, y \geq 0$ (d) $x + 2y \geq 4, x + y \leq 3, x \geq 0, y \leq 0$	1
16.	Corner points of the feasible region determined by the system of linear constraints are (0, 3),(1,1) and (3,0). Let $Z = px + qy$, where p, q>0. Condition on p and q so that the minimum of Z occurs at (3,0) and (1,1) is (a) p=2q (b) p=q/2 (c) p=3q (d) p=q	1
17.	The number of onto functions from a set A with m elements to a set B with n elements, where $m \geq n$, is given by: (a)nm (b)mn (c) $\sum_{k=0}^{n}(-1)^k n_{C_k}(n-k)^m$ (d) n!	1
18.	A mapping is selected at random from set $A = \{1, 2, ..., 20\}$ into itself. The probability that mapping selected is an injective, is a) $\frac{20}{20^{20}}$ b) $\frac{19!}{20^{19}}$ c) $\frac{19}{20}$ d) none of these	1
	ASSERTION-REASON BASED QUSETIONS: (Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (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 but R is false. (d) A is false but R is true.	

19.	Assertion(A): $\int_{-2}^{2} \log\left(\frac{1+x}{1-x}\right) dx = 0$ Reason(R): If f is an odd function, then $\int_{-a}^{a} f(x)dx = 0$	1
20.	Assertion(**A**): Projection of $\vec{a}$ on $\vec{b}$ is same as projection of $\vec{b}$ on $\vec{a}$. Reasoning (**R**): Angle between of $\vec{a}$ and $\vec{b}$ is same as angle between $\vec{b}$ and $\vec{a}$ numerically.	1
	Section B	
21.A	**What is the domain of function** $\cos^{-1}(2x-3)$?	
	OR	2
21.B	Find the value of $\sin\left(2\sin^{-1}\left(\frac{3}{5}\right)\right)$.	
22.	**Differentiate** $\tan^{-1}\left(\frac{1+\cos x}{\sin x}\right)$ **with respect to x.**	2
23.A	**Given** $\frac{d}{dx}(F(x)) = \frac{1}{\sqrt{2x-x^2}}$ **and** $F(1)=0$, **find** $F(x)$.	2
	OR	
23.B	Find the area of the region bounded by the curve $y = \lvert x-1 \rvert$ and $y = 1$	
24.	Find the value of k so that the function **f** is continuous at $x = \frac{\pi}{2}$ $f(x) = \begin{cases} \frac{k\cos x}{\pi - 2x}, & \text{if } x \neq \frac{\pi}{2} \\ 5, & \text{if } x = \frac{\pi}{2} \end{cases}$	2
25.	If the sum of two-unit vectors is a unit vector, prove that the magnitude of their difference is $\sqrt{3}$.	2
	Section C	
26.A	If $x=a(\cos t+t\sin t)$ and $y=a(\sin t-t\cos t)$, $0 < t < \frac{\pi}{2}$, find $\frac{dy}{dx}$ **and** $\frac{d^2y}{dx^2}$	3
	OR	
26.B	**If** $\sqrt{1-u^2} + \sqrt{1-v^2} = a(u-v)$, **then prove that** $\frac{dv}{du} = \frac{\sqrt{1-v^2}}{\sqrt{1-u^2}}$	
27.	**Find the absolute maximum value and the absolute minimum value of the following fu in the given intervals:** $f(x) = 4x - \frac{1}{2}x^2$, **x is in** $\left[-2, \frac{9}{2}\right]$.	3
28.A	Using integration, find the area of the region enclosed by the parabola $4y = 3x^2$ and the line $3x-2y+12=0$.	3
	OR	
28.B	Using integration, find the area of the region bounded by the lines $3x-2y+1=0$, $2x+3y-21=0$ and $x-5y+9=0$.	
29.A	Equations of sides of a parallelogram ABCD are as follows: **AB:** $\frac{x+1}{1} = \frac{y-2}{-2} = \frac{z-1}{2}$ **BC:** $\frac{x-1}{3} = \frac{y+2}{-5} = \frac{z-5}{3}$ **CD:** $\frac{x-4}{1} = \frac{y+7}{-2} = \frac{z-8}{2}$ **DA:** $\frac{x-2}{3} = \frac{y+3}{-5} = \frac{z-4}{3}$ Find the equation of diagonal BD.	3
	OR	
29.B	An aeroplane is flying along the line $\vec{r} = \lambda(\hat{i} - \hat{j} + \hat{k})$ where λ is a scalar and another aeroplane is flying along the line $\vec{r} = (\hat{i} - \hat{j}) + \mu(-2\hat{j} + \hat{k})$ where μ is a scalar. Find the shortest possible distance between them.	

30.	Solve the following Linear Programming Problem graphically: Maximize Z = 3x + 9y subject to the constraints $x + y \geq 10$, $x + 3y \leq 60$, $x \leq y$, $x \geq 0, y \geq 0$	3
31.	If the probability that a problem will be solved by three students is $\frac{1}{2}, \frac{1}{3}$ **and** $\frac{1}{6}$, then what is the probability that the problem will be solved if all three students try the problem simultaneously?	3
Section D		
32.	Determine the product $\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}$ and $\begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$ and use it to solve the following system of equations: $x - y + z = 4,\ x - 2y - 2z = 9,\ 2x + y + 3z = 1$	5
33.A	Find: $\int \sqrt{\tan x} + \sqrt{\cot x}\, dx$	5
	OR	
33.B	Evaluate: $\int_0^1 \frac{\log(1+x)}{1+x^2} dx$	
34.A	Solve the differential equation- $$x\frac{dy}{dx} + y - x + xy\cot x = 0$$	5
	OR	
34.B	Find the particular solution of the differential equation $$x\frac{dy}{dx} - y + x\operatorname{cosec}\left(\frac{y}{x}\right) = 0\ ;\ y(1) = 0$$	
35.	Find the vector and Cartesian equations of the line passing through point $A(2, 1, 3)$ and perpendicular to the lines $$\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3} \quad \text{and} \quad \frac{x}{-3} = \frac{y}{2} = \frac{z}{5}$$	5
Section E		
36.	**<u>Case Study -1:</u>** Excessive use of screens can result in vision problems, obesity, sleep disorders, anxiety, low retention problems and can impede social and emotional comprehension and expression. It is essential to be mindful of the amount of time we spend on screens and to reduce our screen-time by taking regular breaks, setting time limits, and engaging in non-screen-based activities.	4

In a class of students of the age group 14 to 17, the students were categorised into three groups according to a feedback form filled by them. The first group constituted of the students who spent more than 4 hours per day on the mobile screen or the gaming screens, while the second group spent 2 to 4 hours /day on the same activities. The third group spent less than 2 hours /day on the same. The first group with the high screen time is 60% of all the students, whereas the second group with moderate screen time is 30% and the third group with low screen time is only 10% of the total number of students. It was observed that 80% students of first group faced severe anxiety and low retention issues, with 70% of second group, and 30% of third group having the same symptoms.

(i) What is the total percentage of students who suffer from anxiety and low retention issues in the class? (2M)

(ii) A student is selected at random, and he is found to suffer from anxiety and low retention issues. What is the probability that he/she spends screen time more than 4 hours per day? (2M)

37. **Case Study -2:** — 4

A small town is analyzing the pattern of a new street light installation. The lights are set up in such a way that the intensity of light at any point x metres from the start of the street can be modelled by $\mathbf{f(x) = e^x \sin x}$, where x is in metres.

Based on the above, answer the following:

(i) Find the intervals on which the f(x) is increasing or decreasing, $x \in [0,\pi]$. (2M)

(ii) Verify, whether each critical point when $x \in [0,\pi]$ is a point of local maximum or local minimum or a point of inflexion. (2M)

38. **Case Study -3:** — 4

A teacher is keen to assess the learning of her students on the concept of "relations" taught to them. She writes the following five relations each defined on the set $\boldsymbol{A} = \{\mathbf{1}, \mathbf{2}, \mathbf{3}\}$.

$\boldsymbol{R_1} = \{(\mathbf{2}, \mathbf{3}), (\mathbf{3}, \mathbf{2})\}$

$\boldsymbol{R_2} = \{(\mathbf{1}, \mathbf{2}), (\mathbf{1}, \mathbf{3}), (\mathbf{3}, \mathbf{2})\}$

$\boldsymbol{R_3} = \{(\mathbf{1}, \mathbf{2}), (\mathbf{2}, \mathbf{1}), (\mathbf{1}, \mathbf{1})\}$

$\boldsymbol{R_4} = \{(\mathbf{1}, \mathbf{1}), (\mathbf{1}, \mathbf{2}), (\mathbf{3}, \mathbf{3}), (\mathbf{2}, \mathbf{2})\}$

$\boldsymbol{R_5} = \{(\mathbf{1}, \mathbf{1}), (\mathbf{1}, \mathbf{2}), (\mathbf{3}, \mathbf{3}), (\mathbf{2}, \mathbf{2}), (\mathbf{2}, \mathbf{1}), (\mathbf{2}, \mathbf{3}), (\mathbf{3}, \mathbf{2})\}$

The students are asked to answer the following questions about the above relations.

(i) Identify the relation which is reflexive and transitive but not symmetric. (1 M)

(ii) Identify the relation which is reflexive and symmetric but not transitive. (1 M)

(iii) (a) Identify the relations which are symmetric but neither reflexive nor transitive. (2M)

OR

(iii) (b) What pairs should be added to the relation $\mathbf{R_2}$ to make it an equivalence relation?

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