PRE-BOARD-I EXAMINATION, CLASS XII 2024-25 CHENNAI REGION

CLASS XII — Max Marks : 80

SUB: MATHEMATICS (CODE-041) — DURATION :3HOURS

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)** 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 calculators is not allowed.

SECTION-A [1 ×20 =20]

(This section comprises of multiple-choice questions (MCQs) of 1 mark each)
Select the correct option (Question 1 - Question 18):

Q1. For which of the given values of x and y, the following pair of matrices are equal?

$$\begin{bmatrix} 3x+7 & 5 \\ y+1 & 2-3x \end{bmatrix}, \begin{bmatrix} 0 & y-2 \\ 8 & 4 \end{bmatrix}$$

(a) $x = \frac{-1}{3}, y = 7$ (b) no such x and y possible (c) $y = 7,\ x = \frac{-2}{3}$ (d) $x = \frac{-1}{3}, y = \frac{-2}{3}$

Q2. Assume $\boldsymbol{X}, \boldsymbol{Y}, \boldsymbol{Z}, \boldsymbol{W}$ and P are matrices of order $2 \times n, 3 \times k, 2 \times p, n \times 3$ and $\boldsymbol{p} \times \boldsymbol{k}$, respectively. Then the restriction on $\boldsymbol{n}, \boldsymbol{k}$ and $\boldsymbol{p}$ so that $\boldsymbol{PY} + \boldsymbol{WY}$ will be defined are:
(a) $k = 3, p = n$(b) $\boldsymbol{k}$ is arbitrary, $\boldsymbol{p} = 2$ (c) p is arbitrary, $k = 3$ (d) $k = 2, p = 3$

Q3. The interval in which the function y=x^2e^{-x} is increasing is:
(a) (-∞, ∞) (b)(-2, 0) (c) (2, ∞) (d) (0, 2)

Q4. A and B are two matrices such that $AB = A$ and $BA = B$ then B^2 is
(a) A (b) B (c) 0 (d) I

Q5. The general solution of the differential equation $\log\left(\frac{dy}{dx}\right) + x = 0$ is
(a) $y = e^{-x} + c$ (b) $y = -e^{-x} + c$ (c) $y = e^{x} + c$ (d) $y = -e^{x} + c$

Q6. If A is a square matrix of order 3 such that |A| = - 5 then value of $|-AA'|$ is
(a) 125 (b) - 125 (c) 25 (d) – 25

Q7. If A, 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

Q8. Two events A and B will be independent, if
(a) A and B are mutually exclusive
(b) P(A′B′) = [1 – P(A)] [1 – P(B)]
(c) P(A) = P(B)
(d) P(A) + P(B) = 1

Q9. A vector in the direction of vector $\hat{\imath} - 2\hat{\jmath} + 2\hat{k}$ that has magnitude 15 is
(a) $-5\hat{\imath} - 10\hat{\jmath} - 10\hat{k}$ (b) $5\hat{\imath} + 10\hat{\jmath} + 10\hat{k}$ (c) $-5\hat{\imath} + 10\hat{\jmath} + 10\hat{k}$ (d) $5\hat{\imath} - 10\hat{\jmath} + 10\hat{k}$

.0. If $|\vec{a}| = 3, |\vec{b}| = 4$ and $|\vec{a} + \vec{b}| = 5$, then $|\vec{a} - \vec{b}| =$
(A) 3 (B) 4 (C) 5 (D) 8

Q11. The region represented by graph of the inequality 2x + 3y > 6 is
(a) half plane that contains the origin
(b) half plane that neither contains the origin nor the points on the line 2x + 3y=6
(c) whole XOY-plane excluding the points on the line 2x + 3y = 6
(d) entire XOY plane

Q12. $\int e^x \sec x\,(1 + \tan x)\,dx = \cdots$
(a) $e^x \cos x + c$ (b) $e^x \sec x + c$ (c) $e^x \sin x + c$ (d) $e^x \tan x + c$

Q13. $\int_0^{2\pi} \text{cosec}^7\, x dx =$
(a) 0 (b) 1 (c) 4 (d) 2π

Q14. The number of arbitrary constants in the particular solution of a differential equation of third order is /are
(a) 3 (b) 2 (c) 1 (d) 0

Q15. If $\cos\left[\tan^{-1}\left\{\cot\left(\sin^{-1}\frac{1}{2}\right)\right\}\right] = \cdots$
(a) 1 (b) 0 (c) $\frac{1}{\sqrt{2}}$ (d) $\frac{1}{2}$

Q16. The corner points of the feasible region in the graphical representation of a linear programming problem are (2,72), (15,20) and (40,15). If z = 18x+9y be the objective function, then:
(a) z is maximum at (2,72), minimum at (15,20)
(b) z is maximum at (15,20), minimum at (40,15)
(c) z is maximum at (40,15), minimum at (15,20)
(d) z is maximum at (40,15), minimum at (2,72)

Q17. If x = t^2, y= t^3, then $\frac{d^2y}{dx^2}$=
(a) $\frac{3}{2}$ (b) $\frac{3}{4t}$ (c) $\frac{3}{2t}$ (d) $\frac{3t}{2}$

Q18. The area bounded by the line y = x, x-axis and lines x = – 1 to x = 2, is
a) 0 sq. units b) $\frac{1}{2}$ sq units c) $\frac{3}{2}$ sq units d) $\frac{5}{2}$ sq units

ASSERTION – REASON BASED QUESTIONS

Directions: Each of these questions contains two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

Q19. Consider the function $f(x)=\begin{cases} x^2 - 5x + 6\,x - 3, & \text{for } x \neq 3 \\ k, & \text{for } x = 3 \end{cases}$ is continuous at x = 3
Assertion (A): The value of k is 4
Reason (R): If f(x) is continuous at a point a then $\lim_{x\to a} f(x) = f(a)$

Q20. Assertion (A) : If $y = tan^{-1}\left(\frac{\cos x + sinx}{\cos x - sinx}\right)$, $-\frac{\pi}{4} < x < \frac{\pi}{4}$ then $\frac{dy}{dx} = 1$
Reason(R) : $\frac{\cos x + sinx}{\cos x - sinx} = \tan(x + \frac{\pi}{4})$

SECTION B
VERY SHORT ANSWER TYPE QUESTIONS(VSA)
(Each question carries 2 marks)

Q21. Evaluate : $\sin^{-1}\left(\sin\frac{3\pi}{4}\right) + \cos^{-1}\left(\cos\frac{3\pi}{4}\right) + \tan^{-1}(1)$

Q22. Function f is defined as $f(x) = \begin{cases} 2x + 2, & \text{if} \quad x < 2 \\ k, & \text{if} \quad x = 2 \\ 3x, & \text{if} \quad x > 2 \end{cases}$ Find the value of k for which the function f is continuous at x = 2.
OR

If $x = a(\theta - \sin\theta)$ and $y = a(1 + \cos\theta)$, find $\frac{dy}{dx}$ at $\theta = \frac{\pi}{3}$

Q23. Find the point on the curve $y^2 = 8x$ for which the abscissa and ordinate change at the same rate

Q24. Find the projection of the vector $\vec{a} = 2\hat{\imath} + 3\hat{\jmath} + 2\hat{k}$ on the vector $\vec{b} = \hat{\imath} + 2\hat{\jmath} + \hat{k}$.
OR
If $\vec{a} = 4\hat{\imath} - \hat{\jmath} + \hat{k}$ and $\vec{b} = 2\hat{\imath} - 2\hat{\jmath} + \hat{k}$, then find a unit vector along the vector $\vec{a} \times \vec{b}$.

Q25. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, then write the value of $\vec{a}\cdot\vec{b} + \vec{b}\cdot\vec{c} + \vec{c}\cdot\vec{a}$.

SECTION C
SHORT ANSWER TYPE QUESTIONS(SA)
(Each question carries 3 marks)

Q26. Find the intervals in which the function $f(x) = \frac{3}{2}x^4 - 4x^3 - 45x^2 + 51$ is strictly increasing and strictly decreasing

Q27. The volume of a cube is increasing at the rate of 9 cm^3/s. How fast is its surface area increasing when the length of an edge is 10 cm?

Q28. Evaluate: $\int_{-1}^{2} |x^3 - x|dx$
OR
Find $\int \frac{x+3}{\sqrt{5-4x-2x^2}}dx$

Q29. Let $\vec{a} = 4\hat{\imath} + 5\hat{\jmath} - \hat{k}, \vec{b} = \hat{\imath} - 4\hat{\jmath} + 5\hat{k}$ and $\vec{c} = 3\hat{\imath} + \hat{\jmath} - \hat{k}$. Find a vector $\vec{d}$ which is perpendicular to both $\vec{c}$ and $\vec{b}$ and $\vec{d} \cdot \vec{a} = 21$.

OR

Show that the lines $\frac{x+1}{3} = \frac{y+3}{5} = \frac{z+5}{7}$ and $\frac{x-2}{1} = \frac{y-4}{3} = \frac{z-6}{5}$ intersect. Also find their point of intersection.

Q30. Consider the following Linear Programming Problem: Minimize $Z = x + 2y$

Subject to $2x + y \geq 3, x + 2y \geq 6, x, y \geq 0$. Show graphically that the minimum of Z occurs at more than two points.

Q31. A problem is given to three students whose probabilities of solving it are $\frac{1}{3}, \frac{1}{4}$ and $\frac{1}{6}$ respectively. If the events of solving the problem are independent, find probabilities that at least one of them solves it.

OR

A man is known to speak truth 3 out of 4 times. He throws a die and reports that it is a six. Find the probability that it is actually a six.

SECTION D

LONG ANSWER TYPE QUESTIONS(LA)

(Each question carries 5 marks)

Q32. Use product $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -3 \\ 3 & -2 & 4 \end{bmatrix} \begin{bmatrix} -2 & 0 & 1 \\ 9 & 2 & -3 \\ 6 & 1 & -2 \end{bmatrix}$ to solve the system of equations:

$x - y + 2z = 1, \ 2y - 3z = 1, \ 3x - 2y + 4z = 2$

Q33. Draw the graph of y=|x+1| and find the area bounded by it with x- axis, x = −4 and x=2.

Q34. If x and y are connected parametrically by the equations and $x = \frac{\sin^3 t}{\sqrt{\cos 2t}}, y = \frac{\cos^3 t}{\sqrt{\cos 2t}}$ find $\frac{dy}{dx}$

OR

Determine a, b, c so that f(x) = $\begin{cases} \dfrac{\sin(a+1)x + \sin x}{x}, & x < 0 \\ c, & x = 0 \\ \dfrac{\sqrt{x + bx^2} - \sqrt{x}}{bx^{3/2}}, & x > 0 \end{cases}$ is continuous at x = 0.

Q35. Find the shortest distance between the lines.

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4} \quad and \quad \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$$

OR

Find the vector equation of the line passing through the point (1, 2, – 4) and perpendicular to the two lines:

$$\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7} \quad and \quad \frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$$

SECTION E

(3 case study questions carry 4 marks each)

Q36. Vani and Mani are playing Ludo at home while it was raining outside. While rolling the dice Vani's brother Varun observed and noted the possible outcomes of the throw every time belongs to the set $\{1,2,3,4,5,6\}$. Let A be the set of players while B be the set of all possible outcomes.A $= \{$ Vani, Mani $\}, B = \{1,2,3,4,5,6\}$.

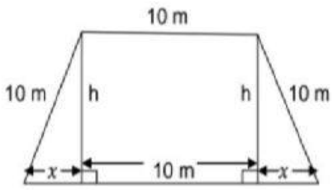
Answer the following questions:

a. Let $R: B \to B$, be defined by $R = \{(x, y) : y$ is divisible by $x\}$.Verify that whether R is reflexive, symmetric and transitive. (2marks)

b. Is it possible to define an onto function from A to B? Justify. (1mark)

c. Which kind of relation is R defined on B given by
R= $\{(1,2), (2,2), (1,3), (3,4), (3,1), (4,3), (5,5)\}$? (1mark)
OR
Find the number of possible relations from A to B .

Q37. 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:



I. Find area **A** of the gate expressed as a function of **x**.

II. Find value of $\frac{dA}{dx}$.

III. Find x and show that area is maximum

OR

Find maximum area of trapezium.

Q38. Case-Study 3:

A biased die is tossed and respective probabilities for various faces to turn up are the following :

Face	1	2	3	4	5	6
Probability	$0 \cdot 1$	$0 \cdot 24$	$0 \cdot 19$	$0 \cdot 18$	$0 \cdot 15$	K

Based on the above information, answer the following questions:

(a) What is the value of K ? 2 marks

(b) If a face showing an even number has turned up, then what is the probability that it is the face with 2 or 4 ? 2marks

END OF PAPER