

SAMPLE QUESTION PAPER - 2025-26
CLASS XII - MATHEMATICS (041)

Time Allowed: 3 Hours

Maximum Marks: 80

General Instructions:

1. This Question Paper contains **38** questions. All questions are compulsory.
 2. The question paper is divided into FIVE Sections – A, B, C, D and E.
 3. Section **A** comprises of **20** questions of **1** mark each.
 4. Section **B** comprises of **5** questions of **2** marks each.
 5. Section **C** comprises of **6** questions of **3** marks each.
 6. Section **D** comprises of **4** questions of **5** marks each.
 7. Section **E** comprises of **3** Case Study Based Questions of **4** marks each.
 8. There is no overall choice in the question paper. However, an internal choice has been provided in **2** questions in Section B, **3** questions in Section C, **2** questions in Section D and **2** questions in Section E (in the sub-parts).
 9. Use of calculators is **not** permitted.
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SECTION A (20 Marks)

This section comprises 20 questions of 1 mark each. Questions 1-18 are Multiple Choice Questions (MCQs) and questions 19-20 are Assertion-Reason based questions.

Multiple Choice Questions (MCQs)

1. Let R be a relation on the set $\mathbb{N}$ of natural numbers defined by xRy if x divides y . Then R is:
 - (a) Reflexive and Symmetric
 - (b) Transitive but not Symmetric
 - (c) Reflexive and Transitive
 - (d) An Equivalence relation
2. If $\cos\left(\sin^{-1}\left(\frac{1}{2}\right) + \cos^{-1}\left(\frac{1}{2}\right)\right)$ is equal to:
 - (a) 0
 - (b) 1
 - (c) $\frac{1}{2}$
 - (d) $\frac{\sqrt{3}}{2}$
3. If $f : \mathbb{R} \rightarrow \mathbb{R}$ is defined by $f(x) = 3x - 2$, then $f^{-1}(x)$ is:
 - (a) $3x + 2$
 - (b) $\frac{x}{3} - 2$
 - (c) $\frac{x+2}{3}$
 - (d) $\frac{x-2}{3}$
4. The principal value of $\tan^{-1}(-\sqrt{3})$ is:
 - (a) $\frac{2\pi}{3}$
 - (b) $-\frac{\pi}{6}$
 - (c) $-\frac{\pi}{3}$
 - (d) $\frac{\pi}{3}$

5. Let $A = \{1, 2, 3\}$. The number of equivalence relations containing $(1, 2)$ is:
- 1
 - 2
 - 3
 - 4
6. If a matrix A is both symmetric and skew-symmetric, then A is a:
- Diagonal matrix
 - Zero matrix
 - Square matrix
 - Identity matrix
7. If A is a square matrix of order 3 and $|A| = -2$, then $|adj(A)|$ is equal to:
- 4
 - 2
 - 8
 - 2
8. If A is an invertible matrix of order 2, then $\det(A^{-1})$ is equal to:
- $\det(A)$
 - $\frac{1}{\det(A)}$
 - 1
 - 0
9. The matrix $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ is the inverse of:
- $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$
 - $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
 - $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$
 - $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$
10. The value of x for which $\begin{vmatrix} 3 & x \\ x & 1 \end{vmatrix} = \begin{vmatrix} 3 & 2 \\ 4 & 1 \end{vmatrix}$ is:
- $2\sqrt{2}$
 - 4
 - $\pm 2\sqrt{2}$
 - ± 4
11. The value of $\int_{-1}^1 (x^3 + x) dx$ is:
- 2
 - 1
 - 1

- (d) 0
12. If $y = \log(\sqrt{\sin x})$, then $\frac{dy}{dx}$ is:
- (a) $\cot x$
 (b) $\frac{1}{2} \cot x$
 (c) $\frac{1}{\sqrt{\sin x}}$
 (d) $\frac{\cos x}{\sqrt{\sin x}}$
13. The integrating factor of the differential equation $x \frac{dy}{dx} - y = 2x^2$ is:
- (a) x
 (b) $-x$
 (c) $\frac{1}{x}$
 (d) $-\frac{1}{x}$
14. The slope of the tangent to the curve $y = x^2 - 2x + 1$ at $x = 1$ is:
- (a) 0
 (b) 1
 (c) 2
 (d) -1
15. The order and degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^2 - 3\left(\frac{dy}{dx}\right)^2 + y = 0$ are:
- (a) Order 3, Degree 2
 (b) Order 3, Degree is not defined
 (c) Order 2, Degree 3
 (d) Order 1, Degree 2
16. The minimum value of the function $f(x) = x \log x$ is:
- (a) $-\frac{1}{e}$
 (b) e
 (c) 1
 (d) 0
17. The projection of the vector $\mathbf{a} = 2\hat{i} - \hat{j} + \hat{k}$ on the vector $\mathbf{b} = \hat{i} + 2\hat{j} + 2\hat{k}$ is:
- (a) $\frac{2}{3}$
 (b) $\frac{1}{3}$
 (c) $\frac{2}{\sqrt{9}}$
 (d) $\frac{1}{9}$
18. The length of the perpendicular from the origin to the plane $\mathbf{r} \cdot (3\hat{i} - 4\hat{j} + 12\hat{k}) = 52$ is:
- (a) 4 units
 (b) 52 units
 (c) 13 units
 (d) 12 units
19. If $P(A) = 0.8$ and $P(B|A) = 0.5$, then $P(A \cap B)$ is:
- (a) 0.4

- (b) 0.3
- (c) 0.25
- (d) 0.5

Assertion-Reasoning Based Questions

Questions 19 and 20 are Assertion-Reasoning based questions. In these questions, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct answer from the following options:

- (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.

20. **Assertion (A):** The function $f(x) = |x - 1|$, $x \in \mathbb{R}$ is not differentiable at $x = 1$. **Reason (R):** A function is not differentiable at a point where the graph has a sharp corner or a cusp.
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SECTION B (10 Marks)

This section comprises 5 questions of 2 marks each.

21. Find the value of k so that the function $f(x) = \begin{cases} \frac{\sin x}{x}, & \text{if } x < 0 \\ x^2 + k, & \text{if } x \geq 0 \end{cases}$ is continuous at $x = 0$.
22. If $\vec{a}$ is a unit vector and $(\vec{x} - \vec{a}) \cdot (\vec{x} + \vec{a}) = 8$, find $|\vec{x}|$.

OR

Find the direction cosines of the line passing through the points $P(2, 3, -1)$ and $Q(4, 5, 2)$.

23. Find $\int \frac{dx}{x^2 - 6x + 13}$.

OR

Evaluate $\int_0^{\frac{\pi}{2}} \sin^2 x \, dx$.

24. Construct a 2×2 matrix $A = [a_{ij}]$ whose elements are given by $a_{ij} = e^{2i+j}$.
25. A pair of dice is thrown. What is the probability that the sum of the numbers is 8 or more, if 4 appears on the first die?
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SECTION C (18 Marks)

This section comprises 6 questions of 3 marks each.

26. Show that the function $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = \frac{2x-1}{3}$, is invertible. Hence find f^{-1} .
27. Find the equation of the tangent to the curve $y = x^3 - x + 1$ at the point where the curve crosses the y-axis.

OR

The total revenue in Rupees received from the sale of x units of a product is given by $R(x) = 3x^2 + 36x + 5$. Find the marginal revenue when $x = 5$.

28. Solve the differential equation $e^x \tan y \, dx + (1 - e^x) \sec^2 y \, dy = 0$.

OR

Find the particular solution of the differential equation $\frac{dy}{dx} = 1 + x + y + xy$, given that $y = 0$ when $x = 1$.

29. Find the vector equation of the line passing through the point $(1, 2, -4)$ and parallel to the vector $2\hat{i} + 3\hat{j} - 5\hat{k}$. Also, find its Cartesian equation.
30. Using properties of determinants, prove that:

$$\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = (a-b)(b-c)(c-a)$$

OR

If $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$, show that $A^2 - 5A + 7I = 0$.

31. Determine the maximum value of $Z = 3x + 4y$ if the feasible region of a LPP (Linear Programming Problem) is given by $x + y \leq 4, x \geq 0, y \geq 0$.
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SECTION D (20 Marks)

This section comprises 4 questions of 5 marks each.

33. Find the area of the region bounded by the parabola $y^2 = 4x$ and the line $x = 3$.

OR

Find the area of the region lying above the x -axis and included between the circle $x^2 + y^2 = 8x$ and the parabola $y^2 = 4x$.

34. Solve the following system of equations using matrix method:

$$x + y + z = 6$$

$$y + 3z = 11$$

$$x - 2y + z = 0$$

35. Show that the height of the cylinder of maximum volume that can be inscribed in a sphere of radius R is $\frac{2R}{\sqrt{3}}$.

OR

Evaluate $\int_{\pi/6}^{\pi/3} \frac{\sin x + \cos x}{\sqrt{\sin 2x}} dx$.

36. Find the shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$.
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SECTION E (12 Marks)

This section comprises 3 case study based questions of 4 marks each.

37. Case Study 1: Navigation and Vector Algebra

A ship is being guided by two lighthouses. Lighthouse A is located at $A(2, 4, 3)$ and Lighthouse B is located at $B(-1, 5, 8)$. The ship is currently positioned at the origin $O(0, 0, 0)$.

Based on the given information, answer the following questions:

- Find the position vector of Lighthouse B. (1 Mark)
- Find the vector $\vec{AB}$. (1 Mark)
- Calculate the scalar projection of vector $\vec{OB}$ on vector $\vec{OA}$. (2 Marks)

OR

- Find a vector perpendicular to both $\vec{OA}$ and $\vec{OB}$. (2 Marks)

38. Case Study 2: Disease Testing and Bayes' Theorem

In a city, 20% of the population are known to have a certain disease. A medical test has been developed to detect the disease. The test correctly diagnoses 90% of the people who have the disease (True Positive) and correctly identifies 80% of the people who do not have the disease (True Negative). A person is selected at random from the population and is given the test.

Based on the given information, answer the following questions:

- (a) Find the probability that a person is correctly diagnosed by the test. (1 Mark)
- (b) If the test result is positive, find the probability that the person actually has the disease. (3 Marks)

OR

- (c) Find the probability that the person has the disease given the test result is negative. (3 Marks)

39. Case Study 3: Rate of Change and Optimization

A water tank has the shape of an inverted circular cone with a base radius of 4 meters and a height of 8 meters. Water is being poured into the tank at a constant rate of $2 \text{ m}^3/\text{min}$.

(Volume of a cone is $V = \frac{1}{3}\pi r^2 h$)

Based on the given information, answer the following questions:

- (a) Express the radius r of the water surface in terms of its height h . (1 Mark)
- (b) Find the rate at which the water level is rising ($\frac{dh}{dt}$) when the water depth (h) is 4 meters. (3 Marks)

OR

- (c) If the rate of change of volume were $\frac{dV}{dt} = 2h$, find the rate of change of height ($\frac{dh}{dt}$) when $h = 4$ meters. (3 Marks)
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