

No. of pages - 24

(E)

No. of printed pages - 23

MID-TERM EXAMINATION (2026-27)

CLASS : XII

SUBJECT: MATHEMATICS (041)

Time Allowed : 3 hours

Maximum Marks : 80

समय : 3 घंटे

अधिकतम अंक - 80

सामान्य निर्देश:

निम्नलिखित निर्देशों को बहुत सावधानी से पढ़िए और उनका सख्ती से पालन कीजिए।

1. इस प्रश्न पत्र में 38 प्रश्न हैं। सभी प्रश्न अनिवार्य हैं।
2. यह प्रश्न पत्र पाँच खंडों में विभाजित है - क, ख, ग, घ एवं ङ।
3. खंड-क में प्रश्न संख्या 1 से 18 तक बहुविकल्पीय तथा प्रश्न संख्या 19 एवं 20 अधिकथन एवं तर्क आधारित 1 अंक के प्रश्न हैं।
4. खंड-ख में प्रश्न संख्या 21 से 25 तक अति लघुउत्तरीय (VSA) प्रकार के 2 अंक के प्रश्न हैं।
5. खंड-ग में प्रश्न संख्या 26 से 31 तक अति लघुउत्तरीय (SA) प्रकार के 3 अंक के प्रश्न हैं।
6. खंड-घ में प्रश्न संख्या 32 से 35 तक दीर्घ-घुत्तरीय (LA) प्रकार के 5 अंकों के प्रश्न हैं।
7. खंड-ङ में प्रश्न संख्या 36 से 38 तक प्रकरण अध्ययन आधारित 4 अंकों के प्रश्न हैं।
8. प्रश्न-पत्र में समग्र विकल्प नहीं दिया गया है। यद्यपि, खण्ड-ख के 2 प्रश्नों में, खण्ड-ग के 3 प्रश्नों में, खण्ड-घ के 2 प्रश्नों में और खण्ड-ङ के 2 प्रश्नों में आंतरिक विकल्प का प्रावधान दिया गया है।
9. कैल्कुलेटर का उपयोग वर्जित है।

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, question No. 1 to 18 are multiple choice questions (MCQs) type and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each.
4. In Section-B, question No. 21 to 25 are very short answer (VSA) type questions, carrying 2 marks each.
5. In Section-C, question No. 26 to 31 are Short answer (SA) type questions, carrying 3 marks each.
6. In Section-D, question No. 32 to 35 are long answer (LA) type questions, carrying 5 marks each.
7. In Section-E, question 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 2 questions in Section-E.
9. Use of calculators is not allowed.

SECTION-A

This section has 20 multiple choice questions of 1 mark each.

1. Which of the following relation in $A = \{1, 2, 3\}$ is equivalence relation?

(a) $\{(1, 1), (2, 2), (1, 2)\}$

(b) $\{(1, 2), (2, 2), (3, 3), (2, 3)\}$

(c) $\{(1, 1), (2, 2), (3, 3)\}$

(c) $\{(1, 2), (2, 3), (1, 3), (3, 1), (2, 1), (3, 2)\}$ (1)

2. If $A = \begin{bmatrix} 0 & 99 & -297 \\ -99 & 0 & 789 \\ 297 & -789 & 0 \end{bmatrix}$, then $|A|$ is :

(a) 7289

(b) 0

(c) -9289

(d) 9801 (1)

3. If $\sin^{-1} x = -\frac{\pi}{3}$, then $x^2 + \frac{1}{4}$ is :

(a) 1

(b) 0

(c) $\frac{5}{4}$

(d) $\frac{3}{4}$ (1)

4. A function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined as $f(x) = x^2 + 5x - 4$ is :

(a) Injective but not surjective

(b) Surjective but not injective

(c) Both injective and surjective

(d) Neither injective nor surjective (1)

5. If A and B are two matrices of order n, then which of the following is NOT correct :

(a) $(AB)' = B'A'$

(b) $|KA| = K^n |A|$

(c) $|A| = |B| \Rightarrow A = B$

(d) $|A| = |A'|$ (1)

6. $\sin\left(\sin^{-1}\frac{2\pi}{3}\right) :$

(a) $\frac{2\pi}{3}$

(b) $\frac{\sqrt{3}}{2}$

(c) $\frac{3\pi}{2}$

(d) $\frac{\pi}{3}$ (1)

7. The derivative of $\tan^{-1} x^3$ with respect to x is :

(a) $\frac{1}{1+x^6}$

(b) $\frac{x^3}{1+x^6}$

(c) $\frac{3x^2}{1+x^6}$

(d) $\frac{-3x^2}{1+x^6}$ (1)

8. If $f(x) = K(x - \cos x)$ is decreasing in R, then K belongs to :

(a) $(-\infty, \infty)$

(b) $(0, \infty)$

(c) $(-\infty, 0)$

(d) $\{0\}$ (1)

9. If $f(x) = |x|$ is bijective function from $A \rightarrow [0, \infty)$, then A is :

(a) $\mathbb{R}^-$

(b) $\mathbb{R}$

(c) $\mathbb{R}^+$

(d) $\mathbb{R}^+ \cup \{0\}$ (1)

10. The product of order and degree of the given differential equation $\frac{d}{dx}\left(\frac{d^2y}{dx^2}\right) = 7$ is :

(a) 4

(b) 1

(c) 2

(d) 3

(1)

11. $\int \cos^7 x \, dx$ is equal to :

(a) 0

(b) 1

(c) 2

(d) -2

(1)

12. If $[P]_{m \times n} = [A]_{m \times 3}[B]_{3 \times 5}[C]_{5 \times 1}$ where P, A, B, C are matrices of given order then the values of m & n are respectively :

(a) 1, 2

(b) 3, 2

(c) 2, 1

(d) 5, 3

(1)

13. If $y = \tan^{-1} \frac{2x}{1-x^2}$ then $\frac{dy}{dx}$ is equal to :

(a) $\frac{2}{1+x^2}$

(b) $\frac{-1}{1+x^2}$

(c) $\frac{-2}{1+x^2}$

(d) $\frac{1}{1+x^2}$

(1)

14. $\int \cos x \sin^7 x \, dx$ is equal to :

(a) $\cos^8 x + C$

(b) $\frac{\cos^8 x}{8} + C$

(c) $\frac{\sin^8 x}{8} + C$

(d) $\frac{\sin^7 x}{8} + C$

(1)

15. If $\begin{vmatrix} x & 2x \\ 3 & x \end{vmatrix} = \begin{vmatrix} 2 & 11 \\ 1 & 3 \end{vmatrix}$, then the all possible values of x are :

(a) 2, 3

(b) $\frac{11}{2}, 2$

(c) 1, 3

(d) 1, 5

(1)

16. The diagonal of square of side $2\sqrt{2}$ cm is increasing at the rate of 2 cm/sec which of the following is the rate at which this area is increasing?

(a) $8 \text{ cm}^2/\text{sec}$

(b) $12 \text{ cm}^2/\text{sec}$

(c) $6\sqrt{2} \text{ cm}^2/\text{sec}$

(d) $\sqrt{2} \text{ cm}^2/\text{sec}$

(1)

17. If A is a non-singular matrix of order 3 such that $|A| = 5$, then $|A^{-1}|$ is :

(a) $\frac{1}{5}$

(b) 25

(c) $\frac{1}{25}$

(d) 5

(1)

18. The point of inflection of a function $f(x)$ is the point where :

(a) $f'(x) = 0$ and $f'(x)$ changes its sign from positive to negative from left to right

(b) $f'(x) = 0$ and $f'(x)$ changes its sign from negative to positive from left to right

(c) $f'(x) = 0$ and $f'(x)$ does not change its sign from left to right of that point

(d) $f'(x) \neq 0$

(1)

Assertion-Reason Based Questions

Direction : In question numbers 19 and 20 two statements are given one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the following options :

- (a) Both Assertion (A) and Reason (R) are true and the Reason (R) is the correct explanation of the Assertion (A).
- (b) Both Assertion (A) and Reason (R) are true and the Reason (R) is not the correct explanation of the Assertion (A).
- (c) Assertion (A) is true, but Reason (R) is false.
- (d) Assertion (A) is false, but Reason (R) is true.

1. **Assertion (A) :** $\sin x$ is differentiable at $x = \frac{\pi}{2}$.

Reason (R) : $\lim_{x \rightarrow \frac{\pi}{2}} \sin x = \sin \frac{\pi}{2}$ (1)

2. **Assertion (A) :** $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin^5 x = 0$

Reason (R) : $\int_{-a}^a f(x) = 0$ if $f(x)$ is an odd function. (1)

SECTION-B

This section has 5 Very Short Answer questions of 2 marks each.

21. Draw the graph of $\cos^{-1} x$ in principal value branch. (2)

For Visually Impaired Students only

Solve $\sin \left[\cot^{-1} \sqrt{2} \{ \cos(\tan^{-1} 1) \} \right]$ (2)

22. If $y = \sin^{-1} \frac{\sqrt{1+x} + \sqrt{1-x}}{2}$, then show that $2\sqrt{1-x^2} \frac{dy}{dx} + 1 = 0$ (2)

OR

Differentiate $(\sin x)^x$ with respect to x . (2)

23. Evaluate $\int \frac{x+3}{x^2-2x+3} dx$ (2)

OR

Evaluate $\int e^x \left[\tan^{-1} x + \frac{1}{1+x^2} \right] dx$ (2)

24. Find the intervals in which the function given by $f(x) = \cos 3x$, $x \in \left[0, \frac{\pi}{2} \right]$ is : (2)

(a) Increasing

(b) Decreasing

25. If $\begin{bmatrix} x & 2x & 3 \\ 1 & 1 & -1 \end{bmatrix} = 0$ (Null Matrix) then find x .

SECTION-C

This section has 6 Short Answer (SA) questions of 3 marks each.

26. Evaluate $\int \frac{x + \sin x}{1 + \cos x} dx$ (3)

27. Find the domain of $\sin^{-1}(3 - 2x)$ (3)

28. If the function $f(x) = \begin{cases} \frac{e^{3x} - e^{-5x}}{x} & \text{if } x \neq 0 \\ a & \text{if } x = 0 \end{cases}$ is continuous at $x = 0$, then

find a . (3)

OR

Find all the points of discontinuity of the function f defined by

$$f(x) = \begin{cases} x + 2 & \text{if } x < 1 \\ 0 & \text{if } x = 1 \\ x - 2 & \text{if } x > 1 \end{cases} \quad (3)$$

29. For the matrix $A = \begin{bmatrix} 3 & 2 \\ 1 & 1 \end{bmatrix}$, find the numbers α and β such that $A^2 + \alpha A + \beta I = 0$ (3)

30. Evaluate $\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{x^9 - 3x^5 + 7x^3 - x + 1}{\cos^2 x} dx$ (3)

OR

Evaluate $\int_0^{\frac{\pi}{2}} \log_e \sin x \, dx$ (3)

31. A cylindrical drum containing diesel and kept vertical, the diesel is leaking out at the rate of $20 \text{ cm}^3/\text{sec}$. If the radius of the drum is 30 cm and height is 1.2 meter, find the rate at which the level of the diesel is changing when diesel level is 80 cm. (3)

OR

A mobile network company has 500 subscribers and collects ₹ 300 per subscriber per month. The company proposes to increase the monthly charges and it is believed that with every increase of ₹ 1, one subscriber will discontinue the service. Find what increase will bring maximum revenue. (3)

SECTION-D

This section has 4 Long Answer questions of 5 marks each.

32. If $A = \begin{vmatrix} 2 & 3 & 1 \\ -3 & 2 & 1 \\ 5 & -4 & -2 \end{vmatrix}$, find the A^{-1} . Using A^{-1} solve the following system of equations

$$2x - 3y + 5z = 11, 3x + 2y - 4z = -5, x + y - 2z = -3 \quad (5)$$

33. Using integration find the area of the region bounded by the curve $x^2 = 4y$ and the straight line $x = 4y - 2$. (5)

OR

Using integration find the area of the ellipse $2x^2 + 9y^2 = 36$ bounded between the line

$$y = 0 \text{ and } y = \frac{\sqrt{2}}{3}x \text{ in the first quadrant.} \quad (5)$$

34. Show that the relation R in the set Z of integers given by $R = \{(a, b) : 3 \text{ divides } (a-b)\}$ is an equivalence relation. Write the equivalence class containing 1. (5)

OR

Let $A = \mathbb{R} - \{3\}$, $B = \mathbb{R} - \{1\}$ and $f : A \rightarrow B$ be defined by $f(x) = \frac{x-2}{x-3}$. Prove that 'f' is invertible. Also find the inverse of $f(x)$. (5)

35. Find the particular solution of the differential equation $xydx - (x + 2y^2)dy = 0$ given that $y = 1$ when $x = 0$. (5)

SECTION-E

This section has 3 Case Study questions of 4 marks each.

36. A school conducted a Mathematics and Science Olympiad. The number of students from Class XII-A and Class XII-B who qualified at the School Level and District Level are represented by the matrix

$$A = \begin{bmatrix} 18 & 12 \\ 15 & 10 \end{bmatrix}$$

where the rows represent the classes and the columns represent the School Level and District Level qualifiers, respectively.

The school also uses the matrix $B = \begin{bmatrix} 4 & 2 \\ 3 & 5 \end{bmatrix}$ for further data analysis.

Based on the above information, Answer the following questions :

- (i) Find the transpose of matrix A. (1)
- (ii) Find the determinant of matrix B. (1)
- (iii) Find the inverse of matrix B. (2)

OR

- (iii) The school awards ₹ 500 to each School Level qualifier and ₹ 1000 to each District Level qualifier. Find the total prize amount awarded to Class XII-B. (2)

37. A particle moves along a straight line according to

$$s = t^3 - 6t^2 + 9t$$

where s (Distance) is in meters and t (Time) is in seconds.

Based on the above information, Answer the following questions :

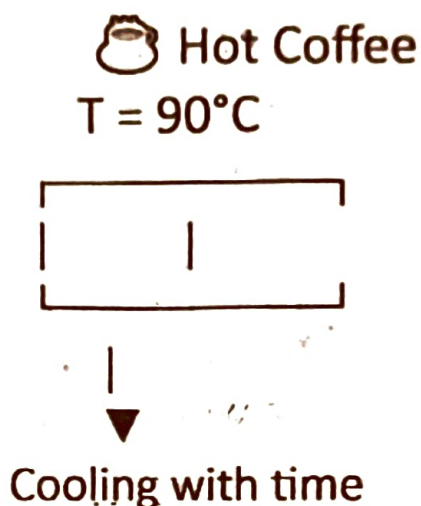
- (i) How to calculate the velocity from above expression. (1)
- (ii) Find the velocity function. (1)
- (iii) Find the time when the particle is at rest. (2)

OR

- (iii) Find the acceleration when $t = 3s$. (2)

38. A cup of coffee is placed on a table in a room. As time passes, the coffee cools down, the rate of decrease of the temperature of the coffee is directly proportional to the difference between its temperature and the surrounding room temperature.

If the room temperature is 25°C and the temperature of the coffee at the time t minutes is $T^{\circ}\text{C}$.



Based on the above information, Answer the following questions :

- (i) Represent the condition in the form of Differential Equation. (2)
- (ii) Solve the Differential Equation. (2)