

CLASS: XII
MID-TERM EXAMINATION (2026-27)
SUBJECT: MATHEMATICS (041)
SET-B1

Time: 3 Hrs.**Max. Mark: 80****General Instructions:**

1. This Question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there is some internal choice in some questions.
2. Section A has 18 MCQ's and 02 Assertion Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer (VSA) questions of 2 marks each.
4. Section C has 6 Short Answer (SA) questions of 3 marks each.
5. Section D has 4 Long Answer (LA) questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment (04 marks each) with sub parts.
7. Internal Choice is provided in 2 questions in Section-B, 2 questions in Section-C, 2 Questions in Section-D. You have to attempt only one alternative in all such questions.

SECTION A**(Multiple Choice Questions) Each question carries 1 mark.**

1. If the set A contains 5 elements and the set B contains 6 elements, then the number of bijective functions from A to B is

a) 720 ☒ b) 120 c) 30 d) 0

$5 \times 4 \times 3 \times 2 \times 1 = 120$

2. Let $A = \{3, 5\}$. Then number of reflexive relations of A is:

a) 2 ☒ b) 4 c) 0 d) 8

$2^{4-2} = 4$

3. The domain of the function $f(x) = \cos^{-1}(2x - 3)$ is:

a) $[1, 2]$ b) $(1, 2)$ c) $[-1, 1]$ d) $(-1, 1)$

4. The principal value of $\cos^{-1}\left(\cos\left(\frac{13\pi}{6}\right)\right)$ is:

a) $\frac{13\pi}{6}$ ☒ b) $\frac{\pi}{6}$ c) $\frac{\pi}{3}$ d) $\frac{\pi}{2}$

$2\pi + \frac{\pi}{6} = \frac{13\pi}{6}$
 $2\pi - \frac{\pi}{6} = \frac{11\pi}{6}$
 $\frac{\pi}{6}$

5. The number of all possible matrices of order 2×3 with each entry 1 or 2 is

a) 16 b) 6 c) 64 d) 24

6^6

6. If $A = \begin{bmatrix} 1 & 12 & 4y \\ 6x & 5 & 2x \\ 8x & 4 & 6 \end{bmatrix}$ is a symmetric matrix, then $(2x + y)$ is:

a) -8 b) 0 c) 6 ☒ d) 8

$\begin{bmatrix} 1 & 12 & 4y \\ 6x & 5 & 2x \\ 8x & 4 & 6 \end{bmatrix} = \begin{bmatrix} 1 & 6x & 4y \\ 12 & 5 & 4 \\ 4y & 2x & 6 \end{bmatrix}$

7. Let P be a skew-symmetric matrix of order 3. If $|P| = \alpha$, then $(2022)^\alpha$ is

$2x = 4$
 $x = 2$
 $y = 8$
 $2x + y = 12$
 $12 - 4 = 8$

- a) 0 b) 1 c) 2022 d) $(2022)^3$

8. If the points (x_1, y_1) , (x_2, y_2) and $(x_1 + x_2, y_1 + y_2)$ are collinear, then $x_1 y_2$ is equal to:

- a) $x_2 y_1$ b) $x_1 y_1$ c) $x_2 y_2$ d) $x_1 x_2$

9. If $x = A \cos 4t + B \sin 4t$, then $\frac{d^2 x}{dt^2}$ is equal to

- a) x b) $-x$ c) $16x$ ☒ d) $-16x$

10. If $x e^y = 1$, then the value of $\frac{dy}{dx}$ at $x = 1$ is

- a) -1 b) 1 c) $-e$ d) $-\frac{1}{e}$

11. The function $f(x) = x^2 - 4x + 6$ is increasing in the interval

- a) $(0, 2)$ b) $(-\infty, 2]$ c) $[1, 2]$ ☒ d) $[2, \infty)$

12. The radius of a circle increases uniformly at 3 cm/s . When the radius is 2 cm , the rate at

which the area (cm^2/s) of the circle is increasing is

- a) 6π b) 9π ☒ c) 12π d) 18π

13. If $\int \frac{2x}{x^2} dx = k \cdot 2^{\frac{1}{x}} + C$, then k is equal to

- a) $\frac{-1}{\log 2}$ b) $-\log 2$ ☒ c) -1 d) $\frac{1}{2}$

14. If $\int_0^a \frac{dx}{1+x^2} = \frac{\pi}{8}$, then the value of a is:

- a) $\frac{1}{6}$ b) $-\frac{1}{2}$ c) $-\frac{1}{6}$ d) $\frac{1}{2}$

15. The area (in sq. units) bounded by the curve $y = \frac{1}{2}x^2$, x -axis and ordinate $x = 2$ is:

- a) $\frac{1}{3}$ b) $\frac{2}{3}$ c) 1 d) $\frac{4}{3}$

16. The area of the region bounded by the curve $y = x + 1$ and the lines $x = 2$, $x = 3$ and x -axis in square units is:

- a) $\frac{7}{2}$ b) $\frac{9}{2}$ c) $\frac{11}{2}$ d) $\frac{13}{2}$

17. The objective function $Z = ax + by$ of an LPP has maximum value 42 at $(4, 6)$ and minimum value 19 at $(3, 2)$. Which of the following is true?

- a) $a = 9, b = 1$ b) $a = 5, b = 2$ c) $a = 3, b = 5$ d) $a = 5, b = 3$

18. If the feasible region of a linear programming problem with objective function

$Z = ax + by$, is bounded, then which of the following is correct?

- a) It will have neither maximum nor minimum value.

$$\begin{aligned} \frac{dx}{dt} &= A(-\sin 4t \cdot 4) + B(\cos 4t \cdot 4) \\ &= -4A \sin 4t + 4B \cos 4t \\ \frac{d^2 x}{dt^2} &= -4(A \cos 4t - B \sin 4t) \\ &= -4(A \cos 4t + B \sin 4t) \\ &= -16(A \cos 4t + B \sin 4t) \end{aligned}$$

$$\begin{aligned} \text{Let } 2x - 4 &= 0 \\ 2x &= 4 \\ x &= 2 \end{aligned}$$

$$\begin{aligned} \frac{dv}{dr} &= 3 \\ \frac{dA}{dt} &= 2\pi r \frac{dv}{dt} \\ &= 4\pi \cdot 2 \cdot 3 \\ &= 24\pi \end{aligned}$$

b) It will have both maximum and minimum values.

c) It will only have a maximum value.

d) It will only have a minimum value.

ASSERTION-REASON: In the following questions, a statement of Assertion(A) is followed by a statement of Reason(R). Choose the correct answer out of the following choices.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true and R is not correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

19. Assertion (A): The value of $\int e^x \sin x \, dx = \frac{1}{2} e^x (\sin x - \cos x) + C$.

Reason (R): The integral of $e^x \sin x$ can be solved using integration by parts twice.

20. Assertion (A): The maximum value of the function $f(x) = x^5, x \in [-1, 1]$, is attained at its critical point $x = 0$.

Reason (R): For a continuous function on $[a, b]$, absolute maximum occurs either at the critical point or at an end-points.

SECTION-B

(This section comprises of very short answer type-questions (VSA) of 2 marks each.)

21(a). Find the principal value of $\tan^{-1}(1) + \cos^{-1}\left(-\frac{1}{2}\right) + \sin^{-1}\left(-\frac{1}{\sqrt{2}}\right)$.

cos $\pi -$
sin $\pi -$
sec $\pi -$

OR

21(b). If $\cot^{-1}(3x + 5) > \frac{\pi}{4}$, then find the range of the value of x .

22. Show that the determinant $\begin{vmatrix} x & \sin \theta & \cos \theta \\ -\sin \theta & -x & 1 \\ \cos \theta & 1 & x \end{vmatrix}$ is independent of θ .

23. Determine the value of 'k' for which the following function is continuous at $x = 3$:

$$f(x) = \begin{cases} \frac{(x+3)^2 - 36}{x-3}; & x \neq 3 \\ k; & x = 3 \end{cases}$$

24. Find the interval in which the function $f(x) = x^4 - 4x^3 + 10$ is strictly decreasing.

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25(a). Evaluate: $\int_1^3 \frac{\sqrt{x}}{\sqrt{x} + \sqrt{4-x}} \, dx$.

OR

25(b). Find: $\int \frac{\cos 2x}{(\cos x + \sin x)^2} \, dx$.

SECTION-C

(This section comprises of short answer type questions (SA) of 3 marks each.)

26(a). Consider $f: R_+ \rightarrow [4, \infty)$ given by $f(x) = x^2 + 4$. Show that f is one-one and onto.

OR

26(b). Show that the relation R in the set A of all triangles as given by:

$R = \{(T_1, T_2) : T_1 \text{ is similar to } T_2\}$, is equivalence relation.

27. If $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$, $f(x) = x^2 - 2x - 3$, show that $f(A) = O$. Hence, find A^4 . *mult by A^2*

28. Find $\frac{dy}{dx}$ if $(x^2 + y^2)^2 = xy$.

29(a). If $y = \sin^{-1} x$, show that $(1 - x^2) \frac{d^2y}{dx^2} - x \frac{dy}{dx} = 0$.

OR

29(b). If $x = a \sec^3 \theta$, $y = a \tan^3 \theta$, then find $\frac{dy}{dx}$ at $\theta = \frac{\pi}{4}$.

30(a). The two equal sides of an isosceles triangle with fixed base b are decreasing at the rate of 3cm/s . How fast is the area of the triangle decreasing when two equal sides are equal to the base?

OR

30(b). Find both the maximum value and the minimum value of $3x^4 - 8x^3 + 12x^2 - 48x + 25$ on the interval $[0, 3]$.

31. Solve the following linear programming problem graphically:

Minimise: $Z = x - 5y$ subject to the constraints:

$$x - y \geq 0, -x + 2y \geq 2, x \geq 3, y \leq 4, y \geq 0.$$

SECTION-D

(This section comprises of long answer type questions (LA) of 5 marks each.)

32(a). Using matrix method, solve the following system of equations:

$$x - 2y = 10, 2x + y + 3z = 8, -2y + z = 7.$$

OR

32(b). If $A = \begin{pmatrix} 0 & 1 & 3 \\ 1 & 2 & a \\ 2 & 3 & 1 \end{pmatrix}$ and $A^{-1} = \frac{1}{2} \begin{pmatrix} 1 & -8 & 5 \\ -1 & 6 & -3 \\ 1 & 2b & 1 \end{pmatrix}$, find the values of a and b . Hence,

solve the given system of equations by matrix method: $y + 3z = 5, x + 2y + z = 8, 2x + 3y + z = 13$.

33. Find $\frac{dy}{dx}$ if $y = x^{\sin x} + \sin(x^x)$.

34(a). Find: $\int \frac{x^2 + x + 1}{(x^2 + 1)(x + 2)} dx$.

OR

34(b). Evaluate: $\int_{-5}^0 f(x) dx$, where $f(x) = |x| + |x + 2| + |x + 5|$.

35. Sketch the graph of $y = x|x|$ and hence find the area bounded by this curve, x - axis and the ordinates $x = -2$ and $x = 2$, using integration.

SECTION-E

(This section comprises of 3 case-study/passage-based questions of 4 marks each with sub parts. All case study questions have three sub parts (i), (ii), (iii) of marks 1, 1, 2 respectively.)

36. Ramesh, the owner of a sweet selling shop, purchased some rectangular card-board sheets of dimension 25cm by 40cm to make container packets without top. Let x cm be the length of the side of the square to be cut out from each corner to give that sheet the shape of the container by folding up the flaps.

Based on the above information answer the following questions:

- i) Express the volume (V) of each container as function of x only.
- ii) Find $\frac{dV}{dx}$ and $\frac{d^2V}{dx^2}$.
- iii) (a). For what value of x , the volume of each container is maximum?

OR

- iii) (b) Check whether V has a point of inflection at $x = \frac{65}{6}$ or not?

37. On her birthday, Seema decided to donate some money to children of an orphanage home. If there were 8 children less, everyone would have got ₹10 more. However, if there were 16 more children, everyone would have got ₹10 less. Let the number of children be x and the amount distributed by Seema for one child be y (in rupees).

Based on the above information, answer the following:

- i) Formulate the system of linear equations representing the given situation in terms of x and y .
- ii) Represent the system of equations in the matrix form $AX = B$ and find $|A|$.
- iii)(a). Using the matrix method, find the number of children (x) and the amount received by each child (y)

OR

- iii)(b). If the matrix equation is scaled such that matrix A becomes $2A$, find the value of the determinant $|(2A)^{-1}|$.

38. Raji visited the exhibition along with her family. The exhibition had a huge swing, which attracted many children. Raji found that the swing traced the path of a parabola as given by

$$y = x^2.$$

Based on the above information, answer the following:

i) Examine surjectivity of the function $f: R \rightarrow R$ be defined by $f(x) = x^2$.

ii) Examine injectivity of the function $f: N \rightarrow N$ be defined by $f(x) = x^2$.

iii)(a). Is the function $f: \{1, 2, 3, \dots, \dots\} \rightarrow \{1, 4, 9, 16, \dots, \dots\}$ be defined by $f(x) = x^2$ is bijective?

OR

iii)(b). Discuss injective and surjective for the function $f: Z \rightarrow Z$ defined by $f(x) = x^2$.