Academic Year	:	**2025 – 2026**
Examination	:	**BOARD**
Month	:	**MARCH 2026**
CLASS	:	**12**

Paper Code : 041

Roll No. ☐☐☐☐

Candidates must write the Code on the title page of the answer-book.

Name of the Candidate :

NOTE	
(I)	Please check that this question paper contains ***11*** printed pages.
(II)	Code Number given on the right-hand side of the question paper should be written on the title page of the answer-book by the candidate.
(III)	Please check that this question paper contains **38** questions.
(IV)	**Please write down the Serial Number of the question in the answer-book before attempting it.**
(V)	The first 15 minutes time has been allotted to read this question paper. The students will read the question paper only and will not write any answer on the answer-book during this period.
(VI)	Please write down the Roll No. and the Name of the Candidate on the top of the question paper, in the space provided, before reading the questions.

MATHEMATICS

Time allowed : Three hours

Maximum Marks : 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

1. *This Question Paper has 5 Sections A - E.*
2. ***Section A** has 20 MCQs carrying 1 mark each.*
3. ***Section B** has 5 questions carrying 02 marks each.*
4. ***Section C** has 6 questions carrying 03 marks each.*
5. ***Section D** has 4 questions carrying 05 marks each.*
6. ***Section E** has 3 case based integrated units of assessment with sub-parts of the values of 1, 1 and 2 marks each respectively.*
7. ***All Questions are compulsory**. However, an internal choice in 2 Qs of 5 marks, 2 Qs of 3 marks and 2 Questions of 2 marks has been provided. An internal choice has been provided in the 2marks questions of Section E.*
8. *Draw neat figures wherever required. Take π = 22/7 wherever required if not stated.*

Section - A

Section A consists of 20 questions of 1 mark each.

1. Let $A = \{a, b\}$, then the number of reflexive relations defined on A is **1**

(A) 16

(B) 8

(C) 4

(D) 2

2. If A and B are square matrices both of order 3, such that $|A| = -3$ and $|B| = 2$, then $|2AB|$ is equal to **1**

(A) 48

(B) – 48

(C) – 24

(D) – 12

3. If $y = \log\cos^2\sqrt{x}$, then $\frac{dy}{dx}$ is **1**

(A) $\frac{\tan\sqrt{x}}{\sqrt{x}}$

(B) $2\tan\sqrt{x}$

(C) $-\frac{\tan\sqrt{x}}{\sqrt{x}}$

(D) $-\frac{\sqrt{x}}{\tan\sqrt{x}}$

4. If $f(x) = |x|$, then $f'(1)$ **1**

(A) is – 1

(B) is + 1

(C) is 0

(D) does not exist

5. If $f(x) = x^2 + ax + 3$ is strictly increasing in the interval (3, 4), then the minimum value of a is **1**

(A) – 6

(B) – 8

(C) 6

(D) 8

6. The value of $\int \frac{dx}{9x^2+6x+10}$ is equal to **1**

(A) $\frac{1}{3}\tan^{-1}(3x+1) + C$

(B) $\frac{1}{9}\tan^{-1}(3x+1) + C$

(C) $\tan^{-1}\left(\frac{3x+1}{3}\right) + C$

(D) $\frac{1}{9}\tan^{-1}\left(\frac{3x+1}{3}\right) + C$

7. The value of λ for which the two vectors $2\hat{\imath} - \hat{\jmath} + 2\hat{k}$ and $3\hat{\imath} + \lambda\hat{\jmath} + \hat{k}$ are perpendicular is **1**

(A) 2

(B) 4

(C) 6

(D) 8

8. The maximum value of $Z = 3x + 4y$ subject to the constraints $x + y \leq 1$ and $x, y \geq 0$ is **1**

(A) 3

(B) 4

(C) 7

(D) 0

9. The relation $R = \{(1, 1), (2, 2), (3, 3), (1, 2), (2, 3), (1, 3)\}$ on set $A = \{1, 2, 3\}$ is **1**

(A) Reflexive only

(B) Transitive only

(C) Reflexive and Transitive

(D) Symmetric

10. Let A is square matrix such that $A^2 = A$. What is the value of $(I + A)^3$? **1**

(A) $7A + I$

(B) $A + 7I$

(C) $7A + 7I$

(D) None of these

11. The value of $\int_{-2}^{2} \sin^5 x \cos x \, dx$ is equal to **1**

(A) $\frac{64}{3}$

(B) 0

(C) $2 \sin^6 2$

(D) $\sin^6(-2) - \sin^6 2$

12. What is the number of all possible matrices of order 3×3 with each entry 0 or 1? **1**

(A) 23

(B) 52

(C) 512

(D) 51

13. If $|\vec{a}| = 8$, $|\vec{b}| = 3$ and If $|\vec{a} \times \vec{b}| = 12$, then the value of $\vec{a} \cdot \vec{b}$ is **1**

(A) $6\sqrt{3}$

(B) $8\sqrt{3}$

(C) $12\sqrt{3}$

(D) None of these

14. If A and B are square matrices of the same order, then $(A + B)(A - B)$ is equal to **1**

(A) $A^2 - B^2$

(B) $A^2 - BA + B^2 + AB$

(C) $A^2 - B^2 + BA - AB$

(D) $A^2 - BA - AB - B^2$

15. In an LPP, corner points of the feasible region determined by the system of linear constraints are (1, 1), (3, 0) and (0, 3). If $Z = ax + by$, where $a, b > 0$ is to be minimized, the condition on a and b, so that the minimum of Z occurs at (3, 0) and (1, 1), will be **1**

(A) $a = 2b$

(B) $a = b/2$

(C) $a = 3b$

(D) $a = b$

16. If a matrix A is both symmetric and skew-symmetric, then **1**

(A) A is an identity matrix

(B) A is a null matrix

(C) A is a non-square matrix

(D) None of these

17. The set of points where the functions f given by $f(x) = |x - 3| \cos x$ is differentiable is **1**

(A) $\mathbb{R}$

(B) $\mathbb{R} - \{3\}$

(C) $(0, \infty)$

(D) None of these

18. The derivative of $\log_{10} x$ w.r.t. x is **1**

(A) $(\log_{10} e)/ x$

(B) $(\log_{10} x)/ e$

(C) $(\log_{10} e)$

(D) None of these

DIRECTION: In question numbers 19 and 20, a statement of **Assertion** (**A**) is followed by a statement of **Reason** (**R**). Choose the correct option.

19. ***Assertion*** **A**: If A is a skew-symmetric matrix of order 3, then $|A| = 0$. **1**

Reason **R**: If A is a square matrix of order 3, then $|A| = |A'|$.

(A) Both Assertion (A) and Reason (R) are true, and reason (R) is the correct explanation of assertion (A)

(B) Both Assertion (A) and Reason (R) are true, and Reason (R) is not the correct explanation of Assertion (A)

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

20. ***Assertion*** **A**: $\left\langle \frac{1}{\sqrt{5}}, \frac{1}{\sqrt{5}}, \frac{1}{\sqrt{5}} \right\rangle$ cannot be the direction cosines of a line. **1**

Reason **R**: If l, m, n are the direction cosines of a line, then $l^2 + m^2 + n^2 = 1$.

(A) Both Assertion (A) and Reason (R) are true, and reason (R) is the correct explanation of assertion (A)

(B) Both Assertion (A) and Reason (R) are true, and Reason (R) is not the correct explanation of Assertion (A)

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Section - B

Section B consists of 5 questions of 2 marks each.

21. Show that the function f defined by $f(x) = |x - 1|$ is not differentiable at $x = 1$. **2**

OR

Prove that the function given by $f(x) = \cos x$ is strictly decreasing in $(0, \pi)$.

22. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, then find the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$. **2**

23. Find the general solution of the differential equation $x \cos y \, dy = (x \log x + 1)e^x \, dx$. **2**

24. Let $f: \mathbb{R} \longrightarrow \mathbb{R}$ is defined by $f(x) = x^2 - 3x + 2$. Find $f(f(x))$. **2**

25. Let $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$. If $A + A' = I$, find the value of α. **2**

OR

Show that $\begin{vmatrix} 0 & -2026 & 2025 \\ 2026 & 0 & -2024 \\ -2025 & 2024 & 0 \end{vmatrix} = 0$.

SECTION C

Section C consists of 6 questions of 3 marks each.

26. 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. **3**

OR

Prove that $f(\alpha)f(-\beta) = f(\alpha - \beta)$, if $f(\alpha) = \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$.

27. If $y = (x + \sqrt{1 + x^2})^n$, prove that $(1 + x^2)\frac{d^2y}{dx^2} + x\frac{dy}{dx} = n^2 y$. **3**

28. Three vectors $\vec{a}, \vec{b}, \vec{c}$ satisfy the condition $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. Evaluate the quantity $\mu = \vec{a} \cdot \vec{b} + \vec{c} \cdot \vec{a} + \vec{b} \cdot \vec{c}$, if $|\vec{a}| = 3, |\vec{b}| = 4, |\vec{c}| = 2$. **3**

29. Find the following integral: **3**

$$\int \cos x \tan^{-1}(\sin x)\, dx$$

OR

Evaluate the following integral:

$$\int \frac{e^x}{(e^x+1)(e^x+3)}\, dx$$

30. Solve the following LPP graphically: **3**

Maximize $Z = 2x + 3y$

subject to the constraints

$x + 4y \leq 8$

$2x + 3y \leq 12$

$3x + y \leq 9$

where $x \geq 0, y \geq 0$.

31. If $y = \cos x^2 + \cos^2 x + \cos^2 (x^2) + \cos (x^x)$, find $\frac{dy}{dx}$. **3**

SECTION D

Section D consists of 4 questions of 5 marks each.

32. Given that **5**

$$y = \tan^{-1}\left(\frac{\sqrt{1+x^2}+\sqrt{1-x^2}}{\sqrt{1+x^2}-\sqrt{1-x^2}}\right)$$

where $x^2 \leq 1$. Find the value of $\frac{dy}{dx}$.

33. Find the particular solution of the differential equation **5**

$$(1+\sin x)\frac{dy}{dx} = -x - y\cos x$$

Given that $y(0) = 1$.

OR

Find the area of the region bounded by the ellipse $9x^2 + 4y^2 = 36$.

34. A car manufacturing factory has two plants, X and Y. Plant X manufactures 70% of cars and plant Y manufactures 30%. 80% of the cars at plant X and 90% of the cars at plant Y are rated of standard quality. A car is chosen at random and is found to be of standard quality. What is the probability that it has come from plant X? **5**

35. Show that the lines **5**

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

intersect. Also, find their point of intersection.

OR

Find the shortest distance between the lines l_1 and l_2 given by:

$$l_1 : \vec{r} = \hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda(4\hat{\imath} + 6\hat{\jmath} + 12\hat{k})$$

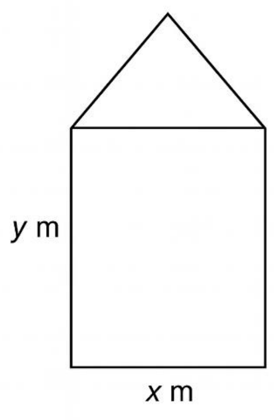
$$l_2 : \vec{r} = 3\hat{\imath} + 3\hat{\jmath} - 5\hat{k} + \mu(6\hat{\imath} + 9\hat{\jmath} + 18\hat{k})$$

SECTION E

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

36. **Case Study based – 1**

A window is in the form of a rectangle surmounted by an equilateral triangle on its length. Let the rectangular part have length and breadth x and y metres respectively.



Based on the given information, answer the following questions:

(i) If the perimeter of the window is 12 m, find the relation between x and y. **1**

(ii) Using the expression obtained in (i), write an expression for the area of the window as a function of x only. **1**

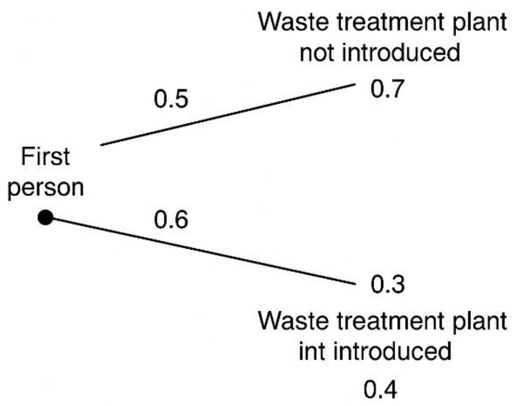
(iii) Find the dimensions of the rectangle that will allow maximum light through the window. (use expression obtained in (ii)) **2**

OR

If it is given that the area of the window is 50 m^2, find an expression for its perimeter in terms of x.

37. Case Study based – 2

Two persons are competing for a position on the Managing Committee of an organisation. The probabilities that the first and the second person will be appointed are 0·5 and 0·6 respectively. Also, if the first person gets appointed, then the probability of introducing waste treatment plant is 0·7 and the corresponding probability is 0·4, if the second person gets appointed.



Based on the above information, answer the following questions:

(i) What is the probability that the waste treatment plant is introduced? **2**

(ii) After the selection, if the waste treatment plant is introduced, what is the probability that the first person had introduced it? **2**

OR

Find the probability that the second person gets appointed and introduces the waste treatment plant.

38. Case Study based – 3

During the festival season, there was a mela organized by the Resident Welfare Association at a park, near the society. The main attraction of the mela was a huge swing installed at one corner of the park. The swing is traced to follow the path of a parabola given by $x^2 = y$.

Based on the above information, answer the following questions:

(i) Let $f : \mathbb{N} \longrightarrow \mathbb{R}$ is defined by $f(x) = x^2$. What will be the range? **1**

(ii) Let $f : \mathbb{N} \longrightarrow \mathbb{R}$ is defined by $f(x) = x^2$. Check if the function is injective or not. **1**

(iii) Let $f : \{ 1, 2, 3, ...\} \rightarrow \{1, 4, 9, 16, ... \}$ be defined by $f(x) = x^2$. Prove that the function is bijective. **2**

OR

Let $f : \mathbb{R} \longrightarrow \mathbb{R}$ is defined by $f(x) = x^2$. Show that f is neither injective nor surjective.