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 **9** 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. A function $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = 1 + x^4$ is **1**

(a) One-One

(b) Onto

(c) Bijective

(d) Neither one-one nor onto

2. The rate of change of the volume of a spherical bubble with respect to its radius *r* at *r* = 3 cm is **1**

(a) 24π cm³/cm

(b) 36π cm²/cm

(c) 36π cm³/cm

(d) 24π cm²/cm

3. Let the vectors $\vec{a}$ and $\vec{b}$ be such that $|\vec{a}| = \sqrt{3}$ and $|\vec{b}| = 2/\sqrt{3}$. If $\vec{a} \times \vec{b}$ is a unit vector, then the angle between $\vec{a}$ and $\vec{b}$ is **1**

(a) $\pi/2$

(b) $\pi/3$

(c) $\pi/6$

(d) $\pi/4$

4. If $\begin{vmatrix} 2x & 5 \\ 12 & x \end{vmatrix} = \begin{vmatrix} 6 & -5 \\ 4 & 3 \end{vmatrix}$, then the value of x is **1**

(a)3

(b) ±7

(c) 7

(d) ±3

5. The cartesian equation of a line is $6x - 2 = 3y + 1 = 2z - 2$. The direction ratios of the line are **1**

(a) 2, –1, 3

(b) 1, –2, –3

(c) 1, 2, 3

(d) 3, 1, 2

6. The sum of the order and degree of the differential equation $\left(1 + \left(\frac{dy}{dx}\right)^2\right)^3 = \frac{d^2y}{dx^2}$ is **1**

(a) 2

(b) 3

(c) 6

(d) 4

7. What is the value of $\tan^{-1}\sqrt{3} - \sec^{-1}(-2)$? **1**

(a) π

(b) $\pi/3$

(c) $2\pi/3$

(d) $-\pi/3$

8. Corner points of the feasible region determined by the system of linear constraints are (0, 3), (1, 1) and (3, 0). Let $Z = px + qy$, where $p, q > 0$. Condition on p and q so that the minimum of Z occurs at (3, 0) and (1, 1) is **1**

(a) $p = 2q$

(b) $2p = q$

(c) $p = 3q$

(d) $p = q$

9. If $A = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$, then the value of A^3 is **1**

(a) $4\begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

(b) $\begin{bmatrix} 12 & 0 & 0 \\ 0 & 12 & 0 \\ 0 & 0 & 12 \end{bmatrix}$

(c) $\begin{bmatrix} 64 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

(d) $\begin{bmatrix} 64 & 0 & 0 \\ 0 & 64 & 0 \\ 0 & 0 & 64 \end{bmatrix}$

10. The function $f(x) = x + \frac{4}{x}$ has **1**

(a) A local maximum at $x = 2$ and local minima at $x = -2$

(b) A local minimum at $x = 2$ and local maximum at $x = -2$

(c) Absolute maxima at $x = 2$ and absolute minima at $x = -2$

(d) Absolute minima at $x = 2$ and absolute maxima at $x = -2$

11. If $f(x) = \begin{cases} x + k, & \text{if } x < 3 \\ 4, & \text{if } x = 3 \\ 3x - 5, & \text{if } x > 3 \end{cases}$ is continuous at $x = 3$ then the value of k is **1**

(a) 1

(b) 6

(c) 7

(d) 3

12. The projection of $3\hat{\imath} + 3\hat{\jmath} + \hat{k}$ on $9\hat{\imath} - 6\hat{\jmath} + 2\hat{k}$ is **1**

(a) 4

(b) 2

(c) 1

(d) 3

13. The value of the integral $\int_{-\pi}^{\pi} \cos^2 x \sin^3 x \, dx$ is **1**

(a) π

(b) 2π

(c) 0

(d) –π

14. The solution set of the inequality $2x + 3y < 6$ is **1**

(a) open half-plane containing origin

(b) open half-plane not containing origin

(c) whole *XY*-plane except the points lying on the line $2x + 3y = 6$

(d) half plane containing the origin and the points lying on the line $2x + 3y = 6$

15. Let *A* and *B* be two events where $P(A) = 1/4$, $P(B) = 1/2$ and $P(A \cap B) = 1/8$. Then, $P(\text{not } A \text{ and not } B)$ is equal to **1**

(a) 7/8

(b) 3/8

(c) 5/8

(d) 1/8

16. The value of the integral $\int \frac{1}{\sin^2 x \cos^2 x} dx$ is **1**

(a) $\tan x + \cot x + C$

(b) $-\tan x - \cot x + C$

(c) $-\tan x + \cot x + C$

(d) $\tan x - \cot x + C$

17. The integrating factor of differential equation $\frac{dy}{dx} + y \tan x = 2x + x^2 \tan x$ is **1**

(a) $\ln|\sec x + \tan x|$

(b) $\sec x$

(c) $\tan x$

(d) $\cos x$

18. If matrices A and B are of order 2×3 and 3×2 respectively. Then the order of $B'A'$ is **1**

(a) 2×3

(b) 3×2

(c) 2×2

(d) 3×3

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**: Two coins are tossed simultaneously. The probability of getting two heads, if it is known that at least one head comes up is 1/3. **1**

Reason **R**: Let E and F be the events associated with the same random experiment, then $P(E|F) = \frac{P(E \cap F)}{P(F)}$.

(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**: The vector equation of a line passing through the points $A(-1, 0, 2)$ and $B(3, 4, 6)$ is $\vec{r} = (-\hat{i} + 2\hat{k}) + \lambda(\hat{i} + 4\hat{j} + \hat{k})$. **1**

Reason **R**: The equation of a line passing through a point with position vector $\vec{a}$ and parallel to $\vec{b}$ is $\vec{r} = \vec{a} + \lambda\vec{b}$.

(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. Discuss the continuity of **2**

$$f(x) = \begin{cases} 5x - 4, & \text{if } 0 < x < 1 \\ 4x^2 - 3x, & \text{if } 1 \le x < 2 \\ 3x + 4, & \text{if } x \ge 2 \end{cases}$$

at the points $x = 1$ and 2.

OR

Find $\frac{dy}{dx}$ at $x = 1$, $y = \pi/4$ if $\sin(2y) + \cos(xy) = k$.

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

23. Probabilities of solving a specific problem independently by A and B are 1/2 and 2/3 respectively. If both try to solve the problem independently, find the probability that **2**

(i) the problem is solved

(ii) exactly one of them solves the problem.

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

25. Find the position vector of a point R which divides the line joining two points P and Q whose position vectors are $2\vec{a} + \vec{b}$ and $\vec{a} - 3\vec{b}$ externally in the ratio 1 : 2. **2**

OR

Find the area of the parallelogram whose one side and a diagonal are represented by co-initial vectors $\hat{\imath} - \hat{\jmath} + \hat{k}$ and $4\hat{\imath} + 5\hat{k}$.

SECTION C

Section C consists of 6 questions of 3 marks each.

26. Evaluate the followin definite integral **3**

$$\int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\tan x}}.$$

27. Find the intervals in which the function *f* is given by (x) = sin x + cos x, $0 \le x \le 2\pi$, is strictly increasing or decreasing. **3**

OR

Find the absolute maximum and absolute minimum values of the function $(x) = 2x^3 - 15x^2 + 36x + 1$ on the interval [1, 5].

28. Evaluate the following indefinite integral: **3**

$$\int \frac{(x^2+1)}{(x^2+2)(x^2+3)} dx.$$

29. In the Linear Programming Problem, find the point/points giving maximum value for $Z = 5x + 10y$ subject to constraints: **3**

$x + 2y \le 120,$

$x + y \ge 60,$

$x - 2y \ge 0,$

where $x, y \ge 0$

30. Find the general solution of the differential equation: **3**

$$(1 + x^2)dy + 2xy\ dx = \cot x\ dx \text{ ,(where } x \neq 0)$$

OR

Solve the following differential equation:

$$\frac{dy}{dx} = \frac{xy}{x^2+y^2}$$

31. If $\vec{a} = 2\hat{\imath} + 2\hat{\jmath} + 3\hat{k}$, $\vec{b} = -\hat{\imath} + 2\hat{\jmath} + \hat{k}$ and $\vec{c} = 3\hat{\imath} + \hat{\jmath}$ are such that $\vec{a} + \lambda\vec{b}$ is perpendicular to $\vec{c}$, then find the value of λ. **3**

SECTION D

Section D consists of 4 questions of 5 marks each.

32. Find the equation of the line passing through the point $A(1, 2, -4)$ and perpendicular to the lines **5**

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

Also, find the angle between the given lines.

OR

Find the shortest distance between the lines given by

$\vec{r} = (8 + 3\lambda)\hat{\imath} - (9 + 16\lambda)\hat{\jmath} + (10 + 7\lambda)\hat{k}$ and

$\vec{r} = \left(15\hat{\imath} + 29\hat{\jmath} + 5\hat{k}\right) + \mu(3\hat{\imath} + 8\hat{\jmath} - 5\hat{k})$.

33. Draw a rough sketch of the region bounded by $y = 1 + |x + 1|$, $x = -2$, $x = 2$ and $y = 0$. Using integration, find the area of the shaded region. **5**

34. For a positive constant a, differentiate $a^{t+\frac{1}{t}}$ with respect to $\left(t + \frac{1}{t}\right)^a$, where t is a non zero real number. **5**

OR

Find the value of $\frac{dy}{dx}$, if $y^x + x^y + x^x = ab$, where a and b are constants.

35. If $A = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$, find BA. Use this to solve the following system of equations **5**

$y + 2z = 8$,

$x - y = -5$ and

$2x + 3y + 4z = 18$.

SECTION E

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

36. **Case Study based – 1**

Let A be the set of 30 students of class XII in a school. Define a function f by $f: A \to \mathbb{N}$, where $\mathbb{N}$ is the set of natural numbers such that $f(x)$ = roll number of student x.

On the basis of the given information, answer the following:

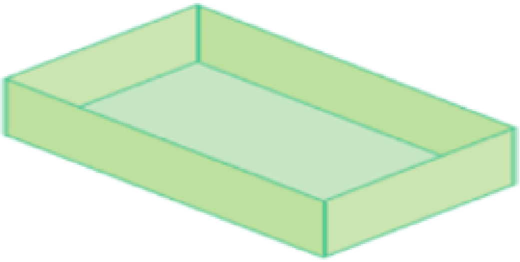
(i) Is f is bijective function? Give reasons to support your answer. **2**

(ii) Let R be a relation defined by the teacher to plan the seating arrangement of students in pairs, where $R = \{(x, y): x, y$ are roll numbers of students such that $y = 3x\}$. List the elements of R. Is the relation R reflexive, symmetric and transitive? Justify your answer. **2**

OR

Let R be a relation defined by $R = \{(x, y): x, y$ are roll numbers of students such that $y = x^3\}$. List the elements of R. Is R a function? Justify your answer.

37. Case Study based – 2



A factory makes an open cardboard box for a jewellery shop from a square sheet of size 18 cm by cutting off squares from each corner and folding up the flaps. Based on the above information answer the following questions if x is the length of each square cut from corners.

(i) Find the volume of the open box in terms of x. **1**

(ii) Write the condition for volume V to be maximum. **1**

(iii) What should be the size of square to be cut off so that the volume V is maximum? **2**

OR

Find the maximum volume V of the open box.

38. Case Study based – 3

According to the recent research, air turbulence has increased in various regions around the world due to climate change. Turbulence makes flights bumpy and often delays the flights. Assume that, an airplane observes severe turbulence, moderate turbulence or light turbulence with equal probabilities. Further, the chance of an airplane reaching late to the destination are 55%, 37% and 17% due to severe, moderate and light turbulence respectively.

On the basis of the above information, answer the following questions:

(i) Find the probability that an airplane reached its destination late. **2**

(ii) If the airplane reached its destination late, find the probability that it was due to moderate turbulence. **2**