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For CBSE 2026 Board Exams - Class 12

MATHEMATICS

SUBJECT CODE - 041



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O.P. GUPTA
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General Instructions : Same as given in PTS-01.

SECTION A

(Question numbers 01 to 20 carry 1 mark each.)

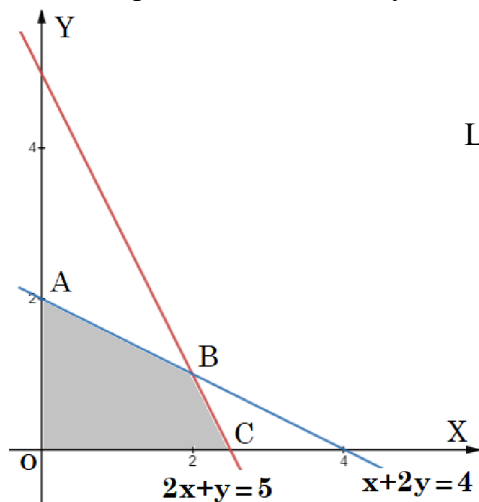
Followings are **multiple choice questions**. Select the correct option in each one of them.

01. Given that A is a square matrix of order 3 and $|\text{adj.}A| = 49$, then $|A^{-1}|$ is equal to
 (a) ± 7 (b) $\pm \frac{1}{49}$ (c) $\pm \frac{1}{7}$ (d) -7 only
02. For $A = \begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$, $A + A^T$ equals
 (a) $2 \begin{bmatrix} \cos \theta & 0 \\ 0 & \cos \theta \end{bmatrix}$ (b) $\begin{bmatrix} \cos 2\theta & 0 \\ 0 & \cos 2\theta \end{bmatrix}$ (c) $\begin{bmatrix} \cos \theta & 0 \\ 0 & \cos \theta \end{bmatrix}$ (d) $2 \begin{bmatrix} 0 & \cos \theta \\ \cos \theta & 0 \end{bmatrix}$
03. If $\vec{a}$ and $\vec{b}$ are parallel vectors, then which of the following is true?
 (a) $\vec{a} \cdot \vec{b} = 0$ (b) $\vec{a} = \lambda \vec{b}$ (c) $\vec{a} \cdot \vec{b} = \vec{0}$ (d) $\vec{a} \times \vec{b} = 0$
04. Let $\tan^{-1} : \mathbb{R} \rightarrow \left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$. Then $\tan^{-1}(-1) =$
 (a) $-\frac{\pi}{4}$ (b) $\frac{3\pi}{4}$ (c) $\frac{5\pi}{4}$ (d) $\frac{7\pi}{4}$
05. Let $A = \{i, s, h, a\}$. If $R : A \rightarrow A$ is given by $R = \{(i, i), (s, s), (a, a), (a, h)\}$, then which of the following ordered pair must be added to make R a reflexive relation?
 (a) (h, a) (b) (s, h) (c) (h, h) (d) (h, i)
06. If m and n respectively, are the order and degree of the differential equation $x \left(\frac{dy}{dx}\right)^2 - \frac{d^2y}{dx^2} = 0$, then $(mn) =$
 (a) 1 (b) 2 (c) 3 (d) 4
07. The feasible region, for the inequalities $x \geq 0$, $x + y \leq 1$ and, $y \geq 0$, lies in
 (a) IV Quadrant (b) III Quadrant (c) II Quadrant (d) I Quadrant
08. What is the number of vectors of unit length perpendicular to both the vectors $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$?
 (a) 0 (b) 1
 (c) 2 (d) infinitely many unit vectors are possible
09. If $f(x)$ is an odd function, then the value of $\int_{-a}^a f(x)dx =$
 (a) $2 \int_0^a f(x)dx$ (b) $\int_0^a f(x)dx$ (c) $2 \int_0^{\frac{a}{2}} f(x)dx$ (d) 0

10. Minor of the element 9 in $\Delta = \begin{vmatrix} 2 & 4 & 9 \\ 3 & 6 & -9 \\ -2 & -3 & 1 \end{vmatrix}$ is

- (a) 0 (b) -3 (c) 3 (d) 1

11. The feasible region in a LPP is as shown in the graph below. The corner points are denoted by A, B, C and O.



Let $Z = 2x + 5y$, then the value of $Z_{\max} - Z_{\min}$ equals

- (a) 0 (b) 4
(c) 10 (d) 1

12. If $0 < x < \frac{\pi}{2}$, and $\begin{vmatrix} 2\sin x & -1 \\ 1 & \sin x \end{vmatrix} = \begin{vmatrix} 3 & 0 \\ -4 & \sin x \end{vmatrix}$, then the values of x is

- (a) $\frac{\pi}{3}$ (b) $\frac{\pi}{6}, \frac{\pi}{2}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{4}$

13. Given that the matrices A and B of order $3 \times m$ and $3 \times n$ respectively, are such that AB and BA both exist, then order of A is

- (a) 3×4 (b) 4×3 (c) 3×3 (d) cannot be determined

14. Two independent events A and B are such that $P(A) = 0.6$ and $P(B) = 0.5$.

Based on this information, which of the following options is **incorrect**?

- (a) $P(A \cap B) = 0.3$ (b) $P(A \cup B) = 0.8$ (c) $P(A|B) = P(A)$ (d) $P(B|A) = P(A)$

15. Integration factor of the differential equation $\left(\frac{dy}{dx}\right) - \frac{y}{x} = x^2$ is denoted by $f(x)$. Then $f'(x) =$

- (a) $\frac{1}{x}$ (b) $-\frac{1}{x}$ (c) $\frac{1}{x^2}$ (d) $-\frac{1}{x^2}$

16. If $y = x^e$, then $\frac{dy}{dx} =$

- (a) x^e (b) $e \cdot x^{e-1}$ (c) $e \cdot x^e$ (d) $x^e \times \log x$

17. The direction angle made by the line $\frac{x-1}{1} = \frac{y+1}{\sqrt{2}} = \frac{z-2}{-1}$ with positive direction of x-axis, is

- (a) $\frac{\pi}{3}$ (b) $\frac{\pi}{6}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}, \frac{5\pi}{6}$

18. If $|\vec{a}| = 2, |\vec{b}| = 2\sqrt{3}$ and $\vec{a} \perp \vec{b}$, then the value of $|\vec{a} + \vec{b}|$ is

- (a) 16 (b) ± 4 (c) 4 (d) ± 16

Followings are **Assertion-Reason based questions**.

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 the correct explanation of A.
- (c) A is true but R is false.
- (d) A is false but R is true.

19. **Assertion (A)** : There is no value of 'b' for which the function $f(x) = x + \cos x + b$ is strictly decreasing over $\mathbb{R}$ (set of real numbers).

Reason (R) : If $f'(x) \geq 0$ in $x \in [a, b]$ then, $f(x)$ is an increasing function in $x \in [a, b]$.

20. **Assertion (A)** : $\hat{i} + \hat{j} + 2\hat{k}$ is a vector parallel to the line $\vec{r} = \hat{i} - \hat{j} + \hat{k} + \lambda(\hat{i} + \hat{j} + 2\hat{k})$.

Reason (R) : In the vector form of line $\vec{r} = x_1\hat{i} + y_1\hat{j} + z_1\hat{k} + \lambda(a_1\hat{i} + b_1\hat{j} + c_1\hat{k})$, a vector parallel to the line is $a_1\hat{i} + b_1\hat{j} + c_1\hat{k}$.

SECTION B

(Question numbers 21 to 25 carry 2 marks each.)

21. Using principal values, evaluate $\sin^{-1}\left(\sin \frac{2\pi}{3}\right) + \cos^{-1}\left(\cos \frac{2\pi}{3}\right)$.

OR

Let $A = \{1, 2, 3\}$. Write all the possible equivalence relations defined on set A.

22. For the function $f(x) = 4x - \frac{1}{2}x^2$, $-2 \leq x \leq \frac{9}{2}$, find the absolute maximum value and absolute minimum value.

23. Find the vector equation of the line joining the points (1, 2, 3) and (-3, 4, 3). Also write its Cartesian equation.

OR

If a line makes the angles α , β and γ with the coordinate axes, then evaluate : $\cos 2\alpha + \cos 2\beta + \cos 2\gamma$.

24. If $x = a \sec \theta$, $y = b \tan \theta$, then find $\frac{d^2y}{dx^2}$ at $\theta = \frac{\pi}{6}$.

OR

If $f(x) = \begin{cases} \frac{\log(1+4x) - \log(1-x)}{x}, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases}$ is continuous at $x = 0$, then find the value of k.

25. If $\vec{p} + \vec{q} + \vec{r} = \vec{0}$ and $|\vec{p}| = 3$, $|\vec{q}| = 5$, $|\vec{r}| = 7$, then find the angle between $\vec{p}$ and $\vec{q}$.

SECTION C

(Question numbers 26 to 31 carry 3 marks each.)

26. Find : $\int \frac{1}{\sin(x-a)\cos(x-b)} dx$.

27. For events E and F, $P(E) = 0.4$, $P(F) = 0.5$ and $P(E \cup F) = 0.7$.

Using the concept of conditional probability, find $P(E|F) + P(F|E)$.

OR

A girl throws a die. If she gets a 5 or 6, she tosses a coin three times and notes the number of heads. If she gets 1, 2, 3 or 4, she tosses a coin once and notes whether a head or tail is obtained. If she obtained exactly one head, what is the probability that she threw 1, 2, 3 or 4 with the die?

28. Evaluate : $\int_0^{2\pi} |\cos x| dx$.

OR

Evaluate : $\int_0^3 \{|x| + |x-1|\} dx$.

29. Solve the differential equation : $x^2 y dx - (x^3 + y^3) dy = 0$.

OR

Find the particular solution of the following differential equation :

$\cos y dx + (1 + 2e^{-x}) \sin y dy = 0$; $y(0) = \frac{\pi}{4}$.

30. A linear programming problem is as follows.

To maximize: $Z = (x + y)$

Subject to constraints: $2x + y \leq 50$, $x + 2y \leq 40$, $x \geq 0$, $y \geq 0$.

In the feasible region, find the point at which maximum value of Z occurs. Solve graphically.

31. Find : $\int \frac{x dx}{x^2 + 3x + 2}$.

SECTION D

(Question numbers 32 to 35 carry 5 marks each.)

32. Using integration, find the area of the smaller region bounded between $y = \sqrt{36 - x^2}$ and $x = 4$.

33. Using differentiation, find two positive numbers whose sum is 15 and the sum of whose squares is minimum.

OR

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

34. Determine the equations of a line passing through the point $(1, 2, -4)$ and perpendicular to the two lines $\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$ and; $\frac{x-15}{3} = \frac{y-29}{8} = \frac{5-z}{5}$.

OR

If $\vec{\alpha} = 3\hat{i} - \hat{j}$ and $\vec{\beta} = 2\hat{i} + \hat{j} - 3\hat{k}$, then express $\vec{\beta}$ in the form of $\vec{\beta} = \vec{\beta}_1 + \vec{\beta}_2$, where $\vec{\beta}_1$ is parallel to $\vec{\alpha}$ and $\vec{\beta}_2$ is perpendicular to $\vec{\alpha}$.

35. If $A = \begin{pmatrix} 2 & 3 & 10 \\ 4 & -6 & 5 \\ 6 & 9 & -20 \end{pmatrix}$, find A^{-1} . Using A^{-1} solve the following system of equations :

$\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 2$, $\frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 5$, $\frac{6}{x} + \frac{9}{y} - \frac{20}{z} = -4$; $x, y, z \neq 0$.

SECTION E

(Question numbers 36 to 38 carry 4 marks each.)

This section contains **three Case-study / Passage based questions**.

First two questions have **three sub-parts** (i), (ii) and (iii) of **marks 1, 1 and 2** respectively.

Third question has **two sub-parts** of **2 marks** each.

36. **CASE STUDY I** : Read the following passage and the answer the questions given below.

An organization conducted bike race under two different categories – Boys and Girls.

There were 28 participants in all. Among all of them, finally three from category 1 and two from category 2 were selected for the final race. Ravi forms two sets B and G with these participants for his college project.

Let $B = \{b_1, b_2, b_3\}$ and $G = \{g_1, g_2\}$, where B represents the set of Boys selected and G the set of Girls selected for the final race.



- (i) How many relations are possible from B to G?
- (ii) Among all the possible relations which are defined from B to G, how many functions can be formed from B to G?
- (iii) Let $R : B \rightarrow B$ be defined by $R = \{(x, y) : x \text{ and } y \text{ are students of the same sex}\}$. Check if R is an equivalence relation.

OR

- (iii) A function $f : B \rightarrow G$ be defined by $f = \{(b_1, g_1), (b_2, g_2), (b_3, g_1)\}$. Check if f is bijective (i.e., one-one and onto both). Justify your answer.

37. **CASE STUDY II :** Read the following passage and answer the questions given below.



Mr Neeraj Jha is a business analyst. He offers his expert-views to the companies. A ball manufacturing company hires Mr Jha for his services.

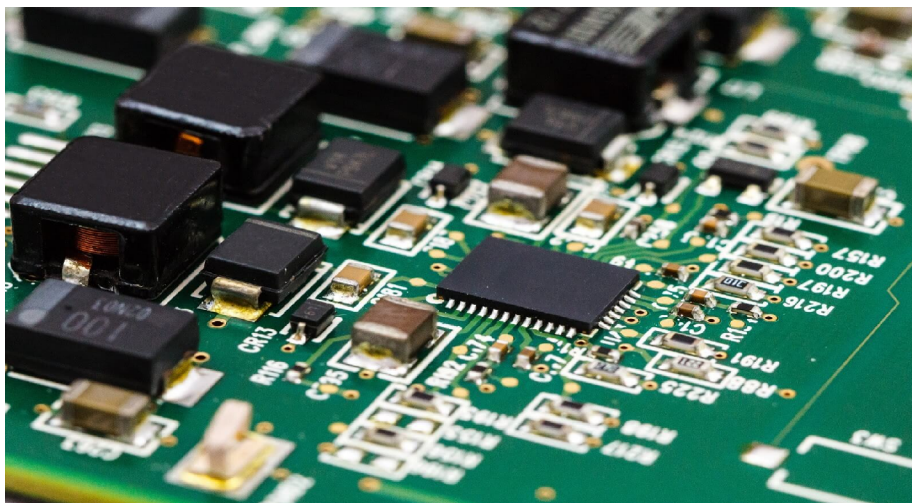
Mr Jha observed that $P(x) = -5x^2 + 1250x + 30$ (in ₹) is the total profit function of this ball manufacturing company, where x is the production of the company.

- (i) Differentiate $P(x)$ with respect to x.
- (ii) What will be the production when the profit is maximum?
- (iii) What will be the maximum profit?

OR

- (iii) Check if the profit function $P(x)$ is strictly increasing in the interval $x \in (0, 125)$?

38. **CASE STUDY III :** Read the following passage and answer the questions given below.



An electronic assembly consists of two kinds of sub-systems say, A and B.
From previous testing procedures, the following probabilities are assumed to be known:
 $P(A \text{ fails}) = 0.2$, $P(B \text{ fails alone}) = 0.15$, $P(A \text{ and } B \text{ fail}) = 0.15$.

- (i) Find $P(B \text{ fails})$ and, $P(A \text{ fails alone})$.
- (ii) Find $P(A \text{ fails} \mid B \text{ has failed})$.

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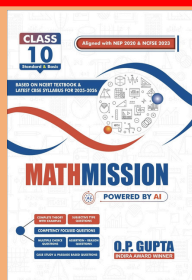
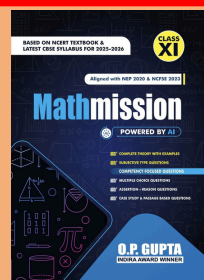
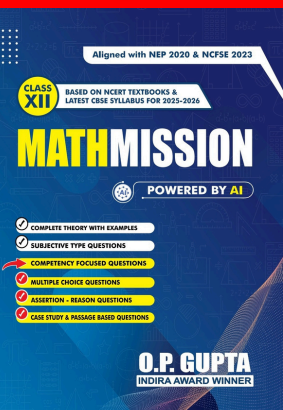
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ABOUT THE AUTHOR

O.P. GUPTA having taught math passionately over a decade, has devoted himself to this subject. Every book, study material or practice sheets, tests he has written, tries to teach serious math in a way that allows the students to learn math without being afraid. Undoubtedly his mathematics books are best sellers on Amazon and Flipkart. His resources have helped students and teachers for a long time across the country. He has contributed in CBSE Question Bank (issued in April 2021). Mr Gupta has been invited by many educational institutions for hosting sessions for the students of senior classes. Being qualified as an electronics & communications engineer, he has pursued his graduation later on with mathematics from University of Delhi due to his passion towards mathematics. He has been honored with the prestigious INDIRA AWARD by the Govt. of Delhi for excellence in education.

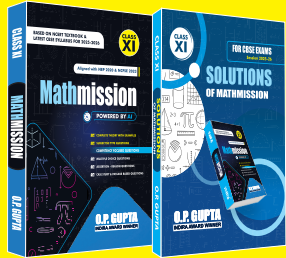
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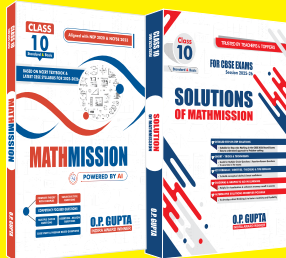
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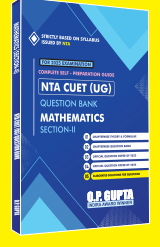
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