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O.P. GUPTA

INDIRA AWARD WINNER



For CBSE 2026 Board Exams - Class 12

MATHEMATICS

SUBJECT CODE - 041



a compilation by
O.P. GUPTA
INDIRA AWARD WINNER

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. The order of the matrix A such that $\begin{bmatrix} 2 & 0 \\ 1 & 0 \\ 3 & 4 \end{bmatrix} A = \begin{bmatrix} 1 & -8 \\ 1 & -2 \\ 9 & 2 \end{bmatrix}$, is
 (a) 2×3 (b) 3×2 (c) 2×2 (d) 2×1
02. If A is a square matrix of order 3 such that $A(\text{adj.}A) = \begin{bmatrix} -2 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -2 \end{bmatrix}$ then, $|A| =$
 (a) 8 (b) -2 (c) -8 (d) -3
03. Let $\vec{a} = \alpha\hat{i} + 3\hat{j} - 6\hat{k}$ and $\vec{b} = 2\hat{i} - \hat{j} - \beta\hat{k}$. If $\vec{a}$ and $\vec{b}$ are collinear vectors then, the value of $(\alpha + \beta)$ is
 (a) -6 (b) -2 (c) -8 (d) 12
04. The greatest integer function defined by $f(x) = [x]$, $0 < x < 2$ is not differentiable at $x =$
 (a) 0 (b) $\frac{1}{2}$ (c) 1 (d) $\frac{3}{4}$
05. $\int e^x \left(\log \sqrt{x} + \frac{1}{2x} \right) dx =$
 (a) $e^x \times \log x + C$ (b) $e^x \times \log \sqrt{x} + C$ (c) $e^x \times \frac{1}{2x} + C$ (d) $\frac{e^x}{\log \sqrt{x}} + C$
06. The number of arbitrary constants in the particular solution of a differential equation of second order is (are)
 (a) 0 (b) 1 (c) 2 (d) 3
07. The objective function of a linear programming problem, is
 (a) a constant (b) a linear function to be optimized
 (c) an inequality (d) a quadratic expression
08. The length of the perpendicular drawn from the point $(4, -7, 3)$ on the y-axis is
 (a) 3 units (b) 4 units (c) 5 units (d) 7 units
09. $\int_1^e \frac{\log x}{x} dx$ is equal to
 (a) $\frac{e^2}{2}$ (b) 1 (c) $\frac{1}{2}$ (d) $-\infty$
10. If $\begin{vmatrix} 2 & 3 & 2 \\ x & x & x \\ 4 & 9 & 1 \end{vmatrix} + 3 = 0$, then the value of x is

- (a) 3 (b) 0 (c) 1 (d) -1
11. The corner points of the feasible region determined by the system of linear inequalities are $(0, 0)$, $(4, 0)$, $(2, 4)$ and $(0, 5)$. If the maximum value of $z = ax + by$, where $a, b > 0$ occurs at both $(2, 4)$ and $(4, 0)$, then
 (a) $a = 2b$ (b) $2a = b$ (c) $a = b$ (d) $3a = b$
12. The matrix $\begin{bmatrix} 2 & -1 & 3 \\ \lambda & 0 & 7 \\ -1 & 1 & 4 \end{bmatrix}$ is not invertible for
 (a) $\lambda = -1$ (b) $\lambda = 0$ (c) $\lambda = 1$ (d) $\lambda \in \mathbb{R} - \{1\}$
13. Let $A = [a_{ij}]$ be a 2×2 matrix whose elements are given by $a_{ij} = \left| (i)^2 - j \right|$. Then $a_{12} + a_{22} =$
 (a) 3 (b) 2 (c) 1 (d) -1
14. Integration factor for differential equation $\left(\frac{e^{-2\sqrt{x}}}{\sqrt{x}} - \frac{y}{\sqrt{x}} \right) \frac{dx}{dy} = 1$, is
 (a) $2\sqrt{x}$ (b) $e^{2\sqrt{x}}$ (c) $e^{\sqrt{x}}$ (d) $e^{-2\sqrt{x}}$
15. If A and B are two independent events with $P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{4}$, then $P(B' | A)$ is equal to
 (a) $\frac{1}{4}$ (b) $\frac{1}{3}$ (c) $\frac{3}{4}$ (d) 1
16. The function $f(x) = \frac{x-1}{x(x^2-1)}$ is discontinuous at
 (a) exactly one point (b) exactly two points
 (c) exactly three points (d) no point
17. How many reflexive relations are possible in a set A, whose $n(A) = 3$?
 (a) 2^3 (b) 2^4 (c) 2^5 (d) 2^6
18. A point P lies on the line segment joining the points $(-1, 3, 2)$ and $(5, 0, 6)$. If x-coordinate of P is 2, then its z-coordinate is
 (a) -1 (b) 4 (c) $\frac{3}{2}$ (d) 8

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)** : Let $X = \{1, 2, 3\}$ and $S : X \rightarrow X$ such that $S = \{(1, 1), (2, 2), (3, 3), (1, 2)\}$. Then, the relation S is a reflexive relation on X.
Reason (R) : A relation S defined in a set X is called symmetric relation, if $(a, b) \in S$ implies $(b, a) \in S$ for all $a, b \in X$.
20. **Assertion (A)** : The position vectors of two points A and B are respectively $\overrightarrow{OA} = 2\hat{i} - \hat{j} - \hat{k}$ and $\overrightarrow{OB} = 2\hat{i} - \hat{j} + 2\hat{k}$. The position vector of a point P which divides the line segment joining A and B in the ratio 2:1 is $\overrightarrow{OP} = 2\hat{i} - \hat{j} + \hat{k}$.

Reason (R) : For vectors $\vec{a}$ and $\vec{b}$, scalar product is defined as $\vec{a} \cdot \vec{b} = |\vec{a}| |\vec{b}| \sin \theta$, where θ is the angle between the vectors $\vec{a}$ and $\vec{b}$.

SECTION B

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

21. Find the value of $\sin^{-1} \left[\sin \left(-\frac{17\pi}{8} \right) \right]$.

OR

Find range of the function $f(x) = \tan^{-1} x + \frac{1}{2} \sin^{-1} x$.

22. The side of an equilateral triangle is increasing at the rate of 2 cm/s. At what rate is its area increasing when the side of the triangle is 20 cm?

23. Show that $|\vec{a}| |\vec{b}| + |\vec{b}| |\vec{a}|$ is perpendicular to $|\vec{a}| |\vec{b}| - |\vec{b}| |\vec{a}|$, for any two non-zero vectors $\vec{a}$ and $\vec{b}$.

OR

Find the vector and Cartesian equations of the line which passes through the point (3, 4, 5) and is parallel to the vector $2\hat{i} + 2\hat{j} - 3\hat{k}$.

24. If $y = e^x + e^{-x}$, then show that $\frac{dy}{dx} = \sqrt{y^2 - 4}$.

25. If $\vec{a} = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{b} = 5\hat{i} - 3\hat{j} - 4\hat{k}$, then find the ratio $\frac{\text{Projection of vector } \vec{a} \text{ on vector } \vec{b}}{\text{Projection of vector } \vec{b} \text{ on vector } \vec{a}}$.

SECTION C

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

26. Find : $\int \frac{x^3 + 1}{x^3 - x} dx$.

27. A card from a pack of 52 cards is lost. From the remaining cards of the pack, two cards are drawn randomly one-by-one without replacement and are found to be both kings. Find the probability of the lost card being a king.

OR

During the Annual School Fair, a **Lucky Draw** game is organized. A box contains 5 red, and 7 black balls. A student picks two balls one after another without replacement.

Prizes are awarded as follows.

- Red ball → Chocolate hamper
- White ball → Stationery kit
- Black ball → Storybook

If the first ball drawn is red, what is the probability that the second ball is also red?

28. Evaluate : $\int_{-1}^5 (|x| + |x+1| + |x-5|) dx$.

OR

Find the value of $\int_0^1 \tan^{-1} \left(\frac{1-2x}{1+x-x^2} \right) dx$.

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

OR

Find the particular solution of the differential equation

$$\cos y \, dx + (1 + e^{-x}) \sin y \, dy = 0, \text{ given that } y = \frac{\pi}{4} \text{ when } x = 0.$$

30. Solve the following Linear Programming Problem graphically :
Maximize $Z = 30x + 20y$ subject to $1.5x + 3y \leq 42$, $3x + y \leq 24$, $x \geq 0$, $y \geq 0$.

31. Find : $\int \frac{2x+1}{\sqrt{3+2x-x^2}} dx$.

SECTION D

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

32. If $A = \begin{bmatrix} 1 & 2 & -3 \\ 3 & 2 & -2 \\ 2 & -1 & 1 \end{bmatrix}$, then find A^{-1} and use it to solve the system of the linear equations given as : $x + 2y - 3z = 6$, $3x + 2y - 2z = 3$, $2x - y + z = 2$.

OR

Evaluate the product AB , where $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$.

Hence solve the system of linear equations : $x - y = 3$, $2x + 3y + 4z = 17$, $y + 2z = 7$.

33. Find the shortest distance between the following lines and hence write whether the lines are intersecting or not.

$$\frac{x-1}{2} = \frac{y+1}{3} = z, \quad \frac{x+1}{5} = \frac{y-2}{1}, z = 2.$$

OR

Show that the lines $\frac{x-2}{1} = \frac{y-2}{3} = \frac{z-3}{1}$ and $\frac{x-2}{1} = \frac{y-3}{4} = \frac{z-4}{2}$ intersect.

Also, find the coordinates of the point of intersection.

34. Find the points of local maxima and local minima, of the function $f(x) = \sin x - \cos x$, $0 < x < 2\pi$. Also find the local maximum and local minimum values.
35. Find the area of the region bounded by the curves $x^2 + y^2 = 4$, $y = \sqrt{3}x$ and x -axis in the first quadrant.

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.

**ONE - NATION
ONE - ELECTION**

FESTIVAL OF DEMOCRACY

GENERAL ELECTION - 2019



A general election of Lok Sabha is a gigantic exercise. About 911 million people were eligible to vote and voter turnout was about 67%, the highest ever.

Let I be the set of all citizens of India who were eligible to exercise their voting right in general election held in 2019. A relation 'R' is defined on I as follows.

$$R = \{(V_1, V_2) : V_1, V_2 \in I \text{ and both use their voting right in general election - 2019}\}.$$

(i) Two friends X and $Y \in I$.

X and Y both exercised their voting right in the general election - 2019.

Then, state if $(X, Y) \in R$ is true or not. Give reason.

(ii) Mr. 'H' and his wife 'W' both exercised their voting right in general election - 2019.

Then, state if the following statement is true or not. Give reason.

"If $(H, W) \in R$ then, we may or may not have $(W, H) \in R$."

(iii) Check if R is reflexive or, symmetric. Give reasons to support your answer.

OR

(iii) Mr. Ghanshyam exercised his voting right in general election - 2019.

While his brother (having voting right), Mr. Radheshyam went to have fun at a nearby mall.

Can we have $(\text{Ghanshyam}, \text{Radheshyam}) \in R$? Give reason.

If Miss. Radhika (having voting right) goes with Mr. Radheshyam to the mall skipping the voting exercise, then is it correct to say $(\text{Radhika}, \text{Radheshyam}) \notin R$? Give reason.

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



A survey was conducted among Class 12 students of a school to analyze how the choice of main subject affects performance in board exams.

The data collected shows : 40% students opted for Mathematics, 35% for Biology, and 25% for Commerce.

The probability that a student scores more than 90% in the board exam is

- 0.7 if the student opted for Mathematics
- 0.5 if the student opted for Biology
- 0.4 if the student opted for Commerce

Now, a student is selected at random from the class.

(i) Find the probability that the selected student scored more than 90%.

(ii) What is the probability that a student scoring above 90% had opted for Mathematics?

(iii) Find the probability that a student who did not score above 90% had opted for Biology.

OR

(iii) If two students are selected at random (with replacement), find the probability that both of them scored above 90%.

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

A mobile company in a town has 500 subscribers on its list and collects fixed charges of ₹ 300/- per subscriber per year.



The company proposes to increase the annual subscription and it is believed that for every increase of ₹ 1/-, one subscriber will discontinue the service of this company.

- (i) If the mobile company increases ₹ x /-, then obtain the function $R(x)$, which represents the earning of the company. Also, find $R'(x)$.
- (ii) What increase will bring maximum earning for the company? Use second derivative test.

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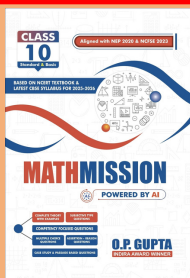
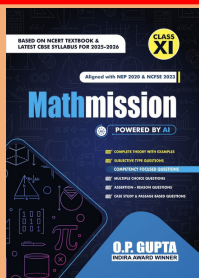
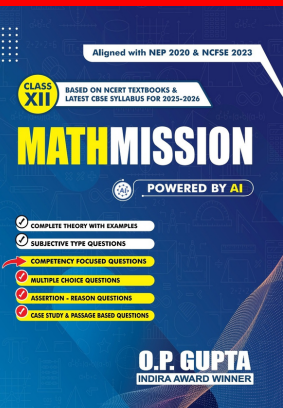
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ABOUT THE AUTHOR

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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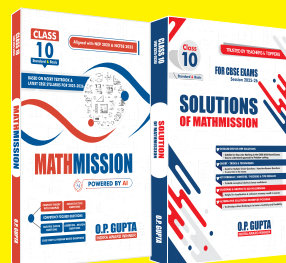
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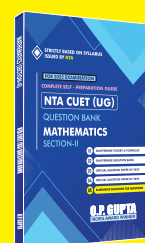
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