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PLEASURE TEST SERIES
PTS-33

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. $\int \frac{\sqrt{\cot x^2}}{\sin x^2 \cos x^2} x\, dx =$

(a) $-\sqrt{\cot x} + C$ (b) $\sqrt{\cot x^2} + C$ (c) $-x\sqrt{\cot x^2} + C$ (d) $-\sqrt{\cot x^2} + C$

02. Let $A = BC$. Here A, B and C are non-singular matrices of same order. If the given equation is pre-multiplied by 'inverse of A' on both sides, then the equation becomes

(a) $AA^{-1} = BCA^{-1}$ (b) $A^{-1}A = A^{-1}BC$ (c) $I = BA^{-1}C$ (d) $A^{-1}A = BCA^{-1}$

03. $\vec{a}$ and $\vec{b}$ represent the diagonals of a parallelogram, then area of this parallelogram is given by

(a) $|\vec{a} \times \vec{b}|$ (b) $\frac{1}{2}|\vec{a} \times \vec{b}|$ (c) $2|\vec{a} \times \vec{b}|$ (d) $\frac{1}{2}|(\vec{a} + \vec{b}) \times (\vec{a} - \vec{b})|$

04. If $f(x) = \frac{x^2 - 1}{x - 1}$, when $x \neq 1$ is given to be continuous at $x = 1$, then the value of $f(1)$ is

(a) 1 (b) –2 (c) 1 (d) 2

05. If A is a square matrix of order 2 and $|A| = 3$, then the value of $|2AA'|$ is

(a) 36 (b) $\frac{1}{36}$ (c) ±6 (d) 6

06. Assume that the function f (x) have its second derivative at $x = c$ such that $f'(c) = 0$ and $f''(c) > 0$, then $x = c$ is

(a) a point of local maxima (b) a point of local minima
(c) a point of inflection (d) a point of global maxima

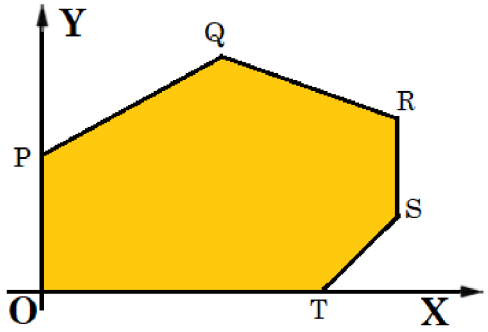
07. The feasible solution for a linear programming is as shown in figure below.

The corner points of feasible region are P(0, 4), Q(4, 6), R(8, 5), S(8, 2) and T(6, 0).

Let $Z = 5x + y$ be the objective function.

Maximum value of Z is

(a) 38 (b) 45
(c) 40 (d) 42



08. The vector projection of the vector $\hat{i} - \hat{j}$ on the vector $3\hat{i} + \hat{k}$ is

(a) $\frac{3}{\sqrt{10}}$ (b) $\frac{9\hat{i} + 3\hat{k}}{10}$ (c) $\frac{3\hat{i} + \hat{k}}{\sqrt{10}}$ (d) $\frac{3\hat{i} + \hat{k}}{10}$

09. The value of $\int_{-\pi/6}^{\pi/6} \cos x \log\left(\frac{1+x}{1-x}\right) dx$ is

(a) 0 (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{2}$

10. Let C_{ij} represents cofactor of a_{ij}, then C_{31} in $\begin{vmatrix} 3 & 0 & 4 \\ 1 & 2 & 0 \\ -1 & 2 & -5 \end{vmatrix}$ is

(a) 8 (b) –8 (c) 4 (d) –4

11. The optimal value of the objective function is attained at the points
(a) on x-axis
(b) on y-axis
(c) which are corner points of feasible region
(d) which are inside the feasible region

12. If the matrix $A = \begin{pmatrix} 3 & 5 \\ 7 & 9 \end{pmatrix}$ is written as $A = X + Y$, where X is a symmetric matrix and Y is a skew-symmetric matrix, then the matrix X is given by

(a) $\begin{pmatrix} 3 & 3 \\ 6 & 9 \end{pmatrix}$ (b) $\begin{pmatrix} 3 & 6 \\ 6 & 9 \end{pmatrix}$ (c) $\begin{pmatrix} 3 & 7 \\ 5 & 9 \end{pmatrix}$ (d) $\begin{pmatrix} 0 & -2 \\ 2 & 0 \end{pmatrix}$

13. For $A = \begin{pmatrix} 1 & 2 & 0 \\ 0 & 0 & 4 \\ -2 & 0 & 0 \end{pmatrix}$ and $B = \begin{pmatrix} 13 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 0 \end{pmatrix}$, then $|AB|$ equals

(a) -16 (b) -1040 (c) 1040 (d) 0

14. If $P(A) = 0.6$, $P(B) = 0.5$ and $P(B|A) = 0.4$, then $P(A \cup B) =$

(a) 0.24 (b) 0.86 (c) 0.28 (d) 0.48

15. Integration factor of $\frac{dx}{dy} = 2y + x$ is

(a) e^{-2x} (b) e^{y} (c) e^{x} (d) e^{-y}

16. Differentiation of $f(x) = |x - 3|$, $x > 3$ w. r. t. x

(a) is –1 (b) is 1
(c) is 0 (d) doesn't exist, as f is non differentiable

17. A vector with a magnitude of 2 and in the direction of $\hat{i} + 2\hat{j} - 2\hat{k}$, is

(a) $\frac{2}{3}\hat{i} + \frac{4}{3}\hat{j} - \frac{4}{3}\hat{k}$ (b) $\pm\left(\frac{2}{3}\hat{i} + \frac{4}{3}\hat{j} - \frac{4}{3}\hat{k}\right)$ (c) $-\frac{2}{3}\hat{i} - \frac{4}{3}\hat{j} + \frac{4}{3}\hat{k}$ (d) $2\hat{i} + 4\hat{j} - 4\hat{k}$

18. Angle between the lines $\frac{x-2}{1} = \frac{y-1}{3} = \frac{z-3}{-4}$ and $\frac{x+2}{1} = \frac{y-5}{5} = \frac{z+1}{4}$ is

(a) π (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) 0

*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) :** If $\sin^{-1} x + \sin^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{2}$, then the value of x is $\frac{\sqrt{3}}{2}$.

Reason (R) : If $x \in$ Real numbers, then $0 < \cot^{-1} x < \pi$.

20. **Assertion (A) :** For a line which is equally inclined with coordinate axes, the direction cosines are given by $\pm\frac{1}{\sqrt{3}}, \pm\frac{1}{\sqrt{3}}, \pm\frac{1}{\sqrt{3}}$.

Reason (R) : $\vec{r} = x_1\hat{i} + y_1\hat{j} + z_1\hat{k} + \lambda(a_1\hat{i} + b_1\hat{j} + c_1\hat{k})$ represents vector equation of a line which passes through the point $(a_1\hat{i} + b_1\hat{j} + c_1\hat{k})$ and which is parallel to the vector $x_1\hat{i} + y_1\hat{j} + z_1\hat{k}$.

SECTION B

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

21. Check if the relation R in the set $\mathbb{R}$ of real numbers defined as $R = \{(a, b) : a < b\}$ is

(i) symmetric,

(ii) transitive.

OR

Find the largest value of $f(x) = \tan^{-1} 1 - \tan^{-1} x,\ x \in [0,1]$.

22. Show that the function f, which is given by $f(x) = \tan^{-1}(\sin x + \cos x)$ is strictly decreasing for all $x \in \left(\frac{\pi}{4}, \frac{\pi}{2}\right)$.

OR

If $y = (\cos x)^{\tan x}$, find $\frac{dy}{dx}$.

23. Find the vector and Cartesian equations of a line passing through (–1, –2, 5) and parallel to the line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{3-z}{1}$.

24. If $y = \log(1 + 2t^2 + t^4),\ x = \tan^{-1} t,$ then find $\frac{d^2y}{dx^2}$ in terms of 'x' only.

25. Using vectors, find the area of triangle ABC, where A(6, 5, –1), B(3, 2, 1) and, C(4, 5, 5).

SECTION C

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

26. Evaluate : $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \left(\sin|x| + \cos|x|\right) dx$.

27. If E and F are two independent events then, show that the probability of occurrence of 'at least one of E and F' is given by $1 - P(\overline{E})\ P(\overline{F})$.

OR

A man is known to speak truth 4 out of 5 times. He throws a pair of dice and reports that it is a doublet. What is the probability that it is actually a doublet?

28. Show that : $\int_0^1 \frac{x^2}{1+2x} dx = \frac{1}{8}\log 3$.

29. Find the particular solution of the differential equation :

$$x\frac{dy}{dx}\sin\left(\frac{y}{x}\right)+x-y\sin\left(\frac{y}{x}\right)=0, \text{ given that } y(1)=\frac{\pi}{2};\ x>0.$$

Hence, express the result as a function of the form $y=f(x)$.

OR

Solve the differential equation : $(1-y^2)(1+\log x)dx+2xydy=0$, if $y=0$ when $x=1$.

30. Solve the following Linear Programming problem graphically.

Maximise $Z=300x+600y$

Subject to $x+2y\le 12,\ 2x+y\le 12,\ x+\frac{5}{4}y\ge 5,\ x\ge 0,\ y\ge 0$.

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

OR

Find : $\int\frac{(x^4-x)^{\frac{1}{4}}}{x^5}dx$.

SECTION D

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

32. Make a rough sketch of the region $\{(x,y):x^2+y^2\le 16a^2 \text{ and } y^2\le 6ax\}$ and find the area of the region using integration.

33. Express $\tan^{-1}\left(\frac{\cos x}{1-\sin x}\right),\ -\frac{3\pi}{2}<x<\frac{\pi}{2}$ in the simplest form.

OR

Prove that the relation R on Z (set of integers), defined by
$R=\{(x,y):(x-y) \text{ is divisible by } 5\}$ is an equivalence relation.

Also find equivalence class [0].

34. For any two vectors $\vec{a}$ and $\vec{b}$, prove that $(\vec{a}\times\vec{b}).(\vec{a}\times\vec{b})=|\vec{a}|^2\ |\vec{b}|^2-(\vec{a}.\vec{b})^2$.

OR

$\overrightarrow{AB}=3\hat{i}-\hat{j}+\hat{k}$ and $\overrightarrow{CD}=-3\hat{i}+2\hat{j}+4\hat{k}$ are two vectors. The position vectors of the points A and C are $6\hat{i}+7\hat{j}+4\hat{k}$ and $-9\hat{j}+2\hat{k}$, respectively. Find the position vector of a point P on the line AB and a point Q on the line CD such that $\overrightarrow{PQ}$ is perpendicular to $\overrightarrow{AB}$ and $\overrightarrow{CD}$ both.

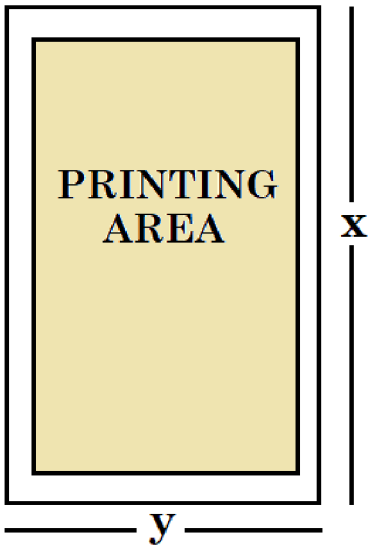
35. The monthly incomes of Abhinay and Neha are in the ratio 3 : 4 and their monthly expenditures are in the ratio 5 : 7. If each saves ₹15,000 per month, find their monthly incomes using matrix method.

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 then answer the questions given below.

Following is the pictorial description for a particular page, selected by a school administration, for printing purposes.



The total area of the page is 150 cm^2.
The combined width of the margin at the top and bottom is 3 cm and at the sides, it is 2 cm.

(i) Obtain an expression for area (S) of the page where printing can be done, (express in terms of x and y both).
Assume that the total length and width of the page is x and y, respectively (as seen in the figure).

(ii) Find the area (S) of the printable region of the page, in terms of x only.

(iii) Find $\frac{dS}{dx}$. Also find the value of x (in cm), at which $\frac{dS}{dx} = 0$.
Finally write the corresponding value of y (in cm).

OR

(iii) For what value of x (in cm), the area (S) of prinatble region is maximum?
Write the maximum area of printable region of the page. Use Second Derivative test.

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

Sachin Pandey runs a company which deals in production of electric shavers for men.

The manager of company proposes to produce x shavers in a day at a cost of ₹$\left(\frac{x^2}{4} + 35x + 25\right)$.

The electronic shavers produced in the company are distributed to the sellers at a price of ₹$\left(50 - \frac{x}{2}\right)$ each.

(i) Write an expression for the profit function, P(x).
(ii) Write an expression of 'marginal profit function'.
(iii) How many units of electronic shavers must be produced to have maximum profit? Also write the maximum profit. Use Second Derivative test.

OR

(iii) Use First Derivative test, to find the number of electronic shavers that must be produced to maximize the profit. Also write the maximum profit.

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

The CEO of a payment gateway company calls an urgent meeting to decide whether to adopt a new UPI Plugin-based technology.
From past company data, it is observed that
- 60% of the company's new technology proposals are approved.
- when a technology is approved, there is a 70% chance that it turns out to be successful in the market.
- when a technology is not approved, there is still a 20% chance that it later becomes successful (due to independent team adoption or external partnerships).

Let A be the event that the proposal is approved, and S be the event that the technology becomes successful.

(i) Find the probability that the technology becomes successful i.e., P(S).

(ii) If the technology later becomes successful, find the probability that it had been approved by the company i.e., P(A|S).

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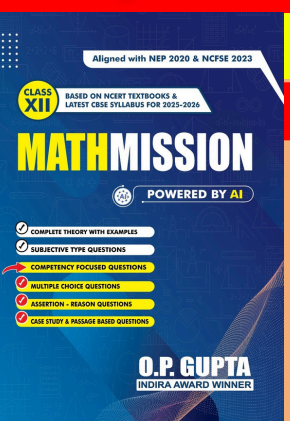

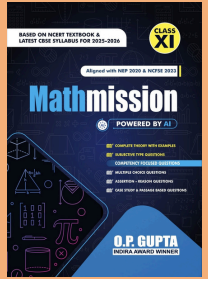

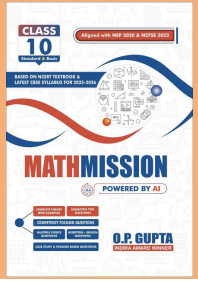

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ABOUT THE AUTHOR

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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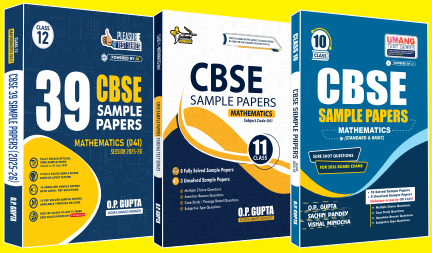

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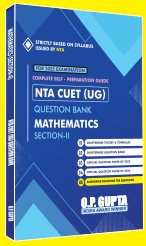

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