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PLEASURE TEST SERIES PTS-27

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. If $A=\begin{bmatrix} x+3 & 8 \\ 3 & 2 \end{bmatrix}$ is non-invertible matrix, then the value of x is

(a) 12 (b) 6 (c) 3 (d) 9

02. Let $A=\{1,2,3,...,100\}$.

Let a relation R be defined on A, given by $R=\{(x,y): xy \text{ is a perfect square}\}$.

Then the equivalence class [2] is

(a) {2, 8, 18, 32, 50} (b) {2, 8, 18, 32}

(c) {2, 8, 18, 32, 50, 72, 98} (d) None of these

03. Let $\sin^{-1}(2x)+\cos^{-1}\left(\frac{1}{2}\right)=\frac{\pi}{2}$. Then the value of 'x' is

(a) $\frac{1}{8}$ (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) 8

04. If $A=\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$ and $A+A'=I$, then the value of α is

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

05. If $A=\begin{bmatrix} 3 & -5 \\ 2 & 0 \end{bmatrix}$ and $B=\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$, then $AB=$

(a) $\begin{bmatrix} 3 & 5 \\ 2 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} -3 & -5 \\ -2 & 0 \end{bmatrix}$ (c) $\begin{bmatrix} 3 & -5 \\ 2 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} -3 & 5 \\ -2 & 0 \end{bmatrix}$

06. If A is a square matrix of order 3 such that $|A|\neq 0$, then which of the following is not true?

(a) $|\text{adj.}A|=|A|^2$ (b) $|A|=|A'|$ (c) $|A|^{-1}=|A^{-1}|$ (d) A is a singular matrix

07. If $y=\sin(2\sin^{-1}x)$, then $(1-x^2)y_2$ is equal to

(a) $-xy_1+4y$ (b) $-xy_1-4y$ (c) xy_1-4y (d) xy_1+4y

08. If $y=\tan^{-1}(e^{2x})$, then $\frac{dy}{dx}$ is equal to

(a) $\frac{2e^{2x}}{1+e^{4x}}$ (b) $\frac{1}{1+e^{4x}}$ (c) $\frac{2}{e^{2x}+e^{-2x}}$ (d) $\frac{1}{e^{2x}-e^{-2x}}$

09. The function $f(x)=\begin{cases} x^2 & \text{for } x<1 \\ 2-x & \text{for } x\geq 1 \end{cases}$ is

(a) not differentiable at $x = 1$
(b) differentiable at $x = 1$
(c) not continuous at $x = 1$
(d) neither continuous nor differentiable at $x = 1$

10. The confidence gained by playing x games of tennis at a trial function is given by $C(x) = 11 + 15x + 6x^2 - x^3$.
Then, the marginal confidence gained after playing 5 games, is
(a) $15 + 12x - 3x^2$ (b) $15 + 2x - 3x^2$ (c) $15 + 2x + 3x^2$ (d) 0

11. The function $(x - \sin x)$ decreases for
(a) all x (b) $x < \frac{\pi}{2}$ (c) $0 < x < \frac{\pi}{4}$ (d) no value of x

12. $\int x \sec^2(5 + x^2)dx$ equals
(a) $\tan(5 + x^2) + C$ (b) $\frac{1}{2}\tan(5 + x^2) + C$ (c) $-\frac{1}{2}\tan(5 + x^2) + C$ (d) $-\tan(5 + x^2) + C$

13. $\int \frac{x - 1}{(x - 2)(x - 3)}dx =$
(a) $2\log|x - 3| - \log|x - 2| + C$ (b) $\log|x - 3| - \log|x - 2| + C$
(c) $\log|x - 3| - 2\log|x - 2| + C$ (d) $2\log|x - 3| + \log|x - 2| + C$

14. Value of $\int \frac{\cos\sqrt{x}\,dx}{\sqrt{x}}$ is
(a) $-2\sin\sqrt{x} + C$ (b) $\sin\sqrt{x} + C$ (c) $2\cos\sqrt{x} + C$ (d) $2\sin\sqrt{x} + C$

15. The value of $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{\cos x - \sin x}{1 + \sin 2x}dx$ is
(a) $\frac{\pi}{12}$ (b) π (c) $\frac{\pi}{2}$ (d) 0

16. Sum of order and degree of the differential equation $\left(\frac{dy}{dx}\right)^3 + y\left(\frac{d^2y}{dx^2}\right) = 0$, is
(a) 1 (b) 2 (c) 3 (d) 4

17. Which of the following represents equation of a line passing through the points (x_1, y_1, z_1) and (x_2, y_2, z_2)?
(a) $\frac{x_2 - x_1}{x - x_1} = \frac{y_2 - y_1}{y - y_1} = \frac{z_2 - z_1}{z - z_1}$ (b) $\frac{\pm(x_2 - x_1)}{x - x_1} = \frac{\pm(y_2 - y_1)}{y - y_1} = \frac{\pm(z_2 - z_1)}{z - z_1}$
(c) $\frac{x - x_1}{x_2 - x_1} = \frac{y - y_1}{y_1 - y_2} = \frac{z - z_1}{z_2 - z_1}$ (d) $\frac{x - x_1}{x_2 - x_1} = \frac{y - y_1}{y_2 - y_1} = \frac{z - z_1}{z_2 - z_1}$

18. The probability of solving a specific question independently by A and B are $\frac{1}{3}$ and $\frac{1}{5}$ respectively. If both try to solve the question independently, the probability that the question is solved, is

(a) $\frac{7}{15}$ (b) $\frac{8}{15}$ (c) $\frac{14}{15}$ (d) $\frac{2}{15}$

*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) :** The value of $\tan\left(\frac{\sec^{-1}x+\text{cosec}^{-1}x}{2}\right)=1$, if $x\in\mathbb{R}-(-1,1)$.

Reason (R) : For $y=\tan^{-1}x$, we always have $y\in\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$.

20. **Assertion (A) :** Acute angle between the vectors $\hat{i}+\hat{j}-\hat{k}$ and $2\hat{i}+3\hat{k}$ is, $\cos^{-1}\left(\frac{1}{\sqrt{39}}\right)$.

Reason (R) : For vectors $\vec{a}$ and $\vec{b}$, the acute angle between them is, $\cos^{-1}\left(\frac{|\vec{a}.\vec{b}|}{|\vec{a}||\vec{b}|}\right)$.

SECTION B

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

21. If $3\tan^{-1}x=\pi$ and $\cot^{-1}y=\frac{\pi}{4}$, then write the value of $(x+y)^2$.

22. Prove that $f(x)=\frac{1}{1+x^2}$ is neither increasing nor decreasing on $x\in\mathbb{R}$.

23. Show that the vectors A($2\hat{i}$), B($-\hat{i}-4\hat{j}$) and C($-\hat{i}+4\hat{j}$) represent the vertices of an isosceles triangle.

OR

Find the direction cosines of the line $\frac{x-2}{2}=\frac{2y-5}{-3}$, $z=-1$.

24. Find the inverse of $A=\begin{pmatrix}1 & -1\\ 0 & 2\end{pmatrix}$, also find the value of AA^{-1}.

OR

Find the value of $(x-y)$ from the matrix equation

$$2\begin{bmatrix}x & 5\\ 7 & y-3\end{bmatrix}+\begin{bmatrix}-3 & -4\\ 1 & 2\end{bmatrix}=\begin{bmatrix}7 & 6\\ 15 & 14\end{bmatrix}.$$

25. Find a vector $\vec{r}$ of magnitude $5\sqrt{2}$ units which makes an angle of $\frac{\pi}{4}$ and $\frac{\pi}{2}$ with the y-axis and z-axis, respectively.

SECTION C

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

26. Let L be the set of all lines in a plane and R be the relation in L defined as

$R=\{(L_1, L_2): L_1 \text{ is perpendicular to } L_2\}$.

Show that R is symmetric but neither reflexive nor transitive.

OR

Prove that the function $f : N \to N$ defined by $f(x) = x^2 + x + 1$ is one-one but not onto.

27. If $f(x) = \dfrac{\tan\left(\dfrac{\pi}{4} - x\right)}{\cot 2x}$ for $x \neq \dfrac{\pi}{4}$, find the value which can be assigned to $f(x)$ at $x = \dfrac{\pi}{4}$ so that the function $f(x)$ becomes continuous at every point in $x \in \left[0, \dfrac{\pi}{2}\right]$.

28. Prove that $x^2 - y^2 = c(x^2 + y^2)^2$ is the general solution of the differential equation $(x^3 - 3xy^2)\,dx = (y^3 - 3x^2y)\,dy$, where c is a parameter.

OR

Find the particular solution of the D.E. : $\dfrac{dy}{dx} - 3y\cot x = \sin 2x$, given that $y = 2$ when $x = \dfrac{\pi}{2}$.

29. Find the shortest distance between the lines $\vec{r} = 4\hat{i} - 3\hat{j} + \lambda(\hat{i} + 2\hat{j} - 2\hat{k})$ and $\vec{r} = \hat{i} + \hat{j} - 2\hat{k} - \mu(2\hat{i} + 4\hat{j} - 4\hat{k})$.

30. In a class of 100 students, 40 students like Mathematics (event E), 50 students like Chemistry (event F), and 70 students like either Mathematics or Chemistry.
Based on this information, answer the following.
(i) Find the probability that a student likes both Mathematics and Chemistry.
(ii) Find the probability that a student likes Mathematics given that he likes Chemistry.
(iii) Find the probability that a student likes Chemistry given that he likes Mathematics.

31. Evaluate : $\displaystyle\int_{\pi/6}^{\pi/3} \frac{\sin x + \cos x}{\sqrt{\sin 2x}}\,dx$.

OR

Find : $\displaystyle\int_{-1}^{2} |x^3 - x|\,dx$.

SECTION D

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

32. Find the area enclosed between by the circle $x^2 + y^2 = 16$ and the lines $\sqrt{3}y = x$, $x = 0$ in the first quadrant using integration.

OR

Using integration, find the area of the region bounded in first quadrant by $4x^2 + 9y^2 = 36$.

33. Find the foot of the perpendicular to the line $\dfrac{x}{2} = \dfrac{y-1}{-3} = \dfrac{z-1}{3}$ drawn from the point (1, 3, 2).

34. Solve the following linear programming problem graphically.

Minimise $z = 3x + 2y$

Subject to the constraints : $x \geq 0, y \geq 0, 3x + 4y \leq 60, y \geq 3, x \geq 2y$.

Also, write the maximum value of z.

35. A water tank has the shape of an inverted right circular cone with its axis vertical and vertex lowermost. Its semi-vertical angle is $\tan^{-1}\left(\dfrac{1}{2}\right)$. Water is poured into it at a constant rate of 5 cubic metre per hour. Find the rate at which the level of the water is rising at the instant when the depth of water in the tank is 4 m.

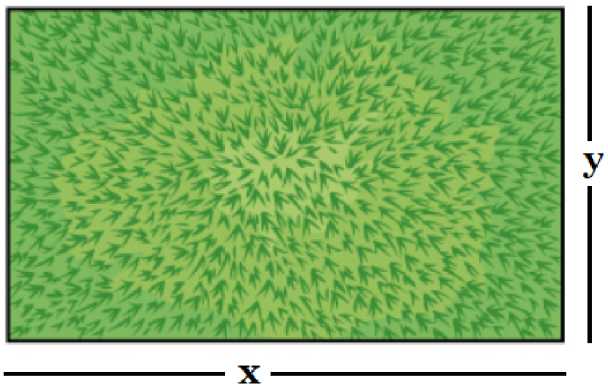
OR

Show that the maximum value of function, $f(x) = x + \frac{1}{x}$ is less than its minimum value. Use the first derivative test.

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.



Manjit wants to donate a rectangular plot of land for a school in his village.
When he was asked to give dimensions of the plot, he told that :

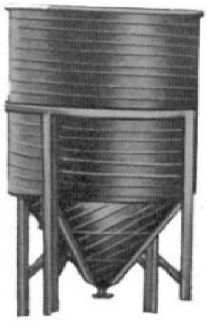
- If its length is decreased by 50 m and breadth is increased by 50 m, then its area will remain same,
- If length is decreased by 10 m and breadth is decreased by 20 m, then its area will decrease by 5300 m^2.

(i) Assume that the length and breadth of the land be x and y (in metres) respectively. Find the equations in terms of x and y.
(ii) Using matrices, represent the linear equations obtained above in **(i)**.
(iii) Using matrices, determine the dimensions of the land (in metres). Also write the area of the rectangular plot of land (in square metres).

OR

(iii) Suppose that, Manjit gave the information about his plot in the following manner :
If its length is decreased by 50 m and breadth is increased by 50 m, then its area will remain the same, but if length is decreased by 20 m and breadth is decreased by 10 m, then its area will be decreased by 4800 m^2. In this situation, what will be dimensions of the plot? Assume that the length and breadth of the land be x and y (in metres) respectively. Use matrices.

37. **CASE STUDY II :** Read the following passage and answer the questions given below.
A tank, as shown in the figure below, formed using a combination of a cylinder and a cone, offers better drainage as compared to a flat bottomed tank.



A tap is connected to such a tank whose conical part is full of water. Water is dripping out from a tap at the bottom at the uniform rate of 2 cm^3/s.

The semi-vertical angle of the conical tank is 45°.

(i) Find the volume of water in the tank in terms of its radius r.

(ii) Find rate of change of radius at an instant when $r = 2\sqrt{2}$ cm.

(iii) Find the rate at which the wet surface of the conical tank is decreasing at an instant when radius $r = 2\sqrt{2}$ cm.

OR

(iii) Find the rate of change of height 'h' at an instant when slant height is 4 cm.

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

Pankaj went to a nearby market for shopping of some readymade garments.
The probability that Pankaj will buy a shirt is 0.2, the probability that he will buy a trouser is 0.3, and the probability that he will buy a shirt given that he buys a trouser is 0.4.

(i) Find the probability that Pankaj will buy both a shirt and a trouser.

(ii) Find the probability that Pankaj will buy a trouser given that he buys a shirt.

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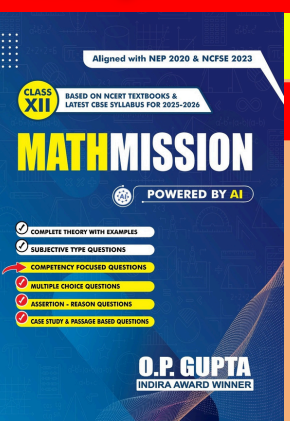

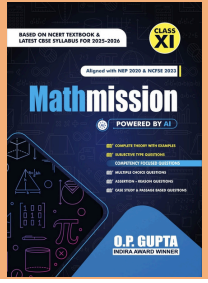

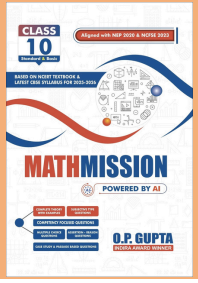

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ABOUT THE AUTHOR

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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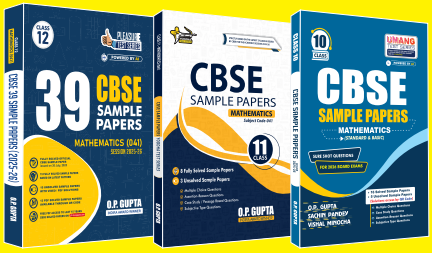

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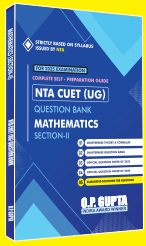

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