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PLEASURE TEST SERIES PTS-31

For CBSE 2026 Board Exams - Class 12

MATHEMATICS

SUBJECT CODE - 041

a compilation by

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. For the square matrices A and B of same order, which of the following is incorrect?

(a) $(A+B)' = A' + B'$ (b) $(AB)' = B'A'$ (c) $(kA)' = \frac{1}{k} A'$ (d) $(B')' = B$

02. The least value of the function $f(x) = 2\cos x + x$ in the closed interval $\left[0, \frac{\pi}{2}\right]$ is

(a) 2 (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{6} + \sqrt{3}$ (d) Least value doesn't exist

03. The magnitude of $\frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} - \frac{1}{\sqrt{3}}\hat{k}$ is

(a) $\frac{1}{3}$ (b) $\frac{1}{\sqrt{3}}$ (c) 3 (d) 1

04. The function f given by $f(x) = [x]$, where $[\ .\ ]$ is g.i.f., is continuous at

(a) $x \in R - \{0\}$ (b) $x = 0$ (c) $x \in R$ (d) $x = \frac{3}{2}$

05. $\int \frac{\sin^3 x + \cos^3 x}{\sin^2 x \cos^2 x} dx =$

(a) $\text{cosec}\, x - \sec x + C$ (b) $\sec x + \text{cosec}\, x + C$

(c) $\sec x + \cos x + C$ (d) $\sec x - \text{cosec}\, x + C$

06. The sum of the order and degree of the differential equation : $\frac{d}{dx}\left\{\left(\frac{dy}{dx}\right)^3\right\} = 0$, is

(a) 1 (b) 2 (c) 3 (d) 4

07. Let $Z = 2x + 3y$ be the objective function for a linear programming problem.

Following table depicts the corner points of feasible region and corresponding value of Z.

Corner Points	Value of Z
A (6, 0)	12
B (3, 2)	12
C (0, 2)	6

Value of Z is maximum at

(a) a unique point (b) no point (c) two points only (d) infinitely many points

08. Which of the following represents an expression for the acute angle between $\vec{a}$ and $\vec{b}$?

(a) $\cos^{-1}\frac{|\vec{a}.\vec{b}|}{|\vec{a}\,\vec{b}|}$ (b) $\cos^{-1}|\vec{a}.\vec{b}|$ (c) $\cos^{-1}\frac{|\vec{a}.\vec{b}|}{|\vec{a}||\vec{b}|}$ (d) $\cos^{-1}|\vec{a}\times\vec{b}|$

09. $\int_{-\pi}^{\pi} x\cos x\,dx$ equals

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

10. The real function $f(x)=2x^3-3x^2-36x+7$ is

(a) strictly increasing in $(-\infty,-2)$ and strictly decreasing in $(-2,\infty)$

(b) strictly decreasing in $(-2, 3)$

(c) strictly decreasing in $(-\infty,3)$ and strictly increasing in $(3,\infty)$

(d) strictly decreasing in $(-\infty,-2)\cup(3,\infty)$

11. In a linear programming problem, the constraints on the decision variables x and y are $x-y\geq 0$, $y\geq 1$, $0\leq x\leq 2$. The feasible region

(a) is not in the first quadrant (b) is unbounded in the first quadrant

(c) is bounded in the first quadrant (d) does not exist

12. The minimum value of $4x+\frac{16}{x}$, $x>0$ is

(a) 0 (b) -8 (c) 16 (d) $\sqrt[2]{16}$

13. The function $f(x)=\log\left(\frac{1}{x}\right)$ strictly decreases in

(a) $(-\infty, 0)$ (b) $(0, \infty)$ (c) $(-\infty, \infty)$ (d) $(1, \infty)$

14. If $P(\text{not } A)=0.7$, $P(B)=0.7$ and $P(B\,|\,A)=0.5$, then $P(\bar{A}\,|\,\bar{B})$ is

(a) 0.1 (b) 0.05 (c) 0.15 (d) 0.5

15. Which of the following satisfies the differential equation $\frac{dx}{dy}+x=y$?

(a) $y=C-\log|1-y+x|$ (b) $y=C-\log|1+y+x|$

(c) $y=C+\log|1-y+x|$ (d) $y=C-\log|1-y-x|$

16. If $y=A\cos\log x-B\sin\log x$, then $x\left(\frac{dy}{dx}\right)$ is equal to

(a) $(A\sin\log x+B\cos\log x)$ (b) $-(A\cos\log x+B\sin\log x)$

(c) $-(A\sin\log x+B\cos\log x)$ (d) $(A\cos\log x+B\sin\log x)$

17. Which of the following represents position vector of the mid-point of line segment joining the points $A(\hat{i}-2\hat{j}+7\hat{k})$ and $B(5\hat{i}+\hat{k})$?

(a) $3\hat{i}-\hat{j}+4\hat{k}$ (b) $2\hat{i}+\hat{j}-3\hat{k}$ (c) $\hat{j}-3\hat{i}-4\hat{k}$ (d) $6\hat{i}-2\hat{j}+8\hat{k}$

18. The direction cosines of the line $\frac{x-1}{3}=\frac{3y-6}{2}$, $z=-4$ are given by

(a) $0,\pm\frac{9}{\sqrt{85}},\pm\frac{2}{\sqrt{85}}$ (b) $\pm\frac{9}{\sqrt{85}},\pm\frac{2}{\sqrt{85}},0$ (c) $\pm\frac{9}{\sqrt{85}},0,\pm\frac{2}{\sqrt{85}}$ (d) $\pm 9, \pm 2, 0$

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) :** The principal value of $\tan^{-1}\left(\tan\frac{4\pi}{3}\right)=\frac{\pi}{3}$.

Reason (R) : If $y=\tan^{-1}x$, then $-\frac{\pi}{2}<y<\frac{\pi}{2}$.

20. **Assertion (A) :** The acute angle between the line $\vec{r}=2\hat{j}+\hat{k}+\lambda(\hat{k}-\hat{j})$ and the z-axis is $\frac{\pi}{3}$.

Reason (R) : The acute angle θ between the lines $\vec{r}=x_1\hat{i}+y_1\hat{j}+z_1\hat{k}+\lambda(a_1\hat{i}+b_1\hat{j}+c_1\hat{k})$ and $\vec{r}=x_2\hat{i}+y_2\hat{j}+z_2\hat{k}+\mu(a_2\hat{i}+b_2\hat{j}+c_2\hat{k})$ is given by $\cos\theta=\frac{|a_1a_2+b_1b_2+c_1c_2|}{\sqrt{a_1^2+b_1^2+c_1^2}\sqrt{a_2^2+b_2^2+c_2^2}}$.

SECTION B

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

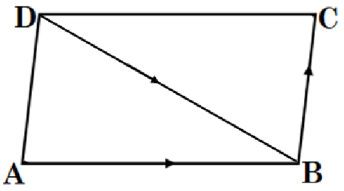
21. Simplify : $\cot^{-1}\frac{1}{\sqrt{x^2-1}}$, $x<-1$.

OR

Show that the **signum** function $f:R\to R$ given by $f(x)=\begin{cases}1, \text{ if } x>0\\0, \text{ if } x=0\\-1, \text{ if } x<0\end{cases}$ is neither one-one nor onto.

22. Find the value of x ($x>0$), if $\begin{bmatrix}x & -5 & -1\end{bmatrix}\begin{bmatrix}1 & 0 & 2\\0 & 2 & 1\\2 & 0 & 3\end{bmatrix}\begin{bmatrix}x\\4\\1\end{bmatrix}=O$.

23. The diagram given represents a parallelogram ABCD.
Let $\overrightarrow{AB}=3\hat{i}+\hat{j}+4\hat{k}$ and $\overrightarrow{DB}=2\hat{i}+2\hat{j}+3\hat{k}$.



Write its diagonal $\overrightarrow{AC}$.
Is it possible to find the area of parallelogram ABCD?
If yes, determine the area in Sq. units.

OR

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

24. Find $\frac{dy}{dx}$, at $t=\frac{2\pi}{3}$ when $x=10(t-\sin t)$ and $y=12(1-\cos t)$.

25. Find the Cartesian and vector equations of the line which passes through the point (–2, 4, –5) and parallel to the line given by $10(x+3)=6(y-4)=5(8-z)$.

SECTION C

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

26. If $A=\begin{bmatrix}1 & -1\\2 & 1\end{bmatrix}$, $B=\begin{bmatrix}0 & 1\\2 & 4\end{bmatrix}$, $C=\begin{bmatrix}-1 & 2\\1 & -4\end{bmatrix}$ and $AB-CD=O$, then find the matrix D.

27. Solve the following linear programming problem graphically.

Minimise $z = 3x + 5y$

Subject to the constraints : $x + 2y \geq 10,\ x + y \geq 6,\ 3x + y \geq 8,\ x \geq 0,\ y \geq 0$.

28. Consider the experiment of throwing coin. If it shows a head, toss it again. But if it shows tail then, throw a die. Find the conditional probability of the event 'the die shows a number greater than 4' given that 'there is at least one tail'.

OR

Three persons A, B and C apply for a job of manager in a private company. Chances of their selection are in the ratio 1:2:4. The probability that A, B and C can introduce changes to increase the profits of a company are 0.8, 0.5 and 0.3 respectively. If increase in the profit does not take place, find the probability that it is due to the appointment of A.

29. Evaluate : $\int_0^{\pi/2} (2\log\cos x - \log\sin 2x)\,dx$.

OR

Evaluate : $\int_0^{\pi} \frac{x}{9\sin^2 x + 16\cos^2 x}\,dx$.

30. Find the particular solution of the differential equation $x\frac{dy}{dx} + y + \frac{1}{1+x^2} = 0$, if it is given that $y(1) = 0$.

OR

Find the general solution of the differential equation

$x(y^3 + x^3)dy = (2y^4 + 5x^3y)dx$.

31. If $f(x) = x\sqrt{x+5}$ such that $\frac{d}{dx}[F(x)] = f(x)$, then find $F(x)$.

SECTION D

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

32. Using integration, find the area of the parabola $y^2 = 4ax$ bounded by its latus-rectum.

33. If R be the relation defined on Q (the set of rational numbers) as $aRb \Leftrightarrow |a-b| \leq \frac{1}{2}$, then show that R is not an equivalence relation.

OR

Show that the relation R defined on set $A = \{x \in Z : 0 \leq x \leq 12\}$, given by $R = \{(a,b) : |a-b|$ is a multiple of $4\}$ is an equivalence relation.

Hence, find the set of all elements related to 1 in R.

34. If $\vec{a}$ and $\vec{b}$ are two vectors of equal magnitude and α is the angle between them, then prove that $\frac{|\vec{a}+\vec{b}|}{|\vec{a}-\vec{b}|} = \cot\left(\frac{\alpha}{2}\right)$.

35. Water is dripping out from a conical funnel of semi-vertical angle $\frac{\pi}{4}$ at the uniform rate of $2\ cm^2/s$ in its surface area through a tiny hole at the vertex in the bottom. When the slant height of the water is 4 cm, find the rate of decrease of the slant height of water.

OR

Find the intervals in which the function $f(x)=\frac{x}{\log x}$ is strictly increasing and/or strictly decreasing.

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.

A professional typist Miss Radha charges ₹145/- for typing 10 English and 3 Hindi pages, while she charges ₹180/- for typing 3 English and 10 Hindi pages.

(i) Assuming that the charges (in ₹) of typing one English page be x and that of one Hindi page be y, then represent the situation given above using matrices?

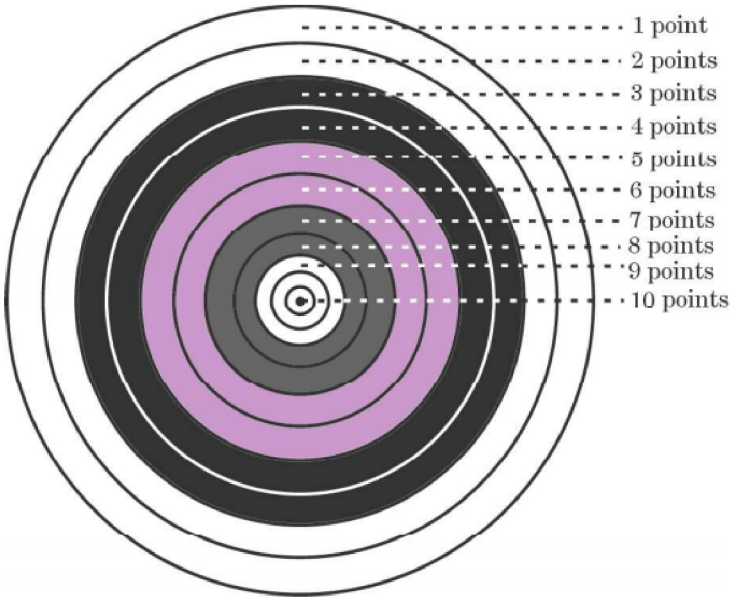
(ii) Is the system of equations obtained in **(i)**, a consistent system? Use the concept of matrices and determinants to answer.

(iii) Use matrices to find the charges for typing one page of English?
What are the charges for typing one page of Hindi?

OR

(iii) Use matrices to find the charges for typing 2 pages of English and 1 page of Hindi.
What are the charges for typing 1 page of English and 2 pages of Hindi?

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



In a game of Archery, each ring of the Archery target is valued. The centre-most ring is worth 10 points and rest of the rings are allotted points 9 to 1 in sequential order moving outwards. Archer A is likely to earn 10 points with a probability of 0.8 and Archer B is likely the earn 10 points with a probability of 0.9.

(i) Write the probability that archer A does not earn 10 points.

(ii) Write the probability that archer B does not earn 10 points.

(iii) If both of them hit the Archery target, then find the probability that exactly one of them earns 10 points.

OR

(iii) If both of them hit the Archery target, then find the probability that both of them earn 10 points. Also, write the probability if none of them earns 10 point.

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

An electrician used resistors in electronic circuits to reduce current flow, while installing some electronic instruments in an office.

He knows that the Combined resistance R of two resistors in parallel combination is given by the expression : $\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}$, where R_1 and R_2 are the respective resistances of two resistors with the condition $R_1+R_2=K$, $(R_1,R_2>0)$, where K is a constant.

(i) Write the value of R in terms of R_1 only.

(ii) For what value of R_1 (in terms of K), the maximum value of R is obtained? Find the relation between R_1 and R_2, if R is maximum. Write the maximum value of R. Use derivatives.

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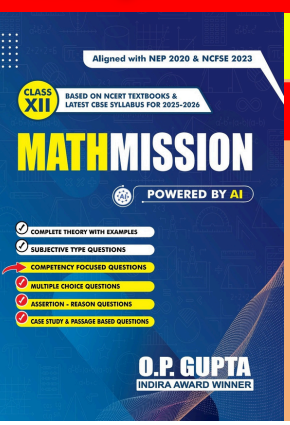

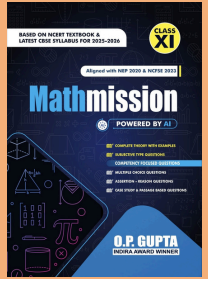

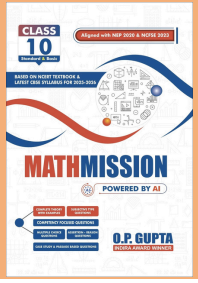

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ABOUT THE AUTHOR

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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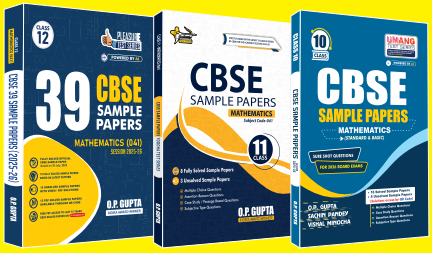

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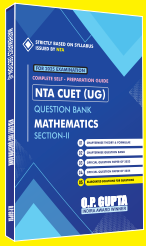

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