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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. If $A=\left[a_{ij}\right]$ is a square matrix of order 2 such that $a_{ij}=\begin{cases}1, \text{ when } i\neq j\\ 0, \text{ when } i=j\end{cases}$, then A^2 is

(a) $\begin{vmatrix}1 & 0\\ 0 & 1\end{vmatrix}$ (b) $\begin{vmatrix}1 & 1\\ 0 & 0\end{vmatrix}$ (c) $\begin{bmatrix}1 & 1\\ 1 & 0\end{bmatrix}$ (d) $\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$

02. Value of k, $(k>0)$ for which $A=\begin{bmatrix}k & 8\\ 4 & 2k\end{bmatrix}$ is a singular matrix is

(a) 4 (b) -4 (c) ± 4 (d) 0

03. If $(x-1)\hat{i}+12\hat{j}-3\hat{k}=5\hat{i}+2x\hat{j}-3\hat{k}$, then the value of x is

(a) 6 (b) 5 (c) 12 (d) 0

04. The value of a, (where $a<0$) for which the function $f(x)=\begin{cases}\dfrac{1-\cos(ax)}{x\sin x}, & x\neq 0\\ \dfrac{1}{2}, & x=0\end{cases}$ is continuous at $x=0$, is

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

05. If $\int_0^a \frac{1}{1+4x^2}dx=\frac{\pi}{8}$, then the value of 'a' is

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

06. Solution of $\frac{dy}{dx}=\left(\frac{y}{x}\right)^{\frac{1}{3}}$ is

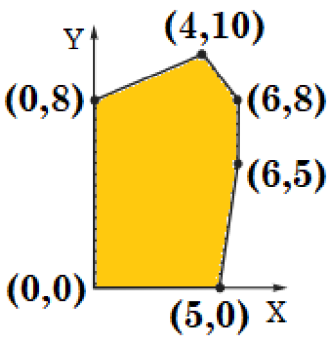
(a) $y^{2/3}-x^{2/3}=C$ (b) $y^{2/3}+x^{2/3}=C$ (c) $y^{1/3}-x^{1/3}=C$ (d) $y^{1/3}+x^{1/3}=C$

07. In the given graph, the feasible region for a LPP is shaded.

The objective function $Z=2x+3y$, will be minimum at

(a) (4, 10) (b) (6, 8)

(c) (0, 8) (d) (6, 5)



08. Unit vector in the direction of $\hat{i}+2\hat{j}-2\hat{k}$ is

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

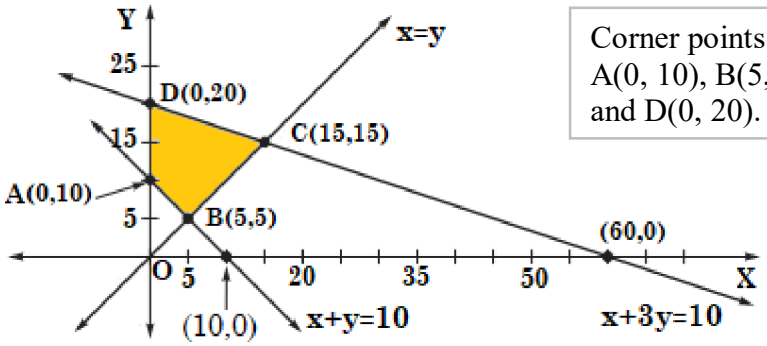
09. The value of $\int_{\sqrt{3}}^{2\sqrt{2}} \frac{x}{\sqrt{x^2+1}}dx$ is

(a) 3 (b) 1 (c) $\log\left(\frac{3}{2}\right)$ (d) $\log\left(\frac{9}{4}\right)$

10. If $A=\begin{bmatrix}1 & -1 & 0\\ 2 & 3 & 4\\ 0 & 1 & 2\end{bmatrix}$ and $B=\begin{bmatrix}2 & 2 & -4\\ -4 & 2 & -4\\ 2 & -1 & 5\end{bmatrix}$, then

(a) $A^{-1}=6B$ (b) $A^{-1}=B$ (c) $B^{-1}=B$ (d) $B^{-1}=\frac{1}{6}A$

11. Based on the given shaded region as the feasible region in the graph, at which point (s) is the objective function $Z=3x+9y$ maximum?



Corner points are located at A(0, 10), B(5, 5), C(15, 15) and D(0, 20).

(a) Point B (b) Point C
(c) Point D (d) every point on the line segment CD

12. If $\begin{bmatrix}2a+b & a-2b\\ 5c-d & 4c+3d\end{bmatrix}=\begin{bmatrix}4 & -3\\ 11 & 24\end{bmatrix}$, then the value of $(a+b-c+2d)$ is

(a) 8 (b) 10 (c) 4 (d) –8

13. Given that A is a square matrix of order 3 and $|A|=4$, then $|\text{adj.}(2A)|$ is equal to

(a) 2^6 (b) 2^8 (c) 2^{12} (d) 2^{10}

14. If $2P(A)=P(B)=\frac{5}{13}$ and $P(A\,|\,B)=\frac{2}{5}$, then $P(A\cup B)=$

(a) $\frac{1}{26}$ (b) $\frac{11}{26}$ (c) $\frac{15}{26}$ (d) $\frac{2}{5}$

15. Degree of the differential equation $\frac{d}{dx}\left[\left(\frac{d^2y}{dx^2}\right)^4\right]=0$ is

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

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

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

17. The cosine of the angle which the vector $\sqrt{2}\,\hat{i}+\hat{j}+\hat{k}$ makes with y-axis, is

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

18. $\frac{x-1}{1}=\frac{y+1}{2}=\frac{z-2}{-1}$ in vector form is represented by

(a) $\vec{r}=\hat{i}-\hat{j}+2\hat{k}+\lambda(\hat{i}+2\hat{j}-\hat{k})$ (b) $\vec{r}=\hat{i}-\hat{j}+2\hat{k}+\lambda(\hat{i}+2\hat{j}+\hat{k})$

(c) $\vec{r}=\hat{i}+\hat{j}+2\hat{k}+\lambda(\hat{i}+2\hat{j}-\hat{k})$ (d) $\vec{r}=\hat{i}-2\hat{j}+\hat{k}+\lambda(\hat{i}+2\hat{j}-\hat{k})$

*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 acute angle 'θ' between the lines given by $\vec{r}=2\hat{i}+\hat{j}-\hat{k}+\lambda(\hat{i}+\hat{j}-\hat{k})$ and $\vec{r}=\hat{i}-\hat{j}+\lambda(\hat{i}+\hat{k})$ is $\frac{\pi}{4}$.

Reason (R) : If two lines with direction ratios $a_1,b_1,c_1;\ a_2,b_2,c_2$ are parallel, then we always have $\frac{a_1}{a_2}=\frac{b_1}{b_2}=\frac{c_1}{c_2}$.

20. **Assertion (A) :** A relation S in set $X=\{1,2,3\}$ is defined as $S=\{(1,1),(1,2),(2,2)\}$.
If the ordered pair (2, 1) is added to the relation S, then S becomes a symmetric relation.
Reason (R) : Let a relation S is defined on set X and $(a,a)\in S\ \forall\ a\in X$ then, S is a symmetric relation.

SECTION B

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

21. Simplify : $\tan\left(\frac{1}{2}\cos^{-1}\frac{2}{\sqrt{5}}\right)$.

OR

Let the function $f:\mathbb{R}\to\mathbb{R}$ be defined by $f(x)=\cos x\ \forall\ x\in\mathbb{R}$.
Show that the function f is neither one-one nor onto.

22. Show that for all $m\geq 1$, $f(x)=\sqrt{3}\sin x-\cos x-2mx+n$ is decreasing on $\mathbb{R}$ (real numbers).

23. Two adjacent sides of a parallelogram are $2\hat{i}-4\hat{j}-5\hat{k}$ and $2\hat{i}+2\hat{j}+3\hat{k}$.
Find the two unit vectors parallel to its diagonals.

OR

Write the parametric equations of the line which passes through (1, 2, –3) and (3, 3, 2).

24. If $y=(\sin x)^x$, then find $\frac{dy}{dx}$.

25. If $|\vec{a}+\vec{b}|=60$, $|\vec{a}-\vec{b}|=40$ and $|\vec{a}|=22$, then find $|\vec{b}|$.

SECTION C

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

26. Find : $\int\frac{x-3}{(x-1)^3}e^x\,dx$.

27. Suppose that 6% of the people with blood group O are left handed and 10% of those with other blood groups are left handed, 30% of the people have blood group O.

If a left handed person is selected at random, what is the probability that he/she will have blood group O?

OR

A company conducts a survey and reports that 35% of respondents in a city are vegetarian and 65% of the respondents eat home-cooked meals daily. Assume these two eating habits are independent. A person is chosen at random from this population.

(i) Find the probability that the chosen person is both vegetarian and eats home-cooked meals daily.

(ii) Find the probability that the chosen person is either vegetarian or eats home-cooked meals daily.

(iii) If the chosen person eats home-cooked meals daily, what is the probability that he is vegetarian?

28. Evaluate : $\int_0^{\pi} \frac{x}{1+\sin x}\,dx$.

OR

Evaluate : $\int_1^3 \left[|x|+|x-2|\right]dx$.

29. Solve the differential equation : $\frac{dy}{dx} = -\left[\frac{x+y\cos x}{1+\sin x}\right]$, if $y(0)=1$.

OR

Solve the differential equation : $x^2\frac{dy}{dx} - xy = 1+\cos\left(\frac{y}{x}\right)$, $x \neq 0$.

30. Solve the following Linear Programming Problem graphically.

To maximize : $Z = (40x+50y)$

Subject to constraints : $x \geq 0,\ y \geq 0,\ 3x+y \leq 9,\ x+2y \leq 8$.

Also mention the x and y coordinates of the point where maximum value of Z is obtained.

31. Find : $\int \frac{1}{x(2+x^5)}\,dx$.

SECTION D

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

32. Using integration, find the area above x-axis, which is bounded by $\frac{x^2}{16}+\frac{y^2}{12}=1$, $y=0$ and the ordinates represented by both the latus-rectums (i.e., $x=-2,\ x=2$) of the given ellipse.

33. Let R be the relation defined in the set $A=\{1,2,3,4,5,6,7,8,9\}$ by $R=\{(x,y): x,y \in A,\ x$ and y are either both odd or both even$\}$. Show that R is an equivalence relation.
Write all the equivalence classes of set A.

OR

Let a relation R on the set $\mathbb{R}$ of real numbers be defined as $(a,b) \in R \Leftrightarrow 1+ab>0\ \forall a,b \in \mathbb{R}$.
Show that R is reflexive and symmetric. Is it transitive?

34. Show that the lines $\vec{r}=(-2\hat{i}+3\hat{j})+\lambda(4\hat{i}-6\hat{j}+12\hat{k})$ and $\vec{r}=(2\hat{i}+3\hat{j}+2\hat{k})+\mu(2\hat{i}-3\hat{j}+6\hat{k})$ are parallel. Hence, find the shortest distance between them.

OR

Isha is standing at a point P on a path represented by the line $\frac{x-6}{1}=\frac{2-y}{2}=\frac{z-2}{2}$ and she wants to reach a point Q on another path represented by the line $\frac{x+4}{3}=\frac{y}{-2}=\frac{z+1}{-2}$ in least time.

Determine the equation of the path PQ, which should be traced by her.

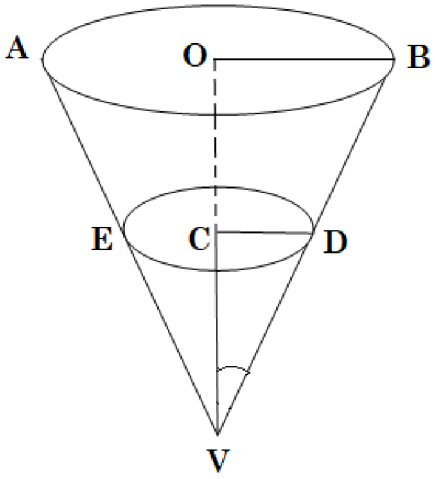
35. If $A = \begin{bmatrix} 1 & 3 & 4 \\ 2 & 1 & 2 \\ 5 & 1 & 1 \end{bmatrix}$, find A^{-1}.

Hence, solve the system of equations : $x + 3y + 4z = 8$, $2x + y + 2z = 5$ and $5x + y + z = 7$.

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.



Water is stored in a conical vessel, whose axis is vertical. It is found that water is dripping out through a tiny hole at the vertex of the conical vessel.

The semi-vertical angle of the conical vessel is $\frac{\pi}{6}$.

(i) Let at an instant, the radius, slant height and height of the water cone VECD formed be 'r', 'x' and 'h' respectively. What is the relation between ' x ' and ' r '?

(ii) For the symbols as mentioned in **(i),** what is the relation between 'h' and ' r '?

(iii) If water is dripping out at a steady rate of $1\ cm^3/s$ through the tiny hole at the vertex of the conical vessel then, find the rate of decrease of slant height, when the slant height of water cone in the vessel is 4 cm.

OR

(iii) Suppose water is dripping out from this conical funnel 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 cone is 4 cm, find the rate of decrease of the slant height.

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

A state government passes a bill in its assembly which makes it compulsory for all the male drivers in the three categories - cyclists, scooter drivers and car drivers - to buy insurance policy from the state owned insurance company.

The insurance company insured 2000 cyclists, 4000 scooter drivers and 6000 car drivers. The probability of an accident involving a cyclist, scooter driver and a car driver are 0.01, 0.03 and 0.15 respectively. One of the insured persons meets with an accident.

(i) Write the probability that the person chosen is a scooter driver.

(ii) Write the probability that the person chosen is a car driver.

(iii) What is the probability that the insured person meets with an accident?

OR

(iii) What is the probability that the insured person is a cyclist, if he meets with an accident?

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

A retired person wants to plant some trees in the community park of his area.

The local nursery charges the cost of planting trees by the following formula :

$C(x) = x^3 - 45x^2 + 600x$, where x represents the number of trees and C(x) represents the cost of planting x trees in rupees.

The manager of a government regulated local nursery has imposed a restriction that it can plant 10 to 20 trees in one community park for a fair distribution.

(i) What is the derivative of $C(x) = x^3 - 45x^2 + 600x$ with respect to x? Also find the possible number of trees, if $C'(x) = 0$.

(ii) For how many trees should the person place the order, so that his expenses are least?

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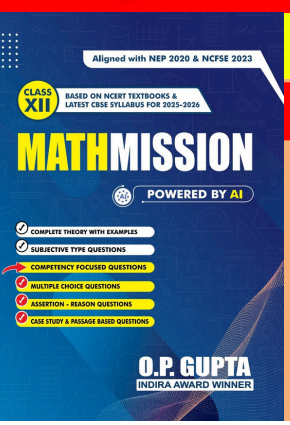

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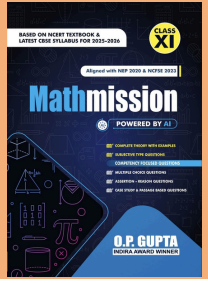

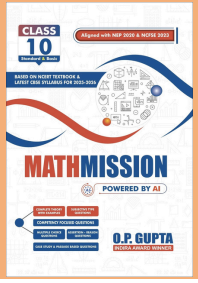

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ABOUT THE AUTHOR

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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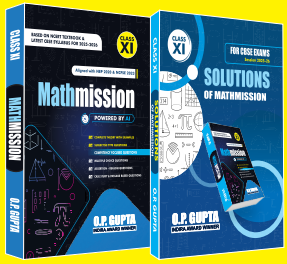

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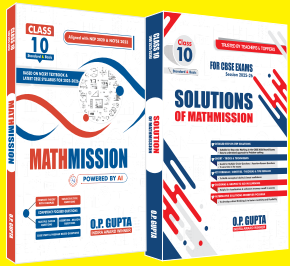

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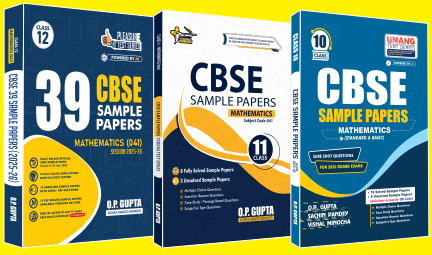

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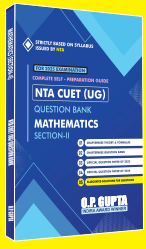

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