

ADVANCED MATH CLASSES

@ Think Academy, Najafgarh

(For Half Yearly Exam. Paper)

Class : XII

Subject : Mathematics (041)

MATHEMATICS-041

For 2026-27 Exams

Maximum Marks : 80

Time : 3 Hours

General Instructions :

- All questions are compulsory.
- This question paper consists of **38 questions** divided into **five sections A, B, C, D and E**.
- Section A comprises of **20 questions of one mark** each (from Q01 - 20).
Section B comprises of **05 questions of two marks** each (from Q21 - 25).
Section C comprises of **06 questions of three marks** each (from Q26 - 31).
Section D comprises of **04 questions of five marks** each (from Q32 - 35).
Section E comprises of **03 Case-study** based question with **sub-parts** (from Q36 - 38).
- There is no overall choice. However, **internal choice** has been provided in
 - **02 Questions of Section B**
 - **03 Questions of Section C**
 - **02 Questions of Section D**
 - **02 Questions of Section E**

You have to attempt only one of the alternatives in all such questions.

SECTION A

(Question numbers 01 to 20 carry **1 mark** each.)

Followings are **multiple choice questions**. Select the correct options (from **Q01 to 18**).

Q01. If $A = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$, then the value of $|A A'|$ is

- (a) -9 (b) 3 (c) $\frac{1}{9}$ (d) 9

Q02. If $(\begin{matrix} 2023 & 2024 & 2025 \end{matrix}) \begin{pmatrix} 2023 & 2025 & 1 \\ 2022 & 2024 & 0 \\ 2021 & 2022 & 1 \end{pmatrix} \begin{pmatrix} 2021 \\ 2022 \\ 2023 \end{pmatrix} = A$, then the order of matrix A is

- (a) 3 by 3 (b) 1 by 1 (c) 3 by 1 (d) 1 by 3

Q03. If $f(x) = \begin{cases} \frac{x^2 - 1}{x - 1}, & \text{when } x \neq 1 \\ 2k, & \text{when } x = 1 \end{cases}$ is given to be continuous at $x = 1$, then the value of k is

- (a) -1 (b) -2 (c) 1 (d) 2

Q04. If $\left| \frac{A^{-1}}{2} \right| = \frac{1}{k|A|}$, where A is a 3×3 matrix, then the value of k is

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

Q05. $\int \frac{x-1}{(x-2)(x-3)} dx$ equals

- (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) $\log|x-2| - \log|x-3| + C$

Q06. 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) 8 (d) $\frac{1}{4}$

Q07. $\int_e^{e^2} \frac{\log x}{x} dx$ equals

- (a) $\frac{1}{2}$ (b) $\frac{3}{2}$ (c) $-\frac{3}{2}$ (d) $-\frac{1}{2}$

Q08. Let $A = \{1, 2, 3\}$. Then total number of reflexive relations on set A is

- (a) 8 (b) 64 (c) 16 (d) 32

Q09. If $\begin{bmatrix} x & 2 \\ 3 & x-1 \end{bmatrix}$ is a singular matrix, then the product of all possible values of x is

- (a) 6 (b) -6 (c) 0 (d) -7

Q10. Principal value of $\tan^{-1}\left(\tan \frac{7\pi}{6}\right)$ is

- (a) $\frac{7\pi}{6}$ (b) $-\frac{\pi}{6}$ (c) $\frac{\pi}{6}$ (d) $-\frac{7\pi}{6}$

Q11. If $f(x) = \log \sin x$, then $f'(x) =$

- (a) $\frac{1}{\sin x}$ (b) $\tan x$ (c) $\cot x$ (d) $-\cot x$

Q12. If $y = 5e^{7x} + 6e^{-7x}$, such that $y'' - ky = 0$, then the value of k will be

- (a) -49 (b) 1 (c) 49 (d) 0

Q13. If $\begin{vmatrix} \alpha & 3 & 4 \\ 1 & 2 & 1 \\ 1 & 4 & 1 \end{vmatrix} = 0$, then the value of α is

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

Q14. 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) $2 \sin \sqrt{x} + C$

Q15. The function $f(x) = [x]$, where $[x]$ denotes the greatest integer less than or equal to x , is continuous at

- (a) $x = 1$ (b) $x = 1.5$ (c) $x = -2$ (d) $x = 4$

Q16. For the function $y = \frac{x-7}{(x-2)(x-3)}$, the value of $\left(\frac{dy}{dx}\right)_{\text{at } x=7}$ is

- (a) -20 (b) $\frac{1}{20}$ (c) $-\frac{1}{20}$ (d) 20

Q17. Let $\int \frac{e^x}{\sqrt{5-4e^x-e^{2x}}} dx = f(x) + C$. Then $f(x) =$

- (a) $\sin^{-1}\left(\frac{e^x+2}{3}\right)$ (b) $\tan^{-1}\left(\frac{e^x+2}{3}\right)$ (c) $\frac{1}{3} \sin^{-1}\left(\frac{e^x+2}{3}\right)$ (d) $\cos^{-1}\left(\frac{e^x+2}{3}\right)$

- Q18.** If $A = \begin{pmatrix} 3 & 5 \\ 7 & 9 \end{pmatrix}$ is written as $A = P + Q$, where P is a symmetric matrix and Q is skew symmetric matrix, then the matrix P will be 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) $\begin{pmatrix} 0 & -2 \\ 2 & 0 \end{pmatrix}$

Followings are **Assertion (A) - Reason (R) based questions** (from Q19 to 20).

Read the following statements carefully to mark the correct option out of the options given below.

- (a) A is true, R is true; R is a correct explanation for A.
 (b) A is true, R is true; R is not a correct explanation for A.
 (c) A is true, R is false.
 (d) A is false, R is true.
- Q19.** **Assertion (A) :** The domain of the function $f(x) = \cos^{-1}\left(\frac{2x}{3}\right)$ is $x \in \left[-\frac{3}{2}, \frac{3}{2}\right]$.
Reason (R) : $\cos^{-1} x$ is defined when $-1 \leq x \leq 1$.
- Q20.** **Assertion (A) :** If $\begin{pmatrix} 2025 \\ 2024 \end{pmatrix} \begin{pmatrix} 2 & 0 & 2 & 3 \end{pmatrix} = X$, then order of X will be 2×4 .
Reason (R) : Determinant value of a singular matrix is always non-zero.

SECTION B

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

- Q21.** Simplify : $\sin^{-1}\left[2x\sqrt{1-x^2}\right]$, $x \in \left[-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right]$.

OR

Evaluate : $3 \sin^{-1}\left(\frac{1}{\sqrt{2}}\right) + 2 \cos^{-1}\left(\frac{\sqrt{3}}{2}\right) + \cos^{-1}(0)$. Use principal values.

- Q22.** Find whether the function $f(x) = \cos\left(2x + \frac{\pi}{4}\right)$, is increasing or decreasing in $x \in \left(\frac{3\pi}{8}, \frac{5\pi}{8}\right)$.

OR

A spherical ice-ball melts uniformly. When its radius is 10 cm, determine the rate of change of its volume with respect to the radius.

- Q23.** Find the value of $(x - y)$ from the matrix equation

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

- Q24.** Find the matrix X and Y , if $X + Y = \begin{pmatrix} 7 & 0 \\ 2 & 5 \end{pmatrix}$ and $X - Y = \begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$.

- Q25.** Let R be an equivalence relation defined in the set $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ by
 $R = \{(x, y) : x, y \in A, x \text{ and } y \text{ are either both odd or both even}\}.$

Write all the equivalence classes of set A .

SECTION C

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

- Q26.** Using determinants, find the area of ΔPQR with vertices $P(3, 1)$, $Q(9, 3)$ and $R(5, 7)$. Also, find the equation of line PQ using determinants.

- Q27.** Let $f : N \rightarrow R$ be a function defined as $f(x) = 4x^2 + 12x + 15$, where R is the range of f .

Show that the function $f(x)$ is one-one.

OR

Check whether a function $f: \mathbb{R} \rightarrow \left[-\frac{1}{2}, \frac{1}{2}\right]$ defined as $f(x) = \frac{x}{1+x^2}$ is one-one and onto or not.

Q28. If $y = (\sin^{-1} x)^2$, $x > 0$, show that $(1-x^2)\left(\frac{d^2y}{dx^2}\right) - x\left(\frac{dy}{dx}\right) - 2 = 0$.

OR

If $y = \left(x + \frac{1}{x}\right)^x + (\log x)^x$, then find $\frac{dy}{dx}$.

Q29. Let a relation R on the set $\mathbb{R}$ of real numbers be defined as

$$(a, b) \in R \Leftrightarrow 1 + ab > 0 \quad \forall a, b \in \mathbb{R}.$$

Show that R is reflexive and symmetric. Is it transitive? Justify your answer in each case.

Q30. Find : $\int \cos 2x \cos 4x \cos 6x \, dx$.

OR

Evaluate : $\int_1^5 (|x-1| + |x-2| + |x-4|) \, dx$.

Q31. Find the sub-intervals in which $f(x) = \log(2+x) - \frac{x}{2+x}$, $x > -2$ is increasing or decreasing.

SECTION D

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

Q32. Prove that $\int_a^b f(x) \, dx = \int_a^b f(a+b-x) \, dx$. Hence, evaluate $\int_{-\pi/2}^{\pi/2} \frac{\cos^2 x}{1+e^x} \, dx$.

Q33. Amongst all pairs of positive numbers with product 64, find those whose sum is the least.

OR

A particle moves along the curve $y = \frac{2}{3}x^3 + 1$. Find the coordinates of the points on the curve at which the y -coordinate is changing twice as fast as the x coordinate.

Q34. Solve the following system of equations by using matrix method

$$x + 2y + 3z = 6, \quad 2x - y + z = 2, \quad 3x + 2y - 2z = 3.$$

OR

If $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$, then show that $A^3 - 6A^2 + 7A + 2I = O$.

Q35. Find the area of the smaller region bounded by the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$ and the line $\frac{x}{5} + \frac{y}{4} = 1$, using integration.

SECTION E

This section contains **three Case-study based questions** (from Q36 to 38).

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.

Q36. Let $f(x)$ be a real valued function. Then its

- Left Hand Derivative (L.H.D.) : $Lf'(a) = \lim_{h \rightarrow 0} \frac{f(a-h) - f(a)}{-h}$
- Right Hand Derivative (R.H.D.) : $Rf'(a) = \lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h}$

Also, a function $f(x)$ is said to be differentiable at $x = a$ if its L.H.D. and R.H.D. at $x = a$ exist and both are equal.

$$\text{Let } f(x) = \begin{cases} |x-3|, & x \geq 1 \\ \frac{x^2}{4} - \frac{3x}{2} + \frac{13}{4}, & x < 1 \end{cases}$$

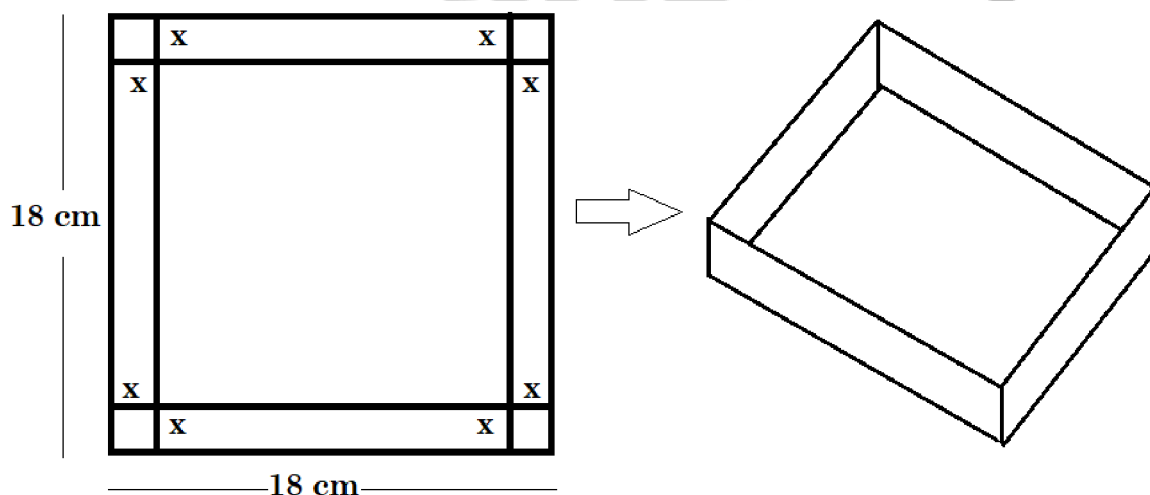
Based on the given information, answer the following questions.

- What is R.H.D. of $f(x)$ at $x = 1$?
- What is L.H.D. of $f(x)$ at $x = 1$?
- Check if the function $f(x)$ is differentiable at $x = 1$.

OR

- Find $f'(2)$ and $f'(-1)$.

- Q37.** For an EMC project, a student of Class XII makes an open cardboard box for a jewellery shop from a square sheet of side 18 cm by cutting off squares from each corner and folding up the flaps.



Assume that 'x' be the side of squares cut off from each corner (as shown in the diagram above).

Based on the given information, answer the following questions.

- For the open box, find the length, breadth and height in terms of x.
- Write an expression for the volume of the open box.
- For what value of 'x', the open box will have maximum volume? Use derivatives.

OR

- Find the maximum value of volume of the open box. Use derivatives.

- Q38.** Minor of an element a_{ij} of a determinant is the determinant obtained by deleting its i^{th} row and j^{th} column in which a_{ij} lies. Minor of a_{ij} is denoted by M_{ij} .

Cofactor of an element a_{ij} , denoted by A_{ij} , is defined by, $A_{ij} = (-1)^{i+j} M_{ij}$, where M_{ij} is minor of a_{ij} . Sometimes C_{ij} is used in place of A_{ij} to denote the cofactor of element a_{ij} .

Moreover the determinant of a square matrix A is the sum of the products of the element of any row (or column) with their corresponding cofactors.

That is, if $A = [a_{ij}]_{3 \times 3}$, then $|A| = a_{11}A_{11} + a_{12}A_{12} + a_{13}A_{13}$.

$$\text{Let } A = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 0 & -2 \\ 1 & 0 & 4 \end{bmatrix}.$$

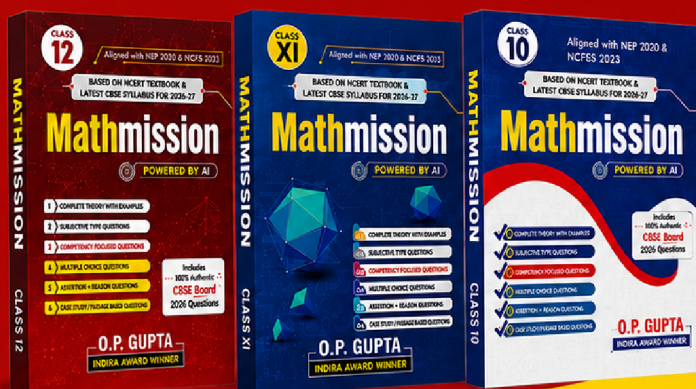
Using the information given above, answer the following questions.

(i) Find the value of $M_{13} + M_{12}$ in $|A|$. Also find the product of M_{31} and M_{22} .

(ii) For the matrix A given above, write the value of $a_{11}A_{21} + a_{12}A_{22} + a_{13}A_{23}$. Also find $|A|$.

MOST REPUTED REFRESHER BOOKS OF CLASSES XII, XI & X

MATHMISSION by O.P. GUPTA



BUY NOW ON

amazon

Flipkart



This all-inclusive Refresher-Guide features

- Theory
- Examples
- Subjective Questions
- Multiple Choice Questions
- Assertion Reason Questions
- Case Study Questions
- Answers

GET BULK-ORDER @ THE DISCOUNTED PRICES FOR
SCHOOLS, TUTIONS & COACHING INSTITUTES



To Order, Message On WhatsApp @
+91 9650350480

Secure your copy today and ace your
Mathematics Exams!



SCAN QR-CODE
TO BUY ON AMAZON



Schools, Coaching centres,
individual teachers can
Buy the MS Word or PDF
format : Customized Tests /
Ready-made Tests / MCQs /
Case-Study & Worksheets
for classes X, XI & XII.

To know more, message on
WhatsApp @ 9650350480.

Grab the best Seller book for X, XI & XII Maths (041) CBSE Exams.

☑ **MATHMISSION FOR XII, XI & X**
(Refresher Guide with Competency Focused Questions)

• These books are developed as per CBSE curriculum for 2026-27.

☑ **CBSE SAMPLE PAPERS FOR XII, XI & X**

☑ **NTA CUET (UG) QUESTION BANK IN MATHS**

(Order now at Discounted rate on WhatsApp - 9650350480)

Join Our Mathematics Learning & Teachers Community

To support **collaborative learning and resource sharing** in Mathematics, dedicated WhatsApp groups have been created for:

Maths Teachers Community	Students of Classes XI & XII	Students of Classes IX & X
		

These groups aim to share:

- ✓ Quality Mathematics Resources
- ✓ Board Exam Discussions & Solutions
- ✓ Important Practice Questions & Updates
- ✓ Healthy Academic Interaction

❶ How to Join?

Please **scan the QR-Code** corresponding to your category (Teachers / Class IX - X Students / Class XI - XII Students) to join the relevant group.

Alternatively, you can **touch the QR-Code** too, after opening in the Drive PDF App.

✳ Important Guidelines

- Teachers are requested NOT to join student groups.
- Students are requested NOT to join teachers' groups.

☑ If you are already a member of any of our existing groups, please avoid joining another group to prevent repeated notifications of the same resources.

Instead, you may share this opportunity with your colleagues or students who may benefit from these Mathematics learning communities.

With Regards

O.P. Gupta

Author - Mathmission Series of Books

Founder & Mentor

THE O.P. GUPTA ADVANCED MATH CLASSES

@ Thana Road, Najafgarh, New Delhi

■ WhatsApp: +91 9650350480



Dedicated to helping students and teachers strengthen conceptual understanding and excel in Mathematics.

MATHEMATICIA BY O.P. GUPTA

...a name you can bank upon!



Feel Safe to **Share this Document** with other math scholars

CLICK NOW

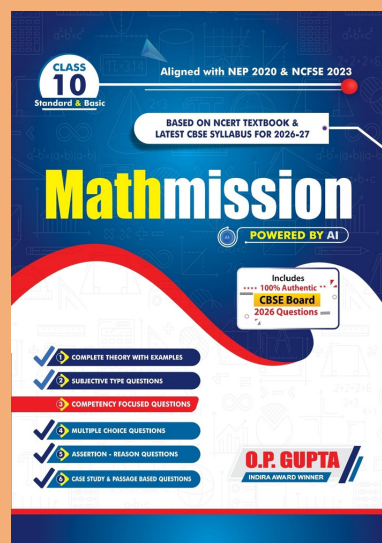
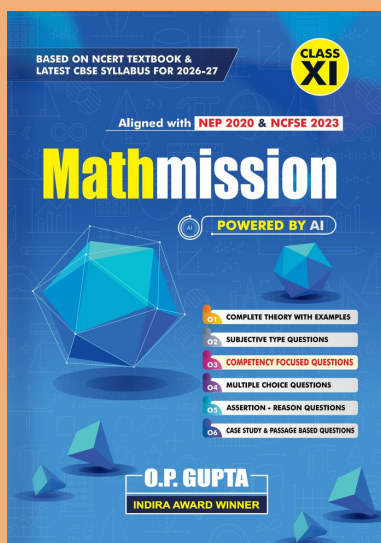
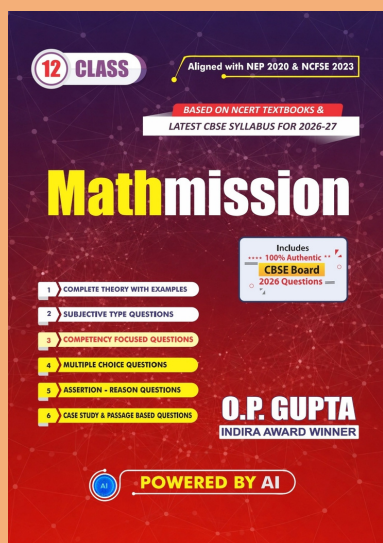
TO

Download



**FREE PDF TESTS AND
ASSIGNMENTS OF THE
CLASSES XII, XI & X**

or, just type -
theopgupta.com



Click on the
Book cover
to buy!



Many **Direct Questions**
from our **Books** have
been asked frequently in
the recent **CBSE Exams**.

Latest 2026-27 Edition

MATHMISSION FOR XII, XI & X

By **O.P. GUPTA**

Buy our
books on
amazon
Flipkart