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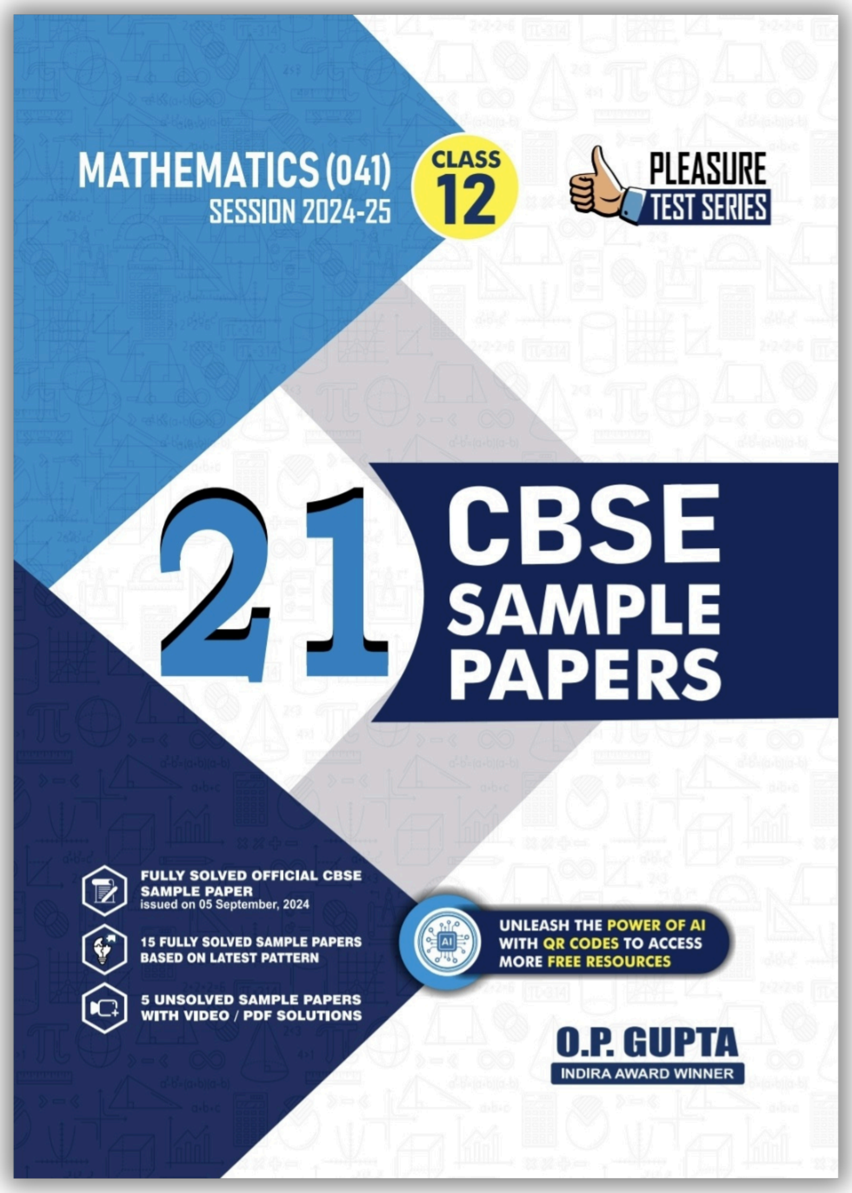
Class XII - Mathematics (041)

CBSE 21 SAMPLE PAPERS

[Pleasure Tests Series]



By O.P. GUPTA
Indira Award Winner

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PLEASURE TEST SERIES

For CBSE 2025 Board Exams - Class 12

MATHEMATICS (041)

PTS-01

a compilation by

O.P. GUPTA

INDIRA AWARD WINNER

Time Allowed : 180 Minutes **Max. Marks : 80**

General Instructions :

1. This Question paper contains **five sections - A, B, C, D and E**. Each section is compulsory. However, there are **internal choices** in some questions.
2. Section A has **18 MCQs** and **02 Assertion-Reason (A-R)** based questions of **1 mark** each.
   Section B has **05 questions** of **2 marks** each.
   Section C has **06 questions** of **3 marks** each.
   Section D has **04 questions** of **5 marks** each.
   Section E has **03 Case-study / Source-based / Passage-based** questions with **sub-parts** (with a total of **4 marks** for each Case-study / Source-based / Passage-based question).
3. 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 option in each one of them.*

01. If for a square matrix P, $P.(\text{adj}.P)=\begin{bmatrix}-2025 & 0 & 0\\ 0 & -2025 & 0\\ 0 & 0 & -2025\end{bmatrix}$, then $|P|+|\text{adj}.P|=$

(a) $2025^2\times 2024$ (b) $(-2025)+1$ (c) 2025×2024 (d) $(-2025)^2+2025$

02. X and Y are two matrices such that the transpose of $(X+Y)$ is $\begin{bmatrix}2 & -1\\ 7 & 6\end{bmatrix}$. If $Y=\begin{bmatrix}3 & -2\\ 6 & 0\end{bmatrix}$, then which of the following is correct?

(a) $X=\begin{bmatrix}-1 & 1\\ 1 & 6\end{bmatrix}$ (b) $X=\begin{bmatrix}-1 & 9\\ -7 & 6\end{bmatrix}$ (c) $X=\begin{bmatrix}1 & -9\\ 7 & -6\end{bmatrix}$ (d) $X=\begin{bmatrix}-4 & 4\\ 0 & 7\end{bmatrix}$

03. Function f defined by $f(x)=e^{-x}$ is strictly increasing when

(a) $x\in\phi$ (b) $x\in(-\infty,0)$ (c) $x\in[0,\infty)$ (d) $x\in(-\infty,\infty)$

04. If A, B and C are square matrices of order 3 and $\det(BC)=2\det(A)$, then what is the value of $\det(2A^{-1}BC)$?

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

05. The value of 'n', such that the differential equation

$\frac{dy}{dx}=\frac{x^2+y^2}{x^n}$; where $x,\ y\in R^+$ is homogeneous, is

(a) 0 (b) 1 (c) 2 (d) 3

06. If $\begin{vmatrix} 2 & -3 & 1 \\ k & -1 & 1 \\ 0 & 4 & 1 \end{vmatrix} = 0$, then

(a) $7k = 10$ (b) $7k + 10 = 0$ (c) $10k + 7 = 0$ (d) $10k = 7$

07. If A is a square matrix of order n, then the number of minors in the determinant of A are

(a) n (b) $n - 1$ (c) n^2 (d) n^n

08. Delhi Metro is highly popular mode of transport among the commuters. The Metro connects numerous stations across Delhi NCR. Among them are Dwarka and Hauz Khas. Wishi takes the Metro scheduled at 8:25 AM from Dwarka station to Hauz Khas station every morning. The probability that the Metro is late is $\frac{3}{4}$ and, the probability that Wishi gets a seat in the Metro is $\frac{1}{15}$. The probability that the Metro is on time and she gets a seat in it is

(a) $\frac{1}{20}$ (b) $\frac{1}{4}$ (c) $\frac{1}{60}$ (d) $\frac{7}{10}$

09. There are two non-zero vectors $\vec{a}$ and $\vec{b}$ such that $\vec{a}.\vec{b} = 0$. Then the projection of $\vec{a}$ on $\vec{b}$ is

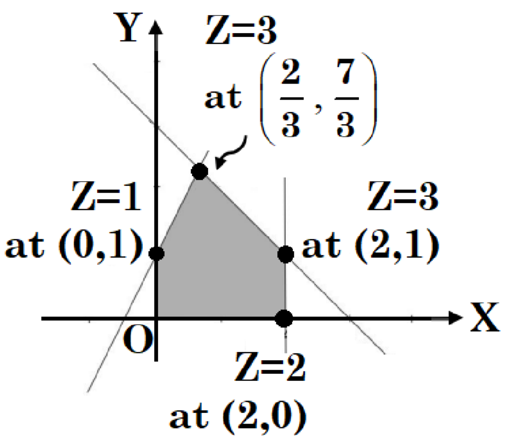
(a) 1 (b) 0 (c) 2 (d) can not be determined

10. Let $y = f(x)$ be a real function such that its first-order derivative is same as its second-order derivative. Then $f(x) =$

(a) x (b) 2^x (c) e^x (d) no such function exists

11. Shown below is the feasible region of a linear programming problem (L.P.P.) whose objective function is : Maximize $Z = x + y$.

A student Drishti claimed that there exists **no optimal solution** for the L.P.P. as there is no unique maximum value at the corner points of its feasible region. Based on her statement, choose most appropriate option.



(a) Her claim is correct, as there are two corner points of its feasible region at which maximum value of Z occurs.

(b) Her claim is false, as there are exactly two corner points i.e., $\left(\frac{2}{3}, \frac{7}{3}\right)$ and $(2, 1)$ at which the maximum value of Z occurs, which is 3.

(c) Her claim is false, as every point on the line joining $\left(\frac{2}{3}, \frac{7}{3}\right)$ and $(2, 1)$ gives the maximum value of Z, which is 3.

(d) Her claim is false, as the maximum value of Z occurs at (2, 0), which is 2.

12. If $f(x)$ is continuous for all real values of x, then $\int_{\frac{a}{4}}^{\frac{b}{4}} f(4x)dx$ equals

(a) $4\int_a^b f(x)dx$ (b) $\frac{1}{4}\int_{4a}^{4b} f(x)dx$ (c) $\frac{1}{4}\int_a^b f(x)dx$ (d) $4\int_{4a}^{4b} f(x)dx$

13. For the function $y=\sin^{-1}\{|x|-1\}$

(a) Domain $= x\in[-1, 1]$, Range $= y\in\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

(b) Domain $= x\in(-2, 2)$, Range $= y\in\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

(c) Domain $= x\in(-1, 1)$, Range $= y\in\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

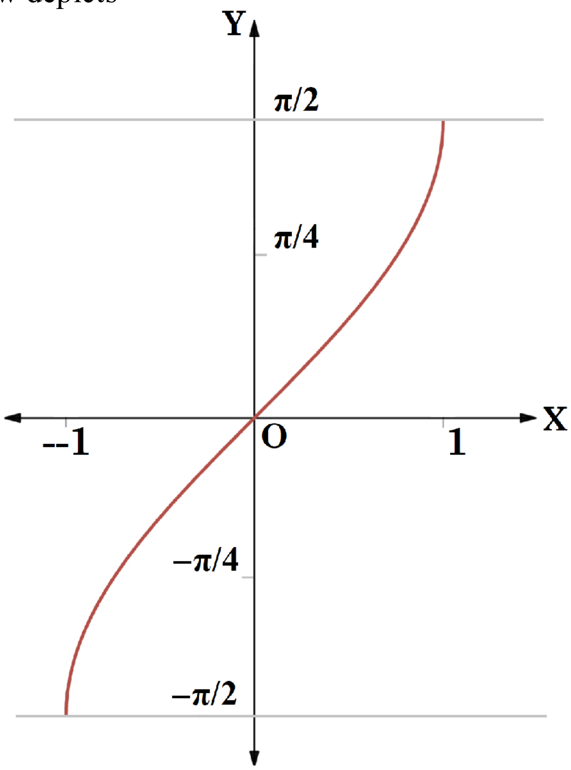
(d) Domain $= x\in[-2, 2]$, Range $= y\in\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

14. A differential equation has an order of 3 and a degree of 2. Which of the following could this differential equation be?

(a) $\frac{d^3y}{dx^3}-\left(\frac{d^2y}{dx^2}\right)^2=0$ (b) $\tan\left(\frac{d^2y}{dx^2}\right)+\left(\frac{d^3y}{dx^3}\right)^2=0$

(c) $\left(\frac{d^3y}{dx^3}\right)^2+\frac{d^2y}{dx^2}-\left(\frac{dy}{dx}\right)^3=0$ (d) $\left(\frac{d^3y}{dx^3}\right)^3+\left(\frac{dy}{dx}\right)^2=0$

15. The graph drawn below depicts



(a) $y=\cos^{-1}x$ (b) $y=\text{cosec}^{-1}x$ (c) $y=\sin^{-1}x$ (d) $y=\cot^{-1}x$

16. $f(x)=|\sin x|$ is non-differentiable at

(a) $x=n\pi,\ n\in Z$ (b) $x=(2n\pm1)\pi,\ n\in Z$

(c) $x=(2n\pm1)\frac{\pi}{2},\ n\in Z$ (d) $x=\mathbb{R}-\left\{(2n\pm1)\frac{\pi}{2}\right\},\ n\in Z$

17. If [.] denotes the greatest integer function, then $f(x)=[x]$ is discontinuous at

(a) infinite points, in $2<x<5$ (b) only two points, in $2<x<5$

(c) only three points, in $2 < x < 5$ (d) no point, in $2 < x < 5$

18. The area under the curve $x^2 = y$ between the line $x = 0$ and $x = k$ is 9 square units. Which of the following could be the correct value of k?

(a) $\frac{3}{2}$ (b) 9 (c) 3 (d) $\frac{9}{2}$

*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) :** All the points in the feasible region of an L.P.P. (linear programming problem) are optimal solutions to the problem.

Reason (R) : Every point in the feasible region satisfies all the constraints of an L.P.P. (linear programming problem).

20. **Assertion (A) :** If the angle between $\vec{p}$ and $\vec{q}$ is obtuse, then $\vec{p}.\vec{q} < 0$.

Reason (R) : Value of $\cos\theta$ lies in $(-1, 0)$, when $90^\circ < \theta < 180^\circ$.

SECTION B

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

21. If $4x + \frac{1}{x} = 4$, then find $\cos^{-1}x - \sin^{-1}2x$.

22. The total cost (in ₹) of manufacturing 'n' earphone sets per day in a Karnataka based start-up Maxier Electronics Limited is given by $C(n) = 0.0001n^2 + 4n + 400$. Find $C(n = 100)$.
Also, find the marginal cost of manufacturing 10000 earphone sets.

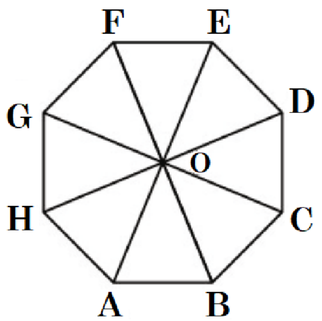
23. If $y = a\,x^{n+2} + \frac{b}{x^{n+1}}$, where $n \in N$ and $a, b \in \mathbb{R}$, then prove that $x^2\frac{d^2y}{dx^2} = (n+1)(n+2)\,y$.

OR

Differentiate the function $y = \cos^{-1}\left(\frac{1-3^{2x}}{1+3^{2x}}\right)$ with respect to x.

24. A bird is sitting on an electric wire (assuming that the wire has no slack). If the equation of wire is given by $\frac{x+1}{-3} = y - 2 = z$ and the position of bird is at a point P such that the distance between P and Q(–1, 2, 0) is $6\sqrt{11}$ units, then find the position of bird (coordinates of point P).

25. Shown below is a regular octagon ABCDEFGH, with centre O.



Show that $\overrightarrow{AE} + \overrightarrow{FB} + \overrightarrow{CG} + \overrightarrow{HD} = 2(\overrightarrow{AD} - \overrightarrow{BC})$.

OR

A parallelogram ABCD is constructed such that its adjacent sides, AB and AD, are $3\vec{a}-5\vec{b}$ and $\vec{a}-2\vec{b}$ respectively. If $|\vec{a}|=\sqrt{2}$, $|\vec{b}|=\sqrt{8}$ and the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{3}$, find the length of diagonal BD.

SECTION C

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

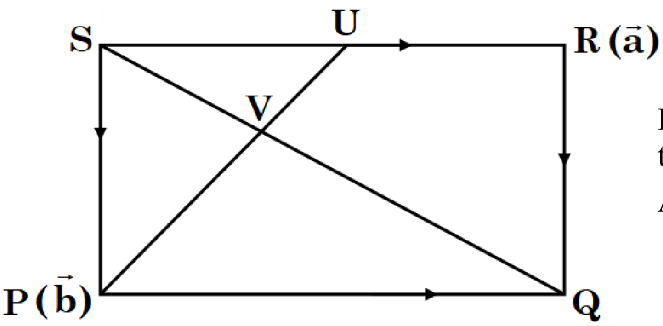
26. A cylindrical disk of radius R and height H is pressed by a hydraulic press. During the process, the radius and the height of the disk change such that the cylindrical shape is retained and the volume (V) of the disk remains constant. What is the ratio of the rate of change of height to the rate of change of radius in terms of R?

27. Sumathi bought a luxury car for ₹ y. The price $P(t)$ of the car depreciates as $\frac{d\,P(t)}{dt}=-a\,(T-t)$, after 't' years; where 'T' is the total life of the car (in years) and 'a' is an arbitrary constant. Find the value of the car when the car has been used for 'T' years, in terms of 'y'.

OR

The first derivative of a function y with respect to x is given by $-\frac{1}{x^2(1+x^2)}$. Find the function, if it is given that $y=\frac{\pi}{4}$, when $x=1$.

28. In the rectangle PQRS below, S is at the origin and the position vectors of the points R and P are $\vec{a}$ and $\vec{b}$ respectively.



Point U bisects SR. Use vectors to prove that V divides PU and QS in the same ratio. Also find the ratio in which V divides QS.

29. Evaluate : $\int\sqrt{\sqrt{x^2+4}+x}\;dx$.

OR

Evaluate : $\int e^x\left\{\frac{x^3+x+1}{(x^2+1)^{3/2}}\right\}dx$.

30. Consider the following Linear Programming Problem.

Maximize $Z=x+2y$

Subject to $2x+3y\geq 6$, $4x+y\geq 4$; $x,\ y\geq 0$.

Show graphically that the maximum value of Z will not occur.

31. A company conducts a mandatory health check-up for all the newly hired employees, to check for infections that could affect other employees. A blood infection affects roughly 5% of the population. The probability of a false positive report on the test for this infection is 4%, while the probability of a false negative report on the test is 3%. If a person tests positive for the infection, what is the probability that he is actually infected?

OR

There are four cards numbered 1 to 4, one number on one card. Two cards are drawn at random without replacement. Find the probability distribution of the sum of the numbers on the two cards drawn.

SECTION D

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

32. Draw the rough sketch of the curve $y = \sin 2x$; where $\frac{\pi}{12} \le x \le \frac{\pi}{6}$.

Using integration, find the area of the region bounded by the curve $y = \sin 2x$ from the ordinates $x = \frac{\pi}{12}$ to $x = \frac{\pi}{6}$ and the x-axis.

33. The curve $y = ax^2 + bx + c$; (where $a, b, c \in \mathbb{R}$ and $a \ne 0$) passes through the points $(-1, 0)$, $(2, 12)$ and $(3, 20)$. Use matrix method to determine the values of a, b and c by solving the system of linear equations in a, b and c. Find the equation of the curve. If $y = ax^2 + bx + c = 0$, then write the real roots of quadratic equation (if possible).

34. The vertices of a ΔABC are A(1, 1, 0), B(1, 2, 1) and C(–2, 2, –1). Find the equations of the medians through A and B. Use the equations so obtained to find the coordinates of the centroid.

OR

Find the Cartesian equation of a line L_2 which is the mirror image of the line L_1 with respect to line L : $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$, given that line L_1 passes through the point P(1, 6, 3) and parallel to line L.

35. Discuss the continuity of $f(x) = \begin{cases} x\, e^{-\left(\frac{1}{|x|} + \frac{1}{x}\right)}, & \text{if } x \ne 0 \\ 0, & \text{if } x = 0 \end{cases}$ at $x = 0$.

Is it differentiable at the same point? Justify your answer.

OR

If $\sqrt{1+x^2} + \sqrt{1+y^2} = a(x-y)$, then show that $\frac{dy}{dx} = \sqrt{\frac{1+y^2}{1+x^2}}$.

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** (i) and (ii) of **2 marks** each.*

36. **CASE STUDY I :**

Sumaiya cuts a metallic wire of length ‘a’ m into two pieces. She uses both pieces to create two squares of different side lengths.
Assume that the wire of length ‘x’ m is used to make the first square.
Based on the above information, answer the following questions.
(i) Express the side lengths of both squares in terms of ‘a’ and ‘x’ only.
(ii) Find an expression for the Combined area (A) of both squares in terms of ‘x’.
(iii) Determine the side lengths of both the squares (in terms of ‘a’) for which the Combined area (A) will be minimum. Use derivatives.

OR

(iii) Using derivatives, find the minimum value of Combined area (A) of both squares in terms of ‘a’.

37. CASE STUDY II :

Pratibha Vikas is an innovative program by the Government of Delhi, where cultural and literacy competitions are held between schools at cluster, block, district and state levels.

One of those competitions - Yogasana, is conducted under two categories : Middle school and High school. From South Delhi district, three students from middle school and two students from high school were selected for the state level.

Let $M=\{m_1, m_2, m_2\}$ and $H=\{h_1, h_2\}$, represent the set of students from middle school and high school respectively who got selected for the state level from that district.

A relation $R: M \to M$ is defined by $R=\{(x, y): \text{x and y are students from the same category}\}$.

On the basis of the above information, answer the following questions.

(i) Check if the relation R is reflexive. Justify your answer.

(ii) Check if the relation R is symmetric. Justify your answer.

(iii) Check if the relation R is transitive. Is R an equivalence relation? Justify your answer.

OR

(iii) Let a function $f: M \to H$ is defined as $f=\{(m_1, h_1), (m_2, h_2), (m_3, h_2)\}$. Check whether the function f is one-one and onto. Justify your answer.

38. CASE STUDY III :

A survey conducted among the consumers suggests that approximately 30% of all the products ordered online across various e-commerce websites are returned. Two products that are ordered online are selected at random. If X represents the number of products that are returned, then answer the following questions.

(i) Find the probability distribution of X.

(ii) Find the expectation of X.

PLEASURE TEST SERIES

For CBSE 2025 Board Exams - Class 12

MATHEMATICS (041)
PTS-21

a compilation by
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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 $A=\begin{bmatrix} x+3 & 8 \\ 3 & 2 \end{bmatrix}$ 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) $|adj.A|=|A|^2$ (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 $x\in R$.

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. Three numbers are selected at random (without replacement) from first six positive integers. If X denotes the smallest of the three numbers obtained, find the probability distribution of X. Also find the mean of the distribution.

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

OR

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

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.

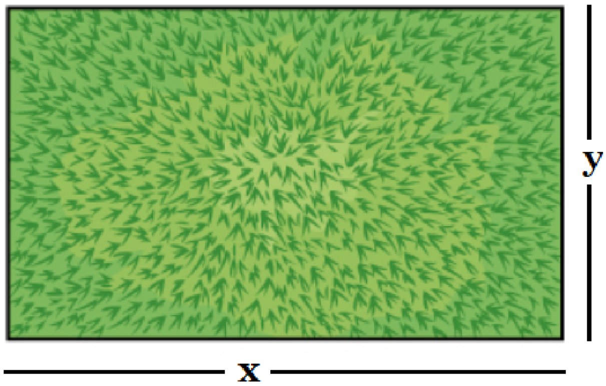
OR

Show that the maximum value of function, $f(x) = x + \dfrac{1}{x}$ 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 $2 \text{ cm}^3/\text{s}$.

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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PLEASURE TEST SERIES

For CBSE 2025 Board Exams - Class 12

MATHEMATICS (041)
PTS-22

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. The order of the matrix A such that $\begin{bmatrix} 2 & 0 \\ 1 & 0 \\ 3 & 4 \end{bmatrix} A = \begin{bmatrix} 1 & -8 \\ 1 & -2 \\ 9 & 2 \end{bmatrix}$, is

(a) 2×3 (b) 3×2 (c) 2×2 (d) 2×1

02. If A is a square matrix of order 3 such that $A(\text{adj}.A) = \begin{bmatrix} -2 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -2 \end{bmatrix}$ then, $|A| =$

(a) 8 (b) -2 (c) -8 (d) -3

03. Let $\vec{a} = \alpha\hat{i} + 3\hat{j} - 6\hat{k}$ and $\vec{b} = 2\hat{i} - \hat{j} - \beta\hat{k}$. If $\vec{a}$ and $\vec{b}$ are collinear vectors then, the value of $(\alpha+\beta)$ is

(a) -6 (b) -2 (c) -8 (d) 12

04. The greatest integer function defined by $f(x) = [x],\ 0 < x < 2$ is not differentiable at $x =$

(a) 0 (b) $\frac{1}{2}$ (c) 1 (d) $\frac{3}{4}$

05. $\int e^x \left(\log\sqrt{x} + \frac{1}{2x} \right) dx =$

(a) $e^x \times \log x + C$ (b) $e^x \times \log\sqrt{x} + C$ (c) $e^x \times \frac{1}{2x} + C$ (d) $\frac{e^x}{\log\sqrt{x}} + C$

06. The number of arbitrary constants in the particular solution of a differential equation of second order is (are)

(a) 0 (b) 1 (c) 2 (d) 3

07. The objective function of a linear programming problem, is

(a) a constant (b) a linear function to be optimized

(c) an inequality (d) a quadratic expression

08. The length of the perpendicular drawn from the point $(4, -7, 3)$ on the y-axis is

(a) 3 units (b) 4 units (c) 5 units (d) 7 units

09. $\int_1^e \frac{\log x}{x} dx$ is equal to

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

10. If $\begin{vmatrix} 2 & 3 & 2 \\ x & x & x \\ 4 & 9 & 1 \end{vmatrix} + 3 = 0$, then the value of x is

(a) 3 (b) 0 (c) 1 (d) −1

11. The corner points of the feasible region determined by the system of linear inequalities are $(0, 0), (4,0), (2,4)$ and $(0,5)$. If the maximum value of $z = ax + by$, where $a, b > 0$ occurs at both $(2,4)$ and $(4,0)$, then

(a) $a = 2b$ (b) $2a = b$ (c) $a = b$ (d) $3a = b$

12. The matrix $\begin{bmatrix} 2 & -1 & 3 \\ \lambda & 0 & 7 \\ -1 & 1 & 4 \end{bmatrix}$ is not invertible for

(a) $\lambda = -1$ (b) $\lambda = 0$ (c) $\lambda = 1$ (d) $\lambda \in R - \{1\}$

13. Let $A = [a_{ij}]$ be a 2×2 matrix whose elements are given by $a_{ij} = \left| (i)^2 - j \right|$. Then $a_{12} + a_{22} =$

(a) 3 (b) 2 (c) 1 (d) −1

14. Integration factor for differential equation $\left(\frac{e^{-2\sqrt{x}}}{\sqrt{x}} - \frac{y}{\sqrt{x}} \right) \frac{dx}{dy} = 1$, is

(a) $2\sqrt{x}$ (b) $e^{2\sqrt{x}}$ (c) $e^{\sqrt{x}}$ (d) $e^{-2\sqrt{x}}$

15. If A and B are two independent events with $P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{4}$, then $P(B' \mid A)$ is equal to

(a) $\frac{1}{4}$ (b) $\frac{1}{3}$ (c) $\frac{3}{4}$ (d) 1

16. The function $f(x) = \frac{x-1}{x(x^2-1)}$ is discontinuous at

(a) exactly one point (b) exactly two points
(c) exactly three points (d) no point

17. How many reflexive relations are possible in a set A, whose $n(A) = 3$?

(a) 2^3 (b) 2^4 (c) 2^5 (d) 2^6

18. A point P lies on the line segment joining the points $(-1, 3, 2)$ and $(5, 0, 6)$. If x-coordinate of P is 2, then its z-coordinate is

(a) −1 (b) 4 (c) $\frac{3}{2}$ (d) 8

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) :** Let $X = \{1, 2, 3\}$ and $S : X \to X$ such that $S = \{(1,1), (2,2), (3,3), (1,2)\}$. Then, the relation S is a reflexive relation on X.

Reason (R) : A relation S defined in a set X is called symmetric relation, if $(a,b) \in S$ implies $(b,a) \in S$ for all $a, b \in X$.

20. **Assertion (A) :** The position vectors of two points A and B are respectively $\overrightarrow{OA} = 2\hat{i} - \hat{j} - \hat{k}$ and $\overrightarrow{OB} = 2\hat{i} - \hat{j} + 2\hat{k}$. The position vector of a point P which divides the line segment joining A and B in the ratio $2:1$ is $\overrightarrow{OP} = 2\hat{i} - \hat{j} + \hat{k}$.

Reason (R) : For vectors $\vec{a}$ and $\vec{b}$, scalar product is defined as $\vec{a}.\vec{b}=|\vec{a}||\vec{b}|\sin\theta$, where θ is the angle between the vectors $\vec{a}$ and $\vec{b}$.

SECTION B

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

21. Find the value of $\sin^{-1}\left[\sin\left(-\frac{17\pi}{8}\right)\right]$.

OR

Find range of the function $f(x)=\tan^{-1}x+\frac{1}{2}\sin^{-1}x$.

22. The side of an equilateral triangle is increasing at the rate of 2 cm/s. At what rate is its area increasing when the side of the triangle is 20 cm?

23. Show that $|\vec{a}|\,\vec{b}+|\vec{b}|\,\vec{a}$ is perpendicular to $|\vec{a}|\,\vec{b}-|\vec{b}|\,\vec{a}$, for any two non-zero vectors $\vec{a}$ and $\vec{b}$.

OR

Find the vector and Cartesian equations of the line which passes through the point (3, 4, 5) and is parallel to the vector $2\hat{i}+2\hat{j}-3\hat{k}$.

24. If $y=e^{x}+e^{-x}$, then show that $\frac{dy}{dx}=\sqrt{y^2-4}$.

25. If $\vec{a}=2\hat{i}-\hat{j}+2\hat{k}$ and $\vec{b}=5\hat{i}-3\hat{j}-4\hat{k}$, then find the ratio $\frac{\text{Projection of vector } \vec{a} \text{ on vector } \vec{b}}{\text{Projection of vector } \vec{b} \text{ on vector } \vec{a}}$.

SECTION C

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

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

27. A card from a pack of 52 cards is lost. From the remaining cards of the pack, two cards are drawn randomly one-by-one without replacement and are found to be both kings. Find the probability of the lost card being a king.

OR

An urn contains 5 red, 2 white and 3 black balls. Three balls are drawn, one-by-one, at random without replacement. Find the probability distribution of the number of white balls. Also, find the mean of the number of white balls drawn.

28. Evaluate : $\int_{-1}^{5}\left(|x|+|x+1|+|x-5|\right)dx$.

OR

Find the value of $\int_{0}^{1}\tan^{-1}\left(\frac{1-2x}{1+x-x^2}\right)dx$.

29. Solve the differential equation : $(x^2-y^2)\,dx+2xy\,dy=0,\ x>0$.

OR

Find the particular solution of the differential equation

$\cos y\,dx+(1+e^{-x})\sin y\,dy=0$, given that $y=\frac{\pi}{4}$ when $x=0$.

30. Solve the following Linear Programming Problem graphically :
Maximize $Z=30x+20y$ subject to $1.5x+3y\le 42$, $3x+y\le 24$, $x\ge 0$, $y\ge 0$.

31. Find : $\int \frac{2x+1}{\sqrt{3+2x-x^2}}dx$.

SECTION D

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

32. If $A = \begin{bmatrix} 1 & 2 & -3 \\ 3 & 2 & -2 \\ 2 & -1 & 1 \end{bmatrix}$, then find A^{-1} and use it to solve the system of the linear equations given as : $x+2y-3z=6,\ 3x+2y-2z=3,\ 2x-y+z=2$.

OR

Evaluate the product AB, where $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$.

Hence solve the system of linear equations : $x-y=3$, $2x+3y+4z=17$, $y+2z=7$.

33. Find the shortest distance between the following lines and hence write whether the lines are intersecting or not.

$$\frac{x-1}{2}=\frac{y+1}{3}=z,\quad \frac{x+1}{5}=\frac{y-2}{1}, z=2.$$

OR

Show that the lines $\frac{x-2}{1}=\frac{y-2}{3}=\frac{z-3}{1}$ and $\frac{x-2}{1}=\frac{y-3}{4}=\frac{z-4}{2}$ intersect.

Also, find the coordinates of the point of intersection.

34. Find the points of local maxima and local minima, of the function $f(x)=\sin x-\cos x,\ 0<x<2\pi$. Also find the local maximum and local minimum values.

35. Find the area of the region bounded by the curves $x^2+y^2=4$, $y=\sqrt{3}x$ and x-axis in the first quadrant.

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.

ONE - NATION
ONE - ELECTION

FESTIVAL OF DEMOCRACY

GENERAL ELECTION - 2019

A general election of Lok Sabha is a gigantic exercise. About 911 million people were eligible to vote and voter turnout was about 67%, the highest ever.

Let I be the set of all citizens of India who were eligible to exercise their voting right in general election held in 2019. A relation 'R' is defined on I as follows.

$R=\{(V_1, V_2): V_1, V_2 \in I$ and both use their voting right in general election - 2019$\}$.

(i) Two friends X and $Y \in I$.
X and Y both exercised their voting right in the general election - 2019.
Then, state if $(X, Y) \in R$ is true or not. Give reason.

(ii) Mr. 'H' and his wife 'W' both exercised their voting right in general election - 2019.
Then, state if the following statement is true or not. Give reason.
"If $(H, W) \in R$ then, we may or may not have $(W, H) \in R$."

(iii) Check if R is reflexive or, symmetric. Give reasons to support your answer.

OR

(iii) Mr. Ghanshyam exercised his voting right in general election - 2019.
While his brother (having voting right), Mr. Radheshyam went to have fun at a nearby mall.
Can we have (Ghanshyam, Radheshyam) $\in R$? Give reason.
If Miss. Radhika (having voting right) goes with Mr. Radheshyam to the mall skipping the voting exercise, then is it correct to say (Radhika, Radheshyam) $\notin R$? Give reason.

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

Utkarsh was doing a survey on a school. Theme of the survey was 'the average number of hours spent on study' by students selected at random. At the end of survey, he prepared the following report related to the data.
Let X denotes the average number of hours spent on study by students. The probability that X can take the values x, has the following form, where k is some constant.

$$P(X=x)=\begin{cases} 0.2, & \text{if } x=0 \\ kx, & \text{if } x=1 \text{ or } 2 \\ k(6-x), & \text{if } x=3 \text{ or } 4 \\ 0, & \text{otherwise} \end{cases}.$$

(i) What is the value of k?
(ii) What is the probability that the average study time of students is not more than 1 hour?
(iii) What is the probability that the average study time to students is at least 3 hours?
What is the probability that the average study time of students is exactly 2 hours?

OR

(iii) What is the probability that the average study time of students is at least 1 hour?

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

A mobile company in a town has 500 subscribers on its list and collects fixed charges of ₹ 300/- per subscriber per year.

The company proposes to increase the annual subscription and it is believed that for every increase of ₹ 1/-, one subscriber will discontinue the service of this company.

(i) If the mobile company increases ₹ x/-, then obtain the function $R(x)$, which represents the earning of the company. Also, find $R'(x)$.

(ii) What increase will bring maximum earning for the company? Use second derivative test.

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PLEASURE TEST SERIES

For CBSE 2025 Board Exams - Class 12

MATHEMATICS (041)
PTS-23

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 $A=\begin{bmatrix}1 & 2 & -2\\ 0 & -1 & 3\end{bmatrix}$ satisfies $A+X=O$, then $X=$

(a) $\begin{bmatrix}1 & 2 & -2\\ 0 & -1 & 3\end{bmatrix}$ (b) $\begin{bmatrix}-1 & -2 & 2\\ 0 & 1 & -3\end{bmatrix}$ (c) $\begin{bmatrix}-1 & -2 & 2\\ 0 & 1 & 3\end{bmatrix}$ (d) $\begin{bmatrix}-1 & -2 & 2\\ 0 & -1 & 3\end{bmatrix}$

02. If A is a square matrix of order 3, $|A'|=2$, then $|A'A|=$

(a) 8 (b) 2 (c) 4 (d) 16

03. If ΔABC be a right angled triangle such that $\angle B=\frac{\pi}{2}$ then, which of the following is true?

(a) $|\overrightarrow{AB}|=|\overrightarrow{BC}|+|\overrightarrow{CA}|$ (b) $|\overrightarrow{AB}|^2=|\overrightarrow{BC}|^2+|\overrightarrow{CA}|^2$

(c) $\overrightarrow{AC}.\overrightarrow{AB}=0$ (d) $\overrightarrow{BC}.\overrightarrow{BA}=0$

04. The value of '8k' for which the function $f(x)=\begin{cases}\frac{1-\cos 2x}{8x^2}, \text{ if } x\neq 0\\ 2k, \text{ if } x=0\end{cases}$ is continuous at $x=0$, is

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

05. If $f'(x)=1-\frac{1}{x}$ and $f(1)=0$, then $f(x)=$

(a) $x-\log|x|+1$ (b) $x+\log|x|-1$ (c) $x-\log|x|-1$ (d) $x+\log|x|+1$

06. Integration factor for $\frac{dx}{dy}-x=\sin^2 y$ is

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

07. The solution set of the inequality $3x+5y\geq 4$ is

(a) an open half-plane not containing the origin
(b) an open half-plane containing the origin
(c) the whole XY-plane not containing the line $3x+5y=4$
(d) a closed half-plane containing the origin

08. If $\hat{a}$ and $\hat{b}$ are unit vectors, and θ is the angle between then, $|\hat{a}-\hat{b}|=$

(a) $2\cos\left(\frac{\theta}{2}\right)$ (b) $\cos\left(\frac{\theta}{2}\right)$ (c) $\sin\left(\frac{\theta}{2}\right)$ (d) $2\sin\left(\frac{\theta}{2}\right)$

09. The value of $\int_0^{\pi}|\cos x|dx$ is

(a) 0 (b) 2 (c) 1 (d) -2

10. If A and B are square matrices of the same order, then $(AB')' =$

(a) BA^{-1} (b) $A'B'$ (c) $B'A'$ (d) BA'

11. For the following LPP,

Maximum $Z = 3x + 4y$

Subject to constraints $x - y \geq 1$, $x \leq 3$, $x \geq 0$, $y \geq 0$.

The maximum value is

(a) 17 (b) 18 (c) 3 (d) 9

12. If $\begin{vmatrix} 2x & 2 \\ 1 & x \end{vmatrix} = \begin{vmatrix} 1 & 4 \\ 0 & 2 \end{vmatrix}$, then the possible value (s) of 'x' is/are

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

13. If $A = \left[a_{ij}\right]_{3\times3}$ and $|A| = 4$, then $|4A| =$

(a) 4^8 (b) 4^4 (c) 2^4 (d) 2^6

14. If $2P(A) = P(B) = \dfrac{5}{13}$ and A and B are independent events, then $P(A \cap B) =$

(a) $\dfrac{1}{26}$ (b) $\dfrac{5}{26}$ (c) $\dfrac{11}{13}$ (d) $\dfrac{25}{338}$

15. The general solution of the differential equation $\sqrt{1-y^2}\,dx - \sqrt{1-x^2}\,dy = 0$ is

(a) $\sin^{-1}x^2 - \sin^{-1}y^2 = C$ (b) $\tan^{-1}x - \tan^{-1}y = C$

(c) $\sin^{-1}x - \sin^{-1}y = C$ (d) $\sin^{-1}\sqrt{1-x^2} - \sin^{-1}\sqrt{1-y^2} = C$

16. If $y = \cos^{-1}x$ implies that $(1-x^2)y_2 + kxy_1 = 0$, then k is equal to

(a) 1 (b) -1 (c) 2 (d) any Real no.

17. Which of the following represents one of the vector components of vector $2\hat{i} - \hat{j} + 7\hat{k}$?

(a) 2 (b) -1 (c) 7 (d) $-\hat{j}$

18. For $\vec{r} = 2\hat{i} - \hat{j} + 7\hat{k} + \lambda(\sqrt{2}\hat{i} - \hat{j} + \hat{k})$, the direction angles are

(a) $\dfrac{\pi}{4}, \dfrac{\pi}{3}, \dfrac{\pi}{3}$ (b) $\dfrac{\pi}{4}, \dfrac{2\pi}{3}, \dfrac{\pi}{3}$ (c) $\dfrac{3\pi}{4}, \dfrac{2\pi}{3}, \dfrac{\pi}{6}$ (d) $\dfrac{3\pi}{4}, \dfrac{\pi}{3}, \dfrac{2\pi}{3}$

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) :** Principal value of $\sec^{-1}\left(\sec\dfrac{4\pi}{3}\right) = \dfrac{2\pi}{3}$.

Reason (R) : For $y = \operatorname{cosec}^{-1}x$, $-\pi \leq y \leq \pi$.

20. **Assertion (A) :** A unit vector in the direction of $\hat{i} - 2\hat{j} + 2\hat{k}$ is $\dfrac{\hat{i} - 2\hat{j} + 2\hat{k}}{3}$.

Reason (R) : For the vector $\vec{r} = x_1\hat{i} + y_1\hat{j} + z_1\hat{k}$, the unit vector in the direction of $\vec{r}$ is given by $\dfrac{x_1\hat{i} + y_1\hat{j} + z_1\hat{k}}{\sqrt{x_1^2 + y_1^2 + z_1^2}}$.

SECTION B

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

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

OR

Consider $f:\mathbb{R}\to\mathbb{R}$, given by $f(x)=4x+3$. Show that f is one-one and onto both.

22. The surface area (A) of a cube is increasing at the rate of $3.6\ cm^2/s$. How fast is the volume (V) increasing, when the edge length of cube is $a=10$ cm ?

23. If the sum of two unit vectors $\hat{a}$ and $\hat{b}$ is also a unit vector, then show that the magnitude of their difference is $\sqrt{3}$.

OR

Write the direction ratios of the line $\frac{x+3}{2}=\frac{5-y}{3}, z=-2$.

Hence, find the vector equation of above line.

24. If $\sin^2 y+\cos(xy)=\pi$, then find $\frac{dy}{dx}$.

25. Find the direction cosines of $\overrightarrow{AB}$, if it is given that $A(\hat{j}-2\hat{k})$ and $B(\hat{i}+3\hat{j}+\hat{k})$.

SECTION C

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

26. Find : $\int\sqrt{\frac{1-x}{1+x}}dx$.

OR

Find : $\int\frac{\cos x\ dx}{\sqrt{\sin^2 x-2\sin x-3}}$.

27. In a game, a man wins a rupee for a six and looses a rupee for any other number when a fair die is thrown. The man decided to throw a die thrice but to quit as and when he gets a six. Find the expected value of the amount he will lose or win.

OR

A card is lost from a pack of 52 playing cards. Two cards are drawn from the remaining cards. What is the probability that they both are diamonds?

28. Evaluate : $\int_{-5}^{5}\frac{x^2\ dx}{1+2^x}$.

29. Solve the differential equation : $e^x\,dy+(y\,e^x+2x)\,dx=0$.

OR

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

30. Solve the following Linear Programming Problem graphically.

Maximize $Z=10500x+9000y$ subject to $x+y\le 50,\ 2x+y\le 80,\ x\ge 0,\ y\ge 0$.

Mention the point at which maximum value of Z is obtained.

31. Find : $\int\frac{\sqrt{\cos 2x}}{\cos x}dx$.

SECTION D

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

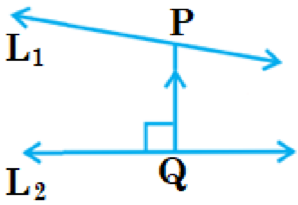
32. Find the area of the region bounded by the curve $y = x^2$ and the line $y = 4$.

33. Let N be the set of all natural numbers and R be a relation on $N \times N$ defined by $(a, b) R (c, d) \Leftrightarrow ad = bc$ for all $(a, b), (c, d) \in N \times N$.
Show that R is an equivalence relation on $N \times N$.

OR

Show that $f : [-1, 1] \to \mathbb{R}$, given by $f(x) = \dfrac{x}{x+2}$ is one-one.
Is the function, $f : [-1, 1] \to \mathbb{R}$ an onto function?

34. Given two lines, $L_1 : \vec{r} = \hat{i} + 2\hat{j} + \hat{k} + \lambda(\hat{i} - \hat{j} + \hat{k})$ and $L_2 : \vec{r} = 2\hat{i} - \hat{j} - \hat{k} + \mu(2\hat{i} + \hat{j} + 2\hat{k})$.



Write the equation of line PQ, as seen in the diagram above, if it is given that the line PQ is perpendicular to both the lines L_1 and L_2.

OR

Let ABCD is a parallelogram. The position vectors of the points A, B and C are respectively given as $4\hat{i} + 5\hat{j} - 10\hat{k}$, $2\hat{i} - 3\hat{j} + 4\hat{k}$ and $2\hat{j} - \hat{i} - \hat{k}$. Find the vector equation of the diagonal BD.

35. If $A = \begin{pmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{pmatrix}$, find adj.A and verify that $A(\text{adj.}A) = (\text{adj.}A)A = |A| I_3$.

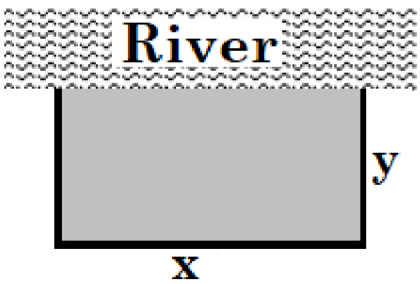
SECTION E

*(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.

A farmer Ram Kishan wishes to fence off his rectangular field of given area ($A = 100$ units^2).

The length of the field lies along a straight river.



(i) Assuming that along the river, no fencing is needed for the field, what should be the length (L) of fencing around the field, in terms of x and y? Here x and y denote the length and breadth of the field, respectively (see the diagram given above).

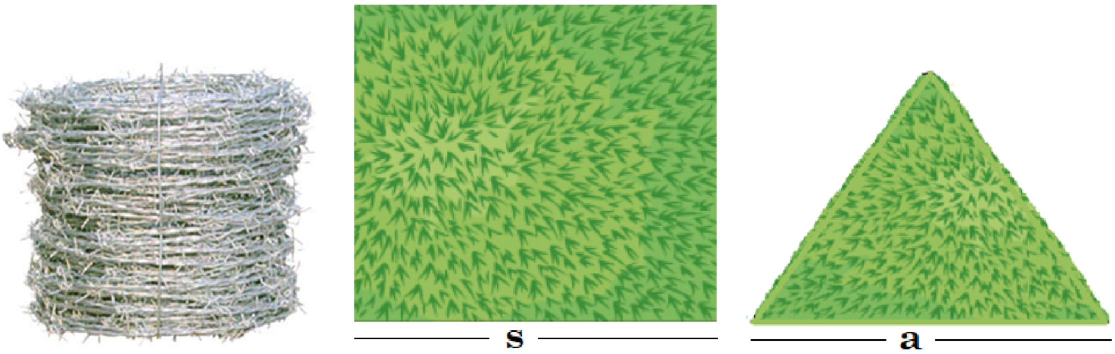
(ii) Find the length of fencing (L) in terms of x alone.

(iii) For what value of x, the length of fencing (L) will be least? Use derivatives.

OR

(iii) What is the value of y, if the length of fencing (L) is least?
Also write the minimum value of L.

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



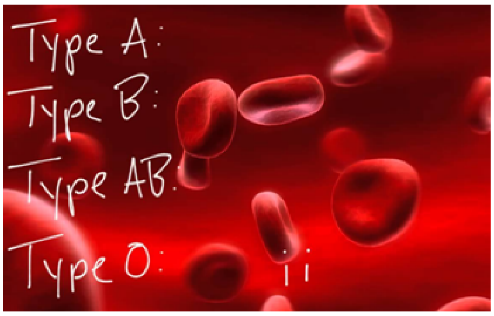
A farmer Nikhil Jha has two small pieces of agricultural land - one is in the shape of square and, the other is in the shape of an equilateral triangle.
To save his crops from stray animals, he decides to fence his fields.
For this purpose, he has a wire of length 40 m. This wire has to be cut into two pieces to fence around the fields.
The first piece of wire of length x m, is used for fencing around the triangular field and the other piece is used for the square field.

(i) Obtain the area of triangular field in terms of x.
(ii) Obtain the area of square field in terms of x.
(iii) For what value of x, the combined area (A) of triangular and square field is minimum? What is the length of wire used for fencing the square field? Use derivatives.

OR

(iii) Using second derivatives, write the minimum value of combined area (A) of triangular and square field.

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



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

(i) What is the probability that the person selected is a left handed person? Write your answer in percentage.
(ii) If a left handed person is selected at random, what is the probability that he/she will have blood group O?

PLEASURE TEST SERIES

For CBSE 2025 Board Exams - Class 12

MATHEMATICS (041)
PTS-24

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 is a symmetric matrix of order 3, then which of the following is not symmetric matrix?

(a) $A+A^T$ (b) $A.A^T$ (c) $A-A^T$ (d) $\frac{1}{2}(A+A^T)$

02. Let $P=ACB$. If $A=\begin{pmatrix}2 & 3\\ 3 & 2\end{pmatrix}$, $B=\begin{pmatrix}2\\ 1\\ 5\end{pmatrix}$ and $C=\begin{pmatrix}0 & 0 & 4\\ 5 & 1 & -1\end{pmatrix}$, then the order of matrix P is

(a) 1×2 (b) 2×3 (c) 2×2 (d) 2×1

03. If $\vec{a}=\hat{i}+\hat{j}-2\hat{k}$ and, $\vec{b}=-\hat{i}+2\hat{j}+2\hat{k}$ are two vectors, then $\vec{a}+\vec{b}$ equals

(a) -1 (b) $2\hat{i}-\hat{j}-4\hat{k}$ (c) $3\hat{j}$ (d) $-2\hat{i}+\hat{j}+4\hat{k}$

04. The value of 'k' for which the function $f(x)=\begin{cases}\frac{1-\sqrt{x}}{x-1}, & \text{if } x\neq 1\\ k, & \text{if } x=1\end{cases}$ is continuous at $x=1$, is

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

05. $\int\frac{\sec^2 x}{\tan x-1}dx$ equals

(a) $\frac{(\tan x-1)^2}{2}+C$ (b) $-\frac{1}{\tan x-1}+C$ (c) $\log|\tan x-1|+C$ (d) $\frac{1}{\tan x-1}+C$

06. The solution of D.E. $\frac{dy}{dx}=\frac{y}{x^2}$, $y>0$ is

(a) $y=k\,e^{-\frac{1}{x}}$ (b) $y=k\,e^{\frac{1}{x}}$ (c) $y=k\,e^{-x}$ (d) $y=k\,e^{x}$

07. The maximum value of $Z=4x+3y$ subject to constraint $x+y\leq 8;\ x,y\geq 0$ is

(a) 56 (b) 32 (c) 65 (d) 24

08. The scalar projection of the vector $3\hat{i}-x\hat{k}$ on the vector $\hat{i}+\sqrt{2}\hat{j}+\hat{k}$ is $\frac{1}{2}$, then $x=$

(a) 0 (b) 1 (c) 2 (d) -2

09. The shortest distance between the lines $\vec{r}=\vec{a}_1+\lambda\vec{b}$ and $\vec{r}=\vec{a}_2+\mu\vec{b}$ is given by

(a) $\left|\frac{\vec{b}\times(\vec{a}_2-\vec{a}_1)}{\vec{b}}\right|$ (b) $\frac{|\vec{b}\times(\vec{a}_2-\vec{a}_1)|}{|\vec{a}_2-\vec{a}_1|}$ (c) $\frac{|\vec{b}.(\vec{a}_2-\vec{a}_1)|}{|\vec{b}|}$ (d) $\frac{|\vec{b}\times(\vec{a}_2-\vec{a}_1)|}{|\vec{b}|}$

10. If $\Delta = \begin{vmatrix} 1 & 3 & -2 \\ 4 & -5 & 6 \\ 3 & 5 & 2 \end{vmatrix}$, then the cofactor of a_{32} (the element of third row and second column) is

(a) 14 (b) –14 (c) 3 (d) 2

11. If a linear programming problem has same optimal value at two points, then it has

(a) infinite solutions (b) two solutions (c) unique solution (d) three solutions

12. If a non-singular matrix A satisfying $2A^2 + A - I = O$ then, $A^{-1} =$

(a) $A + 2I$ (b) $-2A - I$ (c) $I + 2A$ (d) $2A - I$

13. If A is square matrix of order 3×3 such that $|adj.A| = 16$, such that $|2A|^2 = 2^x$, then $x =$

(a) 1 (b) 2 (c) 8 (d) 10

14. Which of the following may represent priori probability of the hypothesis E_i, when Bayes' theorem is applied?

(a) $P(A)$ (b) $P(E_i)$ (c) $P(E_i \mid A)$ (d) $P(\bar{A})$

15. The general solution of the differential equation $\frac{dy}{dx} = \frac{x}{y}$ is

(a) $y^2 = x^2 + C$ (b) $x - y = C$ (c) $xy = C$ (d) $x - y^2 = C$

16. If $y^{\frac{1}{x}} = a$, $(a > 0)$, then $\frac{dy}{dx} =$

(a) y (b) ay (c) a^x (d) $y(\log_e a)$

17. Let $A = \{m, a, t, h\}$. If a relation R in the set A is given by $R = \{(m, m), (a, t), (t, a), (h, t), (t, h)\}$, then R is

(a) only reflexive (b) only symmetric (c) only transitive (d) equivalence

18. Vector equation of line passing through (1, 0, –2) and parallel to y-axis, is

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

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) :** Unit vector along $\hat{i} + 2\hat{j} - \hat{k}$ is $\pm\left(\frac{\hat{i} + 2\hat{j} - \hat{k}}{\sqrt{6}}\right)$.

Reason (R) : For two non-zero vectors $\vec{a}$ and $\vec{b}$, $\vec{a}.\vec{b} = 0$ implies $\vec{a} \perp \vec{b}$.

20. **Assertion (A) :** $\int_{-\pi}^{\pi} (x + \sin x)\,dx = 0$.

Reason (R) : $\int_{-a}^{a} f(x)\,dx = \begin{cases} 2\int_{0}^{a} f(x)\,dx, \text{ if } f(-x) = f(x) \\ 0, \text{ if } f(-x) = -f(x) \end{cases}$.

SECTION B

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

21. A relation R in the set of real numbers $\mathbb{R}$ is given by $R = \{(a, b) : a > b, \text{ such that } a, b \in \mathbb{R}\}$.

Check the transitivity of relation R. Is it symmetric?

OR

Find the value of $\text{cosec}^{-1}\left[\text{cosec}\left(\frac{3\pi}{5}\right)\right]$.

22. Find the interval in which $f(x)=\cos 3x,\ x\in\left[0,\frac{\pi}{2}\right]$ is increasing and/or decreasing.

23. Write the unit vectors which are perpendicular to both the vectors $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}+\hat{j}$.

OR

The equations of two perpendicular lines are $x=ay+b,\ z=cy+d$ and $x=ty+u$, $z=vy+w$. Write the value of $(a\,t+c\,v)$.

24. If $\cos y=x\cos(a+y)$ then, prove that $\frac{dy}{dx}=\frac{\cos^2(a+y)}{\sin a}$.

25. If $|\vec{a}|=4$ and $-3\le\lambda\le 2$, then find the range of $|\lambda\,\vec{a}|$.

SECTION C

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

26. Find : $\int\frac{\cos x}{\cos 3x}dx$.

27. Two integers are selected at random from the integers one to eleven. If their sum is even, find the probability that both the numbers are odd.

OR

A bag contains 5 red and 4 black balls, a second bag contains 3 red and 6 black balls. One of the two bags is selected at random and two balls are drawn at random (without replacement). What is the probability that both the balls drawn are red?

28. Evaluate : $\int_{-\pi}^{\pi}\frac{\cos^2 x}{1+e^x}dx$.

OR

Evaluate : $\int_{0}^{3/2}|x\cos(\pi x)|dx$.

29. Solve the differential equation : $(1+e^{x/y})dx+e^{x/y}\left(1-\frac{x}{y}\right)dy=0$.

OR

Solve the differential equation : $ydx-(x+2y^2)dy=0$.

30. Solve the following Linear Programming Problem graphically :
Minimize $Z=5x+8y$ subject to constraints $x+y\le 5, x\le 4, y\ge 2, x\ge 0,\ y\ge 0$.
Also, write the coordinate of point at which Z_{min} is obtained.

31. Find : $\int\frac{e^x\,dx}{e^{2x}+4e^x+3}$.

SECTION D

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

32. Find the area enclosed by the parabola $4y=3x^2$ and the line $2y=3x+12$.

33. Find the value of 'λ' for which the following lines are perpendicular to each other :

$$\frac{x-5}{5\lambda+2}=\frac{2-y}{5}=\frac{1-z}{-1};\ \frac{x}{1}=\frac{y+\frac{1}{2}}{2\lambda}=\frac{z-1}{3}.$$

Hence, find whether the lines intersect or not (use the concept of shortest distance).

OR

Find the foot of perpendicular drawn from the point (2, 3,–8) to the line $\frac{4-x}{2}=\frac{y}{6}=\frac{1-z}{3}$.

Also, find the perpendicular distance from the given point to the line.

34. Determine whether the relation R defined on the set R of all real numbers as $R=\{(a,b): a,b\in R \text{ and } a-b+\sqrt{3}\in S$, where S is the set of all irrational numbers$\}$, is reflexive, symmetric and transitive.

OR

Consider $f:\mathbb{R}-\left\{-\frac{4}{3}\right\}\to\mathbb{R}-\left\{\frac{4}{3}\right\}$ given by $f(x)=\frac{4x+3}{3x+4}$.

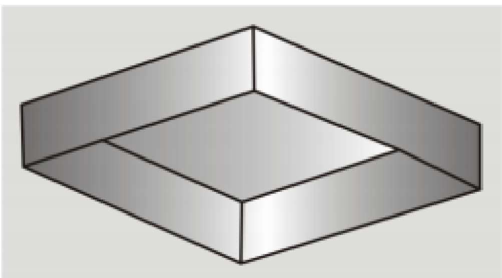
Show that f is one-one and onto.

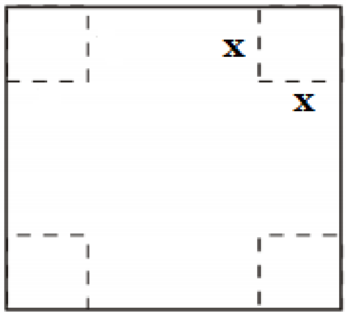
35. Using matrices, solve the system of equations : $3x+4y+5z=18$, $2x-y+8z=13$, and $5x-2y+7z=20$.

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 factory 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 is the side-length of each square cut from the corners.

(i) Write the volume (V) of the open box as a function of x, where 'x' is the side-length of each square to be cut-off from the corners.

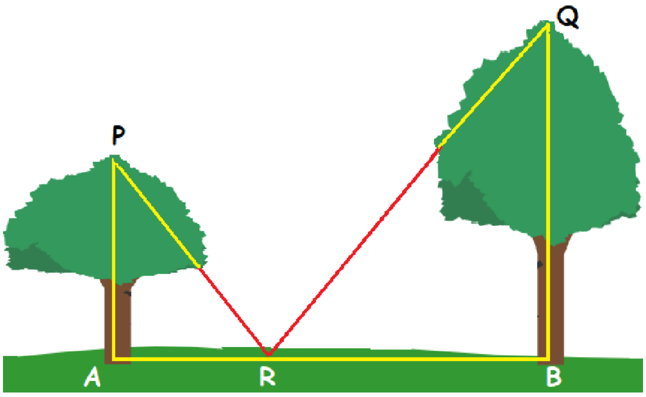
(ii) Write the conditions on $\frac{dV}{dx}$ and $\frac{d^2V}{dx^2}$, so that the volume (V) is maximum.

(iii) Find the maximum volume (V) of the open box. Also find the total area of the removed squares.

OR

(iii) What should be the side of square to be cut off so that the volume (V) is maximum?

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



Reeta goes for walk in a Community Park daily.
She notices two trees in a line (as seen in the figure above), whose heights are $AP = 16$ m and $BQ = 22$ m respectively, are 20 m apart from each other.

(i) Reeta stands at a point (*say*, R) in between these trees such that $AR = x$ m.
Obtain an expression for $RP^2 + RQ^2$, in terms of x.

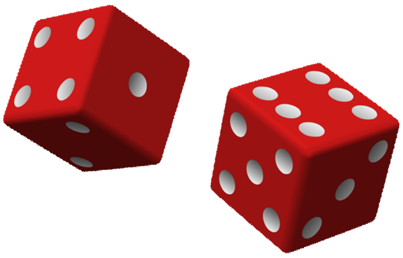
(ii) Let $f(x) = RP^2 + RQ^2$. Then, find $f'(x)$.

(iii) Is the function $f(x)$ differentiable in $x \in (0, 20)$? Find the intervals in which, $f(x)$ is strictly increasing / decreasing.

OR

(iii) At what value of x, $f'(x) = 0$? Can we say that $f(x)$ is minimum?
Also write the minimum value of $f(x)$. Use second derivative test.

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



Raghunath and Haridas are playing a game using a biased die.
This biased die is tossed and respective probabilities for various faces to turn up are listed in the following table :

Face	1	2	3	4	5	6
Probability	0.1	0.24	0.19	0.18	0.15	K

(i) What is the value of K?

(ii) If a face showing an even number has turned up, then what is the probability that it is the face with '4' or '6'?

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) $\operatorname{cosec} x-\sec x+C$ (b) $\sec x+\operatorname{cosec} x+C$

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

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 $x-y\ge 0,\ y\ge 1,\ 0\le x\le 2$. 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 $\tan^{-1}\left(\tan\dfrac{4\pi}{3}\right)=\dfrac{\pi}{3}$.

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

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 $\dfrac{\pi}{3}$.

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 $\cos\theta=\dfrac{|a_1a_2+b_1b_2+c_1c_2|}{\sqrt{a_1^2+b_1^2+c_1^2}\sqrt{a_2^2+b_2^2+c_2^2}}$.

SECTION B

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

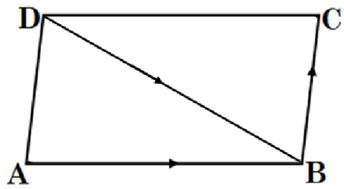
21. Simplify : $\cot^{-1}\dfrac{1}{\sqrt{x^2-1}}$, $x<-1$.

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, $\vec{r}=2\hat{i}+\hat{j}+\hat{k}+\mu(\hat{j})$.

24. Find $\dfrac{dy}{dx}$, at $t=\dfrac{2\pi}{3}$ 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 : $x+2y\ge 10$, $x+y\ge 6$, $3x+y\ge 8$, $x\ge 0$, $y\ge 0$.

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 $aRb \Leftrightarrow |a-b| \le \frac{1}{2}$, then show that R is not an equivalence relation.

OR

Show that the relation R defined on set $A = \{x \in Z : 0 \le x \le 12\}$, 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 $2\text{ cm}^2/\text{s}$ 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.

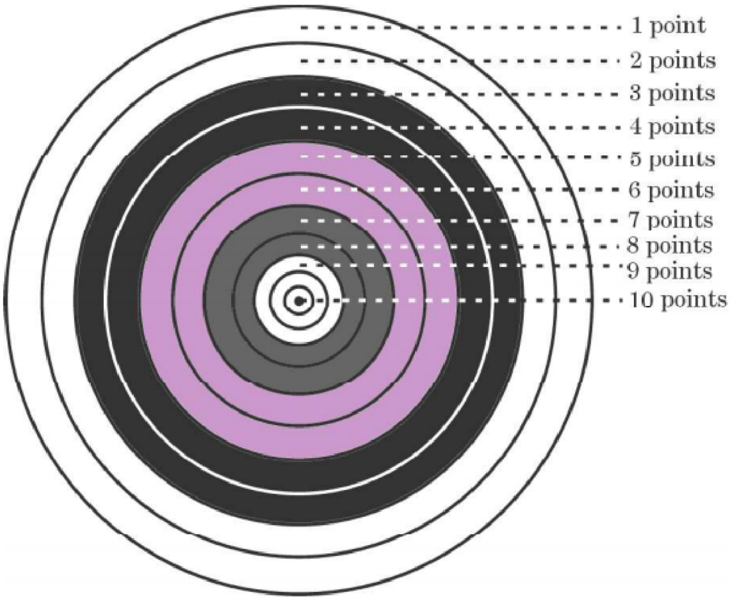
A professional typist Miss Radha charges ₹145/- for typing 10 English and 3 Hindi pages, while she charges ₹180/- for typing 3 English and 10 Hindi pages.

(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.

PLEASURE TEST SERIES

For CBSE 2025 Board Exams - Class 12

MATHEMATICS (041) PTS-26

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. Given that A is a square matrix of order 3 and $|adj.A| = 49$, then $|A^{-1}|$ is equal to

(a) ± 7 (b) $\pm\frac{1}{49}$ (c) $\pm\frac{1}{7}$ (d) -7 only

02. For $A = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$, $A + A^T$ equals

(a) $2\begin{bmatrix} \cos\theta & 0 \\ 0 & \cos\theta \end{bmatrix}$ (b) $\begin{bmatrix} \cos 2\theta & 0 \\ 0 & \cos 2\theta \end{bmatrix}$ (c) $\begin{bmatrix} \cos\theta & 0 \\ 0 & \cos\theta \end{bmatrix}$ (d) $2\begin{bmatrix} 0 & \cos\theta \\ \cos\theta & 0 \end{bmatrix}$

03. If $\vec{a}$ and $\vec{b}$ are parallel vectors, then which of the following is true?

(a) $\vec{a}.\vec{b} = 0$ (b) $\vec{a} = \lambda\vec{b}$ (c) $\vec{a}.\vec{b} = \vec{0}$ (d) $\vec{a}\times\vec{b} = 0$

04. Let $\tan^{-1}: R \to \left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$. Then $\tan^{-1}(-1) =$

(a) $-\frac{\pi}{4}$ (b) $\frac{3\pi}{4}$ (c) $\frac{5\pi}{4}$ (d) $\frac{7\pi}{4}$

05. Let $A = \{i, s, h, a\}$. If $R: A \to A$ is given by $R = \{(i,i),(s,s),(a,a),(a,h)\}$ then, which of the following ordered pair must be added to make R a reflexive relation?

(a) (h,a) (b) (s,h) (c) (h,h) (d) (h,i)

06. If m and n respectively, are the order and degree of the differential equation

$x\left(\frac{dy}{dx}\right)^2 - \frac{d^2y}{dx^2} = 0$, then $(mn) =$

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

07. The feasible region, for the inequalities $x \geq 0,\ x + y \leq 1$ and, $y \geq 0$, lies in

(a) IV Quadrant (b) III Quadrant (c) II Quadrant (d) I Quadrant

08. What is the number of vectors of unit length perpendicular to both the vectors $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$?

(a) 0 (b) 1
(c) 2 (d) infinitely many unit vectors are possible

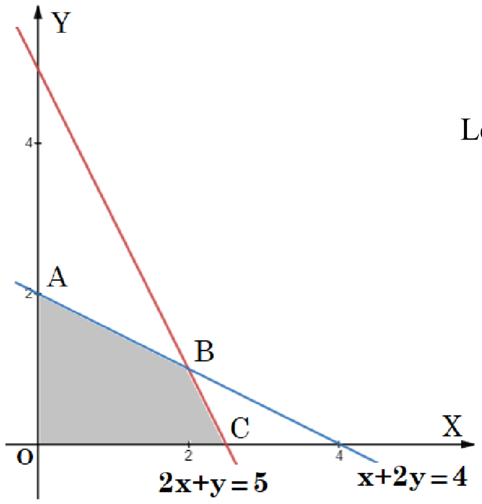
09. If $f(x)$ is an odd function then, the value of $\int_{-a}^{a} f(x)dx =$

(a) $2\int_0^a f(x)dx$ (b) $\int_0^a f(x)dx$ (c) $2\int_0^{a/2} f(x)dx$ (d) 0

10. Minor of the element 9 in $\Delta = \begin{vmatrix} 2 & 4 & 9 \\ 3 & 6 & -9 \\ -2 & -3 & 1 \end{vmatrix}$ is

(a) 0 (b) –3 (c) 3 (d) 1

11. The feasible region in a LPP is as shown in the graph below.
The corner points are denoted by A, B, C and O.



Let $Z = 2x + 5y$ then, the value of $Z_{max} - Z_{min}$ equals

(a) 0 (b) 4
(c) 10 (d) 1

12. If $0 < x < \frac{\pi}{2}$, and $\begin{vmatrix} 2\sin x & -1 \\ 1 & \sin x \end{vmatrix} = \begin{vmatrix} 3 & 0 \\ -4 & \sin x \end{vmatrix}$, then the values of x is

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{6}, \frac{\pi}{2}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{4}$

13. Given that the matrices A and B of order $3 \times m$ and $3 \times n$ respectively, are such that AB and BA both exist, then order of A is

(a) 3×4 (b) 4×3 (c) 3×3 (d) cannot be determined

14. The probability distribution of a random variable X, where k is a constant, is given below :

$$P(X = x) = \begin{cases} 0.1, \text{ if } x = 0 \\ kx^2, \text{ if } x = 1 \\ kx, \text{ if } x = 2 \text{ or } 3 \\ 0, \text{ otherwise} \end{cases}.$$

Then, $P(X \le 2)$ equals

(a) 0.15 (b) 0.55 (c) 0.25 (d) 0.45

15. Integration factor of the differential equation $\left(\frac{dy}{dx}\right) - \frac{y}{x} = x^2$ is denoted by $f(x)$. Then $f'(x) =$

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

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

(a) x^e (b) $e.\, x^{e-1}$ (c) $e.x^e$ (d) $x^e \times \log x$

17. The direction angle made by the line $\frac{x-1}{1} = \frac{y+1}{\sqrt{2}} = \frac{z-2}{-1}$ with positive direction of x-axis, is

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{6}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}, \frac{5\pi}{6}$

18. If $|\vec{a}| = 2, |\vec{b}| = 2\sqrt{3}$ and $\vec{a} \perp \vec{b}$, then the value of $|\vec{a}+\vec{b}|$ is

(a) 16 (b) ±4 (c) 4 (d) ±16

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) :** There is no value of 'b' for which the function $f(x) = x + \cos x + b$ is strictly decreasing over $\mathbb{R}$ (set of real numbers).

Reason (R) : If $f'(x) \geq 0$ in $x \in [a, b]$ then, $f(x)$ is an increasing function in $x \in [a, b]$.

20. **Assertion (A) :** $\hat{i} + \hat{j} + 2\hat{k}$ is a vector parallel to the line $\vec{r} = \hat{i} - \hat{j} + \hat{k} + \lambda(\hat{i} + \hat{j} + 2\hat{k})$.

Reason (R) : In the vector form of line $\vec{r} = x_1\hat{i} + y_1\hat{j} + z_1\hat{k} + \lambda(a_1\hat{i} + b_1\hat{j} + c_1\hat{k})$, a vector parallel to the line is $a_1\hat{i} + b_1\hat{j} + c_1\hat{k}$.

SECTION B

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

21. Using principal values, evaluate $\sin^{-1}\left(\sin\frac{2\pi}{3}\right) + \cos^{-1}\left(\cos\frac{2\pi}{3}\right)$.

OR

Let $A = \{1, 2, 3\}$. Write all the possible equivalence relations defined on set A.

22. For the function $f(x) = 4x - \frac{1}{2}x^2, -2 \leq x \leq \frac{9}{2}$, find the absolute maximum value and absolute minimum value.

23. Find the vector equation of the line joining the points (1, 2, 3) and (–3, 4, 3). Also write its Cartesian equation.

OR

If a line makes the angles α, β and γ with the coordinate axes, then evaluate : $\cos 2\alpha + \cos 2\beta + \cos 2\gamma$.

24. If $x = a\sec\theta,\ y = b\tan\theta$, then find $\frac{d^2y}{dx^2}$ at $\theta = \frac{\pi}{6}$.

OR

If $f(x) = \begin{cases} \frac{\log(1+4x) - \log(1-x)}{x}, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases}$ is continuous at $x = 0$, then find the value of k.

25. If $\vec{p} + \vec{q} + \vec{r} = \vec{0}$ and $|\vec{p}| = 3, |\vec{q}| = 5, |\vec{r}| = 7$ then find the angle between $\vec{p}$ and $\vec{q}$.

SECTION C

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

26. Find : $\int \frac{1}{\sin(x-a)\cos(x-b)}dx$.

27. Three cards are drawn successively with replacement from a well shuffled pack of 52 cards. Find the mean of the number of red cards.

OR

A girl throws a die. If she gets a 5 or 6, she tosses a coin three times and notes the number of heads. If she gets 1, 2, 3 or 4, she tosses a coin once and notes whether a head or tail is obtained. If she obtained exactly one head, what is the probability that she threw 1, 2, 3 or 4 with the die?

28. Evaluate : $\int_0^{2\pi} |\cos x|\, dx$.

OR

Evaluate : $\int_0^{3} \{|x| + |x-1|\}\, dx$.

29. Solve the differential equation : $x^2 y dx - (x^3 + y^3) dy = 0$.

OR

Find the particular solution of the following differential equation :

$\cos y\, dx + (1 + 2e^{-x}) \sin y\, dy = 0;\ y(0) = \frac{\pi}{4}$.

30. A linear programming problem is as follows.

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

Subject to constraints: $2x + y \le 50$, $x + 2y \le 40$, $x \ge 0,\ y \ge 0$.

In the feasible region, find the point at which maximum value of Z occurs. Solve graphically.

31. Find : $\int \frac{x\, dx}{x^2 + 3x + 2}$.

SECTION D

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

32. Using integration, find the area of the smaller region bounded between $y = \sqrt{36 - x^2}$ and $x = 4$.

33. Using differentiation, find two positive numbers whose sum is 15 and the sum of whose squares is minimum.

OR

Two equal sides of an isosceles triangle with fixed base b (in centimeter) are decreasing at the rate of 3 cm/s. How fast is the area decreasing when two equal sides are equal to the base?

34. Determine the equations of a line passing through the point (1, 2, –4) and perpendicular to the two lines $\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$ and; $\frac{x-15}{3} = \frac{y-29}{8} = \frac{5-z}{5}$.

OR

If $\vec{\alpha} = 3\hat{i} - \hat{j}$ and $\vec{\beta} = 2\hat{i} + \hat{j} - 3\hat{k}$, then express $\vec{\beta}$ in the form of $\vec{\beta} = \vec{\beta}_1 + \vec{\beta}_2$ where $\vec{\beta}_1$ is parallel to $\vec{\alpha}$ and $\vec{\beta}_2$ is perpendicular to $\vec{\alpha}$.

35. If $A = \begin{pmatrix} 2 & 3 & 10 \\ 4 & -6 & 5 \\ 6 & 9 & -20 \end{pmatrix}$, find A^{-1}. Using A^{-1} solve the following system of equations :

$\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 2,\ \frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 5,\ \frac{6}{x} + \frac{9}{y} - \frac{20}{z} = -4;\ x, y, z \ne 0$.

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.
An organization conducted bike race under two different categories – Boys and Girls.
There were 28 participants in all. Among all of them, finally three from category 1 and two from category 2 were selected for the final race. Ravi forms two sets B and G with these participants for his college project.
Let $B = \{b_1, b_2, b_3\}$ and $G = \{g_1, g_2\}$, where B represents the set of Boys selected and G the set of Girls selected for the final race.

(i) How many relations are possible from B to G?
(ii) Among all the possible relations which are defined from B to G, how many functions can be formed from B to G?
(iii) Let $R : B \to B$ be defined by $R = \{(x, y) : x \text{ and } y \text{ are students of the same sex}\}$.
Check if R is an equivalence relation.

OR

(iii) A function $f : B \to G$ be defined by $f = \{(b_1, g_1), (b_2, g_2), (b_3, g_1)\}$.
Check if f is bijective (i.e., one-one and onto both). Justify your answer.

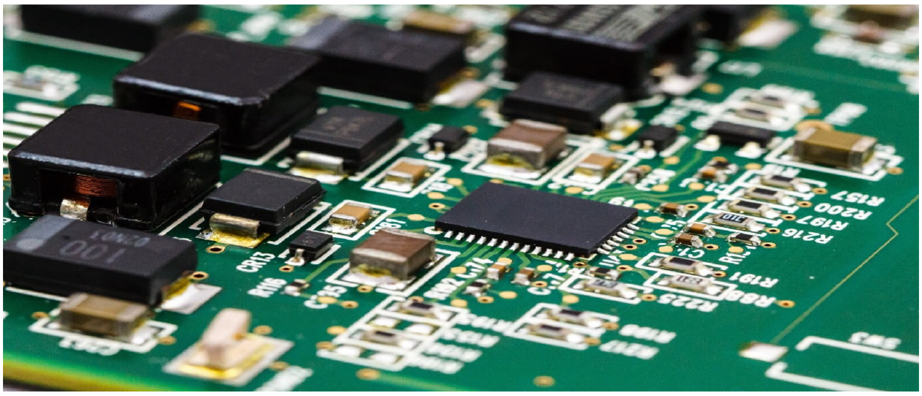
37. **CASE STUDY II :** Read the following passage and answer the questions given below.

Mr Neeraj Jha is a business analyst. He offers his expert-views to the companies.
A ball manufacturing company hires Mr Jha for his services.
Mr Jha observed that $P(x) = -5x^2 + 1250x + 30$ (in ₹) is the total profit function of this ball manufacturing company, where x is the production of the company.
(i) Differentiate $P(x)$ with respect to x.
(ii) What will be the production when the profit is maximum?
(iii) What will be the maximum profit?

OR

(iii) Check if the profit function P(x) is strictly increasing in the interval $x \in (0, 125)$?

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



An electronic assembly consists of two kinds of sub-systems *say*, A and B.
From previous testing procedures, the following probabilities are assumed to be known:

$$\text{P(A fails)} = 0.2,\ \text{P(B fails alone)} = 0.15,\ \text{P(A and B fail)} = 0.15.$$

(i) Find P(B fails) and, P(A fails alone).

(ii) Find $\text{P(A fails | B has failed)}$.

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PLEASURE TEST SERIES

For CBSE 2025 Board Exams - Class 12

MATHEMATICS (041) PTS-27

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 $A=\left[a_{ij}\right]$ is a singular matrix of order n, then

(a) $|A|\neq 0$ (b) $|A|=0$ (c) $|A|=1$ (d) $|A|\in$ any Real no.

02. If $A=\begin{pmatrix}1 & 0\\ -1 & 5\end{pmatrix}$, then $|A'|=$

(a) 25 (b) ±5 (c) 1 (d) 5

03. If $\vec{a}$ and $\vec{b}$ are two non-zero vectors such that $|\vec{a}\times\vec{b}|=|\vec{a}.\vec{b}|$, then the acute angle between the vectors $\vec{a}$ and $\vec{b}$ is

(a) 45° (b) 60° (c) 30° (d) 90°

04. If $y=\log(\cos e^x)$ then, $\frac{dy}{dx}$ is

(a) $e^{-x}\cos e^x$ (b) $e^x\cot e^x$ (c) $e^x\sin e^x$ (d) $-e^x\tan e^x$

05. Let $\int \sin 3x\, dx = k\cos 3x + C$, then the value of k is

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

06. Order and degree (if defined) of the D.E. : $\frac{d^2y}{dx^2}+\frac{dy}{dx}-\frac{1}{4}y=0$, are respectively

(a) 1, 1 (b) 2, 2 (c) 2, 1 (d) 1, not defined

07. In a linear programming problem, the constraints on the decision variables x and y are $x-3y\geq 0$, $y\geq 0$, $0\leq x\leq 3$. The feasible region

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

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

08. The value of $\vec{a}.(\vec{a}\times\vec{b})$, where $\vec{a}=17\hat{i}+24\hat{j}-53\hat{k}$, $\vec{b}=3\hat{i}+4\hat{j}-19\hat{k}$, is

(a) $\vec{0}$ (b) 0 (c) 1 (d) 1154

09. The value of $\int_{\pi/4}^{\pi/2}\sqrt{1-\sin 2x}\, dx$ is

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

10. If A is a square matrices of the order 3 such that $|A|=8$, then $|(A')^{-1}|=$

(a) 8 (b) $\frac{1}{8}$ (c) $\frac{1}{64}$ (d) 64

11. The point which does not lie in the half-plane $2x+3y-12\le 0$, is

(a) (1, 2) (b) (2, 1) (c) (2, 3) (d) (–3, 2)

12. If $A=\begin{bmatrix}0 & 2\\ 3 & -4\end{bmatrix}$ and $kA=\begin{bmatrix}0 & 3a\\ 2b & 24\end{bmatrix}$, then the values of k, a and b respectively are

(a) $-6,-12,-18$ (b) $-6,-4,-9$ (c) $-6,12,18$ (d) $-6,4,9$

13. If the matrix $\begin{bmatrix}2p+3 & 4 & 5\\ -4 & 4p+6 & -6\\ -5 & 6 & -2p-3\end{bmatrix}$ is a skew symmetric matrix, then $p=$

(a) $-\frac{3}{2}$ (b) $\frac{3}{2}$ (c) 0 (d) any Real no.

14. From the set {1, 2, 3, 4, 5}, two numbers 'a' and 'b' (such that, $a\ne b$) are chosen at random. Then, the probability that $\frac{a}{b}$ is an integer, is

(a) 0.50 (b) 0.25 (c) 0.75 (d) 0.10

15. The integration factor for the D.E. given by $\frac{dy}{dx}-\frac{y}{x}=x\sin x$, is

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

16. The derivative of $\sin^{-1}(2x\sqrt{1-x^2})$ w.r.t. $\sin^{-1}x$, $\frac{1}{\sqrt{2}}<x<1$, is

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

17. For two orthogonal vectors $\vec{a}$ and $\vec{b}$, which of the following is always true?

(a) $\vec{a}\times\vec{b}=0$ (b) $\vec{a}\times\vec{b}=\vec{0}$ (c) $\vec{a}.\vec{b}\in$ Real no. (d) $\vec{a}.\vec{b}=0$

18. The x-coordinate of a point on the line $\frac{x-2}{3}=\frac{y-2}{-1}=\frac{z-1}{-3}$ is '4'. Then its z-coordinate is

(a) $\frac{4}{3}$ (b) 4 (c) -1 (d) 1

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) :** Let $f:R\to R$ given by $f(x)=x^2$. Then $f(x)$ is one-one and onto both.

Reason (R) : $f:A\to B$ is one-one $\Leftrightarrow f(\alpha)=f(\beta)\Rightarrow\alpha=\beta\ \forall\ \alpha,\beta\in A$

$\Leftrightarrow \alpha\ne\beta\Rightarrow f(\alpha)\ne f(\beta)\ \forall\ \alpha,\beta\in A$.

Also, $f:A\to B$ is onto $\Leftrightarrow f(A)=B$ i.e., range of $f=$ co-domain of f.

20. **Assertion (A) :** If $(2\hat{i}+m\hat{j}+4\hat{k})\times(\hat{i}+4\hat{j}+2\hat{k})=\vec{0}$, then $m=8$.

Reason (R) : If $\vec{x}\ne 0$, $\vec{y}\ne 0$ and $\vec{x}\times\vec{y}=\vec{0}$ then, $\vec{x}$ and $\vec{y}$ must be parallel vectors.

Moreover, for parallel vectors $\vec{x} = a_1\hat{i} + b_1\hat{j} + c_1\hat{k}$ and $\vec{y} = a_2\hat{i} + b_2\hat{j} + c_2\hat{k}$ we have, $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$.

SECTION B

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

21. Find the interval in which $\sin^{-1} x < \cos^{-1} x$.

OR

Let $(a, b) \in R \Leftrightarrow 1 + ab > 0 \ \forall a, b \in \mathbb{R}$. Then Show that R is reflexive but not transitive.

22. Find the absolute maximum value of $f(x) = [x(x-1)+1]^{\frac{1}{3}}$, $0 \le x \le 1$.

23. Cartesian equation of a line is given as, $3x + 2 = 1 - 2y = z + 5$. Then find the equation of a line parallel to the given line and passing through the point (–1, –2, 0).

OR

Consider the line $4x = 3y = 2z$. Write the acute angle made by this line with x-axis.

24. For what value of k, is $f(x) = \begin{cases} \dfrac{\sqrt{3}\sin x + \cos x}{x + \frac{\pi}{6}}, & x \neq -\frac{\pi}{6} \\ k, & x = -\frac{\pi}{6} \end{cases}$ continuous at $x = -\frac{\pi}{6}$?

25. If $\vec{a}, \vec{b}, \vec{c}$ are three vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, then prove that $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$.

SECTION C

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

26. Find : $\int \left[\frac{1}{x} - \frac{1}{2x^2}\right] e^{2x} dx$.

27. A card from a pack of 52 playing cards is lost. From the remaining cards, three cards are drawn at random (without replacement) and are found to be all spades. Find the probability of the lost card being a spade.

OR

A coin is biased so that the head is 4 times as likely to occur as tail. If the coin is tossed 3 times, find the probability distribution of the number of tails. Also, find the mean.

28. Find : $\int \frac{x^2 + 1}{(x^2 + 2)(x^2 + 3)} dx$.

OR

Find : $\int \frac{\sin x - x\cos x}{x(x + \sin x)} dx$.

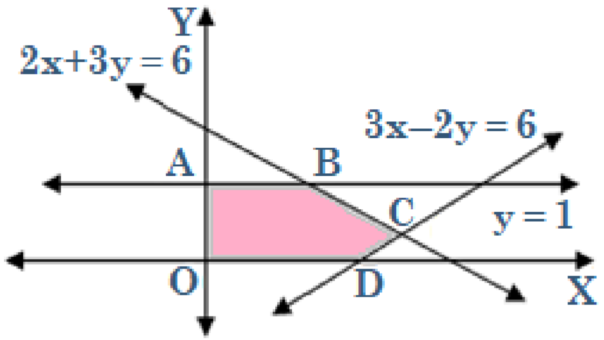
29. Solve the differential equation $\frac{dy}{dx} + 2xy = y$; $y(0) = 1$ and express the result in the form of $y = f(x)$. Hence, write $y = f(2)$.

OR

Solve the differential equation : $y + \frac{d}{dx}(xy) = x\log x$.

30. Find : $\int_0^{\pi} \frac{e^{\cos x}}{e^{\cos x} + e^{-\cos x}} dx$.

31. Observe the following graph carefully.



Let $A(0,1)$, $B\left(\frac{3}{2},1\right)$, $C\left(\frac{30}{13},\frac{6}{13}\right)$, $D(2,0)$ and O(0, 0) be the corner points.

Answer each of the following :

(i) What will be the maximum value of $z = 8x + 9y$?

(ii) Mention the point at which z is maximum.

(iii) Mention the possible constraint (s) responsible for this type of feasible region.

SECTION D

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

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

OR

Sketch the graph of $y = |x+2| + |x-2|$, if $-3 \le x \le 3$ and hence find the enclosed area.

33. Let N denote the set of all natural numbers and R be the relation on $N \times N$ defined by $(a,b)\,R\,(c,d)$ if $ad(b+c) = bc(a+d)$. Show that R is an equivalence relation.

34. The scalar product of the vector $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ with a unit vector along the sum of vectors $\vec{b} = 2\hat{i} + 4\hat{j} - 5\hat{k}$ and $\vec{c} = \lambda\hat{i} + 2\hat{j} + 3\hat{k}$ is equal to 1. Find the value of λ.
Also write the angle made by $\vec{c}$ with y-axis.

OR

Find the shortest distance between the lines
$\vec{r} = 3\hat{i} + 2\hat{j} - 4\hat{k} + \lambda(\hat{i} + 2\hat{j} + 2\hat{k})$ and $\vec{r} = 5\hat{i} - 2\hat{j} + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})$.
If the lines intersect, find their point of intersection.

35. Show that the product $\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix} \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix} = 8\,I_3$.

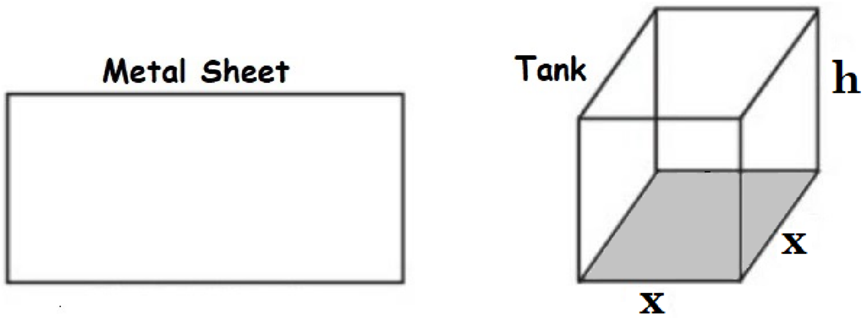
Hence, use it to solve the system of equations : $x - y + z = 4$, $x - 2y - 2z = 9$, $2x + y + 3z = 1$.

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 answer the questions given below.

A Social organization working for welfare of the society, decides to conserve water in a village.



For this purpose, the organization proposes to construct an open water tank having a square base, by using a metal sheet. The area of the metal sheet is to be least and water to be stored in the tank is 4000 cubic metres.

(i) Represent area (A) of the metal sheet to be used for making the open water tank, in terms of ‘x’ and ‘h’, where ‘h’ is the height of the tank and ‘x’ is the length of square base (refer the diagram given above).

(ii) Represent the volume of the water stored in the tank in terms of ‘x’ and ‘h’.

(iii) Find $\frac{dA}{dx}$ and $\frac{d^2A}{dx^2}$. Also find the value of ‘x’ and ‘h’ at which, $\frac{dA}{dx}=0$.

OR

(iii) Use second derivative test, to find the least area (A) of the water tank.

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

Shyam and Radha wanted to play a game with balls of two different colors - red and black.
Shyam has two boxes I and II. Box I contains 3 red and 6 black balls. Box II contains 5 red and ‘n’ black balls.
One of the two boxes, box I and box II is selected by Radha at random, and then Radha draws a ball at random.

(i) Find $P(E_1)$, $P(E_2)$ and, $P(A|E_1)$, where E_1 : box I is selected, E_2 : box II is selected and, A : getting a red ball.

(ii) If the probability of the red ball taken out from the box II is $\frac{3}{5}$, then what is the value of ‘n’?

(iii) What is the probability that the ball drawn is found to be red?

OR

(iii) What is the probability of the red ball taken out from the box I?

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

Anaya Plastic Company is expert in making boxes of different sizes and shapes.
It receives an order to manufacture a right circular cylindrical box.

Each box must be of volume $125\pi\ \text{cm}^3$.

(i) Let ‘r’ and ‘h’ denote the radius of circular base and height of cylindrical box respectively.
Obtain an expression for the surface area (S) in terms of ‘r’.
Obtain an expression for S in terms of ‘h’ also.
(ii) Find the value of ‘r’ and ‘h’ if surface area (S) is least. Use derivatives.
What is the relation between ‘r’ and ‘h’?

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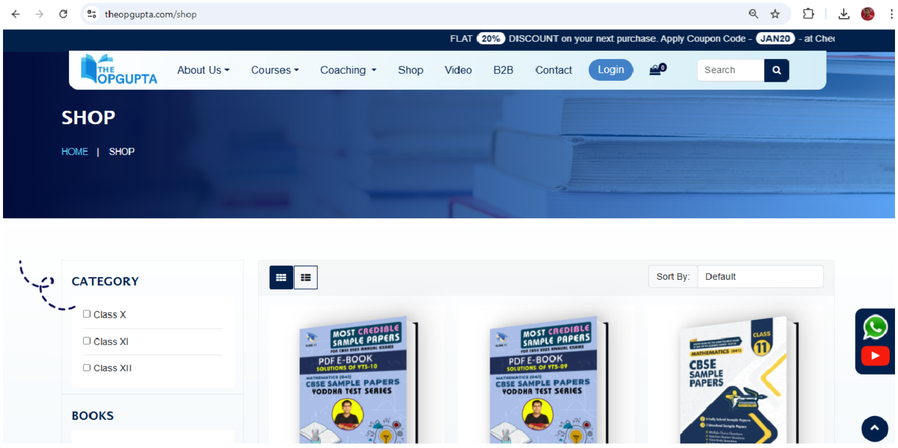

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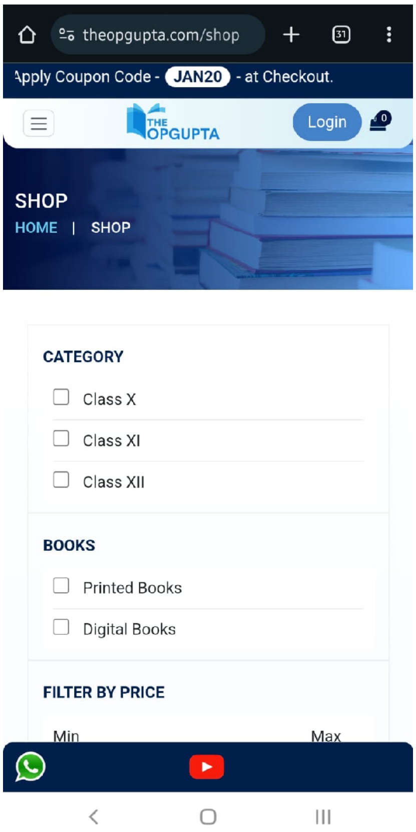

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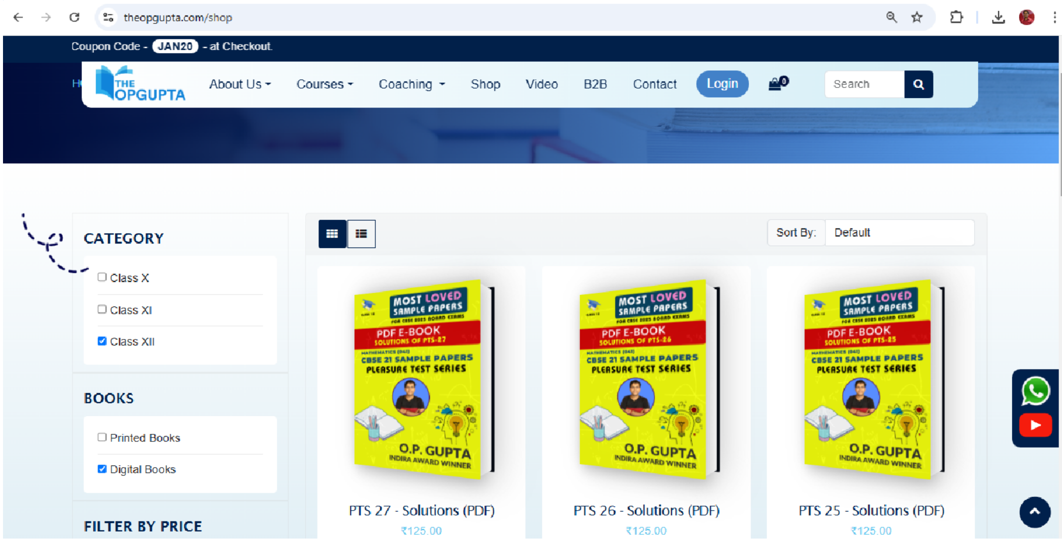

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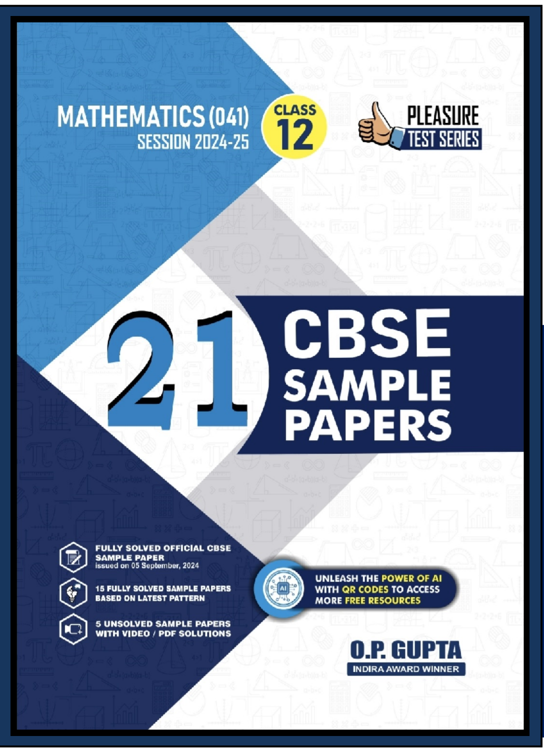

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