CHENNAI SAHODAYA SCHOOLS COMPLEX

(General Instructions)

- Please check that this question paper contains 5 printed pages.
- Please write down the serial number of the question before attempting it.
- Reading time of 15 minutes is given to read the question paper alone. No writing during this time.
- This Question paper contains 38 questions. All questions are compulsory.
- This Question paper is divided into five Sections - A, B, C, D and E.
- In Section A, Questions no. 1 to 18 are multiple choice questions (MCQs) and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.
- In Section B, Questions no. 21 to 25 are Very Short Answer (VSA) - type questions, carrying 2 marks each.
- In Section C, Questions no. 26 to 31 are Short Answer (SA) - type questions, carrying 3 marks each.
- In Section D, Questions no. 32 to 35 are Long Answer (LA) - type questions, carrying 5 marks each.
- In Section E, Questions no. 36 to 38 are case study-based questions carrying 4 marks each.
- There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and one sub-part each in 2 questions of Section E.
- Use of calculators is not allowed.

COMMON EXAMINATION
Class-12
(Mathematics 041/1)

Roll No.: | **Maximum Marks: 80**

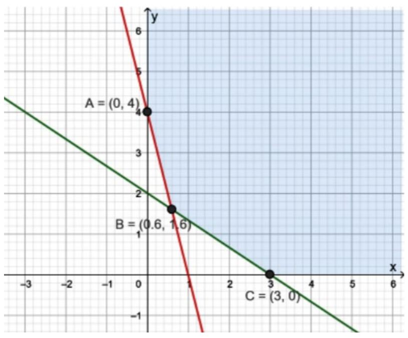
Date: 17/12/2025 | **Time allowed: 3 hours**

	SECTION A	
1	If (2A - (B)= $\begin{bmatrix} 6 & -6 & 0 \\ -4 & 2 & 1 \end{bmatrix}$ and (2B + (A) = $\begin{bmatrix} 3 & 2 & 5 \\ -2 & 1 & -7 \end{bmatrix}$ then A = ? (A) $\begin{bmatrix} 4 & 2 & 1 \\ -2 & 3 & -1 \end{bmatrix}$ (B) $\begin{bmatrix} -3 & 2 & 1 \\ 2 & 1 & -1 \end{bmatrix}$ (C) $\begin{bmatrix} 3 & 2 & -1 \\ 2 & -1 & 1 \end{bmatrix}$ (D) $\begin{bmatrix} 3 & -2 & 1 \\ -2 & 1 & -1 \end{bmatrix}$	[1]
2	IfΔ (x) = $\begin{vmatrix} \sin\frac{x}{2} & 1 & 1 \\ 1 & \sin\frac{x}{2} & -\sin\frac{x}{2} \\ -\sin\frac{x}{2} & 1 & -1 \end{vmatrix}$ $\forall$ x $\in$ [0, π] then (A) The range of Δ(x) is [2, 4] (B) The range of Δ (x) is [-4, 2] (C) Δ (x) is not defined (D) None of these	[1]
3	If a matrix A is such that $3A^3 + 2A^2 + 5A + I = 0$, then A^{-1} is equal to (A) $3A^2$ - 2A - 5 (B) $3A^2$ + 2A + 5 (C) none of these (D) - ($3A^2$ + 2A + 5I)	[1]
4	If f(x) =$\begin{cases} \frac{\sqrt{1+kx}-\sqrt{1-kx}}{x}, & for -1 \le x < 0 \\ 2x^2+3x-2, & for\ 0 \le x \le 1 \end{cases}$ is continuous at x = 0, then k is equal to (A) - 3 (B) - 2 (C) - 4 (D) - 1	[1]
5	The vector equation of the x - axis is given by (A) $\vec{r} = \hat{j} - \hat{k}$ (B) $\vec{r} = \lambda\hat{i}$ (C) $\vec{r} = \hat{j} + \hat{k}$ (D) $\vec{r} = \hat{i}$	[1]

6 The degree of the differential equation $x^2\frac{d^2y}{dx^2} = \left(x\frac{dy}{dx} - y\right)^3$ is: **[1]**

(A) 2 (B) 1 (C) 6 (D) 3

7 The corner points of the shaded unbounded feasible region of an LPP are (0, 4), (0.6, 16) and (3, 0) as shown in the figure. The minimum value of the objective function Z = 4x + 6y occurs at **[1]**



(A) (0.6, 1.6) and (3, 0) only
(B) (0.6, 1.6) only
(C) at every point of the line segment joining the points (0.6, 1.6) and (3,0)
(D) (3, 0) only

8 Two vectors $\vec{a} = a_1\hat{\imath} + a_2\hat{\jmath} + a_3\hat{k}$ and $\vec{b} = b_1\hat{\imath} + b_2\hat{\jmath} + b_3\hat{k}$ are collinear if **[1]**

(A) $a_1 b_1 + a_2 b_2 + a_3 b_3 = 0$ (B) $\frac{a_1}{b_1} = \frac{a_2}{b_2} = \frac{a_3}{b_3}$ (C) $a_1 = b_1, a_2 = b_2, a_3 = b_3$
(D) $a_1 + a_2 + a_3 = b_1 + b_2 + b_3$

9 $\int \frac{x+\sin x}{1+\cos x}dx$ is equal to **[1]**

(A) $x - \tan\frac{x}{2} + C$ (B) $\log|x + \sin x| + C$ (C) $\log|1 + \cos x| + C$ (D) $x.\tan\frac{x}{2} + C$

10 Let A = $\begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix}$, then **[1]**

(A) $A^T = -A$ (B) $A^T = A$ (C) $A^T = I$ (D) $A^T = IA$

11 The optimal value of the objective function is attained at the points **[1]**

(A) given by intersection of inequations with the axes only
(B) given by intersection of inequations with y - axis only
(C) given by intersection of inequations with x - axis only
(D) given by corner points of the feasible region

12 In a hexagon ABCDEF $\overrightarrow{AB} = a, \overrightarrow{BC} = \vec{b}$ and $\overrightarrow{CD} = \vec{c}$. Then $\overrightarrow{AE} =$ **[1]**

(A) $\vec{a} + 2\vec{b} + 2\vec{c}$ (B) $\vec{b} + \vec{c}$ (C) $\vec{a} + \vec{b} + \vec{c}$ (D) $2\vec{a} + \vec{b} + \vec{c}$

13 For any 2× 2 matrix, If A(adj (A) = $\begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$, then |A| is equal to **[1]**

(A) 100 (B) 20 (C) 10 (D) 0

14 A speaks truth in 75% cases and B speaks truth in 80% cases. Probability that they contradict each other in a statement is **[1]**

(A) $\frac{13}{20}$ (B) $\frac{3}{5}$ (C) $\frac{7}{20}$ (D) $\frac{2}{5}$

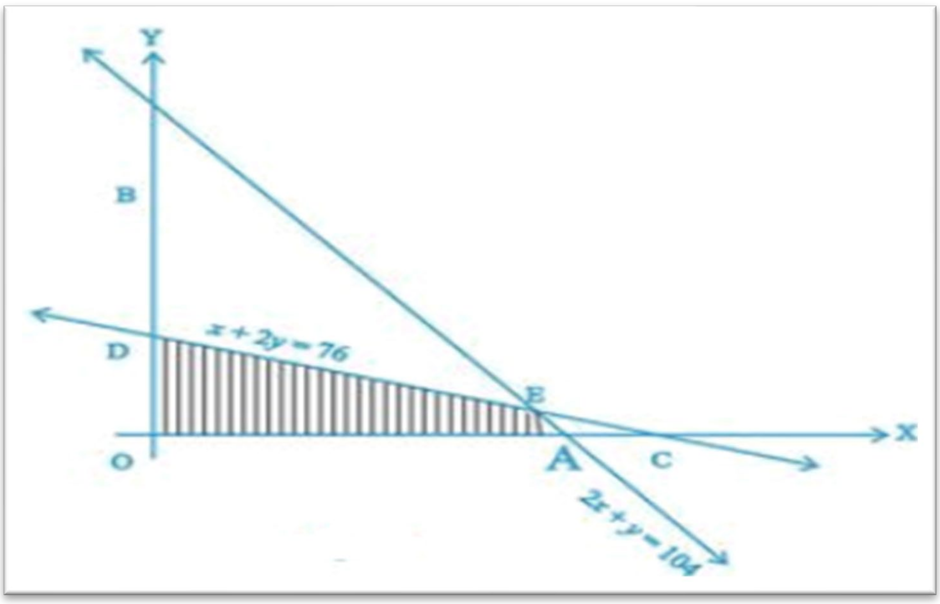
15 The integrating factor of the differential equation $(x \log x)\frac{dy}{dx} + y = 2\log x$ is **[1]**

(A) log(log x) (B) e^x (C) log x (D) x

16 The position vectors of three consecutive vertices of a parallelogram ABCD are $A(4\hat{\imath} + 2\hat{\jmath} - 6\hat{k})$, $B(5\hat{\imath} - 3\hat{\jmath} + \hat{k})$ and $C(12\hat{\imath} + 4\hat{\jmath} + 5\hat{k})$. The position vector of D is given by **[1]**

(A) $-11\hat{\imath} - 9\hat{\jmath} + 2\hat{k}$ (B) $-3\hat{\imath} - 5\hat{\jmath} - 10\hat{k}$ (C) $11\hat{\imath} + 9\hat{\jmath} - 2\hat{k}$ (D) $21\hat{\imath} + 3\hat{\jmath}$

17	If $y = \sqrt{\sin x + \sqrt{\sin x + \sqrt{\sin x + \ldots\infty}}}$ then $\frac{dy}{dx} = ?$ (A) $\frac{\sin x}{(2y+1)}$ (B) $\frac{\sin x}{(2y-1)}$ (C) $\frac{\cos x}{(2y-1)}$ (D) $\frac{\cos x}{(y-1)}$	**[1]**
18	The angle between the lines $\frac{x+1}{1} = \frac{4-y}{-1} = \frac{z-5}{2}$ and $\frac{x+3}{-3} = \frac{y-2}{5} = \frac{z+5}{4}$ is: (A) $\frac{\pi}{4}$ (B) $\cos^{-1}\left(\frac{2}{3}\right)$ (C) $\frac{\pi}{2}$ (D) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$	**[1]**
19	**Assertion ((A):** If the circumference of the circle is changing at the rate of 10 cm/s, then the area of the circle changes at the rate 30 cm ^{2} /s, if radius is 3 cm. **Reason (R):** If A and r are the area and radius of the circle, respectively, then rate of change of area of the circle is given by $\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$. (A) Both A and R are true and R is the correct explanation of A. (B) Both A and R are true but R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	**[1]**
20	**Assertion ((A):** The Greatest Integer Function f: R → R, given by f(x) = [x] is one - one. **Reason (R):** A function f: A → B is said to be injective if f((A) = f((B) ⇒ a = b. (A) Both A and R are true and R is the correct explanation of A. (B) Both A and R are true but R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	**[1]**
	Section B	
21	Evaluate: - $\tan^{-1}\left(-\frac{1}{\sqrt{3}}\right) + \cot^{-1}\left(\frac{1}{\sqrt{3}}\right) + \tan^{-1}\left(\sin\left(-\frac{\pi}{2}\right)\right)$ **OR** Write the interval for the principal value of function and draw its graph: $\cot^{-1}$ x.	**[2]**
22	Find the absolute maximum and the absolute minimum values of the function f(x) = (x - 2)$\sqrt{x-1}$ in the given interval [1, 9].	**[2]**
23	A balloon, in the form of a right circular cone surmounted by a hemisphere, having a diameter equal to the height of the cone, is being inflated. How fast is its volume changing with respect to its total height h, when h = 9 cm. **OR** An edge of a variable cube is increasing at the rate of 10 cm/sec. How fast the volume of the cube is increasing when the edge is 5 cm long?	**[2]**
24	Evaluate: $\int \frac{\cos^9 x}{\sin x} dx$.	**[2]**
25	Find the intervals of function f(x) = 6 + 12x + 3x^2 - 2x ^{3} is (a) increasing (b) decreasing.	**[2]**
	Section C	
26	Evaluate: $\int$ (e $^{\log x}$ + sin x) cos x dx **OR** Evaluate: $\int \frac{(2x+9)}{(x+2)(x-3)^2} dx$.	**[3]**
27	Evaluate: $\int_0^{\frac{\pi}{2}} (2\log\cos x - \log\sin 2x)\, dx$	**[3]**
28	Solve the following differential equation, given that y = 0, when x $=\frac{\pi}{4}$: $(x^2 - y^2)$ dx + 2xy dy = 0 . **OR** Find the solution of differential equation: (1 + x^2)dy + 2xy dx = cot x dx	**[3]**
29	Solve the following linear programming problem graphically: Minimise: Z = x + 2y subject to the constraints: x + 2y ≥ 100, 2x - y ≤ 0, 2x + y ≤ 200, x ≥ 0, y ≥ 0.	**[3]**

	OR Determine the maximum value of Z = 3x + 4y if the feasible region (shade(D) for a LPP as shown in Figure. 	
30	One bag contains 4 white and 5 black balls. Another bag contains 6 white and 7 black balls. A ball is transferred from first bag to the second bag and then a ball is drawn from the second bag. Find the probability that the ball drawn is white.	[3]
31	Differentiate the function: $\cot^{-1}\left[\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right], 0 < x < \frac{\pi}{2}$ w.r.t. x.	[3]
	Section D	
32	Draw the graph of the curve $y^2 = 9 - x^2$ and find the area bounded by the curve and the lines y = 0, y = 2 using integration.	[5]
33	Let n be a fixed positive integer. Define a relation R in Z as follows: for every a, b ∈ Z, a R b if and only if a - b is divisible by n. Show that R is an equivalence relation. **OR** Let A = R – {3} and B = R – {1}. Define a function f : A → B by $f(x) = \frac{x-2}{x-3}$. Is f one to one? Justify your answer.	[5]
34	Find the shortest distance between the lines: $\frac{x+1}{2} = \frac{y-1}{1} = \frac{z-9}{-3}$ and $\frac{x-3}{2} = \frac{y+15}{-7} = \frac{z-9}{5}$. **OR** Find the equations of the line passing through the point (1, 2, -4) and perpendicular to the lines $\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$ and $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$.	[5]
35	Given $A = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}, B = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$, find BA and use this to solve the system of equations y + 2z = 7, x - y = 3, 2x + 3y + 4z = 17.	[5]
	Section E	
36	**Read the following text carefully and answer the questions that follow:** Mr. Ajay is taking up subjects of mathematics, physics, and chemistry in the examination. His probabilities of getting a grade A in these subjects are 0.2, 0.3, and 0.5 respectively.	[4]

1. Find the probability that Ajay gets Grade A in all subjects. (1)
2. Find the probability that he gets Grade A in no subjects. (1)
3. Find the probability that he gets Grade A in two subjects. (2)

OR

Find the probability that he gets Grade A in at least one subject. (2)

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37 **Read the following text carefully and answer the questions that follow:** **[4]**

A helicopter starts at an initial point A(1, 2, -1) and travels to point B(3, 1, 4). A tower is located at point C(-1, 3, 2). All coordinates are in kilometers.

1. Write the **displacement vector** representing the helicopter's path from A to B. (1)
2. Find the **area of the triangle** formed by the points A, B, and C. (1)
3. Determine the **unit vector** in the direction of $\overrightarrow{AC}$. (2)

OR

Find a vector that is **perpendicular** to both $\overrightarrow{AB}$ and $\overrightarrow{AC}$. (2)

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38 **Read the following text carefully and answer the questions that follow:** **[4]**

A tin can manufacturer designs a cylindrical tin can for a company making sanitizer and disinfectors. The tin can is made to hold 3 litres of sanitizer or disinfector. The cost of material used to manufacture the tin can is ₹ 100/m ^{2} .

1. If r cm be the radius and h cm be the height of the cylindrical tin can, then express the surface area as a function of radius (r)? (1)
2. Find the radius of the can that will minimize the cost of tin used for making can? (1)
3. Find the height that will minimize the cost of tin used for making can? (2)

OR

Find the minimum cost of material used to manufacture the tin can. (2)

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