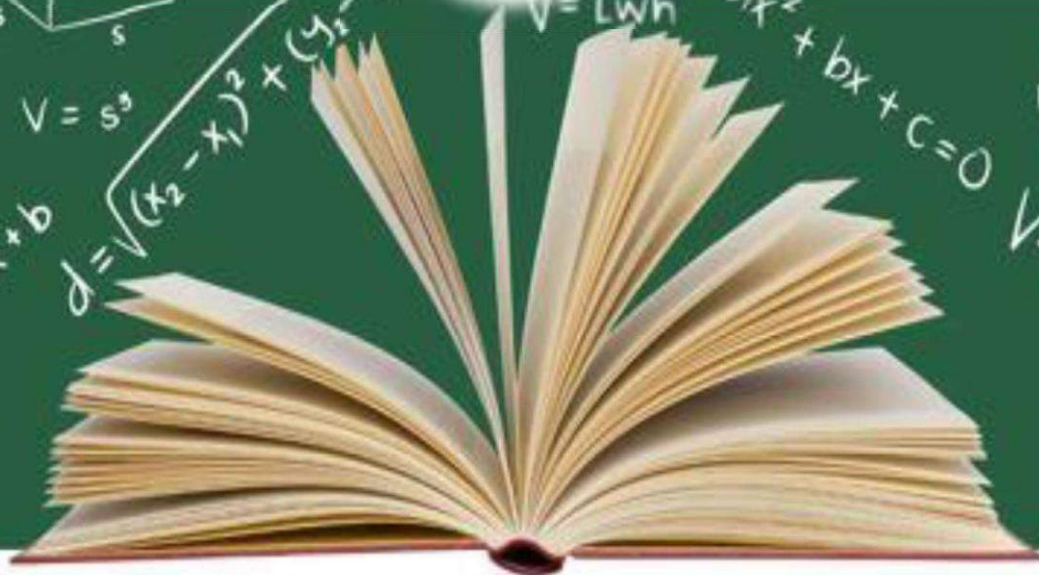




KENDRIYA VIDYALAYA SANGATHAN
HYDERABAD REGION

MATHEMATICS
12
CLASS



20 - MODEL QUESTION PAPERS
SESSION 2025-26

OUR PATRONS



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INDEX

S. No.	Name of Paper	Page No
1	Model Question Paper – 1	3-8
2	Model Question Paper – 2	9-15
3	Model Question Paper - 3	16-22
4	Model Question Paper - 4	23-27
5	Model Question Paper - 5	28-32
6	Model Question Paper - 6	33-39
7	Model Question Paper – 7	40-47
8	Model Question Paper – 8	48-52
9	Model Question Paper - 9	53-59
10	Model Question Paper - 10	60-65
11	Model Question Paper - 11	66-70
12	Model Question Paper – 12	71-76
13	Model Question Paper - 13	77-72
14	Model Question Paper - 14	83-89
15	Model Question Paper - 15	90-94
16	Model Question Paper - 16	95-99
17	Model Question Paper - 17	100-104
18	Model Question Paper - 18	105-109
19	Model Question Paper - 19	110-114
20	Model Question Paper - 20	115-120

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER-1 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

SECTION-A

[1 × 20 = 20]

(This section comprises of multiple choice questions (MCQs) of 1 mark each)

Select the correct option (Question 1 - Question 18):

Q. No	Question	Marks
1.	If the matrix A is both symmetric and skew symmetric, then (A) A is a diagonal matrix (B) A is a zero matrix (C) A is a square matrix (D) None of these	1
2.	If $x = e^{\frac{x}{y}}$ then $\frac{dy}{dx}$ is equal to (A) $\frac{x-y}{x \log x}$ (B) $\frac{y-x}{\log x}$ (C) $\frac{y-x}{x \log x}$ (D) $\frac{x-y}{\log x}$	1
3.	The rate of change of the surface area of the sphere of radius r when the radius is increasing at the rate of 2 cm/s is proportional to (A) $\frac{1}{r^2}$ (B) $\frac{1}{r}$ (C) r (D) r^2	1
4.	The domain of the function defined by $f(x) = \sin^{-1} x + \cos x$ is (A) $[-1, 1]$ (B) $[-1, \pi + 1]$ (C) $(-\infty, \infty)$ (D) ϕ	1

5.	Matrices A and B will be inverse of each other only if (A) $AB = BA$ (C) $AB = 0, BA = I$ (B) $AB = BA = 0$ (D) $AB = BA = I$	1
6.	The function $f(x) = [x]$, where $[x]$ denotes the greatest integer function is continuous at: (A) 4 (B) -1 (C) 2 (D) 1.5	1
7.	$\int \frac{\cos 2x - \cos 2\theta}{\cos x - \cos \theta} dx$ is equal to: (A) $2(\sin x + x \cos \theta) + c$ (C) $2(\sin x + 2x \cos \theta) + c$ (B) $2(\sin x - x \cos \theta) + c$ (D) $2(\sin x - 2x \cos \theta) + c$	1
8.	The value of $\cos^{-1}(-1) - \sin^{-1}(1)$ is (A) π (B) $\frac{\pi}{2}$ (C) $\frac{3\pi}{2}$ (D) $-\frac{3\pi}{2}$	1
9.	If area of triangle is 35 sq units with vertices (2, -6), (5, 4) and (k, 4). Then k is (A) 12 (B) -2 (C) -12, -2 (D) 12, -2	1
10.	The solution of differential equation $xdy - ydx = 0$ represents (A) a rectangular hyperbola (C) Straight line passing through origin (B) Parabola whose vertex is at origin (D) a circle whose centre is at origin	1
11.	The function $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = x - 4$ is: (A) Bijective (C) Injective but not Surjective (B) Surjective but not Injective (D) Neither Surjective nor Injective	1
12.	Let $\vec{a}$ and $\vec{b}$ be two unit vectors and θ is the angle between them. Then $\vec{a} + \vec{b}$ is a unit vector if (A) $\theta = \frac{\pi}{4}$ (B) $\theta = \frac{\pi}{3}$ (C) $\theta = \frac{\pi}{2}$ (D) $\theta = \frac{2\pi}{3}$	1
13.	The Corner points of the feasible region determined by a set of constraints are P(0,5), Q(3,5), R(5,0) and S(4,1) and the objective function is $Z = ax + 2by$ where $a, b > 0$. The condition on a and b such that the maximum Z occurs at Q and S is (A) $a - 5b = 0$ (B) $a - 3b = 0$ (C) $a - 2b = 0$ (D) $a - 8b = 0$	1
14.	The maximum value of $(\frac{1}{x})^x$ is: (A). e (B) e^e (C) $e^{\frac{1}{e}}$ (D) $(\frac{1}{e})^{\frac{1}{e}}$	1
15.	The linear inequalities or equations or restrictions on the variables of a linear programming problem are called: (A). a constraint (C). Objective function (B). Decision variables (D). None of the above	1
16.	The value of μ for which the vectors $3i - 6j + k$ and $2i - 4j + \mu k$ are parallel is: (A) $\frac{2}{3}$ (B) $\frac{3}{2}$ (C) $\frac{5}{2}$ (D) $\frac{2}{5}$	1
17.	If A and B are two events such that $P(A) \neq 0$ and $P\left(\frac{B}{A}\right) = 1$, then (A). $A = \emptyset$ (B) B subset of A (C) A subset of B (D) $B = \emptyset$	1
18.	The function $f(x) = x - [x]$, where $[x]$ denotes the greatest integer function is (A) continuous at integer points only (C) continuous at non-integer points only (B) continuous everywhere (D) differentiable everywhere	1

	Directions: In the following question, each question contains Assertion (A) and Reason (R). Each question has 4 choices (a), (b), (c) and (d) out of which only one is correct. The choices are: A. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). B. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A). C. Assertion (A) is true but Reason (R) is false. D. Assertion (A) is false but Reason (R) is true.	1
19.	Assertion (A): The relation $f: \{1,2,3,4\} \rightarrow \{x,y,z,p\}$ defined by $f = \{(1,x), (2,y), (3,z)\}$ is a bijective function. Reason (R): The function $f: \{1,2,3\} \rightarrow \{x,y,z,p\}$ such that $f = \{(1,x), (2,y), (3,z)\}$ is one-one.	
20.	Assertion (A): The derivative of e^{x^3} w.r.t. $\log x$ is $3x^3 e^{x^3}$. Reason (R): The derivative of e^{x^3} w.r.t. $\log x$ is $3x^3 e^{x^3} + e^2$.	1

SECTION-B

[2 × 5 = 10]

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21.	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 $\vec{b}$.	2
22.	If $A = \begin{pmatrix} 2 & 0 & 1 \\ 2 & 1 & 3 \\ 1 & -1 & 0 \end{pmatrix}$, then find a matrix X such that $A^2 - 5A + 4I + X = 0$	2
23.	If $y = (\sin x)^{(\sin x)^{(\sin x) \dots \infty}}$, then prove that $\frac{dy}{dx} = \frac{y^2 \cot x}{(1 - y \log \sin x)}$. (OR) If $y = \log \tan \left(\frac{\pi}{4} + \frac{x}{2} \right)$, then prove that $\frac{dy}{dx} - \sec x = 0$	2
24.	Evaluate $\int_0^{2\pi} \sin x dx$ (OR) Find the area of the region enclosed by the curve $y^2 = x$, $x = 3$ and the x-axis in the first quadrant.	2
25.	Find the points on the line $\frac{x+2}{3} = \frac{y+1}{2} = \frac{z-3}{2}$ at a distance of 5 units from the point P(1, 3, 3).	2

SECTION-C

[3 × 6 = 18]

(This section comprises of 6 short answer (SA) type questions of 3 marks each.)

26.	A particle moves along the curve $3y = ax^3 + 1$ such that at a point with x-coordinate 1, y-coordinate is changing twice as fast as x-coordinate. Find the value of a. (OR) If $x = a(\theta - \sin \theta)$, $y = a(1 - \cos \theta)$, find $\frac{d^2y}{dx^2}$	3
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27.	Evaluate $\int_0^{\frac{\pi}{4}} \frac{\sin x + \cos x}{9 + 16 \sin 2x} dx$	3
28.	Three vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ satisfy the condition $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. Evaluate the quantity $\mu = \vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$, if $ \vec{a} = 3$, $ \vec{b} = 4$ and $ \vec{c} = 2$.	3
29.	Find the general solution of the differential equation $(xy - x^2)dy = y^2 dx$. (OR) Find the general solution of the differential equation $(x^2 + 1)\frac{dy}{dx} + 2xy = \sqrt{x^2 + 4}$.	3
30.	Minimize $Z = 5x + 10y$ subject to the constraints; $x + 2y \leq 120$; $x + y \geq 6$; $x - 2y \geq 0$; $x, y \geq 0$	3
31.	A bag contains $(2n+1)$ coins. It is known that $(n-1)$ of these coins have a head on both sides, whereas the rest of the coins are fair. A coin is picked up at random from the bag and is tossed. If the probability that the toss results in a head is $\frac{31}{42}$, determine the value of n . (OR) Two students Mehul and Rashi are seeking admission in a college. The probability that Mehul is selected is 0.4 and the probability of selection of exactly one of them is 0.5. Find the chances of selection of Rashi. Also find the probability of selection of at least one of them.	3

SECTION-D

[5 × 4 = 20]

(This section comprises of 4 long answer (LA) type questions of 5 marks each)

32.	Find the vector and Cartesian equations of the lines which is perpendicular to the lines with equations $\frac{x+2}{1} = \frac{y-3}{2} = \frac{z+1}{4}$ and $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and passes through the point $(1, 1, 1)$. Also find the angle between the given lines.	5
33.	Solve the system of equations $\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 4$; $\frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 1$; $\frac{6}{x} + \frac{9}{y} - \frac{20}{z} = 2$ (OR) For two matrices $A = \begin{bmatrix} 3 & -6 & -1 \\ 2 & -5 & -1 \\ -2 & 4 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -2 & -1 \\ 0 & -1 & -1 \\ 2 & 0 & 3 \end{bmatrix}$, find the product AB and hence solve the system of equations: $3x - 6y - z = 3$ $2x - 5y - z + 2 = 0$ $-2x + 4y + z = 5$	5
34.	Find the maximum and minimum values of $x + \sin 2x$ on $[0, 2\pi]$.	5
35.	Find the area of the region bounded by the ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$.	5

SECTION-E

[5 × 4 = 20]

(This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each).

Case Study-1

36	Consider the mapping $f: A \rightarrow B$ is defined by $f(x) = \frac{x-1}{x-2}$ such that f is a bijection. Based on the above information, solve the following questions:	
	(i). Domain of f is: (A). $R - \{2\}$ (B). R (C). $R - \{1, 2\}$ (D). $R - \{0\}$	1
	(ii). Range of f is: a. R (A). R (B) $R - \{1\}$ (C). $R - \{0\}$ (D). $R - \{1, 2\}$	1
	(iii). If $g: R - \{2\} \rightarrow R - \{1\}$ is defined by $g(x) = 2f(x) - 1$, then $g(x)$ in terms of x is: (A) $\frac{x+2}{x}$ (B) $\frac{x+1}{x-2}$ (C) $\frac{x-2}{x}$ (D) $\frac{x}{x-2}$ (OR) The function g defined above, is: (A) one-one (B) many-one (C) into (D) None of these	2

Case Study-2

37	An architecture designs an auditorium for a school for its cultural activities. The floor of the auditorium is rectangular in shape and has a fixed perimeter P .	
		
	Based on the above information, solve the following questions:	
	(i) If x and y represents the length and breadth of the rectangular region, then relation between the variables is (A) $x + y = p$ (B) $x^2 + y^2 = p^2$ (C) $2(x + y) = p$ (D) $x + 2y = p$	1
	(ii) The area (A) of the rectangular region, as a function of x , can be expressed as (A) $A = px + \frac{x}{2}$ (B) $A = \frac{px+x^2}{2}$ (C) $A = \frac{px-2x^2}{2}$ (D) $A = \frac{x^2}{2} + px^2$	1
	(iii) School's manager is interested in maximizing the area of floor 'A' for this to be happen, the value of x should be:	2

	(A)p	(B) $\frac{p}{2}$	(C) $\frac{p}{3}$	(D) $\frac{p}{4}$	
	(OR)				
	(iii)The value of y, for which the area of floor is maximum, is:				
	(A) $\frac{p}{2}$	(B) $\frac{p}{3}$	(C) $\frac{p}{4}$	(D) $\frac{p}{16}$	

Case Study-3

38	There are two antiaircraft guns, name as A and B. The probabilities that the shell fired from them hits an airplane are 0.3 and 0.2 respectively. Both of them fired one shell at an airplane at the same time.  Based on the above information, solve the following Q1. What is the probability that the shell fired from exactly one of them hit the plane? Q2. If it is known that the shell fired from exactly one of them hit the plane, then what is the probability that it was fired from B?	2 2
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KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER-2 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

SECTION-A

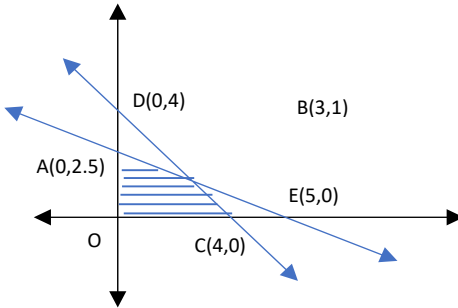
[1 × 20 = 20]

(This section comprises of multiple choice questions (MCQs) of 1 mark each)

Select the correct option (Question 1 - Question 18):

1	If $A = [a_{ij}]$ is an identity matrix, then which of the following is true? A. $a_{ij} = \begin{cases} 0, & \text{if } i = j \\ 1, & \text{if } i \neq j \end{cases}$ B. $a_{ij} = 1, \forall i, j$ C. $a_{ij} = 0, \forall i, j$ D. $a_{ij} = \begin{cases} 0, & \text{if } i \neq j \\ 1, & \text{if } i = j \end{cases}$	1
2	If $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 5 \end{bmatrix}$, then A^{-1} is: A. $\begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$ B. $\begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$	1

	$C. \frac{1}{30} \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 5 \end{bmatrix}$ $D. \frac{1}{30} \begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$	
3	For any square matrix A, $(A - A^T)^T$ is always : A. An identity matrix B. A null matrix C. A skew symmetric matrix D. A symmetric matrix	1
4	If $A \cdot (adj A) = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$, then the value of $A + adj A$ is equal to : A. 12 B. 9 C. 3 D. 27	1
5	Let A be the area of a triangle having vertices (x_1, y_1), (x_2, y_2) and (x_3, y_3). Which of the following is correct? A. $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = \pm A$ B. $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = \pm 2A$ C. $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = \pm \frac{A}{2}$ D. $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}^2 = A^2$	1
6	The value of k for which the function $f(x) = \begin{cases} x^2, & x \geq 0 \\ kx, & x < 0 \end{cases}$ is differentiable at $x = 0$ is : A. 1 B. 2 C. Any real number D. 0	1
7	If $y = \frac{\cos x - \sin x}{\cos x + \sin x}$, then $\frac{dy}{dx}$ is : A. $-\sec^2\left(\frac{\pi}{4} - x\right)$ B. $\sec^2\left(\frac{\pi}{4} - x\right)$	1

	C. $\ln \left \sec \left(\frac{\pi}{4} - x \right) \right$ D. $-\ln \left \sec \left(\frac{\pi}{4} - x \right) \right$	
8	$\int 2^{x+2} dx$ is equal to: A. $2^{x+2} + c$ B. $2^{x+2} \ln 2 + c$ C. $\frac{2^{x+2}}{\ln 2} + c$ D. $2 \cdot \frac{2^x}{\ln 2} + c$	1
9	$\int_0^2 \sqrt{4-x^2} dx$ equals: A. $2 \ln 2$ B. $-2 \ln 2$ C. $\frac{\pi}{2}$ D. π	1
10	What is the product of the order and degree of the differential equation? $\frac{d^2y}{dx^2} \sin x \sin y + \left(\frac{dy}{dx} \right)^3 \cos \cos y = \sqrt{y} ?$ A. 3 B. 2 C. 6 D. Not defined	1
11	$x \ln \ln x \frac{dy}{dx} + y = 2 \ln \ln x$ is an example of a: A. Variable separable differential equation. B. Homogeneous differential equation. C. First order linear differential equation. D. Differential equation whose degree is not defined.	1
12	Besides non negativity constraints, the figure given below is subject to which of the following constraints  A. $x + 2y \leq 5 ; x + y \leq 4$ B. $x + 2y \geq 5 ; x + y \leq 4$ C. $x + 2y \geq 5 ; x + y \geq 4$ D. $x + 2y \leq 5 ; x + y \geq 4$	1

13	In ΔABC, $\overrightarrow{AB} = \hat{i} + \hat{j} + 2\hat{k}$ and $\overrightarrow{AC} = 3\hat{i} - \hat{j} + 4\hat{k}$. If D is the mid-point of BC, then $\overrightarrow{AD}$ is equal to : A. $4\hat{i} + 6\hat{j}$ B. $2\hat{i} - 2\hat{j} + 2\hat{k}$ C. $\hat{i} - \hat{j} + \hat{k}$ D. $2\hat{i} + 3\hat{k}$	1
14	If the point $P(a, b, 0)$ lies on the line $\frac{x+1}{2} = \frac{y+2}{3} = \frac{z+3}{4}$, then (a, b) is : A. $(1, 2)$ B. $(\frac{1}{2}, \frac{2}{3})$ C. $(\frac{1}{2}, \frac{1}{4})$ D. $(0, 0)$	1
15	If α, β and γ are the angles which a line makes with positive directions of x, y and z axes respectively, then which of the following is not true? A. $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$ B. $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma = 2$ C. $\cos 2\alpha + \cos 2\beta + \cos 2\gamma = -1$ D. $\cos \alpha + \cos \beta + \cos \gamma = 1$	1
16	The restrictions imposed on decision variables involved in an objective function of a linear programming problem are called: A. Feasible solutions B. Constraints C. Optimal solutions D. Infeasible solutions	1
17	If $P(A \cap B) = \frac{1}{8}$ and $P(A') = \frac{3}{4}$, then $P\left(\frac{B}{A}\right)$ is equal to : A. $\frac{1}{2}$ B. $\frac{1}{3}$ C. $\frac{1}{6}$ D. $\frac{2}{3}$	1
18	If A and B are independent events, then which of the following is not true? A. A' and B are independent events. B. A and B' are independent events. C. A' and B' are independent events. D. None of these	1
	Question number 19 and 20 are Assertion and Reason based question. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answers from the codes A, B C and D as given below. 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 and R is false. D. A is false and R is true.	
19	Assertion(A): The relation $R = \{(1, 2)\}$ on the set $A = \{1, 2, 3\}$ is transitive. Reasoning (R): A relation R on a non-empty set A is said to be transitive if $(a, b), (b, c) \in R \Rightarrow (a, c) \in R$, for all $a, b, c \in A$.	1
20	Assertion(A): The function $f(x) = (x + 2)e^{-x}$ is strictly increasing on $(-1, \infty)$. Reasoning (R): A function $f(x)$ is strictly increasing if $f'(x) > 0$.	1
SECTION-B		
21	Find the principal value of $\left(\cos^{-1} \cos \frac{13\pi}{6}\right)$. OR Find the value of $\tan^{-1}(\sqrt{3}) - \sec^{-1}(-2)$	2
22	If $x = a \tan^3 \theta$ and $y = a \sec^3 \theta$, then find $\frac{dy}{dx}$.	2
23	Evaluate : $\int \frac{\sec^2 x}{\sqrt{\tan^2 x + 4}} dx$ OR Evaluate $\int \sqrt{1 - \sin 2x} dx$, $\frac{\pi}{4} < x < \frac{\pi}{2}$	2
24	If $ \vec{a} = 2$, $ \vec{b} = 7$ and $\vec{a} \times \vec{b} = -3\hat{i} + \hat{j} + 2\hat{k}$, find the angle between $\vec{a}$ and $\vec{b}$.	2
25	A die, whose faces are marked 1, 2, 3 in red and 4, 5, 6 in green is tossed. Let, A be the event "number obtained is even" and B be the event "number is marked red". Find whether the events A and B are independent or not.	2
SECTION-C		
26	If $(\cos y)^x = (\sin x)^y$, then find $\frac{dy}{dx}$.	3
27	Find the intervals in which the function $f(x) = 3x^4 - 4x^3 - 12x^2 + 5$ is I. strictly increasing II. strictly decreasing	3
28	Evaluate : $\int_0^{\frac{\pi}{4}} \frac{\sin x + \cos x}{16 + 9 \sin 2x} dx$ OR Prove that $\int_0^a f(x) dx = \int_0^a f(a - x) dx$, and hence evaluate $\int_0^1 x^2(1 - x)^n dx$.	3
29	Find the area of the region $\{(x, y) : y \geq x^2, y \leq x \}$ OR If the area bounded by the parabola $y^2 = 16ax$ and the line $y = 4mx$ is $\frac{a^2}{12}$ sq. units, then using integration, find the value of m.	3

30	Find the particular solution of the differential equation $\frac{dy}{dx} = 1 + x^2 + y^2 + x^2y^2$, given that $y = 0$ when $x = 1$. OR Find the particular solution of the differential equation $x \frac{dy}{dx} \sin\left(\frac{y}{x}\right) + x - y \sin\left(\frac{y}{x}\right) = 0$, given that $y(1) = \frac{\pi}{2}$.	3
31	Maximize $Z = 3x + 9y$ Subject to constraints $x + 3y \leq 60$ $x + y \geq 10$ $x \leq y$ $x, y \geq 0$ Solve the above L.P.P graphically.	3
SECTION-D		
32	Let N be the set of natural numbers and R be the relation on $N \times N$ defined by $(a, b) R (c, d)$ iff $ad = bc$ for all $a, b, c, d \in N$. Show that R is an equivalence relation. OR Show that the function $f: N \rightarrow N$ defined by $f(x) = x^2 + x + 1$ is one-one but not onto.	5
33	If $A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 3 \\ 1 & -2 & 1 \end{bmatrix}$ then find A^{-1} and hence solve the system of system of linear equations: $x + y + z = 6, y + 3z = 7$ and $x - 2y + z = 0$. OR Solve the system of equations $\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 4$; $\frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 1$; $\frac{6}{x} + \frac{9}{y} - \frac{20}{z} = 2$	5
34	Evaluate: $\int_1^4 [x - 1 + x - 2 + x - 3] dx$	5
35	Find the co-ordinates of the foot of the perpendicular drawn from the point $A(-1, 8, 4)$ to the line joining points $B(0, -1, 3)$ and $C(2, -3, -1)$. Hence find the image of the point A in the line BC .	5
SECTION-E		
36	Read the following passage and answer the questions given below: In an Office three employees Jayant, Sonia and Olivia process a calculation in an excel form. Probability that Jayant, Sonia, Olivia process the calculation respectively is 50%, 20% and 30%. Jayant has a probability of making a mistake as 0.06, Sonia has probability 0.04 to make a mistake and Olivia has a probability 0.03. Based on the above information, answer the following questions. I. Find the probability that Sonia processed the calculation and committed a mistake. II. Find the total probability of committing a mistake in processing the calculation. III. The boss wants to do a good check. During check, he selects a calculation form at random from all the days. If the form selected at random has a mistake, find the probability that the form is not processed by Jayant.	1 1 2

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER- 3 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Section - A

Section A consists of 20 questions of 1 mark each.

1. The area bounded by the parabola $y^2 = 8x$ and its latus rectum is
 - (a) $16/3$ sq units
 - (b) $32/3$ sq units
 - (c) $8/3$ sq units
 - (d) $64/3$ sq units
2. If $\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}|$, then $\vec{a}, \vec{b}$ are
 - (a) perpendicular
 - (b) like parallel
 - (c) unlike parallel
 - (d) coincident
3. Let $f(x) = x^3 + \frac{3}{2}x^2 + 3x + 3$, then $f(x)$ is
 - (a) an even function
 - (b) an odd function
 - (c) an increasing function
 - (d) a decreasing function

4. If $P = \begin{bmatrix} 1 & 2 & 1 \\ 1 & 3 & 1 \end{bmatrix}$ and $Q = PP^T$, then the value of $|Q|$ is
 (a) 2
 (b) -2
 (c) 1
 (d) 0
5. $\int \frac{dx}{x(x^7+1)}$ is equal to
 (a) $\log\left(\frac{x^7}{x^7+1}\right) + C$
 (b) $\frac{1}{7} \log\left(\frac{x^7}{x^7+1}\right) + C$
 (c) $\log\left(\frac{x^7+1}{x^7}\right) + C$
 (d) $\frac{1}{7} \log\left(\frac{x^7+1}{x^7}\right) + C$
6. The value of $\int_0^1 \frac{dx}{e^x+e}$ is
 (a) $\frac{1}{e} \log\left(\frac{1+e}{2}\right)$
 (b) $\log\left(\frac{1+e}{2}\right)$
 (c) $\frac{1}{e} \log(1+e)$
 (d) $\log\left(\frac{2}{1+e}\right)$
7. If $A = \{1, 3, 5, 7\}$ and $B = \{1, 2, 3, 4, 5, 6, 7, 8\}$, then the number of one-one function from A into B is
 (a) 1340
 (b) 1860
 (c) 1430
 (d) 1680
8. The relation $\operatorname{cosec}^{-1}\left(\frac{x^2+1}{2x}\right) = 2\cot^{-1}x$ is valid for
 (a) $x \geq 1$
 (b) $x \geq 0$
 (c) $|x| \geq 1$
 (d) none of these
9. If $x = e^{y+e^{y+e^{t+t}}}$, then $\frac{dy}{dx}$ is equal to
 (a) $\frac{1}{x}$
 (b) $\frac{1-x}{x}$
 (c) $\frac{x}{1+x}$
 (d) None of these
10. The points of discontinuity of $\tan x$ are
 (a) $n\pi, n \in I$
 (b) $2n\pi, n \in I$
 (c) $(2n+1)\frac{\pi}{2}, n \in I$
 (d) None of these

11. Which of the following function is decreasing on $(0, \frac{\pi}{2})$
- $\sin 2x$
 - $\cos 3x$
 - $\tan x$
 - $\cos 2x$
12. A coin and a six faced die, both unbiased are thrown simultaneously. The probability of getting a head on the coin and an odd number on the die is,
- $\frac{1}{2}$
 - $\frac{3}{4}$
 - $\frac{1}{4}$
 - $\frac{2}{3}$
13. The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^2 = x \sin\left(\frac{d^2y}{dx^2}\right)$
- 1
 - 3
 - 2
 - none of these
14. Solution of $\frac{dy}{dx} + y \sec x = \tan x$ is
- $y (\sec x + \tan x) = \sec x + \tan x - x + c$
 - $y = \sec x + \tan x - x + c$
 - $y (\sec x + \tan x) = \sec x + \tan x + x + c$
 - none of these
15. The direction cosines of the line joining the points (4, 3, -5) and (-2, 1, -8) are
- $\left(\frac{6}{7}, \frac{2}{7}, \frac{3}{7}\right)$
 - $\left(\frac{2}{7}, \frac{3}{7}, \frac{-6}{7}\right)$
 - $\left(\frac{6}{7}, \frac{3}{7}, \frac{2}{7}\right)$
 - none of these
16. The projections of a line segment on x, y, z axes are 12, 4, 3. The length and the direction cosines of the line segment are
- $13, < \frac{12}{13}, \frac{4}{13}, \frac{3}{13} >$
 - $19, < \frac{12}{19}, \frac{4}{19}, \frac{3}{19} >$
 - $11, < \frac{12}{11}, \frac{14}{11}, \frac{3}{11} >$
 - none of these
17. If A and B are mutually exclusive events with $P(B) \neq 1$, then $P(A/\bar{B})$ is equal to (here, $\bar{B}$ is the complement of the event B)
- $\frac{1}{P(B)}$
 - $\frac{1}{1-P(B)}$

- (c) $\frac{P(A)}{P(B)}$
 (d) $\frac{P(A)}{1-P(B)}$

18. Equation to the curve through (2, 1) whose slope at the point (x, y) is $\frac{x^2+y^2}{2xy}$, is

- (a) $2(x^2 - y^2) = 3x$
 (b) $2(y^2 - x^2) = 6y$
 (c) $x(x^2 - y^2) = 6$
 (d) none of these

19. Assertion: The relation R in a set $A = \{1, 2, 3, 4\}$ defined by $R = \{(x, y): 3x - y = 0\}$ has the domain = $\{1, 2, 3, 4\}$ and range = $\{3, 6, 9, 12\}$

Reason: Domain & range of the relation (R) is respectively the set of all first & second entries of the distinct ordered pair of the relation.

- (a) Assertion is true, Reason is true; Reason is a correct explanation for Assertion.
 (b) Assertion is true, Reason is true; Reason is not a correct explanation for Assertion.
 (c) Assertion is true; Reason is false.
 (d) Assertion is false; Reason is true.

20. Assertion: If $A = \begin{bmatrix} \sqrt{3} & 1 \\ 2 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} x & y & z \\ a & b & c \end{bmatrix}$, then orders of $(A + B)$ is 2×3

Reason: If $[a_{ij}]$ and $[b_{ij}]$ are two matrices of the same order, then the order of $A + B$ is the same as the order of A or B

- (a) Assertion is true, Reason is true; Reason is a correct explanation for Assertion.
 (b) Assertion is true, Reason is true; Reason is not a correct explanation for Assertion.
 (c) Assertion is true; Reason is false.
 (d) Assertion is false; Reason is true.

Section - B

This section comprises of very short answer type-questions (VSA) of 2 marks each.

21. A die, whose faces are marked 1, 2, 3 in red and 4, 5, 6 in green is tossed. Let, A be the event “number obtained is even” and B be the event “number is marked red”. Find whether the events A and B are independent or not.

22. Show that the relation R on $\mathbf{R} \times \mathbf{R}$ defined as $R = \{(a, b): (a \leq b)\}$, is reflexive and transitive but not symmetric.

23. Write the value of $\int \frac{2-3\sin x}{\cos^2 x} dx$.

OR

Write the value of $\int \sec x (\sec x + \tan x) dx$.

24. If $|\vec{a}| = 8$, $|\vec{b}| = 3$ and $|\vec{a} \times \vec{b}| = 12$, then find the angle between $\vec{a}$ and $\vec{b}$.

OR

Write the value of λ , so that the vectors $\vec{a} = 2\hat{i} + \lambda\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + 3\hat{k}$ are perpendicular to each other.

25. The equation of a line is $5x - 3 = 15y + 7 = 3 - 10z$ Write the direction cosines of the line.

Section - C

This section comprises of short answer type questions (SA) of 3 marks each.

26. Prove that $\tan\left\{\frac{\pi}{4} + \frac{1}{2}\cos^{-1}\frac{a}{b}\right\} + \tan\left\{\frac{\pi}{4} - \frac{1}{2}\cos^{-1}\left(\frac{a}{b}\right)\right\} = \frac{2b}{a}$

27. If $\begin{bmatrix} 2x & 5 \\ 8 & x \end{bmatrix} = \begin{bmatrix} 6 & -2 \\ 7 & 3 \end{bmatrix}$, then write the value of x .

28. Show that $y = \log(1+x) - \frac{2x}{2+x}$, $x > -1$ is an increasing function of x , throughout its domain.

OR

Find the intervals in which the function given by $f(x) = \sin x + \cos x$, $0 \leq x \leq 2\pi$ is

(i) increasing

(ii) decreasing.

29. If $y = (\sin x)^x + \sin^{-1}\sqrt{x}$, then find $\frac{dy}{dx}$.

(OR)

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

30. If θ is the angle between two vectors $\hat{i} - 2\hat{j} + 3\hat{k}$ and $3\hat{i} - 2\hat{j} + \hat{k}$, find $\sin \theta$.

31. Evaluate $\int_{-1}^2 |x^3 - x| dx$.

OR

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

Section - D

This section comprises of long answer-type questions (LA) of 5 marks each.

32. Solve the following differential equation $\operatorname{cosec} x \log|y| \frac{dy}{dx} + x^2 y^2 = 0$.

OR

Solve the following differential equation. $x \cos\left(\frac{y}{x}\right) \frac{dy}{dx} = y \cos\left(\frac{y}{x}\right) + x$; $x \neq 0$

33. Find the values of p , so that the lines

$$l_1: \frac{1-x}{3} = \frac{7y-14}{p} = \frac{z-3}{2} \text{ and } l_2: \frac{7-7x}{3p} = \frac{y-5}{1} = \frac{6-z}{5}$$

are perpendicular to each other. Also, find the equation of a line passing through a point $(3, 2, -4)$ and parallel to line l_1 .

34. Maximize $Z=5x+3y$ subject to the constraints:

$$3x+5y \leq 15,$$

$$\begin{aligned} 5x+2y &\leq 10, \\ x &\geq 0, \\ y &\geq 0. \end{aligned}$$

OR

Minimize $Z=3x+5y$ such that:

$$\begin{aligned} x+3y &\geq 3, \\ x+y &\geq 2, \\ x, y &\geq 0. \end{aligned}$$

35. Evaluate $\int_0^{\pi/2} \frac{x \sin x \cos x}{\sin^4 x + \cos^4 x} dx$.

Section - E

Case study based questions are compulsory.

36. Mahesh runs a form processing agency. He collects forms from different offices and then extracts data and records data on computer. In his office three employees Vikas, Sarita and Ishaan process incoming copies of a form. Vikas process 50% of the forms. Sarita processes 20% and Ishaan the remaining 30% of the forms. Vikas has an error rate of 0.06, Sarita has an error rate of 0.04 and Ishaan has an error rate of 0.03.



Based on the above information answer the following questions.

- The total probability of committing an error in processing the form.
- The manager of the company wants to do a quality check. During inspection he selects a form at random from the day's output of processed forms. If the form selected at random has an error, the probability that the form is not processed by Vikas.

37. RK Verma is production analyst of a ready-made garment company. He has to maximize the profit of company using data available. He finds that $P(x) = -6x^2 + 120x + 25000$ (in Rupee) is the total profit function of a company where x denotes the production of the company.



Based on the above information, answer the following questions.

(i) Find the profit of the company, when the production is 3 units.

(ii) Find $P'(5)$

(iii) Find the interval in which the profit is strictly increasing.

OR

(iv) Find the production, when the profit is maximum.

38. Two farmers cultivate wheat and rice. Their production is given by the equations:

$$2x + 4y = 20, \text{ and } 3x + 5y = 29$$

Where x and y denote the number of fields of the first and second farmer respectively.

Based on the above information answer the following:

(i) Write the above system of equations in the form $AX = B$ clearly specifying A , X and B . Also find $|A|$

(ii) Solve for x and y using determinants.

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER- 4 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

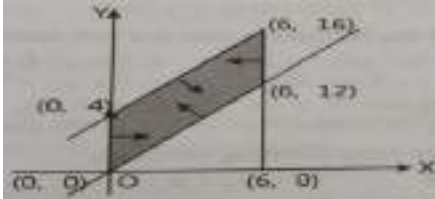
General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

SECTION - A

Q. No.	Questions	Marks
1	If $A = \begin{bmatrix} \frac{1}{3} & 0 \\ 1 & \frac{1}{3} \end{bmatrix}$, then $\det(A^T) =$ a) $\det A$ (b). $-\det A$ (c) 0 (d) None of these	1M
2	If $A = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$ such that $A + A^T = I$ then find the value of θ a) $\frac{2}{\pi}$ b) $\frac{\pi}{3}$ c) $-\frac{2}{\pi}$ d) $-\frac{\pi}{3}$	1M
3	If $y = 3 \log \sqrt{\sin x}$, then $\frac{dy}{dx}$ at $x = \frac{\pi}{4}$ is , a) 3 b) $\frac{3}{2}$ c) $\frac{2}{3}$ d) $-\frac{3}{2}$	1M
4	$\int \frac{1}{\sin^2 x \cos^2 x} dx =$ (a) $\tan x + \cot x + c$ (b). $\tan x - \cot x + c$ (c) $\cot x = \tan x + c$ (d) $-\tan x \cdot \cot x + c$	1M

5	The general solution of the differential equation $ydx - xdy = 0$ (given $x, y > 0$) is of the form a) $xy = c$ b) $x = cy^2$ c) $y = cx$ d) $y = cx^2$	1M
6	If $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, then A^2 is equal to (a) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}$ (c) $\begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$	1M
7	If A is a square matrix of order 3 and $ A = 6$, then value of $ adjA $ is a) 6 b) 36 c) 27 d) 216	1M
8	The value of k for which the function f , given by $f(x) = \begin{cases} kx + 1, & x \leq \pi \cos x, \\ x > \pi \end{cases}$ is continuous at $x = \pi$, is a) $\frac{2}{\pi}$ b) $\frac{\pi}{2}$ c) $-\frac{2}{\pi}$ d) $-\frac{\pi}{2}$	1M
9	The difference of the order and the degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^3 + x^4 = 0$ is: a) 1 b) 2 c) -1 d) 0	1M
10	Let $\vec{a}$ and $\vec{b}$ be two unit vectors and θ is the angle between them, $\vec{a} + \vec{b}$ is a unit vector if: a) $\theta = \frac{\pi}{2}$ b) $\theta = \frac{\pi}{3}$ c) $\theta = \frac{\pi}{4}$ d) $\theta = \frac{2\pi}{3}$	1M
11	If $\begin{bmatrix} x & 2 \\ 3 & x-1 \end{bmatrix}$ is a singular matrix, then the product of all possible values of x is: a) 6 b) 0 c) -6 d) 7	1M
12	The magnitude of projection of $(2\hat{i} - \hat{j} + 2\hat{k})$ on $(\hat{i} + 2\hat{j} + 2\hat{k})$ (a) $\frac{4}{81}$ (b) $\frac{12}{9}$ (c) $\frac{8}{9}$ (d) $\frac{8}{81}$	1M
13	The feasible region for an LPP is shown shaded in the figure. Let $Z = 3x - 4y$ be an objective function. Maximum value of Z is  (a) 0 (b) 8 (c) 12 (d) -18	1M
14	Unit vector along $\overrightarrow{PQ}$ where coordinates of P and Q respectively are $(2, 1, -1)$ and $(4, 4, -7)$ is	1M

	a) $2\hat{i} + 3\hat{j} - 6\hat{k}$ b) $-2\hat{i} - 3\hat{j} + 6\hat{k}$ c) $\frac{2}{7}\hat{i} + \frac{3}{7}\hat{j} - \frac{6}{7}\hat{k}$ d) $-\frac{2}{7}\hat{i} - \frac{3}{7}\hat{j} + \frac{6}{7}\hat{k}$	
15	The vector equation of the symmetrical form of equation of straight line $\frac{x-5}{3} = \frac{y+4}{7} = \frac{z-6}{2}$ is (a) $\vec{r} = (3i + 7j + 2k) + \mu(5i + 4j - 6k)$ (b) $\vec{r} = (5i + 4j - 6k) + \mu(3i + 7j + 2k)$ (c) $\vec{r} = (5i - 4j - 6k) + \mu(3i - 7j - 2k)$ (d) $\vec{r} = (5i - 4j + 6k) + \mu(3i + 7j + 2k)$	1M
16	The corner points of feasible solution region determined by the system of linear constraints are (0, 10), (5, 5), (15, 15), (0, 20). Let $Z = px + qy$, where $p, q > 0$. Condition on p and q so that the maximum of Z occurs at both the points (15, 15) and (0, 20) is p = q (B) p = 2q (C) q = 2p (D) q = 3p	1M
17	If $P(A \cap B) = 70\%$ and $P(B) = 85\%$, then $P(A/B)$ is equal to: a. 17/14 b. 14/17 c. $\frac{7}{8}$ d. $\frac{1}{8}$	1M
18	For what value of λ , the projection of vector $\hat{i} + \lambda\hat{j}$ on vector $\hat{i} - \hat{j}$ is $\sqrt{2}$? a) -1 b) 1 c) 0 d) 3	1M
	Questions number 19 and 20 are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (a), (b), (c) and (d) as given below. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true.	
19	Let $A = \{1, 2, 3, 4, 6\}$. If R is the relation on A defined by $\{(a, b): a, b \in A, b \text{ is exactly divisible by } a\}$. Assertion: The relation R in Roster form is $\{(6, 3), (6, 2), (4, 2)\}$. Reason: The domain and range of R is $\{1, 2, 3, 4, 6\}$.	1M
20	Let C be the circumference and A be the area of a circle. Assertion (A): The rate of change of the area with respect to radius is equal to C. Reason (R) : The rate of change of the area with respect to diameter is $\frac{C}{2}$	1M
	SECTION-B (Question nos. 21 to 25 are very short Answer type questions carrying 2 marks each)	
21	Find the value of $\left[\sin^{-1} \sin \left(\frac{13\pi}{7} \right) \right]$ (OR) Simplify : $\tan^{-1} 1 + \cos^{-1} \left(-\frac{1}{2} \right) + \sin^{-1} \left(-\frac{1}{2} \right)$	2M

22	If the product of two positive numbers is 9, then find the numbers so that the sum of their squares is minimum.	2M
23	Evaluate: $\int e^x \left(\frac{x}{(1+x)^2} \right) dx$	2M
24	Show that the function $(x) = \frac{16\sin x}{4+\cos x} - x$, is strictly decreasing in $\left(\frac{\pi}{2}, \pi\right)$ OR Find the interval in which the function $f(x) = x^3 + \frac{1}{x^3}$, $x \neq 0$, is decreasing.	2M
25	Find the point on the curve $y^2 = 8x$ for which the abscissa and ordinate change at the same rate.	2M
SECTION-C (Question nos. 26 to 31 are short Answer type questions carrying 3 marks each)		
26	If $y = e^{ax}$ then prove that $(1-x^2)\left(\frac{dy}{dx}\right)^2 = a^2 y^2$	3M
27	Find $\int e^{x^2} (x^5 + 2x^3) dx$	3M
28	Find a particular solution of the differential equation $\frac{dy}{dx} + y \cot x = 4x \operatorname{cosec} x$, $x \neq 0$, given that $y = 0$ when $x = \frac{\pi}{2}$ OR Find the general solution of the differential equation : $\frac{dy}{dx} = (1+x^2)(1+y^2)$	3M
29	Solve graphically: Maximize $z = 1000x + 600y$ subject to the constraints, $x + y \leq 200$, $y - 4x \geq 0$, $x \geq 20$, $x, y \geq 0$ OR Solve the following linear programming problem graphically Maximize $z = 5x + 3y$ Subject to the constraints $3x + 5y \leq 15$ $5x + 2y \leq 10$ $x, y \geq 0$	3M
30	A fair coin and an unbiased die are tossed. Let A be the event, “Head appears on the Coin” and B be the event “3 comes on the die”. Find whether A and B are independent events or not.	3M
31	If $f(x) = x \sin^2 x$, then find the value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} f(x) dx$ OR Find $\int \frac{2}{(1-x)(1+x^2)} dx$	3M
SECTION-D (Question nos. 32 to 35 are Long Answer type questions carrying 5 marks each)		

32	Let R be a relation on $\mathbf{N} \times \mathbf{N}$ defined by $R = \{(x, y) \text{ such that } (a, b) R (c, d) \text{ implies that } ad = bc, \text{ and } x, y \text{ belongs to } \mathbf{N}\}$ Then prove that R is an Equivalence relation on N OR Let $f: R - \left\{-\frac{4}{3}\right\} \rightarrow R$ be a function defined as $(x) = \frac{4x}{3x+4}$. Show that f is a one one function. Also check whether f is an onto function or not.	5M
33	Find the area of the smaller part of the circle $x^2 + y^2 = a^2$ cut of by the line $x = \frac{a}{\sqrt{2}}$	5M
34	Solve the following system of equations by matrix method: $\begin{aligned} x + 2y + 3z &= 6 \\ 2x - y + z &= 2 \\ 3x + 2y - 2z &= 3 \end{aligned}$	5M
35	Find the foot of the perpendicular drawn from the point $(2, 3, -8)$ to the line $\frac{x-4}{2} = \frac{y}{-6} = \frac{z-1}{3}$. Also, find the perpendicular distance of the given line from the given point. OR Find the vector and the Cartesian equations of a line passing through the point $(1, 2, -4)$ and parallel to the line joining the points $A(3, 3, -5)$ and $B(1, 0, -11)$. Hence find the distance between the two lines.	5M
	SECTION-E (Question nos. 36 to 38 are source based/case based/passage based/integrated units of assessment questions carrying 4 marks each)	
37	 A player is playing the carrom game, in the above picture suppose the striker is at point $A(1, 1, 3)$, a white coin is at the point $B(2, 3, 5)$ and the black coin at $C(4, 5, 7)$. Based on the above information answer the following (i) Write the vector, if the striker hits the white coin? (ii) Find the distance covered by the striker to the white coin? (iii) a) Find the unit vector in the direction of the vectors $\overrightarrow{AB} + \overrightarrow{BC}$ and $\overrightarrow{AB} - \overrightarrow{BC}$ OR b) Using vectors find the area of the triangle formed by the vertices A, B and C.	1M 1M 2M
38	In an agricultural institute, scientists do experiments with varieties of seeds to grow them in different environments to produce healthy plants and get more yield. A scientist observed that a particular seed grew very fast after germination. He had recorded growth of plant since germination and he said that its growth can be defined by the function $f(x) = \frac{1}{3}x^3 - 4x^2 + 15x + 2$, $0 \leq x \leq 10$ where x is the number of days the plant is exposed to sunlight. On the basis of the above information, answer the following questions : (i) What are the critical points of the function (x) ? (ii) Using second derivative test, find the minimum value of the function.	2M 2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER- 5 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q. No.	QUESTION	MARK
	<u>SECTION-A</u> (This section comprises of multiple-choice questions (MCQs) of 1 mark each)	
1	Let A be 3x3 square matrix such that $ adj A = 64$. Then $ A $ is equals to A) 8 only B) -8 only C) 64 D) 8 or -8	1
2	If A is square matrix of order 3x3 and $ A = 4$ then the value of $ 2A $ is A) 12 B) 15 C) 32 D) 16	1
3	If a matrix has 24 elements, the number of possible orders it can have, is A) 13 B) 3 C) 5 D) 8	1
4	If $\begin{bmatrix} x+y & 2 \\ 5 & xy \end{bmatrix} = \begin{bmatrix} 6 & 2 \\ 5 & 8 \end{bmatrix}$, then the value of $(\frac{24}{x} + \frac{24}{y})$ is A) 7 B) 6 C) 8 D) 18	1
5	If $A = \begin{bmatrix} 3 & 4 \\ 5 & 2 \end{bmatrix}$ and $2A + B$ is null matrix, then B is equals to A) $\begin{bmatrix} 6 & 8 \\ 10 & 4 \end{bmatrix}$ B) $\begin{bmatrix} -6 & -8 \\ -10 & -4 \end{bmatrix}$ C) $\begin{bmatrix} 5 & 8 \\ 10 & 3 \end{bmatrix}$ D) $\begin{bmatrix} -5 & -8 \\ -10 & -3 \end{bmatrix}$	1
6	Which of the following statements is true for the function $f(x) = \begin{cases} x^2 + 3, & x \neq 0 \\ 1, & x = 0 \end{cases}$?	1

	(A) $f(x)$ is continuous and differentiable $\forall x \in R$ (B) $f(x)$ is continuous $\forall x \in R$ (C) $f(x)$ is continuous and differentiable $\forall x \in R - \{0\}$ (D) $f(x)$ is discontinuous at infinitely many points	
7	The derivative of $\cos(x^2)$ w.r.t x , at $x = \sqrt{\pi}$ is (A) 1 (B) 0 (C) $-2\sqrt{\pi}$ (D) $2\sqrt{\pi}$	1
8	Let $f(x)$ be a differentiable on (a,b) and continuous on $[a,b]$. Then this function $f(x)$ is strictly decreasing in (a,b) if (A) $f'(x) < 0, \forall x \in (a,b)$ (B) $f'(x) > 0, \forall x \in (a,b)$ (C) $f'(x) = 0, \forall x \in (a,b)$ (D) $f'(x) \geq 0, \forall x \in (a,b)$	1
9	If $\frac{d}{dx}(f(x)) = \log x$, then $f(x)$ equals to (A) $\frac{1}{x} + c$ (B) $x(\log(x/e) + c)$ (C) $x(\log x + x) + c$ (D) $-\frac{1}{x} + c$	1
10	$\int_0^{\frac{\pi}{6}} \sec^2(x - \frac{\pi}{6}) dx$ is equals to (A) $\sqrt{3}$ (B) $-\sqrt{3}$ (C) $-\frac{1}{\sqrt{3}}$ (D) $\frac{1}{\sqrt{3}}$	1
11	The area bounded by the curve $y = x^2$ and the lines $x = 0$ and $x = 1$ and x - axis is A) $1/3$ B) $1/6$ C) $1/2$ D) $1/4$	1
12	The integrating factor of the differential equation $(1-x^2) \frac{dy}{dx} + xy = ax, -1 < x < 1$ is A) $\frac{1}{x^2-1}$ B) $\frac{1}{-x^2+1}$ C) $\frac{1}{\sqrt{x^2-1}}$ D) $\frac{1}{\sqrt{-x^2+1}}$	1
13	The sum of order and degree of the differential equation $[1 + (\frac{dy}{dx})^2]^3 = \frac{d^2y}{dx^2}$ respectively are A) 4 B) 3 C) 5 D) 2	1
14	The value of 'p' if the projection of vector $\hat{i} + p\hat{j}$ on vector $\hat{i} - \hat{j}$ is $\sqrt{2}$ A) -1 B) 0 C) 1 D) 3	1
15	The vector joining two points A(2,-3,5) and B(3,-4,7) is (A) $\hat{i} - \hat{j} + 2\hat{k}$ (B) $\hat{i} + \hat{j} + 2\hat{k}$ (C) $-\hat{i} - \hat{j} - 2\hat{k}$ (D) $-\hat{i} + \hat{j} - 2\hat{k}$	1
16	The number of corner points of the feasible region determined by the constraints $x \geq 0, y \geq 0, x - y \geq 0, 2y \leq x + 2$ is A) 0 B) 1 C) 2 D) 3	1
17	A linear programming problem deals with the optimization of a/an A) logarithmic function B) linear function C) quadratic function D) exponential function	1
18	If $P(A/B) = 0.3, P(A) = 0.4$ and $P(B) = 0.8$, then $P(B/A)$ is equals to A) 0.6 B) 0.3 C) 0.06 D) 0.4	1
	<i>Questions number 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below.</i> A) Both Assertion (A) and Reason (R) is the correct explanation of the Assertion (A)	

	B) Both Assertion (A) and Reason (R) is not the correct explanation of the Assertion (A) C) Assertion (A) is true, but (R) is false D) Assertion (A) is false, but (R) is true	
19	Assertion (A) : The range of the function $f(x) = 2\sin^{-1}x + \frac{3\pi}{2}$, where $x \in [-1, 1]$, is $[\frac{\pi}{2}, \frac{5\pi}{2}]$ Reason (R) : The range of the principal value branch of $\sin^{-1}x$ is $[0, \pi]$.	1
20	Assertion (A): The Principal value of the function $f(x) = \sin^{-1}(\sin \frac{2\pi}{3}) + \cos^{-1}(\cos \frac{2\pi}{3})$, where $x \in [-1, 1]$ is π Reason (R): The range of the principal value branch of $\cos^{-1}x$ is $[0, \pi]$ and $\sin^{-1}x$ is $[-\frac{\pi}{2}, \frac{\pi}{2}]$	1
	<u>SECTION – B</u> <i>This section comprises very short answers (VSA) type questions of 2 marks each.</i>	
21	Check whether the function $f(x) = x x$ is differentiable at $x = 0$ or not. OR If $y = \sqrt{\tan \sqrt{x}}$, prove that $\sqrt{x} \, dy/dx = \frac{1+y^4}{4y}$.	2
22	If the product of two positive numbers is 9, find the numbers so that the sum of their squares is minimum.	2
23	If α, β, γ are the angles made by the lines with x, y and z axes then show that $\cos 2\alpha + \cos 2\beta + \cos 2\gamma = -1$	2
24	Let $\vec{a} = 2\hat{i} - 4\hat{j} + 5\hat{k}$, $\vec{b} = 3\hat{i} - 6\hat{j} + 2\hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ are such that $(\vec{a} + \mu\vec{b})$ is perpendicular to $\vec{c}$, then find the value of μ. OR If $\vec{a}$ and $\vec{b}$ are two non-zero vectors such that $(\vec{a} + \vec{b})$ is perpendicular to $\vec{a}$ and $(2\vec{a} + \vec{b})$ is perpendicular to $\vec{b}$, then prove that $\vec{b} = \sqrt{2} \vec{a}$	2
25	Find the principal value of $\cos^{-1}(1/2) - 2\sin^{-1}(-1/2)$.	2
	<u>SECTION – C</u> <i>This section comprises short answers (SA) type questions of 3 marks each</i>	
26	Find the intervals in which the function $f(x) = 2x^3 - 9x^2 + 12x + 15$ is strictly increasing or strictly decreasing.	3
27	The volume of cube is increasing at the rate of $9 \text{ cm}^3/\text{sec}$. How fast is surface area is increasing when the length of the edge is 10 cm.	3
28	Find $\int \frac{1}{\cos(x-a) \cos(x-b)} dx$ OR Evaluate $\int \frac{\cos x}{(\sin x - 1)(\sin x - 2)} dx$	3
29	Using vectors find the area of triangle with vertices are A (1,1,2), B (2,3,5), C (1,5,5). OR Show that the points A, B, C with position vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} - 3\hat{j} - 5\hat{k}$ and $3\hat{i} - 4\hat{j} - 4\hat{k}$ respectively, are the vertices of a right-angled triangle. Hence find the area of the triangle.	3
30	Solve the following linear programming problem graphically: Maximise $z = 600x + 400y$, Subject to constraints	3

	$\begin{aligned} x+2y &\leq 12, \\ 2x+y &\leq 12, \\ x+1.25y &\geq 5, \\ x &\geq 0, y \geq 0 \end{aligned}$	
31	Two events A and B are independent. If $P(A) = 0.6$ and $P(\text{not } B) = 0.3$ Then find the probability that (i) Both the events A and B occur (ii) Exactly one of the events A or B occurs.	3
	<u>SECTION-D</u> <i>This section comprises Long answers (LA) type questions of 5 marks each</i>	
32	If $A = \begin{bmatrix} 1 & -2 & 0 \\ 2 & -1 & -1 \\ 0 & -2 & 1 \end{bmatrix}$, find A^{-1} and use it to solve the system of following equations: $x-2y = 10, 2x-y-z = 8, -2y+z = 7$ OR If $A = \begin{bmatrix} -1 & a & 2 \\ 1 & 2 & x \\ 3 & 1 & 1 \end{bmatrix}$ and $A^{-1} = \begin{bmatrix} 1 & -1 & 1 \\ -8 & 7 & -5 \\ b & y & 3 \end{bmatrix}$, find the value of $(a+x) - (b+y)$.	5
33	Using integration, find the area of the region bounded by the curves $y = x^2$, $y = x+2$ and x- axis.	5
34	Find the shortest distance between the following two lines: $\vec{r} = (4\hat{i} - \hat{j}) + \lambda(\hat{i} + 2\hat{j} - 3\hat{k}), \vec{r} = (\hat{i} - \hat{j} + 2\hat{k}) + \mu(2\hat{i} + 4\hat{j} - 5\hat{k}).$ OR Show that the lines $\vec{r} = (3\hat{i} + 2\hat{j} - 4\hat{k}) + \lambda(\hat{i} + 2\hat{j} + 2\hat{k}), \vec{r} = (5\hat{i} - 2\hat{j}) + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})$ are intersecting. Hence find their point of intersection.	5
35	If $x = a(\cos t + t \sin t)$, $y = a(\sin t - t \cos t)$ find $\frac{d^2y}{dt^2}, \frac{d^2x}{dt^2}, \frac{d^2y}{dx^2}$ OR If $\sqrt{1-x^2} + \sqrt{1-y^2} = a(x-y)$, prove that $\frac{dy}{dx} = \sqrt{\frac{1-y^2}{1-x^2}}$	5
	<u>SECTION-E</u> <i>This section comprises 3 case study-based questions of 4 marks each.</i>	
36	Case Study-1 An organization conducted bike race under 2 different categories boys and girls. In all there were 250 participants. Among all of them finally three from category 1 and 2 from category 2 were selected for the final race. Ravi forms two sets B and G with these participants for his college projects. Let $B = \{b_1, b_2, b_3\}$, $G = \{g_1, g_2\}$ where B represents for the set of boys selected and G the set of all girls who were selected for the final race. Ravi decides to explore these two sets for various types of relations and functions. On the basis of the above information, answer the following questions: (i) Ravi wishes to form all the relations possible from B to G. How many such relations possible? (ii) Write smallest equivalence relation on G.	1 1

	(iii) (a) Ravi defines a relation from B to B as $R_1 = \{(b_1, b_2), (b_2, b_1)\}$. Write the minimum ordered pairs to be added to R_1 so that it becomes (A) reflexive but not symmetric, (B) reflexive and symmetric but not transitive. OR (b) If the track of the final race (for biker b_1) follows the curve $x^2 = 4y$, (where $0 \leq x \leq 20\sqrt{2}$ and $0 \leq y \leq 200$), then state whether the track represents one-one and onto or not. Justify?	2
37	Case Study-2 The traffic police have installed Over Speed Violation Detection (OSVD) system at various locations in a city. These cameras can capture a speeding vehicle from a distance of 300 m and even function in the dark. A camera is installed on a pole at a height of 5 m. It detects a car travelling away from the pole at the speed of 20m/s. At any point 'x' m away from the base of the pole, the angle of elevation of the speed camera from the car is θ. On the basis of the above information, answer the following questions: (i) Express θ in terms of height of the camera installed on the pole and x. (ii) Find $\frac{d\theta}{dx}$. (iii) Find the rate of change of angle of elevation with respect to time at an instant when the car is 50 m away from the pole. OR If the rate of change of angle of elevation with respect to time of another car at a distance of 50 m from the base of the pole is $3/101$ rad, then find the speed of the car.	1 1 2
38	Case Study-3 According to the recent research, air turbulence has increased in various regions around the world due to climate change. Turbulence makes flights bumpy and often delays the flights. Assume that, an airplane observes severe turbulence, moderate turbulence or light turbulence with equal probabilities. Further, the chance of an airplane reaching late to the destination are 55% , 37% and 17% due to severe, moderate and light turbulence respectively. On the basis of the above information, answer the following questions: (i) Find the probability that an airplane reached its destination late. (ii) If the airplane reached its destination late, find the probability that it was due to moderate turbulence.	2 2

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION
MODEL QUESTION PAPER - 6 (2025 – 26)
CLASS- XII
SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

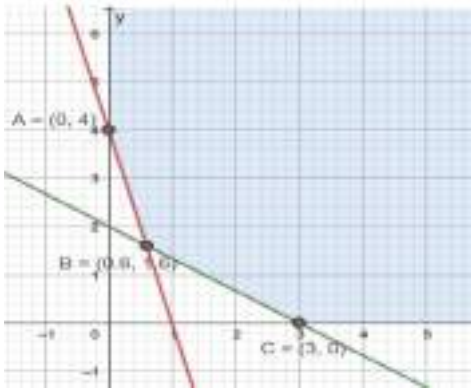
General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

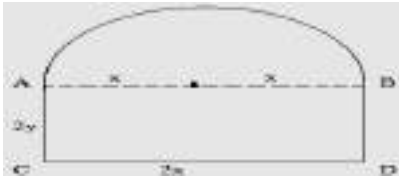
Q. No.	Question	Marks
SECTION – A (1 x 20 = 20) (This section comprises of multiple choice questions (MCQs) of 1 mark each)		
1	If $A = \begin{bmatrix} \sin \alpha & \cos \alpha \\ -\cos \alpha & \sin \alpha \end{bmatrix}$ then the value of the product AA^T is a) Null matrix b) I c) A^2 d) A	1M
2	Let $A = \begin{bmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{bmatrix}$, then the only correct statement about the matrix A is a) A^{-1} does not exist. b) $A^2 = I$ c) A is a zero matrix d) $A = (-1)I$, where I is identity matrix	1M
3	The value of the integral $\int_{-\pi}^{\pi} \cos^2 x \sin^3 x dx$ a) π b) 2π c) 0 d) $-\pi$	1M

4	If A and B are invertible matrices of order 3, $ A = 2$ and $ (AB)^{-1} = 6$. Find $ B $ a) 3 b) $\frac{1}{3}$ c) 12 d) $\frac{1}{12}$	1M
5	Find x, if $\begin{vmatrix} 2 & 4 \\ 5 & 1 \end{vmatrix} = \begin{vmatrix} 2x & 4 \\ 6 & x \end{vmatrix}$ a) 1 b) ± 2 c) $\pm \sqrt{3}$ d) $\pm \sqrt{2}$	1M
6	The sum of order and degree of differential equation $\frac{dy}{dx} + \frac{1}{\left(\frac{dy}{dx}\right)} = \sin x$ is, a) 1 b) 2 c) 3 d) not defined	1M
7	If $(3\hat{i} + \lambda\hat{j} + 6\hat{k}) \times (2\hat{i} - 2\hat{j} + \mu\hat{k}) = \vec{0}$, then $\lambda + \mu =$ a) 1 b) 2 c) 3 d) 0	1M
8	If $y = (\sin x)^x$, then $\frac{dy}{dx} =$ a) $y(x \cot x + \log \sin x)$ b) $x(\sin x)^{x-1}$ c) $y(x \tan x + \log \sin x)$ d) $x \cot x - \log \sin x$	1M
9	Let A & B be two events where $P(A) = \frac{1}{4}$, $P(B) = \frac{1}{2}$ & $P(A \cap B) = \frac{1}{8}$. Then, $P(\overline{A} \cap \overline{B}) =$ a) $\frac{7}{8}$ b) $\frac{3}{8}$ c) $\frac{5}{8}$ d) $\frac{1}{8}$	1M
10	If $A = \begin{bmatrix} 2 & 0 & -3 \\ 4 & 3 & 1 \\ -5 & 7 & 2 \end{bmatrix}$ is expressed as the sum of a symmetric and skew symmetric matrix, then the symmetric matrix is a) $A = \begin{bmatrix} 2 & 2 & -4 \\ 2 & 3 & 4 \\ -4 & 4 & 2 \end{bmatrix}$ b) $A = \begin{bmatrix} 2 & 4 & -5 \\ 0 & 3 & 7 \\ -3 & 1 & 2 \end{bmatrix}$ c) $A = \begin{bmatrix} 4 & 2 & -4 \\ 2 & 6 & 4 \\ -4 & 4 & 4 \end{bmatrix}$ d) $A = \begin{bmatrix} 4 & 4 & -8 \\ 4 & 6 & 8 \\ -8 & 8 & 4 \end{bmatrix}$	1M
11	If $f(x) = \begin{cases} \frac{1 - \cos 4x}{x^2}, & x \neq 0 \\ k, & x = 0 \end{cases}$ is a continuous function at $x = 0$, then $k =$ a) 2 b) 4 c) 8 d) 16	1M
12	If $\vec{a}$ is a unit vector and $(\vec{a} + \vec{x}) \cdot (\vec{x} - \vec{a}) = 17$, then $ \vec{x} =$ a) ± 4 b) 4 c) $\pm 3\sqrt{2}$ d) $3\sqrt{2}$	1M

13	The corner points of the shaded unbounded feasible region of an LPP are (0, 4), (0.6, 1.6) and (3, 0) as shown in the figure. The minimum value of the objective function $Z = 4x + 6y$ occurs at (a) (0.6, 1.6) <i>only</i> (b) (3, 0) <i>only</i> (c) at both (0.6, 1.6) and (3, 0) (d) at every point of the line-segment joining the points (0.6, 1.6) and (3, 0).		1M
14	The projection of the vector $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ on $\vec{b} = \hat{i} - 2\hat{j} + \hat{k}$ is: (a) $\frac{\sqrt{5}}{2}$ (b) $\frac{5}{\sqrt{2}}$ (c) $\frac{5}{\sqrt{6}}$ (d) $\frac{\sqrt{6}}{5}$	1M	
15	If a line makes an angle α, β, γ with x, y z axis, then $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma =$ a) 1 b) 2 c) 0 d) 3	1M	
16	Corner points of the feasible region determined by the system of linear constraints are (0, 10), (5, 5), (15, 15) and (0, 20). Let $Z = px + qy$ where $p, q > 0$. Condition on p and q so that the maximum of Z occurs at both the points (15, 15) and (0, 20) is a) $p = 2q$ b) $2p = q$ c) $p = q$ d) $q = 3p$	1M	
17	Direction cosines of the line joining the points (3, 7, -2) & (1, 4, 4) are a) (2,3,-6) b) (-2,-3,6) c) $(\frac{2}{7}, \frac{3}{7}, \frac{-6}{7})$ d) $(\frac{1}{7}, \frac{2}{7}, \frac{3}{7})$	1M	
18	The integrating factor of the differential equation is: $\frac{dy}{dx} - 2y \tan x = \sin x$ a) $2 \sec x$ b) $\cos^2 x$ c) $\sec^2 x$ d) $(\sec^{-1} x)^2$	1M	
ASSERTION-REASON BASED QUESTIONS <i>(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (a), (b), (c) and (d) as given below.)</i> (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.			
19	Assertion: The Relation R defined on $A = \{a, b, c\}$ and given by $R = \{(a, a), (b, b), (c, c), (a, b), (b, a), (a, c), (c, a)\}$ is an equivalence relation. Reason: A relation R is said to be equivalence relation if it is Reflexive, Symmetric and Transitive.	1M	
20	Assertion: function $f(x) = x$, has a point of local minima at $x = 0$	1M	

	Reason: $x = a$ is called a point of local minima for a function $f(x)$ if there is $h > 0$, such that $f(a - h) \geq f(a) \leq f(a + h)$, irrespective whether the function is differentiable at $x = a$ or not.	
SECTION B (2 x 5 = 10) (This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)		
21	Find the intervals the function $y = x^2 (2 - x)^2$ is increasing. OR Find the intervals of increasing for the function $f(x) = \sin x - \cos x$, $x \in [0, \pi]$	2M
22	Find the Principle branch value of $\cos^{-1}\{\cos \frac{13\pi}{6}\}$	2M
23	If $y = e^x + e^{-x}$, then show that $\frac{dy}{dx} = \sqrt{y^2 - 4}$.	2M
24	Evaluate $\int \frac{1 - \tan x}{1 + \tan x} dx$ OR Evaluate $\int \frac{e^x(x+4)}{(x+5)^2} dx$	2M
25	The volume of a sphere is increasing at the rate of 3 cm^3 per second. Find the rate of increase of its surface area, when the radius is 2cm.	2M
SECTION C (3 x 6 = 18) (This section comprises of 6 short answer (SA) type questions of 3 marks each.)		
26	Two students Raju and Ravi are seeking job in a company. The probability that Raju is selected is 0.4 and the probability of selection of exactly one of the them is 0.5. Chances of selection of them is independent of each other. Find the chances of selection of Ravi. Also find the probability of selection of at least one of them. OR Probabilities of solving a specific problem independently by A and B are $\frac{1}{2}$ and $\frac{1}{3}$, respectively. If both try to solve problem independently, then find the probability that (i) problem is solved. (ii) exactly one of them solves the problem.	3M
27	Solve the following Linear Programming Problem graphically: Objective function Maximize $Z = 5x + 10y$ Subject to constraints: $x + 2y \leq 120$, $x + y \geq 60$, $y \leq x$, $x, y \geq 0$	3M
28	Find the general solution of the differential equation: $(y^2 + 1) \frac{dx}{dy} + 2xy = \frac{1}{1 + y^2}$ OR Find the particular solution of the differential equation $y + x \sin\left(\frac{y}{x}\right) = x \frac{dy}{dx}$, given that when $x = 2$, $y = \pi/2$	3M

29	Evaluate the following Integral: $\int_{-5}^5 \frac{x^2}{1+e^x} dx \quad \text{OR} \quad \int_0^4 (x-1 + x-2) dx$	3M
30	Evaluate $\int \frac{2x}{(x^2+1)(x^2+2)} dx$	3M
31	If $y\sqrt{1+x^2} = \log[\sqrt{1+x^2} - x]$, then show that $(1+x^2)\frac{dy}{dx} + xy + 1 = 0$	3M
SECTION D (5m x 4 = 20m) <i>(This section comprises of 4 long answer (LA) type questions of 5 marks each)</i>		
32	Let $A = \{1, 2, 3, 4, \dots, 9\}$ be the set and R be a relation on $A \times A$ defined by: $(a, b) R (c, d) \Leftrightarrow a + d = b + c$ for all $(a, b), (c, d) \in N \times N$. Show that R is an equivalence relation on $A \times A$. Also, find the equivalence class of $(2,6)$. OR A function $f: [0, \infty) \rightarrow [-5, \infty)$ be defined by $f(x) = 3x^2 + 9x - 5$ Prove that the function is a one-one and on-to function.	5M
33	Find area enclosed by $y = x^2$ the line $y = x + 2$ and the x-axis. OR Find the area of the region given by $4x^2 + 9y^2 \leq 36$ and $1 \leq x \leq 2$.	5M
34	Use the product $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -3 \\ 3 & -2 & 4 \end{bmatrix} \begin{bmatrix} -2 & 0 & 1 \\ 9 & 2 & -3 \\ 6 & 1 & -2 \end{bmatrix}$ to solve the system of equations $x + 3z = 9; \quad -x + 2y - 2z = 4; \quad 2x - 3y + 4z = -3$	5M
35	(i) If $\vec{a} = 4\hat{i} + 5\hat{j} - \hat{k}$, $\vec{b} = -\hat{i} + 4\hat{j} - 5\hat{k}$, then find another vector $\vec{d}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$, and such that $\vec{c} \cdot \vec{d} = 21$ where $\vec{c} = 3\hat{i} + \hat{j} - \hat{k}$. (ii) Also find the sine of angle between the vectors: $\vec{a} = 4\hat{i} + 5\hat{j} - \hat{k}$, $\vec{b} = -\hat{i} + 4\hat{j} - 5\hat{k}$	5M
SECTION E (4m x 3 = 12m) <i>(This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)</i>		
Case Study-1		

36	Mr. Shashi, who is an architect, designs a building for a small company. The design of window on the ground floor is proposed to be different than other floors. The window is in the shape of a rectangle which is surmounted by a semi-circular opening. This window is having a perimeter of 10m as shown adjacent. based on the above information answer the following 	
i	If 2x and 2y represents the length and breadth of the rectangular portion of the windows, then find the relation between the variables x and y.	1M
ii	Find the combined area (A) of the rectangular region and semi-circular region of the window expressed as a function of x.	1M
iii	Find the maximum value of area A, of the whole window. (OR) The owner of this small company is interested in maximizing the area of the whole window so that maximum light input is possible. For this to happen, find the length of rectangular portion of the window	2M
Case Study-2		
37	For Republic Day Parade Fly past, Stunning bird's eye visuals of the formations and the aircraft flying above the clouds will be telecasted. Two aero planes leading the fly-past flying one above the other need to maintain constant distance between them and have to follow the path given by the equation of line : $\frac{x-200}{90} = \frac{y-200}{-60} = \frac{z+100}{-20} \text{ and } \vec{r} = \lambda(9\hat{i} - 6\hat{j} - 2\hat{k})$ Based on the following information, answer the following question 	
i	What type of safe path followed by two planes and why?	1M
ii	Find unit vector in the direction of the path followed by the planes?	1M
iii	Find the shortest distance between the two planes which will be maintained throughout the journey.	2M
Case Study- 3		
38	The members of a consulting firm rent cars from three rental agencies :  Agency X  Agency Y  Agency Z 50% from agency X, 30% from agency Y and 20% from agency Z.	

	From past experience, it is known that 9% of the cars from agency X need a service and tuning before renting, 12% of cars from agency Y need a service and tuning before renting and 10% of the cars from agency Z need a service and tuning before renting. Assume that the rental car delivered to the firm needs service and tuning. For the information given above, answer the following.	
i	What is the probability that the car needs service and tuning?	2M
ii	Find the probability that the cars need service and tuning, if it came from agency Z.	2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER- 7 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q.NO.	Question	Marks
1	The value of $\int_{-2}^2 (x \cos x + \sin x + 1) dx$ is (a) 2 (b) 0 (c) -2 (d) 4	1M
2	$\int \frac{\sin 2x}{\sin^2 x + 2 \cos^2 x} dx$ is equal to (a) $-\log(1 + \sin^2 x) + C$ (b) $\log(1 + \cos^2 x) + C$ (c) $-\log(1 + \cos^2 x) + C$ (d) $\log(1 + \tan^2 x) + C$	1M

3	If $ \vec{a} \times \vec{b} ^2 + \vec{a} \cdot \vec{b} ^2 = 144$ and $ \vec{a} = 4$, then $ \vec{b} $ is equal to (a) 16 (b) 8 (c) 3 (d) 12	1M
4	If A and B are two equivalence relations defined on set C, then (a) $A \cup B$ is an equivalence relation (b) $A \cap B$ is not an equivalence relation (c) $A \cap B$ is an equivalence relation (d) none of the above	1M
5	If $x = e^y$ then $\frac{dy}{dx}$ is equal to (a) $\frac{1}{x}$ (b) $\frac{1-x}{x}$ (c) $\frac{x}{1+x}$ (d) None of these	1M
6	The derivative of $\log x $ is (a) $\frac{1}{x}, x > 0$ (b) $\frac{1}{ x }, x \neq 0$ (c) $\frac{1}{x}, x \neq 0$ (d) None of these	1M
7	Which of the following function is decreasing on $(0, \pi/2)$? (a) $\sin 2x$ (b) $\cos 3x$ (c) $\tan x$ (d) $\cos 2x$	1M
8	The condition that $f(x) = ax^3 + bx^2 + cx + d$ has no extreme value is (a) $b^2 > 3ac$ (b) $b^2 = 4ac$ (c) $b^2 = 3ac$ (d) $b^2 < 3ac$	1M
9	$\int_0^{\pi/2} \frac{\sin x - \cos x}{1 + \sin x \cos x} dx$ is equal to (a) 0 (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) π	1M

10	The area bounded by the curve $y = \frac{1}{2}x^2$, the x -axis and the ordinate $x = 2$ is (a) $\frac{1}{3}$ sq unit (b) $\frac{2}{3}$ sq unit (c) 1 sq unit (d) $\frac{4}{3}$ sq unit	1M
11	The solution of $\frac{dy}{dx} = \frac{ax+g}{by+f}$ represents a circle, when (a) $a = b$ (b) $a = -b$ (c) $a = -2b$ (d) $a = 2b$	1M
12	If A and B are two symmetric matrices of same order. Then, the matrix $AB - BA$ is equal to (a) a symmetric matrix (b) a skew-symmetric matrix (c) a null matrix (d) the identity matrix	1M
13	The family of curves $y = e^{a \sin x}$, where a is an arbitrary constant is represented by the differential equation (a) $\log y = \tan x \frac{dy}{dx}$ (b) $y \log y = \tan x \frac{dy}{dx}$ (c) $y \log y = \sin x \frac{dy}{dx}$ (d) $\log y = \cos x \frac{dy}{dx}$	1M
14	The order of the differential equation whose solution is $y = a \cos x + b \sin x + ce^{-x}$, is (a) 3 (b) 1 (c) 2 (d) 4	1M
15	If A & B are two independent events such that $P(A) = \frac{1}{2}$ and $P(B) = \frac{1}{3}$, then P (neither A nor B) is equal to (a) $\frac{2}{3}$ (b) $\frac{1}{6}$ (c) $\frac{5}{6}$ (d) $\frac{1}{3}$	1M
16	If the points (x_1, y_1) , (x_2, y_2) and (x_1+x_2, y_1+y_2) are collinear, then $x_1 y_2$ is equal to	1M

	(a) x_2y_1 (b) x_1y_1 (c) x_2y_2 (d) x_1x_2	
17	If $P(A \cup B) = 0.83$, $P(A) = 0.3$ and $P(B) = 0.6$, then the events will be (a) Not independent (b) independent (c) cannot say anything (d) None of the above	1M
18	If $\vec{x}$ and $\vec{y}$ are unit vectors and $\vec{x} \cdot \vec{y} = 0$, then (a) $ \vec{x} + \vec{y} = 1$ (b) $ \vec{x} + \vec{y} = \sqrt{3}$ (c) $ \vec{x} + \vec{y} = 2$ (d) $ \vec{x} + \vec{y} = \sqrt{2}$	1M
19	Let us define $\tan^{-1} A + \tan^{-1} B = \tan^{-1} \left(\frac{A+B}{1-AB} \right)$ Assertion : The value of $\tan^{-1} \left(\frac{3}{4} \right) + \tan^{-1} \left(\frac{1}{7} \right)$ is $\frac{\pi}{4}$. Reason : If $x > 0, y > 0$ then $\tan^{-1} \left(\frac{x}{y} \right) + \tan^{-1} \left(\frac{y-x}{y+x} \right) = \frac{\pi}{4}$ (a) Assertion is true, Reason is true, Reason is a correct explanation for assertion. (b) Assertion is true, Reason is true, Reason is not a correct explanation for assertion. (c) Assertion is true, Reason is false. (d) Assertion is false, Reason is true.	1M
20	Assertion: If A is a matrix of order 2×2 , then $ \text{adj}A = A $ Reason: $ A = A^T $ (a) Assertion is true, reason is true, reason is a correct explanation for assertion. (b) Assertion is true, reason is true, reason is not a correct explanation for assertion. (c) Assertion is true, reason is false. (d) Assertion is false, reason is true.	1M
SECTION B This section comprises of very short answer type questions (VSA) of 2 marks each		
21	The cost (in rupees) of producing x items in factory, each day is given by $C(x) = 0.00013x^3 + 0.002x^2 + 5x + 2200$ Find the marginal cost when 150 items are produced.	2M

22	Write the value of $\int \frac{e^x}{1+e^{2x}} dx$.	2M
23	Write a unit vector in the direction of the sum of the vectors $\vec{a} = 2\hat{i} + 2\hat{j} - 5\hat{k}$ and $\vec{b} = 2\hat{i} + \hat{j} - 7\hat{k}$. OR If $\vec{a} = \hat{i} - \hat{j} + 7\hat{k}$ and $\vec{b} = 5\hat{i} - \hat{j} + \lambda\hat{k}$, then find the value of λ , so that $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are perpendicular vectors.	2M
24	Write the vector equation of a line passing through point $(1, -1, 2)$ and parallel to the line whose equation is $\frac{x-3}{1} = \frac{y-1}{2} = \frac{z+1}{-2}$.	2M
25	Two groups are computing for the positions of the Board of Directors of a corporation. The probabilities that the first and second groups will win are 0.6 and 0.4 respectively. Further, if the first group wins, the probability of introducing a new product is 0.7 and if second group wins probability of introducing new product is 0.3. Find the probability that new product is introduced by the second group.	2M
SECTION C (This section comprises of short answer type questions (SA) of 3 marks each)		
26	Consider the following Linear Programming Problem: Minimise $Z = x + 2y$ Subject to $2x+y \geq 3, x + 2y \geq 6, x, y \geq 0$ Show graphically that the minimum of Z occurs at more than two points	3M
27	Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = 4\hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{c} = \hat{i} - 2\hat{j} + \hat{k}$. Find a vector of magnitude 6 units, which is parallel to the vector $2\vec{a} - \vec{b} + 3\vec{c}$.	3M
28	Evaluate $\int_0^{\pi/2} x^2 \sin x dx$. OR Evaluate $\int_{\pi/4}^{\pi/2} \cos 2x \cdot \log(\sin x) dx$	3M
29	Solve for $x, \cos^{-1} x + \sin^{-1} \left(\frac{x}{2} \right) = \frac{\pi}{6}$.	3M

30	Evaluate $\int \frac{x^2+x+1}{(x^2+1)(x+2)} dx$.	3M
31	Given $A = \begin{bmatrix} 2 & -3 \\ -4 & 7 \end{bmatrix}$, compute A^{-1} and show that $2A^{-1} = 9I - A$. OR If $A = \begin{bmatrix} 2 & 3 \\ 5 & -2 \end{bmatrix}$ be such that $A^{-1} = kA$, then find the value of k.	3M
SECTION D (This section comprises of long answer-type questions (LA) of 5 marks each)		
32	(a) Find the shortest distance between the lines l_1 and l_2 whose vector equations are $\vec{r} = (-i^{\wedge} - j^{\wedge} - k^{\wedge}) + \lambda(7i^{\wedge} - 6j^{\wedge} + k^{\wedge})$ and $\vec{r} = (3i^{\wedge} + 5j^{\wedge} + 7k^{\wedge}) + \mu(i^{\wedge} - 2j^{\wedge} + k^{\wedge})$. Where λ and μ are parameters (b) Find the image of the point (1,2, 1) with respect to the line $\frac{x-3}{1} = \frac{y+1}{2} = \frac{z-1}{3}$. Also find the equation of the line joining the given point and its image.	5M
33	Draw the rough sketch of the curve $y = 20 \cos 2x$; (where $\pi/6 \leq x \leq \pi/3$) using integration, find the area of the region bounded by the curve $y = 20 \cos 2x$ from the ordinates $x = \frac{\pi}{6}$ to $x = \frac{\pi}{3}$ and the x - axis.	5M
34	If $A = \begin{bmatrix} 1 & -1 \\ 2 & -1 \end{bmatrix}$, $B = \begin{bmatrix} a & 1 \\ b & -1 \end{bmatrix}$ and $(A + B)^2 = A^2 + B^2$ then find the values of a and b OR Find the adjoint of the matrix $A = \begin{bmatrix} -1 & -2 & -2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{bmatrix}$ and hence show that $A(\text{adj } A) = A I_3$	

35	If $x = \cos t + \log \tan\left(\frac{t}{2}\right)$, $y = \sin t$, then find the values of $\frac{d^2y}{dt^2}$ and $\frac{d^2y}{dx^2}$ at $t = \frac{\pi}{4}$. OR Find the values of a and b, if the function f defined by $f(x) = \begin{cases} x^2 + 3x + a, & x \leq 1 \\ bx + 2, & x > 1 \end{cases}$ is differentiable at $x = 1$.	5M
SECTION E (This section comprises of 3 case-study/passage-based questions of 4 marks each with two sub-parts. First case study questions have three sub parts (i), (ii), (iii) of marks 1,1,2 respectively. The second and third case study questions have two sub parts of 2 marks each)		
36	An organization conducted bike race under 2 different categories-boys and girls. In all, there were 250 participants. 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 $B = \{b_1, b_2, b_3\}$, $G = \{g_1, g_2\}$ where B represents the set of boys selected and G the set of girls who were selected for the final race. Ravi decides to explore these sets for various types of relations and functions. On the basis of the above information, answer the following questions: (i) Ravi wishes to form all the relations possible from B to G. How many such relations are possible? (ii) Write the smallest equivalence relation on G. iii) (a) Ravi defines a relation from B to B as $R_1 = \{(b_1, b_2), (b_2, b_1)\}$. Write the minimum ordered pairs to be added in R_1 so that it becomes (A) reflexive but not symmetric, (B) reflexive and symmetric but not transitive. OR (iii) (b) If the track of the final race (for the biker b_1) follows the curve $x^2 = 4y$; (where $0 \leq x \leq 20\sqrt{2}$ & $0 \leq y < 200$), then state whether the track represents a one-one and onto function or not. (Justify).	1M 1M 2M
37	Chemical reaction, a process in which one or more substances, the reactants, are converted to one or more different substances, the products. Substances are either chemical elements or compounds. A chemical reaction rearranges the constituent atoms of the reactants to create different substances as products.	

	In a certain chemical reaction, a substance is converted into another substance at a rate proportional to the square of the amount of the first substance present at any time t. Initially ($t = 0$) 50 g of the first substance was present; 1 hr later, only 10 g of it remained. (i) Find an expression that gives the amount of the first substance present at any time t. (ii) What is the amount present after 2 hr ?	2M 2M
38	An insurance company believes that people can be divided into two classes: those who are accident prone and those who are not. The company's statistics show that an accident-prone person will have an accident at sometime within a fixed one-year period with probability 0.6, whereas this probability is 0.2 for a person who is not accident prone. The company knows that 20% of the population is accident prone. On the basis of above information, answer the following questions. (i) What is the probability that a new policyholder will have an accident within a year of purchasing a policy? (ii) Suppose that a new policy holder has an accident within a year of purchasing a policy. What is the probability that he or she is accident prone?	2M 2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER-8 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

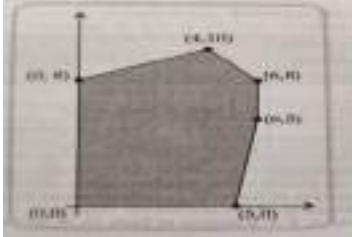
Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q. No.	Question	Marks
SECTION – A (1 x 20 = 20)		
<i>(This section comprises of multiple-choice questions (MCQs) of 1 mark each)</i>		
1	The value of $\tan^{-1} \left[2 \sin \left(2 \cos^{-1} \frac{\sqrt{3}}{2} \right) \right]$ is (a) $\frac{\pi}{3}$ (b) $\frac{2\pi}{3}$ (c) $-\frac{\pi}{3}$ (d) $\frac{\pi}{6}$	1M
2	If A is a square matrix such that $A^2 = A$, then $(I + A)^3 - 7A$ is equal to a) A b) I – A c) I d) 3A	1M
3	If $A = \begin{bmatrix} 2 & x-3 & x-2 \\ 3 & -2 & -1 \\ 4 & -1 & -5 \end{bmatrix}$ is a symmetric matrix then x is a) 3 (b) 6 (c) 8 (d) 0	1M
4	A is 3×3 matrix such that $A (\text{adj } A) = 10I$ then $ \text{adj } A $ a) 1 b) 10 c) 100 d) 1000	1M

5	If $\begin{bmatrix} 2x+5 & 3 \\ 5x+2 & 9 \end{bmatrix}$ is singular matrix then $x =$ a) 13 b) 9 c) -9 d) -13	1M
6	If A and B are square matrices of order 3 such that $ A = -1$ and $ B = 3$, then the value of the determinant of $3AB$ is a) -9 b) -27 c) -81 d) 81	1M
7	Find the value (s) of k so that the following function is continuous at $x = 0$, $f(x) =$ $\begin{cases} \frac{1-\cos kx}{x \sin x}, & \text{if } x \neq 0 \\ \frac{1}{2}, & \text{if } x = 0 \end{cases}$ 1) 1 2) -1 3) ± 1 4) None of these	1M
8	The amount of pollution content added in air in a city due to x-diesel vehicles is given by $P(x) = 0.005x^3 + 0.02x^2 + 30x$. The marginal increase in pollution content when 3 diesel vehicles are added a) 30 units b) 30.255 units c) 31 units d) 31.255 units	1M
9	$\int \frac{\cos 2x - \cos 2\theta}{\cos x - \cos \theta} dx$ is equal to a) $2(\sin x + x \cos \theta) + C$ b) $2(\sin x - x \cos \theta) + C$ c) $2(\sin x + 2x \cos \theta) + C$ d) $2(\sin x - 2x \cos \theta) + C$	1M
10	$\int_0^{\frac{\pi}{2}} \cos x e^{\sin x} dx$ is equal to a) $e + 1$ b) $e - 1$ c) e d) $-e$	1M
11	Area of the region bounded by the curve $y = \cos x$ between $x = 0$ and $x = \pi$ is a) 2 sq. units b) 4 sq. units c) 3 sq. units d) 1 sq. unit	1M
12	The integrating factor of the differential equation $y dx - (x + 2y^2)dy = 0$ is a) $1/x$ b) e^x c) y d) $1/y$	1M
13	The degree of the differential equation $\left(\frac{dy}{dx}\right)^2 + \left(\frac{d^2y}{dx^2}\right)^3 = \sin\left(\frac{dy}{dx}\right)$ is a) 1 b) 2 c) 3 d) undefined	1M
14	The scalar product of $5\mathbf{i} + \mathbf{j} - 3\mathbf{k}$ and $3\mathbf{i} - 4\mathbf{j} + 7\mathbf{k}$ is a) 15 b) -15 c) 10 d) -10	1M
15	What is the vector in the direction of the vector $\hat{i} - 2\hat{j} + 2\hat{k}$ that has magnitude 9 is a) $\hat{i} - 2\hat{j} + 2\hat{k}$ b) $\frac{\hat{i} - 2\hat{j} + 2\hat{k}}{3}$ c) $3(\hat{i} - 2\hat{j} + 2\hat{k})$ d) $9(\hat{i} - 2\hat{j} + 2\hat{k})$	1M
16	The feasible solution for a LPP is shown in given figure. Let $Z = 3x - 4y$ be the objective function Minimum of Z occurs at 	1M

17	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) $3a = b$	1M
18	Given two independent events A and B such that $P(A) = 0.3$, $P(B) = 0.6$ and $P(A' \cap B')$ is a) 0.9 b) 0.18 c) 0.28 d) 0.1	1M
ASSERTION-REASON BASED QUESTIONS <i>(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)</i> (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.		
19	Assertion (A): $f(x) = [x]$ not continuous at $x = 2$ Reason (R): $f(x) = [x]$ not differentiable at $x = 2$	1M
20	Assertion (A) : The relation R on the set $N \times N$ defined by $(a, b)R(c, d) \Leftrightarrow a + d = b + c$, for all $(a, b), (c, d) \in N \times N$ is an equivalence relation. Reason (R) : Any relation is an equivalence relation, if it is reflexive, symmetric and transitive	1M
SECTION B (2 x 5 =10) <i>(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)</i>		
21	Find the domain of the function $f(x) = \sin^{-1}(x^2 - 4)$. Also find its range.	2M
22	Find $\frac{dy}{dx}$ at $x = 1, y = \frac{\pi}{4}$. If $\sin^2 y + \cos xy = K$	2M
23	Find the values of x for which function $f(x) = 2 + 3x - x^3$ is decreasing (OR) Find the smallest value of the polynomial $x^3 - 18x^2 + 96x$ in $[0, 9]$	2M
24	Find the angle between the two vectors $\vec{a} = \hat{i} - \hat{j}$ and $\vec{b} = \hat{i} + \hat{k}$.	2M
25	If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{a} \cdot \vec{b} = 1$ and $\vec{a} \times \vec{b} = \hat{j} - \hat{k}$, then find $ \vec{b} $ (OR) Find area of parallelogram whose diagonals are $4\hat{i} - \hat{j} - 3\hat{k}$ and $-2\hat{i} + \hat{j} - 2\hat{k}$.	2M
SECTION C (3 x 6 =18) <i>(This section comprises of 6 short answer (SA) type questions of 3 marks each.)</i>		
26	Prove that $y = \frac{4\sin\theta}{2+\cos\theta} - \theta$ is an increasing function of θ in $[0, \frac{\pi}{2}]$	3M
27	A rectangular Sheet of tin 45 cm by 24 cm is to be made into a box without top, by cutting off square from each corner and folding up the flaps. What should be the side of the square to be cut off so that the volume of the box is maximum? (OR) Find the maximum slope of the curve $y = -x^3 + 3x^2 + 9x - 27$	3M
28	Find the vector and Cartesian equation of the line passing through the point $P(-1, 3, -2)$ and perpendicular to the lines $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$, $\frac{x+2}{-3} = \frac{y-1}{2} = \frac{z+1}{5}$	3M

29	Find $\int \frac{dx}{x\sqrt{x^4-1}}$ OR Evaluate: $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{dx}{1+\sqrt{\tan x}}$	3M
30	Find graphically, Minimize: $z = x + 2y$ subject to constraints given below. $x + 2y \geq 100, 2x - y \leq 0, 2x + y \leq 200, x, y \geq 0$	3M
31	There are two boxes, namely Box I and Box II. Box I contains 3 red and 6 black balls. Box II contains 5 red and 5 black balls. One of the two boxes is selected at random and a ball is drawn at random. The ball drawn is found to be red. Find the probability that this red ball comes out from box - II. (OR) Assume that each born child is equally likely to be a boy or a girl. If a family has two children, then what is the conditional probability that both are girls?	3M
SECTION D (5 x 4 =20) (This section comprises of 4 long answer (LA) type questions of 5 marks each)		
32	If $A = \begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix}$, then find A^{-1} . Hence solve the following system of equations: $2x - 3y + 5z = 11, 3x + 2y - 4z = -5, x + y - 2z = -3$ (OR) If $A = \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{bmatrix}$, then show that $A^3 - 4A^2 - 3A + 11I = O$. Hence find A^{-1}	5M
33	If $y = x^x$, prove that $\frac{d^2y}{dx^2} - \frac{1}{y} \left(\frac{dy}{dx}\right)^2 - \frac{y}{x} = 0$	5M
34	Using integration, find the area of the region bounded by the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$.	5M
35	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 $\vec{r} = (5\hat{i} - \hat{j}) + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})$. Also, find whether the lines are intersecting or not. (OR) Find the image of the point (1,6,3) in the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$. Also, find the length of the segment joining the given point and its image	5M
SECTION D (4 x 3 =12) (This section comprises of 3 case-study/passage-based questions of 4 marks each with sub parts. The first two case study questions have three sub parts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two sub parts of 2 marks each)		
Case Study-1		
36	Raja visited the Exhibition along with her family. The Exhibition had a huge swing, which attracted many children. Raja found that the swing traced the path of a Parabola as given by $y = x^2$.  Based on the above information, answer the following questions.	
i	Let $f: N \rightarrow R$ be defined by $f(x) = x^2$. Find the Range of the function f?	1M
ii	Check the injectivity of the function $f: N \rightarrow N$ be defined by $f(x) = x^2$	1M

iii	Let $f: R \rightarrow R$ be defined by $f(x) = x^2$. Check if f is one-one or not. (OR) Let $f: R \rightarrow R$ be defined by $f(x) = x^2$. Check if f is onto or not	2M
Case Study-2		
37	A tank formed using a combination of a cylinder and a cone, offers better drainage as compared to float 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 conical tank is 45°  Based on the above information, answer the following questions	1M
i	Find the Volume of water in the tank in terms of its radius	1M
ii	Find the rate of change of radius at an instant when $r = 2\sqrt{2}\text{cm}$	2M
iii	Find the rate at which the wet surface of the conical tank is decreasing at an instant when radius $r = 2\sqrt{2} \text{ cm}$ (OR) Find the rate of change of height 'h' at an instant when slant height is 4 cm.	
Case Study- 3		
38	Tiki has started late for college. She is running towards Laboni bus-stop. To reach college she has to change buses from either Hidco Crossing or Dharmatala. For that she would take either bus A or bus B. Probability of getting into bus A, B are $3/7$, $4/7$ respectively. If she gets on bus A coming from Karunamoyee, she would get bus 1 or 2 from Hidco crossing. Probability of getting bus 1 from Hidco crossing is $2/5$, probability of getting bus 2 from Hidco crossing is $3/5$. If she gets on bus B from Quality crossing and gets bus 1 or bus 3 from Dharmatala. Probability of getting bus 1 from Dharmatala is $1/3$, probability of getting bus 3 from Dharmatala is $2/3$  Based on the above information, answer the following questions	
i	Tiki reaches college by bus 1. What is the probability that she caught bus B?	2M
ii	What is the probability that she reaches college by bus 2?	2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER- 9 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

SECTION – A (1 × 20 = 20)

(This section comprises of multiple-choice questions (MCQs) of 1 mark each)

1	The value of $\sin\left(\frac{\pi}{3} - \sin^{-1}\left(-\frac{1}{2}\right)\right)$ is (A) $\frac{1}{2}$ (B) $\frac{1}{3}$ (C) $\frac{1}{4}$ (D) 1	1m
2	If $A = (a_{ij})$ is a square matrix of order 2 such that $a_{ij} = \begin{cases} 1, & \text{when } i \neq j \\ 0, & \text{when } i = j \end{cases}$ then A is: (A) $\begin{pmatrix} 1 & 0 \\ 1 & 0 \end{pmatrix}$ (B) $\begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix}$ (C) $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ (D) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$	1m
3	Number of symmetric matrices of order 3x3 with each entry 1 or -1 is (A) 256 (B) 64 (C) 512 (D) 4	1m
4	For what value of x, the matrix $\begin{pmatrix} 3-x & 2 \\ x+1 & 3 \end{pmatrix}$ is singular? (A) 2 (B) $\frac{7}{2}$ (C) $\frac{7}{5}$ (D) $\frac{9}{5}$	1m

5	A matrix A of order 3 x 3 has determinant 8. What is the value of $ 4A $ (A) 613 (B) 421 (C) 512 (D) 291	1m
6	The co-factor of a_{32} in the determinant $\begin{vmatrix} 2 & 0 & 1 \\ 5 & 3 & 8 \\ 3 & 2 & 1 \end{vmatrix}$ is: (A) 11 (B) -11 (C) 12 (D) 10	1m
7	The number of points of discontinuity of $f(x)=[x]$ in $[3,7]$ is (A) 4 (B) 5 (C) 6 (D) 8	1m
8	The rate of change of the area of a circle with respect to its radius r at $r = 6$ cm is (A) 10π (B) 12π (C) 8π (D) 11π	1m
9	The value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin^9 x \, dx$ is: (A) 0 (B) 1 (C) -1 (D) 2	1m
10	If $\frac{d}{dx}(f(x)) = 5x^4 - \frac{4}{x^5}$ such that $f(2)=0$. Then $f(x)$ is (A) $x^5 + \frac{1}{x^4} - \frac{129}{8}$ (B) $x^5 + \frac{1}{x^4} + \frac{129}{8}$ (C) $x^5 + \frac{1}{x^4} - \frac{513}{6}$ (D) $x^5 + \frac{1}{x^4} + \frac{513}{6}$	1m
11	The area of the region bounded by $y = \cos x$ between $x = 0$ and $x = \pi$ is (A) 2sq unit (B) 4sq unit (C) 6sq unit (D) 1sq unit	1m
12	Integrating factor of the differential equation $\frac{dy}{dx} + y \tan x - \sec x = 0$ is (A) $\cos x$ (B) $\sec x$ (C) $e^{\cos x}$ (D) $e^{\sec x}$	1m
13	If $ \vec{a} = 2$, $ \vec{b} = 5$ and $ \vec{a} \times \vec{b} = 8$, then $\vec{a} \cdot \vec{b}$ is (A) 6 (B) 1 (C) 7 (D) 0	1m
14	The projection of the vector $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ on $\vec{b} = \hat{i} - 2\hat{j} + \hat{k}$ is: (A) $\frac{\sqrt{5}}{2}$ (B) $\frac{5}{\sqrt{2}}$ (C) $\frac{5}{\sqrt{6}}$ (D) $\frac{\sqrt{6}}{5}$	1m
15	The direction ratios of the line $\frac{2x-1}{3} = \frac{1-3y}{2} = \frac{z-3}{4}$ are: (A) 3,2,4 (B) 3,-2,4 (C) $\frac{3}{2}, \frac{2}{3}, 4$ (D) $\frac{3}{2}, -\frac{2}{3}, 4$	1m
16	Which of the following points is not in the feasible region of the constraints: $x + 2y \leq 8, 3x + 2y \leq 12, x \geq 0, y \geq 0$. (A) (0, -1) (B) (0, 1) (C) (2, 2) (D) (4, 0)	1m
17	Two dice are thrown once. If it is known that the sum of the numbers on the dice was less than 6 the probability of getting a sum 3 is (A) $\frac{1}{18}$ (B) $\frac{5}{18}$ (C) $\frac{1}{5}$ (D) $\frac{2}{5}$	1m

18	An LPP is one that is concerned with finding _____ of a linear function called _____ function of several variables (say x and y), subject to the conditions that the variables are _____ and satisfy set of linear inequalities called linear constraints. (A) objective, optimal value, negative. (B) optimal value, objective, negative. (C) optimal value, objective, non – negative. (D) objective, optimal value, non – negative.	1m
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ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)

- (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.

19	Let W be the set of words in the English dictionary. A relation R is defined on W as $R = \{(x, y) \in W \times W \text{ such that } x \text{ and } y \text{ have at least one letter in common}\}$ Assertion (A): R is reflexive. Reason (R): R is symmetric.	1m
20	Assertion(A): Let $y = t^{10} + 1; x = t^8 + 1$; then $\frac{d^2y}{dx^2} = \frac{20}{8}t$. Reason(R): In parametric differentiation $\frac{d^2y}{dx^2} = \frac{\frac{d}{dt}(\frac{dy}{dx})}{\frac{dx}{dt}}$	1m

SECTION B (2 x 5 =10)

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21	If $\cos(\tan^{-1} x) = \sin\left(\cot^{-1}\left(\frac{3}{4}\right)\right)$, then find the value of x. (OR) Simplify: $\tan^{-1}\left[2 \cos\left\{2 \sin^{-1}\left(\frac{1}{2}\right)\right\}\right]$	2m
22	If $x^2 + 2xy + y^3 = 42$ then find $\frac{dy}{dx}$.	2m

23	In a competition, a child tries to inflate a huge spherical balloon bearing slogans against child labour at the rate of 900 cubic centimetre of gas per second. Find the rate at which the radius of the balloon is increasing when its radius is 15 cm. (OR) The length x of a rectangle is decreasing at the rate of 5 cm/minute and the width y is increasing at the rate of 4 cm/minute, when $x = 8$ cm and $y = 6$ cm, find the rate of change of the area of rectangle.	2m
24	Find a vector perpendicular to each of the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ where $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ on $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$.	2m
25	If $\vec{a} = 2, \vec{b} = \sqrt{3}$ and $\vec{a} \cdot \vec{b} = \sqrt{3}$ find the angle between $\vec{a}$ and $\vec{b}$. (OR) Find the area of parallelogram, whose adjacent sides are determined by the vectors $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}, \vec{b} = 2\hat{i} + \hat{j} - 4\hat{k}$	2m
SECTION C (3 x 6 = 18) (This section comprises of 6 short answer (SA) type questions of 3 marks each.)		
26	Prove that the function f given by $f(x) = \log \sin x$ is strictly increasing on $\left(0, \frac{\pi}{2}\right)$ and strictly decreasing on $\left(\frac{\pi}{2}, \pi\right)$.	3m
27	Find the maximum profit that a company can make, if the profit function is given by $P(x) = 72 + 42x - x^2$, where x is the number of units and P is profit in rupees.	3m
28	Evaluate: $\int \frac{\sin^6 x + \cos^6 x}{\sin^2 x \cdot \cos^2 x} dx$ (OR) Evaluate: $\int (\sqrt{\cot x} + \sqrt{\tan x}) dx$	3m
29	If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, find the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$. (OR) Let $\vec{a} = \hat{i} + 4\hat{j} + 2\hat{k}, \vec{b} = 3\hat{i} - 2\hat{j} + 7\hat{k}$, and $\vec{c} = 2\hat{i} - \hat{j} + 4\hat{k}$. Find a vector $\vec{d}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$, and $\vec{c} \cdot \vec{d} = 15$.	3m
30	Solve the following Linear Programming Problem by graphical method: <i>Minimize</i> $Z = 20x + 10y$ subjected to	3m

	$x + 2y \leq 40; 3x + y \geq 30; 4x + 3y \geq 60; x, y \geq 0.$	
31	In a bilateral cricket series between India and South Africa, the probability that India wins the first match is 0.6. If India wins any match, then the probability that it wins the next match is 0.4, otherwise the probability is 0.3. Also, it is given that there is no tie in any match. Based on the above information answer the following questions: (i) What is the probability that India won the second match, if India has already loose the first match? (ii) What is the probability that India losing the third match, if India has already loose the first two matches? (iii) Find the probability that India is losing the first two matches.	3m
SECTION D (5 x 4 =20) (This section comprises of 4 long answer (LA) type questions of 5 marks each)		
32	If $A = \begin{pmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{pmatrix}$, find A^{-1}. Hence solve the given equations $2x - 3y + 5z = 11; 3x + 2y - 4z = -5; x + y - 2z = -3.$ (OR) Find the product AB, where $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$ and use it to solve the equations: $x - y = 3, 2x + 3y + 4z = 17, y + 2z = 7.$	5m
33	Find $\frac{dy}{dx}$, if $y = (\tan x)^{\cot x} + (\cot x)^{\tan x}.$	5m
34	A horse is tied to a peg at one corner of a square-shaped grass field of side 15 m by means of a 5 m long rope (see Fig.). Find the area of that part of the field in which the horse can graze by using integration. (OR) An electron is moving in an elliptical orbit defined by the equation $\frac{x^2}{25} + \frac{y^2}{64} = 1$. Find the area enclosed by this orbit using integration.	
35	Find the coordinates of the image of the point (2, 3, 4) with respect to the line $\vec{r} = (2\hat{j} + 4\hat{k}) + \gamma (2\hat{i} + 4\hat{j} + \hat{k})$; where γ is a scalar. Also, find the distance of the image from the origin.	5m

SECTION D (5 x 4 =20)

(This section comprises of 3 case-study/passage-based questions of 4 marks each with sub parts. The first two case study questions have three sub parts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two sub parts of 2 marks each)

36	There are two antiaircraft guns, named as A and B. The probabilities that the shell fired from them hits an airplane are 0.3 and 0.2 respectively. Both of them fired one shell at an airplane at the same time.  (i) What is the probability that the shell fired? (ii) What is the probability that the shell fired from exactly one of them hit the plane? (iii) If it is known that the shell fired from exactly one of them hit the plane, then what is the probability that it was fired from B? (OR) (iii) If it is known that the shell fired from exactly one of them hit the plane, then what is the probability that it was fired from A?	1m 1m 2m 2m
37	Read the following passage and answer the questions given below. A sports stadium is elliptical in shape. The district sports administration wants to design a rectangular football field with the maximum possible area. The football field is given by the graph of $\frac{x^2}{36} + \frac{y^2}{25} = 1$.  (i) If the length and the breadth of the rectangular field be '2x' and '2y' respectively, then find the area function in terms of 'x'. (ii) Find the critical point of the function obtained in (i). (iii) Use first derivative test to find the length '2x' and width '2y' of the soccer field, that will maximize its area. OR (iii) Use second derivative test to find the length '2x' and width '2y' of the soccer field, that will maximize its area.	1m 1m 2m 2m

38	The students of Class 12 of a school planned to plant saplings along straight lines, parallel to each other to one side of the playground ensuring that they had enough play area. Let us assume that they planted one of the rows of the sapling along the line $y = 2x + 4$. Let L be the set of all lines which are parallel to each other in ground and R be a relation in L. Let the relations R_1 and R_2 are defined on L as follows. $R_1 = \{ (L_1, L_2) : L_1 \parallel L_2, \text{ Where } L_1, L_2 \in L \}$ $R_2 = \{ (L_1, L_2) : L_1 \perp L_2, \text{ Where } L_1, L_2 \in L \}$ Answer the following questions using the above information: (i) Verify whether R_1 satisfies reflexive, symmetric and transitive or not? (ii) Verify whether R_2 satisfies reflexive, symmetric and transitive or not?	2m 2m
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KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER- 10 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q. No.	Questions	Marks
SECTION – A (20 x 1 = 20) <i>(This section comprises of multiple choice questions (MCQs) of 1 mark each)</i>		
1	Let $A = \{a, b, c\}$ then the number of reflexive relations on A is	1M
	(a) 64	(b) 32
	(c) 8	(d) 81
2	If A and B are symmetric matrices then $AB - BA$ is	1M
	(a) symmetric matrix	(b) Skew symmetric matrix
	(c) Neither symmetric nor skew symmetric	(d) Can't be determined
3	If the function $f(x) = \begin{cases} \frac{kx}{ x }, & \text{if } x < 0 \\ 3, & \text{if } x \geq 0 \end{cases}$ is continuous at $x=0$, then $k=$	1M
	(a) -3	(b) 3
	(c) -2	(d) 2

4	If $A = \begin{bmatrix} 1 & 2 \\ 4 & 4 \end{bmatrix}$ and $ 2A = k A $ then $k =$		1M
	(a) -4	(b) 8	
	(c) 4	(d) 2	
5	The function $f(x) = \log x$ is increasing on		1M
	(a) $(-\infty, \infty)$	(b) $(1, \infty)$	
	(c) $(-1, \infty)$	(d) $(0, \infty)$	
6	The value of $\cos^{-1}\left(\cos \frac{7\pi}{6}\right)$		1M
	(a) $\frac{\pi}{3}$	(b) $\frac{7\pi}{6}$	
	(c) $\frac{5\pi}{6}$	(d) $\frac{\pi}{6}$	
7	$\begin{vmatrix} \cos 15^\circ & \sin 15^\circ \\ \sin 75^\circ & \cos 75^\circ \end{vmatrix} =$		1M
	(a) 1	(b) 0	
	(c) -1	(d) $\frac{1}{2}$	
8	$\int e^x \sec x (1 + \tan x) dx =$		1M
	(a) $e^x \sec x + C$	(b) $e^x \tan x + C$	
	(c) $e^x \sec x \tan x + C$	(d) $e^x (1 + \tan x) + C$	
9	The vector equation of a line which passes through the point (2, -4, 5) and is parallel to the line $\frac{x+3}{3} = \frac{4-y}{2} = \frac{z+8}{6}$ is...		1M
	(a) $\vec{r} = (-2\hat{i} + 4\hat{j} - 5\hat{k}) + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})$		
	(b) $\vec{r} = (2\hat{i} - 4\hat{j} + 5\hat{k}) + \mu(3\hat{i} - 2\hat{j} + 6\hat{k})$		
	(c) $\vec{r} = (2\hat{i} - 4\hat{j} + 5\hat{k}) + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})$		
	(d) $\vec{r} = (-2\hat{i} + 4\hat{j} - 5\hat{k}) + \mu(3\hat{i} - 2\hat{j} + 6\hat{k})$		
10	The general solution of differential equation $x^5 \frac{dy}{dx} = -y^5$ is		1M
	(a) $x^4 + y^4 = C$	(b) $x^{-4} + y^{-4} = C$	
	(c) $x^4 + y^{-4} = C$	(d) $x^{-4} + y^4 = C$	
11	The vectors $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - 3\hat{j} - 5\hat{k}$ and $\vec{c} = -3\hat{i} + 4\hat{j} + 4\hat{k}$ represents the sides of		1M
	(a) an equilateral triangle	(b) a right angle triangle	
	(c) an obtuse angled triangle	(d) an isosceles triangle	
12	$\int_0^4 x - 1 dx =$		1M

	(a) 4	(b) 3	
	(c) 1	(d) 5	
13	The sum of order and degree of the differential equation: $2x^2 \frac{d^2y}{dx^2} - 3 \frac{dy}{dx} + y = 0$		1M
	(a) 2	(b) 1	
	(c) 0	(d) 3	
14	The lines $\frac{x-5}{7} = \frac{2-y}{5} = \frac{z}{1}$ and $\frac{x}{1} = \frac{2y-1}{\lambda} = \frac{z}{3}$ are at right angles then the value of λ is		1M
	(a) 2	(b) -4	
	(c) -2	(d) 4	
15	The restrictions imposed on decision variables involved in any objective function of a linear programming problem are called...		1M
	(a) constraints	(b) feasible solutions	
	(c) infeasible solutions	(d) optimal solutions	
16	If A and B are events such that $P(A/B) = P(B/A)$, then		1M
	(a) $A \subset B$ but $A \neq B$	(b) $A = B$	
	(c) $A \cap B = \emptyset$	(d) $P(A) = P(B)$	
17	Two events A and B will be independent, if		1M
	(a) A and B are mutually exclusive	(b) $P(A'B') = [(1 - P(A))][(1 - P(B))]$	
	(c) $P(A) = P(B)$	(d) $P(A) + P(B) = 1$	
18	The corner points of the feasible region determined by the system of linear constraints are (0, 3), (1, 1), and (3, 0). Let $Z = px + qy$, where p, q .condition on p and q, so that the minimum of Z occurs at (3, 0) and (1,1) is ...		1M
	(a) $p = 2q$	(b) $p = q/2$	
	(c) $p = 3q$	(d) $p = q$	
ASSERTION-REASON BASED QUESTIONS (Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.) (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.			
19	Assertion (A): The principal value of $\cot^{-1}(\sqrt{3})$ is $\frac{\pi}{6}$ Reason (R): Domain of $\cot^{-1}(x)$ is $\mathbb{R} - \{-1, 1\}$.		1M

20	Assertion (A): $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + \hat{j} - \hat{k}$ are perpendicular vectors Reason (R): Two vectors are perpendicular iff $\vec{a} \cdot \vec{b} = 0$	1M
SECTION B (5 x 2 =10) (This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)		
21	If the function $f(x) = \begin{cases} \frac{x^2+3x-10}{x-2}, & \text{if } x \neq 2 \\ k, & \text{if } x = 2 \end{cases}$ is continuous at $x=2$, then find k. OR Find $\frac{dy}{dx}$ at $x = 1$ and $y = \frac{\pi}{4}$, if $\sin^2 y + \cos(xy) = k$.	2M
22	If $\vec{a}, \vec{b}$ and $\vec{c}$ are three vectors such that $ \vec{a} = 7, \vec{b} = 24$ and $ \vec{c} = 25$ and $\vec{a} + \vec{b} + \vec{c} = 0$ then find the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$	2M
23	From a lot of 10 bulbs which includes 2 defectives, a sample of 2 bulbs is drawn at random without replacement. Find the probability distribution of the number of defective bulbs.	2M
24	If $y = (\sin^{-1} x)^2$, then show that $(1 - x^2) \frac{d^2y}{dx^2} - x \frac{dy}{dx} - 2 = 0$ OR Differentiate $x^{\sin x}, x > 0$ w.r.t x	2M
25	Find $\int (\tan^2 x \sec^4 x) dx$	2M
SECTION C (6 x 3 =18) (This section comprises of 6 short answer (SA) type questions of 3 marks each.)		
26	If $A = \begin{pmatrix} 0 & -\tan \frac{\alpha}{2} \\ \tan \frac{\alpha}{2} & 0 \end{pmatrix}$ and I is the unit matrix of order 2, then show that $I + A = (I - A) \begin{pmatrix} \cos \alpha & -\sin \alpha \\ \sin \alpha & \cos \alpha \end{pmatrix}$	3M
27	Find local maximum and local minimum values of the function f given by $f(x) = 3x^4 + 4x^3 - 12x^2 + 12$ OR Sand is pouring from a pipe at the rate of $12\text{cm}^3/\text{s}$. The falling sand forms a cone on the ground in such a way that the height of the cone is always one-sixth of the radius of the base. How fast is the height of the sand cone increasing when the height is 4cm?	3M
28	Evaluate: $\int \frac{5x+3}{\sqrt{x^2+4x+10}}$ OR Evaluate: $\int \frac{\cos x}{(1+\sin x)(2+\sin x)} dx$	3M
29	Find a particular solution of the differential equation: $(1+x^2) \frac{dy}{dx} + 2xy = \frac{1}{1+x^2}, \quad y = 0 \text{ when } x = 1$	3M

30	If $\vec{a} = \hat{i} + 4\hat{j} + 2\hat{k}$ and $\vec{b} = 3\hat{i} - 2\hat{j} + 7\hat{k}$ then find another vector $\vec{d}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$ and $\vec{c} \cdot \vec{d} = 15$, where $\vec{c} = 2\hat{i} - \hat{j} + 4\hat{k}$. OR By using vector method, find the area of the triangle with vertices A (1, 1, 2), B (2, 3, 5) and C(1, 5, 5)	3M
31	Solve the following linear programming problem graphically: Minimize $Z = 3x + 8y$ subject to the constraints $3x + 4y \geq 8, 5x + 2y \geq 11, x \geq 0, y \geq 0$	3M
SECTION D (4 x 5 =20) <i>(This section comprises of 4 long answer (LA) type questions of 5 marks each)</i>		
32	Let R be a relation on the set $A = N \times N$, where N is the set of natural numbers, defined by $(a, b) R (c, d)$ if and only if $ad = bc$. Show that R is an equivalence relation. OR Show that $f : R^+ \rightarrow [-9, \infty]$ defined by $f(x) = 5x^2 + 6x - 9$ is bijective function.	5M
33	Evaluate: $\int_0^{\pi} \frac{x \tan x}{\sec x + \tan x} dx$	5M
34	Using integration, find the area of the region bounded by the parabola $y^2 = 4x$, the lines $x = 0$ and $x = 3$ and the x-axis	5M
35	Find the shortest distance between the lines $\frac{x-1}{2} = \frac{y+1}{3} = z$ and $\frac{x+1}{5} = \frac{y-2}{1}, z = 2$ OR Show that the lines $\frac{x+1}{3} = \frac{y+3}{5} = \frac{z+5}{7}$ and $\frac{x-2}{1} = \frac{y-4}{3} = \frac{z-6}{5}$ intersect. Also, find the point of intersection.	5M
SECTION E (3 x 4 =12) <i>(This section comprises of 3 case-study/passage-based questions of 4 marks each with sub parts. The first two case study questions have three sub parts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two sub parts of 2 marks each)</i>		
Case Study-1		
36	Two schools decided to award prizes to their teachers for three qualities: knowledge(x); guidance(y); and motivation (z). School A decided to award a total of Rs.8700 for three values to 4, 5 and 2 teachers respectively. While School B decided to award a total of Rs.8500 for three values to 3, 4 and 5 teachers respectively. If all the three prizes together amount to Rs.2200. Based on this information answer the following questions.	

i	By using matrix multiplication, write the system of linear equations.	1M
ii	By assuming 'A' as a coefficient matrix, find $\text{adj}A$	1M
iii	What is the award prize in Rupees for knowledge (x), guidance (y), and motivation (z). OR <i>Verify $A(\text{adj}A) = A I$, where I is a unit matrix</i>	2M
Case Study-2		
37	A wire of length 28m is to be cut into two pieces. One of the pieces is to be made into a square and the other into a circle. Based on this information answer the following by assuming x is the length of the wire of the first part, A is the combined area of the square and the circle, r is the radius of the circle.	
i	What is the combined area $A(x)$?	1M
ii	What is the rate of change of 'A' w.r.t x?	1M
iii	Find the critical points of $A(x)$ and write the condition for A to be minimum OR At which point the combined area $A(x)$ is minimum?	2M
Case Study- 3		
38	A doctor is to visit a patient. From the past experience, it is known that the probabilities that he will come by train, bus, scooter or by other means of transport are respectively $\frac{3}{10}$, $\frac{1}{5}$, $\frac{1}{10}$ and $\frac{2}{5}$. The probabilities that he will be late are $\frac{1}{4}$, $\frac{1}{3}$, and $\frac{1}{12}$, if he comes by train, bus and scooter respectively. but if he comes by other means of transport, then he will not be late. 	
i	When the doctor arrives late, what is the probability that he comes by train?	2M
ii	When the doctor arrives late, what is the probability that he comes by scooter?	2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER- 11 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q.No	Question	Marks
SECTION – A (1 x 20 = 20) (This section comprises of multiple choice questions (MCQs) of 1 mark each)		
1	$\sin \left[\frac{\pi}{3} - \sin^{-1} \left(-\frac{1}{2} \right) \right] =$ A) 1 B) $\frac{1}{2}$ C) $-\frac{1}{2}$ D) -1	1M
2	$A = (a_{ij})_{m \times n}$ is a square matrix, if A.) $m < n$ B) $m > n$ C) $m = n$ D) none of these	1M
3	The number of all possible matrices of order 3×3 with each entry 0 or 1 is: A) 27 B) 18 C) 81 D) 512	1M
4	If $A = \begin{pmatrix} a & 2 \\ 2 & a \end{pmatrix}$ and $ A ^3 = 125$ then a = A) ± 3 B) 5 C) ± 2 D) 4	1M
5	A is an invertible matrix of order 3×3 and $ A = 9$, then value of $ A^{-1} =$ A) 9 B) -9 C) $\frac{1}{9}$ D) $-\frac{1}{9}$	1M
6	Given a square matrix A of order 3×3 , such that $ A = 12$, then the value of $ A \cdot \text{adj} A $ is A) 12 B) 144 C) 1728 D) 72	1M
7	If $x^2 + y^2 = 5$ then $dy/dx =$ A) $-x^2$ B) $-2x$ C) x^2/y^2 D) $-x/y$	1M

8	If $x = mt$ and $y = mt^2$, then dy/dx at $t = 1$ is A) 3 B) 2 C) 1/2 D) 1/3	1M
9	$\int \frac{1}{x \log x} dx =$ A) $1/x$ B) $\log x$ C) $\log(\log x)$ D) $\log \frac{1}{x}$	1M
10	$\int e^x \left[\tan^{-1} x + \frac{1}{1+x^2} \right] dx =$ A) $e^x \tan^{-1} x + c$ B) $\frac{e^x}{1+x^2} + c$ C) $e^x(1+x^2)$ D) none of these	1M
11	$\int \frac{e^x(x^2+1)}{(x+1)^2} dx =$ A) $(x+1)^2 e^x + c$ B) $(x^2-1)e^x + c$ C) $(x-1)e^x + c$ D) $\frac{x-1}{x+1} e^x + c$	1M
12	$\int \frac{1}{x^2+2x+2} dx$ A) $x \tan^{-1}(x+1) + c$ B) $\tan^{-1}(x+1) + c$ C) $(x+1) \tan^{-1} x + c$ D) $\tan^{-1} x + c$	1M
13	Area of the region bounded by the curve $y^2 = 4x$, y-axis and the line $y = 3$ is A) 2 B) 9/4 C) 9/3 D) 9/2	1M
14	General Solution of $\frac{dy}{dx} = (1+x^2)(1+y^2)$ is A) $\tan^{-1} x + \tan^{-1} y = c$ B) $\tan^{-1} x + y + \frac{1}{3}y^3 + c = 0$ C) $\tan^{-1} y + x + \frac{1}{3}x^3 + c = 0$ D) none of these	1M
15	Degree of the differential equation $\frac{d^2y}{dx^2} + 5 \cos\left(\frac{dy}{dx}\right) = 5y$ is A) 1 B) 2 C) 3 D) not defined	1M
16	Let $\vec{a}$ and $\vec{b}$ be two unit vectors and θ is the angle between them, then $\vec{a} + \vec{b}$ is a unit vector if $\theta =$ A) $\pi/6$ B) $\pi/4$ C) $2\pi/3$ D) $\pi/2$	1M
17	If θ is the angle between two vectors $\vec{a}$ and $\vec{b}$, then $ \vec{a} \cdot \vec{b} = \vec{a} \times \vec{b} $ when $\theta =$ A) 0 B) $\pi/4$ C) $\pi/2$ D) π	1M
18	If A and B are two events such that $P(A) + P(B) - P(A \cap B) = P(A)$, then A) $P(B/A) = 1$ B) $P(A/B) = 1$ C) $P(B/A) = 0$ D) $P(A/B) = 0$	1M
ASSERTION-REASON BASED QUESTIONS <i>(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)</i> (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.		
19	Assertion (A) : $f(x) = (x-1)e^x + 1$ is strictly increasing function for all $x > 0$ Reason (R) : $f'(x) > 0$, for all $x \in (0, \infty)$	1M

20	Assertion (A): The function $f : \mathbb{R} \rightarrow \mathbb{R}$, given by $f(x) = x^3$ is injective. Reason (R) : The function $f : X \rightarrow Y$ is injective, if $f(x) = f(y) \Rightarrow x = y$ for all $x, y \in X$	1M
SECTION B (2 x 5 =10) (This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)		
21	Solve : $2 \tan^{-1}(\cos x) = \tan^{-1}(2 \csc x)$.	2M
22	For what values of λ is the function defined by $f(x) = \begin{cases} \lambda(x^2 - 2x), & \text{if } x \leq 0 \\ 4x + 1, & \text{if } x > 0 \end{cases}$ Continuous at $x = 1$? OR If $x = \sqrt{a^{\sin^{-1} t}}$, $y = \sqrt{a^{\cos^{-1} t}}$, then show that $\frac{dy}{dx} = -\frac{y}{x}$	2M
23	The total cost $C(x)$ in Rupees, associated with the production of x units of an item is given by $C(x) = 0.005x^3 - 0.02x^2 + 30x + 5000$. Find the marginal cost when 3 units are produced, where by marginal cost we mean the instantaneous rate of change of total cost at any level of output. OR The length x of a rectangle is decreasing at the rate of 5 cm/minute and the width y is increasing at the rate of 4 cm/minute. When $x = 8$ cm and $y = 6$ cm, find the rates of change of (a) the perimeter, and (b) the area of the rectangle.	2M
24	Find the unit vector in the direction of the sum of the vectors, $\vec{a} = 2\hat{i} + 2\hat{j} - 5\hat{k}$ and $\vec{a} = 2\hat{i} + \hat{j} + 3\hat{k}$.	2M
25	Find the area of the parallelogram whose adjacent sides are determined by the vectors $\vec{a} = \hat{i} - \hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} - 7\hat{j} + \hat{k}$.	2M
SECTION C (3 x 6 =18) (This section comprises of 6 short answer (SA) type questions of 3 marks each.)		
26	Find the solution of $\frac{dy}{dx} - \frac{y}{x} + \operatorname{cosec}\left(\frac{y}{x}\right) = 0$, given that $y = 0$ when $x = 1$. OR Solve : $x \log x \cdot \frac{dy}{dx} + y = \frac{2}{x} \log x$.	3M
27	Show that $\log(1+x) - \frac{2x}{2+x}$, $x > -1$ is an increasing function of x throughout its domain. OR Find the intervals in which the function f given by $f(x) = \sin x + \cos x$, $0 \leq x \leq 2\pi$ is increasing or decreasing.	3M
28	Evaluate: $\int_0^\pi \frac{x}{1+\sin x} dx$ OR Evaluate: $\int (\sin^{-1} x)^2 dx$	3M
29	Find the values of p so that the lines $\frac{1-x}{3} = \frac{7y-14}{2p} = \frac{z-3}{2}$ and $\frac{7-7x}{3p} = \frac{y-5}{1} = \frac{6-z}{5}$ are at right angles.	3M

30	Find the maximum value of the function $C = 2x + 3y$ graphically, Subject to the constraints $x+2y \leq 10$, $2x+y \leq 14$, $x \geq 0$, $y \geq 0$	3M
31	Given three identical boxes I, II and III, each containing two coins. In box I, both coins are gold coins, in box II, both are silver coins and in the box III, there is one gold and one silver coin. A person chooses a box at random and takes out a coin. If the coin is of gold, what is the probability that the other coin in the box is also of gold?	3M
SECTION D (5 x 4 =20) (This section comprises of 4 long answer (LA) type questions of 5 marks each)		
32	If $A = \begin{pmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{pmatrix}$ then show that $A^3 - 4A^2 - 3A + 11I = 0$ and hence find A^{-1} .	5M
33	If $\cos y = x \cos(a + y)$, $\cos a \neq \pm 1$, then prove that $\frac{dy}{dx} = \frac{\cos^2(a+y)}{\sin a}$. OR If $y = \sin^{-1} x$, show that $(1 - x^2)y'' - xy' = 0$	5M
34	Find the area bounded by the curve $y = \cos x$, between $x = 0$ and $x = 2\pi$ OR Find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	5M
35	Find the shortest distance between the lines $\vec{r} = (1 - t)\hat{i} + (t - 2)\hat{j} + (3 - 2t)\hat{k}$ and $\vec{r} = (s + 1)\hat{i} + (2s - 1)\hat{j} - (2s + 1)\hat{k}$.	5M
SECTION D (5 x 4 =20) (This section comprises of 3 case-study/passage-based questions of 4 marks each with sub parts. The first two case study questions have three sub parts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two sub parts of 2 marks each)		
Case Study-1		
36	A scout master wants to make different groups of students so that they can be given different tasks. Students started making groups with their friends, then the scout master interfere and told them to make groups as per a rule "a student will make group with roll number in such a way that the difference of roll number is divisible by 3. 	
i	Write a relation R in set-builder form for the rule told by the scout master.	1M
ii	Which roll number of students will be in the group of students with roll number 2, if there are 30 students in the class?	1M

iii	Which roll number of students will be in the group of students with roll number 3, if there are 30 students in the class?	2M
Case Study-2		
37	Husband and wife appear in an interview for two vacancies in the same post. The probability of husband's selection is $1/7$ and that of wife's selection is $1/5$.  Based on the above information, answer the following questions.	1M
i	Both of them will be selected	1M
ii	Only one of them will be selected.	2M
iii	None of them will be selected.	
	OR	
	At least one of them will be selected	
Case Study- 3		
38	An Aeroplane is flying with a velocity of 300m/sec at an altitude of 1 km from the Earth's surface. 	
i	i) Find an expression for dx/dt in terms of θ , where θ is the angle of elevation of the aeroplane from the bottom of the control tower and x is the horizontal distance between the aero plane and the control tower.	2M
ii	ii) Find the rate at which the angle of elevation of the Aero plane changes from the control tower at an instant when the horizontal distance of the plane is 500m from it.	2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION
MODEL QUESTION PAPER-12 (2025 – 26)
CLASS- XII
SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q No	Questions	Marks
SECTION – A (1 x 20 = 20) <i>(This section comprises of multiple choice questions (MCQs) of 1 mark each)</i>		
1	Let A be a non-singular matrix of order 3x3 and $ A = 5$, then the value of $ \text{adj}A $ is (a) 5 (b) 25 (c) 125 (d) -5	1M
2	A relation R is defined on a set of human beings as $R = \{(x, y): x \text{ is } 5 \text{ cm shorter than } y\}$ then R is..... (e) Reflexive only (f) Reflexive & Transitive (g) Symmetric & transitive (h) Neither reflexive nor symmetric nor transitive	1M
3	If $f(x) = \begin{cases} x + k, & \text{if } x < 3 \\ 4, & \text{if } x = 3 \\ 3x - 5 & \text{if } x > 3 \end{cases}$ is continuous at $x = 3$ then the value of k is: (e) 1 (f) 6 (g) 7 (h) 3	1M

4	If matrices A and B are of order 1x3 and 3x1 respectively. Then the order of $A'B'$ is....		1M
	(e) 1 X 3	(f) 3 X 1	
	(g) 1 X 1	(h) 3 X 3	
5	A function $f: R \rightarrow R$ defined by $f(x) = x^2$ is		1M
	(e) One-One	(f) Onto	
	(g) Bijective	(h) Neither one-one nor onto	
6	The solution set of the inequality $3x + 5y \leq 4$ is		1M
	(e) An open half-plane not containing the origin	(f) An open half-plane containing the origin	
	(g) The whole XY-plane not containing the line $3x + 5y = 4$	(h) A closed half plane containing the origin	
7	The degree of the differential equation $\frac{d^2y}{dx^2} + 3\left(\frac{dy}{dx}\right)^2 = x^2 \log\left(\frac{d^2y}{dx^2}\right)$ is		1M
	(e) 2	(f) Not defined	
	(g) 1	(h) 0	
8	The integrating factor of differential equation $\frac{dy}{dx} - 2y \tan x = \sin x$ is....		1M
	(e) $2 \sec x$	(f) $\cos^2 x$	
	(g) $\sec^2 x$	(h) $(\sec^{-1} x)^2$	
9	The projection of $3\hat{i} + 3\hat{j} + \hat{k}$ on $9\hat{i} - 6\hat{j} + 2\hat{k}$ is		1M
	(a) 4	(b) 2	
	(c) 1	(d) 3	
10	If $(2\hat{i} + 6\hat{j} + 27\hat{k}) \times (\hat{i} + \lambda\hat{j} + \mu\hat{k}) = \vec{0}$ then the value of $\lambda + \mu$ is....		1M
	(e) 0	(f) 3	
	(g) $\frac{33}{2}$	(h) $\frac{27}{2}$	
11	The rate of change of the volume of a spherical bubble with respect to its radius r at $r = 3$ cm is ...		1M
	(e) $24\pi \text{ cm}^3/\text{cm}$	(f) $36\pi \text{ cm}^2/\text{cm}$	
	(g) $36\pi \text{ cm}^3/\text{cm}$	(h) $24\pi \text{ cm}^2/\text{cm}$	
12	The value of the integral $\int \frac{1}{\sin^2 x \cos^2 x} dx$ is :		1M
	(a) $\tan x + \cot x + C$	(b) $-\tan x - \cot x + C$	
	(c) $-\tan x + \cot x + C$	(d) $\tan x - \cot x + C$	
13	The function $f(x) = x + \frac{4}{x}$ has		1M
	(e) A local maximum at $x = 2$ and local minima at $x = -2$	(f) A local minimum at $x = 2$ and local maximum at $x = -2$	
	(g) Absolute maxima at $x = 2$ and absolute minima at $x = -2$	(h) Absolute minima at $x = 2$ and absolute maxima at $x = -2$	
14	The value of the integral $\int_{-\pi}^{\pi} \cos^2 x \sin^3 x dx$		1M
	(a) π	(b) 2π	
	(c) 0	(d) $-\pi$	

15	If an LPP admits optimal solution at two consecutive vertices of a feasible region, then		1M
	(a) The optimal solution occurs at every point on the line joining these two points.	(b) The LPP under consideration is not solvable.	
	(c) The required optimal solution is at a mid-point of the line joining two points.	(d) The LPP under consideration must be reconstructed.	
16	Direction cosines of the line joining the points (3, 7, -2), (1, 4, 4) are		1M
	(a) (2,3,-6)	(b) (-2, -3, -6)	
	(c) $\left(\frac{2}{7}, \frac{3}{7}, \frac{-6}{7}\right)$	(d) $\left(\frac{1}{7}, \frac{2}{7}, \frac{3}{7}\right)$	
17	Let A & B be two events where $P(A) = \frac{1}{4}$, $P(B) = \frac{1}{2}$ and $P(A \cap B) = \frac{1}{8}$ then, $P(\text{not A and not B}) =$		1M
	(e) $\frac{7}{8}$	(f) $\frac{3}{8}$	
	(g) $\frac{5}{8}$	(h) $\frac{1}{8}$	
18	The value of the cofactor of the element of second row and third column in the matrix $\begin{bmatrix} 4 & 3 & 2 \\ 2 & -1 & 0 \\ 1 & 2 & 3 \end{bmatrix}$		1M
	(e) -5	(f) 5	
	(g) 11	(h) -11	

ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)

(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.

19	Assertion (A): The vector equation of a line passing through the points A (-1, 0, 2) and B (3, 4, 6) is $\vec{r} = (-\hat{i} + 2\hat{k}) + \lambda(\hat{i} + \hat{j} + \hat{k})$ Reason (R): The equation of a line passing through a point with position vector and parallel to $\vec{b}$ is $\vec{r} = \vec{a} + \lambda\vec{b}$	1M
20	Assertion (A): Two coins are tossed simultaneously. The probability of getting two heads, if it is known that at least one head comes up is $\frac{1}{3}$ Reason (R): Let E and F be two events with a random experiment, then $P(F/E) = \frac{P(E \cap F)}{P(E)}$	1M

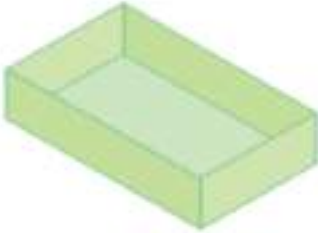
SECTION B (5 x 2 =10)

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21	Express the matrix $A = \begin{bmatrix} 3 & -2 & -4 \\ 3 & -2 & -5 \\ -1 & 1 & 2 \end{bmatrix}$ as a sum of symmetric and skew symmetric matrix.	2M
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22	Evaluate: $\tan^{-1} \left[2 \cos \left(2 \sin^{-1} \frac{1}{2} \right) \right]$	2M
23	Examine the following function $f(x) = \begin{cases} 5x - 4 & 0 < x < 1 \\ 4x^2 - 3x & 1 \leq x < 2 \\ 3x + 4 & x \geq 2 \end{cases}$ for continuity at $x=2$ OR Check the differentiability of $f(x) = \begin{cases} x^2 + 1, & 0 \leq x < 1 \\ 3 - x, & 1 \leq x \leq 2 \end{cases}$	2M
24	Find the position vector of a point R which divides the line joining two points P and Q whose position vectors are $2\vec{a} + \vec{b}$ and $\vec{a} - 3\vec{b}$ externally in the ratio 1:2. OR Find the area of the parallelogram whose adjacent sides are determined by the vectors $\vec{a} = \hat{i} - \hat{j} + 3\hat{k}$, $\vec{b} = 2\hat{i} - 7\hat{j} + \hat{k}$	2M
25	Probabilities of solving a specific problem independently by A and B are $\frac{1}{2}$ and $\frac{2}{3}$ respectively. If both try to solve the problem independently, find the probability that (i) The problem is solved (ii) exactly one of them solves the problem.	2M
SECTION C (6 x 3 =18) (This section comprises of 6 short answer (SA) type questions of 3 marks each.)		
26	Solve the following Linear Programming Problem graphically: Maximize $Z = 5x + 10y$ Subject to constraints: $x + 2y \leq 120$, $x + y \geq 60$, $y \leq x$, $x, y \geq 0$	3M
27	Evaluate: $\int_{\pi/6}^{\pi/3} \frac{dx}{1 + \sqrt{\tan x}}$ OR Evaluate $\int_1^3 [x - 1 + x - 2] dx$	3M
28	Evaluate: $\int x \sin^{-1} x dx$	3M
29	Find the general solution of the differential equation: (1 + $x^2) dy + 2xy dx = \cot x dx, (x \neq 0)$ OR Solve the differential equation $\frac{dy}{dx} = \frac{xy}{x^2 + y^2}$	3M
30	If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$, and $\vec{c} = 3\hat{i} + \hat{j}$ are such that $\vec{a} + \lambda \vec{b}$ is perpendicular to $\vec{c}$, then find the value of λ .	3M
31	Find the intervals in which the function f given by $f(x) = \sin x + \cos x$, $0 \leq x \leq 2\pi$, is strictly increasing or decreasing. OR	3M

	Find the absolute maximum and absolute minimum values of the function $f(x) = 2x^3 - 15x^2 + 36x + 1$ on the interval $[1, 5]$	
SECTION D (4 x 5 =20) (This section comprises of 4 long answer (LA) type questions of 5 marks each)		
32	If $A = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$, then find BA and use this to solve the system of equations $y + 2z = 8, x - y = -5$ and $2x + 3y + 4z = 18$	5M
33	If $x = a(\cos t + t \sin t)$ and $y = a(\sin t + t \cos t)$, $0 < t < \pi/2$ then find $\frac{d^2x}{dt^2}, \frac{d^2y}{dt^2}$ and $\frac{d^2y}{dx^2}$ OR Find $\frac{dy}{dx}$, if $(\cos x)^y = (\cos y)^x$	5M
34	Find the vector and Cartesian equations of the line passing through the point A (1, 2, -4) and perpendicular to the lines $\frac{x-4}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-1}{1} = \frac{y+2}{-3} = \frac{z-3}{5}$. OR Find the shortest distance between the lines given by $\vec{r} = (8 + 3\lambda)\hat{i} - (9 + 16\lambda)\hat{j} + (10 + 7\lambda)\hat{k}$ and $\vec{r} = (15\hat{i} + 29\hat{j} + 5\hat{k}) + \mu(3\hat{i} + 8\hat{j} - 5\hat{k})$	5M
35	Using integration, find the area of the region bounded by the curve $\frac{x^2}{9} + \frac{y^2}{4} = 1$	5M
SECTION D (3 x 4 =12) (This section comprises of 3 case-study/passage-based questions of 4 marks each with sub parts. The first two case study questions have three sub parts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)		
Case Study-1		
36	An organization conducted bike race under two different categories – Boys and Girls. There were 82 participants in all. Among all of them, finally two from Category 1 and three from Category 2 were selected for the final race. Ravi forms two sets B and G with these participants for his college project.  Let $B = \{b_1, b_2\}$ and $G = \{g_1, g_2, g_3\}$, where B represents the set of Boys and G represents set of Girls selected for the final race. Based on the above information answer the following questions.	
i	How many relations are possible from B to G?	1M
ii	Among all possible relations from B to G, how many functions can be formed from B to G?	1M

iii	Let $R: B \rightarrow B$ be defined by $R = \{(x, y)/x \text{ and } y \text{ are students of same sex}\}$. Check whether R is equivalence relation or not. OR Let $f: G \rightarrow B$ be defined by $f = \{(g_1, b_1), (g_2, b_2), (g_3, b_1)\}$. Check whether f is bijective or not. Justify your answer.	2M
Case Study-2		
37	A factory makes an open cardboard box for a jewelers shop from a square sheet of size 18 cm by cutting off squares from each corner and folding up the flaps. Based on the above information answer the following questions if x is the length of each square cut from corners. 	
i	Find the volume of the open box in terms of x.	1M
ii	Write the condition for volume V to be maximum.	1M
iii	What should be the size of square to be cut off so that the volume V is maximum? OR Find the maximum volume V of the open box.	2M
Case Study- 3		
38	A magician has three bags. 1st bag contains 4 red, 5 green and 6 yellow balls, 2nd bag contains 5 red, 5 green and 5 yellow balls and 3rd bag contains 6 red, 4 green and 5 yellow balls. The magician is showing a trick to randomly draw a ball from a bag. The probability of drawing a ball from 1st bag, 2nd bag and 3rd bag is 25%, 35% and 40% respectively. 	
i	The magician drew a red ball. What is the probability that he drew from 1st bag?	2M
ii	If E_1, E_2, E_3 are the three mutually exclusive and exhaustive events and E is an event associated with them, then find $\sum_{i=1}^3 P(E_i / E)$	2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION
MODEL QUESTION PAPER-13 (2025 – 26)
CLASS- XII
SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q.No.	Questions	Marks
SECTION – A (1 x 20 = 20) (This section comprises of multiple choice questions (MCQs) of 1 mark each) Select the correct option (Question 1 - Question 18)		
1	Let A be a non-singular matrix of order 3×3 and $ A = 5$, then the value of $ \text{adj}A $ is (e) 5 (f) 25 (g) 125 (h) -5	1M
2	A relation R is defined on a set of human beings as $R = \{(x, y) : x \text{ is } 5 \text{ cm shorter than } y\}$ then R is..... (i) Reflexive only (j) Reflexive & Transitive (k) Symmetric & transitive (l) Neither reflexive nor symmetric nor transitive	1M
3	If $f(x) = \begin{cases} x + k, & \text{if } x < 3 \\ 4, & \text{if } x = 3 \\ 3x - 5 & \text{if } x > 3 \end{cases}$ is continuous at $x = 3$ then the value of k is: (i) 1 (j) 6 (k) 7 (l) 3	1M

4	If matrices A and B are of order 1×3 and 3×1 respectively. Then the order of $A'B'$ is....		1M
	(i) 1×3	(j) 3×1	
	(k) 1×1	(l) 3×3	
5	A function $f: R \rightarrow R$ defined by $f(x) = x^2$ is _____		1M
	(i) One-One	(j) Onto	
	(k) Bijective	(l) Neither one-one nor onto	
6	The solution set of the inequality $3x + 5y \leq 4$ is		1M
	(i) An open half-plane not containing the origin	(j) An open half-plane containing the origin	
	(k) The whole XY-plane not containing the line $3x + 5y = 4$	(l) A closed half plane containing the origin	
7	The degree of the differential equation $\frac{d^2x}{dx^2} + 3\left(\frac{dy}{dx}\right)^2 = x^2 \log\left(\frac{d^2x}{dx^2}\right)$ is ____		1M
	(i) 2	(j) Not defined	
	(k) 1	(l) 0	
8	The integrating factor of differential equation $\frac{dy}{dx} - 2y \tan x = \sin x$ is....		1M
	(i) $2 \sec x$	(j) $\cos^2 x$	
	(k) $\sec^2 x$	(l) $(\sec^{-1} x)^2$	
9	The projection of $3\hat{i} + 3\hat{j} + \hat{k}$ on $9\hat{i} - 6\hat{j} + 2\hat{k}$ is		1M
	(e) 4	(f) 2	
	(g) 1	(h) 3	
10	If $(2\hat{i} + 6\hat{j} + 27\hat{k}) \times (\hat{i} + \lambda\hat{j} + \mu\hat{k}) = \vec{0}$ then the value of $\lambda + \mu$ is....		1M
	(i) 0	(j) 3	
	(k) $\frac{33}{2}$	(l) $\frac{27}{2}$	
11	The rate of change of the volume of a spherical bubble with respect to its radius r at $r = 3\text{cm}$ is ...		1M
	(i) $24\pi \text{ cm}^3/\text{cm}$	(j) $36\pi \text{ cm}^2/\text{cm}$	
	(k) $36\pi \text{ cm}^3/\text{cm}$	(l) $24\pi \text{ cm}^2/\text{cm}$	
12	The value of the integral $\int \frac{1}{\sin^2 x \cos^2 x} dx$ is :		1M
	(a) $\tan x + \cot x + c$	(b) $-\tan x - \cot x + c$	
	(c) $-\tan x + \cot x + c$	(d) $\tan x - \cot x + c$	
13	The function $f(x) = x + \frac{4}{x}$ has		1M
	(i) A local maximum at $x = 2$ and local minima at $x = -2$	(j) A local minimum at $x = 2$ and local maximum at $x = -2$	
	(k) Absolute maxima at $x = 2$ and absolute minima at $x = -2$	(l) Absolute minima at $x = 2$ and absolute maxima at $x = -2$	
14	The value of the integral $\int_{-\pi}^{\pi} \cos^2 x \sin^3 x dx$		1M
	(a) π	(b) 2π	
	(c) 0	(d) $-\pi$	
15	If an LPP admits optimal solution at two consecutive vertices of a feasible region, then		1M
	(a) The optimal solution occurs at every point on the line joining these two points.	(b) The LPP under consideration is not solvable.	

	(c) The required optimal solution is at a mid-point of the line joining two points.	(d) The LPP under consideration must be reconstructed.	
16	Direction cosines of the line joining the points (3, 7, -2), (1, 4, 4) are		1M
	(a) (2, 3, -6)	(b) (-2, -3, -6)	
	(c) $\left(\frac{2}{7}, \frac{3}{7}, \frac{-6}{7}\right)$	(d) $\left(\frac{1}{7}, \frac{2}{7}, \frac{3}{7}\right)$	
17	Let A & B be two events where $P(A) = \frac{1}{4}$, $P(B) = \frac{1}{2}$ and $P(A \cap B) = \frac{1}{8}$ then, $P(\text{not A and not B}) =$		1M
	(i) $\frac{7}{8}$	(j) $\frac{3}{8}$	
	(k) $\frac{5}{8}$	(l) $\frac{1}{8}$	
18	The value of the cofactor of the element of second row and third column in the matrix $\begin{bmatrix} 4 & 3 & 2 \\ 2 & -1 & 0 \\ 1 & 2 & 3 \end{bmatrix}$		1M
	(i) -5	(j) 5	
	(k) 11	(l) -11	
ASSERTION-REASON BASED QUESTIONS <i>(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)</i> (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.			
19	Assertion (A): The vector equation of a line passing through the points A (-1, 0, 2) and B (3, 4, 6) is $\vec{r} = (-\hat{i} + 2\hat{k}) + \lambda(\hat{i} + \hat{j} + \hat{k})$ Reason (R): The equation of a line passing through a point with position vector and parallel to $\vec{b}$ is $\vec{r} = \vec{a} + \lambda\vec{b}$		1M
20	Assertion (A): Two coins are tossed simultaneously. The probability of getting two heads, if it is known that at least one head comes up is $\frac{1}{3}$ Reason (R): Let E and F be two events with a random experiment, then $P(F/E) = \frac{P(E \cap F)}{P(E)}$		1M

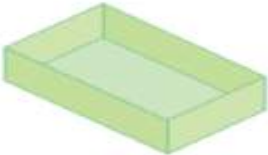
SECTION B (5 x 2 =10) <i>(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)</i>		
21	Express the matrix $A = \begin{bmatrix} 3 & -2 & -4 \\ 3 & -2 & -5 \\ -1 & 1 & 2 \end{bmatrix}$ as a sum of symmetric and skew symmetric matrix.	2M
22	Evaluate: $\tan^{-1} \left[2 \cos \left(2 \sin^{-1} \frac{1}{2} \right) \right]$	2M

23	Examine the following function $f(x) = \begin{cases} 5x - 4 & 0 < x < 1 \\ 4x^2 - 3x & 1 \leq x < 2 \\ 3x + 4 & x \geq 2 \end{cases}$ for continuity at $x=2$ OR Check the differentiability of $f(x) = \begin{cases} x^2 + 1, & 0 \leq x < 1 \\ 3 - x, & 1 \leq x \leq 2 \end{cases}$	2M
24	Find the position vector of a point R which divides the line joining two points P and Q whose position vectors are $2\vec{a} + \vec{b}$ and $\vec{a} - 3\vec{b}$ externally in the ratio 1:2. OR Find the area of the parallelogram whose adjacent sides are determined by the vectors $\vec{a} = \hat{i} - \hat{j} + 3\hat{k}$, $\vec{b} = 2\hat{i} - 7\hat{j} + \hat{k}$	2M
25	Probabilities of solving a specific problem independently by A and B are $\frac{1}{2}$ and $\frac{2}{3}$ respectively. If both try to solve the problem independently, find the probability that (i) The problem is solved (ii) exactly one of them solves the problem.	2M

SECTION C (6 x 3 =18) <i>(This section comprises of 6 short answer (SA) type questions of 3 marks each.)</i>		
26	Solve the following Linear Programming Problem graphically: Maximize $Z = 5x + 10y$ Subject to constraints: $x + 2y \leq 120$, $x + y \geq 60$, $y \leq x$, $x, y \geq 0$	3M
27	Evaluate: $\int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\tan x}}$ OR Evaluate $\int_1^3 [x - 1 + x - 2] dx$	3M
28	Evaluate: $\int x \sin^{-1} x dx$	3M
29	Find the general solution of the differential equation: $(1 + x^2) dy + 2xy dx = \cot x dx$, $(x \neq 0)$ OR Solve the differential equation $\frac{dy}{dx} = \frac{xy}{x^2 + y^2}$	3M
30	If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$, and $\vec{c} = 3\hat{i} + \hat{j}$ are such that $\vec{a} + \lambda \vec{b}$ is perpendicular to $\vec{c}$, then find the value of λ.	3M
31	Find the intervals in which the function f given by $f(x) = \sin x + \cos x$, $0 \leq x \leq 2\pi$, is strictly increasing or decreasing. OR Find the absolute maximum and absolute minimum values of the function $f(x) = 2x^3 - 15x^2 + 36x + 1$ on the interval $[1, 5]$	3M

SECTION D (4 x 5 =20) <i>(This section comprises of 4 long answer (LA) type questions of 5 marks each)</i>
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32	If $A = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$, then find BA and use this to solve the system of equations $y + 2z = 8, x - y = -5$ and $2x + 3y + 4z = 18$	5M
33	If $x = a(\cos t + t \sin t)$ and $y = a(\sin t + t \cos t)$, $0 < t < \pi/2$ then find $\frac{d^2x}{dt^2}, \frac{d^2y}{dt^2}$ and $\frac{d^2y}{dx^2}$ OR Find $\frac{dy}{dx}$, if $(\cos x)^y = (\cos y)^x$	5M
34	Find the vector and Cartesian equations of the line passing through the point A (1, 2, -4) and perpendicular to the lines $\frac{x-4}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-1}{1} = \frac{y+2}{-3} = \frac{z-3}{5}$. OR Find the shortest distance between the lines given by $\vec{r} = (8 + 3\lambda)\hat{i} - (9 + 16\lambda)\hat{j} + (10 + 7\lambda)\hat{k}$ and $\vec{r} = (15\hat{i} + 29\hat{j} + 5\hat{k}) + \mu(3\hat{i} + 8\hat{j} - 5\hat{k})$	5M
35	Using integration, find the area of the region bounded by the curve $\frac{x^2}{9} + \frac{y^2}{4} = 1$	5M
SECTION D (3 x 4 = 12) (This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)		
Case Study-1		
36	A school is organizing a debate competition with participants as speakers $S = \{S_1, S_2, S_3, S_4\}$ and these are judged by judges $J = \{J_1, J_2, J_3\}$. Each speaker can be assigned one judge. Let R be a relation from set S to J defined as $R = \{(x, y): \text{speaker } x \text{ is judged by judge } y, x \in S, y \in J\}$.  Based on the above, answer the following :	
i	How many relations are possible from S to J?	1M

ii	A student identifies a function from S to J as $f = \{(S_1, J_1), \{(S_2, J_2), \{(S_3, J_2), \{(S_4, J_3)\}\}$. Check if it is bijective.	1M
iii	How many one-one functions can be there from set S to set J? OR Another student considers a relation $R_1 = \{(S_1, S_2), (S_2, S_4)\}$ in set S. Write minimum ordered pairs to be included in R_1 so that R_1 is reflexive but not symmetric.	2M
Case Study-2		
37	A factory makes an open cardboard box for a jeweler's shop from a square sheet of size 18 cm by cutting off squares from each corner and folding up the flaps. Based on the above information answer the following questions if x is the length of each square cut from corners.	
i	Find the volume of the open box in terms of x .	1M
ii	Write the condition for volume V to be maximum.	1M
iii	What should be the size of square to be cut off so that the volume V is maximum? OR Find the maximum volume V of the open box.	2M
Case Study- 3		
38	A magician has three bags. 1st bag contains 4 red, 5 green and 6 yellow balls, 2nd bag contains 5 red, 5 green and 5 yellow balls and 3rd bag contains 6 red, 4 green and 5 yellow balls. The magician is showing a trick to randomly draw a ball from a bag. The probability of drawing a ball from 1st bag, 2nd bag and 3rd bag is 25%, 35% and 40% respectively.	
i	The magician drew a red ball. What is the probability that he drew from 1st bag?	2M
ii	If E_1, E_2, E_3 are the three mutually exclusive and exhaustive events and A is an event associated with them, then find $\sum_{i=1}^3 P(E_i/A)$	2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER-14 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

SECTION – A (1 x 20 = 20)

(This section comprises of multiple-choice questions (MCQs) of 1 mark each)

1	Which of the following is an example of a One-One and Onto function? (A) $f: R \rightarrow R, f(x) = x^2$ (B) $f: R \rightarrow R, f(x) = x + 1$ (C) $f: Z \rightarrow Z, f(x) = 2x$ (D) None of these	1m
2	The value of $\sin^{-1}\left(-\frac{1}{2}\right)$ is (A) $\frac{\pi}{6}$ (B) $-\frac{\pi}{6}$ (C) $\frac{5\pi}{6}$ (D) $-\frac{\pi}{4}$	1m
3	If A is a matrix of order 3×2 and B is a matrix of order 2×3 , the order of BA is (A) 3×2 (B) 2×3 (C) 2×2 (D) 3×3	1m
4	If A and B are two matrices of the same order, where A is a skew-symmetric matrix and B is a symmetric matrix, then $(A + B)^T$ is: (A) $A + B$ (B) $A - B$ (C) $-A + B$ (D) $-(A + B)$	1m

5	If A is a 3×3 matrix and $ A =5$, then $ kA $ (where k is a constant) is: (A) 5 (B) $k A $ (C) $k^9 A $ (D) $k^3 A $	1m
6	The inverse of the matrix $\begin{bmatrix} 9 & x \\ x & 4 \end{bmatrix}$ exists if and only if (A) $x = 6$ (B) $x = -6$ (C) $x = \pm 6$ (D) $x \neq \pm 6$	1m
7	If A is a square matrix such that $A^2 = A$, then $\det(A)$ is: (A) 0 (B) 1 (C) Either 0 or 1 (D) None of these	1m
8	The derivative of e^{x^2} is: (A) $2xe^{x^2}$ (B) xe^{x^2} (C) e^{x^2} (D) None of these	1m
9	The function $f(x) = x $ is (A) Differentiable at $x=0$ (B) Continuous but not differentiable at $x=0$ (C) Discontinuous at $x=0$ (D) Differentiable at all points	1m
10	For a function $f(x)$, if $f'(x) = 0$ and $f''(x) < 0$, then $f(x)$ has: (A) A local maximum at that point (B) A local minimum at that point (C) A point of inflection at that point (D) None of the above	1m
11	The value of $\int \sin^2 x \, dx$ is: (A) $\frac{x}{2} - \frac{\sin 2x}{4} + C$ (B) $\frac{x}{2} + \frac{\sin 2x}{4} + C$ (C) $\cos^2 x + C$ (D) $x^2 + \sin 2x + C$	1m
12	The integral $\int \frac{1}{1+x^2} dx$ is: (A) $\log 1+x^2 + c$ (B) $\frac{1}{2} \log 1+x^2 + c$ (C) $\tan^{-1} x + c$ (D) $\frac{1}{2} \tan^{-1} x + c$	1m
13	The area under the curve $y=f(x)$ between $x=a$ and $x=b$ is given by: (A) $\int_a^b f'(x) dx$ (B) $\int_0^b f(x) dx$ (C) $\int_a^b f(x) dx$ (D) $\int_b^a f(x) dx$	1m
14	The solution of the differential equation $\frac{dy}{dx} = 3x^2 + 2$ is: (A) $y = x^3 + 2x + C$ (B) $y = x^3 + 2x^2 + C$ (C) $y = 3x^3 + 2x + C$ (D) None of the above	1m
15	The order of the differential equation $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = 0$ is: (A) 1 (B) 2 (C) 3 (D) None	1m
16	If $\vec{a} = 3\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{b} = 4\hat{i} + \hat{j} - 3\hat{k}$, then the cross product $\vec{a} \times \vec{b}$ is : (A) $\hat{i} - 17\hat{j} - 7\hat{k}$ (B) $\hat{i} + 17\hat{j} + 7\hat{k}$ (C) $\hat{i} - 17\hat{j} + 7\hat{k}$ (D) $\hat{i} + 17\hat{j} - 7\hat{k}$	1m
17	Which of the following represents the feasible region for the constraints $x + 2y \leq 10$ and $x \geq 0, y \geq 0$ (A) The area above the line $x + 2y = 10$ in the first quadrant	1m

	(B) The area below the line $x + 2y = 10$ in the first quadrant (C) The area above the x-axis and below the line $y = 5$ (D) The entire first quadrant	
18	If an LPP has optimal solution (Maxima) at two corner points of the feasible region, then (A) LPP will give unique solution. (B) LPP will give infinite solutions. (C) LPP will give two solutions. (D) LPP does not have any solution.	1m
ASSERTION-REASON BASED QUESTIONS <i>(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)</i> (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.		
19	Assertion (A): Two non-zero vectors $\vec{a}$ and $\vec{b}$ are parallel if and only if $\vec{a} \times \vec{b} = \vec{0}$. Reason (R): The cross product of two vectors is zero when the vectors are either parallel or one of them is the zero vector.	1m
20	Assertion (A): If $P\left(\frac{A}{B}\right) = P(A)$, then events A and B are independent. Reason (R): Two events are independent if the occurrence of one does not affect the probability of occurrence of the other.	1m

SECTION B (2 x 5 =10) <i>(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)</i>		
21	Draw the rough graph of $\sin^{-1} x$ and hence find its domain and range.	2m
22	Find the value of k so that the function $f(x) = \begin{cases} \frac{k \cos x}{\pi - 2x} & \text{if } x \neq \frac{\pi}{2} \\ 5 & \text{if } x = \frac{\pi}{2} \end{cases}$ is continuous at $x = \frac{\pi}{2}$. (OR) Find the values of a and b such that the function defined by $f(x) = \begin{cases} 5 & \text{if } x \leq 2 \\ ax + b & \text{if } 2 \leq x \leq 10 \\ 21 & \text{if } x \geq 10 \end{cases}$ is a continuous function.	2m

23	The total cost $C(x)$ in Rupees, associated with the production of x units of an item is given by $C(x) = 0.005x^3 - 0.02x^2 + 30x + 5000$. Find the marginal cost when 3 units are produced, where by marginal cost we mean the instantaneous rate of change of total cost at any level of output.	2m
24	Find the projection of the vector $-\hat{i} + 2\hat{j} + 3\hat{k}$ onto the vector $\hat{i} - \hat{j} + 2\hat{k}$. (OR) If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ are such that $\vec{a} + \gamma\vec{b}$ is perpendicular to $\vec{c}$. Then find the value of γ .	2m
25	Find the area of a parallelogram whose adjacent sides are given by the vectors $\vec{a} = 3\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$. (OR) If either $\vec{a} = \vec{0}$ or $\vec{b} = \vec{0}$, then $\vec{a} \times \vec{b} = \vec{0}$. Is the converse true? Justify your answer with an example.	2m

SECTION C (3 x 6 =18)		
(This section comprises of 6 short answer (SA) type questions of 3 marks each.)		
26	Find the intervals in which the function given by $f(x) = 2x^3 - 3x^2 - 36x + 7$ is (a) strictly increasing (b) strictly decreasing?	3m
27	The volume of a cube is increasing at a rate of 9 cubic centimetres per second. How fast is the surface area increasing when the length of an edge is 10 centimetres?	3m
28	Evaluate: $\int \frac{3x-1}{(x-1)(x-2)(x-3)} dx$ (OR) Evaluate: $\int_0^{\frac{\pi}{4}} \log(1 + \tan x) dx$	3m
29	Solve the following linear programming problem graphically: Maximise $Z = 4x + y$ subject to the constraints: $x + y \leq 50$, $3x + y \leq 90$, $x \geq 0$, $y \geq 0$.	3m
30	Find the vector and Cartesian equations of the 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 $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$. (OR) Find the values of p so that the lines $\frac{1-x}{3} = \frac{7y-14}{2p} = \frac{z-3}{2}$ and $\frac{7-7x}{3p} = \frac{y-5}{1} = \frac{6-z}{5}$ are right angles.	3m

31	Probability of solving specific problem independently by A and B are $\frac{1}{2}$ and $\frac{1}{3}$ respectively. If both try to solve the problem independently, find the probability that (i) the problem is solved (ii) exactly one of them solves the problem (OR) In a hostel, 60% of the students read Hindi newspaper, 40% read English newspaper and 20% read both Hindi and English newspapers. A student is selected at random. (a) Find the probability that she reads neither Hindi nor English newspapers. (b) If she reads Hindi newspaper, find the probability that she reads English newspaper. (c) If she reads English newspaper, find the probability that she reads Hindi newspaper.	3m
SECTION D (5 x 4 =20) <i>(This section comprises of 4 long answer (LA) type questions of 5 marks each)</i>		
32	If $A = \begin{bmatrix} 1 & 2 & -3 \\ 2 & 3 & 2 \\ 3 & -3 & -4 \end{bmatrix}$ then find A^{-1}. Using A^{-1} solve the system of equations: $x + 2y - 3z = -4, 2x + 3y + 2z = 2, 3x - 3y - 4z = 11.$	5m
33	Prove that $x - 1 + x - 2$ is continuous at $x=1,2$ but not differentiable at $x=1,2$. (OR) If $y = \sqrt{\sin x + \sqrt{\sin x + \sqrt{\sin x + \sqrt{\sin x} \dots}}}$, then find $\frac{dy}{dx}$ in terms of x	5m
34	A woman discovered a scratch along a straight line on a circular table top of radius 8 cm. She divided the table into 4 equal quadrants and discovered the scratch passing through the origin inclined at an angle $\frac{\pi}{4}$ anticlockwise along the positive direction of $x - axis$, Find the area of the region enclosed by the $x - axis$, the scratch and the circular table top in the first quadrant, using integration.	5m
35	Find the distance between the line $\frac{x}{2} = \frac{2y-6}{4} = \frac{1-z}{-1}$ and another line parallel to it passing through the point $(4, 0, -5)$. (OR) Find the co-ordinates of the foot of perpendicular drawn from the point $A(1, 8, 4)$ to the line joining the points $B(0, -1, 3)$ and $C(2, -3, -1)$.	5m
SECTION D (5 x 4 =20) <i>(This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)</i>		

36	Sherlin and Dhanju are playing Ludo at home during Covid-19. While rolling the dice, Sherlin's sister Raji observed and noted the possible outcomes of the throw every time belongs to set $\{1, 2, 3, 4, 5, 6\}$. Let A be the set of players while B be the set of all possible outcomes. $A = \{S, \}$, $B = \{1, 2, 3, 4, 5, 6\}$. Answer the following questions based on the given information: (i) Raji wants to know the number of relations possible from A to B. Find the number of all possible relations. (ii) Raji wants to know the number of functions from A to B. Find the number of all possible functions. (iii) Let R be a relation on B defined by $R = \{ (1,2), (2, 2), (1, 3), (3, 4), (3, 1), (4, 3), (5, 5) \}$. Verify R is symmetric and transitive? (OR) Let $R: B \rightarrow B$ be defined by $R = \{(x, y): y \text{ is divisible by } x\}$. Verify that whether R is symmetric and transitive.	 1m 1m 2m
37	In an office three employees Aman, Aryan and Biswajit process incoming copies of a certain form. Aman processes 50% of the forms, Aryan processes 20% and Biswajit the remaining 30% of the forms. Aman has an error rate of 0.06, Aryan has an error rate of 0.04 and Biswajit has an error rate of 0.03. Based on the above information answer the following: (i) Find the probability that an error is committed in processing given that Aryan processed the form. (ii) The total probability of committing an error in processing the form is. (iii) The manager of the company wants to do a quality check. During inspection he selects a form at random from the days output of processed forms. If the form selected at random has an error, the probability that the form is not processed by Aman. (OR) The manager of the company wants to do a quality check. During inspection he selects a form at random from the days output of processed forms. If the form selected at random has an error, the probability that the form is processed by Aryan.	 1m 1m 2m

38	An architecture designs an auditorium for a school for its cultural activities. The floor of the auditorium is rectangular in shape and has a fixed perimeter P (Let x and y represents length and breadth of the rectangular region). Based on the above information, solve the following questions: (i) Find area of the region in terms of x. (ii) Find the maximum area of the floor.		2m 2m
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KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION
MODEL QUESTION PAPER-15 (2025 – 26)
CLASS- XII
SUBJECT: Mathematics (041)

Time: 3 Hours

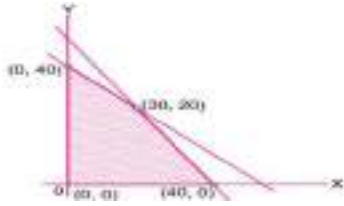
Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q.No	Question	Marks
SECTION – A (1 x 20 = 20)		
(This section comprises of multiple choice questions (MCQs) of 1 mark each)		
1	The domain of the function $\cos^{-1}(2x - 1)$ a) $[0,1]$ b) $[-1, 1]$ c) $(0,1)$ d) $[0,1)$	1M
2	The number of all possible matrices of order 3×3 with each entry 0 or 1 or -1 is a) 3^3 b) 3^6 c) 3^4 d) 3^9	1M
3	If $A = \begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix}$ and $A^2 - kA - I_2 = O$, then the value of k is a) 4 b) -4 c) 8 d) -8	1M
4	If the area of triangle with vertices $(3,2)$ $(-1, 4)$ and $(6,k)$ is 7 sq.m then k is a) 3 b) -4 c) 4 d) 3, -4	1M
5	A is 3×3 matrix such that $ A = 4$ then $ A \text{ adj } A =$ a) 4 b) 16 c) 64 d) 256	1M

6	$\ln \begin{bmatrix} 2 & 0 & 6 \\ -1 & 4 & 3 \\ 1 & 5 & 9 \end{bmatrix}$ minor of element “ 3 “ and cofactor of ‘ a_{32} ’ is a) 10, -12 b) -10, 12 c) -10, -12 d) 10, 12	1M
7	If $y = \sqrt{\sin x + y}$, then $\frac{dy}{dx}$ is equal to: a) $\frac{\cos x}{1-2y}$ b) $\frac{\cos x}{2y-1}$ c) $\frac{\sin x}{1-2y}$ d) $\frac{\sin x}{2y-1}$	1M
8	The interval in which the function, $f(x) = x^2 e^{-x}$ is strictly increasing is a) $(-\infty, \infty)$ b) $(-\infty, 0)$ c) $(2, \infty)$ d) $(0, 2)$	1M
9	$\int \frac{x^3}{x+1} dx$ is equal to a) $x + \frac{x^2}{2} + \frac{x^3}{3} - \log 1+x + C$ b) $x + \frac{x^2}{2} - \frac{x^3}{3} - \log 1-x + C$ c) $x - \frac{x^2}{2} - \frac{x^3}{3} - \log 1+x + C$ d) $x - \frac{x^2}{2} + \frac{x^3}{3} - \log 1+x + C$	1M
10	$\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{dx}{1+\cos 2x}$ is equal to a) 1 b) 2 c) 3 d) 4	1M
11	Area of the region bounded by the curve $y^2 = 4x$, y – axis and the line $y = 3$ is a) 2 b) $\frac{9}{4}$ c) $\frac{9}{3}$ d) $\frac{9}{2}$	1M
12	The solution of the differential equation $\frac{dy}{dx} + \sqrt{\frac{1-y^2}{1-x^2}} = 0$ is: a) $y + \sin^{-1} y = \sin^{-1} x + c$ b) $\sin^{-1} y - \sin^{-1} x = c$ c) $\sin^{-1} y + \sin^{-1} x = c$ d) $\sin^{-1} y - \sin^{-1} x = cxy$	1M
13	If m and n are the order and degree, respectively of the differential equation $y \left(\frac{dy}{dx}\right)^3 + x^3 \left(\frac{d^2y}{dx^2}\right)^2 - xy = \sin x$, then the value of m + n is: a) 5 b) 2 c) 3 d) 4	1M
14	The angle between two vectors $\vec{a}$ and $\vec{b}$ with magnitudes $\sqrt{3}$ and 4, respectively, and $\vec{a} \cdot \vec{b} = 2\sqrt{3}$ is a) $\frac{\pi}{6}$ b) $\frac{\pi}{3}$ c) $\frac{\pi}{2}$ d) $\frac{5\pi}{2}$	1M
15	A unit vector perpendicular to both the vectors $\hat{i} - 2\hat{j} + 3\hat{k}$ and $\hat{i} + 2\hat{j} - \hat{k}$ is: a) $\pm \frac{1}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$ b) $\pm \frac{1}{\sqrt{3}}(-\hat{i} + \hat{j} + \hat{k})$ c) $\pm \frac{1}{\sqrt{3}}(\hat{i} + \hat{j} - \hat{k})$ d) $\pm \frac{1}{\sqrt{3}}(\hat{i} - \hat{j} + \hat{k})$	1M
16	Feasible region (shaded) for a LPP is shown in the given figure. The maximum value of the $Z = 0.4x + y$ is:  a) 32 b) 40 c) 50 d) 41	1M
17	In an LPP, if the objective function $Z = ax + by$ has the same maximum value on two corner points of the feasible region, then the number of points of which Z_{max} occurs is (a) 0 (b) 2 (c) finite (d) infinite	1M

18	If A and B are two independent events such that $P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{4}$, then $P\left(\frac{B'}{A}\right)$ is: a) $\frac{1}{4}$ b) $\frac{1}{8}$ c) $\frac{3}{4}$ d) 1	1M
ASSERTION-REASON BASED QUESTIONS <i>(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)</i> (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.		
19	Assertion (A): If $x = \tan \theta$, $y = \sec \theta$ then $dy/dx = \sin \theta$ Reason (R): $\frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta}$	1M
20	Assertion (A): The $f: R \rightarrow R$ given by $f(x) = [x]$ is bijection. Reason (R) : A function is said to be bijection, if it is both one-one and onto	1M
SECTION B (2 x 5 =10) <i>(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)</i>		
21	Evaluate $\sin^{-1}\left(\sin \frac{3\pi}{4}\right) + \cos^{-1}(\cos \pi) + \tan^{-1}(1)$.	2M
22	If $f(x) = \begin{cases} \frac{\sin(a+1)x+2\sin x}{x}, & x < 0 \\ 2, & x = 0 \\ \frac{\sqrt{1+bx}-1}{x}, & x > 0 \end{cases}$ is continuous at $x = 0$, then find the value of a and b.	2M
23	Sand is pouring from a pipe at the rate of $12\text{cm}^3/\text{s}$. The falling sand forms a cone on the ground in such a way that the height of the cone is always one – sixth of the radius of the base. How fast is the height of the sand cone increasing when the height is 4cm? (OR) The surface area of a spherical balloon is increasing at the rate of $2\text{ cm}^2/\text{s}$. At what rate is the volume of the balloon is increasing when the radius of the balloon is 8 cm?	2M
24	Find 'λ' when the projection of $\vec{a} = \lambda\hat{i} + \hat{j} + 4\hat{k}$ on $\vec{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$ is 4 units	2M
25	If $\vec{a}$ and $\vec{b}$ are two vectors such that $ \vec{a} + \vec{b} = \vec{b} $, then prove that $(\vec{a} + 2\vec{b})$ is perpendicular to $\vec{a}$. (OR) Given vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} - 3\hat{j} - 5\hat{k}$, $3\hat{i} - 4\hat{j} - 4\hat{k}$ are the position vectors of A, B and C respectively. Find the area of triangle ABC	2M
SECTION C (3 x 6 =18) <i>(This section comprises of 6 short answer (SA) type questions of 3 marks each.)</i>		
26	Show that $y = \log(1+x) - \frac{2x}{2+x}$, $x > -1$ is in increasing function of x throughout its domain	3M
27	Find the intervals in which the function $f(x) = \frac{x^4}{4} - x^3 - 5x^2 + 24x + 12$ is (a) strictly increasing (b) strictly decreasing (OR) Find two positive numbers x and y such that $x + y = 60$ and xy^3 is maximum	3M
28	Find the angle between the pair of lines given below. $\frac{x+3}{3} = \frac{y-1}{5} = \frac{z+3}{4}, \frac{x+1}{1} = \frac{y-4}{1} = \frac{z-5}{2}$	3M

29	Find $\int \frac{x^2}{x^4 - x^2 - 12} dx$ (OR) Evaluate: $\int_0^{\pi} \frac{x}{1 + \sin x}$	3M
30	Find graphically, the maximum value of $Z = 2x + 5y$ subject to constraints given below. $2x + 4y \leq 8, 3x + y \leq 6, x + y \leq 4, x \geq 0, y \geq 0$	3M
31	Bag A Contains 3 red 2 black balls, while bag B Contains 2 red and 3 black balls. A ball is drawn at random from bag A is transferred to bag B and then one ball is drawn at random from bag B. If this ball was to be found to be a red ball, find the probability that the ball is drawn from bag A was red (OR) A fair coin and unbiased die are tossed. Let A be the event "Head appears on the coin" and B be the event "3 comes on the die". Find whether A and B are independent events or not.	3M
SECTION D (5 x 4 = 20) (This section comprises of 4 long answer (LA) type questions of 5 marks each)		
32	Use product $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -3 \\ 3 & -2 & 4 \end{bmatrix} \begin{bmatrix} -2 & 0 & 1 \\ 9 & 2 & -3 \\ 6 & 1 & -2 \end{bmatrix}$ to solve the system of equations $x + 3z = 9, -x + 2y - 2z = 4, 2x - 3y + 4z = -3$ (OR) Using matrix method, solve the following system of equations $\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 4, \frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 1, \frac{6}{x} + \frac{9}{y} - \frac{20}{z} = 2, x, y, z \neq 0$	5M
33	(a) If $\sqrt{1 - x^2} + \sqrt{1 - y^2} = a(x - y)$, then prove that $\frac{dy}{dx} = \sqrt{\frac{1 - y^2}{1 - x^2}}$ OR (b) If $x = a(\cos \theta + \log \tan \frac{\theta}{2})$ and $y = \sin \theta$, then find $\frac{d^2y}{dx^2}$ at $\theta = \frac{\pi}{4}$	5M
34	Draw a rough sketch of $y = 2 + x + 1 $ Using integration, find the area of the region bounded by the curve $y = 2 + x + 1 , x = -4, x = 3$ and $y = 0$	5M
35	Find the point Q on the line $\frac{2x+4}{6} = \frac{y+1}{2} = \frac{-2z+6}{-4}$ at a distance of $3\sqrt{2}$ from the point P(1, 2, 3) (OR) Find the value of λ , so that the lines $\frac{1-x}{3} = \frac{7y-14}{\lambda} = \frac{z-3}{2}$ and $\frac{7-7x}{3\lambda} = \frac{y-5}{1} = \frac{6-z}{5}$ are at right angles. Also, find whether the lines are intersecting or not.	5M
SECTION D (4 x 3 = 12) (This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts)		
Case Study-1		
36	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. 	

	Based on the above information, answer the following questions.	
i	How many relations are possible from B to G?	1M
ii	Among all the possible relations from B to G, how many functions can be formed from B to G.	1M
iii	Let $R: B \rightarrow B$ 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) A function $f: B \rightarrow G$ be defined by $f = \{(b_1, g_1), (b_2, g_2), (b_3, g_1)\}$. Check if f is bijective. Justify your answer.	2M
Case Study-2		
37	In a residential society comprising of 100 houses there, were 60 children between the age of 10-15 years. They were inspired by their teachers to start composting to ensure that biodegradable waste is recycled, for this purpose, instead of each child doing it for only his/ her house. Children convinced the residents welfare association to do it as a society initiative for this they identified a square area in the local park. Local authorities charged amount of Rs.50 per square meter for space so that there is no misuse of the space and resident welfare association takes it seriously association hired a laborer for digging out 250 m^2 and he charged Rs.400 (depth)² association will like to have minimum cost.  Based on the above information, answer the following questions	1M
i	Let side of square plot is x m and its depth is h meters then what is the cost C for the pit?	1M
ii	What is the value of h (in metre) for which $\frac{dc}{dh} = 0$?	2M
iii	Find $\frac{d^2 c}{dh^2}$. (OR) Find the value of x (in mt) for minimum cost?	
Case Study- 3		
38	A factory has three machines A, B and C to manufacture bolts. Machine A manufacture 20%, machine B manufacture 30% and machine C manufacture 50% of the total bolts. Out of their respective outputs 3%, 4% and 2% are defective. A bolt is drawn at random from total production and it is found to be defective. Based on the above information, answer the following questions 	
i	What is the probability that it is manufactured by the machine C?	2M
ii	What is the probability that it is manufactured by the machine B?	2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER-16 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q.No	Question	Marks
SECTION – A (1 x 20 = 20) (This section comprises of multiple choice questions (MCQs) of 1 mark each)		
1	In the set Z of all integers, which of the following relation R is a symmetric relation: (a) xRy : if $x \leq y$ (b) xRy : if 'x-y is an even positive integer' (c) xRy : if $x = y$ (d) xRy : if x is a factor of y	1M
2	If $\cos(\sin^{-1}\frac{2}{5} + \cos^{-1}x) = 0$ then x = ____ (a) $\frac{1}{5}$ (b) $\frac{2}{5}$ (c) 0 (d) 1	1M
3	For the square matrix A of order 2 x 2 if $A \times \text{adj}(A) = \begin{bmatrix} 8 & 0 \\ 0 & 8 \end{bmatrix}$ then the value of A is (a) 8 (b) 4 (c) $4\sqrt{2}$ (d) 64	1M
4	If A is a matrix of order 3 x 4 and whose element is defined by $a_{ij} = \frac{1}{2} -3i + j $ then a_{32} is: (a) $\frac{3}{2}$ (b) $\frac{7}{2}$ (c) $\frac{5}{2}$ (d) $\frac{-7}{2}$	1M

5	If $A = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$ then A^{2023} is equal to (a) $\begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ (c) $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 2023 & 0 \\ 0 & 0 \end{bmatrix}$	1M
6	If $x \cdot e^y = 1$ then $\frac{dy}{dx}$ at $x = -1$ is (a) -1 (b) 1 (c) e (d) e^{-1}	1M
7	The value of “k” so that $f(x) = \begin{cases} \frac{x-4}{ x-4 } + k, & \text{if } x < 4 \\ 2k, & \text{if } x \geq 4 \end{cases}$ is continuous at $x = 4$ is ____ (a) -1 (b) 0 (c) 1 (d) $\frac{-1}{3}$	1M
8	The point on the curve $y^2 = 8x$ for which the change of abscissa is same as the change of ordinate (a) (4, 2) (b) (2, 4) (c) (2, 2) (d) (4, 4)	1M
9	The value of $\int_{-1}^1 x x dx$ is (a) $\frac{1}{6}$ (b) $\frac{1}{3}$ (c) $\frac{-1}{6}$ (d) 0	1M
10	If A is symmetric the $B^T A B$ is ____ (a) symmetric (b) skew-symmetric (c) diagonal matrix (d) Scalar matrix	1M
11	The number of total possible matrices of order 3×3 with each entry 2 or 0: (a) 9 (b) 256 (c) 64 (d) 512	1M
12	$\int \frac{1}{\sqrt{9-4x^2}} dx$ is equal to (a) $\frac{1}{6} \sin^{-1}\left(\frac{2x}{3}\right) + c$ (b) $\frac{1}{2} \sin^{-1}\left(\frac{2x}{3}\right) + c$ (c) $\sin^{-1}\left(\frac{2x}{3}\right) + c$ (d) $\frac{3}{2} \sin^{-1}\left(\frac{2x}{3}\right) + c$	1M
13	The angle between the two vectors $\vec{a}$ and $\vec{b}$ with $ \vec{a} = \sqrt{3}$ and $ \vec{b} = 4$ and $\vec{a} \cdot \vec{b} = 2\sqrt{3}$ is (a) $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{3}$	1M
14	If $ \vec{a} \times \vec{b} ^2 + \vec{a} \cdot \vec{b} ^2 = 144$ and $ \vec{a} = 4$ then the value of $ \vec{b} $ is (a) 2 (b) 1 (c) 3 (d) 9	x1M
15	The general solution of $e^{\frac{dy}{dx}} = x^2$ is (a) $y = x \log x - x + k$ (b) $y = 2x \log x - 2x + k$ (c) $y = 2x \log x - x^2 + k$ (d) None of these	1M
16	The number of feasible solutions of the linear programming problem given: maximize $Z = 15x + 30y$, subject to the constraints: $3x + y \leq 12$, $x + 2y \leq 10$, $x \geq 0$, $y \geq 0$ are (a) 1 (b) 2 (c) 3 (d) infinite	1M
17	The corner points of the feasible region for the linear programming problem are A(15,0) B(0,40) C(6,12) and D(4,18) of the objective function $Z = 20x + 10y$ then the minimum $Z =$ ____ (a) 300 (b) 400 (c) 240 (d) 260	1M
18	If A and B are two independent events and $P(A) = \frac{1}{4}$ $P(B) = \frac{1}{6}$ then $P(\bar{A} \cap \bar{B}) =$ ____ (a) $\frac{1}{24}$ (b) $\frac{5}{8}$ (c) $\frac{5}{24}$ (d) $\frac{1}{8}$	1M

ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (a), (b), (c) and (d) as given below.)

(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.

19	Assertion: The range of the function $f(x) = 2 \sin^{-1}x + \frac{3\pi}{2}$ is $[\frac{\pi}{2}, \frac{5\pi}{2}]$ where $x \in [-1, 1]$ Reason: The Principal value branch of $\sin^{-1}x$ is $[-\frac{\pi}{2}, \frac{\pi}{2}]$	1M
20	Assertion: The order and degree of the differential equation $\frac{d^2y}{dx^2} + (\frac{dy}{dx})^2 + \sin(\frac{dy}{dx}) + 1 = 0$ are 2, Not defined respectively. Reason: The order of a differential equation is the order of its highest derivative and the highest integral power of the highest order derivative in polynomial form of differentials is called degree of the differential equation.	1M

SECTION B (2 x 5 =10)

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

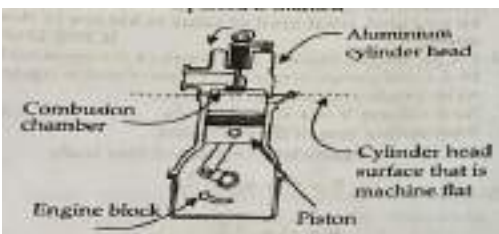
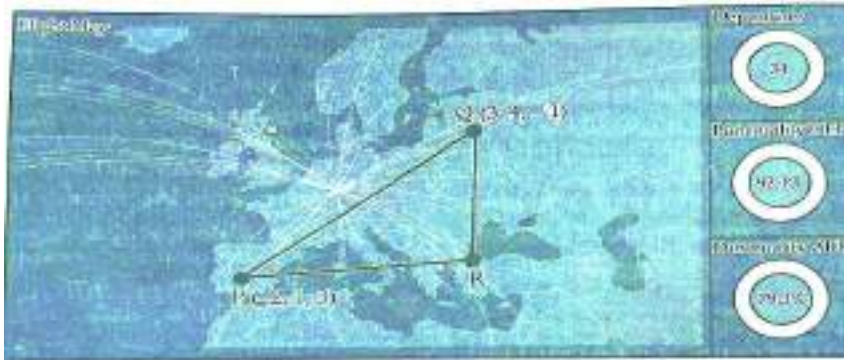
21	Show that the relation S on the set of real numbers defined as $S = \{ (a,b): a \leq b^2, \text{ where } a, b \in \mathbf{R} \}$ is neither reflexive nor symmetric. (OR) Let a relation R on the set N of natural numbers defined by $R = \{ (x,y) : 3x^2 - 7xy + 4y^2 = 0, x, y \in \mathbf{N} \}$. Check whether R is an equivalence relation or not?	2M
22	Find the derivative of $\tan^{-1}x$ with respect to $\log x$, where $x \in (1, \alpha)$ (OR) Check the differentiability of the function $f(x) = x - 2 $ at $x = 2$.	2M
23	Find the interval for which the function $f(x) = x^4 - \frac{4x^3}{3}$ is strictly increasing?	2M
24	Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three vectors such that $ \vec{a} = 1, \vec{b} = 2, \vec{c} = 3$, projection of $\vec{b}$ on $\vec{a}$ is same as projection of $\vec{c}$ on $\vec{a}$ and $\vec{b}$ is perpendicular to $\vec{c}$ then find the value of $ 3\vec{a} - 2\vec{b} + 2\vec{c} $	2M
25	Find the unit vector perpendicular to both $3\vec{i} + \vec{j} + 2\vec{k}$ and $2\vec{i} - 2\vec{j} + 4\vec{k}$	2M

SECTION C (3 x 6 =18)

(This section comprises of 6 short answer (SA) type questions of 3 marks each.)

26	Verify whether the function $f: \mathbf{Z} \rightarrow [\frac{-1}{2}, \frac{1}{2}]$ defined by $f(x) = \frac{x}{1+x^2}$ is one-one and on-to or not?	3M
27	If $x = a e^t(\sin t + \cos t)$ and $y = a e^t(\sin t - \cos t)$ then prove that $\frac{dy}{dx} = \frac{x+y}{x-y}$ (OR) If $y = x^x$ then prove that $\frac{d^2y}{dx^2} - \frac{1}{y} \left(\frac{dy}{dx} \right)^2 - \frac{y}{x} = 0$	3M

28	Evaluate $\int \frac{2x+1}{(x+1)^2(x-1)} dx$ (OR) Evaluate $\int \frac{e^x}{\sqrt{5-4e^x-e^{2x}}} dx$	3M
29	Evaluate $\int_{\pi/6}^{\pi/3} \frac{1}{1+\sqrt{\cot x}} dx$ (OR) $\int_0^{3/2} x \cos \pi x dx$	3M
30	Solve the Linear programming problem graphically: Objective function $Z = 3x + 2y$ Subject to the constraints; $x + 2y \leq 10$, $3x + y \leq 15$ and $x \geq 0$, $y \geq 0$. Also determine the Max Z at which obtained.	3M
31	Two persons A and B speak the truth in 65% and 85% of the cases respectively. In what percentage of the cases are they likely to contradict each other in stating the same fact?	3M
SECTION D (5 x 4 =20) <i>(This section comprises of 4 long answer (LA) type questions of 5 marks each)</i>		
32	Given $A = \begin{bmatrix} 1 & 2 & 0 \\ -2 & -1 & -2 \\ 0 & -1 & 1 \end{bmatrix}$, then find A^{-1}. Hence, solve the system of linear equations $x - 2y = 10$, $2x - y - z = 8$, $-2y + z = 7$ (OR) A furniture workshop produces three types of furniture – chairs, tables and beds each day. On a particular day the total number of furniture pieces produced is 45. It was also found that production of beds exceeds that of chairs by 8, while the total production of beds and chairs together is twice the production of tables. Determine then units produced of each type of furniture, using matrix method.	5M
33	Using integration find the area of the region bounded by the lines $2x + y = 4$, $3x - 2y = 6$ and $x - 3y + 5 = 0$.	5M
34	Find the equation of the diagonals of the parallelogram PQRS whose vertices are P(4, 2, -6), Q(5, -3, 1), R(12, 4, 5) and S(11, 9, -2). Use these equations to find the point of intersection of diagonals. (OR) Find the image of the point (-1, 5, 2) in the line $\frac{2x-4}{2} = \frac{y}{2} = \frac{z-2}{3}$. Find the length of the line segment joining the points (given point and the image point).	5M
35	Solve the differential equation $(x^2-1)\frac{dy}{dx} + 2xy = \frac{2}{x^2-1}$ (OR) Solve the differential equation $\{x \sin^2(\frac{y}{x}) - y\}dx + x dy = 0$, given that $y = \frac{\pi}{4}$, $x = 1$	5M
SECTION D (5 x 4 =20) <i>(This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)</i>		
Case Study-1		

36	Read the following text and answer the following questions: Engine displacement is the measure of the cylinder volume swept by all the pistons of a piston engine. The piston moves inside the cylinder bore one complete cycle of a four-cylinder four stroke engine. The cylinder bore is in the form of circular cylinder open at the top is made from a metal sheet of area $75\pi \text{ cm}^2$. Based on the above information answer the following questions:		
i	If the radius of the cylinder is r cm and height is h cm, then the volume (V) of the cylinder in terms of radius ' r ' is ?	1M	
ii	Find $\frac{dV}{dr}$	1M	
iii	Find the radius of the cylinder when its volume is maximum. (OR) For maximum volume, $h > r$. State true or false and justify.	2M	
Case Study-2			
37	The flight path of two airplanes in a flight simulator game are shown below. The co-ordinates of the airport Q is $(3, 4, -1)$ and P is $(-2, 1, 3)$. Airplane1 flies directly from P to Q. Airplane2 has a layover at R and then flies to Q. The path of Airplane2 from P to R is represented by the vector $5\vec{i} + \vec{j} - 2\vec{k}$ 		
i	Find the vector that represents the flight path of Airplane1.	1M	
ii	Write the vector representation of the path of Airplane2 from R to Q	1M	
iii	What is the angle between the flight paths of Airplane1 and Airplane2 just after takeoff? (OR) Consider that Airplane1 started the flight with a full fuel tank. Find the position vector of the point where one third of the fuel runs out if the entire fuel is required for the flight.	2M	
Case Study- 3			
38	A shopkeeper sells three types of flower seeds A1, A2 and A3. They are sold in the form of a mixture, where the proportions of these seeds are 2:2:1 respectively. The germination rates of the three type of seeds are 45%, 60% and 35% respectively. Based on the above information answer the following questions:		
i	Calculate the probability that a randomly chosen seed will germinate.	2M	
ii	Calculate the probability that the seed is of type A2, given that a randomly chosen seed germinates.	2M	

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER-17 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q. No.	Question	Marks
SECTION – A (1 x 20 = 20) <i>(This section comprises of multiple-choice questions (MCQs) of 1 mark each)</i>		
1	$\tan^{-1} \sqrt{3} + \cot^{-1} \sqrt{3} =$ A) $\frac{\pi}{3}$ B) $\frac{2\pi}{3}$ C) $\frac{\pi}{2}$ D) π	1M
2	$\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} x^2 \cos x \, dx =$ A) 0 B) 1 C) 2 D) 3	1M
3	$\int e^{\log x} \, dx =$ A) $e^{\log x}$ B) $xe^{\log x}$ C) $\frac{1}{x} e^{\log x}$ D) $x^2/2$	1M
4	Number of possible orders of a matrix that contains 6 elements. A) 2 B) 3 C) 4 D) 6	1M

5	If $\begin{pmatrix} x+y & 2 \\ 5+z & xy \end{pmatrix} = \begin{pmatrix} 6 & 2 \\ 5 & 8 \end{pmatrix}$ then (x, y) = A) (2, 4) B) (4, 2) C) both A & B are correct D) both A & B wrong	1M
6	If area of a triangle with vertices (3, 2), (-1, 4) and (6, k) is 7 sq. units, then possible values of k is/are A) 3 B) -4 C) -3, 4 D) 3, -4	1M
7	If $\begin{vmatrix} 2x & -1 \\ 4 & 2 \end{vmatrix} = \begin{vmatrix} 3 & 0 \\ 2 & 1 \end{vmatrix}$ then x = A) 3 B) 2/3 C) 3/2 D) -1/4	1M
8	If $A = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$, then adj A is A) 3^{27} B) 3^9 C) 3^6 D) 3^2	1M
9	The derivative of $\tan^{-1} \left(\frac{1+x}{1-x} \right)$ with respect to x is A) $\frac{1}{1+x^2}$ B) $\frac{2}{1+x^2}$ C) $\frac{1}{1-x^2}$ D) $\frac{2}{1-x^2}$	1M
10	If $y = \log x$ then $\frac{d^2y}{dx^2} =$ A) $-1/x^2$ B) $1/x$ C) 1 D) x	1M
11	General solution of $\frac{dy}{dx} = xy$ is A) $y = x + y$ B) $\log y = x + c$ C) $\log y = x^2/2 + c$ D) none of these	1M
12	Sum of the order and degree of the differential equation $\frac{d^2y}{dx^2} - 3 \left(\frac{dy}{dx} \right)^2 + 5y = 8$ is A) 1 B) 2 C) 3 D) 4	1M
13	Area bounded by the curve $y = x^3$, the x-axis and the ordinates $x = -2$ and $x = 1$ is A) -9 B) -15/4 C) 15/4 D) 17/4	1M
14	Corner points of the feasible region for an LPP are (0, 3), (5, 0), (6, 8), (0, 8). Let $Z = 4x - 6y$ be the objective function. The point at which the minimum of Z occurs is A) (0, 3) B) (0, 8) C) (5, 0) D) (6, 8)	1M
15	1 Shown below is a linear programming problem (LPP). Maximise $Z = x + y$ subject to the constraints: $x + y \leq 1$, $-3x + y \geq 3$, $x \geq 0$, $y \geq 0$ Which of the following is true about the feasible region of the above LPP? A) It is bounded B) It is unbounded C) There is no feasible region for the given LPP D) Cannot conclude anything from the given LPP	1M
16	Let the vectors $\vec{a}$ and $\vec{b}$ be such that $ \vec{a} = 3$ and $ \vec{b} = \frac{\sqrt{2}}{3}$, then $\vec{a} \times \vec{b}$ is a unit vector, then the angle between $\vec{a}$ and $\vec{b}$ is A) $\pi/6$ B) $\pi/4$ C) $\pi/3$ D) $\pi/2$	1M
17	The value of $\hat{i} \cdot (\hat{j} \times \hat{k}) + \hat{j} \cdot (\hat{i} \times \hat{k}) + \hat{k} \cdot (\hat{i} \times \hat{j})$ is A) 0 B) -1 C) 1 D) 3	1M
18	If A and B are two events such that $P(A) \neq 0$ and $P(B/A) = 1$ then A) $A \subset B$ B) $B \subset A$ C) $B \neq \Phi$ D) $A = \Phi$	1M

ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)

(A) Both (A) and (R) are true and (R) is the correct explanation of (A). dx

(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.

19	Assertion (A) : The rate of change in the area of a circle with respect to r is $2\pi r$ Reason (R) : dy/dx represents the rate of change of y with respect to x	1M
20	Assertion (A): If R is the relation defined in set $\{1, 2, 3, 4, 5, 6\}$ as $R = \{(a, b) : b = a + 1\}$, then R is reflexive Reason (R) : no integer is equal to its successor.	1M

SECTION B (2 x 5 =10)

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21	Write $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ in the simplest form.	2M
22	Find the value of k for which the function defined by $f(x) = \begin{cases} \frac{k \cos x}{\pi - 2x}, & \text{if } x \neq \frac{\pi}{2} \\ 3, & \text{if } x = \frac{\pi}{2} \end{cases}$ is continuous at $x = \pi/2$ OR Find $\frac{d}{dx}(\sec(\tan\sqrt{x}))$	2M
23	A stone is dropped into a quiet lake and waves move in circles at a speed of 4cm per second. At the instant, when the radius of the circular wave is 10 cm, how fast is the enclosed area increasing? OR A ladder 5 m long is leaning against a wall. The bottom of the ladder is pulled along the ground, away from the wall, at the rate of 2cm/s. How fast is its height on the wall decreasing when the foot of the ladder is 4 m away from the wall ?	2M
24	Find a vector in the direction of vector $\vec{a} = \hat{i} - 2\hat{j}$ that has magnitude 7 units.	2M
25	Find the projection of the vector $\hat{i} + 3\hat{j} + 7\hat{k}$ on the vector $7\hat{i} - \hat{j} + 8\hat{k}$.	2M

SECTION C (3 x 6 =18)

(This section comprises of 6 short answer (SA) type questions of 3 marks each.)

26	Show that the differential equation $(x^2 + xy)dy = (x^2 + y^2)dx$ is homogeneous and solve it. OR Solve : $x \frac{dy}{dx} + y - x + xy \cot x = 0, x \neq 0$.	3M
27	Find the intervals in which the function f given by $f(x) = 4x^3 - 6x^2 - 72x + 30$ is (a) increasing (b) decreasing. OR Show that $\log 1+x - \frac{2x}{2+x}, x > -1$ is an increasing function of x throughout its domain.	3M
28	Evaluate: $\int \frac{1}{\cos^2 x (1 - \tan x)^2} dx$ OR Find: $\int_0^2 x(2-x)^5 dx$	3M

29	Find the values of p so that the lines $\frac{1-x}{3} = \frac{7y-14}{2p} = \frac{z-3}{2}$ and $\frac{7x-7}{3p} = \frac{y-5}{1} = \frac{6-z}{5}$ are at right angles.	3M
30	Find the maximum value of the function $C = 2x + 3y$ graphically, Subject to the constraints $X+2y \leq 10$, $2x+y \leq 14$, $x \geq 0$, $y \geq 0$	3M
31	Given that the two numbers appearing on throwing two dice are different. Find the probability of the event 'the sum of numbers on the dice is 4'.	3M
SECTION D (5 x 4 =20) (This section comprises of 4 long answer (LA) type questions of 5 marks each)		
32	Find the product $\begin{pmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{pmatrix} \begin{pmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{pmatrix}$ and hence solve the equations $x - y = 3$, $2x + 3y + 4z = 17$ and $y + 2z = 7$	5M
33	If $y = \tan^{-1} \left(\frac{\sqrt{1+\sin x} + \sqrt{1-\sin x}}{\sqrt{1+\sin x} - \sqrt{1-\sin x}} \right)$ then find $\frac{dy}{dx}$. where $x \in [0, \frac{\pi}{2}]$ OR Find $\frac{dy}{dx}$, if $y^x + x^y + x^x = a^b$	5M
34	Sketch the graph of $y = x+3 $ and evaluate $\int_{-6}^0 x+3 dx$ OR Find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	5M
35	Find the vector equation of the 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 $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$	5M
SECTION D (5 x 4 =20) (This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)		
Case Study-1		
36	In class 6, the teacher conducted a survey on the fruits and vegetables the students like most. The class leader is asked to record the data. from the data it was found that the top most 3 fruits liked by most of them are Apple, Orange, Mango whereas the 3 vegetables most of them like are Tomatoes, Carrot, Cucumber. The teacher put it in 2 sets $F = \{\text{Apple, Orange, Mango}\}$ and $V = \{\text{Tomatoes, Carrot, Cucumber}\}$ 	
i	How many relations are possible from F to V?	1M
ii	How many functions are possible from F to V?	1M
iii	How many one to one functions are possible from F to V? OR How many bijections are possible from F to V?	2M

Case Study-2

37	In a survey at Vande Bharat Train, IRCTC asked passengers to rate and review the food served in train. IRCTC asked 500 passengers selected at random to rate food according to price (low, medium ,or high) and food (1,2,3,or 4 stars). The results of this survey are presented in the two-way, or contingency, table below. The numbers in this table represent frequencies. For example, in the third row and fourth column, 40people rated the prices high and the food 4 stars. <table><tr><th>Price/Rating</th><th>*</th><th>**</th><th>***</th><th>****</th><th>*****</th></tr><tr><td>Low</td><td>20</td><td>30</td><td>90</td><td>10</td><td>150</td></tr><tr><td>Medium</td><td>50</td><td>80</td><td>90</td><td>30</td><td>250</td></tr><tr><td>High</td><td>20</td><td>10</td><td>30</td><td>40</td><td>100</td></tr><tr><td>Total</td><td>90</td><td>120</td><td>210</td><td>80</td><td>500</td></tr></table> 	Price/Rating	*	**	***	****	*****	Low	20	30	90	10	150	Medium	50	80	90	30	250	High	20	10	30	40	100	Total	90	120	210	80	500	1M
Price/Rating	*	**	***	****	*****																											
Low	20	30	90	10	150																											
Medium	50	80	90	30	250																											
High	20	10	30	40	100																											
Total	90	120	210	80	500																											
i	Find the probability that the passenger rates the prices medium?	1M																														
ii	Find the probability that the passenger rates the food 2 stars.	1M																														
iii	Suppose the passenger selected rates the price high. What is the probability that he rates the restaurant 1 star? OR Suppose the passenger selected does not rate the food 4 stars. What is the probability that she rates the prices high?	2M																														

Case Study- 3

38	Rain Water Harvesting pits are very essential to conserve water and use it for further use.An engineer was asked to design a cuboidal pit with a fixed volume of 256m^3 and with a square base 	
i	What will be the value of edge of base so that total surface is minimum?	2M
ii	Find the height of tank and also the total surface area?	2M

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION
MODEL QUESTION PAPER-18 (2025 – 26)
CLASS- XII
SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

Q. No.	QUESTION	MARK
	<u>SECTION-A</u> (This section comprises of multiple-choice questions (MCQs) of 1 mark each)	1
1	If for a square matrix A, $A \cdot (\text{adj}A) = \begin{bmatrix} 2025 & 0 & 0 \\ 0 & 2025 & 0 \\ 0 & 0 & 2025 \end{bmatrix}$ then the value of $ A + \text{adj}A $ is equal to A) 1 B) 2025 + 1 C) $(2025)^2 + 45$ D) $2025 + (2025)^2$	1
2	If A is square matrix of order 3x3 and $ A = 4$ then the value of $ 3A $ is A) 12 B) 15 C) 108 D) 16	1
3	If a matrix has 36 elements, the number of possible orders it can have, is A) 13 B) 3 C) 5 D) 9	1
4	If $\begin{bmatrix} x+y & 2 \\ 5 & xy \end{bmatrix} = \begin{bmatrix} 6 & 2 \\ 5 & 8 \end{bmatrix}$, then the value of $(\frac{24}{x} + \frac{24}{y})$ is A) 7 B) 6 C) 8 D) 18	1
5	If $A = \begin{bmatrix} 3 & 4 \\ 5 & 2 \end{bmatrix}$ and $2A + B$ is null matrix, then B is equals to	1

	A) $\begin{bmatrix} 6 & 8 \\ 10 & 4 \end{bmatrix}$ B) $\begin{bmatrix} -6 & -8 \\ -10 & -4 \end{bmatrix}$ C) $\begin{bmatrix} 5 & 8 \\ 10 & 3 \end{bmatrix}$ D) $\begin{bmatrix} -5 & -8 \\ -10 & -3 \end{bmatrix}$	
6	6. Which of the following statements is true for the function $f(x) = \begin{cases} x^2 + 3, & x \neq 0 \\ 1, & x = 0 \end{cases}$? (A) $f(x)$ is continuous and differentiable $\forall x \in \mathbb{R}$ (B) $f(x)$ is continuous $\forall x \in \mathbb{R}$ (C) $f(x)$ is continuous and differentiable $\forall x \in \mathbb{R} - \{0\}$ (D) $f(x)$ is discontinuous at infinitely many points	1
7	The derivative of $\sin(x^2)$ w.r.t x , at $x = \sqrt{\pi}$ is (A) 1 (B) -1 (C) $-2\sqrt{\pi}$ (D) $2\sqrt{\pi}$	1
8	Let $f(x)$ be a differentiable on (a, b) and continuous on $[a, b]$. Then this function $f(x)$ is strictly increasing in (a, b) if (A) $f'(x) < 0, \forall x \in (a, b)$ (B) $f'(x) > 0, \forall x \in (a, b)$ (C) $f'(x) = 0, \forall x \in (a, b)$ (D) $f'(x) \geq 0, \forall x \in (a, b)$	1
9	If $\frac{d}{dx}(f(x)) = \log x$, then $f(x)$ equals to (A) $\frac{1}{x} + c$ (B) $x(\log x - 1) + c$ (C) $x(\log x + x) + c$ (D) $-\frac{1}{x} + c$	1
10	$\int_0^{\frac{\pi}{6}} \sec^2(x - \frac{\pi}{6}) dx$ is equals to (A) $\sqrt{3}$ (B) $-\sqrt{3}$ (C) $\frac{1}{\sqrt{3}}$ (D) $-\frac{1}{\sqrt{3}}$	1
11	The area bounded by the curve $y = x^2$ and the lines $x = 1$ and x - axis is (A) $1/3$ (B) $1/6$ (C) $1/2$ (D) $1/4$	1
12	The integrating factor of the differential equation $(1 - x^2) \frac{dy}{dx} + xy = ax, -1 < x < 1$ is (A) $\frac{1}{x^2 - 1}$ (B) $\frac{1}{-x^2 + 1}$ (C) $\frac{1}{\sqrt{x^2 - 1}}$ (D) $\frac{1}{\sqrt{-x^2 + 1}}$	1
13	The order and degree of the differential equation $[1 + (\frac{dy}{dx})^2]^3 = \frac{d^2y}{dx^2}$ respectively are (A) 1, 2 (B) 2, 3 (C) 2, 1 (D) 2, 6	1
14	The value of 'p' for which the vectors $2\hat{i} + p\hat{j} + \hat{k}$ and $-4\hat{i} - 6\hat{j} + 26\hat{k}$ are perpendicular to each other, is (A) 3 (B) -3 (C) $-17/3$ (D) $17/3$	1
15	The vector joining two points A (2, -3, 5) and B (3, -4, 7) is (A) $\hat{i} - \hat{j} + 2\hat{k}$ (B) $\hat{i} + \hat{j} + 2\hat{k}$ (C) $-\hat{i} - \hat{j} - 2\hat{k}$ (D) $-\hat{i} + \hat{j} - 2\hat{k}$	1
16	The number of corner points of the feasible region determined by the constraints $x \geq 0, y \geq 0, x + y \geq 4$ is (A) 0 (B) 1 (C) 2 (D) 3	1
17	A linear programming problem deals with the optimization of a/an (A) logarithmic function (B) linear function (C) quadratic function (D) exponential function	1
18	If $P(A/B) = 0.3, P(A) = 0.4$ and $P(B) = 0.8$, then $P(B/A)$ is equals to (A) 0.6 (B) 0.3 (C) 0.06 (D) 0.4	1

	Questions number 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below. A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of the Assertion (A) B) Both Assertion (A) and Reason (R) are true and R is not the correct explanation of the Assertion (A) C) Assertion (A) is true, but (R) is false D) Assertion (A) is false, but (R) is true	
19	Assertion (A) : The range of the function $f(x) = 2\sin^{-1} x + \frac{3\pi}{2}$, where $x \in [-1,1]$, is $[\frac{\pi}{2}, \frac{5\pi}{2}]$ Reason (R) : The range of the principal value branch of $\sin^{-1}x$ is $[0,\pi]$.	1
20	Assertion (A): The Principal value of the function $f(x) = \sin^{-1}(\sin\frac{3\pi}{4}) + \cos^{-1}(\cos\frac{3\pi}{4})$, where $x \in [-1,1]$, is π Reason (R) : The range of the principal value branch of $\cos^{-1} x$ is $[0,\pi]$ and $\sin^{-1} x$ is $[-\frac{\pi}{2}, \frac{\pi}{2}]$	1
	SECTION – B <i>This section comprises very short answers (VSA) type questions of 2 marks each.</i>	
21	Check whether the function $f(x)= x$ is differentiable at $x = 0$ or not. OR If $y = \sqrt{\tan\sqrt{x}}$, prove that $\sqrt{x} \, dy/dx = \frac{1+y^2}{4y}$.	2
22	Show that the function $f(x) = x^3 + x^2 + x + 1$ has neither maxima nor minima.	2
23	If α, β, γ are the angles made by the lines with x, y and z axes then show that $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma = 2$	2
24	Find the area of a parallelogram whose adjacent sides are $2\hat{i}-4\hat{j}+5\hat{k}$ and $3\hat{i}-6\hat{j}+2\hat{k}$. OR If $\vec{a}$ and $\vec{b}$ are two non-zero vectors such that $(\vec{a} + \vec{b})$ is perpendicular to $\vec{a}$ and $(2\vec{a} + \vec{b})$ is perpendicular to $\vec{b}$, then prove that $\vec{b} = \sqrt{2} \vec{a}$	2
25	Find the principal value of $\tan^{-1}\sqrt{3} - \sec^{-1}(-2)$.	2
	SECTION – C <i>This section comprises short answers (SA) type questions of 3 marks each</i>	
26	Find the intervals in which the function $f(x) = x^3 - 12x^2 + 36x + 17$ is strictly increasing or strictly decreasing.	3
27	The volume of sphere is increasing at the rate of $8 \text{ cm}^3/\text{sec}$. Find the rate at which the surface area is increasing when the radius of the sphere is 12 cm.	3
28	Find $\int \frac{1}{\cos(x-a) \cos(x-b)} dx$ OR Evaluate $\int \frac{1}{(x-1)(x-2)(x-3)} dx$	3
29	Using vectors find the area of triangle with vertices are A (1,1,2), B (2,3,5), C (1,5,5). OR Show that the points A, B, C with position vectors $2\hat{i}-\hat{j}+\hat{k}$, $\hat{i}-3\hat{j}-5\hat{k}$ and $3\hat{i}-4\hat{j}-4\hat{k}$ respectively, are the vertices of a right-angled triangle. Hence find the area of the triangle.	3

30	Solve the following linear programming problem graphically: Maximise $z = 500x + 300y$, Subject to constraints $x + 2y \leq 12$, $2x + y \leq 12$, $4x + 5y \geq 20$, $x \geq 0, y \geq 0$.	3
31	E and F are independent events such that $P(\bar{E}) = 0.6$ and $P(E \cup F) = 0.6$. Find $P(F)$ and $P(\bar{E} \cap \bar{F})$.	3
	SECTION-D <i>This section comprises Long answers (LA) type questions of 5 marks each</i>	
32	Solve the system of equations by matrix method: $x + 2y + 3z = 6, 2x - y + z = 2, 3x + 2y - 2z = 3$ OR If $A = \begin{bmatrix} 1 & 2 & -3 \\ 3 & 2 & -2 \\ 2 & -1 & 1 \end{bmatrix}$ find A^{-1} and use it to solve the following equations $x + 2y - 3z = 6, 3x + 2y - 2z = 3, 2x - y + z = 2$	5
33	Using integration, find the area of the ellipse $\frac{x^2}{16} + \frac{y^2}{4} = 1$, included between the lines $x = -2$ and $x = 2$.	5
34	Find the shortest distance between the following two lines: $\vec{r} = (\hat{i} + 2\hat{j} + \hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k}), \vec{r} = (2\hat{i} - \hat{j} - \hat{k}) + \mu(2\hat{i} + \hat{j} + 2\hat{k})$. OR Show that the lines $\vec{r} = (3\hat{i} + 2\hat{j} - 4\hat{k}) + \lambda(\hat{i} + 2\hat{j} + 2\hat{k}), \vec{r} = (5\hat{i} - 2\hat{j}) + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})$ are intersecting. Hence find their point of intersection.	5
35	If $x^y = e^{x-y}$, prove that $\frac{dy}{dx} = \frac{\log x}{(1 + \log x)^2}$ OR If $y = (\tan^{-1} x)^2$ prove that $(x^2 + 1)^2 \frac{d^2 y}{dx^2} + 2x(x^2 + 1) \frac{dy}{dx} = 2$	5
	SECTION-E <i>This section comprises 3 case study-based questions of 4 marks each.</i>	
36	Case Study-1 Q.36. An organization conducted bike race under 2 different categories boys and girls. In all there were 250 participants. Among all of them finally three from category 1 and 2 from category 2 were selected for the final race. Ravi forms two sets B and G with these participants for his college projects. Let $B = \{b_1, b_2, b_3\}$, $G = \{g_1, g_2\}$ where B represents for the set of boys selected and G the set of all girls who were selected for the final race. Ravi decides to explore these two sets for various types of relations and functions. On the basis of the above information, answer the following questions: (i) Ravi wishes to form all the relations possible from B to G. How many such relations possible? [1 mark] (ii) Write smallest equivalence relation on G. [1 mark] (iii) (a) Ravi defines a relation from B to B as $R_1 = \{(b_1, b_2), (b_2, b_1)\}$. Write the minimum ordered pairs to be added to R_1 so that it	4

	becomes (A) reflexive but not symmetric, (B) reflexive and symmetric. [2 marks] OR (b) If the track of the final race (for biker b_1) follows the curve $x^2 = 4y$, (where $0 \leq x \leq 20\sqrt{2}$ and $0 \leq y \leq 200$), then state whether the track represents one-one and onto or not. Justify? [2 marks]	
37	Case Study-2 A tank is formed using 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 top at the bottom at the uniform rate of $2 \text{ cm}^3/\text{s}$. The semi vertical angle is 45°. On the basis of the above information, answer the following questions: (i) Find the volume of water tank in terms of its radius r. [1mark] (ii) Find the rate of change of radius at an instant when $r = 2\sqrt{2} \text{ cm}$. [1 mark] (iii) Find the rate at which the wet surface area of the conical tank is decreasing at an instant when radius $r = 2\sqrt{2} \text{ cm}$. [2 marks] OR Find the rate of change of height 'h' at an instant when slant height is 4 cm. [2marks]	4
38	Case Study-3 According to the recent research, air turbulence has increased in various regions around the world due to climate change. Turbulence makes flights bumpy and often delays the flights. Assume that, an airplane observes severe turbulence, moderate turbulence or light turbulence with equal probabilities. Further, the chance of an airplane reaching late to the destination are 55% , 37% and 17% due to severe, moderate and light turbulence respectively. On the basis of the above information, answer the following questions: (i) Find the probability that an airplane reached its destination late. [2 marks] (ii) If the airplane reached its destination late, find the probability that it was due to moderate turbulence. [2 marks]	4

KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER-19 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

SECTION-A

[1 × 20 = 20]

(This section comprises of multiple-choice questions (MCQs) of 1 mark each)

Select the correct option (Question 1 - Question 18):

Q.No.	Question	Marks
1.	Given matrix $A = \begin{bmatrix} 3 & -1 & 2 \\ 4 & 5 & 9 \\ 1 & 3 & 4 \end{bmatrix}$, then the value of $3a_{22} - 4a_{33}$ is (A) -1 (B) 8 (C) 11 (D) 3	1
2.	If $x = e^{x-y}$ then $\frac{dy}{dx}$ is equal to (A) $\frac{x-1}{x}$ (B) $\frac{1-x}{\log x}$ (C) $\frac{1-x}{x}$ (D) $\frac{x-1}{\log x}$	1
3.	The maximum value of $x^3 - 3x$ is (A) 0 (B) 1 (C) -2 (D) 2	1
4.	The domain of $\sin^{-1}(2x)$ is (A) [0, 1] (B) [-1, 1] (C) [-1/2, 1/2] (D) [-2, 2]	1

5.	If $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$ and $A+A^T = I$, then value of α is (A) $\frac{\pi}{6}$ (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$	1
6.	The function $f(x) = [x]$ where $[x]$ is greatest integer less than or equal to x is continuous at (A) 4 (B) 1.5 (C) -2 (D) 1	1
7.	$\int \frac{1}{e^x + e^{-x}} dx$ is equal to (A) $\tan^{-1}e^x + c$ (B) $\tan^{-1}e^{-x} + c$ (C) $\log(e^x + e^{-x}) + C$ (D) $\log(e^x - e^{-x}) + C$	1
8.	The principal value of $\tan^{-1}[\tan(\frac{3\pi}{5})]$ (A) $2\pi/5$ (B) $-2\pi/5$ (C) $3\pi/5$ (D) $-3\pi/5$	1
9.	Given that A is a square matrix of order 3 and $ A = -4$, then $ \text{adj } A $ is equal to (A) 4 (B) -4 (C) 16 (D) -16	1
10.	If p and q are the degree and order of the differential equation $\left[\frac{d^2y}{dx^2}\right]^2 + 3\frac{dy}{dx} + \frac{d^3y}{dx^3} = 4$, then the value of $2p-3q$ is (A) 7 (B) -7 (C) 3 (D) -3	1
11.	The number of relations on the set $A = \{1, 2, 3\}$ are (A) 9 (B) 2^3 (C) 3 (D) 2^9	1
12.	The value of α for which the vectors $2i+j+3k$ and $i-\alpha j+4k$ are orthogonal is (A) 12 (B) -14 (C) 14 (D) -12	1
13.	Corner points of the feasible region for an LPP are (0,2), (3,0), (6,0), (6,8) and (0,5). Let $Z = 4x + 6y$ be the objective function. Then, Maximum of Z – Minimum of Z = (A) 60 (B) 48 (C) 42 (D) 18	1
14.	The sign of $f'(x)$ changes from positive to negative as x increases through $x = a$ then (A) $x = a$ is a point of local minimum (B) $x = a$ is a point of local maximum (C) $x = a$ is not a point of inflection (D) None of these	1
15.	The linear inequalities or equations or restrictions on the variables of a linear programming problem are called: (A). constraints (B). Decision variables (C). Objective function (D). None of the above	1
16.	Given $\overrightarrow{PQ} = 2i + j - 3k$ and position vector of P is $3j-2k$, then the position vector of Q is (A) $2i-2j-k$ (B) $2i+4j-5k$ (C) $2i+4j-k$ (D) $2i-2j-5k$	1
17.	Out of 30 consecutive integers, 2 are chosen at random. The probability that their sum is odd, is (A) $14/29$ (B) $16/29$ (C) $15/29$ (D) $10/29$	1
18.	The number of points of discontinuity of $f(x) = x - x-1 $ is (A) 2 (B) 1 (C) 0 (D) 3	1
	Directions: In the following question, each question contains Assertion (A) and Reason (R). Each question has 4 choices (a), (b), (c) and (d) out of which only one is correct. The choices are:	1

19.	A. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). B. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A). C. Assertion (A) is true but Reason (R) is false. D. Assertion (A) is false but Reason (R) is true. Assertion (A): The relation R in a set $A = \{1, 2, 3, 4\}$ defined by $R = \{(x, y) : 3x - y = 0\}$ have the Domain = $\{1, 2, 3, 4\}$ and Range = $\{3, 6, 9, 12\}$. Reason (R): Domain and range of the relation (R) is respectively the set of all first and second entries of the distinct ordered pair of the relation.	
20.	Assertion (A): $\sin x$ is a continuous function. Reason (R): if $f(x)$ and $g(x)$ both are continuous functions, then $\text{gof}(x)$ is also a continuous function	1

SECTION-B

[2 × 5 = 10]

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21.	Using vectors, find the area of triangle ABC, with vertices A(1, 2, 3), B(2, -1, 4) and C(4, 5, -1).	2
22.	Given $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ and $A^{100} = 2^k A$ then find k.	2
23.	If $y = 5\cos x - 3\sin x$, then prove that $\frac{d^2y}{dx^2} + y = 0$	2
24.	Evaluate $\int e^x \left(\frac{x-3}{(x-1)^2} \right) dx$	2
25.	Find the points on the line $\frac{x+2}{3} = \frac{y+1}{2} = \frac{z-3}{2}$ at a distance of 5 units from the point P(1,3,3).	2

SECTION-C

[3 × 6 = 18]

(This section comprises of 6 short answer (SA) type questions of 3 marks each.)

26.	Gas is escaping from a spherical balloon at the rate of $900\text{cm}^3/\text{s}$. How fast is the surface area, radius of balloon shrinking when the radius of the balloon is 30cm?	3
27.	Evaluate $\int_0^2 x^2 + 2x - 3 dx$	3
28.	Find a vector of magnitude 6, perpendicular to each of the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$, where $\vec{a} = i + j + k$ and $\vec{b} = i + 2j + 3k$.	3
29.	Find the particular solution of the differential equation $(x+y) dy + (x-y) dx = 0$, given that when $x=1, y=1$. (OR) Find the general solution of the differential equation $\cos^2 x \frac{dy}{dx} + y = \tan x$.	3
30.	Maximize $Z = 8x + 9y$ subject to the constraints; $2x + 3y \leq 6$; $3x - 2y \leq 6$; $y \leq 1$; $x, y \geq 0$	3

31.	Often it is taken that a truthful person commands, more respect in the society. A man is known to speak the truth 4 out of 5 times. He throws a die and reports that it is a six. Find the probability that it is actually a six.	3
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SECTION-D

[5 × 4 = 20]

(This section comprises of 4 long answer (LA) type questions of 5 marks each)

32.	Find the vector and Cartesian equations of the lines which is perpendicular to the lines with equations $\frac{x+2}{1} = \frac{y-3}{2} = \frac{z+1}{4}$ and $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and passes through the point (1, 1, 1). Also find the angle between the given lines.	5
33.	Given $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$ verify that $BA=6I$, use the result to solve the system of linear equations $x - y = 3$; $2x + 3y + 4z = 17$; $y + 2z = 7$.	5
34.	Show that the right circular cone of least curved surface area and given volume has an altitude equal to $\sqrt{2}$ times the radius of the base.	5
35.	Find the area of the region bounded by the ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$.	5

SECTION-E

[5 × 4 = 20]

(This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each).

Case Study-1

36	Students of Grade 12, planned to plant saplings along straight lines, parallel to each other to one side of the playground ensuring that they had enough play area. Let us assume that they planted one of the rows of the saplings along the line $y = x - 4$. Let L be the set of all lines which are parallel on the ground and R be a relation on L. Answer the following using the above information. (i). Let relation R be defined by $R = \{(L_1, L_2) : L_1 \parallel L_2 \text{ where } L_1, L_2 \in L\}$ then R is _____ relation (A) Equivalence (B) Only reflexive (C) Not reflexive (D) Symmetric but not transitive (ii). Let $R = \{(L_1, L_2) : L_1 \perp L_2 \text{ where } L_1, L_2 \in L\}$ which of the following is true? (A) R is Symmetric but neither reflexive nor transitive (B) R is Reflexive and transitive but not symmetric (C) R is Reflexive but neither symmetric nor transitive (D). R is an Equivalence relation	4
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	(iii). The function $f: R \rightarrow R$ defined by $f(x) = x - 4$ is _____ (A). Bijjective (B). Surjective but not injective (C). Injective but not Surjective (D). Neither Surjective nor Injective (OR) (iii). Let $f: R \rightarrow R$ be defined by $(x) = x - 4$. Then the range of $f(x)$ is _____ (A) R (B) Z (C) W (D) Q	
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Case Study-2

37	The Government declare that farmers can get Rs. 300 per quintal for their onions on 1st July and after that, the price will be dropped by Rs. 3 per quintal per extra day. Shyam's father has 80 quintal of onion in the field on 1st July and he estimates that crop is increasing at the rate of 1 quintal per day. Based on the above information, answer the following question (i) If x is the number of days after 1st July, then price and quantity of onion respectively can be expressed as (A) Rs $(300-3x)$, $(80+x)$ quintals (B) Rs $(300-3x)$, $(80-x)$ quintals (C) Rs $(300+x)$, 80 quintals (D) None of these (ii) Revenue R as a function of x can be represented as (A) $R(x) = 3x^2 - 60x - 24000$ (B) $R(x) = -3x^2 + 60x + 24000$ (C) $R(x) = 3x^2 + 40x - 16000$ (D) $R(x) = 3x^2 - 60x - 14000$ (iii) Find the number of days after 1st July, when Shyam's father attain maximum revenue. (A) 10 (B) 20 (C) 12 (D) 22 (OR) On which day should Shyam's father harvest the onions to maximize his revenue. (A) 22th July (B) 20th July (C) 12th July (D) 11th July	4
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Case Study-3

38	A husband and a wife appear in an interview for two vacancies for the same post. The probability of husband's selection is $\frac{1}{7}$ and that of wife's selection is $\frac{1}{5}$. On the basis of the above information, answer the following question. (i) P (only one selected) (ii) P (none selected)	2 2
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KENDRIYA VIDYALAYA SANGATHAN: HYDERABAD REGION

MODEL QUESTION PAPER- 20 (2025 – 26)

CLASS- XII

SUBJECT: Mathematics (041)

Time: 3 Hours

Maximum Marks: 80

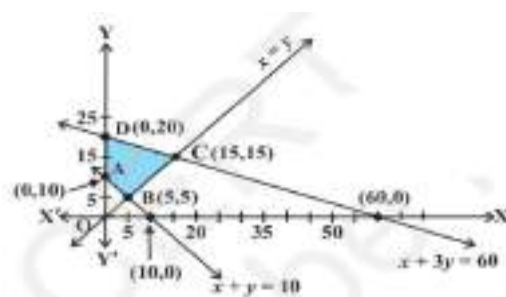
General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This Question paper contains 38 questions. All questions are compulsory.
- (ii) This Question paper is divided into five Sections - A, B, C, D and E.
- (iii) 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.
- (iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
- (v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
- (vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
- (vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
- (ix) Use of calculators is not allowed.

SECTION – A

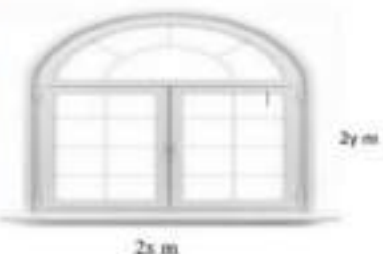
Q.NO	Question	Marks
1	The number of all matrices of order 2×2 with each entry 2 or 3 is a) 4 b) 8 c) 16 d) 32	1M
2	If $A = \begin{bmatrix} \alpha & 2 \\ 2 & \alpha \end{bmatrix}$ and $ A ^3 = 27$ then the value of α is a) ± 1 b) ± 2 c) $\pm\sqrt{5}$ d) $\pm\sqrt{7}$	1M
3	The angle between $\hat{i} - \hat{j}$ and $\hat{j} - \hat{k}$ is a) $\frac{\pi}{3}$ b) $\frac{2\pi}{3}$ c) $\frac{\pi}{6}$ d) $\frac{5\pi}{6}$	1M
4	If the function $f(x) = \begin{cases} 3x - 8, & x \leq 5 \\ 2k, & x > 5 \end{cases}$ is continuous, then the value of k is a) $\frac{2}{7}$ b) $\frac{7}{2}$ c) $\frac{3}{7}$ d) $\frac{4}{7}$	1M
5	$\int e^x \left(\log \sqrt{x} + \frac{1}{2x} \right) dx =$ a) $e^x \log x + c$ b) $e^x \log \sqrt{x} + c$ c) $\frac{e^x}{2x} + c$ d) $e^x \log x^2 + c$	1M

6	The order and the degree of the differential equation $\left(\frac{dy}{dx}\right)^3 + \left(\frac{d^3y}{dx^3}\right)^3 + 5x = 0$ a) 3 ; 6 b) 3 ; 3 c) 3;9 d) 6;3	1M
7	The graph of the inequality $2x + 3y > 6$ is a) Half plane that contains the origin b) Half plane that neither contains the origin nor the points of the line $2x + 3y = 6$ c) Whole XOY-plane excluding the points on the line $2x + 3y = 6$ d) Entire XOY-plane	1M
8	If $\vec{a}, \vec{b}$ and $\vec{c}$ are the position vectors of the points $A(2,3,-4)$, $B(3,-4,-5)$ and $C(3,2,-3)$ respectively then $\vec{a} + \vec{b} + \vec{c} =$ a) $\sqrt{113}$ b) $\sqrt{185}$ c) $\sqrt{209}$ d) $\sqrt{203}$	1M
9	$\int_0^{\frac{\pi}{2}} \frac{dx}{1 + \sqrt{\cot x}} dx =$ a) $\frac{\pi}{3}$ b) $\frac{\pi}{2}$ c) $\frac{\pi}{6}$ d) $\frac{\pi}{4}$	1M
10	For what value of x the matrix $\begin{bmatrix} 6-x & 4 \\ 3-x & 1 \end{bmatrix}$ is a singular matrix a) 1 b) -1 c) 2 d) -2	1M
11	Based on the given shaded region as the feasible region in the graph, at which point(s) is the objective function $z = 3x + 9y$ maximum  a) Point B b) Point C c) Point D d) every point on the line segment CD	1M
12	If $\begin{vmatrix} 2 & 4 \\ 5 & 1 \end{vmatrix} = \begin{vmatrix} 2x & 4 \\ 6 & x \end{vmatrix}$, then $x =$ a) ± 1 b) ± 2 c) $\pm\sqrt{2}$ d) $\pm\sqrt{3}$	1M
13	If $A = \begin{bmatrix} 3 & 1 \\ 2 & -3 \end{bmatrix}$, then the value of $\text{adj } A$ is a) 11 b) -11 c) 9 d) -9	1M

14	If A and B are two independent events such that $P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{2}$, Find $P(A'/B')$ a) $\frac{1}{2}$ b) $\frac{2}{3}$ c) $\frac{1}{6}$ d) $\frac{5}{6}$	1M
15	The integrating factor of the differential equation $x \frac{dy}{dx} - y = x^2 \cos x$ is a) $\log x$ b) $-\log x$ c) x d) $\frac{1}{x}$	1M
16	If $e^x + e^y = e^{x+y}$, then $\frac{dy}{dx} =$ a) e^{y-x} b) e^{x+y} c) $-e^{y-x}$ d) $2e^{x-y}$	1M
17	The value of p for which $p(\hat{i} + \hat{j} + \hat{k})$ is a unit vector is a) 0 b) $\frac{1}{\sqrt{3}}$ c) 1 d) $\sqrt{3}$	1M
18	The coordinates of the foot of the perpendicular drawn from the point $(2, -3, 4)$ on the y -axis is a) $(2, 3, 4)$ b) $(-2, -3, -4)$ c) $(0, -3, 0)$ d) $(2, 0, 4)$	1M
	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 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.	
19	Assertion (A): The number of onto functions from a set P containing 5 elements to a set Q containing 2 elements is 30. Reason (R): Number of onto functions from a set containing m elements to a set containing n elements is n^m .	1M
20	Assertion (A): $\vec{a} = \hat{i} + \hat{j} + 2\hat{k}$ is perpendicular to $\vec{b} = -\hat{i} + \hat{j}$ Reason (R): Two vectors $\vec{a}$ and $\vec{b}$ are perpendicular to each other if $\vec{a} \cdot \vec{b} = 0$	1M
	SECTION B This section comprises of very short answer type questions (VSA) of 2 marks each	
21	Show that the signum function $f: R \rightarrow R$ given by	2M

	$f(x) = \begin{cases} 1, & \text{if } x > 0 \\ 0, & \text{if } x = 0 \\ -1, & \text{if } x < 0 \end{cases}$ Is neither one-one nor onto OR Find the value of $\sin^{-1} \left[\sin \left(\frac{13\pi}{7} \right) \right]$	
22	If $x = at^2$, $y = 2at$ then find $\frac{d^2y}{dx^2}$	2M
23	The radius of a right circular cylinder is increasing at the rate of 2cm/s and its height is decreasing at the rate of 8cm/s. Find the rate of change of its volume, when the radius is 3 cm and height is 6cm.	2M
24	Using vectors, find the area of triangle ABC with vertices $A(1, 1, 1)$, $B(1, 2, 3)$ and $C(2, 3, 1)$.	2M
25	Find the angle between the lines $\vec{r} = (2\hat{j} - 3\hat{k}) + \lambda(\hat{i} + 2\hat{j} + 2\hat{k})$ and $\vec{r} = (2\hat{i} + 6\hat{j} + 3\hat{k}) + \lambda(2\hat{i} + 3\hat{j} - 6\hat{k})$ OR Find the value of k so that the lines $x = -y = kz$ and $x - 2 = 2y + 1 = -z + 1$ are perpendicular to each other	2M
	SECTION C (This section comprises of short answer type questions (SA) of 3 marks each)	
26	Find $\int \sin^{-1} x \, dx$.	3M
27	Evaluate $\int_{-4}^4 x + 2 \, dx$. OR Evaluate $\int_1^3 \frac{\sqrt{x}}{\sqrt{x} + \sqrt{4-x}} \, dx$	3M
28	Find $\int \frac{2x}{x^2 + 3x + 2} \, dx$	3M
29	Find the general solution of the following differential equation $2xe^{\frac{y}{x}} dy + \left(x - 2ye^{\frac{y}{x}} \right) dx = 0$ OR Find a particular solution of the differential equation $\frac{dy}{dx} + y \cot x = 4x \operatorname{cosec} x, x \neq 0, \text{ given that } y = 0 \text{ when } x = \frac{\pi}{2}$	3M
30	Solve the following linear programming problem graphically Maximize $z = 5x + 3y$ Subject to the constraints $3x + 5y \leq 15$	3M

	$5x + 2y \leq 10$ $x, y \geq 0$	
31	A bag contains 19 tickets, numbered 1 to 19. A ticket is drawn at random and then another ticket is drawn without replacing the first one in the bag. Find the Probability that both tickets will show even numbers OR A fair coin and an unbiased die are tossed. Let A be the event, "Head appears on the coin" and B be the event "3 comes on the die". Find whether A and B are independent events or not.	3M
	SECTION D (This section comprises of long answer-type questions (LA) of 5 marks each)	
32	If $A = \begin{bmatrix} 3 & 4 & 2 \\ 0 & 2 & -3 \\ 1 & -2 & 6 \end{bmatrix}$; Find A^{-1} Hence, solve the following system of equations $3x + 4y + 2z = 8, \quad 2y - 3z = 3, \quad x - 2y + 6z = -2$	5M
33	Let N be the set of natural numbers and R be the relation on $N \times N$ defined by $(a, b) R (c, d)$ iff $ad = bc$ for all $a, b, c, d \in N$. Show that R is an equivalence relation. OR Show that the relation R on the set Z of all integers defined by $(x, y) \in R \Rightarrow (x - y)$ is divisible by 3 is an equivalence relation.	5M
34	If the area between the curves $x = y^2$ and $x = 4$ divided into two equal parts by the line $x = a$, then find the value of a using integration.	5M
35	Find the foot of the perpendicular drawn from the point $(2, 3, -8)$ to the line $\frac{x-4}{2} = \frac{y}{-6} = \frac{z-1}{3}$. Also, find the perpendicular distance of the given line from the given point. OR Find the vector and the Cartesian equations of a line passing through the point $(1, 2, -4)$ and parallel to the line joining the points $A(3, 3, -5)$ and $B(1, 0, -11)$. Hence find the distance between the two lines.	5M
	SECTION E (This section comprises of 3 case-study/passage-based questions of 4 marks each with two sub-parts. First two case study questions have three sub parts (i), (ii), (iii) of marks 1,1,2 respectively. The third case study question has two sub parts of 2 marks each)	

36	Case-study 1   Read the following passage and answer the questions given below ($2x$ and $2y$ are length and breadth of rectangular part) The windows of a newly constructed building are in the form of a rectangle surmounted by a semi-circle. The perimeter of each window is 40m. (i) Find the relation between x and y (ii) What is the area of the window in terms of x (iii) Find the value of x for which area of window will be maximum? OR Find the value of y for which area of window will be maximum?	1M 1M 2M
37	Case Study -2 The total profit function of a company is given by $P(x) = -5x^2 + 125x + 37500$ where x is the production of the company? (i) Find the critical point of the function? (ii) Find the interval in which the function is strictly increasing? (iii) If $P(x) = -5x^2 + mx + 37500$ and 14 is the critical point, then find the value of m OR Find the absolute maximum for this value of m in $[0, 16]$	1M 1M 2M
38	Case Study -3 An insurance company believes that people can be divided into two classes: those who are accident prone and those who are not. The company's statistics show that an accident-prone person will have an accident at sometime within a fixed one-year period with probability 0.6, whereas this probability is 0.2 for a person who is not accident prone. The company knows that 20 percent of the population is accident prone. Based on the given information, answer the following questions. (i) What is the probability that a new policyholder will have an accident within a year of purchasing a policy? (ii) Suppose that a new policyholder has an accident within a year of purchasing a policy. What is the probability that he or she is accident prone? 	2M 2M

*** ALL THE BEST **