Directorate of Education, GNCT of Delhi
Practice Paper (Session 2025 – 26)
Class XII
Mathematics (CODE: 041)

Time Allowed: 3 Hours **Maximum Marks: 80**

General Instructions:

1. This question paper contains **FIVE sections – A, B, C, D & E**. Each part is compulsory.
   However, there are internal choices in some questions.
2. **Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.**
3. **Section B has 5 Very Short Answer (VSA)-type questions of 2 marks each.**
4. **Section C has 6 Short Answer (SA)-type questions of 3 marks each.**
5. **Section D has 4 Long Answer (LA)-type questions of 5 marks each.**
6. **Section E has 3 source based/case based/passage based/integrated units of assessment (4 marks each) with sub parts.**

SECTION – A **(Multiple Choice Questions)** **Each question carries 1 mark** **Each MCQ has four options with only one correct option, choose the correct option.**		
1.	The domain of $f(x)=\cos^{-1}(2x)$ is : (a) $[-1,1]$ (b) $[-2,2]$ (c) $[\frac{-1}{2},\frac{1}{2}]$ (d) $[\frac{-1}{4},\frac{1}{4}]$	1
2.	Let A = $\{9, -17\}$, then the number of reflexive relations defined on A is : (a) 2 (b) 4 (c) 8 (d) 16	1
3.	If A is a square matrix of order 3 & $\lvert 2A\rvert=32$, then the value of $\lvert\mathrm{adj}A\rvert$ is (a) 16 (b) 36 (c) 64 (d) 216	1
4.	For which value of x, are the determinants $\begin{vmatrix} x & 3 \\ 5 & x \end{vmatrix}$ & $\begin{vmatrix} -5 & 1 \\ 0 & -2 \end{vmatrix}$ equal? (a) 0 (b) ± 5 (c) -5 only (d) 5 only	1
5.	If A is a row matrix of order $a\times b$, B is a Column Matrix of order $b\times c$ and C is a square matrix of order $3\times b$, then $(2a+3b+c)=$ (a) 5 (b) 7 (c) 10 (d) 12	1

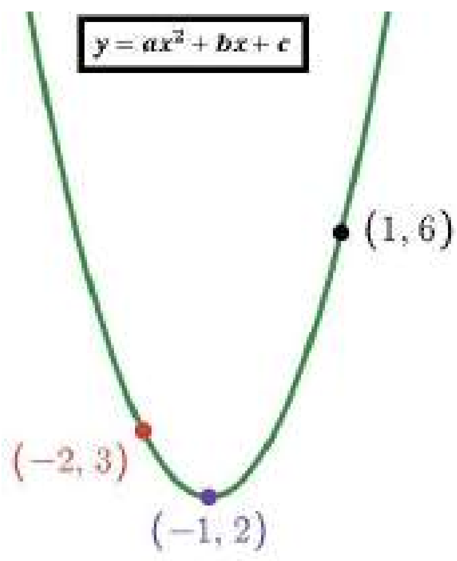
6.	If A is a square matrix of order 3 with $\|A\| \neq 1$, then A.(adj A) is Not a/an (a) Diagonal Matrix (b) Scalar Matrix (c) Identity Matrix (d) Symmetric Matrix	1
7.	The value of the cofactor of the element of second row and third column in the matrix $\begin{pmatrix} 5 & 3 & 2 \\ 2 & -1 & 0 \\ 1 & 2 & 3 \end{pmatrix}$ is (a) -5 (b) 5 (c) -7 (d) 7	1
8.	If $x = \sin t$ and $y = \cos t$, then $\frac{d^2y}{dx^2}$ is : (a) $\sec^3 t$ (b) $-\sec^3 t$ (c) $\operatorname{cosec}^3 t$ (d) $-\operatorname{cosec}^3 t$	1
9.	If $(\cos x)^y = (\cos y)^x$, then $\frac{dy}{dx} =$ (a) $\frac{y\tan x + \log(\cos y)}{x\tan y - \log(\cos x)}$ (b) $\frac{y\tan x - \log(\cos y)}{x\tan y - \log(\cos x)}$ (c) $\frac{y\tan x + \log(\cos y)}{x\tan y + \log(\cos x)}$ (d) $\frac{x\tan y + \log(\cos x)}{y\tan x + \log(\cos y)}$	1
10.	Derivative of $\tan^{-1}\left(\frac{x}{\sqrt{1-x^2}}\right)$ with respect to $\sin^{-1}\left(2x\sqrt{1-x^2}\right)$ is (a) 0 (b) 0.5 (c) 1 (d) 2	1
11.	If the rate of change of volume of a sphere is twice the rate of change of its radius, then the surface area of the sphere is : (a) $\frac{1}{2}$ sq.unit (b) 1 sq. unit (c) 2 sq. unit (d) 4 sq. unit	1
12.	The area (in Sq. units) bounded by the parabola $y^2 = x$, $y-axis$ & the line $y = 3$ is : (a) $\frac{1}{3}$ (b) 1 (c) 3 (d) 9	1

13.	The value of $4\times\int_0^{\frac{\pi}{2}}\left(\frac{\sin^{0.5}x}{\sin^{0.5}x+\cos^{0.5}x}\right)dx$ is $(a)\ \frac{\pi}{4}$ $(b)\ \frac{\pi}{2}$ $(c)\ \pi$ $(d)\ 2\pi$	1
14.	The general solution of the differential equation $\frac{dx}{dy}=\frac{x}{y}$ is $(a)\ xy=c$ $(b)\ x+y=c$ $(c)\ x-y=c$ $(d)\ \frac{x}{y}=c$	1
15.	The integrating factor for solving the differential equation $x\frac{dy}{dx}=x+y$ is $(a)\ e^x$ $(b)\ e^{-x}$ $(c)\ \log x$ $(d)\ \frac{1}{x}$	1
16.	In an LPP, corner points of the feasible region determined by the system of linear constraints are (1, 1), (4, 0) and (0, 4). If $Z=px+qy$, where $p,\ q>0$ is to be minimized, the condition on p and q, so that the minimum of Z occurs at (4, 0) and (1, 1), will be : $(a)\ 0.5p=q$ $(b)\ p=q$ $(c)\ 2p=q$ $(d)\ 3p=q$	1
17.	If the feasible region of a linear programming problem with objective function $Z=ax+by$, is bounded, then which of the following is correct? (a) It will only have a maximum value. (b) It will only have a minimum value. (c) It will have both maximum & minimum value. (d) It will have neither maximum nor minimum value.	1

18.	If $\left\|\vec{a}\right\|=1,\left\|\vec{b}\right\|=2\ \&\ \vec{a}.\vec{b}=1,$ then $\left\|\vec{a}+2\vec{b}\right\|=$ $(a)\ 2\sqrt{2}$ $(b)\ 3$ $(c)\ \sqrt{10}$ $(d)\ \sqrt{11}$	1
19.	**ASSERTION-REASON BASED QUESTIONS (Q.19 & Q.20)** **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.** $ASSERTION(A):$ If $\|\vec{a}\times\vec{b}\|^2+\|\vec{a}.\vec{b}\|^2=25\ \&\ \|\vec{a}\|=5$ then $\vec{b}$ is a unit vector. $REASONING(R):\sin^2 x+\cos^2 x=1, \|\vec{a}\times\vec{b}\|=\|\vec{a}\|\|\vec{b}\|\sin\theta$ and $\|\vec{a}.\vec{b}\|=\|\vec{a}\|\|\vec{b}\|\cos\theta.$	1
20.	$ASSERTION(A): P\left(\dfrac{A}{B}\right)+P\left(\dfrac{A'}{B}\right)=1.$ $REASONING(R): A\ \&\ A'$ are complementary events.	1
SECTION B **This section comprises of very short answer type-questions (VSA) of 2 marks each**		
21.	A drone is flying in 3D space. At any instant, its poition vector is given by (4, 9, 2). It moves in a straight path such that every change in its coordinates satisfies the relation: $\dfrac{x-4}{3}=\dfrac{9-y}{2}=\dfrac{3z-6}{12}$ Determine the direction ratios & direction cosines of the path along which drone is moving.	2
22.	$Evaluate: I=\int\dfrac{dx}{(x^2+1)(x^2+4)}.$	2

23.	A company is designing a robotic arm that moves within a limited angular range. The control angle is defined by the function $f(x)=\cos^{-1}\left(\frac{3-2x}{7}\right)$. Determine the range of possible values of x for which the control angle $f(x)$ is defined. OR The greatest integer function $f(x)=[x]$ converts every real number to the nearest smaller integer. (a) Explain with examples, why this function cannot be one-one. (b) Can this function ever be onto if the co-domain is all real number $\mathbb{R}$? Justify logically.	2
24.	If $y=(x+\sqrt{x^2+1})^2$, then prove that $\boxed{(x^2-1)\left(\frac{dy}{dx}\right)^2=4y^2}$. *OR* Show that the function $f(x)=\frac{16\sin x}{4+\cos x}-x$ is strictly decreasing in $(\frac{\pi}{2},\pi)$.	2
25.	Let $\vec{a}=2\hat{i}+3\hat{j}+4\hat{k}, \vec{b}=4\hat{i}-3\hat{j}+9\hat{k}$ & $\vec{c}=3\hat{i}-2\hat{j}+6\hat{k}$. Find a vector $\vec{d}$ which is perpendicular to both $\vec{a}$ & $\vec{b}$ and $\vec{c}.\vec{d}=39$.	2
SECTION C **(This section comprises of short answer type questions (SA) of 3 marks each)**		
26.	If A & B are two independent events, then show that A' & B are also Independent Events. Hence, find the value of $P(A'\cap B)$ such that $P(A\cap B)=0.06, P(A)=0.2$ & $P(B)=0.3$	3

27.	Solve the following Differential Equation when $y(0)=0$: $\frac{dy}{dx}+(\sec^2 x)\, y=\tan x.(\sec^2 x)$ *OR* Find the general solution of the differential equation $xdy-ydx=\sqrt{x^2+y^2}dx$	3
28.	The median of an equilateral triangle is increasing at the rate of $2\sqrt{3}\ cm/\sec$.Find the rate at which its side is increasing. *OR* Prove that: $\frac{d}{dx}\left(\frac{x}{2}\sqrt{a^2-x^2}+\frac{a^2}{2}\sin^{-1}\left(\frac{x}{a}\right)\right)=\sqrt{a^2-x^2}$.	3
29.	Find : $I=\int\frac{(x+\sin 2x)dx}{1+\cos 2x}$ *OR* Evaluate : $I=\int_{-1}^{1}\lvert x\sin \pi x\rvert\, dx$.	3
30.	Given that $\hat{a}$, $\hat{b}$ & $\hat{c}$ are unit vectors such that $\hat{a}.\hat{b}=\hat{a}.\hat{c}=0$ and angle between $\hat{b}$ & $\hat{c}$ is $\frac{\pi}{6}$. (i) Show that $\left\lvert\hat{b}\times\hat{c}\right\rvert=\frac{1}{2}$. (ii) Use this to infer what constant must multiply $\left(\hat{b}\times\hat{c}\right)$ to make it a unit vector. (iii) Hence justify why $\hat{a}=\pm 2\left(\hat{b}\times\hat{c}\right)$.	3

31.	Consider the linear programming problem, where the objective function $Z = 2x + 4y$ needs to be minimized subject to constraints $$2x + y \geq 1000$$ $$x + 2y \geq 800$$ $$x \geq 0, y \geq 0$$	3
	SECTION D **(This section comprises of long answer-type questions (LA) of 5 marks each)**	
32.	If Matrix A = $\begin{pmatrix} 3 & 2 & 1 \\ 4 & 1 & 3 \\ 1 & 1 & 1 \end{pmatrix}$, find A^{-1} and hence solve the following system of linear equations: $3x + 2y + z = 2000$ $4x + y + 3z = 2500$ $x + y + z = 900$	5
	OR	
	Observe the following Graph and Using the concept of Matrices find the values of constants a, b & c. Hence write the expression for y in terms of x. 	5

33.	Using integration find the area bounded by the curve $x^2 + y^2 = 4$. OR A planet orbits its star in an elliptical path modeled by the equation : $$9x^2 + 4y^2 = 36$$ Astronomers want to calculate the total area enclosed by this orbit to understand the region in which the planet moves. Find the area of the elliptical orbit using integration.	5
34.	Find the intervals where $f(x) = \sin^4 x + \cos^4 x, x \in [0, \frac{\pi}{2}]$ is (a) Strictly increasing (b) Strictly Decreasing	5
35.	Two airplanes are flying along different straight-line trajectories, represented by $L_1 : \frac{x-1}{1} = \frac{y-2}{-1} = \frac{z-1}{1}$ & $L_2 : \frac{x-2}{2} = \frac{y+1}{1} = \frac{z+1}{2}$ To avoid mid-air collisions, air traffic controllers need to determine the shortest distance between the two flight paths. Calculate this shortest distance to check if the aircraft are at a safe separation.	5

SECTION - E

This section comprises of 3 case-study/passage-based questions of 4 marks each with two sub-parts.

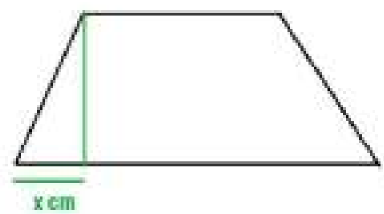
First two case study questions have three sub parts (A), (B) & (C) of marks 1, 1, 2 respectively.

The third case study question has two sub-parts of 2 marks each.

36. A garden designer is planning to create a flower bed in the shape of an isosceles trapezium. The three sides other than the base (two equal non – parallel sides and the smaller base) are all 10 cm each.

To make the design look more appealing, she wants to maximize the area of the trapezium while maintaining these side lengths.

On the basis of above information answer the following questions:



(a) Let the length of the base of smaller triangular region is x cm.
Find the distance between the two parallel sides. 1

(b) Express the area of the trapezium in terms of x. 1

(c) (i) Using First derivative Approach, find the value of x for which the area is maximum and calculate this maximum area. 2

OR

(ii) Using Second derivative Approach, find the value of x for which the area is maximum and calculate this maximum area. 2

37. A jeweller is testing a random sampling method using three identical boxes — Box I, Box II, and Box III. Each box contains two coins, as shown below :

BOX	Gold coins	Silver coins
Box I	2	0
Box II	1	1
Box III	0	2

A person chooses one box at random and draws one coin without looking.The drawn coin turns out to be Gold.

On the basis of above information answer the following questions:

(a) List all the possible outcomes (sample space) when a person randomly chooses a box and draws one coin. 1

(b) Find the probability that the chosen coin is a gold coin. 1

(c) (i) Using the result of (b), find the probability that the other coin in the box is also gold, given that a gold coin has been drawn. 2

OR

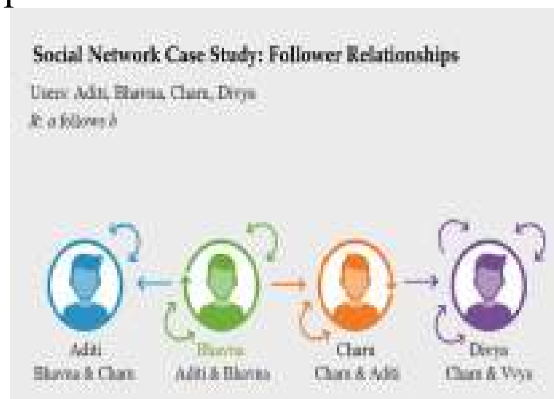
(ii) Using the result of (b), find the probability that the other coin in the box is silver, given that a gold coin has been drawn. 2

38. A social networking app is testing a new feature that connects users based on their interactions. The app records the relation R on the set $A = \{\text{Aditi}, \text{ Bhavna}, \text{ Charu}, \text{ Divya}\}$, where

a R b means "a follows b on the app."

The following data was recorded :

User	Follows
Aditi	Bhavna & Charu
Bhavna	Aditi & Bhavna
Charu	Charu & Aditi
Divya	Charu & Divya



On the basis of above information answer the following questions:

(a) Represent the relation R as a set of ordered pairs and determine whether it is reflexive and symmetric. 2

Give reasons for your answer.

(b) Check whether the relation R is transitive.

Hence, state whether R is an equivalence relation or not. 2