Directorate of Education, GNCT of Delhi
Practice Paper
(Mid Term)
(2026-27)
Class – XII
Mathematics (Code: 041)

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

General Instructions :

- This Question paper contains - F**ive sections A,B,C,D,E**. Each section is compulsory. However, there are internal choices in some questions.
- **Section A** has 18 **MCQ's and 02** Assertion-Reason based questions of 1 mark each(20 Marks)
- **Section B**has 5 **Very Short Answer (VSA)-type** questions of 2 marks each(10 Marks)
- **Section C** has 6 **Short Answer (SA)-type** questions of 3 marks each(18 Marks)
- **Section D** has 4 **Long Answer (LA)-type** questions of 5 marks each(20 Marks)
- Section E has 3 Source based/Case based/passage based/integrated units of assessment (4 marks each) with sub parts(12 Marks)

Section A

(Question number 1 – 18 are of MCQ type questions of one mark each.)

1. Let f: R → R be defined as $f(x)=x^2+5x-4$. Then f is:

(a) Injective but not surjective	**(b) Surjective but not injective**
(c) Boyth injective and surjective	**(d) neither injective nor surjective**

2. If $y=2\sin^{-1}(3x)$, then the range of y is:

(a) [−π,π]	**(b) [0,π]**
(c) [−2π,2π]	**(d) [0,2π]**

3: The principal value of $\cos^{-1}\frac{1}{2}+\sin^{-1}\frac{1}{2}$ is:

(a) π/6	(b) π/3
(c) π/2	(d) π

4: The value of $\sin\left(\sin^{-1}\left(\frac{2\pi}{3}\right)\right)$ **is:**

(a) $\frac{2\pi}{3}$	**(b)** $\frac{\sqrt{3}}{2}$
(c) $\frac{3\pi}{2}$	**(d)** $\frac{\pi}{3}$

5: The number of 2×3 **matrices with entries chosen from {0,1,2} is:**

(a) 9	**(b) 18**
(c) 729	**(d) 36**

6: If A=$\begin{bmatrix} 4 & a & b \\ -2 & 5 & c \\ 3 & 7 & 6 \end{bmatrix}$ **is symmetric, then a+b+c equals:**

(a) 8	**(b) 10**
(c) 12	**(d) 14**

7. If P is a 3×1 **matrix and Q is a** 1×3 **matrix, then PQ is:**

(a) a scalar	**(b) a** 3×3 **matrix**
(c) a 1×1 **matrix only**	**(d) undefined**

8. If $a_{ij}=i+j$ **for a** 2×2 **matrix A, then** A^T **is:**

(a) $\begin{bmatrix} 2 & 3 \\ 3 & 4 \end{bmatrix}$	**(b)** $\begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$
(c) $\begin{bmatrix} 0 & 1 \\ 1 & 2 \end{bmatrix}$	**(d)** $\begin{bmatrix} 2 & 2 \\ 3 & 3 \end{bmatrix}$

9. If $A^2=A$**, then** $(I-A)^2$ **is equal to:**

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

10. If $x^2+y^2=2xy$, then $\frac{dy}{dx}$ is:

(a) $\frac{(y-x)}{(y-x)}$	**(b)** $\frac{(y-x)}{(x-y)}$
(c) $\frac{(x-y)}{(x+y)}$	**(d)** -1

11. The area between $y=x^2$ and x-axis from x=0 to x=2 is:

(a) $\int_0^2 x\,dx$	**(b)** $\int_0^2 x^2\,dx$
(c) $2\int_0^2 x^2\,dx$	**(d)** $\int_0^2 2x\,dx$

12. $\frac{d}{dx}\left[\tan^{-1}\left(x^2\right)\right]$ **is:**

(a) $\frac{2x}{(1+x^2)}$	**(b)** $\frac{2x}{(1+x^4)}$
(c) $\frac{x}{(1+x^4)}$	**(d)** $\frac{1}{(1+x^2)}$

13. The derivative of $\sin^3 x$ with respect to $\cos^3 x$ is:

(a) $-\tan^2 x$	**(b)** $-\tan x$
(c) $-\cot^2 x$	**(d)** $\tan^2 x$

14. The diagonal square of side $2\sqrt{2}\,cm$ is increasing at the rate of $2\,cm/sec$ which of the following is rate at which this area is increasing ?

(a) $8\,cm^2/s$	**(b)** $12\,cm^2/s$
(c) $6\sqrt{2}\,cm^2/s$	**(d)** $\sqrt{2}\,cm^2/s$

15. If $\int \frac{4x}{1+x^2}dx = A\log\left(1+x^2\right)+C$, then A is:

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

16. If $\int_0^a \frac{dx}{\left(1+x^2\right)} = \frac{\pi}{4}$, then a is:

(a) 0	**(b) 1**
(c) $\sqrt{3}$	**(d) $\frac{\pi}{4}$**

17. The product of order and degree of $\frac{d}{dx}\left(\frac{d^2y}{dx^2}\right)=7$ is :

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

18. Which of the following is not homogeneous?

(a) $\frac{(x+y)}{x}$	**(b)** $\frac{\left(x^2+y^2\right)}{x^2}$
(c) $\frac{y}{x}+\cos\frac{y}{x}$	**(d)** $\sin x+\sin y$

Assertion-Reason Based Questions

Note: For questions 19 and 20, 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): If f is onto , then f is one -to- one and if f is one -one , then f is onto.

Reason (R): Every one-one function is always onto and every onto function is always one -to-one .

(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.***

20. Assertion (A): $f(x)=e^{-x}$ **is decreasing on R.**

Reason (R): If $f'(x)<0$ **on an interval, then f is decreasing on that interval.**

(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.***

Section B

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

21. (a) Evaluate $\tan\left[\sin^{-1}\left(\frac{1}{2}\right)+\cos^{-1}\left(\frac{1}{\sqrt{2}}\right)\right]$.

OR

(b) Evaluate $\sin^{-1}\left(\sin\frac{5\pi}{6}\right)+\cos^{-1}\left(\cos\frac{7\pi}{6}\right)$

22. Construct a 2×2 matrix A such that $A^2=-9I$. Hence find A^4.

23. (a) Determine the intervals in which $f(x)=\frac{(x+1)}{(x-2)}$ is increasing

or decreasing.

OR

(b) If $f(a-x)=f(x)$, show that . $\int_0^a f(x)\,dx=\frac{a}{2}\int_0^a f(x)\,dx$

24. Evaluate $\int\frac{dx}{\sqrt{(x^2-6x+13)}}$.

25. Find the particular solution of $\frac{dy}{dx}=y\tan 3x$**, given** $y(0)=2$**.**

Section C

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

26.Let R on $\mathbb{R}$ be defined by $(x, y) \in R$ iff $x - y$ is rational. Test whether R is reflexive, symmetric and transitive.

OR

On $A = -3, -2, -1, 0, 1, 2, 3$, define xRy iff $x - y$ is divisible by 3. Show that R is an equivalence relation.

27. For $A = \begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$ verify that $(AB)^{-1} = B^{-1}A^{-1}$.

28. (a) If $x = e^t(\cos t - \sin t)$, $y = e^t(\sin t + \cos t)$, prove $\frac{dy}{dx} = \tan t$.

OR

(b) If $y = (x^2 + 1)^x$, find $\frac{dy}{dx}$ using logarithmic differentiation.

29.A spherical balloon is inflated at $2\,cm^3/sec$. Find the rate of increase of its radius when $r = 3$ cm.

30. (a) Evaluate $\int_{\frac{-\pi}{6}}^{\frac{\pi}{2}} (\sin|x| + \cos|x|)\,dx$

OR

(b) Evaluate $\int_{\frac{\pi}{12}}^{\frac{5\pi}{12}} \frac{dx}{1 + \sqrt{\cot x}}$.

31. Solve the following differential equation

$x\frac{dy}{dx} = y - x\sin^2\left(\frac{y}{x}\right)$, given that $y(1) = \frac{\pi}{6}$

Section D

(This section contains 4 Long answer (LA) type questions of 5 marks each.)

32. Using integration, find the area of the ellipse $2x^2 + 9y^2 = 36$ bounded between the lines y=0 and $y = \frac{\sqrt{2}}{3}x$ in the first quadrant .

33. (a) Let A=R-{3}, B=R-{1} and define $f:A\to B$ **by** $f(x)=\frac{x-2}{x-3}$

(i) Explain why f is defined , i.e., why $f(x)\in B$ **for every** $x\in A$ **1**

(ii)Prove that f is one-one **2**

(iii) Prove that f is onto **2**

OR

(b) Find the domain and range of $p(x)=\sin^{-1}(2x-1)$**. Also find x when** $p(x)=\frac{\pi}{6.}$. **5**

34. Given A=$\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}$**, B=**$\begin{bmatrix}2 & 0\\ 1 & 2\end{bmatrix}$ **and C=**$\begin{bmatrix}3 & 1\\ 2 & 1\end{bmatrix}$**, find D such that AB−CD is the null matrix.**

35. (a) Evaluate $\int_0^{\frac{\pi}{2}}\log(\cos x)\,dx$

OR

(b) Integrate $\frac{(2x^2+3x+4)}{(x+1)(x^2+1)}dx$.

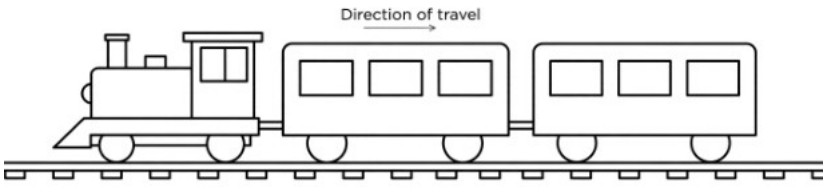
Section E

(Case Study Based Questions carry 4 marks each.)

36. A train travels along a straight track. Its speed v(t) (in km/h) at time t (in minutes) after it starts moving is given by :

$v(t)=5t^2-t^3$ **for** $0\leq t<5$

and $v(t)=4t^2-15t-25$ **for** $t\geq 5$



Based on the above information answer the following:

(a) Find $v'(t)$ *for* $0<t<5$ **[1]**

(b)Find $v'(t)$ *for* $t>5$ **[1]**

(c) Check whether v(t) is continuous at t=5 **[2]**

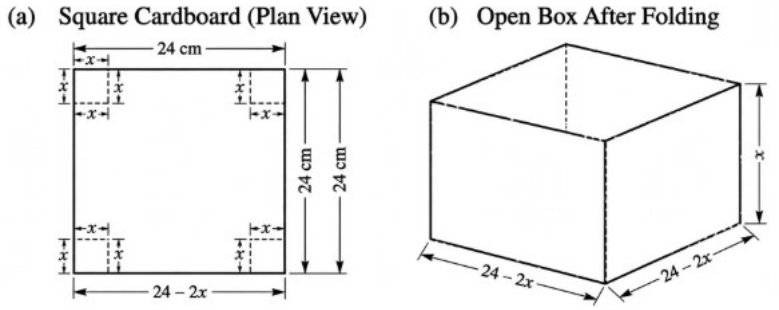
OR

Check whether v(t) is differentiable at t=5 **[2]**

37. A manufacturer wants to make an open rectangular box from a square sheet of cardboard of side 24 cm, by cutting equal squares of side x cm from each corner and folding up the sides.

The volume of the box formed is given by:

$V(x) = x(24 - 2x)^2, 0 < x < 12$



Based on the above information, answer the following:

(a) Find V′(x). **[1]**

(b) Find the critical point(s) of V(x) **[1]**

(c) Use the second derivative test to find the value of x for which the volume is maximum, and hence find the maximum volume. **[2]**

OR

Verify using the second derivative test whether x=12 gives a maximum or minimum volume. [2]

38. A school conducted a Mathematics and Science Olympiad for students of Classes XI and XII. The number of students who qualified at the School Level and District Level is represented by the matrix $A = \begin{bmatrix} 20 & 15 \\ 12 & 18 \end{bmatrix}$

where the rows represent Class XI and Class XII, while the columns represent School Level and District Level qualifiers respectively.

For further analysis, the school uses the matrix $B = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$

Based on the above information, answer the following questions:

(a) Find the inverse of matrix B **[2]**

(b) If $C = \begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix}$ **find BC** **[2]**