Class XII | Session 2026-27
Subject - Mathematics
Sample Question Paper - Set 5

General Instructions:

1. This Question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. Section A has 18 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

1. If A = $\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$, and A + A' = I, if the value of α is **[1]**

a) π
b) $\frac{3\pi}{2}$
c) $\frac{\pi}{6}$
d) $\frac{\pi}{3}$

2. For the set of linear equations **[1]**

λx - 3y+ z = 0

x + λy + 3z = 1

3x + y + 5z = 2

the value of λ, for which the equations does not have unique solution is

a) 1, $\frac{11}{5}$
b) -1, $\frac{-11}{5}$
c) -1, $\frac{11}{5}$
d) $-\frac{11}{5}$, 1

3. Family y = Ax + A^3 of curves is represented by the differential equation of degree: **[1]**

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

4. Differentiation of the following w.r.t. xy = e^{x^3} **[1]**

a) $x^2e^{x^2}$
b) $x^3e^{x^3}$
c) $3x^2e^{x^3}$
d) $x^2e^{x^3}$

5. The direction ratios of the line x - y + z - 5 = 0 = x - 3y - 6 are proportional to **[1]**

a) 2, - 4, 1
b) $\frac{3}{\sqrt{14}}, \frac{1}{\sqrt{14}}, \frac{-2}{\sqrt{14}}$

c) 3, 1, - 2

d) $\frac{2}{\sqrt{41}}, \frac{-4}{\sqrt{41}}, \frac{1}{\sqrt{41}}$

6. The order and degree (if defined) of the differential equation, $\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^3 = x \sin\left(\frac{dy}{dx}\right)$ respectively are: [1]

a) 2, degree not defined

b) 2, 2

c) 2, 3

d) 1, 3

7. Solution of LPP maximize Z = 2x - y subject to x + y $\leq$ 2, x, y $\geq$ 0 [1]

a) 4

b) 2

c) 0

d) 1

8. What is the domain of the function $\cos^{-1}(2x - 3)$? [1]

a) (-1, 1)

b) [1, 2]

c) [-1, 1]

d) [1, 3]

9. $\int x\sqrt{x^2-1}dx = ?$ [1]

a) $\frac{1}{3}\left(x^2-1\right)^{3/2} + C$

b) $\frac{1}{2\sqrt{x^2-1}} + C$

c) $\frac{2}{3}\left(x^2-1\right)^{3/2} + C$

d) $\frac{1}{\sqrt{x^2-1}} + C$

10. The matrix $\begin{bmatrix} 0 & 5 & -7 \\ -5 & 0 & 11 \\ 7 & -11 & 0 \end{bmatrix}$ is [1]

a) an upper triangular matrix

b) a skew-symmetric matrix

c) a symmetric matrix

d) a diagonal matrix

11. The corner points of the feasible region determined by the following system of linear inequalities: [1]
2x + y $\leq$ 10, x + 3y $\leq$ 15, x, y $\geq$ 0 are (0, 0), (5, 0), (3, 4) and (0, 5). Let Z = px + qy, where p, q $\geq$ 0. Condition on p and q so that the maximum of Z occurs at both (3, 4) and (0, 5) is

a) p = q

b) q = 3p

c) p = 3q

d) p = 2q

12. Let f(x) = x^2lxl then the set of values, where f(x) is three times differentiable, is [1]

a) 2

b) Infinite

c) Definite

d) 3

13. Find the angle between the following pairs of lines: $\vec{r} = 2\hat{i} - 5\hat{j} + \hat{k}$ $+\lambda\left(3\hat{i} + 2\hat{j} + 6\hat{k}.\right)$ and $\vec{r} = 7\hat{i} - 6\hat{k}$ $+\ \mu\left(\hat{i} + 2\hat{j} + 2\hat{k}.\right)$ $,\lambda, \mu \in R$ [1]

a) $\theta = \cos^{-1}(\frac{19}{21})$

b) $\theta = \sin^{-1}\left(\frac{19}{21}\right)$

c) $\theta = \cot^{-1}\left(\frac{19}{21}\right)$

d) $\theta = \tan^{-1}\left(\frac{19}{21}\right)$

14. In a certain town, 40% persons have brown hair, 25% have brown eyes, and 15% have both. If a person selected at random has brown hair, the chance that a person selected at random with brown hair is with brown eyes [1]

a) $\frac{2}{3}$

b) $\frac{1}{3}$

c) $\frac{3}{8}$

d) $\frac{3}{20}$

15. The general solution of the differential equation $\frac{dy}{dx} = e^{x+y}$ is **[1]**

a) $e^x + e^y = C$

b) $e^x + e^{-y} = C$

c) $e^{-x} + e^y = C$

d) $e^{-x} + e^{-y} = C$

16. The values of a for which the function f(x) = sin x - ax + b increases on R are **[1]**

a) $(-\infty, -1)$

b) $(-\infty, \infty)$

c) [-1, 1]

d) [1, 1]

17. If $x = at^2$,y = 2 a t, then $\frac{d^2y}{dx^2}$ = **[1]**

a) $\frac{1}{t^2}$

b) 0

c) $-\frac{1}{2a\ t^3}$

d) $\frac{1}{2t^2}$

18. The equation of a line passing through point (2, -1, 0) and parallel to the line $\frac{x}{1} = \frac{y-1}{2} = \frac{2-z}{2}$ is: **[1]**

a) $\frac{x-2}{1} = \frac{y-1}{2} = \frac{z}{2}$

b) $\frac{x-2}{1} = \frac{y+1}{2} = \frac{z}{-2}$

c) $\frac{x+2}{1} = \frac{y-1}{2} = \frac{z}{-2}$

d) $\frac{x+2}{1} = \frac{y-1}{2} = \frac{z}{2}$

19. **Assertion (A):** The Points A(2, 3, -4), B(1, -2, 3) and C(3, 8, -11) are conllinear **[1]**

Reason (R): It direction ratios of AB and BC are proportional, A, BC are collinear points.

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):** $\int \frac{dx}{16+9x^2} = \frac{1}{12}\tan^{-1}\left(\frac{3x}{4}\right)$ **[1]**

Reason (R): $\int \frac{1}{a^2+x^2}dx = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + C$

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

21. If A = $\begin{bmatrix} p & 2 \\ 2 & p \end{bmatrix}$ and $|A^3| = 125$, then find the values of p. **[2]**

OR

Using determinant show that the (5, 5), (- 5, 1) and (10, 7) points are collinear.

22. Evaluate: $\int e^x \frac{(2-x)}{(1-x)^2}dx$. **[2]**

23. Find the absolute maximum and minimum values of a function f given by **[2]**

f (x) = $2x^3 - 15x^2 + 36x + 1$ on the interval [1, 5].

OR

Prove that the function $f(x) = \tan x - 4x$ is strictly decreasing on $\left(\frac{-\pi}{3}, \frac{\pi}{3}\right)$.

24. If A and B are two independent events such that P(A ∪ B) = 0.60 and P(A) = 0.2, find P (B). **[2]**

25. Show that: $\frac{d}{dx}(|x|) = \frac{x}{|x|}, x \neq 0$. **[2]**

Section C

26. Evaluate: $\int_0^{\pi/2} \frac{1}{2\cos x + 4\sin x}dx$ **[3]**

27. Differentiate the function $\cot^{-1}\left[\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right], 0 < x < \frac{\pi}{2}$ w.r.t. x. **[3]**

28. Evaluate $\int \frac{dx}{x(x^5+3)}$. **[3]**

OR

Evaluate the integral: $\int \frac{1}{\sin x(2+3\cos x)} dx$

29. Solve the differential equation $ye^{\frac{x}{y}} dx = \left(xe^{\frac{x}{y}} + y^2\right) dy (y \neq 0)$ **[3]**

OR

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

30. By computing the shortest distance determine whether the pairs of lines intersect or not: **[3]**

$\vec{r} = (\hat{i} + \hat{j} - \hat{k}) + \lambda(3\hat{i} - \hat{j})$ and $\vec{r} = (4\hat{i} - \hat{k}) + \mu(2\hat{i} + 3\hat{k})$

OR

If $\vec{a}, \vec{b}$ and $\vec{c}$ are three vectors such that each one is perpendicular to the vector obtained by sum of the other two and $|\vec{a}| = 3, |\vec{b}| = 4$ and $|\vec{c}| = 5$, then prove that $|\vec{a} + \vec{b} + \vec{c}| = 5\sqrt{2}$.

31. Maximize Z = 100x + 170y subject to **[3]**

$3x+2y \leq 3600$

$x+4y \leq 1800$

$x \geq 0, y \geq 0$

Section D

32. Find the area of the region bounded by the curve $y = x^2$ and the line $y = 4$. **[5]**

33. The scalar product of the vector $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ with a unit vector along the sum of vectors $\vec{b} = 2\hat{i} + 4\hat{j} - 5\hat{k}$ and $\vec{c} = \lambda\hat{i} + 2\hat{j} + 3\hat{k}$ is equal to one. Find the value of λ and hence, find the unit vector along $\vec{b} + \vec{c}$. **[5]**

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 $\vec{p}$, which is perpendicular to both $\vec{a}$ and $\vec{b}$ and $\vec{p} \cdot \vec{c} = 18$.

34. If $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$, prove that $A^n = \begin{bmatrix} 3^{n-1} & 3^{n-1} & 3^{n-1} \\ 3^{n-1} & 3^{n-1} & 3^{n-1} \\ 3^{n-1} & 3^{n-1} & 3^{n-1} \end{bmatrix}$ **[5]**

35. Show that the semi-vertical angle of the cone of the maximum volume and of given slant height is $\cos^{-1} \frac{1}{\sqrt{3}}$ **[5]**

OR

A right circular cylinder is inscribed in a cone. Show that the curved surface area of the cylinder is maximum when the diameter of the cylinder is equal to the radius of the base of the cone.

Section E

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

In an office three employees Govind, Priyanka and Tahseen process incoming copies of a certain form. Govind process 50% of the forms, Priyanka processes 20% and Tahseen the remaining 30% of the forms. Govind has an error rate of 0.06, Priyanka has an error rate of 0.04 and Tahseen has an error rate of 0.03.

i. 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, find the probability that the form is NOT processed by Govind. (1)

ii. Find the probability that Priyanka processed the form and committed an error. (1)

iii. Find the total probability of committing an error in processing the form. (2)

OR

iv. Let A be the event of committing an error in processing the form and let E_1, E_2 and E_3 be the events that Govind, Priyanka and Tahseen processed the form. The value of $\sum_{i=1}^{3} P\left(E_i \mid A\right)$? (2)

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

Priyanka and Renu are playing Ludo at home during Covid-19. While rolling the dice, Priyanka's sister Pummy 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, D}, B = {1, 2, 3, 4, 5, 6}

i. Pummy wants to know the number of functions from A to B. How many number of functions are possible? (1)

ii. Pummy wants to know the number of relations possible from A to B. How many number of relations are possible? (1)

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),}. Is R an equivalence relation? (2)

OR

Show that a relation, R : B $\rightarrow$ B be defined by R = {(x, y) : y is divisible by x} is a reflexive and transitive but not symmetric. (2)

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

Let f(x) be a real valued function. Then its

- Left Hand Derivative (L.H.D.): $Lf'(a) = \lim_{h \to 0} \frac{f(a-h)-f(a)}{-h}$
- Right Hand Derivative (R.H.D.): $Rf'(a) = \lim_{h \to 0} \frac{f(a+h)-f(a)}{h}$

Also, a function f(x) is said to be differentiable at x = a if its L.H.D. and R.H.D. at x = a exist and both are equal.

For the function $f(x) = \begin{cases} |x-3|, x \geq 1 \\ \frac{x^2}{4} - \frac{3x}{2} + \frac{13}{4}, x < 1 \end{cases}$

i. What is R.H.D. of f(x) at x = 1? (1)

ii. What is L.H.D. of f(x) at x = 1? (1)

iii. Check if the function f(x) is differentiable at x = 1. (2)

OR

Find f'(2) and f'(-1). (2)