MADURAI DT

QUARTERLY EXAM - SEPTEMBER - 2025

Class : XII

Mathematics

Maximum Marks : 90

Time Allowed : 3.00 Hours

Part - I

Note : i) All questions are compulsory. ii) Choose the most appropriate answer from the given four alternatives and write the option code and the corresponding answer. 20 ×1 = 20

1. Distance from the origin to the plane $3x - 6y + 2z + 7 = 0$ is

(1) 0 (2) 1 (3) 2 (4) 3

2. The eccentricity of the hyperbola whose latus rectum is 8 and conjugate axis is equal to half the distance between the foci is

(1) $\frac{4}{3}$ (2) $\frac{4}{\sqrt{3}}$ (3) $\frac{2}{\sqrt{3}}$ (4) $\frac{3}{2}$

3. If $A = \begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix}$, then $9I - A =$ (1) A^{-1} (2) $\frac{A^{-1}}{2}$ (3) $3A^{-1}$ (4) $2A^{-1}$

4. The area of the triangle formed by the complex numbers z, iz and $z + iz$ in the Argand's diagram is

(1) $\frac{1}{2}|z|^2$ (2) $|z|^2$ (3) $\frac{3}{2}|z|^2$ (4) $2|z|^2$

5. If $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ and $A(\text{adj } A) = \begin{bmatrix} k & 0 \\ 0 & k \end{bmatrix}$, then $k =$

(1) 0 (2) $\sin\theta$ (3) $\cos\theta$ (4) 1

6. In the case of cramer's rule which of the following are correct ?

(1) $\Delta = 0$ (2) $\Delta \neq 0$ (3) the system has unique solution

(4) the system has infinitely many solutions

7. Which of the following are correct ?

(1) $\arg(Z_1 + Z_2) = \arg(Z_1) + arg(Z_2)$ (2) $\arg(Z_1 - Z_2) = \arg(Z_1) - \arg(Z_2)$

(3) $\arg(Z^n) = \arg(n^Z)$ (4) $\arg\left(\frac{Z_1}{Z_2}\right) = \arg(Z_1) - \arg(Z_2)$

8. If α, β and γ are the roots of $x^3 + px^2 + qx + r$, then $\sum \frac{1}{\alpha}$ is

(1) $-\frac{q}{r}$ (2) $-\frac{p}{r}$ (3) $\frac{q}{r}$ (4) $-\frac{q}{p}$

9. $sin^{-1}\frac{3}{5} - \cos^{-1}\frac{12}{13} + \sec^{-1}\frac{5}{3} - \text{cosec}^{-1}\frac{13}{12}$ is equal to

(1) 2π (2) π (3) 0 (4) $\tan^{-1}\frac{12}{65}$

10. If α and β are the roots of $x^2 + x + 1 = 0$, then $\alpha^{2020} + \beta^{2020}$ is

(1) -2 (2) -1 (3) 1 (4) 2

11. A zero of $x^3 + 64$ is

(1) 0 (2) 4 (3) $4i$ (4) -4

12. $\sin(\tan^{-1} x), |x| < 1$ is equal to

(1) $\frac{x}{\sqrt{1-x^2}}$ (2) $\frac{1}{\sqrt{1-x^2}}$ (3) $\frac{1}{\sqrt{1+x^2}}$ (4) $\frac{x}{\sqrt{1+x^2}}$

13. If $x^3 + 12x^2 + 10ax + 1999$ definitely has a positive root, if and only if

(1) $a \geq 0$ (2) $a > 0$ (3) $a < 0$ (4) $a \leq 0$

14. If $\vec{a}$ and $\vec{b}$ are parallel vectors, then $[\vec{a}, \vec{c}, \vec{b}]$ is equal to

(1) 2 (2) -1 (3) 1 (4) 0

15. If $y = mx + c$ is a tangent to the parabola $y^2 = 4ax$ then the point of contact is

(1) $\left(\frac{a}{m^2}, \frac{2a}{m}\right)$ (2) $\left(\frac{-a}{m^2}, \frac{2a}{m}\right)$ (3) $\left(\frac{a}{m^2}, \frac{-2a}{m}\right)$ (4) $\left(\frac{-a}{m^2}, \frac{-2a}{m}\right)$

16. If the direction cosines of a line are $\frac{1}{c}, \frac{1}{c}, \frac{1}{c}$, then

(1) $c = \pm 3$ (2) $c = \pm\sqrt{3}$ (3) $c > 0$ (4) $0 < c < 1$

17. If the coordinates at one end of a diameter of the circle $x^2 + y^2 - 8x - 4y + c = 0$ are $(11, 2)$, the coordinates of the other end are

(1) $(-5, 2)$ (2) $(2, -5)$ (3) $(5, -2)$ (4) $(-2, 5)$

18. Which of the following are false, in the case of a plane passing through three points whose position vectors are $\vec{a}$, $\vec{b}$ and $\vec{c}$?

(1) $[\vec{r} - \vec{a}\, \vec{b} - \vec{a}\, \vec{c} - \vec{a}] = 0$ (2) $[\vec{r} - \vec{a}\, \vec{a} - \vec{b}\, \vec{c} - \vec{a}] = 0$

(3) $[\vec{r} - \vec{a}\, \vec{b} - \vec{a}\, \vec{a} - \vec{c}] = 0$ (4) $[\vec{r} - \vec{a}\, \vec{a} - \vec{b}\, \vec{a} - \vec{c}] = 0$

19. If $\cot^{-1} 2$ and $\cot^{-1} 3$ are two angles of a triangle, then the third angle is

(1) $\frac{\pi}{4}$ (2) $\frac{3\pi}{4}$ (3) $\frac{\pi}{6}$ (4) $\frac{\pi}{3}$

20. Area of the greatest rectangle inscribed in the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is

(1) $2ab$ (2) ab (3) $\sqrt{ab}$ (4) $\frac{a}{b}$

Part – II

Note : i) Answer any Seven questions. ii) Question number 30 is compulsory. 7X2 = 14

21. If $\operatorname{adj}(A) = \begin{bmatrix} 0 & -2 & 0 \\ 6 & 2 & -6 \\ -3 & 0 & 6 \end{bmatrix}$, find A^{-1}.

22. Find the rank of the following matrices by minor method: $\begin{bmatrix} -1 & 3 \\ 4 & -7 \\ 3 & -4 \end{bmatrix}$

23. If $z_1 = 3 - 2i$ and $z_2 = 6 + 4i$ find $\frac{z_1}{z_2}$ in the rectangular form.

24. Simplify $\left(sin\frac{\pi}{6} + i\,cos\frac{\pi}{6}\right)^{18}$

25. Find a polynomial equation of minimum degree with rational coefficients, having $2 - \sqrt{3}$ as a root.

26. Find the principal value of $tan^{-1}(\sqrt{3})$.

27. Find the general equation of the circle whose diameter is the line segment joining the points $(-4,-2)$and $(1,1)$.

28. A particle acted upon by constant forces $2\hat{\imath} + 5\hat{\jmath} + 6\hat{k}$ and $-\hat{\imath} - 2\hat{\jmath} - \hat{k}$ is displaced from the point $(4,-3,-2)$ to the point $(6,1,-3)$. Find the total work done by the forces.

29. Find the angle between the straight lines $\frac{x-4}{2} = \frac{y}{1} = \frac{z+1}{-2}$ and $\frac{x-1}{4} = \frac{y+1}{-4} = \frac{z-2}{2}$ and state whether they are parallel or perpendicular.

30. Find the length of half major axis of the Ellipse vertices$A'(-3,0)$, and $A\ (3,0)$.

Part – III

Note : i) Answer any Seven questions. ii) Question number 40 is compulsory. 7 ×3 = 21

31. Solve the following system of linear equations, using matrix inversion method: $5x + 2y = 3, 3x + 2y = 5$.

32. Solve the following systems of linear equations by Cramer's rule:$\frac{3}{x} + 2y = 12, \frac{2}{x} + 3y = 13$

33. Simplify $\left(\frac{1+i}{1-i}\right)^3 - \left(\frac{1-i}{1+i}\right)^3$ into rectangular form.

34. Show that the points $1, \frac{-1}{2} + i\frac{\sqrt{3}}{2}$, and $\frac{-1}{2} - i\frac{\sqrt{3}}{2}$ are the vertices of an equilateral triangle.

35. If α, β, γ are the roots of the equation$x^3 + px^2 + qx + r = 0$,find the value of $\Sigma\frac{1}{\beta\gamma}$in terms of the coefficients.

36. For what values of x, the inequality $\frac{\pi}{2} < cos^{-1}(3x - 1) < \pi$ holds?

37. Find the value of $tan\left(cos^{-1}\left(\frac{1}{2}\right) - sin^{-1}\left(-\frac{1}{2}\right)\right)$

38. Prove that the point of intersection of the tangents at $'t_1'$ and $'t_2'$ on the Parabola $y^2 = 4ax$ is $[at_1t_2, a(t_1 + t_2)]$.

39. Find the magnitude and the direction cosines of the torque about the Point $(2,0,-1)$ of a force $2\hat{\imath} + \hat{\jmath} - \hat{k}$ whose line of action passes through the origin.

40. Prove that $[\vec{a} + \vec{b},\ \vec{b} + \vec{c},\ \vec{c} + \vec{a}] = 2\,[\vec{a}, \vec{b}, \vec{c}]$

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Part – IV

Note : i) Answer all the questions. 7×5 = 35

41. a) Using vector method, prove that $\cos(\alpha-\beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$

(OR)

b) Identify the type of conic and find centre, foci, vertices, and directrices of each of the following : $y^2 - 4y - 8x + 12 = 0$

42. a) Verify $(AB)^{-1} = B^{-1}A^{-1}$ with $A = \begin{bmatrix} 0 & -3 \\ 1 & 4 \end{bmatrix}, B = \begin{bmatrix} -2 & -3 \\ 0 & -1 \end{bmatrix}$.

(OR)

b) Discuss the maximum possible number of positive and negative roots of the polynomial equation $9x^9 - 4x^8 + 4x^7 - 3x^6 + 2x^5 + x^3 + 7x^2 + 7x + 2 = 0$.

43. a) If $\vec{a} = 2\hat{\imath} + 3\hat{\jmath} - \hat{k}, \vec{b} = 3\hat{\imath} + 5\hat{\jmath} + 2\hat{k}, \vec{c} = -\hat{\imath} - 2\hat{\jmath} + 3\hat{k}$, verify that $(\vec{a} \times \vec{b}) \times \vec{c} = (\vec{a}.\vec{c})\vec{b} - (\vec{b}.\vec{c})\vec{a}$.

(OR)

b) Solve the equation $6x^4 - 5x^3 - 38x^2 - 5x + 6 = 0$ if it is known that $\frac{1}{3}$ is a solution.

44. a) Find the value of $\sin^{-1}\left(\sin\frac{5\pi}{9}\cos\frac{\pi}{9} + \cos\frac{5\pi}{9}\sin\frac{\pi}{9}\right)$. **(OR)**

b) If $z = x + iy$ and $arg\left(\frac{z-i}{z+2}\right) = \frac{\pi}{4}$, show that $x^2 + y^2 + 3x - 3y + 2 = 0$.

45. a) Solve : $\tan^{-1}\left(\frac{x-1}{x-2}\right) + \tan^{-1}\left(\frac{x+1}{x+2}\right) = \frac{\pi}{4}$. **(OR)**

b) On lighting a rocket cracker it gets projected in a parabolic path and reaches a maximum height of 4m when it is 6m away from the point of projection. Finally it reaches the ground 12m away from the starting point. Find the angle of projection.

46. a) Solve the following system of linear equations, by Gaussian elimination method: $4x + 3y + 6z = 25, x + 5y + 7z = 13, 2x + 9y + z = 1$.

(OR)

b) Find the non-parametric form of vector equation, and Cartesian equation of the plane passing through the point (2,3,6) and parallel to the straight lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-3}{1}$ and $\frac{x+3}{2} = \frac{y-3}{-5} = \frac{z+1}{-3}$.

47. a) Find the equation of the circle passing through the points $(1,1), (2,-1)$, and $(3,2)$.

(OR)

b) Solve the equation $z^3 + 27 = 0$.