QUARTERLY EXAMINATION - 2024

Class : 11 | Reg.No

MATHEMATICS

Time : 3.00 Hours | Total Marks : 90

PART – I

Answer all the questions. $20 \times 1 = 20$

1. The rule $f(x) = x^3$ is a bijection if the domain and the co-domain are given by
   1) $[0,\infty), [0,\infty)$ 2) R,R 3) $(0, \infty)$, R 4) R, $(0,\infty)$

2. The function $f : \mathbb{R} \to \mathbb{R}$ is defined by $f(x) = \frac{(x^2+\cos x)(1+x^4)}{(x-\sin x)(2x-x^3)} + e^{-|x|}$
   1) an odd function 2) neither an odd function nor an even function
   3) an even function 4) both odd function and even function

3. If $A = \{(x,y) : y = \sin x, x \in \mathbb{R}\}$ and $B = \{(x,y) : x = \cos x, x \in \mathbb{R}\}$ then $A \cap B$ contains
   1) no element 2) infinitely many elements 3) only one element 4) cannot be determined

4. If $|x + 2| \le 9$, then x belongs to
   1) $(-\infty, -7)$ 2) $[-11, 7]$ 3) $(-\infty, -7) \cup [11, \infty)$ 4) $(-11, 7)$

5. The number of solutions of $x^2 + |x - 1| = 1$ is
   1) 1 2) 0 3) 2 4) 3

6. The value of $\log_3 11 \cdot \log_{11} 13 \cdot \log_{13} 15 \cdot \log_{15} 27 \cdot \log_{27} 81$ is
   1) 1 2) 2 3) 3 4) 4

7. Which of the following is true?
   1) $\sin\theta = 2$ 2) $\cos\theta = -3$ 3) $\tan\theta = 25$ 4) $\sec\theta = \frac{1}{4}$

8. If $\sin\alpha + \cos\alpha = b$, then $\sin 2\alpha$ is equal to
   1) $b^2 - 1$, if $b \le \sqrt{2}$ 2) $b^2 - 1$, if $b > \sqrt{2}$ 3) $b^2 - 1$, if $b \ge 1$ 4) $b^2 - 1$, if $b \ge \sqrt{2}$

9. If $\pi < 2\theta < \frac{3\pi}{2}$, then $\sqrt{2 + \sqrt{2 + 2\cos 4\theta}}$ equal to
   1) $-2\cos\theta$ 2) $-2\sin\theta$ 3) $2\cos\theta$ 4) $2\sin\theta$

10. If ${}^nC_4, {}^nC_5, {}^nC_6$ are in AP the value of n can be
    1) 14 2) 11 3) 9 4) 5

11. The product of first n odd natural numbers equals
    1) ${}^{2n}C_n \times {}^nP_n$ 2) $\left(\frac{1}{2}\right)^n \times {}^{2n}C_n \times {}^nP_n$ 3) $\left(\frac{1}{4}\right)^n \times {}^{2n}C_n \times {}^{2n}P_n$ 4) ${}^nC_n \times {}^nP_n$

12. Number of diagonals of a polygon having 10 sides is ....
    1) 30 2) 35 3) 45 4) 40

13. The sum of the digits at the 10^{th} place of all numbers formed with the help of 2, 4, 5, 7 taken all at a time is
    1) 432 2) 108 3) 36 4) 18

14. The remainder when 38^{15} is divided by 13 is

1) 12   2) 1   3) 11   4) 5

15. If S_n denotes the sum of n terms of an AP whose common difference is d, the value of $S_n - 2S_{n-1} + S_{n-2}$ is

1) 0   2) 2d   3) 4d   4) d^2

16. If $(1 + x^2)^2 (1 + x)^n = a_0 + a_1x + a_2x^2 + \ldots + x^{n+4}$ and if a_0, a_1, a_2 are in AP, then n is

1) 1   2) 2   3) 3   4) 4

17. Which of the following point lie on the locus of $x^2 + y^2 = 5$

1) (1,1)   2) (0, −1)   3) (1,2)   4) (−2,3)

18. The slope of the line which makes an angle 45° with the line 3x − y = -5 are

1) 1, -1   2) $\frac{1}{2}$, -2   3) 1, $\frac{1}{2}$ 4) 2, $-\frac{1}{2}$

19. The equation of the line with slope 2 and the length of the perpendicular from the origin equal to $\sqrt{5}$ is

1) $x - 2y = \sqrt{5}$ 2) $2x - y = \sqrt{5}$ 3) $2x - y = 5$ 4) $x - 2y - 5 = 0$

20. If one of the lines given by $6x^2 - xy + 4cy^2 = 0$ is $3x + 4y = 0$, then c equals to

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

PART – II

Answer any seven questions. Question No.30 is compulsory. **7 x 2 = 14**

21. Let $X = \{a, b, c, d\}$ and $R = \{(a, a), (b, b), (a, c)\}$. Write down the minimum number of ordered pairs to be included to R to make it i) reflexive (ii) symmetric

22. Let A and B be two sets such that $n(A) = 3$ and $n(B) = 2$. If $(x, 1), (y, 2), (z, 1)$ are in $A \times B$, find A and B, where x, y, z are distinct elements.

23. Solve: (i) $\frac{3(x-2)}{5} \leq \frac{5(2-x)}{3}$.

24. Simplify: $\sqrt{x^2 - 10x + 25}$.

25. If $n! + (n-1)! = 30$, then find the value of n.

26. There are 15 candidates for an examination. 7 candidates are appearing for mathematics examination while the remaining 8 are appearing for different subjects. In how many ways can they be seated in a row so that no two mathematics candidates are together?

27. Write the first 4 terms of the exponential series e^{5x}.

28. Find the family of straight lines (i) Perpendicular (ii) Parallel to $3x + 4y - 12 = 0$.

29. Find the slope of the straight line passing through the points (5,7) and (7,5). Also find the angle of inclination of the line with the x-axis.

30. Find the general solution of $\cos\theta = -\frac{\sqrt{3}}{2}$.

PART – III

Answer any Seven questions. Question No.40 is compulsory. **7 x 3 = 21**

31. If A and B are two sets so that $n(B-A) = 2n(A-B) = 4n(A\cap B)$ and if $n(A\cup B) = 14$, then find $n(P(A))$.

32. From the curve $f(x) = x^2$, draw $f(x) = x^2 + 1, f(x) = (x+1)^2$.

33. If the difference of the roots of the equation $2x^2 - (a+1)x + a - 1 = 0$ is equal to their product, then prove that $a = 2$.

34. solve: $\log_2 x - 3\log_{\frac{1}{2}} x = 6$.

35. A train is moving on a circular track of 1500 m radius at the rate of 66 km/hr. What angle will it turn in 20 seconds?

36. Prove that $\tan\left(\frac{\pi}{4}+\theta\right)\tan\left(\frac{3\pi}{4}+\theta\right) = -1$.

37. Find the rank of the word "GARDEN".

38. The number of bacteria in a certain culture doubles every hour. If there were 30 bacteria present in the culture originally, how many bacteria will be present at the end of 2^{nd} hour, 4^{th} hour and n^{th} hour?

39. Show that $4x^2 + 4xy + y^2 - 6x - 3y - 4 = 0$ represents a pair of parallel lines.

40. Find the coefficient of x^5 in the expansion $(3-2x)^{10}$.

PART – IV

Answer all the questions. **7 x 5 = 35**

41. (*a*) In the set Z of integers, define mRn if $m-n$ is divisible by 7. Prove that R is an equivalence relation.

(OR)

(*b*) Find the largest possible domain of the real valued function $f(x) = \frac{\sqrt{9-x^2}}{\sqrt{x^2-1}}$.

42. (*a*) A simple cipher takes a number and codes it, using the function $f(x) = 3x-4$. Find the inverse this function, determine whether the inverse is also a function and verify the symmetrical property about the line $y = x$ (by drawing the lines).

(OR)

(*b*) Solve : $\frac{x+1}{x+3} < 3$

43. (*a*) Resolve into partial fractions: $\frac{x+1}{x(x-1)^2}$

(OR)

(*b*) Prove that $\cos A \cos 2A \cos 2^2A \cos 2^3A \ldots \cos 2^{n-1}A = \frac{\sin 2^n A}{2^n \sin A}$

44. (*a*) Prove that $\tan 315° \cot(-405°) + \cot 495° \tan(-585°) = 2$

(OR)

(*b*) Prove that ${}^{24}C_4 + \sum_{r=0}^{4} {}^{(28-r)}C_3 = {}^{29}C_4$

45. (*a*) By the principle of mathematical induction, prove that, for $n \geq 1$

$$1^3 + 2^3 + 3^3 + \ldots\ldots\ldots + n^3 = \left(\frac{n(n+1)}{2}\right)^2.$$

(OR)

(*b*) Find seven numbers $A_1, A_2, \ldots, A_7$ so that the sequence $4, A_1, A_2, \ldots, A_7, 7$ is in arithmetic progression and also 4 numbers G_1, G_2, G_3, G_4 so that the sequence $12, G_1, G_2, G_3, G_4, \frac{3}{8}$ is in geometric progression.

46. (*a*) Prove that $\sqrt{\frac{1-x}{1+x}}$ is approximately equal to $1 - x + \frac{x^2}{2}$ when x is very small.

(OR)

(*b*) The coordinates of a moving point P are $\left(\frac{a}{2}(\operatorname{cosec}\theta + \sin\theta), \frac{b}{2}(\operatorname{cosec}\theta - \sin\theta)\right)$ where θ is a variable parameter. Show that the equation of the locus P is $b^2x^2 - a^2y^2 = a^2b^2$.

47. (*a*) Find the distance

(i) between two points (5, 4) and (2, 0)

(ii) from a point (1, 2) to the line $5x + 12y - 3 = 0$

(iii) between two parallel lines $3x + 4y = 12$ and $6x + 8y + 1 = 0$.

(OR)

(*b*) Show that the equation $2x^2 - xy - 3y^2 - 6x + 19y - 20 = 0$ represents a pair of intersecting lines. Show further that the angle between them is $\tan^{-1}(5)$.

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