ST. ANNE'S ACADEMY
(MATHS & PHYSICS TUITION CENTRE)
I FLOOR, JAFRO DENTAL CLINIC, HOLY CROSS COLLEGE ROAD, PUNNAI NAGAR, NAGERCOIL – 629004

Common Quarterly Exam (2023 – 24) – Model Question Paper
CLASS – XI - MATHEMATICS

Time Allowed : 3 Hrs Maximum Marks : 90

PART – I

I. Answer ALL questions. **20x1 = 20**

1) Let A and B be subsets of the universal set $\mathbb{N}$, the set of natural numbers. Then $A' \cup [(A \cap B) \cup B']$ is

(1) A (2) A' (3) B (4) $\mathbb{N}$

2) If $n((A \times B) \cap (A \times C)) = 8$ and $n(B \cap C) = 2$, then $n(A)$ is

(1) 6 (2) 4 (3) 8 (4) 16

3) The range of the function $\frac{1}{1-2\sin x}$ is

(1) $(-\infty, -1) \cup (\frac{1}{3}, \infty)$ (2) $(-1, \frac{1}{3})$ (3) $[-1, \frac{1}{3}]$ (4) $(-\infty, -1] \cup [\frac{1}{3}, \infty)$.

4) The value of $\log_{\sqrt{2}} 512$ is

(1) 16 (2) 18 (3) 9 (4) 12

5) Find a so that the sum and product of the roots of the equation $2x^2 + (a-3)x + 3a - 5 = 0$ are equal is

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

6) If $\frac{kx}{(x+2)(x-1)} = \frac{2}{x+2} + \frac{1}{x-1}$, then the value of k is

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

7) A wheel is spinning at 2 radians/second. How many seconds will it take to make 10 complete rotations?

(1) 10π seconds (2) 20π seconds (3) 5π seconds (4) 15π seconds

8) If $\cos p\theta + \cos q\theta = 0$ and if $p \neq q$, then θ is equal to (n is any integer)

(1) $\frac{\pi(3n+1)}{p-q}$ (2) $\frac{\pi(2n+1)}{p \pm q}$ (3) $\frac{\pi(n \pm 1)}{p \pm q}$ (4) $\frac{\pi(n+2)}{p+q}$

9) $\left(1 + \cos\frac{\pi}{8}\right)\left(1 + \cos\frac{3\pi}{8}\right)\left(1 + \cos\frac{5\pi}{8}\right)\left(1 + \cos\frac{7\pi}{8}\right) =$

(1) $\frac{1}{8}$ (2) $\frac{1}{2}$ (3) $\frac{1}{\sqrt{3}}$ (4) $\frac{1}{\sqrt{2}}$

10) $\cos 1^\circ + \cos 2^\circ + \cos 3^\circ + \ldots + \cos 179^\circ =$

(1) 0 (2) 1 (3) -1 (4) 89

11) In ${}^{2n}C_3 : {}^{n}C_3 = 11 : 1$ then n is

(1) 5 (2) 6 (3)11 (4)7

12) $1 + 3 + 5 + 7 + \cdots + 17$ is equal to

(1) 101 (2) 81 (3) 71 (4) 61

13) The number of parallelograms that can be formed from a set of four parallel lines intersecting another set of three parallel lines.

(1) 6 (2) 9 (3) 12 (4) 18

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

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

15) The value of the series $\frac{1}{2} + \frac{7}{4} + \frac{13}{8} + \frac{19}{16} + \cdots$ is

(1) 14 (2) 7 (3) 4 (4) 6.

16) The sequence $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}+\sqrt{2}}, \frac{1}{\sqrt{3}+2\sqrt{2}}, \cdots$ form an

(1) AP (2) GP (3) HP (4) AGP.

17) Which of the following point lie on the locus of $3x^2 + 3y^2 - 8x - 12y + 17 = 0$

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

18) The coordinates of the four vertices of a quadrilateral are (−2,4), (−1,2), (1,2) and (2,4) taken in order.The equation of the line passing through the vertex (−1,2) and dividing the quadrilateral in the equal areas is

(1) $x+ 1 = 0$ (2) $x + y = 1$ (3) $x + y + 3 = 0$ (4) $x - y + 3 = 0$

19) The image of the point (2, 3) in the line $y = -x$ is

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

20) The solution set of the following inequality $|x - 1| \geq |x - 3|$ is

(1) $[0, 2]$ (2) $[2, \infty)$ (3) $(0, 2)$ (4) $(-\infty, 2)$

PART – II

II. Answer any SEVEN questions. [Question 30 is compulsory] **7x2 = 14**

21) Prove that $\sqrt{5}$ is an irrational number.

22) Eliminate θ from the equations $a \sec\theta - c \tan\theta = b$ and $b \sec\theta + d \tan\theta = c$.

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23) Find the locus of P, if for all values of α, the co-ordinates of a moving point P is $(9\cos\alpha\,,\,9\sin\alpha)$

24) Prove that $\dfrac{(2n)!}{n!} = 2^n(1.3.5\cdots(2n-1))$.

25) Compute the sum of first n terms of the following series:

$$8 + 88 + 888 + 8888 + \cdots$$

26) Prove that $\cos(30^\circ + x) = \dfrac{\sqrt{3}\cos x - \sin x}{2}$

27) If a and b are the roots of the equation $x^2 - px + q = 0$, find the value of $\dfrac{1}{a} + \dfrac{1}{b}$.

28) If ${}^{10}P_{r-1} = 2 \times {}^{6}P_r$, find r.

29) Write the n^{th} term of the following sequence.

$$\tfrac{1}{2},\ \tfrac{2}{3},\ \tfrac{3}{4},\ \tfrac{4}{5},\ \tfrac{5}{6},\ \cdots$$

30) If $n(\mathscr{P}(A)) = 512, n(A \cup B) = 10$ and $n(\mathscr{P}(B)) = 16$, then find $n(A \cap B)$.

PART – III

III. Answer any SEVEN questions. [Question 40 is compulsory] **7x3 = 21**

31) Show that $\dfrac{\sin 8x\cos x - \sin 6x\cos 3x}{\cos 2x\cos x - \sin 3x\sin 4x} = \tan 2x.$

32) Find the range of the function $f(x) = \frac{1}{1-3\cos x}$.

33) Find the coefficient of x^{15} in $\left(x^2 + \dfrac{1}{x^3}\right)^{10}$.

34) If Q is a point on the locus of $x^2 + y^2 + 4x - 3y + 7 = 0$, then find the equation of locus of P which divides segment OQ externally in the ratio 3:4,where O is origin.

35) If the equations $x^2 - ax + b = 0$ and $x^2 - ex + f = 0$ have one root in common and if the second equation has equal roots, then prove that $ae = 2(b + f)$

36) Prove that ${}^{35}C_5 + \sum_{r=0}^{4} {}^{(39-r)}C_4 = {}^{40}C_5$.

37) If the line joining two points A(2,0) and B(3,1) is rotated about A in anticlockwise direction through an angle of 15°, then find the equation of the line in new position.

38) Solve $\log_{5-x}(x^2 - 6x + 65) = 2$.

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

40) If $\tan\frac{\theta}{2} = \sqrt{\frac{1-a}{1+a}}\ \tan\frac{\phi}{2}$, then prove that $\cos\phi = \frac{\cos\theta - a}{1 - a\cos\theta}$.

PART – IV

IV. Answer ALL questions. **7x5 = 35**

41) a) Find all the equations of the straight lines in the family of the lines $y = mx - 3$, for which m and the x-coordinate of the point of intersection of the lines with $x - y = 6$ are integers.

OR

b) The formula for converting from Fahrenheit to Celsius temperatures is $y = \frac{5x}{9} - \frac{160}{9}$ Find the inverse of this function and determine whether the inverse is also a function.

42) a) By the principle of mathematical induction, prove that, for $n \geq 1$

$$1^2 + 3^2 + 5^2 + \cdots + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}.$$

OR

b) If $A + B + C = \pi$, prove that $\cos^2 A + \cos^2 B + \cos^2 C = 1 - 2\cos A\cos B\cos C$.

43) a) If t_k is the k^{th} term of a GP, then show that t_{n-k}, t_n, t_{n+k} also form a GP for any positive integer k.

OR

b) The normal boiling point of water is $100^{\circ}C$ or $212^{\circ}F$ and the freezing point of water is $0^{\circ}C$ or $32^{\circ}F$. (i) Find the linear relationship between C and F Find (ii) the value of C for $98.6^{\circ}F$ and (iii) the value of F for $38^{\circ}C$

44) a) Solve $\sqrt{3}\tan^2\theta + \left(\sqrt{3} - 1\right)\tan\theta - 1 = 0$

OR

b) If $\theta + \phi = \alpha$ and $\tan\theta = k\tan\phi$, then prove that $\sin(\theta - \phi) = \frac{k-1}{k+1}\sin\alpha$.

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45) a) Resolve the following rational expression into partial fractions.

$$\frac{x^3+2x+1}{x^2+5x+6}$$

OR

b) Find the square root of $7-4\sqrt{3}$.

46) a) Find the number of strings of 5 letters that can be formed with the letters of the word PROPOSITION.

OR

b) Prove that $\sqrt[3]{x^3+6}-\sqrt[3]{x^3+3}$ is approximately equal to $\frac{1}{x^2}$ when x is sufficiently large.

47) a) Prove that $\dfrac{\cot(180^\circ+\theta)\sin(90^\circ-\theta)\cos(-\theta)}{\sin(270^\circ+\theta)\tan(-\theta)\operatorname{cosec}(360^\circ+\theta)}=\cos^2\theta\cot\theta.$

OR

b) Solve $\dfrac{x+1}{x+3}<3.$