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MATHS

BOOKS - KC SINHA MATHS (HINGLISH)

TRIGONOMETRIC EQUATIONS AND INEQUATIONS - FOR COMPETITION

Solved Examples

1. Find the solution set of the inequality $\sin x > \frac{1}{2}$.



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2. Find the solution set of inequation $\cos x \geq \frac{1}{2}$



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3. With the help of graph, find the solution set of inequation

$$\tan x > -\sqrt{3}$$



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4. The set of all x in the interval $[0, \pi]$ for which

$$2\sin^2 x - 3\sin x + 1 \geq 0 \text{ is } \underline{\hspace{2cm}}$$



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5. If $A = \left\{ \theta : 2\cos^2 \theta + \sin \theta \leq 2 \right\}$, and $B = \left\{ \theta : \frac{\pi}{2} \leq \theta \leq 3\frac{\pi}{2} \right\}$, then the region for $(A \cap B)$ is



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6. In an acute angled $\triangle ABC$, the minimum value of $\tan A \tan B \tan C$

is



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7. 112. If in a ΔABC , $\cos A + \cos B + \cos c = \frac{3}{2}$. Prove that ΔABC is an equilateral triangle.



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8. If $0 < \alpha < \beta < \frac{\pi}{2}$ show that $\alpha - \sin \alpha < \beta - \sin \beta$



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9. Which of the following is not true $\log(1 + x) < x$ for $x > 0$



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10. Find the intervals of monotonicity of the function $y = 2x^2 - \log|x|, x \neq 0$



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11. Show that $1 + \xi n \left(x + \sqrt{x^2 + 1} \right) \geq \sqrt{1 + x^2}$ for all $x \geq 0$.



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12. If $0 < x < \frac{\pi}{2}$ show that $\cos x > 1 - \frac{x^2}{2}$



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13. Let $f(x) = x^2$ and $g(x) = \sin x f$ or all $x \in R$. Then the set of all x satisfying $(fogof)(x) = (gogof)(x)$, where $(fog)(x) = f(g(x))$, is
 $\pm \sqrt{n\pi}, n \in \{0, 1, 2, .\}$ $\pm \sqrt{n\pi}, n \in \{1, 2, .\}$
 $\frac{\pi}{2} + 2n\pi, n \in \{, -2, -1, 0, 1, 2\}$ $2n\pi, n \in \{, -2, -1, 0, 1, 2, \}$



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14. The number of solution of the pair of equations

$2\sin^2 \theta - \cos 2\theta = 0$ and $2\cos^2 \theta = 0$ in the interval $[0, 2\pi]$ is 0 (b) 1 (c) 2

(d) 4



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15. For '0



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16. Let $S \subset (0, \pi)$ denote the set of values of x satisfying the equation

$8^1 + |\cos x| + \cos^2 x + |\cos^{3x}| \rightarrow \infty = 4^3$. Then, $S = \{\pi/3\}$ b.

c. $\{\pi/3, 2\pi/3\}$ d. $\{-\pi/3, 2\pi/3\}$



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17. If $4\sin^4 x + \cos^4 x = 1$, then ξ sequa $< o(n \in \mathbb{Z})$ $n\pi$ (b)

$$n\pi \pm \sin^{-1} \sqrt{\frac{2}{5}} \frac{2n\pi}{3}$$
 (d) $2n\pi \pm \frac{\pi}{4}$



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18. If $[x]$ denote the greatest integer less than or equal to x then the equation $\sin x = [1 + \sin x] + [1 - \cos x]$ has no solution in



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19. If $\frac{1 - \tan x}{1 + \tan x} = \tan y$ and $x - y = \frac{\pi}{6}$, then x, y are respectively (A) $\frac{5\pi}{24}, \frac{\pi}{24}$ (B) $-\frac{7\pi}{24}, -\frac{11\pi}{24}$ (C) $-\frac{115\pi}{24}, \frac{-119\pi}{24}$ (D) none of these



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20. Solve the inequation $2^{\frac{1}{\cos^2 x}} \sqrt{y^2 - y + \frac{1}{2}} \leq 1$



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21. If $\sin \theta = -\frac{1}{2}$ and $\tan \theta = \frac{1}{\sqrt{3}}$ then the most general values of θ equal to (A) $2n\pi + \frac{\pi}{6}$ (B) $2n\pi + \frac{5\pi}{6}$ (C) $2n\pi + \frac{7\pi}{6}$ (D) none of these



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22. If $\tan(A - B) = 1$, $\sec(A + B) = \frac{2}{\sqrt{3}}$, then the smallest positive value of B is. (A) $\frac{25\pi}{24}$ (B) $\frac{19\pi}{24}$ (C) $\frac{13\pi}{24}$ (D) $\frac{11\pi}{24}$



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23. If $\sin x + \cos y = 1$ and $\cos 2x - \cos 2y = 1$ then the values of x and y are (A) $x = n\pi + (-1)^n \frac{\pi}{3}, n \in I, y = m\pi \pm \frac{\pi}{6}, m \in I$ (B) $x = n\pi + (-1)^n \frac{\pi}{6}, n \in I, y = m\pi \pm \frac{\pi}{3}, m \in I$ (C) $x = n\pi + (-1)^n \frac{\pi}{4}, n \in I, y = m\pi \pm \frac{\pi}{4}, m \in I$ (D) none of these



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24. The positive integer value of $n > 3$ satisfying the equation

$$\frac{1}{\sin\left(\frac{\pi}{n}\right)} = \frac{1}{\sin\left(\frac{2\pi}{n}\right)} + \frac{1}{\sin\left(\frac{3\pi}{n}\right)} \text{ is}$$



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25. The number of values of θ in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ such that

$\theta \neq n\frac{\pi}{5}$ for $n \in N$ and $\tan \theta = \cot 5\theta$ as well as $\sin 2\theta = \cos 4\theta$ is



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26. The number of all possible values of θ , where $0 < \theta < \pi$, for which the

system

of

equations

$$(y+z)\cos 3\theta = (xyz)\sin 3\theta, x \sin 3\theta = \frac{2 \cos 3\theta}{y} + \frac{2 \sin 3\theta}{z} \text{ and } (xyz)\sin 3\theta = 0$$

have a solution (x_0, y_0, z_0) with $y_0 z_0 \neq 0$ is



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1. If $\alpha > 0, \beta > 0, \gamma > 0$ and $\alpha + \beta + \gamma < \frac{\pi}{2}$ show that
 $\tan \alpha \tan \beta + \tan \beta \tan \gamma + \tan \gamma \tan \alpha < 1$

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2. If A, B, C are the angles of a right angled triangle, then
 $(\cos^2 A + \cos^2 B + \cos^2 C)$ equals

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3. Prove that : $\cos^2 \alpha + \cos^2(\alpha + \beta) - 2 \cos \alpha \cos \beta \cos(\alpha + \beta) = \sin^2 \beta$

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4. Show that : $\sin^6 \alpha + \cos^6 \alpha \geq \frac{1}{4}$

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5. In a triangle $ABC \cos A + \cos B + \cos C \leq k$ then $k =$



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6. In a triangle $ABC \sin\left(\frac{A}{2}\right)\sin\left(\frac{B}{2}\right)\sin\left(\frac{C}{2}\right) \leq \frac{1}{8}$



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7. Prove that : $\cos 36^\circ > \tan 36^\circ$



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8. Show that : $\sin^4 \alpha + \cos^4 \alpha \geq \frac{1}{2}$



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9. If $0 < \alpha < \frac{\pi}{2}$, show that $\alpha - \frac{\alpha^3}{3} < \sin \alpha$



10. For $n \in Z$, the general solution of $(\sqrt{3} - 1)\sin \theta + (\sqrt{3} + 1)\cos \theta = 2i$ is ($n \in Z$) $\theta = 2n\pi \pm \frac{\pi}{4} + \frac{\pi}{12}$

$$\theta = n\pi + (-1)^n \frac{\pi}{4} + \frac{\pi}{12}$$
$$\theta = 2n\pi \pm \frac{\pi}{4}$$
$$\theta = n\pi + (-1)^n \frac{\pi}{4} - \frac{\pi}{12}$$


11. The general values of θ satisfying the equation $2\sin^2 \theta - 3\sin \theta - 2 = 0$ is ($n \in Z$). (b) $n\pi + (-1)^n \frac{\pi}{6}$

(c) $n\pi + (-1)^n \frac{\pi}{2}$ (d) $n\pi + (-1)^n \frac{5\pi}{6}$ (e) $n\pi + (-1)^n \frac{7\pi}{6}$



12. Find all the solutions of $4\sin^2 x \cos x - 2\sin^2 x = 3\sin x$



13. If $\tan(\pi \cos \theta) = \cot(\pi \sin \theta)$, then $\cos\left(\theta - \frac{\pi}{4}\right)$ is (A) 0 (B) $\frac{1}{2\sqrt{2}}$ (C)

(D) none of these



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14. The general value of x satisfying the equation

$\sqrt{3}s \in x + \cos x - \sqrt{3}$ is given by $x = n\pi + (-1)^n \frac{\pi}{4} + \frac{\pi}{3}$, $n \in \mathbb{Z}$ b.

$x = n\pi + (-1)^n \frac{\pi}{3} + \frac{\pi}{6}$, $n \in \mathbb{Z}$ c. $x = n\pi \pm \frac{\pi}{6}$, $n \in \mathbb{Z}$ d. $x = n\pi \pm \frac{\pi}{3}$, $n \in \mathbb{Z}$



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15. The number of solution(s) of $\sin 2x + \cos 4x = 2$ in the interval

$(0, 2\pi)$ is 0 (b) 2 (c) 3 (d) 4



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16. Let n be a positive integer such that $\sin\left(\frac{\pi}{2n}\right) + \cos\left(\frac{\pi}{2n}\right) = \frac{\sqrt{n}}{2}$

then (A) $n = 6$ (B) $n = 1, 2, 3, \dots, 8$ (C) $n = 5$ (D) none of these



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17. The number of values of θ in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ satisfying the

equation $(\sqrt{3})^{\sec^2(2\theta)} = \tan^4\theta + 2\tan^2\theta$ is 2 (b) 4 (c) 0 (d) 1



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18. Let $f(x) = \max \{\tan x, \cot x\}$. Then number of roots of the

equation $f(x) = \frac{1}{\sqrt{3}} \in (0, 2\pi)$ is (A) 2 (B) 4 (C) 0 (D) infinite



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19. the number of solution of the equation $\tan^2 x - \sec^{10} x + 1 = 0$ in

$(0, 10)$ is -



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20. The number of solutions of the equation

$$|\cos x - \sin x| = 2 \cos x \in [0, 2\pi]$$

is (A) 1 (B) 2 (C) 3 (D) 4



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21. $\sin \theta + \sqrt{3} \cos \theta = 6x - x^2 - 11, 0 \leq 4\theta\pi, x \in R,$ hold for no

values of x and one value of x and two values of θ two values of x and

two values of θ two point of values of (x, θ)



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22. $2 \sin^2 x + \sin^2(2x) = 2, -\pi < x < \pi$ then x equals (A) $\pm \frac{\pi}{2}$ (B) $\pm \frac{\pi}{4}$

(C) $\pm \frac{3\pi}{4}$ (D) none of these



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23. The general solution of the equation $2^{\cos 2x} = 1 = 3 \cdot 2^{-\sin^2 x}$ is (A)

- $n\pi$, $n\varepsilon i$ (B) $\left(n + \frac{1}{2}\right)\pi$, $n\varepsilon I$ (C) $\left(n - \frac{1}{2}\right)\pi$, $n\varepsilon I$ (D) none of these



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24. If $4 \cos^2 \theta + \sqrt{3} = 2(\sqrt{3} + 1) \cos \theta$, then θ is $2n\pi \pm \frac{\pi}{3}$, $n \in I$ (b)

- $2n\pi \pm \frac{\pi}{4}$, $n \in I$ (d) $2n\pi \pm \frac{\pi}{6}$, $n \in I$ (d) none of these



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25. The value of θ lying between 0 and $\frac{\pi}{2}$ and satisfying the equation

$$\begin{vmatrix} 1 + \sin^2 \theta & \cos^2 \theta & 4 \sin 4\theta \\ \sin^2 \theta & 1 + \cos^2 \theta & 4 \sin 4\theta \\ \sin^2 \theta & \cos^2 \theta & 1 + 4 \sin 4\theta \end{vmatrix} = 0 \quad \begin{array}{l} (\text{A}) \frac{7\pi}{24} \text{ or } \frac{11\pi}{24} \\ (\text{B}) \frac{5\pi}{24} \\ (\text{C}) \frac{\pi}{24} \\ (\text{D}) \text{none} \end{array}$$



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26. The equation whose roots are n th power of the roots of the equation,

$$x^2 - 2x \cos \phi + 1 = 0$$
 is given by



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27. If in a triangle ABC , $a^2 + b^2 + c^2 = ca + ab\sqrt{3}$, then the triangle is



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28. Number of solutions of equation $16(\sin^{10} x + \cos^{10} x) = 29 \cos^4 2x$

in interval $[-\pi, \pi]$ is



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29. If $3 \sin x + 4 \cos x = 5$, then the value of

$$90 \tan^2\left(\frac{x}{2}\right) - 60 \tan\left(\frac{x}{2}\right) + 110$$
 is equal to



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30. If x and y are the solutions of the equation $12 \sin x + 5 \cos x = 2y^2 - 8y + 21$ the value of $144 \cot\left(x \frac{y}{2}\right)$ is



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31. Four times the sum of the roots of the equation $\sin 2x + 5 \sin x + 5 \cos x + 1 = 0$ in the interval $[0, 50\pi]$ is $n\pi$, where n is equal to



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32. If $\cos 2\theta + 9 \sin 2\theta - 6 \sin \theta + 54 \cos \theta = 1$, then the value of $100 \tan^2 \theta + 9 + 14$ is equal to



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33. Solve the equation $2(\cos x + \cos 2x) + \sin 2x(1 + 2\cos x) = 2\sin x$ for x ($-\pi \leq x \leq \pi$)

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34. The co-ordinates of points of intersection of the curves $y = \cos x$ and $y = \sin 3x$, $x \in \left[-\frac{\pi}{2}, \frac{\pi}{2} \right]$ are

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35. Show that the equation $e^{\sin x} - e^{-\sin x} - 4 = 0$ has no real solution.

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36. Find all the solution of $4\csc^2 x \sin x - 2\sin^2 x = 3\sin x$

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37. There exists a value of theta between 0 and 2π which satisfies the equation $\sin^4 \theta - 2\sin^2 \theta - 1 = 0$. (True/False)



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38. Find the values of $x \in (-\pi, \pi)$ which satisfy the equation $8^{1+|\cos x| + |\cos^2 x| + |\cos^{2x}|} = 4^3$



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39. The solution set of the system of equations $x + y = \frac{2\pi}{3}$, $\cos x + \cos y = \frac{3}{2}$, where x and y are real, is _____



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40. Consider the system linear equations in x, y , and z given by $(s \in 3\theta)x - y + z = 0$, $(\cos 2\theta)x + 4y + 3z = 0$, $2x + 7y + 7z = 0$.

Find the value of θ for which the system has a non-trivial solution.



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41. The smallest positive root of the equation $\tan x - x = 0$ lies in
(a) $\left(0, \frac{\pi}{2}\right)$ (b) $\left(\frac{\pi}{2}, \pi\right)$ (c) $\left(\pi, \frac{3\pi}{2}\right)$ (d) $\left(\frac{3\pi}{2}, 2\pi\right)$



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42. The set of all x in the interval $[0, \pi]$ for which $2\sin^2 x - 3\sin x + 1 \geq 0$ is _____



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43. The value of θ lying between 0 and $\frac{\pi}{2}$ and satisfying the equation
- $$\begin{vmatrix} 1 + \sin^2 \theta & \cos^2 \theta & 4 \sin 4\theta \\ \sin^2 \theta & 1 + \cos^2 \theta & 4 \sin 4\theta \\ \sin^2 \theta & \cos^2 \theta & 1 + 4 \sin 4\theta \end{vmatrix} = 0$$
- (A) $\frac{7\pi}{24}$ or $\frac{11\pi}{24}$ (B) $\frac{5\pi}{24}$ (C)
 $\frac{\pi}{24}$ (D) none



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44. The general solution of the equation

$$\sin x - 3 \sin 2x + \sin 3x = \cos x - 3 \cos 2x + \cos 2x + \cos 3x \quad \text{is}$$

$$(n \in \mathbb{Z}) n\pi + \frac{\pi}{8} \quad (\text{b}) \frac{n\pi}{2} + \frac{\pi}{8} (-1)^n \frac{n\pi}{2} + \frac{\pi}{8} \quad (\text{d}) 2n\pi + \frac{\cos^{-1} 2}{3}$$



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45. The equation $(\cos p - 1)^x + 2 + (\cos p)x + s \in p = 0$ in the variable

x has real roots. The p can take any value in the interval $(0, 2\pi)$ $(\text{b}) (-\pi)$

$$(\text{c}) \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) \quad (\text{d}) (, \pi)$$



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46. In triangle ABC , angle A is greater than angle B . If the measure of

angles A and B satisfy the equation $3\sin x - 4\sin^3 x - k = 0, 0$



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47. The number of real solutions of the equation $\sin(e^x) = 5^x + 5^{-x}$



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48. If $\exp. \{(\sin^2 x + \sin^4 x + \sin^6 x + \dots \in f.) \ln 2\}$ satisfies the equation $x^2 - 9x + 8 = 0$ find the value off $\frac{\cos x}{\cos x + \sin x}, 0 < x < \frac{\pi}{2}$



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49. The number of solutions of the equation $\tan x + \sec x = 2 \cos x$ lying in the interval $[0, 2\pi]$ is 0 (b) 1 (c) 2 (d) 3



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50. The smallest positive value of x (in degrees) for which $\tan(x + 100^\circ) = \tan(x + 50^\circ) \cdot \tan x \cdot \tan(x - 50^\circ)$ is



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51. Let $2\sin^2 x + 3\sin x - 2 > 0$ and $x^2 - x - 2 < 0$ (x is measured in radians). Then x lies in the interval
(a) $\left(\frac{\pi}{6}, \frac{5\pi}{6}\right)$ (b) $\left(-1, \frac{5\pi}{6}\right)$ (c) $(-1, 2)$
(d) $\left(\frac{\pi}{6}, 2\right)$



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52. Find the smallest positive number p for which the equation $\cos(p\sin x) = \sin(p\cos x)$ has a solution $x \in [0, 2\pi]$.



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53. The general value of θ satisfying the equation $\tan^2 \theta + \sec 2\theta = 1$ is _____



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54. Find all values of theta in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2} \right)$ satisfying the equation $(1 - \tan \theta)(1 + \tan \theta)\sec^2 \theta + 2^{\tan^2 \theta} = 0$



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55. The real roots of the equation $\cos^7 x + \sin^4 x = 1$ in the interval $(-\pi, \pi)$ are _____, _____, and _____



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56. The number of values of x in the interval $[0, 5\pi]$ satisfying the equation $3\sin^2 x - 7\sin x + 2 = 0$ is (a) 0 (b) 5 (c) 6 (d) 10



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57. The number of distinct real roots of $|s \in x \cos x \cos x \cos x s \in x \cos x \cos x \cos x s \in x| = 0$ in the interval

$$-\frac{\pi}{4} \leq x \leq \frac{\pi}{4}$$
 is 0 b. 2 c. 1 d. 3



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58. The number of integral values of k for which the equation $7\cos x + 5\sin x = 2k + 1$ has a solution is (1) 4 (2) 8 (3) 10 (4) 12



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59. The number of solutions of the pair of equations $2s \in^2 \theta - \cos 2\theta = 0$ $2\cos^2 \theta - 3\sin \theta = 0$ in the interval $[0, 2\pi]$ is 0 (b) 1 (c) 2 (d) 4



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60. The number of values of θ in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ such that $\theta \neq n\frac{\pi}{5}$ for $n \in N$ and $\tan \theta = \cot 5\theta$ as well as $\sin 2\theta = \cos 4\theta$ is



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61. The number of all possible values of θ , where $0 < \theta < \pi$, for which the system of equations $(y + z)\cos 3\theta = (xyz)\sin 3\theta$, $x \sin 3\theta = \frac{2 \cos 3\theta}{y} + \frac{2 \sin 3\theta}{z}$ and $(xyz)\sin 3\theta = (x + y + z)\cos 3\theta$ have a solution (x_0, y_0, z_0) with $y_0 z_0 \neq 0$ is



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62.

Let

$P = \{\theta : \sin \theta - \cos \theta = \sqrt{2} \cos \theta\}$ and $Q = \{\theta : \sin \theta + \cos \theta = \sqrt{2} \sin \theta\}$ be two sets. Then



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63. The positive integer value of $n > 3$ satisfying the equation

$$\frac{1}{\sin\left(\frac{\pi}{n}\right)} = \frac{1}{\sin\left(\frac{2\pi}{n}\right)} + \frac{1}{\sin\left(\frac{3\pi}{n}\right)}$$
 is



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64. The number of values of x in the interval $[0, 3\pi]$ satisfying the equation $2\sin^2 x + 5\sin x - 3 = 0$ is



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65. The largest interval lying in $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ for which the function $\left[f(x) = 4^{-x} + 2 + \cos^{-1}\left(\frac{x}{2} - 1\right) + \log(\cos x)\right]$ is defined, is (1) $[0, \pi]$ (2) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ (3) $\left[-\frac{\pi}{4}, \frac{\pi}{2}\right)$ (4) $\left[0, \frac{\pi}{2}\right)$



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