



MATHS

BOOKS - CENGAGE PUBLICATION

TRIGONOMETRIC EQUATIONS

Example

1. Find the smallest positive root of the equation $\sqrt{\sin(1-x)} = \sqrt{\cos x}$

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2. Solve $\sin x + \sin y = \sin(x+y)$ and $|x| + |y| = 1$

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3. Solve the equation $\tan^4 x + \tan^4 y + 2 \cot^2 x \cot^2 y = 3 + \sin^2(x + y)$ for the values of x and y .



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4. If $(1 - \tan \theta)(1 + \tan \theta)\sec^2 \theta + 2^{\tan^2 \theta} = 0$ then in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$, the value of θ is



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5. For which values of a does the equation $4 \sin\left(x + \frac{\pi}{3}\right) \cos\left(x - \frac{\pi}{6}\right) = a^2 + \sqrt{3} \sin 2x - \cos 2x$ have solution? Find the solution for $a > 0$, *any exists*.



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6. Solve the following system of simultaneous equation for x and y .

$$4^{\sin x} + 3^{1/\cos y} = 11 \quad 5x16^{\sin x} - 2x3^{1/\cos y} = 2$$

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$$7. \sin^{10} x + \cos^{10} x = \frac{29}{16} \cos^4 2x$$

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8. Find the number of solutions of the equation

$$1 + e^{\cot^2 x} = \sqrt{2|\sin x| - 1} + \frac{1 - \cos 2x}{1 + \sin^4 x} \text{ for } x \in (0, 5\pi)$$

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9. Find the number of solution of $\theta \in [0, 2\pi]$ satisfying the equation

$$\left((\log)_{\sqrt{3}} \tan \theta \left(\sqrt{(\log)_{\tan \theta} 3 + (\log)_{\sqrt{3}} 3\sqrt{3}} \right) = -1 \right.$$

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10. Prove that the equation $2\sin x = |x| + a$ has no solution for $a \in \left(\frac{3\sqrt{3} - \pi}{3}, \infty \right)$.

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11. Solve $\sin^2 x + \frac{1}{4}\sin^2 3x = \sin x \sin^2 3x$

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12. The equation $2\cos^2\left(\frac{x}{2}\right)\sin^2 x = x^2 + \frac{1}{x^2}$, $0 \leq x \leq \frac{\pi}{2}$ has

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Illustration

1. Find general value of θ which satisfies both $\sin\theta = -1/2$ and $\tan\theta = 1/\sqrt{3}$ simultaneously.

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2. Find the values of θ which satisfy $r \sin\theta = 3$ and $r = 4(1 + \sin\theta)$, $0 \leq \theta \leq 2\pi$

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3. If $\sin A = \sin B$ and $\cos A = \cos B$, find all the values of A in terms of B.

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4. Find the number of roots of the equation $16 \sec^3 \theta - 12 \tan^2 \theta - 4 \sec \theta = 9$ in interval $(-\pi, \pi)$



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5. find the number of solution of $\sin^2 x - \sin x - 1 = 0$ in $[-2\pi, 2\pi]$.

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6. If $x \in (0, 2\pi)$ and $y \in (0, 2\pi)$, then find the number of distinct ordered pairs (x, y) satisfying the equation

$$9 \cos^2 x + \sec^2 y - 6 \cos x - 4 \sec y + 5 = 0$$

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7. If $2 \tan^2 x - 5 \sec x = 1$ for exactly seven distinct value of $x \in \left[0, \frac{n\pi}{2}\right]$, $n \in \mathbb{N}$ then find the greatest value of n .

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8. Solve: $16^{\sin x} + (2x)16^{\cos x} + (2x) = 10, 0 \leq x < 2\pi$



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9. Find the number of solution of the equation $e^{\sin x} - e^{-\sin x} - 4 = 0$



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10. Find the number of solution of $[\cos x] + |\sin x| = 1 \in \pi \leq x \leq 3\pi$
where $[\]$ denotes the greatest integer function.



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11. If the the equation $a \sin x + \cos 2x = 2a - 7$ possesses a solution,
then find the values of a.



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12. find all the possible triplets (a_1, a_2, a_3) such that $a_1 + a_2 \cos(2x) + a_3 \sin^2(x) = 0$ for all real x .

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13. Find the number of solution of the equation $\sqrt{\cos 2x + 2} = (\sin x + \cos x)$ in $[0, \pi]$.

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14. Solve $\sin 2x = 4 \cos x$.

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15. Solve $\frac{\tan 3x - \tan 2x}{1 + \tan 3x \tan 2x} = 1$.

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16. Solve $\frac{3 \sin \theta - \sin 3\theta}{\sin \theta} + \frac{\cos 3\theta}{\cos \theta} = 1$.

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17. Solve $\tan x + \tan 2x + \tan 3x = \tan x \tan 2x \tan 3x$, $x \in [0, \pi]$.

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18. Solve $2 \cos^2 \theta + 3 \sin \theta = 0$.

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19. Solve $4 \cos \theta - 3 \sec \theta = \tan \theta$.

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20. Solve $\sin^3 \theta \cos \theta - \cos^3 \theta \sin \theta = \frac{1}{4}$.

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21. Solve $\sqrt{5 - 2 \sin x} = 6 \sin x - 1$

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22. Solve $\frac{\frac{\sin^3 x}{2} - \frac{\cos^3 x}{2}}{2 + \sin x} = \frac{\cos x}{3}$

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23. Solve $\frac{\sqrt{5} - 1}{\sin x} + \frac{\sqrt{10 + 2\sqrt{5}}}{\cos x} = 8, x \in \left(0, \frac{\pi}{2}\right)$

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24. Find the general values of x and y satisfying the equations

$$5 \sin x \cos y = 1; 4 \tan x = \tan y$$

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25. Solve $\sqrt{3} \sec 2\theta = 2$.

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26. Solve $\sin 2\theta + \cos \theta = 0$.

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27. Solve $\cos \theta + \cos 3\theta - 2 \cos 2\theta = 0$.

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28. Solve $\sec 4\theta - \sec 2\theta = 2$.

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29. Solve $5 \cos 2\theta + 2\cos^2 \frac{\theta}{2} + 1 = 0$, $-\pi < \theta < \pi$.

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30. If $(\cos \theta + \cos 2\theta)^3 = \cos^3 \theta + \cos^3 2\theta$, then the least positive value of θ is equal to $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

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31. $\cos(x)\cos(2x)\cos(3x) = \frac{1}{4}$. Find the general solution.

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32. Solve the equation $\frac{\sqrt{3}}{2}\sin x - \cos x = \cos^2 x$

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33. Solve $8 \sin x = \frac{\sqrt{3}}{\cos x} + \frac{1}{\sin x}$

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34. Solve the equation $2(\cos x + \cos 2x) + \sin 2x(1 + 2 \cos x) = 2 \sin x$
for $x \in [-\pi, \pi]$.

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35. Solve $\tan 3\theta = -1$.

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36. Solve $2 \tan \theta - \cot \theta = -1$.

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37. Solve $\tan 5\theta = \cot 2\theta$.



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38. Solve $(\tan^2 x + 2\sqrt{3}\tan x + 7)(\cot^2 y - 2\sqrt{3}\cot y + 8) \leq 20$ for x and y .



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39. Solve $\tan \theta + \tan 2\theta + \sqrt{3}\tan \theta \tan 2\theta = \sqrt{3}$.



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40. Find common roots of the equations

$2\sin^2 x + \sin^2 2x = 2$ and $\sin 2x + \cos 2x = \tan x$.



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41. Solve $2 \sin^2 x - 5 \sin x \cos x - 8 \cos^2 x = -2$.

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42. Find the number of roots of the equation $\tan\left(x + \frac{\pi}{6}\right) = 2 \tan x$, for $x \in (0, 3\pi)$.

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43. Solve $\sin x - 3 \sin 2x + \sin 3x = \cos x - 3 \cos 2x + \cos 3x$.

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44. Solve $7 \cos^2 \theta + 3 \sin^2 \theta = 4$.

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45. Solve $\frac{\sin^2 2x + 4\sin^4 x - 4\sin^2 x \cos^2 x}{4 - \sin^2 2x - 4\sin^2 x} = \frac{1}{9}$.

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46. Solve $(\log)_{\tan x} (2 + 4\cos^2 x) = 2$

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47. Solve $4\cot 2\theta = \cot^2 \theta - \tan^2 \theta$

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48. Find the most general solution of

$$2^1 |\cos x| + \cos^2 x + |\cos x|^{3+\infty} = 4$$

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49. Solve the equation $\sqrt{3} \cos x + \sin x = \sqrt{2}$.

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50. Solve $\sqrt{3} \cos \theta - 3 \sin \theta = 4 \sin 2\theta \cos 3\theta$.

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51. Find the number of integral value of n so that $\sin x(\sin x + \cos x) = n$ has at least one solution.

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52. Find the smallest positive values of x and y satisfying $x - y = \frac{\pi}{4}$ and $\cot x + \cot y = 2$

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53. For what value of k the equation $\sin x + \cos(k + x) + \cos(k - x) = 2$ has real solutions?

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54. The -number of solutions of the equation $\cos(\pi\sqrt{x-4})\cos(\pi\sqrt{x}) = 1$ is

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55. If $x, y \in [0, 2\pi]$, then find the total number of ordered pairs (x, y) satisfying the equation $\sin x \cos y = 1$

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56. Find the number of solution of $\sin^2 x \cos^2 x = 1 + \cos^2 x \sin^4 x$ in the interval $[0, 2\pi]$.

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57. If $3\sin x + 4\cos ax = 7$ has at least one solution, then find the possible values of a .

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58. Solve $\cos^{50} x - \sin^{50} x = 1$

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59. Solve $\sin^2 x + \cos^2 y = 2\sec^2 z$ for x , y , and z .

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60. Solve $1 + \sin x \sin^2 \frac{x}{2} = 0$.

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61. Solve $\cos 4\theta + \sin 5\theta = 2$.

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62. Solve for y the equation $\sqrt{3} \sin x + \cos x = 8y - y^2 - 18$, where $0 \leq x \leq 4\pi$, $y \in \mathbb{R}$

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63. Solve the equation:

$$\cos^2 \left[\frac{\pi}{4} (\sin x + \sqrt{2} \cos^2 x) \right] - \tan^2 \left[x + \frac{\pi}{4} \tan^2 x \right] = 1$$

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64. Find the number of solution for the equation $\sin x = \frac{x}{10}$

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65. Find the number of roots of equation $x \sin x = 1$

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66. Prove that the least positive value of x , satisfying $\tan x = x + 1$, lies in the interval $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$.

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67. If m and n ($n > m$) are positive integers, then find the number of solutions of the equation $n|\sin x| = m|\cos x|$ or $x \in [0, 2\pi]$. Also find the solution.

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68. Solve $\sin x > -\frac{1}{2}$

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69. Solve $x^2 < \sin \frac{\pi}{2}x$.

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70. Solve $\sin \theta + \sqrt{3} \cos \theta \geq 1$, $-\pi < \theta < \pi$.

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71. Solve $\cos 2x = |\sin x|$, $x \in \left(-\frac{\pi}{2}, \pi\right)$.

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Concept Application Exercise 4 1

1. Solve $\sin^2 \theta - \cos \theta = \frac{1}{4}$, $0 \leq \theta \leq 2\pi$.

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



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3. Find the general solution of $(1 - 2 \cos \theta)^2 + (\tan \theta + \sqrt{3})^2 = 0$.



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4. Solve $\sin 3\theta - \sin \theta = 4 \cos^2 \theta - 2$.



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5. Solve $\cos 2x = |\sin x|$, $x \in \left(-\frac{\pi}{2}, \pi\right)$.



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6. Find the number of solutions of the equation $\sin^4 x + \cos^4 x - 2 \sin^2 x + \frac{3}{4} \sin^2 2x = 0$ in the interval $[0, 2\pi]$

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7. Find number of solution of the equation $2 \sin x + 5 \sin^2 x + 8 \sin^3 x + \dots \infty = 1$ for $x \in [0, 2\pi]$.

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8. 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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9. Solve $\cos ec^2 \theta - \cot^2 \theta = \cos \theta$.

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10. Solve $\sin x \tan x - \sin x + \tan x - 1 = 0$ for $x \in [0, 2\pi]$.

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11. Find number of solutions of equation

$$\sin^2 \theta - \frac{4}{\sin^3 \theta - 1} = 1 - \frac{4}{\sin^3 \theta - 1}, \theta \in [0, 6\pi].$$

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12. Solve $\log_{|\sin x|} (1 + \cos x) = 2$.

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Concept Application Exercise 4 2

1. Solve $2 \sin \theta + 1 = 0$.

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2. $\sin^2 n\theta - \sin^2(n-1)\theta = \sin^2 \theta$ where n is constant and $n \neq 0, 1$

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3. Solve $\cos \theta + \cos 7\theta + \cos 3\theta + \cos 5\theta = 0$,

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4. Solve $3 \tan^2 \theta - 2 \sin \theta = 0$.

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5. If $\sin \theta, 1, \cos 2\theta$ are in G.P., then find the general values of θ

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6.

Solve

$$(\sin 10^\circ)^{\tan x + \tan 3x} = \tan 15^\circ + \tan 30^\circ + \tan 15^\circ \cdot \tan 30^\circ, x \in (0, \pi]$$



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Concept Application Exercise 4.3

1. Solve $\cos \theta = 1/3$.



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2. Solve $\tan \theta \tan 4\theta = 1$ for $0 < \theta < \pi$.



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3. Solve $\cot(x/2) - \operatorname{cosec}(x/2) = \cot x$.



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4. Solve $\cot \theta + \tan \theta = 2 \operatorname{cosec} \theta$.



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5. Solve $\sin 6\theta = \sin 4\theta - \sin 2\theta$.



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6. Solve $\cos \theta + \cos 2\theta + \cos 3\theta = 0$.



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7. Determine the smallest positive value of x which satisfy the equation

$$\sqrt{1 + \sin 2x} - \sqrt{2} \cos 3x = 0$$



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8. If $\cos p\theta + \cos q\theta = 0$, then prove that the different values of θ are in A.P. with common difference $2\pi / (p \pm q)$.

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9. Find the number of solutions for the equation $\sin 5x + \sin 3x + \sin x = 0$ for $0 \leq x \leq \pi$.

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Concept Application Exercise 4 4

1. If $\tan a\theta - \tan b\theta = 0$, then prove that the values of θ forms an A.P.

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2. What is the general solution of the equation: $\tan^2 \theta + 2\sqrt{3} \tan \theta = 1$?

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3. Solve the following equation: $\tan^2 x + (1 - \sqrt{3}) \tan x - \sqrt{3} = 0$

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4. Solve the following equation: $3 \cos^2 \theta - 2\sqrt{3} \sin \theta \cos \theta - 3 \sin^2 \theta = 0$

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5. Solve the following equations :

$$\tan \theta + \tan \left(\theta + \frac{\pi}{3} \right) + \tan \left(\theta + \frac{2\pi}{3} \right) = 3$$

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6. Solve $2 \sin^3 x = \cos x$.



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7. Solve $7 \cos^2 x + \sin x \cos x - 3 = 0$.



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8. If $\tan\left(\frac{p\pi}{4}\right) = \cot\left(\frac{q\pi}{4}\right)$, then prove that $p + q = 2(2n + 1)$, $n \in \mathbb{Z}$.



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9. Solve $\sec \theta - 1 = (\sqrt{2} - 1) \tan \theta$.



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1. Solve $\tan^2 \theta + \cot^2 \theta = 2$.

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2. Solve $3(\sec^2 \theta + \tan^2 \theta) = 5$.

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3. Solve $4 \cos^2 x + 6 \sin^2 x = 5$.

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4. Solve $2^{\cos 2x} + 1 = 3 \cdot 2^{-\sin^2 x}$

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5. Find the number of solution of the equation $\cot^2(\sin x + 3) = 1$ in $[0, 3\pi]$.

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Concept Application Exercise 4 6

1. Solve: $\cot \theta + \operatorname{cosec} \theta = \sqrt{3}$

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2. Solve $\sin \theta + \cos \theta = \sqrt{2} \cos A$.

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3. Solve $\sqrt{2} \sec \theta + \tan \theta = 1$.

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4. Find the number of integral values of k for which the equation $7 \cos x + 5 \sin x = 2k + 1$ has at least one solution.

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Concept Application Exercise 4 7

1. Solve $\cos x + \cos 2x + \dots + \cos(nx) = n, n \in \mathbb{N}$.

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2. Show that $x = 0$ is the only solution satisfying the equation $1 + \sin^2 ax = \cos x$, where a is irrational.

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3. Solve $\sin^4 x = 1 + \tan^8 x$.

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4. Solve $\sin x \left(\cos \frac{x}{4} - 2 \sin x \right) + \left(1 + \sin \frac{x}{4} - 2 \cos x \right) \cos x = 0$.

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5. Solve for x and y $12 \sin x - 2y^2 = 21 - 8y - 5 \cos x$

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6. Solve $\sin 2x + \cos 4x = 2$.

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7. If the equation $\tan(P \cot x) = \cot(P \tan x)$ has a solution in $x \in (0, \pi) - \left\{ \frac{\pi}{2} \right\}$, then prove that $P \leq \frac{\pi}{4}$.

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8. If $\tan^2\{\pi(x + y)\} + \cot^2\{\pi(x + y)\} = 1 + \sqrt{\frac{2x}{1 + x^2}}$ where $x, y \in R$, then find the least possible value of y .

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9. Find the number of real solution of the equation $(\cos x)^5 + (\sin x)^3 = 1$ in the interval $[0, 2\pi]$

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1. Find the number of solution of the equation $\sin x = x^2 + x + 1$.

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2. The number of solution(s) of the equation $\sin x = \log_{10} x$ is/are

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3. Find the number of solution of the equation $2x = 3\pi(1 - \cos x)$.

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4. Solve $\tan x = [x]$, $x \in (0, 3\pi/2)$. Here $[.]$ represents the greatest integer function.

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1. Solve $\sin^2 \theta > \cos^2 \theta$.

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2. Solve $\tan x < 2$.

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3. Solve the inequality $\sin 2x > \sqrt{2} \sin^2 x + (2 - \sqrt{2}) \cos^2 x$

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4. Solve $\tan^3 x + 3 > 3 \tan x + \tan^2 x$.

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5. Solve $2 \cos^2 x + \sin x \leq 2$, where $\pi/2 \leq x \leq 3\pi/2$.

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6. Solve $\cos x > 1 - \frac{2x}{\pi}$.

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Exercises Single Correct Answer Type

1. If $\sin \theta = \frac{1}{2}$ and $\cos \theta = -\frac{\sqrt{3}}{2}$, then the general value of θ is ($n \in Z$).

A. $2n\pi + \frac{5\pi}{6}$

B. $2n\pi + \frac{\pi}{6}$

C. $2n\pi + \frac{7\pi}{6}$

D. $2n\pi + \frac{\pi}{4}$

Answer: A



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2. The most general solution of $\tan \theta = -1$ and $\cos \theta = \frac{1}{\sqrt{2}}$ is

A. $n\pi + \frac{7\pi}{4}$

B. $n\pi + (-1)^n \frac{7\pi}{4}$

C. $2n\pi + \frac{7\pi}{4}$

D. none of these

Answer: C



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3. Sum of roots of the equation $x^2 - 2x^2 \frac{\sin^2(\pi x)}{2} + 1 = 0$ is

A. 0

B. 2

C. 1

D. 3

Answer: A



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4. The number of solutions of the pair of equations $2\sin^2 \theta - \cos 2\theta = 0$
 $2\cos^2 \theta - 3\sin \theta = 0$ in the interval $[0, 2\pi]$ is

A. 0

B. 1

C. 2

D. 4

Answer: C



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5. Number of solutions of equation

$$2\sin\frac{x}{2}\cos^2 x - 2\sin\frac{x}{2}\sin^2 x = \cos^2 x - \sin^2 x \text{ for } x \in [0, 4\pi] \text{ is}$$

A. 6

B. 8

C. 10

D. 12

Answer: C



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6. Number of solutions of the equation

$$4(\cos^2 2x + \cos 2x + 1) + \tan x (\tan x - 2\sqrt{3}) = 0 \text{ in } [0, 2\pi] \text{ is}$$

A. 0

B. 1

C. 2

D. 3

Answer: C



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7. Let θ

A. 6π

B. 7π

C. 8π

D. 4π

Answer: A



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8. Assume that θ is a rational multiple of π such that $\cos \theta$ is a distinct rational. The number of values of $\cos \theta$ is

A. 3

B. 4

C. 5

D. 6

Answer: C



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9. If $x, y \in [0, 2\pi]$ and $\sin x + \sin y = 2$, then the value of $x + y$ is

A. π

B. $\pi/2$

C. 3π

D. none of these

Answer: A



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10. Number of roots of $\cos^2 x + \frac{\sqrt{3} + 1}{2} \sin x - \frac{\sqrt{3}}{4} - 1 = 0$ which lie in the interval $[-\pi, \pi]$ is 2 (b) 4 (c) 6 (d) 8

A. 2

B. 4

C. 6

D. 8

Answer: B



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11. The sum of all the solutions of $\cot \theta = \sin 2\theta$ ($\theta \neq n\pi, n \in \mathbb{Z}$) , $0 \leq \theta \leq \pi$, is $\frac{3\pi}{2}$ (b) π (c) $3\frac{\pi}{4}$ (d) 2π

A. $3\pi/2$

B. π

C. $3\pi/4$

D. 2π

Answer: A



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12. The number of solutions of $12 \cos^3 x - 7 \cos^2 x + 4 \cos x = 9$ is

A. 0

B. 2

C. infinite

D. none of these

Answer: C



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13. Number of solutions of the equation

$$\sin x + \cos x - 2\sqrt{2} \sin x \cos x = 0 \text{ for } x \in [0, \pi] \text{ is}$$

A. 3

B. 0

C. 1

D. 2

Answer: D



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14. The general solution of $\frac{\tan 5x - \tan 4x}{1 + \tan 5x \tan 4x} = 1$ is

A. $n\pi + \frac{\pi}{4}, \forall n \in \mathbb{Z}$

B. $n\pi \pm \frac{\pi}{4}, \forall n \in \mathbb{Z}$

C. ϕ

$$D. n\pi = \frac{\pi}{6}, \forall n \in \mathbb{Z}$$

Answer: A



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15. If $x \sin a + y \sin 2a + z \sin 3a = \sin 4a$
 $x \sin b + y \sin 2b + z \sin 3b = \sin 4b$, $x \sin c + y \sin 2c + z \sin 3c = \sin 4c$
, then the roots of the equation
 $t^3 - \left(\frac{z}{2}\right)t^2 - \left(\frac{y+2}{4}\right)t + \left(\frac{z-x}{8}\right) = 0$, $a, b, c, \neq n\pi$, are (a)
 $\sin a, \sin b, \sin c$ (b) $\cos a, \cos b, \cos c$ (c) $\sin 2a, \sin 2b, \sin 2c$ (d)
 $\cos 2a, \cos 2b, \cos 2c$

A. $\cos a, \cos b, \cos c$

B. $\sin a, \sin b, \sin c$

C. $\sin 2a, \sin 2b, \sin 2c$

D. $\cos 2a, \cos 2b, \cos 2c$

Answer: A



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16. The number of solutions of the equation $\sin 2\theta - 2 \cos \theta + 4 \sin \theta = 4$ in $[0, 5\pi]$ is equal to

A. 3

B. 4

C. 5

D. 6

Answer: A



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17. The number of distinct real roots of the equation

$$\frac{\tan(2\pi x)}{x^2 + x + 1} = -\sqrt{3}$$

is 4 (b) 5 (c) 6 (d) none of these

A. 4

B. 5

C. 6

D. none of these

Answer: B



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18. The smallest positive value of x (in radians) satisfying the equation

$$(\log)_{\cos x} \left(\frac{\sqrt{3}}{2} \sin x \right) = 2 - (\log)_{\sec x} (\tan x), \text{ is } \frac{\pi}{12} \text{ (b) } \frac{\pi}{6} \text{ (c) } \frac{\pi}{4} \text{ (d) } \frac{\pi}{3}$$

A. $\frac{\pi}{12}$

B. $\frac{\pi}{6}$

C. $\frac{\pi}{4}$

D. $\frac{\pi}{3}$

Answer: B



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19. The number of solution of $\sin^4 x - \cos^2 x \sin x + 2 \sin^2 x + \sin x = 0$ in $0 \leq x \leq 3\pi$ is

A. 3

B. 4

C. 5

D. 6

Answer: B



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20. The range of 'y, such that the equation in x, $y + \cos x = \sin x$ has a real solution is

A. $[-2, 2]$

B. $[-\sqrt{2}, \sqrt{2}]$

C. $[-1, 1]$

D. $[-1/2, 1/2]$

Answer: B

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21. Solution of the equation $\sin\left(\sqrt{1 + \sin 2\theta}\right) = \sin \theta + \cos \theta$ is
($n \in \mathbb{Z}$)

A. $n\pi - \frac{\pi}{4}$

B. $n\pi + \frac{\pi}{12}$

C. $n\pi + \frac{\pi}{6}$

D. none of these

Answer: A

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22. One of the general solutions of $\sqrt{3} \cos \theta - 3 \sin \theta = 4 \sin 2\theta \cos 3\theta$ is

A. $(3n \pm 1)\pi/12, \forall n \in \mathbb{Z}$

B. $(4n \pm 1)\pi/9, \forall n \in \mathbb{Z}$

C. $(3n \pm 1)\pi/9, \forall n \in \mathbb{Z}$

D. $(3n \pm 1)\pi/3, \forall n \in \mathbb{Z}$

Answer: C



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23. The general solution of the equation

$$8 \cos x \cos 2x \cos 4x = \sin 6x / \sin x \text{ is}$$

A. $x = (n\pi/7) + (\pi/21), \forall n \in \mathbb{Z}$

B. $x = (2\pi/7) + (\pi/14), \forall n \in \mathbb{Z}$

C. $x = (n\pi/7) + (\pi/14), \forall n \in \mathbb{Z}$

D. $x = (n\pi) + (\pi/14), \forall n \in \mathbb{Z}$

Answer: C



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$$24. \frac{\sin^3 \theta - \cos^3 \theta}{\sin \theta - \cos \theta} - \frac{\cos \theta}{\sqrt{1 + \cot^2 \theta}} - 2 \tan \theta \cot \theta = -1 \text{ if}$$

A. $\theta \in \left(0, \frac{\pi}{2}\right)$

B. $\theta \in \left(\frac{\pi}{2}, \pi\right)$

C. $\theta \in \left(\pi, \frac{3\pi}{2}\right)$

D. $\theta \in \left(\frac{3\pi}{2}, 2\pi\right)$

Answer: B



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25. For `0

A. 0

B. 1

C. 2

D. 3

Answer: C



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26. The least positive solution of $\cot\left(\frac{\pi}{3\sqrt{3}}\sin 2x\right) = \sqrt{3}$ lies in

A. $\left(0, \frac{\pi}{6}\right]$

B. $\left(\frac{\pi}{9}, \frac{\pi}{6}\right)$

C. $\left(\frac{\pi}{12}, \frac{\pi}{9}\right]$

D. $\left(\frac{\pi}{3}, \frac{\pi}{2}\right]$

Answer: A



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27. The number of real roots of the equation $\cos \theta + \sec \theta - \sqrt{15} = 0$ lying in $[0, \pi]$ is

- A. 6
- B. 8
- C. 4
- D. 0

Answer: C



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28. If $\frac{\pi}{2} \leq x \leq 2\pi$, then the number of solutions of $3(\sin x + \cos x) - (\sin^3 x + \cos^3 x) = 8$ is (a) 0 (b) 1 (c) 2 (d) 4

- A. 0
- B. 1
- C. 2

D. 4

Answer: A



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29. If $2 \sin^2 \left(\left(\frac{\pi}{2} \right) \cos^2 x \right) = 1 - \cos(\pi s \in 2x)$, $x \neq (2n + 1) \frac{\pi}{2}$, $n \in I$, then $\cos 2x$ is equal to $\frac{1}{5}$ (b) $\frac{3}{5}$ (c) $\frac{4}{5}$ (d) 1

A. $1/5$

B. $3/5$

C. $4/5$

D. 1

Answer: B



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30. The number of solutions of the equation $\cos 6x + \tan^2 x + \cos 6x \tan^2 x = 1$ in the interval $[0, 2\pi]$ is 4 (b) 5 (c) 6 (d) 7

A. 4

B. 5

C. 6

D. 7

Answer: D



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31. The number of solutions of the equation $\sin^3 x \cos x + \sin^2 x \cos^2 x + \sin x \cos^3 x = 1$ in the interval $[0, 2\pi]$ is/are 0 (b) 2 (c) 3 (d) infinite

A. 0

B. 2

C. 3

D. infinite

Answer: A



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32. The sum of all the solution of the equation $\cos \theta \cos \left(\frac{\pi}{3} + \theta \right) \cos \left(\frac{\pi}{3} - \theta \right) = \frac{1}{4}$ $\theta \in [0, 6\pi]$ is 15π (a) 30π (b) $\frac{100\pi}{3}$ (c) none of these (d)

A. 15π

B. 30π

C. $\frac{100\pi}{3}$

D. none of these

Answer: B



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33. General solution of $\sin^2 x - 5 \sin x \cos x - 6 \cos^2 x = 0$ is

A. (a) $x = n\pi - \pi/4, n \in Z$ only

B. (b) $n\pi + \tan^{-1} 6, n \in Z$ only

C. (c) both (a) and (2)

D. (d) none of these

Answer: C



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34. about to only mathematics

A. 2

B. 4

C. 6

D. none of these

Answer: A



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35. General solution of $\tan \theta + \tan 4\theta + \tan 7\theta = \tan \theta \tan 4\theta \tan 7\theta$ is

A. $\theta = n\pi/12$, where $n \in \mathbb{Z}$

B. $\theta = n\pi/9$, where $n \in \mathbb{Z}$

C. $\theta = n\pi + \pi/12$, where $n \in \mathbb{Z}$

D. none of these

Answer: D



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36. The general solution of $\tan \theta + \tan 2\theta + \tan 3\theta = 0$ is

A. (a) $\theta = n\pi/6, n \in \mathbb{Z}$ only

B. (b) $\theta = n\pi \pm \alpha, n \in \mathbb{Z}$, where $\tan \alpha = 1/\sqrt{2}$ only

C. (c) Both a and b

D. (d) none of these

Answer: B



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37. The number of solution of

$$\sec^2 \theta + \cos^2 \theta + 2 \cos \theta = 8, 0 \leq \theta \leq \pi/2 \text{ is}$$

A. 4

B. 3

C. 0

D. 2

Answer: D



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38. Which of the following is true for

$z = (3 + 2i \sin \theta)(1 - 2i \sin \theta)$ where $i = \sqrt{-1}$? z is purely real for

$\theta = n\pi \pm \frac{\pi}{3}, n \in \mathbb{Z}$ z is purely imaginary for $\theta = n\pi \pm \frac{\pi}{2}, n \in \mathbb{Z}$ z is

purely real for $\theta = n\pi, n \in \mathbb{Z}$ none of these

A. z is purely real for $\theta = n\pi \pm \pi/3, n \in \mathbb{Z}$

B. z is purely imaginary for $\theta = n\pi \pm \pi/2, n \in \mathbb{Z}$

C. z is purely real for $\theta = n\pi, n \in \mathbb{Z}$

D. none of these

Answer: C



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39. The number of solution of $\sin x + \sin 2x + \sin 3x$

$= \cos x + \cos 2x + \cos 3x, 0 \leq x \leq 2\pi$, is

A. 7

B. 5

C. 4

D. 6

Answer: D



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40. Number of solutions of the equation

$$\cos^4 2x + 2 \sin^2 2x = 17(\cos x + \sin x)^8, 0 < x < 2\pi \text{ is}$$

A. 4

B. 8

C. 10

D. 16

Answer: A

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41. The number of values of θ in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ satisfying the equation $(\sqrt{3})^{\sec^2 \theta} = \tan^4 \theta + 2 \tan^2 \theta$ is 2 (b) 4 (c) 0 (d) 1

A. 2

B. 4

C. 0

D. 1

Answer: A

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42. The value of k if the equation $2 \cos x + \cos 2kx = 3$ has only one solution is 2 (b) 2 (c) $\sqrt{2}$ (d) $\frac{1}{2}$

A. 0

B. 2

C. $\sqrt{2}$

D. $1/2$

Answer: C



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43. Number of solution(s) satisfying the equation

$$\frac{1}{\sin x} - \frac{1}{\sin 2x} = \frac{2}{\sin 4x} \text{ in } [0, 4\pi] \text{ equals 0 (b) 2 (c) 4 (d) 6}$$

A. 0

B. 2

C. 4

D. 6

Answer: C



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44. The number of roots of $(1 - \tan \theta)(1 + \sin 2\theta) = 1 + \tan \theta$ for $\theta \in [0, 2\pi]$ is

A. 3

B. 4

C. 5

D. none of these

Answer: C



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45. If $\tan(A - B) = 1$ and $\sec(A + B) = \frac{2}{\sqrt{3}}$, then the smallest positive values of A and B, respectively, are $\frac{25\pi}{24}, \frac{19\pi}{24}$ (b) $\frac{19\pi}{24}, \frac{25\pi}{24}$
 $\frac{31\pi}{24}, \frac{31\pi}{24}$ (d) $\frac{13\pi}{24}, \frac{31\pi}{24}$

A. $\frac{25\pi}{24}, \frac{19\pi}{24}$

B. $\frac{19\pi}{24}, \frac{25\pi}{24}$

C. $\frac{31\pi}{24}, \frac{13\pi}{24}$

D. $\frac{13\pi}{24}, \frac{31\pi}{24}$

Answer: A



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46. If $3 \tan(\theta - 15^\circ) = \tan(\theta + 15^\circ)$, then θ is equal to $n \in \mathbb{Z}$ $n\pi + \frac{\pi}{4}$

(b) $n\pi + \frac{\pi}{8}$ $n\pi + \frac{\pi}{3}$ (d) none of these

A. $n\pi + \frac{\pi}{4}$

B. $n\pi + \frac{\pi}{8}$

C. $n\pi + \frac{\pi}{3}$

D. none of these

Answer: A



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47. If $\tan 3\theta + \tan \theta = 2 \tan 2\theta$, then θ is equal to ($n \in \mathbb{Z}$)

A. $n\pi$

B. $\frac{n\pi}{4}$

C. $\frac{n\pi}{2}$

D. none of these

Answer: A



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48. The solution of

$$4 \sin^2 x + \tan^2 x + \sec^2 x + \cot^2 x - 6 = 0 \text{ is } (n \in \mathbb{Z}) \text{ (a) } n\pi \pm \frac{\pi}{4} \text{ (b)}$$

$$2n\pi \pm \frac{\pi}{4} \text{ (c) } n\pi + \frac{\pi}{3} \text{ (d) } n\pi - \frac{\pi}{6}$$

A. $n\pi \pm \frac{\pi}{4}$

B. $2n\pi \pm \frac{\pi}{4}$

C. $n\pi + \frac{\pi}{3}$

D. $n\pi - \frac{\pi}{6}$

Answer: A



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49. If $\sin 3\alpha = 4 \sin \alpha \sin(x + \alpha) \sin(x - \alpha)$, then

A. $n\pi \pm \pi/4, \forall n \in Z$

B. $n\pi \pm \pi/3, \forall n \in Z$

C. $n\pi \pm \pi/9, \forall n \in Z$

D. $n\pi \pm \pi/12, \forall n \in Z$

Answer: B



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50. The general solution of $4\sin^4 x + \cos^4 x = 1$ is

A. $n\pi \pm \alpha/2, \alpha = \cos^{-1}(1/5), \forall n \in \mathbb{Z}$

B. $n\pi \pm \alpha/2, \alpha = \cos^{-1}(3/5), \forall n \in \mathbb{Z}$

C. $2n\pi \pm \alpha/2, \alpha = \cos^{-1}(1/3), \forall n \in \mathbb{Z}$

D. none of these

Answer: A



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51. For $n \in \mathbb{Z}$, the general solution of

$$(\sqrt{3} - 1)\sin \theta + (\sqrt{3} + 1)\cos \theta = 2 \text{ is } (n \in \mathbb{Z}) \quad \theta = 2n\pi \pm \frac{\pi}{4} + \frac{\pi}{12}$$

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

A. $\theta = 2n\pi \pm \frac{\pi}{4} + \frac{\pi}{12}$

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

C. $\theta = 2n\pi \pm \frac{\pi}{4}$

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

Answer: A



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52. The value of $\cos y \cos\left(\frac{\pi}{2} - x\right) - \cos\left(\frac{\pi}{2} - y\right) \cos x + \sin y \cos\left(\frac{\pi}{2} - x\right) + \cos x \sin\left(\frac{\pi}{2} - y\right)$ is zero if (a) $x = 0$ (b) $y = 0$ (c) $x = y$ (d) $n\pi + y - \frac{\pi}{4} (n \in \mathbb{Z})$

A. $x = 0$

B. $y = 0$

C. $x = y$

D. $n\pi + y - \frac{\pi}{4} (n \in \mathbb{Z})$

Answer: D



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53. One of the general solutions of $4 \sin \theta \sin 2\theta \sin 4\theta = \sin 3\theta$ is

- A. $m\pi + \pi/18, m \in \mathbb{Z}$
- B. $m\pi/2 + \pi/6, \forall m \in \mathbb{Z}$
- C. $m\pi/3 + \pi/18, m \in \mathbb{Z}$
- D. none of these

Answer: C

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54. The equation $\sin^4 x + \cos^4 x + \sin 2x + \alpha = 0$ is solvable for

$-\frac{5}{2} \leq \alpha \leq \frac{1}{2}$ (b) $-3 \leq \alpha < 1 - \frac{3}{2} \leq \alpha \leq \frac{1}{2}$ (d) $-1 \leq \alpha \leq 1$

- A. $-5/2 \leq \alpha \leq 1/2$
- B. $-3 \leq \alpha \leq 1$
- C. $-3/2 \leq \alpha \leq 1/2$
- D. $-1 \leq \alpha \leq 1$

Answer: C



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55. The total number of solutions of $\cos x = \sqrt{1 - \sin 2x}$ in $[0, 2\pi]$ is equal to

A. 2

B. 3

C. 5

D. none of these

Answer: B



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56. The total number of solution of $|\cot x| = \cot x + \frac{1}{\sin x}$, $x \in [0, 3\pi]$, is equal to 1 (b) 2 (c) 3 (d) 0

A. 1

B. 2

C. 3

D. 0

Answer: B



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57. Let α and β be any two positive values of x for which $2 \cos x$, $|\cos x|$, and $1 - 3 \cos^2 x$ are in G.P. The minimum value of $|\alpha - \beta|$ is $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) none of these

A. $\frac{\pi}{3}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{2}$

D. none of these

Answer: D



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58. The number of values of θ satisfying $4 \cos \theta + 3 \sin \theta = 5$ as well as $3 \cos \theta + 4 \sin \theta = 5$ is

A. one

B. two

C. zero

D. none of these

Answer: C



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59. The general solution of $\cos x \cos 6x = -1$ is

A. $x = (2n + 1)\pi, n \in \mathbb{Z}$

B. $x = 2n\pi, n \in \mathbb{Z}$

C. $x = n\pi, n \in \mathbb{Z}$

D. none of these

Answer: A



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60. The number of solution the equation $\cos(\theta)\cos(\pi\theta) = 1$ has 0 (b) 2

(c) 4 (d) 2

A. 0

B. 2

C. 1

D. infinite

Answer: C

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61. Let $\theta \in [0, 4\pi]$ satisfy the equation $(\sin \theta + 2)(\sin \theta + 3)(\sin \theta + 4) = 6$. If the sum of all the values of θ is of the form $k\pi$, then the value of k is 6 (b) 5 (c) 4 (d) 2

A. 6

B. 5

C. 4

D. 2

Answer: B

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62. The number of solutions of $\sum_{r=1}^5 \cos rx = 5$ in the interval $[0, 2\pi]$ is 0 (b) 2 (c) 5 (d) 10

A. 0

B. 2

C. 5

D. 10

Answer: B

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63. If $\cos 3x + \sin\left(2x - \frac{7\pi}{6}\right) = -2$, then x is equal to ($k \in \mathbb{Z}$)

A. $\frac{\pi}{3}(6k + 1)$

B. $\frac{\pi}{3}(6k - 1)$

C. $\frac{\pi}{3}(2k + 1)$

D. none of these

Answer: D

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64. The general solution of the equation $\sin^{100} x - \cos^{100} x = 1$ is (a)

$2n\pi + \frac{\pi}{3}, n \in I$ (b) $n\pi + \frac{\pi}{2}, n \in I$ (c) $n\pi + \frac{\pi}{4}, n \in I$ (d)

$2n\pi = \frac{\pi}{3}, n \in I$

A. $2n\pi + \frac{\pi}{3}, n \in I$

B. $n\pi + \frac{\pi}{2}, n \in I$

C. $n\pi + \frac{\pi}{4}, n \in I$

D. $2n\pi - \frac{\pi}{3}, n \in I$

Answer: B



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65. The sum of all the solution in $[0, 4\pi]$ of the equation

$\tan x + \cot x + 1 = \cos\left(x + \frac{\pi}{4}\right)$ is 3π (b) $\frac{\pi}{2}$ (c) $\frac{7\pi}{2}$ (d) 4π

A. 3π

B. $\pi/2$

C. $7\pi/2$

D. 4π

Answer: C

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66. The total number of solutions of $\log_e |\sin x| = -x^2 + 2x \in [0, \pi]$ is equal to

A. 1

B. 2

C. 4

D. none of these

Answer: B

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67. The total number of solution of $\sin\{x\} = \cos\{x\}$ (where $\{ \}$ denotes the fractional part) in $[0, 2\pi]$ is equal to 5 (b) 6 (c) 8 (d) none of these

A. 5

B. 6

C. 8

D. none of these

Answer: B



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68. The set of all x in $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ satisfying $|4\sin x - 1| < \sqrt{5}$ is given by

(a) $\left(-\frac{\pi}{10}, \frac{3\pi}{10}\right)$ (b) $\left(\frac{\pi}{10}, \frac{3\pi}{10}\right)$ (c) $\left(\frac{\pi}{10}, \frac{3\pi}{10}\right)$ (d) none of these

A. $\left(-\frac{\pi}{10}, \frac{3\pi}{10}\right)$

B. $\left(\frac{\pi}{10}, \frac{3\pi}{10}\right)$

C. $\left(\frac{\pi}{10}, \frac{3\pi}{10}\right)$

D. none of these

Answer: A



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69. If roots of the equation $2x^2 - 4x + 2\sin\theta - 1 = 0$ are of opposite sign, then θ belongs

A. $\left(\frac{\pi}{6}, \frac{5\pi}{6}\right)$

B. $\left(0, \frac{\pi}{6}\right) \cup \left(\frac{5\pi}{6}, 2\pi\right)$

C. $\left(\frac{13\pi}{6}, \frac{17\pi}{6}\right)$

D. $(0, \pi)$

Answer: B



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70. If $|2 \sin \theta - \cos \theta| \geq 1$ and $\theta \neq \frac{n\pi}{2}, n \in \mathbb{Z}$, then

A. $\cos 2\theta \geq 1/2$

B. $\cos 2\theta \geq 1/4$

C. $\cos 2\theta \leq 1/2$

D. $\cos 2\theta \leq 1/4$

Answer: A



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71. Which of the following is not the solution of the equation

$$\sin 5x = 16 \sin^5 x (n \in \mathbb{Z}) ?$$

A. $n\pi$

B. $n\pi + \frac{\pi}{6}$

C. $n\pi - \frac{\pi}{6}$

D. none of these

Answer: D



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72. The number of solutions of the equation

$$|2 \sin x - \sqrt{3}|^{2 \cos^2 x - 3 \cos x + 1} = 1 \text{ in } [0, \pi] \text{ is}$$

- A. 2
- B. 3
- C. 4
- D. 5

Answer: B



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73. One root of the equation $\cos x - x + \frac{1}{2} = 0$ lies in the interval (A)

- $\left[0, \frac{\pi}{2}\right]$ (B) $\left[-\frac{\pi}{2}, 0\right]$ (C) $\left[\frac{\pi}{2}, 0\right]$ (D) none

A. $\left(0, \frac{\pi}{2}\right)$

B. $\left(-\frac{\pi}{2}, 0\right)$

C. $\left(\frac{\pi}{2}, \pi\right)$

D. $\left(\pi, \frac{3\pi}{2}\right)$

Answer: A



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74. The smallest positive x satisfying the equation

$(\log)_{\cos x} \sin x + (\log)_{\sin x} \cos x = 2$ is $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

A. $\pi/2$

B. $\pi/3$

C. $\pi/4$

D. $\pi/6$

Answer: C

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75. The number of ordered pairs which satisfy the equation $x^2 + 2x \sin(xy) + 1 = 0$ are (where $y \in [0, 2\pi]$) (a) 1 (b) 2 (c) 3 (d) 0

A. 1

B. 2

C. 3

D. 0

Answer: B

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76. Consider the system of linear equations in x , y , and z :

$$(\sin 3\theta)x - y + z = 0$$

$$(\cos 2\theta)x + 4y + 3z = 0$$

$$2x + 7y + 7z = 0$$

Which of the following can be the values of θ for which the system has a non-trivial solution ?

A. $n\pi + (-1)^n\pi/6, \forall n \in \mathbb{Z}$

B. $n\pi + (-1)^n\pi/3, \forall n \in \mathbb{Z}$

C. $n\pi + (-1)^n\pi/9, \forall n \in \mathbb{Z}$

D. none of these

Answer: A



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77. The equation $\sin^4 x - 2\cos^2 x + a^2 = 0$ can be solved if

A. $-\sqrt{3} \leq a \leq \sqrt{3}$

B. $-\sqrt{2} \leq a \leq \sqrt{2}$

C. $-1 \leq a \leq 1$

D. none of these

Answer: B



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78. If the inequality $\sin^2 x + a \cos x + a^2 > 1 + \cos x$ holds for any $x \in R$, then the largest negative integral value of a is (a) -4 (b) -3 (c) -2 (d) -1

A. -4

B. -3

C. -2

D. -1

Answer: B



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79. $\sin x + \cos x = y^2 - y + a$ has no value of x for any value of y if a belongs to (a) $(0, \sqrt{3})$ (b) $(-\sqrt{3}, 0)$ (c) $(-\infty, -\sqrt{3})$ (d) $(\sqrt{3}, \infty)$

A. $(0, \sqrt{3})$

B. $(-\sqrt{3}, 0)$

C. $(-\infty, -\sqrt{3})$

D. $(\sqrt{3}, \infty)$

Answer: D



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80. The number of solutions of $[\sin x + \cos x] = 3 + [-\sin x] + [-\cos x]$ (where $[.]$ denotes the greatest integer function), $x \in [0, 2\pi]$, is

A. 0

B. 4

C. infinite

D. 1

Answer: C



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81. The equation $\cos^8 x + b \cos^4 x + 1 = 0$ will have a solution if b belongs to :

A. $(-\infty, 2]$

B. $[2, \infty)$

C. $(-\infty, -2]$

D. none of these

Answer: C



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82. The number of values of $y \in [-2\pi, 2\pi]$ satisfying the equation $|\sin 2x| + |\cos 2x| = |\sin y|$ is 3 (b) 4 (c) 5 (d) 6

A. 3

B. 4

C. 5

D. 6

Answer: B



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83. If both the distinct roots of the equation $|\sin x|^2 + |\sin x| + b = 0 \in [0, \pi]$ are real, then the values of b are $[-2, 0]$ (b) $(-2, 0)$ $[-2, 0]$ (d) *none of these*

A. $[-2, 0]$

B. $(-2, 0)$

C. $[-2, 0)$

D. none of these

Answer: B



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84. $e^{|\sin x|} + e^{-|\sin x|} + 4a = 0$ will have exactly four different solutions in $[0, 2\pi]$ if. $a \in R$ (b) $a \in \left[-\frac{3}{4}, -\frac{1}{4}\right]$ $a \in \left[\frac{-1 - e^2}{4e}, \infty\right]$ (d) none of these

A. $a \in R$

B. $a \in \left[-\frac{e}{4}, -\frac{1}{4}\right]$

C. $a \in \left[\frac{-1 - e^2}{4e}, \infty\right]$

D. none of these

Answer: D



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85. The equation $\tan^4 x - 2\sec^2 x + a = 0$ will have at least one solution if

A. $1 < a \leq 4$

B. $a \geq 2$

C. $a \leq 3$

D. none of these

Answer: C



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86. The total number of ordered pairs (x, y) satisfying $|x| + |y| = 2$, $\sin\left(\frac{\pi x^2}{3}\right) = 1$, is equal to 2 (b) 3 (c) 4 (d) 6

A. 2

B. 3

C. 4

D. 6

Answer: C



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87. If $a, b \in [0, 2\pi]$ and the equation $x^2 + 4 + 3\sin(ax + b) - 2x = 0$ has at least one solution, then the value of $(a + b)$ can be $\frac{7\pi}{2}$ (b) $\frac{5\pi}{2}$ (c) $\frac{9\pi}{2}$ (d) none of these

A. $\frac{7\pi}{2}$

B. $\frac{5\pi}{2}$

C. $\frac{9\pi}{2}$

D. none of these

Answer: A



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88. The sum of all roots of $\sin\left(\pi(\log)_3\left(\frac{1}{x}\right)\right) = 0$ in $(0, 2\pi)$ is $\frac{3}{2}$ (b) 4
(c) $\frac{9}{2}$ (d) $\frac{13}{3}$

A. $3/2$

B. 4

C. $9/2$

D. $13/3$

Answer: C



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89. Find the number of pairs of integer (x, y) that satisfy the following two equations: $\{\cos(xy) = x \tan(xy) = y\}$ 1 (b) 2 (c) 4 (d) 6

A. 1

B. 2

C. 4

D. 6

Answer: A



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90. If no solution of $3 \sin y + 12 \sin^3 x = a$ lies on the line $y = 3x$, then $a \in (-\infty, -9) \cup (9, \infty)$ $a \in [-9, 9]$ $a \in \{-9, 9\}$ *none of these*

A. $a \in (-\infty, -9) \cup (9, \infty)$

B. $a \in [-9, 9]$

C. $a \in \{-9, 9\}$

D. none of these

Answer: A



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Exercises Multiple Correct Type

1. If $4 \sin^4 x + \cos^4 x = 1$, then x is equal to $(n \in \mathbb{Z})$ $n\pi$ (b)

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

A. $n\pi$

B. $n\pi \pm \sin^{-1} \sqrt{\frac{2}{5}}$

C. $\frac{2n\pi}{3}$

D. $2n\pi \pm \frac{\pi}{4}$

Answer: A::B



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2. If $\sin^3 \theta + \sin \theta \cos \theta + \cos^3 \theta = 1$, then θ is equal to $(n \in \mathbb{Z})$

A. $2n\pi$

B. $2n\pi + \frac{\pi}{2}$

C. $2n\pi - \frac{\pi}{2}$

D. $n\pi$

Answer: A::B



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3. A general solution of $\tan^2 \theta + \cos 2\theta = 1$ is ($n \in \mathbb{Z}$)

A. $n\pi - \frac{\pi}{4}$

B. $2n\pi + \frac{\pi}{4}$

C. $n\pi + \frac{\pi}{4}$

D. $n\pi$

Answer: A::C::D



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4. If $\sin x + \cos x = \sqrt{y + \frac{1}{y}}$ for $x \in [0, \pi]$, then $x = \frac{\pi}{4}$ (b) $y = 0$
 $y = 1$ (d) $x = \frac{3\pi}{4}$

A. $x = \pi/4$

B. $y = 0$

C. $y = 1$

D. $x = 3\frac{\pi}{4}$

Answer: A:C



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5. The equation $2 \sin^2\left(\frac{\pi}{2} \cos^2 x\right) = 1 - \cos(\pi \sin 2x)$ is satisfied by

A. $x = (2n + 1)\frac{\pi}{2}, n \in Z$

B. $\tan x = \frac{1}{2}, n \in Z$

C. $\tan x = -\frac{1}{2}, n \in Z$

$$D. x = \frac{n\pi}{2}, n \in Z$$

Answer: A::B::C

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6. If $\sin^2 x - 2\sin x - 1 = 0$ has exactly four different solutions in $x \in [0, n\pi]$, then value/values of n is/are ($n \in N$) 5 (b) 3 (c) 4 (d) 6

A. 5

B. 3

C. 4

D. 6

Answer: A::C

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7. For the smallest positive values of x and y , the equation $2(\sin x + \sin y) - 2 \cos(x - y) = 3$ has a solution, then which of the following is/are true? (a) $\frac{\sin(x + y)}{2} = 1$ (b) $\cos\left(\frac{x - y}{2}\right) = \frac{1}{2}$ number of ordered pairs (x, y) is 2 number of ordered pairs (x, y) is 3

A. $\sin\frac{x + y}{2} = 1$

B. $\cos\left(\frac{x - y}{2}\right) = \frac{1}{2}$

C. number of ordered pairs (x, y) is 2

D. number of ordered pairs (x, y) is 3

Answer: A::B::C

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8. For the equation $1 - 2x - x^2 = \tan^2(x + y) + \cot^2(x + y)$ exactly one value of x exists exactly two values of x exists $y = -1 + n\pi + \frac{\pi}{4}, n \in \mathbb{Z}$ $y = 1 + n\pi + \frac{\pi}{4}, n \in \mathbb{Z}$

A. exactly one values of x exists

B. exactly two values of x exists

C. $y = -1 + n\pi + \pi/4, n \in \mathbb{Z}$

D. $y = 1 + n\pi + \pi/4, n \in \mathbb{Z}$

Answer: A:D



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9. If $x + y = \pi/4$ and $\tan x + \tan y = 1$, then ($n \in \mathbb{Z}$)

A. $\sin x = 0$ always

B. when $x = n\pi + \pi/4$ then $y = -n\pi$

C. when $x = n\pi$ then $y = n\pi + (\pi/4)$

D. when $x = n\pi + \pi/4$ then $y = n\pi - (\pi/4)$

Answer: B::C



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10. If $x + y = 2\pi/3$ and $\sin x / \sin y = 2$, then the

A. number of values of $x \in [0, 4\pi]$ are 4

B. number of values of $x \in [0, 4\pi]$ are 2

C. number of values of $y \in [0, 4\pi]$ are 4

D. number of values of $y \in [0, 4\pi]$ are 8

Answer: A::C



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11. Let $\tan x - \tan^2 x > 0$ and $|2 \sin x| < 1$. Then the intersection of which of the following two sets satisfies both the inequalities?

$$x > n\pi, n \in \mathbb{Z} \quad (\text{b}) \quad x > n\pi - \frac{\pi}{6}, n \in \mathbb{Z}$$

A. $x > n\pi, n \in \mathbb{Z}$

B. $x > n\pi - \pi/6, n \in \mathbb{Z}$

C. $x < n\pi - \pi/4, n \in \mathbb{Z}$

D. $x < n\pi + \pi/6, n \in \mathbb{Z}$

Answer: A::D



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12. If $\cos\left(x + \frac{\pi}{3}\right) + \cos x = a$ has real solutions, then number of integral values of a are 3 sum of number of integral values of a is 0 when $a = 1$, number of solutions for $x \in [0, 2\pi]$ are 3 when $a = 1$, number of solutions for $x \in [0, 2\pi]$ are 2

A. number of integral values of a are 3

B. sum of number of integral values of a is 0

C. when $a = 1$, number of solution for $x \in [0, 2\pi]$ are 3

D. when $a = 1$, number of solutions for $x \in [0, 2\pi]$ are 2

Answer: A::B::D



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13. If $0 \leq x \leq 2\pi$, then $2^{\cos ec^2 x} \sqrt{\frac{1}{2}y^2 - y + 1} \leq \sqrt{2}$

- A. is satisfied by exactly one value of y
- B. is satisfied by exactly two value of x
- C. is satisfied by x for which $\cos x = 0$
- D. is satisfied by x for which $\sin x = 0$

Answer: A::B::C



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14. If the equation $\sin^2 x - a \sin x + b = 0$ has only one solution in $(0, \pi)$ then which of the following statements are correct?

- A. $a \in (-\infty, 1] \cup [2, \infty)$
- B. $b \in (-\infty, 0] \cup [1, \infty)$

C. $a = 1 + b$

D. none of these

Answer: A::B::C



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15. If $(\cos e c^2 \theta - 4)x^2 + (\cot \theta + \sqrt{3})x + \frac{\cos^2(3\pi)}{2} = 0$ holds true for all real x , then the most general values of θ can be given by $n \in \mathbb{Z}$)

$2n\pi + \frac{11\pi}{6}$ (b) $2n\pi + \frac{5\pi}{6}$ $2n\pi \pm \frac{7\pi}{6}$ (d) $n\pi \pm \frac{11\pi}{6}$

A. $2n\pi + \frac{11\pi}{6}$

B. $2n\pi + \frac{5\pi}{6}$

C. $2n\pi \pm \frac{7\pi}{6}$

D. $n\pi \pm \frac{11\pi}{6}$

Answer: A::B



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16. If $(\sin \alpha)x^2 - 2x + b \geq 2$, for all real values of $x \leq 1$ and $\alpha \in \left(0, \frac{\pi}{2}\right) \cup (\pi/2, \pi)$, then possible real value of b is /are
a. 2 b. 3 c. 4 d. 5

A. 2

B. 3

C. 4

D. 5

Answer: C::D



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17. The value of x in $\left(0, \frac{\pi}{2}\right)$ satisfying the equation,
$$\frac{\sqrt{3}-1}{\sin x} + \frac{\sqrt{3}+1}{\cos x} = 4\sqrt{2}$$
 is -

A. $\frac{\pi}{12}$

B. $\frac{5\pi}{12}$

C. $\frac{7\pi}{24}$

D. $\frac{11\pi}{36}$

Answer: A::D

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18. If $\cos 3\theta = \cos 3\alpha$, then the value of $\sin \theta$ can be given by $\pm \sin \alpha$ (b)

$\sin\left(\frac{\pi}{3} \pm \alpha\right) \sin\left(\frac{2\pi}{3} + \alpha\right)$ (d) $\sin\left(\frac{2\pi}{3} - \alpha\right)$

A. $\pm \sin \alpha$

B. $\sin\left(\frac{\pi}{3} \pm \alpha\right)$

C. $\sin\left(\frac{2\pi}{3} + \alpha\right)$

D. $\sin\left(\frac{2\pi}{3} - \alpha\right)$

Answer: A::C::D

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19. Which of the following sets can be the subset of the general solution of $1 + \cos 3x = 2 \cos 2x$ ($n \in \mathbb{Z}$)? (a) $n\pi + \frac{\pi}{3}$ (b) $n\pi + \frac{\pi}{6}$ (c) $n\pi - \frac{\pi}{6}$ (d) $2n\pi$

A. $n\pi + \frac{\pi}{3}$

B. $n\pi + \frac{\pi}{6}$

C. $n\pi - \frac{\pi}{6}$

D. $2n\pi$

Answer: B::C::D



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20. The values of x_1 between 0 and 2π , satisfying the equation

$$\cos 3x + \cos 2x = \frac{\sin(3x)}{2} + \frac{\sin x}{2} \text{ are } \frac{\pi}{7} \text{ (b) } \frac{5\pi}{7} \text{ (c) } \frac{9\pi}{7} \text{ (d) } \frac{13\pi}{7}$$

A. $\frac{\pi}{7}$

B. $\frac{5\pi}{7}$

C. $\frac{9\pi}{7}$

D. $\frac{13\pi}{7}$

Answer: A::B::C::D



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21. Find the value of :- $\sin 495^\circ$



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22. Find the value of :- $\cot 390^\circ$



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23. Find the value of :- $\sin 390^\circ$



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24. Find the value of :- $\sin 240^\circ$



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25. Find the value of :- $\cos 225^\circ$



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26. Find the value of :- $\sin 135^\circ$



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27. Find the value of :- $\cot 225^\circ$



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28. Find the value of :- $\cot 405^\circ$



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29. Find the value of :- $\cot 540^\circ$



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30. Find the value of :- $\tan 225^\circ$



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31. Find the value of :- $\cot 105^\circ$



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Exercises Linked Comprehension Type

1. Find the value of :- $\tan 780^\circ$



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2. Find the value of :- $\cos ec 720^\circ$



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3. Find the value of :- $\cos ec 135^\circ$



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4. Find the value of :- $\cos ec 315^\circ$



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5. Find the value of :- $\sin 450^\circ$



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6. Find the value of :- $\sin 210^\circ$

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7. Find the value of :- $\cos 210^\circ$

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8. Find $\cos 2x$ if $\sec x = \frac{13}{5}$ where $0 \leq x \leq \frac{\pi}{2}$

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9. Find $\sin 2x$ if $\cos x = \frac{\sqrt{3}}{2}$ where $0 \leq x \leq \frac{\pi}{2}$

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10. Find $\cos 2x$ if $\sin x = \frac{\sqrt{3}}{2}$ where $0 \leq x \leq \frac{\pi}{2}$



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11. Find $\sin 2x$ if $\cos x = \frac{1}{\sqrt{2}}$ where $0 \leq x \leq \frac{\pi}{2}$



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12. Find $\cos 2x$ if $\sin x = \frac{1}{\sqrt{2}}$ where $0 \leq x \leq \frac{\pi}{2}$



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13. Find the values of the following trigonometric functions $\cot\left(\frac{-15\pi}{4}\right)$



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14. Simplify : $\tan\left(x - \frac{\pi}{2}\right) \cdot \cos\left(\frac{3\pi}{2} + x\right)$

A. Infinite

B. depends upon the value of b

C. two

D. none of these

Answer: C

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Exercises Matrix Match Type

1. 

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2. 

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3. 



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4. Match the equation in List I with the number of solutions in List II.



- A. $a \quad b \quad c \quad d$
 $q \quad p \quad s \quad r$
- B. $a \quad b \quad c \quad d$
 $q \quad p \quad r \quad s$
- C. $a \quad b \quad c \quad d$
 $s \quad r \quad q \quad p$
- D. $a \quad b \quad c \quad d$
 $p \quad q \quad r \quad s$

Answer: A



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5. Consider the equation $\sin^2 x + (2a - 3)\sin x + (a^2 - 3a + 2) = 0, x \in [0, 2\pi)$ and match the

following lists.



- A. $a \ b \ c \ d$
 $q \ p \ s \ r$
- B. $a \ b \ c \ d$
 $q \ p \ r \ s$
- C. $a \ b \ c \ d$
 $s \ r \ p \ q$
- D. $a \ b \ c \ d$
 $p \ q \ r \ s$

Answer: C



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6. 

- A. $a \ b \ c \ d$
 $r \ p \ s \ q$
- B. $a \ b \ c \ d$
 $r \ q \ s \ p$
- C. $a \ b \ c \ d$
 $s \ r \ p \ q$
- D. $a \ b \ c \ d$
 $q \ r \ r \ p$

Answer: D



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Exercises Numerical Value Type

1. Number of values of p for which equation $\sin^3 x + 1 + p^3 - 3p \sin x = 0$ ($p > 0$) has a root is _____



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2. If $\log_{0.5} \sin x = 1 - \log_{0.5} \cos x$, then the number of solutions of $x \in [-2\pi, 2\pi]$ is



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3. Number of roots of the equation

$(3 + \cos x)^2 = 4 - 2 \sin^8 x$, $x \in [0, 5\pi]$ are _____



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4. Number of solutions (s) of the equation

$$\frac{\sin x}{\cos 3x} + \frac{\sin 3x}{\cos 9x} + \frac{\sin 9x}{\cos 27x} = 0 \text{ in the interval } \left(0, \frac{\pi}{4}\right) \text{ is } \underline{\hspace{2cm}}.$$



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5. Number of solutions of the equation $(\sqrt{3} + 1)^{2x} + (\sqrt{3} - 1)^{2x} = 2^{3x}$

is



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6. Number of integral value(s) of m for which the equation

$$\sin x - \sqrt{3} \cos x = \frac{4m - 6}{4 - m} \text{ has solutions, } x \in [0, 2\pi], \text{ is } \underline{\hspace{2cm}}$$



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7. The number of solutions of the equation

$$\cos^2\left(x + \frac{\pi}{6}\right) + \cos^2 x - 2 \cos\left(x + \frac{\pi}{6}\right) \frac{\cos \pi}{6} = \frac{\sin^2 \pi}{6} \quad \text{in interval } \left(\frac{-\pi}{2}, \frac{\pi}{2}\right) \text{ is } \underline{\hspace{2cm}}$$



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8. If $\cos 4x = a_0 + a_1 \cos^2 x + a_2 \cos^4 x$ is true for all values of $x \in R$, then the value of $5a_0 + a_1 + a_2$ is



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9. Number of integral values of a for which the equation

$$\cos^2 x - \sin x + a = 0 \text{ has roots when } x \in \left(0, \frac{\pi}{2}\right) \text{ is } \underline{\hspace{2cm}}$$



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10. Number of roots of the equation

$$2^{\tan\left(x - \frac{\pi}{4}\right)} - 2(0.25)^{\sin x} \wedge \left(3 \frac{\left(x - \frac{\pi}{4}\right)}{\cos 2x}\right) + 1 = 0, \text{ is } _ _ _$$

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11. The number of solution of $\sin^4 x - \cos^2 x \sin x + 2 \sin^2 x + \sin x = 0$ in $0 \leq x \leq 3\pi$ is

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12. Let k be sum of all x in the interval $[0, 2\pi]$ such that $3 \cot^2 x + 8 \cot x + 3 = 0$, then the value of k/π is _____.

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13. If $\theta \in [0, 5\pi]$ and $r \in R$ such that $2 \sin \theta = r^4 - 2r^2 + 3$ then the maximum number of values of the pair (r, θ) is ___

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14. If $2 \tan^2 x - 5 \sec x = 1$ is satisfied by exactly seven distinct values of $x \in \left[0, \frac{(2n+1)\pi}{2}\right]$, $n \in N$, then the greatest value of n is _____.

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15. If $\sin x + \sin y \geq \cos a \cos x \forall x \in R$, then $\sin y + \cos a$ is equal to ___

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16. If $\sin(\sin x + \cos x) = \cos(\cos x - \sin x)$, and largest possible value of $\sin x$ is $\frac{\pi}{k}$, then the value of k is _____.

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17. The number of solutions of the equation $1 + \cos x + \cos 2x + \sin x + \sin 2x + \sin 3x = 0$, which satisfy the condition $\frac{\pi}{2} < \left| 3x - \frac{\pi}{2} \right| \leq \pi$ is

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18. the least value of 'a' for which the equation $2\sqrt{a} \sin^2 x + \sqrt{a-3} \sin 2x = 5 + \sqrt{a}$ has at least one solution is _____.

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19. The number of ordered pair (x, y) satisfying the equation $\sin^2(x+y) + \cos^2(x-y) = 1$ which lie on the circle $x^2 + y^2 = \pi^2$ is _____.

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20. Find the total no. of ordered pairs (x,y) satisfying $x \left(\sin^2 x + \frac{1}{x^2} \right) = 2 \sin x \sin^2 y$, where $x \in (-\pi, 0) \cup (0, \pi)$ and $y \in [0, 2\pi]$.

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21. Number of solutions of the equation $\cos 5x \times \tan(6|x|) + \sin 5x = 0$ lying in $[-2\pi, \pi)$ is _____.

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Archives Jee Main Single Correct Answer Type

1. If $0 \leq x \leq 2\pi$, then the number of real values of x , which satisfy the equation $\cos x + \cos 2x + \cos 3x + \cos 4x = 0$, is

A. 5

B. 7

C. 9

D. 3

Answer: B



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2. If the sum of all the solutions of the equation $8 \cos x \cdot \left(\cos \left(\frac{\pi}{6} + x \right) \cos \left(\frac{\pi}{6} - x \right) - \frac{1}{2} \right) = 1$ in $[0, \pi]$ is $k\pi$ then k is equal to

A. $20/9$

B. $2/3$

C. $13/9$

D. $8/9$

Answer: C

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Archives Jee Advansed Single Correct Answer Type

1. find the value of the

A. $\pm \sqrt{n\pi}, n \in \{0, 1, 2, \dots\}$

B. $\pm \sqrt{n\pi}, n \in \{1, 2, \dots\}$

C. $\frac{\pi}{2} + 2n\pi, n \in \{\dots, -2, -1, 0, 1, 2, \dots\}$

D. $2n\pi, n \in \{\dots, -2, -1, 0, 1, 2, \dots\}$

Answer: A

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2. For $x \in (0, \pi)$ the equation $\sin x + 2 \sin 2x - \sin 3x = 3$ has

A. infinitely many solutions

B. three solutions

C. one solution

D. no solution

Answer: D



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3. Let $S = \left\{ x \in (-\pi, \pi) : x \neq 0, +\frac{\pi}{2} \right\}$ The sum of all distinct solutions of the equation $\sqrt{3} \sec x + \cos ecx + 2(\tan x - \cot x) = 0$ in the set S is equal to

A. $-\frac{7\pi}{9}$

B. $-\frac{2\pi}{9}$

C. 0

D. $\frac{5\pi}{9}$

Answer: C

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Archives Multiple Correct Answer Type

1. For $0 < \theta < \frac{\pi}{2}$, the solution (s) of

$$\sum_{m=1}^6 \cos ec\left(\theta + \left((m-1)\frac{\pi}{4}\right)\right) \cos ec\left(\theta + \frac{m\pi}{4}\right) = 4\sqrt{2}is(are) \quad (a) \frac{\pi}{4}$$

(b) $\frac{\pi}{6}$ (c) $\frac{\pi}{12}$ (d) $\frac{5\pi}{12}$

A. $\pi/4$

B. $\pi/6$

C. $\pi/12$

D. $5\pi/12$

Answer: C::D

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2. Let $\varphi, \phi \in [0, 2\pi]$ be such that $2 \cos \theta (1 - \sin \phi) = \sin^2 \theta \left(\frac{\tan \theta}{2} + \cot \theta / 2 \right) \cos \phi - 1$, $\tan(2\pi - \theta) > 0$ and $-1 < \sin \theta < -\frac{\sqrt{3}}{2}$ then φ lies between

A. $0 < \phi < \frac{\pi}{2}$

B. $\frac{\pi}{2} < \phi < \frac{4\pi}{3}$

C. $\frac{4\pi}{3} < \phi < \frac{3\pi}{2}$

D. $\frac{3\pi}{2} < \phi < 2\pi$

Answer: A::C::D

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Archives Linked Comprehension Type

1. Consider the statements : P : There exists some $x \in \mathbb{R}$ such that $f(x) + 2x = 2(1+x^2)$ Q : There exists some $x \in \mathbb{R}$ such that $2f(x) + 1 = 2x(1+x)$
 $f(x) = (1-x)^2 \sin^2 x + x^2 \quad \forall x \in \mathbb{R}$ Then (A) both P and Q are true

(B) P is true and Q is false (C) P is false and Q is true (D) both P and Q are false.

A. both P and Q are true

B. P is true and Q is false

C. P is false and Q is true

D. both P and Q are false

Answer: C



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Archives Matrix Match Type

1. Match the statements/expressions in List I with statements/expressions in List II.



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

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

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

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2. The number of values of θ in the interval $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ and $\theta \neq \frac{n\pi}{5}$ is where $n = 0, \pm 1, \pm 2$ and $\tan \theta = \cot(5\theta)$ and $\sin(2\theta) = \cos(4\theta)$ is

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3. The number of distinct solutions of the equation

$$\frac{5}{4}\cos^2 2x + \cos^4 x + \sin^4 x + \cos^6 x + \sin^6 x = 2$$

in the interval $[0, 2\pi]$ is

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4. Let a, b, c be three non-zero real numbers such that the equation $\sqrt{3} a \cos x + 2 b \sin x = c, x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$, has two distinct real roots α and β with $\alpha + \beta = \frac{\pi}{3}$. Then, the value of $\frac{b}{a}$ is _____.

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Single Correct Answer Type

1. The number of solutions of the equation $3^{2\sec^2 x} + 1 = 10 \cdot 3^{\tan^2 x}$ in the interval $[0, 2\pi]$ is

- A. 8
- B. 6
- C. 4
- D. 2

Answer: C



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2. If the sum of the roots of the equation $\sin^2 \theta = k$, ($0 < k < 1$) lying in $[0, 2\pi]$ is equal to the angles of a n -sided regular polygon, then the value of n is (a) 6 (b) 4 (c) 2 (d) none of these

A. 6

B. 4

C. 2

D. none of these

Answer: A



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3. The number of distinct of real roots of the equation $\tan^2 2x + 2 \tan 2x \tan 3x - 1 = 0$ in the interval $\left[0, \frac{\pi}{2}\right]$ is

A. 1

B. 2

C. 3

D. 4

Answer: C



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4. The number of solutions of equation

$$\cos 2x - 3 \cos x + 1 = \frac{1}{(\cot 2x - \cot x) \cdot \sin(x - \pi)} \text{ in } [0, 4\pi] \text{ is}$$

A. 0

B. 2

C. 4

D. 8

Answer: A



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5. The number of distinct real roots of the equation

$$\sqrt{\sin x} - \frac{1}{\sqrt{\sin x}} = \cos x \text{ (where } 0 \leq x \leq 2\pi \text{)} \text{ is}$$

A. 1

B. 2

C. 3

D. more than 3

Answer: B



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6. The number of distinct real roots of the equation

$$\sin^3 x + \sin^2 x + \sin x - 2 \cos x \sin^2 x - \sin 2x - 2 \cos x = 0 \text{ belonging}$$

to the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ is

A. (a) 0

B. (b) 1

C. (c) 2

D. (d) 3

Answer: B

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7. The number of solution of the equation $\sqrt{13 - 18 \tan x} = 6 \tan x - 3$,
where $-2\pi < x < 2\pi$ is

A. 0

B. 2

C. 4

D. 8

Answer: C



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8. The number of solutions of equation $\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1 + \sin \theta & 1 \\ 1 & 1 & 1 + \cot \theta \end{vmatrix} = 0$ in $\theta \in [0, 2\pi]$ is equal to

A. 2

B. 3

C. 4

D. 5

Answer: A



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9. The number of solution of the equation

$$|\cos x| = \cos x - 2 \sin x \text{ in } [0, 6\pi] \text{ is}$$

A. 3

B. 5

C. 7

D. 9

Answer: C



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10. The number of solutions of the equation

$$\log_5 \tan \theta = \log_5 4 \cdot \log_4 (3 \sin \theta) \text{ in } [0, 8\pi] \text{ is}$$

A. 0

B. 2

C. 4

D. none of these

Answer: C



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11. If $\log_{10}(\sin x) + \log_{10}(\tan y) + \log_{10} 2 = 0$ and $\cot y = 2\sqrt{3} \cos x$, then ordered pair (x, y) satisfying the equations simultaneously is(are)

(A) $\left(\frac{\pi}{3}, \frac{\pi}{3}\right)$ (B) $\left(\frac{\pi}{3}, \frac{\pi}{6}\right)$ (C) $\left(\frac{\pi}{6}, \frac{2\pi}{3}\right)$ (D) $\left(\frac{\pi}{3}, \frac{7\pi}{6}\right)$

A. 0

B. 2

C. 4

D. 8

Answer: C



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12. Find the general solution of the equation

$$3^{\sin 2x + 2 \cos^2 x} + 3^{1 - \sin 2x + 2 \sin^2 x} = 28$$

A. 3

B. 4

C. 5

D. 6

Answer: B



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13. If the equation $a \sin^3 x + (b - s)\sin^2 x + (c - b)\sin x = c = 0$ has exactly three distinct solutions in $[0, \pi]$, where $a + b + c = 0$, then which of the following is not the possible value of c/a ?

A. 1

B. $\frac{1}{4}$

C. $\frac{\sqrt{2}}{7}$

D. $\frac{2}{7}$

Answer: A



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14. The number of roots of the equation

$$\sin\left(2x + \frac{\pi}{18}\right)\cos\left(2x - \frac{\pi}{9}\right) = -\frac{1}{4} \text{ in } [0, 2\pi] \text{ is}$$

A. 2

B. 4

C. 6

D. 8

Answer: B



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15. The number of solution satisfying the equations $\tan 4\theta = \cot 5\theta$ and

$$\sin 2\theta = \cos \theta \text{ in } [0, 2\pi] \text{ is}$$

A. 2

B. 3

C. 4

D. 1

Answer: C



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16. If n_1 denotes the maximum number of roots of $\sin \theta = k_1$ in $[0, 2\pi]$ and n_2 denotes the maximum number of roots of $\cos \theta = k_2$ in $[0, 2\pi]$, then

A. $n_1 + n_2 = 5$

B. $n_1 + n_2 = 4$

C. $n_1 + n_2 = 6$

D. $n_1 + n_2 = 3$

Answer: A



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17. $\frac{\sin 3\theta}{2 \cos 2\theta + 1} = \frac{1}{2}$ if $(n \in \mathbb{Z})$

A. $\theta = 2n\pi + \frac{\pi}{6}$

B. $\theta = 2n\pi - \frac{\pi}{6}$

C. $\theta = n\pi + (-1)^n \frac{\pi}{6}$

D. $\theta = n\pi - \frac{\pi}{6}$

Answer: C



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18. The general solution of the equation

$$\frac{1 - \sin x + \dots + (-1)^n \sin^n x + \dots}{1 + \sin x + \dots + \sin^n x + \dots} = \frac{1 - \cos 2x}{1 + \cos 2x}$$
 is

A. $(-1)^n(\pi/6) + n\pi$

B. $(-1)^n(\pi/3) + n\pi$

C. $(-1)^{n+1}(\pi/6) + n\pi$

D. $(-1)^{n-1}(\pi/3) + n\pi, (n \in \mathbb{Z})$

Answer: A

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19. The general solution of the equation, $2 \cot. \frac{\theta}{2} = (1 + \cot \theta)^2$ is
($n \in \mathbb{Z}$)

A. $n\pi + (-1)^n \frac{\pi}{4}$

B. $n\pi + (-1)^n \frac{\pi}{6}$

C. $n\pi + (-1)^n \frac{\pi}{3}$

D. none of these

Answer: B



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20. If $\cos 2\theta = (\sqrt{2} + 1) \left(\cos \theta - \frac{1}{\sqrt{2}} \right)$, then the general value of $\theta (n \in Z)$

A. $2n\pi \pm \frac{\pi}{6}$

B. $n\pi + \frac{\pi}{12}$

C. $n\pi + \frac{7\pi}{36}$

D. none of these

Answer: D



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21. The number of solutions of the equation $16(\sin^5 x + \cos^5 x) = 11(\sin x + \cos x)$ in the interval $[0, 2\pi]$ is

A. 6

B. 7

C. 8

D. 9

Answer: A



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22. The sum of solutions of $\sin \pi x + \cos \pi x = 0$ in $[0, 100]$ is (a) 4375 (b) 4975 (c) 5000 (d) 5025

A. 4375

B. 4975

C. 5000

D. 5025

Answer: D



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23. If $(4 \cos^2 x - 2 \sin x - 3) \sin x = 0$, then x is equal to ($n \in \mathbb{Z}$)

A. (a) $n\pi + \left(\frac{3\pi}{10}\right)$

B. (b) $n\pi + (-1)^{n+1} \left(\frac{3\pi}{10}\right)$

C. (c) $n\pi - \left(\frac{3\pi}{10}\right)$

D. (d) none of these

Answer: B



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24. The number of solutions of the equation $\cos^2\left(\frac{\pi}{3}\cos x - \frac{8\pi}{3}\right) = 1$ in the interval $[0, 10\pi]$ is

A. 1

B. 3

C. 5

D. 7

Answer: C



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25. If $\alpha < \beta < \gamma$ and $\sin \gamma \cos \alpha = 1$, where $\alpha, \gamma \in [\pi, 2\pi]$, then the least integral value of $f(x) = |x - \alpha| + |x - \beta| + |x - \gamma|$ is

A. 0

B. 1

C. 2

D. 3

Answer: C



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26. solve the equation for x , $5^{\frac{1}{2}} + 5^{\frac{1}{2} + \log_5 \sin x} = 15^{\frac{1}{2} + \log_{15} \cos x}$

- A. 50
- B. 100
- C. 200
- D. 400

Answer: A



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27. Given $x + \sin y = 2009$ and $x + 2009 \cos y = 2008$, where $y \in \left[0, \frac{\pi}{2}\right]$,

then $[x+y]$ equals, where $[.]$ represents the greatest integer function,

- A. 2008
- B. 2009
- C. 2100
- D. 2010

Answer: B



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28. The number of solutions of equation $\sin. \frac{5x}{2} - \sin. \frac{x}{2} = 2$ in $[0, 2\pi]$

is

A. 0

B. 1

C. 2

D. 3

Answer: A



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29. Find the general solution of the trigonometric equation

$$3^{\left(\frac{1}{2} + \log_3(\cos x + \sin x)\right)} - 2^{\log_2(\cos x - \sin x)} = \sqrt{2}$$

A. $2n\pi + \frac{5\pi}{4}$

B. $n\pi - \frac{\pi}{4}$

C. $n\pi + (-1)^n \frac{\pi}{4}$

D. $2n\pi + \frac{\pi}{4}$

Answer: A



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30. If the equation $k \sin x + \sqrt{k-2} \cos x + (\tan \alpha + \cot \alpha) = 0$, $0 < \alpha < \frac{\pi}{2}$, possesses real solution, then k belongs to

A. $(-\infty, -3] \cup [2, \infty)$

B. $[-3, 2]$

C. $[0, 2)$

D. \mathbb{R}

Answer: A



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31. If the equation $x^2 + 12 + 3 \sin(a + bx) + 6x = 0$ has at least one real solution, where $a, b \in [0, 2\pi]$, then the value of $a - 3b$ is ($n \in \mathbb{Z}$)

A. $2n\pi$

B. $(2n + 1)\pi$

C. $(4n - 1)\frac{\pi}{2}$

D. $(4n + 1)\frac{\pi}{2}$

Answer: C



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32. The number of solutions of the equation $\sin x \cdot \sin 2x \cdot \sin 3x = 1$ in $[0, 2\pi]$ is

A. 0

B. 1

C. 2

D. 3

Answer: A



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33. The solution set of the system of equations

$$x + y = \frac{2\pi}{3}, \cos x + \cos y = \frac{3}{2}, \text{ where } x \text{ and } y \text{ are real, is } \underline{\hspace{2cm}}$$

A. $n\pi + (-1)^n \sin^{-1} \frac{3}{2} + \frac{\pi}{6}$

B. $2n\pi \pm \cos^{-1} \frac{3}{2} - \frac{\pi}{6}$

C. no solution

D. none of these

Answer: C

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34. The number of distinct real roots of the equation

$$\sin \pi x = x^2 - x + \frac{5}{4} \text{ is}$$

A. 0

B. 1

C. 2

D. 4

Answer: B

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35. The number of ordered 5-tuple (u, v, w, x, y) where

$(u, v, w, x, y \in [1, 11])$ which satisfy the inequality

$$2^{\sin^2 u} + 3^{\cos^2 v} \cdot 3^{\sin^2 w} + \cos^2 x \cdot 5^{\cos^2 y} \geq 720 \text{ is}$$

A. 216

B. 246

C. 432

D. 432

Answer: C



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36. The values of a for which the equation

$\sqrt{a} \sin x - 2 \cos x = \sqrt{2} + \sqrt{2 - a}$ has solutions are

A. $p > 0$

B. $p \leq 3$

C. $1 \leq p \leq 2$

D. $\sqrt{5} - 1 \leq p \leq 2$

Answer: D

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37. If $|\cos ecx| = \frac{5\pi}{4} - \left| \frac{x}{2} \right| \forall x \in (-2\pi, 2\pi)$, then the number of solutions are

A. 8

B. 6

C. 4

D. 2

Answer: A

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38. The number of solution of the equation $|\sin x| = |\cos 3x|$ in $[-2\pi, 2\pi]$ is

A. 32

B. 28

C. 24

D. 30

Answer: C

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39. If $6|\sin x| = x$ when $x \in [0, 2\pi]$, then the number of solutions are

A. 0

B. 3

C. 5

D. 4

Answer: D

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40. The number of solutions of equations $|\tan 2x| = \sin x$ in $[0, \pi]$

A. 2

B. 4

C. 6

D. 8

Answer: B



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41. The number of distinct real roots of the equation $x = \left(\frac{5\pi}{2}\right)^{\cos x}$

A. (a) 0

B. (b) 1

C. (c) 2

D. (d) 3

Answer: D



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42. If $\frac{\sin 3\theta}{\cos 2\theta} < 0$, then θ lies in

A. $\left((3\pi), (8), \frac{23\pi}{48} \right)$

B. $\left(\frac{7\pi}{24}, \frac{3\pi}{8} \right)$

C. $\left(\frac{13\pi}{48}, \frac{7\pi}{24} \right)$

D. $\left(\frac{2\pi}{4}, \frac{7\pi}{12} \right)$

Answer: C



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43. If $2 \sin^2 \left(x - \frac{\pi}{3} \right) - 5 \sin \left(x - \frac{\pi}{3} \right) + 2 < 0$, then belongs to

A. $\left(\frac{(12n - 5)\pi}{6}, \frac{(4n + 1)\pi}{2} \right), n \in Z$

B. $\left(\frac{(6n-7)\pi}{6}, \frac{(2n+1)\pi}{2}\right), n \in \mathbb{Z}$

C. $\left(\frac{(4n+1)\pi}{6}, n\pi\right), n \in \mathbb{Z}$

D. $\left((4n+1)\frac{\pi}{2}, (12n+7)\frac{\pi}{6}\right), n \in \mathbb{Z}$

Answer: D



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44. If equation $x^2 + 2x + 2 + e^\alpha - 2 \sin \beta = 0$ has a real solution in x , then (where $n \in \mathbb{Z}$)

A. $\alpha, \beta \in \mathbb{R}$

B. $\alpha \in (0, 1), \beta \in (\pi/6, \pi/2)$

C. $\alpha \in (0, 1), \beta \in (2n\pi + \pi/6, 2n\pi + 5\pi/6)$

D. $\alpha \in (-\infty, 0], \beta \in (2n\pi - \pi/6)$

Answer: C



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Subjective Type

1. Solve : If $\frac{1}{\cos \theta} + \frac{1}{\cos 3\theta} = \frac{1}{\cos 5\theta}$

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2. Solve : $3 - 2 \cos \theta - 4 \sin \theta - \cos 2\theta + \sin 2\theta = 0$.

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3. $3^{\left(\frac{1}{2} + \log_3 (\cos x + \sin x)\right)} - 2^{\log_2 (\cos x - \sin x)} = \sqrt{2}$

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4. Solve : $\cos 3x \cdot \cos^3 x + \sin 3x \cdot \sin^3 x = 0$

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

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6. Solve : $1 + 2\cos ecx = -\frac{\sec^2 \frac{x}{2}}{2}$

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7. Solve : $2\sin\left(3x + \frac{\pi}{4}\right) = \sqrt{1 + 8\sin 2x \cdot \cos^2 2x}, x \in (0, 2\pi)$

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8. Solve the following system of equations for x and y $5^{\cos ecx - 3\sec^2 y} = 1$
and $2^{2\cos ecx + \sqrt{3}|\sec y|} = 64$

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9. Solve : $2 + \tan x \cdot \cot \frac{x}{2} + \cot x \cdot \tan \frac{x}{2} = 0$.

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Multiple Correct Answers Type

1. If $\alpha \in [-2\pi, 2\pi]$ and $\cos \frac{\alpha}{2} + \sin \frac{\alpha}{2} = \sqrt{2}(\cos 36^\circ - \sin 18^\circ)$,

then a value of α

A. $\frac{7\pi}{6}$

B. $\frac{\pi}{6}$

C. $-\frac{5\pi}{6}$

D. $\frac{\pi}{6}$

Answer: A::D

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2. If $\sin\left(\frac{6}{5}x\right) = 0$ and $\cos\left(\frac{x}{5}\right) = 0$, then

A. $x = (n - 5)\pi$

B. $x = 6(n - 1)\pi$

C. $x = 5\left(n - \frac{1}{2}\right)\pi$

D. $x = 5\left(n + \frac{1}{2}\right)\pi$

Answer: C::D



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3. The equation $x^3 = \frac{3}{4}x = -\frac{\sqrt{3}}{8}$ is satisfied by $x = \cos\left(\frac{5\pi}{18}\right)$ (b)

$x = \cos\left(\frac{7\pi}{18}\right)$ $x = \cos\left(\frac{23\pi}{18}\right)$ (d) $x = \cos\left(\frac{17\pi}{18}\right)$

A. $x = \cos\left(\frac{5\pi}{18}\right)$

B. $x = \cos\left(\frac{7\pi}{18}\right)$

C. $x = \cos\left(\frac{23\pi}{18}\right)$

$$D. x = -\sin\left(\frac{7\pi}{9}\right)$$

Answer: A::B



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4. If $5 \sin x \cos y = 1$, $4 \tan x = \tan y$, then

$$A. x = (m + n)\frac{\pi}{2} + \frac{\pi}{4} + (-1)^m \frac{1}{2} \sin^{-1}\left(-\frac{3}{5}\right), m, n \in Z$$

$$B. y = (n - m)\frac{\pi}{2} + \frac{\pi}{4} + (-1)^{m+1} \frac{1}{2} \sin^{-1}\left(-\frac{3}{5}\right), m, n \in Z$$

$$C. x = (m + n)\frac{\pi}{2} + \frac{\pi}{4} + (-1)^m \frac{1}{2} \sin^{-1}\left(\frac{3}{5}\right), m, n \in Z$$

$$D. y = (n - m)\frac{\pi}{2} + \frac{\pi}{4} + (-1)^{m+1} \frac{1}{2} \sin^{-1}\left(\frac{3}{5}\right), m, n \in Z$$

Answer: A::B



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5. Which of the following are the solutions of equations

$$2 \sin 11x + \cos 3x + \sqrt{3} \sin 3x = 0?$$

A. $x = \frac{n\pi}{7} - \frac{\pi}{84}, n \in \mathbb{Z}$

B. $x = \frac{n\pi}{4} + \frac{7\pi}{48}, n \in \mathbb{Z}$

C. $x = \frac{n\pi}{7} - \frac{\pi}{63}, n \in \mathbb{Z}$

D. $x = \frac{n\pi}{4} + \frac{\pi}{24}, n \in \mathbb{Z}$

Answer: A:B



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6. The function $f(x) = \sqrt{3} \sin x - \cos x$ will increase monotonically in the interval(s)

A. $0 \leq x \leq \frac{\pi}{2}$

B. $-\frac{\pi}{3} \leq x \leq \frac{2\pi}{3}$

C. $\frac{5\pi}{3} \leq x \leq \frac{8\pi}{3}$

$$D. 0 \leq x \leq \pi$$

Answer: B::C



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7. If $\cos 3\theta + \sin 3\theta + (2 \sin 2\theta - 3)(\sin \theta - \cos \theta) > 0$, then θ lies in

A. $\left(2n\pi - \frac{3\pi}{4}, 2n\pi + \frac{\pi}{4}\right), n \in \mathbb{Z}$

B. $\left(2n\pi - \frac{\pi}{2}, 2n\pi + \frac{\pi}{6}\right), n \in \mathbb{Z}$

C. $\left(2n\pi - \frac{\pi}{3}, 2n\pi + \frac{\pi}{3}\right), n \in \mathbb{Z}$

D. $\left(2n\pi - \frac{\pi}{4}, 2n\pi + \frac{3\pi}{4}\right), n \in \mathbb{Z}$

Answer: A::B



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