1. If $\tan 15^\circ + \frac{1}{\tan 75^\circ} + \frac{1}{\tan 105^\circ} + \tan 195^\circ = 2a$, then the value of $\left(a + \frac{1}{a}\right)$ is :

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

(3) 2 (4) $5 - \frac{3}{2}\sqrt{3}$

2. If $\cot\alpha = 1$ and $\sec\beta = -\frac{5}{3}$, where $\pi < \alpha < \frac{3\pi}{2}$ and $\frac{\pi}{2} < \beta < \pi$, then the value of $\tan(\alpha+\beta)$ and the quadrant in which $\alpha+\beta$ lies, respectively are

(1) $-\frac{1}{7}$ and IV$^{\text{th}}$ quadrant (2) 7 and I$^{\text{st}}$ quadrant

(3) -7 and IV$^{\text{th}}$ quadrant (4) $\frac{1}{7}$ and I$^{\text{st}}$ quadrant

3. If $\frac{\sqrt{2}\sin\alpha}{\sqrt{1+\cos 2\alpha}} = \frac{1}{7}$ and $\sqrt{\frac{1-\cos 2\beta}{2}} = \frac{1}{\sqrt{10}}$, $\alpha, \beta \in \left(0, \frac{\pi}{2}\right)$, then $\tan(\alpha+2\beta)$, is equal to

4. The value of $\tan 9^\circ - \tan 27^\circ - \tan 63^\circ + \tan 81^\circ$ is _____.

5. The value of $36\left(4\cos^2 9^\circ - 1\right)\left(4\cos^2 27^\circ - 1\right)\left(4\cos^2 81^\circ - 1\right)\left(4\cos^2 243^\circ - 1\right)$ is

(1) 54 (2) 18

(3) 27 (4) 36

6. The value of $2\sin\left(\frac{\pi}{8}\right)\sin\left(\frac{2\pi}{8}\right)\sin\left(\frac{3\pi}{8}\right)\sin\left(\frac{5\pi}{8}\right)\sin\left(\frac{6\pi}{8}\right)\sin\left(\frac{7\pi}{8}\right)$ is :

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

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

7. The number of integral values of k for which the equation $3\sin x + 4\cos x = k+1$ has a solution, $k \in R$ is _____.

8. $16\sin(20^\circ)\sin(40^\circ)\sin(80^\circ)$ is equal to

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

(3) 3 (4) $4\sqrt{3}$

9. If $\sin^2(10^\circ)\sin(20^\circ)\sin(40^\circ)\sin(50^\circ)\sin(70^\circ) = \alpha - \frac{1}{16}\sin(10^\circ)$, then $16 + \alpha^{-1}$ is equal to _____.

10. The value of $\sin 10^\circ \sin 30^\circ \sin 50^\circ \sin 70^\circ$ is:

(1) $\frac{1}{36}$ (2) $\frac{1}{16}$

(3) $\frac{1}{18}$ (4) $\frac{1}{32}$

11. $96\cos\frac{\pi}{33}\cos\frac{2\pi}{33}\cos\frac{4\pi}{33}\cos\frac{8\pi}{33}\cos\frac{16\pi}{33}$ is equal to

(1) 3 (2) 1

(3) 4 (4) 2

12. Let $S = \left\{\theta \in \left(0, \frac{\pi}{2}\right) : \sum_{m=1}^{9} \sec\left(\theta + (m-1)\frac{\pi}{6}\right)\sec\left(\theta + \frac{m\pi}{6}\right) = -\frac{8}{\sqrt{3}}\right\}$. Then

(1) S $= \left\{\frac{\pi}{12}\right\}$ (2) $S = \left\{\frac{2\pi}{3}\right\}$

(3) $\sum_{\theta\in S}\theta = \frac{\pi}{2}$ (4) $\sum_{\theta\in S}\theta = \frac{3\pi}{4}$

13. The value of $\cot\frac{\pi}{24}$ is:

(1) $\sqrt{2}+\sqrt{3}+2-\sqrt{6}$ (2) $\sqrt{2}+\sqrt{3}+2+\sqrt{6}$

(3) $\sqrt{2}-\sqrt{3}-2+\sqrt{6}$ (4) $3\sqrt{2}-\sqrt{3}-\sqrt{6}$

14. The number of elements in the set $S = \{\theta \in [0, 2\pi] : 3\cos^4\theta - 5\cos^2\theta - 2\sin^6\theta + 2 = 0\}$ is

(1) 10 (2) 8

(3) 12 (4) 9

15. Let $S = \left\{x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) : 9^{1-\tan^2 x} + 9^{\tan^2 x} = 10\right\}$ and $\beta = \sum_{x\in S}\tan^2\left(\frac{x}{3}\right)$, then $\frac{1}{6}\left(\beta - 14\right)^2$ is equal to

(1) 16 (2) 8

(3) 64 (4) 32

16. The number of solutions of the equation $\cos\left(x + \frac{\pi}{3}\right)\cos\left(\frac{\pi}{3} - x\right) = \frac{1}{4}\cos^2 2x$, $x \in [-3\pi, 3\pi]$ is:

(1) 8 (2) 5

(3) 6 (4) 7

17. The number of elements in the set $S = \left\{x \in \mathbb{R} : 2\cos\left(\frac{x^2+x}{6}\right) = 4^x + 4^{-x}\right\}$ is

(1) 1 (2) 3

(3) 0 (4) infinite

18. The sum of all values of x in $[0, 2\pi]$, for which $\sin x + \sin 2x + \sin 3x + \sin 4x = 0$, is equal to :

(1) 8π (2) 11π

(3) 12π (4) 9π

19. The number of solutions of $\sin^7 x + \cos^7 x = 1$, $x \in [0,\ 4\pi]$ is equal to

(1) 11 (2) 7

(3) 5 (4) 9

20. If $0 < x, y < \pi$ and $\cos x + \cos y - \cos(x+y) = \frac{3}{2}$, then $\sin x + \cos y$ is equal to:

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

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

21. The number of solutions of the equation $2\theta - \cos^2\theta + \sqrt{2} = 0$ in R is equal to _____.

22. The number of solutions of the equation $x + 2\tan x = \frac{\pi}{2}$ in the interval $[0,\ 2\pi]$ is

(1) 3 (2) 4

(3) 2 (4) 5

23. Let $S = \{\theta \in [0, 2\pi) :\ \tan(\pi\cos\theta) + \tan(\pi\sin\theta) = 0\}$, then $\sum_{\theta\in S} \sin^2\left(\theta + \frac{\pi}{4}\right)$ is equal to

24. All the pairs $(x,\ y)$, that satisfy the inequality $2^{\sqrt{\sin^2 x - 2\sin x + 5}} \cdot \frac{1}{4^{\sin^2 y}} \le 1$ also satisfy the equation:

(1) $2\sin x = \sin y$ (2) $\sin x = 2\sin y$

(3) $|\sin x| = |\sin y|$ (4) $2|\sin x| = 3\sin y$

25. All possible values of $\theta \in [0, 2\pi]$ for which $\sin 2\theta + \tan 2\theta > 0$ lie in :

(1) $\left(0, \frac{\pi}{2}\right) \cup \left(\pi, \frac{3\pi}{2}\right)$ (2) $\left(0, \frac{\pi}{2}\right) \cup \left(\frac{\pi}{2}, \frac{3\pi}{4}\right) \cup \left(\pi, \frac{7\pi}{6}\right)$

(3) $\left(0, \frac{\pi}{4}\right) \cup \left(\frac{\pi}{2}, \frac{3\pi}{4}\right) \cup \left(\pi, \frac{5\pi}{4}\right) \cup \left(\frac{3\pi}{2}, \frac{7\pi}{4}\right)$ (4) $\left(0, \frac{\pi}{4}\right) \cup \left(\frac{\pi}{2}, \frac{3\pi}{4}\right) \cup \left(\frac{3\pi}{2}, \frac{11\pi}{6}\right)$