



MATHS

JEE (MAIN AND ADVANCED) MATHEMATICS

TRANSFORMATIONS AND IDENTITIES

Solved Examples

1. Prove that $4(\cos 66^\circ + \sin 84^\circ) = \sqrt{3} + \sqrt{15}$.

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2. Show that

$$\sin 34^\circ + \cos 64^\circ - \cos 4^\circ = 0$$

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3. Show that

$$\sin 78^\circ - \sin 18^\circ + \cos 132^\circ = 0$$



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4. Show that

$$\cos \theta + \cos(120^\circ + \theta) + \cos(240^\circ + \theta) = 0$$



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5. Show that

$$\cos 12^\circ + \cos 84^\circ + \cos 132^\circ + \cos 156^\circ = -\frac{1}{2}$$



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$$6. 4 \sin \frac{5\theta}{2} \cos \frac{3\theta}{2} \cos 3\theta =$$



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7. Prove that $4\cos 12^\circ \cos 48^\circ \cos 72^\circ - \cos 36^\circ$



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8. Prove that $\cos 20^\circ \cos 40^\circ \cos 60^\circ \cos 80^\circ = \frac{1}{16}$



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9. If $\cos x \cos y = a$ and $\sin x + \sin y = b$ then prove that

$$\sin(x + y) = \frac{2ab}{a^2 + b^2}$$



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10. If $\cos x \cos y = a$ and $\sin x + \sin y = b$ then prove that

$$\cos(x + y) = \frac{a^2 - b^2}{a^2 + b^2}$$



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11. If $\cos x + \cos y = a$ and $\sin x + \sin y = b$ then prove that

$$\tan(x + y) = \frac{2ab}{a^2 - b^2}$$



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12. If none of the denominators is zero, prove that.

$$\left(\frac{\cos A + \cos B}{\sin A - \sin B} \right)^n + \left(\frac{\sin A - \sin B}{\cos A + \cos B} \right)^n = \begin{cases} 2 \cot^n \left(\frac{A-B}{2} \right) & \text{if } n \text{ is even} \\ 0 & \text{if } n \text{ is odd} \end{cases}$$



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13.
$$\frac{\sin(n+1)\alpha - \sin(n-1)\alpha}{\cos(n+1)\alpha + 2\cos n\alpha + \cos(n-1)\alpha} =$$



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14. Suppose that $\alpha - \beta$ is not an odd multiple of $\frac{\pi}{2}$, $m \in \mathbb{R} - \{0, -1\}$

and $\frac{\sin(\alpha + \beta)}{\cos(\alpha - \beta)} = \frac{1 - m}{1 + m}$. Then show that

$$\tan\left(\frac{\pi}{4} - \alpha\right) = m \tan\left(\frac{\pi}{4} + \beta\right)$$



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15. If $A + B + C = \pi$ then prove that

$$\sin 2A - \sin 2B + \sin 2C = 4 \cos A \sin B \cos C$$



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16. If $A + B + C = \pi$ then prove that

$$\sin^2 \frac{A}{2} + \sin^2 \frac{B}{2} - \sin^2 \frac{C}{2} = 1 - 2 \cos \frac{A}{2} \cos \frac{B}{2} \sin \frac{C}{2}$$



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17. In triangle ABC, prove that

$$\sin \frac{A}{2} + \sin \frac{B}{2} - \sin \frac{C}{2} = -1 + 4 \cos \frac{\pi - A}{4} \cos \frac{\pi - B}{4} \sin \frac{\pi - C}{4}$$



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18. If $A+B+C = 2S$, then

P.T

$$\cos(S - A) + \cos(S - B) + \cos(S - C) + \cos S = 4 \cos \frac{A}{2} \cos \frac{B}{2} \cos \frac{C}{2}$$



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19. If $A + B + C + D = 360^\circ$ then show that

$$\sin A - \sin B + \sin C - \sin D = -4 \cos \left(\frac{A+B}{2} \right) \cos \left(\frac{A+D}{2} \right) \sin \left(\frac{A+C}{2} \right)$$



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Exercise 4 1 Very Short Answer Questions

1. Prove that $\sin 78^\circ + \cos 132^\circ = \frac{\sqrt{5}-1}{4}$.



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2. Prove that $\frac{\sin 70^\circ - \cos 40^\circ}{\cos 50^\circ - \sin 20^\circ} = \frac{1}{\sqrt{3}}.$



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3. Show that

$$\begin{aligned} \sin 10^\circ + \sin 20^\circ + \sin 40^\circ + \sin 50^\circ \\ = \sin 70^\circ + \sin 80^\circ \end{aligned}$$



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4. Prove that $\cos 48^\circ \cdot \cos 12^\circ = \frac{3 + \sqrt{5}}{8}.$



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5. Prove that

$$\cos 20^\circ \cos 40^\circ - \sin 5^\circ \sin 25^\circ = \frac{\sqrt{3} + 1}{4}$$



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6. Prove that $\sin 21^\circ \cos 9^\circ - \cos 84^\circ \cos 6^\circ = \frac{1}{4}$.



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7. Prove that $\cos^2 76^\circ + \cos^2 16^\circ - \cos 76^\circ \cos 16^\circ = \frac{3}{4}$



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Exercise 4 1 Short Answer Questions

1. If x, y, z are non zero real numbers and if $x \cos \theta = y \cos \left(\theta + \frac{2\pi}{3} \right) = z \cos \left(\theta + \frac{4\pi}{3} \right)$ for some $\theta \in R$ then show that $xy + yz + zx = 0$



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2. If $\sin x + \sin y = a$ and $\cos x + \cos y = b$ then find the values of $\tan \frac{x+y}{2}$, $\cot(x+y)$ and $\sin \frac{x-y}{2}$ in terms of a and b (given $a \neq 0 \neq b$)



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3. If $\cos x + \cos y = \frac{4}{5}$ and $\cos x - \cos y = \frac{2}{7}$, then the value of $14 \tan\left(\frac{x-y}{2}\right) + 5 \cot\left(\frac{x+y}{2}\right)$



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4. For any $\alpha \in R$, prove that $\cos^2\left(\alpha - \frac{\pi}{4}\right) + \cos^2\left(\alpha + \frac{\pi}{12}\right) - \cos^2\left(\alpha - \frac{\pi}{12}\right) = \frac{1}{2}$



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5. If none of $A, B, A+B$ is an integral multiple of π , then prove that

$$\frac{1 - \cos A + \cos B - \cos(A + B)}{1 + \cos A - \cos B - \cos(A + B)} = \tan. \frac{A}{2} \cot. \frac{B}{2}$$



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6. If $m \sin B = n \sin(2A + B)$ then show that

$$(m + n) \tan A = (m - n) \tan(A + B)$$



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7. If $\sin(y + z - x), \sin(z + x - y), \sin(x + y - z)$ are in A. P , then prove that $x, \tan y, \tan z$ are also in A.P.



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8. If $\sec(\theta + \alpha) + \sec(\theta - \alpha) = 2 \sec \theta$ and $\cos \alpha \neq 1$, prove that

$$\cos \theta = \pm \sqrt{\cos \frac{\alpha}{2}}$$

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9. Suppose that neither $A - 15^\circ$ nor $A - 75^\circ$ is an integral multiple of 180° . Then prove that $\cot(15^\circ - A) + \tan(15^\circ + A) = \frac{4 \cos 2A}{1 - 2 \sin 2A}$ and deduce that $\tan 15^\circ = 2 - \sqrt{3}$.

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Exercise 4 2 Long Answer Questions

1. If $A + B + C = 180^\circ$, then show that $\sin 2A + \sin 2B + \sin 2C = 4 \sin A \sin B \sin C$.

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2. If $A + B + C = 180^\circ$ then prove that the following:

$$\frac{\cos A}{\sin B \sin C} + \frac{\cos B}{\sin C \sin A} + \frac{\cos C}{\sin A \sin B} = 2$$

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3. If $A + B + C = 180^\circ$ then prove that the following:

$$\sin 2A + \sin 2B - \sin 2C$$

$$= 4 \cos A \cos B \sin C$$

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4. If $A + B + C = 180^\circ$, then show that

$$\cos 2B + \cos 2B + \cos 2C = -4 \cos A \cdot \cos B \cdot \cos C - 1.$$

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5. If $A + B + C = 180^\circ$ then prove that the following:

$$\cos 2A - \cos 2B + \cos 2C = 1 - 4 \sin A \cos B \sin C$$

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6. If $A + B + C = 180^\circ$ then prove that the following:

$$\begin{aligned}\cos 2A + \cos 2B - \cos 2C \\ = 1 - 4 \sin A \sin B \cos C\end{aligned}$$



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7. If $A + B + C = 180^\circ$ then prove that the following

$$\sin A + \sin B + \sin C = 4 \cos \frac{A}{2} \cos \frac{B}{2} \cos \frac{C}{2}$$



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8. If $A + B + C = 180^\circ$ then prove that the following

$$\cos A + \cos B + \cos C = 1 + 4 \sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2}$$



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9. IF A,B,C are angles in the triangle, then prove that

$$\cos A + \cos B - \cos C = -1 + 4 \cos \frac{A}{2} \cdot \cos \frac{B}{2} \cdot \sin \frac{C}{2}$$



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10. If A, B, C are angles in a triangle, then the

$$\sin^2 A + \sin^2 B - \sin^2 C = 2 \sin A \sin B \cos C$$



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11. If A, B, C are angles in a triangle, then prove that

$$\sin^2 A + \sin^2 B + \sin^2 C = 2 + 2 \cos A \cos B \cos C$$



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12. If A, B, C are angles in a triangle, then prove that

$$\cos^2 A + \cos^2 B - \cos^2 C = 1 - 2 \sin A \sin B \cos C.$$

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13. If $A + B + C = \pi$, then prove that

$$\cos^2\left(\frac{A}{2}\right) + \cos^2\left(\frac{B}{2}\right) + \cos^2\left(\frac{C}{2}\right) = 2\left(1 + \sin.\frac{A}{2}\sin.\frac{B}{2}\sin.\frac{C}{2}\right)$$

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14. If $A, B, C = \pi$, then prove that

$$\cos^2.\frac{A}{2} + \cos^2.\frac{C}{2} - \cos^2.\frac{C}{2} = 2\left(\cos.\frac{A}{2}\cos.\frac{B}{2}\sin.\frac{C}{2}\right)$$

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15. If A, B, C are the angles in a triangle then prove that

$$\sin.\frac{A}{2} + \sin.\frac{B}{2} + \sin.\frac{C}{2} = 1 + 4\sin\left(\frac{\pi - A}{4}\right)\sin\left(\frac{\pi - B}{4}\right)\sin\left(\frac{\pi - C}{4}\right)$$

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16. If $A + B + C = 180^\circ$ then prove the following:

$$\begin{aligned} & \cos \frac{A}{2} + \cos \frac{B}{2} + \cos \frac{C}{2} \\ &= 4 \cos \left(\frac{\pi - A}{4} \right) \cos \left(\frac{\pi - B}{4} \right) \cos \left(\frac{\pi - C}{4} \right) \end{aligned}$$



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17. In ΔABC , prove that

$$\cos \frac{A}{2} + \cos \frac{B}{2} - \cos \frac{C}{2} = 4 \cos \frac{\pi + A}{4} \cos \frac{\pi + B}{4} \cos \frac{\pi - C}{4}$$



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18. If $A + B + C = 90^\circ$ then prove that

$$\sin 2A + \sin 2B + \sin 2C = 4 \cos A \cos B \cos C$$



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19. If $A + B + C = \frac{\pi}{2}$, then prove that
 $\cos 2A + \cos 2B + \cos 2C = 1 + 4 \sin A \sin B \sin C$.



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20. If $A + B + C = \frac{\pi}{2}$, then prove that
 $\sin^2 A + \sin^2 B + \sin^2 C = 1 - 2 \sin A \sin B \sin C$.



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21. If $A + B + C = 270^\circ$ then show that

$$\cos^2 A + \cos^2 B - \cos^2 C + 2 \cos A \cos B \sin C = 0$$



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22. If $A + B + C = 270^\circ$ then show that

$$\sin 2A + \sin 2B - \sin 2C = -4 \sin A \sin B \cos C$$

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23. If $A + B + C = 180^\circ$ then prove that the following:

$$\cos 2A + \cos 2B - \cos 2C$$

$$= 1 - 4 \sin A \sin B \cos C$$

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24. If $A + B + C = 2S$ then prove that the following:

$$\cos(S - A) + \cos(S - B) + \cos C$$

$$= 4 \cos\left(\frac{S - A}{2}\right) \cos\left(\frac{S - B}{2}\right) \frac{\cos C}{2} - 1$$

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25. If $A + B + C = 2S$, then prove that

$$\sin(S - A) + \sin(S - B) + \sin C = 4 \cos\left(\frac{S - A}{2}\right) \cos\left(\frac{S - B}{2}\right) \frac{\sin C}{2}$$

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26. If $A + B + C = 0$, then prove that

$$\cos^2 A + \cos^2 B + \cos^2 C = 1 + 2 \cos A \cos B \cos C$$


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27. If $A + B + C = 0$, then prove that

$$\sin 2A + \sin 2B + \sin 2C = -4 \sin A \sin B \sin C.$$


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28. If $A + B + C = 0^\circ$ then prove that

$$\sin A + \sin B - \sin C = -4 \cos \frac{A}{2} \cos \frac{B}{2} \sin \frac{C}{2}$$



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29. If $A + B + C + D = 360^\circ$, then prove that

$$\cos 2A + \cos 2B + \cos 2C + \cos 2D = 4 \cos(A + B) \cos(A + C) \cos(A + D)$$


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30. If $A + B + C + D = 360^\circ$ then prove the following: $\sin A - \sin B + \sin C - \sin D = -4 \cos(A+B)/2 \sin(A+C)/2 \cos(A+D)/2$



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Additional Exercise

1.

$$\cos(B + C - A) - \cos(C + A - B) + \cos(A + B - C) - \cos(A + B + C)$$



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2. If $\cos A = \frac{3}{4}$ then show that $\sin \frac{A}{2} \sin \frac{5A}{2} = \frac{11}{32}$.



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3. Show that

$$\cot(A + 15^\circ) - \tan(A - 15^\circ) = \frac{4 \cos 2A}{1 + 2 \sin 2A} \quad \text{deduce} \quad \text{that}$$

$$\cot 15^\circ = 2 + \sqrt{3}$$



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4. Prove that

$$\begin{aligned} & \cos \alpha + \cos \beta + \cos \gamma + \cos(\alpha + \beta + \gamma) \\ &= 4 \cos \left(\frac{\alpha + \beta}{2} \right) \cos \left(\frac{\beta + \gamma}{2} \right) \cos \left(\frac{\gamma + \alpha}{2} \right) \end{aligned}$$



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5. Prove that

$$\begin{aligned} &1 + \cos 2x + \cos 4x + \cos 6x \\ &= 4 \cos x \cos 2x \cos 3x \end{aligned}$$



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6. Prove that

$$\frac{(\cos \theta - \cos 3\theta)(\sin 8\theta + \sin 2\theta)}{(\sin 5\theta - \sin \theta)(\cos 4\theta - \cos 6\theta)} = 1$$



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7. Prove that

$$\frac{\sin \alpha + \sin 2\alpha + \sin 3\alpha + \sin 4\alpha}{\cos \alpha + \cos 2\alpha + \cos 3\alpha + \cos 4\alpha} = \tan\left(\frac{5\alpha}{2}\right)$$



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8. Prove that

$$2\cos\frac{\pi}{13}\cos\frac{9\pi}{13} + \cos\frac{3\pi}{13} + \cos\frac{5\pi}{13} = 0$$



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9. Prove that

$$\sin 55^\circ - \sin 19^\circ + \sin 53^\circ - \sin 17^\circ = \cos 1^\circ$$



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10. If $A + B + C = 180^\circ$ then prove that

$$\cos^2 A + \cos^2 B - \cos^2 C = 1 - 2 \sin A \sin B \cos C$$



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11. If $A + B + C = 180^\circ$ then prove that

$$\cos^2 A + \cos^2 B + \cos^2 C = 1 - 2 \cos A \cos B \cos C$$

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12. If $A + B + C = 180^\circ$ then prove that

$$\begin{aligned} & \sin \frac{A}{2} + \sin \frac{B}{2} + \sin \frac{C}{2} \\ &= 1 + 4 \sin \left(\frac{\pi - A}{4} \right) \sin \left(\frac{\pi - B}{4} \right) \cos \left(\frac{\pi - C}{4} \right) \end{aligned}$$

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13. If $A + B + C = 0$ then show that

$$1 + \cos A + \cos B + \cos C = 4 \cos \frac{A}{2} \cos \frac{B}{2} \cos \frac{C}{2}$$

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14. Prove that

$$\cos^2 \theta \sin^3 \theta = \frac{1}{16} (2 \sin \theta + \sin 3\theta - \sin 5\theta)$$

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15. Given $\alpha + \beta - \gamma = \pi$ and

$\sin^2 \alpha + \sin^2 \beta - \sin^2 \gamma = \lambda \sin \alpha \sin \beta \cos \gamma$ then find the value of
lambda



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16. If $2 \cos \theta + 2 \cos 3\theta = \cos \alpha$ and $2 \sin \theta + 2 \sin 3\theta = \sin \alpha$ then show
that $\cos 2\theta = -\frac{7}{8}$



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17. Show that $\tan 20^\circ + 4 \sin 20^\circ = (\sqrt{3})$



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18. Show that

$$\cos \frac{\pi}{65} \cos \frac{2\pi}{65} \cos \frac{4\pi}{65} \cos \frac{8\pi}{65} \cos \frac{16\pi}{65} \cos \frac{32\pi}{65} = \frac{1}{64}$$



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Exercise I

1. $\cos 20^\circ \cos 40^\circ - \sin 5^\circ \sin 25^\circ =$

A. 0

B. $\frac{\sqrt{3} + 1}{4}$

C. $\frac{\sqrt{3} - 1}{2}$

D. $\frac{\sqrt{3} - 1}{4}$

Answer: B



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2. $\sin 21^\circ \cos 9^\circ - \cos 84^\circ \cos 6^\circ =$

A. $1/4$

B. $1/8$

C. $3/2$

D. $3/8$

Answer: A



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3. $\frac{\sin 9^\circ - \cos 9^\circ}{\sin 48^\circ \sin 12^\circ} =$

A. 0

B. 1

C. -1

D. 2

Answer: B



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4. $\sin 47^\circ + \sin 61^\circ - \sin 11^\circ - \sin 25^\circ =$

A. $\sin 7^\circ$

B. $\cos 7^\circ$

C. $\tan 7^\circ$

D. $\sin 14^\circ$

Answer: B



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5. $\frac{\sin 70^\circ + \cos 40^\circ}{\cos 70^\circ + \sin 40^\circ} =$

A. 3

B. $\sqrt{3}$

C. $\frac{1}{\sqrt{3}}$

D. $1/2$

Answer: B



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6. $A + C = 2B$ then $\frac{\cos C - \cos A}{\sin A - \sin C} =$

A. $\cot B$

B. $\cot 2B$

C. $\tan 2B$

D. $\tan B$

Answer: D



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7. $\cos 12^\circ + \cos 84^\circ + \cos 132^\circ + \cos 156^\circ =$

A. $\frac{1}{2}$

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

C. $-\frac{1}{4}$

D. $-\frac{1}{2}$

Answer: D



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8. If $\sin x + \sin y = \frac{1}{4}$, $\cos x + \cos y = \frac{1}{3}$ then $\tan\left(\frac{x+y}{2}\right) =$

A. $1/4$

B. $1/2$

C. $3/4$

D. None

Answer: C



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9. $\left(\frac{\cos A + \cos B}{\sin A - \sin B}\right)^{2012} + \left(\frac{\sin A + \sin B}{\cos A - \cos B}\right)^{2012} =$

A. $2 \cos^{2012}\left(\frac{A+B}{2}\right)$

B. $2 \cot^{2012}\left(\frac{A-B}{2}\right)$

C. $2 \tan^{2012}\left(\frac{A+B}{2}\right)$

D. $2 \tan^{2012}\left(\frac{A-B}{2}\right)$

Answer: B



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10. If $\alpha + \beta = \gamma$. then $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma - 2 \cos \alpha \cos \beta \cos \gamma =$

A. 1

B. 0

C. -1

D. 2

Answer: A



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11. If $A + B + C = 270^\circ$ then

$$\cos 2A + \cos 2B = \cos 2C + 4 \sin A \sin B \sin C =$$

A. 0

B. 1

C. 2

D. 3

Answer: B



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12.

$$\cos(\alpha + \beta + \gamma) + \cos(\alpha - \beta - \gamma) + \cos(\beta - \gamma - \alpha) + \cos(\gamma - \alpha - \beta) =$$

A. $2 \cos \alpha \cos \beta \cos \gamma$

B. $3 \cos \alpha \cos \beta \cos \gamma$

C. $4 \cos \alpha \cos \beta \cos \gamma$

D. $6 \cos \alpha \cos \beta \cos \gamma$

Answer: C



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13. $\cos \alpha \sin(\beta - \gamma) + \cos \beta \sin(\gamma - \alpha) + \cos \gamma \sin(\alpha - \beta) =$

A. 1

B. $4 \cos \alpha \cos \beta \cos \gamma$

C. 0

D. $1/2$

Answer: C



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14. If $\sin A + \sin B = l$ and $\cos A - \cos A - \cos B = m$, then $\cos(A - B) =$

A. $\frac{l^2 - m^2}{l^2 + m^2}$

B. $\frac{l^2 + m^2}{l^2 - m^2}$

C. $\frac{2lm}{l^2 + m^2}$

D. $\frac{2lm}{l^2 - m^2}$

Answer: A



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15. If $A + B + C = 270^\circ$ then $\cos 2A + \cos 2B + \cos 2C =$

A. $1 - 4 \sin A \sin B \sin C$

B. $1 - 4 \cos A \cos B \cos C$

C. $4 \sin A \sin B \sin C$

D. $1 + 2 \cos A \cos B \cos C$

Answer: A



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Exercise II

1. If $2 \cos x + 2 \cos 3x = \cos y$ and $2 \sin x + 2 \sin 3x = \sin y$ then $\cos 2x =$

A. $-7/8$

B. $-1/8$

C. $1/8$

D. $7/8$

Answer: A



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2.

$$\frac{1 + \cos 56^\circ + \cos 58^\circ - \cos 66^\circ}{\cos 28^\circ \cos 29^\circ \sin 33^\circ} = k \cos\left(\frac{A}{2}\right) \cos\left(\frac{B}{2}\right) \sin\left(\frac{C}{2}\right) \text{ then } k =$$

A. 0

B. 2

C. 4

D. 1

Answer: C



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3. $\frac{\cos 20^\circ + 8 \sin 10^\circ \sin 50^\circ \sin 70^\circ}{\sin^2 80^\circ} =$

A. 1

B. 2

C. 3

D. 4

Answer: B



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4.
$$\frac{\sin 5\alpha - \sin 3\alpha}{\cos 5\alpha + 2 \cos 4\alpha + \cos 3\alpha} =$$

A. $\cos \alpha / 2$

B. $\cot \alpha$

C. $\tan \alpha / 2$

D. None

Answer: C



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5. If $\cos A = \frac{3}{4}$ then $32\sin\frac{A}{2} \cdot \sin\frac{5A}{2} =$

A. 10

B. -10

C. 11

D. 13

Answer: C



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6.
$$\frac{(\cos \alpha - \cos 3\alpha)(\sin 8\alpha + \sin 2\alpha)}{(\sin 5\alpha - \sin \alpha)(\cos 4\alpha - \cos 6\alpha)} =$$

A. -1

B. -2

C. 2

D. 1

Answer: D



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7. If $3 \sin \alpha = 5 \sin \beta$ then $\frac{\tan\left(\frac{\alpha+\beta}{2}\right)}{\tan\left(\frac{\alpha-\beta}{2}\right)} =$

A. 1

B. 2

C. 3

D. 4

Answer: D



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8. $m \tan(\theta - 30) = n \tan(\theta + 120)$ then $\frac{m+n}{m-n} =$

A. $\cos 2\theta$

B. $2 \cos 2\theta$

C. $\sin 2\theta$

D. $2 \sin 2\theta$

Answer: B



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9. If $\frac{x}{y} = \frac{\cos A}{\cos B}$ then $\frac{x \tan nA + y \tan B}{x + y}$ is equal to

A. $\cot\left(\frac{A + B}{2}\right)$

B. $\tan\left(\frac{A + B}{2}\right)$

C. $\cot(A + B)$

D. $\tan(A + B)$

Answer: B



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10. If $\frac{\cos(\theta_1 - \theta_2)}{\cos(\theta_1 + \theta_2)} + \frac{\cos(\theta_3 + \theta_4)}{\cos(\theta_3 - \theta_4)} = 0$ then

$\tan \theta_1 \cdot \tan \theta_2 \cdot \tan \theta_3 \cdot \tan \theta_4 =$

A. 1

B. 2

C. -1

D. 0

Answer: C



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11. If $\cos 2B = \frac{\cos(A + C)}{\cos(A - C)}$, then $\tan A, \tan B, \tan C$ are in

A. A.P

B. G.P

C. H.P

D. A.G.P

Answer: B



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12. $\sin \alpha = \sin \beta$, $\cos \alpha = \cos \beta$ then

A. $\sin\left(\frac{\alpha + \beta}{2}\right) = 0$

B. $\cos\left(\frac{(\alpha + \beta)}{2}\right) = 0$

C. $\sin\left(\frac{(\alpha - \beta)}{2}\right) = 0$

D. $\cos\left(\frac{(\alpha - \beta)}{2}\right) = 0$

Answer: C



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13. The value of $\sin x + \sin y = a$ and $\cos x + \cos y = b$ then $\cos(x - y) =$

A. $\frac{a^2 + b^2 + 2}{2}$

B. $\frac{a^2 - b^2 + 2}{2}$

C. $\frac{a^2 + b^2 - 2}{2}$

D. $\frac{b^2 - a^2 + 2}{2}$

Answer: C



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14. $\frac{\sin 7\theta + 6 \sin 5\theta + 17 \sin 3\theta + 12 \sin \theta}{\sin 6\theta + 5 \sin 4\theta + 12 \sin 2\theta}$

A. $2 \cos \theta$

B. $\cos \theta$

C. $2 \sin \theta$

D. $\sin \theta$

Answer: A



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15. If $\alpha + \beta + \gamma = 2\theta$ then

$$\cos \theta + \cos(\theta - \alpha) + \cos(\theta - \beta) + \cos(\theta - \gamma) =$$

A. $4\sin \frac{\alpha}{2} \cdot \cos \frac{\beta}{2} \cdot \sin \frac{\gamma}{2}$

B. $4\cos \frac{\alpha}{2} \cdot \cos \frac{\beta}{2} \cdot \cos \frac{\gamma}{2}$

C. $4\sin \frac{\alpha}{2} \cdot \sin \frac{\beta}{2} \sin \frac{\gamma}{2}$

D. $4 \sin \alpha \cdot \sin \beta \cdot \sin \gamma$

Answer: B



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16. If $A + B + C = 2S$ then

$$\cos^2 S + \cos^2(S - A) + \cos^2(S - B) + \cos^2(S - C) =$$

A. $2 \sin A + \cos B \sin C$

B. $4 \cos A / 2 \cos B / 2 \cos C / 2$

C. $2 + 2 \cos A \cos B \cos C$

D. $\sin A \sin B$

Answer: C



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17. If $A + B + C = 180^\circ$, then $\sin 2A + \sin 2B - \sin 2C =$

A. $4 \sin A \cos B \sin C$

B. $4 \cos A \sin B \sin C$

C. $4 \cos A \cos B \sin C$

D. $4 \cos A \sin B \cos C$

Answer: C



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18. If $A + B + C = 90^\circ$ then $\cos^2 A + \cos^2 B + \cos^2 C =$

A. $1 - \cos A \cos B \cos C$

B. $1 + 2 \cos A \cos B \cos C$

C. $2(1 + \cos A \cos B \cos C)$

D. None

Answer: B



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19. If $A + B + C = 90^\circ$ then $\sin^2 A + \sin^2 B + \sin^2 C =$

A. $1 - 2 \sin A \sin B \sin C$

B. $1 + 2 \sin A \sin B \sin C$

C. $1 + 2 \cos A \cos B \cos C$

D. $1 - 2 \cos A \cos B \cos C$

Answer: A



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20. If $A + B + C = 90^\circ$ then $\cos^2 A + \cos^2 B + \cos^2 C =$

A. $1 + 2 \cos A \cos B \cos C$

B. $1 + 2 \sin A \sin B \sin C$

C. $2(1 + \cos A \cos B \cos C)$

D. $2(1 + \sin A \sin B \sin C)$

Answer: D



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21. If $A + B + C = 180^\circ$ then $\cos 2A + \cos 2B + \cos 2C + 1 =$

A. $-4 \sin A \sin B \sin C$

B. $-4 \cos A \cos B \sin C$

C. $-4 \cos A \cos B \cos C$

D. $-4 \sin A \cos B \sin C$

Answer: C



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22. If $A + B + C = 180^\circ$ then

$$\frac{\sin 2A + \sin 2B + \sin 2C}{\cos A + \cos B + \cos C - 1} =$$

A. $4 \cos A / 2 \cos B / 2 \cos C / 2$

B. $4 \sin A / 2 \sin B / 2 \sin C / 2$

C. $8 \cos A / 2 \cos B / 2 \cos C / 2$

D. $1 + 4 \sin A / 2 \sin B / 2 \sin C / 2$

Answer: C

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23. $\cos x + \cos y = \frac{1}{3}$, $\sin nx + \sin y = \frac{1}{4}$ then $\sin(x + y) =$

A. $\frac{7}{25}$

B. $\frac{24}{25}$

C. $\frac{25}{24}$

D. $\frac{25}{7}$

Answer: B

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24. Statement I: If $A + B + C = \pi$ and $\cos A = \cos B \cos C$ then $\cot B \cot C = \frac{1}{3}$

Statement II: If $5 \sin B = \sin(2A + B)$ then $2 \tan(A + B) = 3 \tan A$

Which of the above statements is correct?

A. only I

B. only II

C. Both I and II

D. Neither I nor II

Answer: B



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25. $A = \cos 20^\circ \cos 40^\circ \cos 60^\circ \cos 80^\circ$,

$B = \cos 6^\circ \cos 42^\circ \cos 66^\circ \cos 78^\circ$ and

$C = \cos 36^\circ \cos 72^\circ \cos 108^\circ \cos 144^\circ$ then

A. $A > B > C$

B. $B > C > A$

C. $C > A > B$

D. $A = B = C$

Answer: D



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26. Assertion (A): If $x + y + z = xyz$ then

$$\sum \left(\frac{2x}{1-x^2} \right) = \pi \left(\frac{2x}{1-x^2} \right)$$

Reason (R): If $\tan A + \tan B + \tan C = \tan A \tan B \tan C$ then

$$A + B + C = n\pi, n \in \mathbb{N}$$

A. A is true, R is true and R is correct explanation of A

B. A is true, R is true and R is not correct explanation of A

C. A is true, R is false

D. A is false, R is true.

Answer: A



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27. If $\cos x + \cos y + \cos \alpha = 0$,

$\sin x + \sin y + \sin \alpha = 0$

then $\cot\left(\frac{x+y}{2}\right) =$

A. $\sin \alpha$

B. $\cos \alpha$

C. $\tan \alpha$

D. $\cot \alpha$

Answer: D



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Practive Exercise

1. $\cos 70^\circ + \sin 40^\circ =$

A. $\sin 10^\circ$

B. $\cos 10^\circ$

C. $\tan 10^\circ$

D. $\cot 10^\circ$

Answer: B



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2. $\cos(36^\circ - A)\cos(36^\circ + A) + \cos(54^\circ + A)\cos(54^\circ - A) =$

A. 0

B. $\sin 2A$

C. $\cos 2A$

D. 1

Answer: C



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3. $2(1 - 2\sin^2 7\theta)\sin 3\theta =$

A. $\sin 11\theta - \sin 17\theta$

B. $\sin 17\theta - \sin 11\theta$

C. $\cos 17\theta - \cos 11\theta$

D. $\cos 17\theta + \cos 11\theta$

Answer: B



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4. $\frac{\cos 8A \cos 5A - \cos 12A \cos 9A}{\sin 8A \cos 5A + \cos 12A \sin 9A} =$

A. $\tan 2A$

B. $\tan 4A$

C. $\cot 2A$

D. $\cot 4A$

Answer: B



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5. $\frac{\sin 3\theta + \sin 5\theta + \sin 7\theta + \sin 9\theta}{\cos 3\theta + \cos 5\theta + \cos 7\theta + \cos 9\theta}$ is equal to

A. $\tan 4\theta$

B. $\tan 6\theta$

C. $\tan 2\theta$

D. $\cot 6\theta$

Answer: B



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6. The value of $\frac{2(\sin 2\theta - 2\cos^2 \theta - 1)}{\cos \theta - \sin \theta - \cos 3\theta + \sin 3\theta} =$

A. $\cos \theta$

B. $\sec \theta$

C. $\cos \theta$

D. $\sin \theta$

Answer: C



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7. The value

$$\frac{\cos(A + B + C) + \cos(A - B - C)}{2 \cos(B + C)}$$

A. $\cos A$

B. $\sin A$

C. $2 \cos A$

D. $2 \sin A$

Answer: A



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8. $\left(\frac{\cos A + \cos B}{\sin A - \sin B}\right)^{2013} + \left(\frac{\sin A + \sin B}{\cos A - \cos B}\right)^{2013} =$

A. 1

B. -1

C. 0

D. 2

Answer: C



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9. $\sin 10^\circ + \sin 20^\circ + \sin 40^\circ + \sin 50^\circ - \sin 70^\circ - \sin 80^\circ =$

A. 0

B. $1/2$

C. $3/4$

D. $-1/2$

Answer: A



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10. $\sin 12^\circ \sin 48^\circ \sin 54^\circ =$

A. $1/2$

B. $1/4$

C. $1/8$

D. None

Answer: C



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11. $1 + \cos 2x + \cos 4x + \cos 6x - 4 \cos x \cos 2x \cos 3x =$

A. 1

B. -1

C. 2

D. 0

Answer: D



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12.
$$\frac{\cos 6x + 6 \cos 4x + 15 \cos 2x + 10}{\cos 5x + 5 \cos 3x + 10 \cos x} =$$

A. $\cos x$

B. $\sin x$

C. $2 \sin x$

D. $2 \cos x$

Answer: D



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13. The value of $\cos 20^\circ + 2 \sin^2 55^\circ - 1 - \sqrt{2} \sin 65^\circ =$

A. 0

B. 1

C. -1

D. $\frac{1}{2}$

Answer: A



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14. If $A + B + C = 90^\circ$ then

$$\frac{\cos 2A + \cos 2B + \cos 2C - 1}{\sin A \sin B \sin C} =$$

A. 2

B. 4

C. 3

D. 1

Answer: B



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15. If $x + y + z = 180^\circ$ then $\frac{\sin x + \sin y + \sin z}{\cos \frac{x}{2} \cdot \cos \frac{y}{2} \cdot \cos \frac{z}{2}} =$

A. 0

B. 3

C. 2

D. 4

Answer: D



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16. If $\alpha = \frac{\pi}{21}$ then $\frac{\sin 3\alpha + \sin 7\alpha}{\sin 24\alpha + \sin 14\alpha} =$

A. 0

B. 1

C. -1

D. 2

Answer: C



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17. If $\frac{\sin A - \sin C}{\cos C - \cos A} = \cot B$ then angles A,B,C are in

A. A.P

B. G.P

C. H.P

D. A.G.p

Answer: A



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18. $\sin x + \sin y = \frac{3}{4}$ and $\sin x - \sin y = \frac{2}{5}$ then $\frac{\tan\left(\frac{x-y}{2}\right)}{\tan\left(\frac{x+y}{2}\right)} =$

A. $\frac{15}{8}$

B. $\frac{8}{15}$

C. $\frac{3}{10}$

D. $\frac{10}{3}$

Answer: B



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19.

$$\tan \theta \tan(\theta + 60^\circ) + \tan \theta \tan(\theta - 60^\circ) + \tan(\theta + 60^\circ) \tan(\theta - 60^\circ) = 0$$

A. 0

B. -1

C. -2

D. -3

Answer: D



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20. $\cos(x - y) = 3 \cos(x + y)$ then $\cot x \cot y =$

A. 1

B. 2

C. 3

D. 4

Answer: B



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21. $\frac{\sin(\alpha + \beta)}{\sin(\alpha - \beta)} = \frac{a + b}{a - b}$ then $\frac{\tan \alpha}{\tan \beta} =$

A. $\frac{a}{b}$

B. $\frac{b}{a}$

C. $\frac{a}{2b}$

D. $\frac{2a}{b}$

Answer: A



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22. If $\sin 2x = n \sin 2y$ then $\frac{\tan(x + y)}{\tan(x - y)} =$

A. $\frac{n - 1}{n + 1}$

B. $\frac{1 - n}{1 + n}$

C. $\frac{1 + n}{1 - n}$

D. $\frac{n + 1}{n - 1}$

Answer: D



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23. If $\tan \beta = \cos \theta \tan \alpha$ then $\cot^2 \frac{\theta}{2} =$

A. $\frac{\sin(\alpha + \beta)}{\sin(\alpha - \beta)}$

B. $\frac{\sin(\alpha - \beta)}{\sin(\alpha + \beta)}$

C. $\frac{\cos(\alpha + \beta)}{\cos(\alpha - \beta)}$

D. $\frac{\cos(\alpha - \beta)}{\cos(\alpha + \beta)}$

Answer: A



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24. If $\tan \theta_1 = k \cot \theta_2$ then $\frac{\cos(\theta_1 + \theta_2)}{\cos(\theta_1 - \theta_2)} =$

A. $\frac{1 + k}{1 - k}$

B. $\frac{1 - k}{1 + k}$

C. $\frac{k + 1}{k - 1}$

D. $\frac{k - 1}{k + 1}$

Answer: B



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25. If $\cos \theta = \frac{\cos \alpha - \cos \beta}{1 - \cos \alpha \cos \beta}$ then $\tan^2 \left(\frac{\theta}{2} \right) \tan^2 \left(\frac{\beta}{2} \right) =$

A. $\tan \frac{\alpha}{2}$

B. $\tan^2 \frac{\alpha}{2}$

C. $\cot \frac{\alpha}{2}$

D. $\cot^2 \frac{\alpha}{2}$

Answer: B



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26. If $\cos \theta = \frac{a \cos \phi + b}{a + b \cos \phi}$ then $\frac{\tan \frac{\theta}{2}}{\tan \frac{\phi}{2}} =$

- A. $\frac{a - b}{a + b}$
- B. $\frac{a + b}{a - b}$
- C. $\sqrt{\frac{a + b}{a - b}}$
- D. $\sqrt{\frac{a - b}{a + b}}$

Answer: D



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27. In ΔABC , $\frac{\sin 2A + \sin 2B + \sin 2C}{\sin A + \sin B + \sin C} =$

- A. $4 \sin A / 2 \sin B / 2 \sin C / 2$
- B. $4 \cos A / 2 \cos B / 2 \cos C / 2$
- C. $8 \sin A / 2 \sin B / 2 \sin C / 2$
- D. $1 + 4 \sin A / 2 \sin B / 2 \sin C / 2$

Answer: C



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28. If $A + B + C = 180^\circ$ then $\cos A + \cos B - \cos C =$

A. $-1 + 4 \sin A / 2 \sin B / 2 \sin C / 2$

B. $-1 + 4 \cos A / 2 \cos B / 2 \sin C / 2$

C. $-1 + 4 \cos A / 2 \cos B / 2 \cos C / 2$

D. $-1 + 4 \cos A / 2 \sin B / 2 \cos C / 2$

Answer: B



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29. If $A + B + C = 0^\circ$ then $\sin A + \sin B + \sin C =$

A. $4 \sin A / 2 \sin B / 2 \sin C / 2$

B. $-4 \sin A / 2 \sin B / 2 \sin C / 2$

C. $4 \cos A / 2 \cos B / 2 \cos C / 2$

D. $-4 \cos A / 2 \cos B / 2 \cos C / 2$

Answer: B



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30. If $A + B + C = 270^\circ$ then $\sin 2A + \sin 2B + \sin 2C =$

A. $4 \sin A \sin B \sin C$

B. $4 \cos A \cos B \cos C$

C. $-4 \sin A \sin B \sin C$

D. $-4 \cos A \cos B \cos C$

Answer: D



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31. If $A + B + C = 0^\circ$ then $\sin A + \sin B + \sin C =$

A. $2\cos\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$

B. $2\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$

C. $4\cos\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$

D. $4\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$

Answer: D



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32. $\cos 22^\circ + \cos 78^\circ + \cos 80^\circ =$

A. $4\sin 11^\circ \sin 39^\circ \sin 40^\circ$

B. $1 + 4\cos 11^\circ \cos 39^\circ \cos 40^\circ$

C. $1 + 4\sin 11^\circ \sin 39^\circ \sin 40^\circ$

D. $4\cos 11^\circ \cos 39^\circ \cos 40^\circ$

Answer: C



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33. Statement: If $\sin A = \sin B$, $\cos A = \cos B$ then $A = 2n\pi + B$

Statement :II If $A + B + C = 90^\circ$ then

$$\sin 2A + \sin 2B + \sin 2C = \sin A \sin B \sin C$$

Which of the above statement is correct?

A. only I

B. only II

C. Both I and II

D. Neither I nor II

Answer: A



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34. Statement I: $\cos 52^\circ + \cos 68^\circ + \cos 172^\circ = \frac{1}{2}$

Statement II: $4 \sin A \cos^3 A - 4 \cos A \sin^3 A = \cos 4A$

Which of the above statements is correct?

A. only I

B. only II

C. Both I and II

D. Neither I nor II

Answer: D



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35. $A = \sin 78^\circ - \sin 18^\circ + \cos 132^\circ$

$B = \cos 12^\circ + \cos 84^\circ + \cos 132^\circ + \cos 156^\circ$ and

$C = \frac{\sin 75^\circ + \sin 15^\circ}{\cos 75^\circ + \cos 15^\circ}$ then arrange in the ascending order

A. C,A,B

B. B,A,C

C. A,C,B

D. A,B,C

Answer: B



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36. Assertion A: In ΔABC , $\sum \frac{\cos A}{\sin B \sin C} = 2$

Reason(R): In ΔABC , $\sin A + \sin B + \sin C =$

$$4 \cos \frac{A}{2} \cos \frac{B}{2} \cos \frac{C}{2}$$

A. A is true, R is true and R is correct explanation of A

B. A is true, R is true and R is not correct explanation of A

C. A is true, R is false

D. A is false, R is true.

Answer: B



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