



India's Number 1 Education App

## MATHS

### BOOKS - KC SINHA MATHS (HINGLISH)

### TRIGONOMETRIC RATIO AND IDENTITIES - FOR COMPETITION

#### Solved Examples

1. If  $\pi$



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2.

If  $\sin(A - B) = \frac{1}{\sqrt{10}}$  and  $\cos(A + B) = \frac{2}{\sqrt{29}}$ , find the value of  $2A$  where  $A$  and  $B$  are acute angles.



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3. Suppose  $\sin^3 x \sin 3x = \sum_{m=0}^n C_m \cos mx$  is an identity in  $x$ , where  $C_0, C_1, C_n$  are constants and  $C_n \neq 0$ , the the value of  $n$  is \_\_\_\_\_



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4. Find the sum :  
 $\tan x. \tan 2x + \tan 2x \tan 3x + \dots + \tan nx. \tan(n+1)x$



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5. Sum the series  $\cos ec\theta + \cos ec2\theta + \cos ec4\theta + \dots + n$  terms



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6. Prove that:  $s \in^4 \frac{\pi}{8} + s \in^4 \frac{3\pi}{8} + s \in^4 \frac{5\pi}{8} + s \in^4 \frac{7\pi}{8} = \frac{3}{2}$



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7. Prove that  $\sin \theta + s \in 3\theta + \sin 5\theta + \dots + \sin(2n-1)\theta = \frac{\sin^2 n\theta}{\sin \theta}$ .



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8. Prove that

$$\sum_{k=1}^{n-1} (n-k) \frac{\cos(2k\pi)}{n} = -\frac{n}{2}, \text{ where } n \geq 3 \text{ is an integer} \geq r$$



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9.  $\sum_{p=1}^{\pi} (3p+2) \left[ \sum_{q=1}^{10} \frac{\sin(2q\pi)}{11} - i \frac{\cos(2q\pi)}{11} \right]^p$



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10. If  $\theta = \frac{\pi}{2^n + 1}$ , prove that:  $2^n \cos \theta \cos 2\theta \cos 2^2 \cos 2^{n-1} \theta = 1$ .



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$$11. \cos\left(2\frac{\pi}{7}\right) \cos\left(4\frac{\pi}{7}\right) \cdot \cos\left(6\frac{\pi}{7}\right)$$



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12.

Prove

that:

$$s \in \frac{\pi}{14}, s \in \frac{3\pi}{14}, s \in \frac{5\pi}{14}, s \in \frac{7\pi}{14}, s \in \frac{9\pi}{14}, s \in \frac{11\pi}{14}, s \in \frac{13\pi}{14} = \frac{1}{64}$$



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$$13. \quad \text{If} \quad A = \sin\left(\frac{2\pi}{7}\right) + \sin\left(\frac{4\pi}{7}\right) + \sin\left(\frac{8\pi}{7}\right) \quad \text{and} \\ B = \cos\left(\frac{2\pi}{7}\right) + \cos\left(\frac{4\pi}{7}\right) + \cos\left(\frac{8\pi}{7}\right) \text{ then } \sqrt{A^2 + B^2} \text{ is equal to}$$



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$$14. \tan^2\left(\frac{\pi}{16}\right) + \tan^2\left(\frac{2\pi}{16}\right) + \tan^2\left(\frac{3\pi}{16}\right) + \dots + \tan^2\left(\frac{7\pi}{16}\right) = 35$$



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$$15. \text{ Prove that: } \tan \frac{\pi}{7} \cdot \tan \frac{2\pi}{7} \cdot \tan \frac{3\pi}{7} = \sqrt{7}$$



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16.

Show

that:

$$\left( \tan^2 \frac{\pi}{7} + \tan^2 \frac{2\pi}{7} + \tan^2 \frac{3\pi}{7} \right) \left( \cot^2 \frac{\pi}{7} + \cot^2 \frac{2\pi}{7} + \cot^2 \frac{3\pi}{7} \right) = 105$$



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$$17. \tan \alpha + 2 \tan 2\alpha + 4 \tan 4\alpha + 8 \cot 8\alpha = \cot \alpha$$



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$$18. \text{ Show that: } \frac{\sin x}{\cos 3x} + \frac{\sin 3x}{\cos 9x} + \frac{\sin 9x}{\cos 27x} = \frac{1}{2}(\tan 27x - \tan x)$$



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19.

Show

that:

$$\cot 16^\circ \cdot \cot 44^\circ + \cot 44^\circ \cdot \cot 76^\circ - \cot 76^\circ \cdot \cot 16^\circ = 3$$



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20. Show that: If  $\theta = \frac{2\pi}{7}$ , prove that

$$\tan \theta \tan 2\theta + \tan 2\theta \tan 4\theta + \tan 4\theta \tan \theta = -7$$



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21. Prove that from the equality  $\frac{\sin^4 \alpha}{a} + \frac{\cos^4 \alpha}{b} = \frac{1}{a+b}$  follow the

relation:  $\frac{\sin^8 \alpha}{a^3} + \frac{\cos^8 \alpha}{b^3} = \frac{1}{(a+b)^3}$



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22. If  $A + B + C = \pi$ , express  $S = \sin 3A + \sin 3B + \sin 3C$  as a

product of three trigonometric ratios. If  $S = 0$ , Show that at least one of

the angles is  $60^\circ$ .



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23. Prove that,  $\sin x \cdot \sin y \cdot \sin(x - y) + \sin y \cdot \sin z \cdot \sin(y - z) + \sin z \cdot \sin x \cdot \sin(z - x) + \sin(x - y) \cdot \sin(y - z) \cdot \sin(z - x) = 0$



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24. If  $a \leq 3 \cos x + 5 \sin\left(x - \frac{\pi}{6}\right) \leq b$  for all  $x$ , then  $(a, b)$  is



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25. Prove that  $(2\sqrt{3} + 3)\sin x + 2\sqrt{3}\cos x$  lies between  $-(2\sqrt{3} + \sqrt{15})$  and  $(2\sqrt{3} + \sqrt{15})$ ,



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26. Show that:  $\frac{\sec^2 \theta - \tan \theta}{\sec^2 \theta + \tan \theta}$  lies between 3 and  $\frac{1}{3}$



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27. Prove that  $\frac{\tan 3x}{\tan x}$  never lies between  $\frac{1}{3}$  and 3.



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28. Show that the expression  $\frac{\tan(x + \alpha)}{\tan(x - \alpha)}$  cannot lie between the values  $\tan^2\left(\frac{\pi}{4} - \alpha\right)$  and  $\tan^2\left(\frac{\pi}{4} + \alpha\right)$



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29. Show that the expression  $\cos \theta \left( \sin \theta + \sqrt{\sin^2 \theta + \sin^2 \alpha} \right)$  always lies between the values of  $\pm \sqrt{1 + \sin^2 \alpha}$



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30. If  $f(x) = \sin^6 x + \cos^6 x$  and  $M_1$  and  $M_2$ , be the maximum and minimum values of  $f(x)$  for all values of  $x$  then  $M_1 - M_2$  is equal to

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31. If  $0 < \theta < \pi$ , prove that  $\cot \frac{\theta}{2} \geq 1 + \cot \theta$

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32. 7. If  $\tan \theta = n \tan \phi$ , then maximum value of  $\tan^2(\theta - \phi)$  is equal to

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33. Prove that the inequality  $|\sin nx| \leq n|\sin x|$  is valid for all positive integers  $n$

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**34.** The inequality  $2^{\sin \theta} + 2^{\cos \theta} \geq 2^{1 - \frac{1}{\sqrt{2}}}$ , holds for all real values of  $\theta$

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**35.** If angle C of a triangle ABC be obtuse, then (A)  $0 < \tan A \tan B < 1$  (B)  $\tan A \tan B > 1$  (C)  $\tan A \tan B = 1$  (D) none of these

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**36.** If  $\frac{1}{\cos \alpha \cos \beta} + \tan \alpha \tan \beta = \tan \gamma$ , show that  $\cos 2\gamma \leq 0$

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**37.** If  $\cos(\theta - \phi)$ ,  $\cos(\theta)$ ,  $\cos(\theta + \phi)$  are in HP, then the value of  $\cos(\theta)\sec\left(\frac{\phi}{2}\right)$  is

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**38.**

Prove

that:

$$\frac{2\cos 2^n \theta + 1}{2\cos \theta + 1} = (2\cos \theta - 1)(2\cos 2\theta - 1)(2\cos 2^2\theta - 1)(2\cos 2^{n-1}\theta - 1)$$



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**39.** If  $\theta = 240^\circ$  is the following statement correct?

$$2\sin \frac{\theta}{2} = \sqrt{1 + \sin \theta} - \sqrt{1 - \sin \theta}$$



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**40.** If  $0 < \theta, \phi < \pi$  and  $\cos \phi + \cos \theta - \cos(\theta + \phi) = \frac{3}{2}$  prove that

$$\theta = \phi = \frac{\pi}{3}.$$



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**41.** let  $\cos\left(\frac{\pi}{7}\right), \cos\left(\frac{3\pi}{7}\right), \cos\left(\frac{5\pi}{7}\right)$ , the roots of equation

$$8x^3 - 4x^2 - 4x + 1 = 0 \quad \text{then} \quad \text{the value of}$$

$$\sin\left(\frac{\pi}{14}\right), \sin\left(\frac{3\pi}{14}\right), \sin\left(\frac{5\pi}{14}\right)$$



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42. The product of the sines of the angles of a triangle is  $p$  and the product of their cosines is  $q$ . Show that the tangents of the angles are the roots of the equation  $qx^3 - px^2 + (1 + q)x - p = 0$ .



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43. If  $e^{(\sin^2 x + \sin^4 x + \sin^6 x + \dots \infty) \ln 2}$  satisfies the equation  $x^2 - 9x + 8 = 0$  find the value of  $\frac{\cos x}{\cos x + \sin x}$ ,  $0 < x < \frac{\pi}{2}$



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44. Prove that the function:  $f(x) = \cos^2 x + \cos^2\left(\frac{\pi}{3} + x\right) - \cos x \cdot \cos\left(\frac{\pi}{3} + x\right)$  is constant function. Find the value of that constant



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45. For '0sin(cosx)'



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46. If  $\tan(\alpha) = \frac{p}{q}$  where  $\alpha = 6\beta$ ,  $\alpha$  being an acute angle, prove that:  
 $\frac{1}{2}(p \cos ec 2\beta - \sec 2\beta) = \sqrt{p^2 + q^2}$



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47. if  $\cos^2 \theta = \frac{m^2 - 1}{3}$  and  $\tan^3 \frac{\theta}{2} = \tan \alpha$ , prove that  
 $\cos^{2/3} \alpha + \sin^{2/3} \alpha = \left(\frac{2}{m}\right)^{2/3}$



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**48.** Let  $ABCD$  be a quadrilateral with area 18, side  $AB$  parallel to the side  $CD$ , and  $AB = 2CD$ . Let  $AD$  be perpendicular to  $AB$  and  $CD$ . If a circle is drawn inside the quadrilateral  $ABCD$  touching all the sides, then its radius is 3 (b) 2 (c)  $\frac{3}{2}$  (d) 1



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**49.** Let  $\theta \in \left(0, \frac{\pi}{4}\right)$  and  $t_1 = (\tan \theta)^{\tan \theta}$ ,  
 $t_2 = (\tan \theta)^{\cot \theta}$ ,  $t_3 = (\cot \theta)^{\tan \theta}$ ,  $t_4 = (\cot \theta)^{\cot \theta}$ , then



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**50.** Which of the following number(s) is/are rational? (A)  $\sin 15^\circ$  (B)  
 $\cos 15^\circ$  (C)  $\sin 15^\circ \cos 15^\circ$  (D)  $\sin 15^\circ \cos 75^\circ$



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51.  $\tan 5^\circ$  is (A) rational number (B) Irrational number (C) prime number  
(D) none of these



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52. If  $2 \frac{\sin \alpha}{1 + \cos \alpha + \sin \alpha} = y$  then value of  $\frac{1 - \cos \alpha + \sin \alpha}{1 + \sin \alpha}$  is



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53. If  $\alpha + \beta = \frac{\pi}{2}$  and  $\beta + \gamma = \alpha$  then  $\tan \alpha$  equals (A)  
2( $\tan \beta + \tan \gamma$ ) (B)  $\tan \beta + \tan \gamma$  (C)  $\tan \beta + 2 \tan \gamma$  (D)  $2 \tan \beta + \tan \gamma$



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54. The maximum value of  $(\cos \alpha_1) \cdot (\cos \alpha_2) \dots \cdot (\cos \alpha_n)$ , under the restrictions

$0 \leq \alpha_1, \alpha_2, \dots, \alpha_n \leq \frac{\pi}{2}$  and  $(\cot \alpha_1)(\cot \alpha_2) \dots (\cot \alpha_n) = 1$  is



55. If  $\frac{\sin^4 x}{2} + \frac{\cos^4 x}{3} = \frac{1}{5}$  then  $\tan^2 x = \frac{2}{3}$  (b)

$$\frac{\sin^8 x}{8} + \frac{\cos^8 x}{27} = \frac{1}{125} \tan^2 x = \frac{1}{3}$$
(d)  $\frac{\sin^8 x}{8} + \frac{\cos^8 x}{27} = \frac{2}{125}$



56. For a positive integer n,

$$f_n(\theta) = \left( \frac{\tan \theta}{2} \right) (1 + \sec \theta)(1 + \sec 2\theta)(1 + \sec 4\theta) \dots (1 + \sec 2^n \theta),$$
then



57. If  $T_n = \sin^n \theta + \cos^n \theta$ , then  $\frac{T_6 - T_4}{T_6} = m$  holds for values of m satisfying (A)  $m \in \left[ -1, \frac{1}{3} \right]$  (B)  $m \in \left[ 0, \frac{1}{3} \right]$  (C)  $m \in [-1, 0]$  (D)  $m \in \left[ -1, -\frac{1}{2} \right]$



58. If  $\cot \theta + \tan \theta = x$  and  $\sec \theta - \cos \theta = y$  then (i)  $\sin \theta \cos \theta = -x$   
(ii)  $\sin \theta \tan \theta = -y$  (iii)  $(x^2 y)^{\frac{2}{3}} - (xy^2)^{\frac{2}{3}} = 1$  (iv)  
 $(x^2 y)^{\frac{1}{3}} + (xy^2)^{\frac{1}{3}} = 1$



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59. Which of the following has the maximum value unity: (a)  $\sin^2 x - \cos^2 x$  (b)  $\frac{\sin 2x - \cos 2x}{\sqrt{2}}$  (c)  $-\frac{\sin 2x - \cos 2x}{\sqrt{2}}$  (d)  
 $\left(\sqrt{\frac{6}{5}}\right)\left(\frac{1}{\sqrt{2}}\sin x + \sqrt{3}\cos x\right)$



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60. Prove that a triangle  $ABC$  is equilateral if and only if  $\tan A + \tan B + \tan C = 3\sqrt{3}$ .



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61. If A,B,C are the angles of a given triangle ABC . If  $\cos A \cos B \cos C = \frac{\sqrt{3} - 1}{8}$  and  $\sin A \sin B \sin C = \frac{3 + \sqrt{3}}{8}$  The value of  $\tan A + \tan B + \tan C$  is (A)  $\left(3 + \frac{\sqrt{3}}{\sqrt{3} - 1}\right)$  (B)  $\left(\sqrt{3} + \frac{4}{\sqrt{3} - 1}\right)$  (C)  $\left(6 - \frac{\sqrt{3}}{\sqrt{3} - 1}\right)$  (D)  $\left(\sqrt{3} + \frac{\sqrt{2}}{\sqrt{3} - 1}\right)$



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62. If A,B,C are the angles of a given triangle ABC . If  $\cos A \cos B \cos C = \frac{\sqrt{3} - 1}{8}$  and  $\sin A \sin B \sin C = \frac{3 + \sqrt{3}}{8}$  The value of  $\tan A + \tan B + \tan C = \tan C \tan A$  is (A)  $5 - 4\sqrt{3}$  (B)  $5 + 3\sqrt{3}$  (C)  $6 + \sqrt{3}$  (D)  $6 - \sqrt{3}$



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63. If A,B,C are the angles of a given triangle ABC . If  $\cos A \cos B \cos C = \frac{\sqrt{3} - 1}{8}$  and  $\sin A \sin B \sin C = \frac{3 + \sqrt{3}}{8}$  The cubic equation whose roots are  $\tan A, \tan B, \tan C$  is (A)

$$x^3 - (3 + 2\sqrt{3})x^2 + (5 + 4\sqrt{3})x - (3 + 2\sqrt{3}) = 0 \quad (\text{B})$$

$$x^3 - (3 \pm 2\sqrt{3})x^2 + (5 + 4\sqrt{3})x + (3 + 2\sqrt{3}) = 0 \quad (\text{C})$$

$$x^3 + (3 + 2\sqrt{3})x^2 + (5 + 4\sqrt{3})x + (3 + 2\sqrt{3}) = 0 \quad (\text{D})$$

$$x^3 - (3 + 2\sqrt{3})x^2 + (5 + 4\sqrt{3})x + (3 + 2\sqrt{3}) = 0$$



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64. The maximum value of the expression  $\frac{1}{\sin^2 \theta + 3 \sin \theta \cos \theta + 5 \cos^2 \theta}$  is



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65. If  $K = \sin\left(\frac{\pi}{18}\right) \sin\left(\frac{5\pi}{18}\right) \sin\left(\frac{7\pi}{18}\right)$ , then the numerical value of  $K$  is \_\_\_\_\_



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66. If  $A > 0, B > 0$  and  $A + B = \frac{\pi}{3}$ , the maximum value of  $\tan A \tan B$

is \_\_\_\_\_



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67. If  $\cos \theta = \frac{a}{b+c}$ ,  $\cos \phi = \frac{b}{a+c}$  and  $\cos \psi = \frac{c}{a+b}$  where  $\theta, \phi, \psi \in (0, \pi)$  and  $a, b, c$  are sides of triangle  $ABC$  then  $\tan^2\left(\frac{\theta}{2}\right) + \tan^2\left(\frac{\phi}{2}\right) + \tan^2\left(\frac{\psi}{2}\right) =$



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## Exercise

1. If  $0 < x < \frac{\pi}{2}$  prove that

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



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2. If  $\sin^3 x \sin 3x = \sum_{n=0}^6 c_n \cos^n x$  where  $c_0, c_1, c_2, \dots, c_6$  are constants.

then find the value of  $c_4$



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3.  $\cos \theta + \cos 2\theta + \cos 3\theta + \dots + \cos(n-1)\theta + \cos n\theta =$



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4.

Prove

that

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



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5. Find the value of  $\sin 5^\circ + \sin 77^\circ + \sin 149^\circ + \dots + \sin 293^\circ$



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6. Show that:  $\cos \frac{\pi}{n} + \cos \frac{2\pi}{n} + \dots + \cos \frac{(n-1)\pi}{n} = 0$

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7. Show that:  $\cos \frac{2\pi}{7} + \cos \frac{4\pi}{7} + \cos \frac{6\pi}{7} = -\frac{1}{2}$

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8. find the value of the expression

$$3 \left[ \sin^4 \left( 3 \frac{\pi}{2} - \alpha \right) + \sin^4 (3\pi + \alpha) \right] - 2 \left[ \sin^6 \left( \frac{\pi}{2} + \alpha \right) + \sin^6 (5\pi - \alpha) \right]$$

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9.  $\sin 36^\circ \sin 72^\circ \sin 108^\circ \sin 144^\circ =$

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10.

Prove

that:

$$\sin^2 12^\circ + \sin^2 21^\circ + \sin^2 39^\circ + \sin^2 48^\circ = 1 + \sin^2 9^\circ + \sin^2 18^\circ$$



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11. Prove that:  $\tan 142 \frac{1}{2}^0 = 2 + \sqrt{2} - \sqrt{3} - \sqrt{6}$



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12. If  $0 < \alpha < \frac{\pi}{6}$  and  $\sin \alpha + \cos \alpha = \sqrt{\frac{7}{2}}$ , then  $\frac{\tan \alpha}{2}$  is equal to



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13. If  $\alpha + \beta + \gamma = \frac{\pi}{2}$  and  $\cot \alpha, \cot \beta, \cot \gamma$  are in A.P. then  
 $\cot \alpha \cdot \cot \gamma$



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14. Prove that:  $\cos\left(\frac{2\pi}{15}\right) \cdot \cos\left(\frac{4\pi}{15}\right) \cdot \cos\left(\frac{8\pi}{15}\right) \cdot \cos\left(\frac{16\pi}{15}\right) = \frac{1}{16}$



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15. If  $\cos(\alpha + \beta) = \frac{4}{5}$ ;  $\sin(\alpha - \beta) = \frac{5}{13}$  and  $\alpha, \beta$  lie between  $0 & \frac{\pi}{4}$

then find the value of  $\tan 2\alpha$



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16. Sum the series  
 $\tan \alpha \tan(\alpha + \beta) + \tan(\alpha + \beta) + \tan(\alpha + 2\beta) + \tan(\alpha + 2\beta)\tan(\alpha + 3\beta)$   
to n terms`



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17. prove that  $\cot \theta \cdot \cot 2\theta + \cot 2\theta \cdot \cot 3\theta + 2 = \cot \theta (\cot \theta - \cot 3\theta)$



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18. Show that  $\frac{1 + \sin A}{\cos A} + \frac{\cos B}{1 - \sin B} = \frac{2 \sin A - 2 \sin B}{\sin(A - B) + \cos A - \cos B}$



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19. If  $\frac{\cos^4 x}{\cos^2 y} + \frac{\sin^4 x}{\sin^2 y} = 1$  then prove that  $\frac{\cos^4 y}{\cos^2 x} + \frac{\sin^4 y}{\sin^2 x} = 1$



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20. If  $\theta + \phi + \psi = 2\pi$ , prove that  
 $\cos^2 \theta + \cos^2 \phi + \cos^2 \psi - 2 \cos \theta \cos \phi \cos \psi = 1$



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21. If  $A + B + C = \pi$  and if  $\cos 3A + \cos 3B + \cos 3C = 1$  then show that one angle must be  $120^\circ$ .



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22. show that

$$\sin A \cdot \sin(B - C) + \sin B \cdot \sin(C - A) + \sin C \cdot \sin(A - B) = 0.$$



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23. If  $u_n = \sin^n \theta + \cos^n \theta$ , then prove that  $\frac{u_5 - u_7}{u_3 - u_5} = \frac{u_3}{u_1}$ .



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24.

$$\frac{3x - x^3}{1 - 3x^2} + \frac{3y - y^3}{1 - 3y^2} + \frac{3z - z^3}{1 - 3z^2} = \left( \frac{3x - x^3}{1 - 3x^2} \right) \left( \frac{3z - z^3}{1 - 3z^2} \right) \left( \frac{3y - y^3}{1 - 3y^2} \right)$$



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25. Prove that  $5 \cos \theta + 3 \cos \left( \theta + \frac{\pi}{3} \right) + 3$  lies between  $-4$  and  $10$ .



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**26.** What is the minimum value of  $(\sin^2 \theta + \cos^4 \theta)$ ?



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**27.** Show that the minimum value of  $\sin^8 x + \cos^8 x$  is  $\frac{1}{8}$ .



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**28.** If  $0 < \alpha < \frac{\pi}{2}$  then show that  $\tan \alpha + \cot \alpha > \sin \alpha + \cos \alpha$



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**29.** Prove that :

$$\cos^2 \alpha + \cos^2(\alpha + \beta) - 2 \cos \alpha \cos \beta \cos(\alpha + \beta) = \sin^2 \beta$$



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30. Show that  $3(\tan^2 \theta + \cot^2 \theta) - 9(\cot \theta + \tan \theta) + 10 > 0$



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31. If  $0 < \alpha < \frac{\pi}{2}$ ,  $0 < \beta < \frac{\pi}{2}$  and  $0 < \gamma < \frac{\pi}{2}$  prove that  
 $\sin(\alpha + \beta + \gamma) < \sin \alpha + \sin \beta + \sin \gamma$



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32. If  $0 < \theta, \phi < \pi$  and  $\cos \theta + \cos \phi - \cos(\theta + \phi) = \frac{3}{2}$ , prove that  
 $\theta = \phi = \frac{\pi}{3}$ .



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33. If  $\tan \alpha, \tan \beta$  are the roots of the equation  $x^2 + px + q = 0 (p \neq 0)$   
Then  $\sin^2(\alpha + \beta) + p \sin(\alpha + \beta) \cos(\alpha + \beta) + q \cos^2(\alpha + \beta) =$



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**34.** If  $\cos(\theta - \alpha) = a, \sin(\theta - \beta) = b$ , prove that  
 $a^2 - 2ab \sin(\alpha - \beta) + b^2 = \cos^2(\alpha - \beta)$



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**35.** If  $\tan x \tan y = a$  and  $x + y = 2b$  show that  $\tan x$  and  $\tan y$  are the roots of the equation  $z^2 - (1 - a)\tan 2b \cdot z + a = 0$



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**36.** Prove that ;  $4\sin 27^\circ = (5 + \sqrt{5}) - \sqrt{(3 - \sqrt{5})}$  we have



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



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- 38.** If  $\alpha + \beta + \gamma = \pi$  and  
 $\tan\left(\frac{\beta + \gamma - \alpha}{4}\right)\tan\left(\frac{\gamma + \alpha - \beta}{4}\right)\tan\left(\frac{\alpha + \beta - \gamma}{4}\right) = 1$ . Prove that  
 $1 + \cos \alpha + \cos \beta + \cos \gamma = 0$

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- 39.** If  $(x^2 - x \cos(A + B) + 1)$  is a factor of the expression,  
 $2x^4 + 4x^3 \sin A \sin B - x^2(\cos 2A + \cos 2B) + 4x \cos A \cos B - 2$ , then  
the other  $ax^2 + bx + c$ . Find the value of  $(a + b + c)$  given  
 $A = \frac{3\pi}{8}$  and  $B = \frac{\pi}{24}$

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- 40.** If  $m \sin(\alpha + \beta) = \cos(\alpha - \beta)$ , prove that  
 $\frac{1}{1 - m \sin 2\alpha} + \frac{1}{1 - m \sin 2\beta} = \frac{2}{1 - m^2}$

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41. If  $\tan\left(\frac{\pi}{4} + \frac{\theta}{2}\right) = \tan^3\left(\frac{\pi}{4} + \frac{\alpha}{2}\right)$  then  
$$\sin(\theta) = \frac{\sin(\alpha)(3 + \sin^2(\alpha))}{1 + 3\sin^2(\alpha)}$$



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42. If  $x = X \cos \theta - Y \sin \theta, y = X \sin \theta + Y \cos \theta$  and  
 $x^2 + 4xy + y^2 = AX^2 + BY^2, 0 \leq \theta \leq \frac{\pi}{2}$  then



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43. If  $a, b, c$  and  $k$  are real constants and  $\alpha, \beta, \gamma$  are variables subject to the condition that  $a \tan \alpha + b \tan \beta + c \tan \gamma = k$ , then prove using vectors that  $\tan^2 \alpha + \tan^2 \beta + \tan^2 \gamma \geq \frac{k^2}{a^2 + b^2 + c^2}$



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44. If A,B,C and D are angles of quadrilateral and  $\frac{\sin(A)}{2} \frac{\sin(B)}{2} \frac{\sin(C)}{2} \frac{\sin(D)}{2} = \frac{1}{4}$ , prove that A=B=C=D=π/2



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45.  $\prod_{i=1}^{89} \tan i^\circ = 0$  (A) 1 (B) ∞ (C) none of these



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46.  $\prod_{k=0}^3 \left(1 + \cos \frac{(2k+1)\pi}{8}\right) =$  (A)  $\frac{1}{16}$  (B)  $-\frac{1}{8}$  (C)  $\frac{1}{8}$  (D) 1



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47. If in a ABC,  $\cos^2 A + \cos^2 B + \cos^2 C = 1$ , prove that the triangle is right angled.



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**48.** The value of  $\prod_{k=0}^6 \sin \frac{(2k+1)\pi}{14}$  = (A)  $\frac{1}{16}$  (B)  $\frac{1}{64}$  (C)  $\frac{1}{32}$  (D) none of

these



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**49.** if  $A > 0, B > 0$  and  $A + B = \frac{\pi}{3}$  then the maximum value of  $\tan A \cdot \tan B$  is (A)  $\frac{1}{3}$  (B)  $\frac{1}{6}$  (C)  $\frac{1}{2}$  (D) 1



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**50.** Given that  $\frac{\pi}{2} < \alpha < \pi$  then the expression  $\sqrt{\frac{1 - \sin \alpha}{1 + \sin \alpha}} + \sqrt{\frac{1 + \sin \alpha}{1 - \sin \alpha}}$  (A)  $\frac{1}{\cos \alpha}$  (B)  $-\frac{2}{\cos \alpha}$  (C)  $\frac{2}{\cos \alpha}$  (D) does not exist



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51. If  $A = \cos^2 \theta + \sin^4 \theta$  then for all values of  $\theta$  (A)  $1 \leq A \leq 2$  (B)

$\frac{13}{16} \leq A \leq 1$  (C)  $\frac{3}{4} \leq A \leq \frac{13}{16}$  (D)  $\frac{3}{4} \leq A \leq 1$



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52. Prove that  $5 \cos \theta + 3 \cos\left(\theta + \frac{\pi}{3}\right) + 3$  lies between  $-4$  and  $10$ .



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53. If  $z^7 + 1 = 0$  then  $\cos\left(\frac{\pi}{7}\right)\cos\left(\frac{3\pi}{7}\right)\cos\left(\frac{5\pi}{7}\right)$  is (A)  $\frac{1}{8}$  (B)  $-\frac{1}{8}$  (C)

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



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54. If  $\cos ec A + \cot A = \frac{5}{2}$ , then  $\tan A$  is (A)  $\frac{4}{9}$  (B)  $\frac{3}{5}$  (C)  $\frac{15}{16}$  (D)  $\frac{20}{21}$



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55. If  $x = \cos 10^\circ \cos 20^\circ \cos 40^\circ$ , then the value of x is



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56.  $\alpha \cos^2 3\theta + \beta \cos^4 \theta = 16 \cos^6 \theta + 9 \cos^2 \theta$ . Find  $\alpha$  &  $\beta$  if its a identity



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57. If  $A = \frac{a}{a+1}$  and  $\tan B = \frac{1}{2a+1}$  then the value of  $A + B$  is  
a.  $0$  b.  $\frac{\pi}{2}$   
c.  $\frac{\pi}{3}$  d.  $\frac{\pi}{4}$



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58. If  $\sin x + \sin^2 x + \sin^3 x = 1$  then find the value of  
 $\cos^6 x - 4 \cos^4 x + 8 \cos^2 x$



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59. If  $P_n = \cos^n \theta + \sin^n \theta$  then  $2P_6 - 3P_4 + 1 =$



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60. if  $2 \sec 2\alpha = \tan \beta + \cot \beta$  then one of the value of  $\alpha + \beta$  is (A) pi (B)

$$n\pi - \frac{\pi}{4}, n \in \mathbb{Z}$$
 (C)  $\frac{\pi}{4}$  (D)  $\frac{\pi}{2}$



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61.  $\sin 163^\circ \cos 347^\circ + \sin 73^\circ \sin 167^\circ =$  (A) 0 (B)  $\frac{1}{2}$  (C) 1 (D) none of

these



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62. If  $\sin 2\theta + \sin 2\phi = \frac{1}{2}$  and  $\cos 2\theta + \cos 2\phi = \frac{3}{2}$ , then  $\cos^2(\theta - \phi) =$

(A)  $\frac{3}{8}$  (B)  $\frac{5}{8}$  (C)  $\frac{3}{4}$  (D)  $\frac{5}{4}$



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63. If  $\lim_{x \rightarrow 2} \frac{2x^2 - 4f(x)}{x - 2} = m$ , where  $f(2) = 2, f'(2) = 1$ , then  $\cos ec 10^\circ - \sqrt{3} \sec 10^\circ$  is (A) 3m (B) 2m (C) m (D) none of these



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64. A triangle  $PQR, \angle R = 90^\circ$  and  $\tan\left(\frac{P}{2}\right)$  and  $\tan\left(\frac{Q}{2}\right)$  roots of the  $ax^2 + bx + c = 0$  then prove that  $a + b = c$



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65.  $\tan 100^\circ + \tan 125^\circ + \tan 100^\circ \tan 125^\circ$  is equal to 0 (b)  $\frac{1}{2}$  (c) -1 (d)

1



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**66.** The equation  $a \sin x + b \cos x = c$ , where  $|c| > \sqrt{a^2 + b^2}$  has (A) a unique solution (B) infinite number of solutions (C) no solution (D) none of these



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**67.** The value of  $\cos \frac{2\pi}{7} + \cos \frac{4\pi}{7} + \cos \frac{6\pi}{7}$  is (A) 1 (B) -1 (C)  $\frac{1}{2}$  (D)  $-\frac{1}{2}$



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**68.** Find the minimum and maximum value of both functions: a)  $(12 \sin x - 9 \sin^2 x)$  b)  $(5 \sin^2 \theta + 4 \cos^2 \theta)$



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**69.** If  $\tan \theta + \tan\left(\theta + \frac{\pi}{3}\right) + \tan\left(\theta - \frac{\pi}{3}\right) = k \tan 3\theta$  then k is equal to



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70. If  $\cos A = \frac{3}{4}$ , then  $32 \sin \frac{A}{2} \sin \frac{5A}{2} =$  (A)  $\sqrt{11}$  (B)  $-\sqrt{11}$  (C) 11  
(D) -11



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71. If  $\cos \alpha + \cos \beta = a$ ,  $\sin \alpha + \sin \beta = b$ , then  $\cos(\alpha + \beta)$  is equal to  
(A)  $\frac{2ab}{a^2 + b^2}$  (B)  $\frac{a^2 + b^2}{a^2 - b^2}$  (C)  $\frac{a^2 - b^2}{a^2 + b^2}$  (D)  $\frac{b^2 - a^2}{b^2 + a^2}$



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72. If  $\frac{\cos A}{3} = \frac{\cos B}{4} = \frac{1}{5}$   $-\frac{\pi}{2} < A < 0$   $-\frac{\pi}{2} < B < 0$  then value of  
 $2\sin A + 4 \sin B$  is



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73. If  $3\cos x + 2\cos 3x = \cos y$ ,  $3\sin x + 2\sin 3x = \sin y$ , then  $\cos 2x$  equals



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74. The value of  $K$  in order that  $f(x) = \sin x - \cos x - Kx + 5$  decreases for all positive real value of  $x$  is given by



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75. Range of  $f(x) = \sin^{20} x + \cos^{48} x$  is (A)  $[0, 1]$  (B)  $(0, 1]$  (C)  $(0, \infty)$  (D) none of these



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76. If  $f(x) = \sin^6 x + \cos^6 x$ , then range of  $f(x)$  is  $\left[\frac{1}{4}, 1\right]$  (b)  $\left[\frac{1}{4}, \frac{3}{4}\right]$  (c)  $\left[\frac{3}{4}, 1\right]$  (d) none of these



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77. If  $\sin x, \cos x, \tan x$  are in G.P., then  $\cot^6 x - \cot^2 x =$  (A) 0 (B) -1 (C) 1 (D) depends on x



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78. The inequality  $2^{\sin \theta} + 2^{\cos \theta} \geq 2^{1 - \frac{1}{\sqrt{2}}}$ , holds for all real values of  $\theta$



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79. If  $\cos(x - y), \cos x$  and  $\cos(x + y)$  are in H.P., then  
 $\cos x \cdot \sec\left(\frac{y}{2}\right) =$



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**80.** If  $3 \cos \alpha = 2 \cos(\alpha - 2\beta)$ , then  $\tan(\alpha - \beta)\tan \beta =$  (A) 5 (B) -5 (C)

$$\frac{1}{5}$$
 (D)  $-\frac{1}{5}$



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**81.** If  $\cos x = \tan y, \cos y = \tan z$  and  $\cos z = \tan x$ , prove that

$$\sin x = \sin y = \sin z = \sin 18^\circ$$



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



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**83.** if  $A + B + C = \pi$ , prove that  $\cos A + \cos B + \cos C$  greater than or equal to



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**84.**

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



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**85.** Which of the following number(s) is rational? (A)  $\sin 15^\circ$  (B)  $\cos 15^\circ$   
(C)  $\sin 15^\circ \cos 15^\circ$  (D)  $\sin 15^\circ \cos 75^\circ$



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**86.** Q. Let n be an add integer if  $\sin^n \theta = \sum_{r=0}^n b_r \sin^r \theta$ , for every value of theta then --



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87. If  $0 < x < \frac{\pi}{2}$  and  $\sin^n x + \cos^n x \geq 1$ , then 'n' may belong to interval :

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88. If the mapping  $f(x) = ax + b, a < 0$  maps  $[-1, 1]$  onto  $[0, 2]$  then for all values of  $\theta$ ,  $A = \cos^2 \theta + \sin^4 \theta$  is :

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89.  $\sec^2 \theta = \frac{4xy}{(x+y)^2}$  is true if and only if  $x+y \neq 0$  (b)  $x=y, x \neq 0$   
 $x=y$  (d)  $x \neq 0, y \neq 0$

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90. If  $2 \frac{\sin \alpha}{1 + \cos \alpha + \sin \alpha} = y$  then value of  $\frac{1 - \cos \alpha + \sin \alpha}{1 + \sin \alpha}$  is

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91. If  $f(x) = \sin^2 x + \sin^2\left(x + \frac{\pi}{3}\right) + \cos x \cos\left(x + \frac{\pi}{3}\right)$  and  $g\left(\frac{5}{4}\right) = 1$ ,

then  $(gof)(x)$  is \_\_\_\_\_



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92. If  $f(x) = \cos[\pi]x + \cos[\pi x]$ , where  $[y]$  is the greatest integer function of  $y$  then  $f\left(\frac{\pi}{2}\right)$  is equal to



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93. If  $x_i > 0$  for  $1 \leq i \leq n$  and  $x_1 + x_2 + x_3 + \dots + x_n = \pi$  then the greatest value of the sum  $\sin x_1 + \sin x_2 + \sin x_3 + \dots + \sin_n = \dots$  (A)

n (B)  $\pi$  (C)  $n \sin \frac{\pi}{n}$  (D) none of these



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94. Let  $f(x) = \sin^2\left(\frac{x}{2}\right) + \cos^2\left(\frac{x}{2}\right)$  and  $g(x) = \sec^2 x - \tan^2 x$ . The two functions are equal over the set (A)  $\phi$  (B)  $R$  (C)  $R - \{0\}$  (D) 1



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95. Prove that:

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



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96. If  $0^\circ < \theta < 180^\circ$  then  $\sqrt{2 + \sqrt{2 + \sqrt{2 + \dots + \sqrt{2(1 + \cos \theta)}}}}$ , then being  $n$  number of 2's, is equal to



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97. The minimum value of  $3\tan^2 \theta + 12\cot^2 \theta$  is (A) 6 (B) 15 (C) 24 (D) none of these



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98. If  $a = \sin \frac{\pi}{18} \sin \frac{5\pi}{18} \sin \frac{7\pi}{18}$ , and  $x$  is the solution of the equation  $y = 2[x] + 2$  and  $y = 3[x - 2]$ , where  $[x]$  denotes the integral part of  $x$  then  $a =$  (A)  $[x]$  (B)  $\frac{1}{x}$  (C)  $2[x]$  (D)  $[x]^2$



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99. If  $\alpha$  is the common positive root of the equation  $x^2 - ax + 12 = 0$ ,  $x^2 - bx + 15 = 0$  and  $x^2 - (a + b)x + 36 = 0$  and  $\cos x + \cos 2x + \cos 3x = \alpha$ , then  $\sin x + \sin 2x + \sin 3x =$  (A) 3 (B) -3 (C) 0 (D) none of these



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100. For any real  $\theta$  the maximum value of  $\cos^2(\cos \theta) + \sin^2(\sin \theta)$  is



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**101.** The function  $f(x) = \int_{-1}^x t(e^t - 1)(t - 1)(t - 2)^3(t - 3)^5 dt$  has a local minimum at  $x = 0$  (b) 1 (c) 2 (d) 3



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**102.** find the value of the expression  
 $3\left[\sin^4\left(3\frac{\pi}{2} - \alpha\right) + \sin^4(3\pi + \alpha)\right] - 2\left[\sin^6\left(\frac{\pi}{2} + \alpha\right) + \sin^6(5\pi - \alpha)\right]$



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**103.** If in the expansion of  $(1 + x)^m(1 - x)^n$ , the coefficients of  $x$  and  $x^2$  are 3 and -6 respectively, then m is:



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**104.** The function  $f(x) = \sin^4 x + \cos^4 x$  increasing if '0



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105. Let  $A = \sin x + \tan x$  and  $B = 2x$  in the interval  $0 < x < \frac{\pi}{2}$  then

- (A)  $A > B$  (B)  $A = B$  (C)  $A < B$  (D) none of these



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106. If  $\tan \gamma = \sec \alpha \sec \beta + \tan \alpha \tan \beta$ , then  $\cos 2\gamma$  is necessarily (A)

- $\geq 0$  (B)  $\leq 0$  (C)  $< 0$  (D)  $> 0$



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

variable  $x$  has real roots. The  $p$  can take any value in the interval  $(0, 2\pi)$

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



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**108.** If  $a, b, c$  and  $k$  are real constants and  $\alpha, \beta, \gamma$  are variables subject to the condition that  $a \tan \alpha + b \tan \beta + c \tan \gamma = k$ , then prove using vectors that  $\tan^2 \alpha + \tan^2 \beta + \tan^2 \gamma \geq \frac{k^2}{a^2 + b^2 + c^2}$



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**109.** In a  $\Delta ABC$ , prove that  $(\sin A + \sin B)(\sin B + \sin C)(\sin C + \sin A) > \sin A \sin B \sin C$ .



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**110.** It is known that  $\sin \beta = \frac{4}{5}$  and  $0 < \beta < \pi$  then the value of  $\frac{\sqrt{3} \sin(\alpha + \beta) - \frac{2}{\cos\left(\frac{\pi}{6}\right)} \cos(\alpha + \beta)}{\sin \alpha}$  is



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111. If  $\tan \frac{\theta}{2} = (\csc \theta - \sin \theta)$ , then  $\tan^2 \frac{\theta}{2}$  may be equal to (A)

- $2 - \sqrt{5}$  (B)  $(9 - 4\sqrt{5})(2 + \sqrt{5})$  (C)  $-2 + \sqrt{5}$  (D)  $(9 - 4\sqrt{5})(2 - \sqrt{5})$



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112. If any  $\triangle ABC$ ,  $\tan A + \tan B + \tan C = 6$  and  $\tan A \tan B = 2$ ,

then the values of  $\tan A$ ,  $\tan B$  and  $\tan C$  are respectively (A) 1,2,3 (B)

- 3,2,1 (C) 2,1,3 (D) 1,2,0



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113. If  $u = \sqrt{a^2 \cos^2 \theta + b^2 \sin^2 \theta} + \sqrt{a^2 \sin^2 \theta + b^2 \cos^2 \theta}$ , then the

difference between the maximum and minimum values of  $u^2$  is given by :

- (a)  $(a - b)^2$  (b)  $2\sqrt{a^2 + b^2}$  (c)  $(a + b)^2$  (d)  $2(a^2 + b^2)$



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114.

Assertion

A:

If

$$x = \sin(\alpha - \beta)\sin(\gamma - \delta), y = \sin(\beta - \gamma)\sin(\alpha - \delta), z = \sin(\gamma - \alpha) \cdot \sin(\delta - \alpha)$$

then

$$x + y + z = 0$$

Reason

R

:

$$2\sin A \sin B = \cos(A - B) + \cos(A + B)$$



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115. In  $\triangle ABC$  (A)  $\sin A \sin B \sin C \geq \frac{3\sqrt{3}}{8}$  (B)

$$\sin^2 A + \sin^2 B + \sin^2 C \leq \frac{9}{4} \quad (C) \quad \tan A \tan B \tan C \geq 3\sqrt{3} \quad (D)$$

$\sin A \sin B \sin C$  is always positive



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116. If  $\cos^4 \theta + a, \sin^4 \theta + a$  are the roots of the equation

$x^2 + 2bx + b = 0$  and  $\cos^2 \theta + \beta, \sin^2 \theta$  are the roots of the equation

$x^2 + 4x + 2 = 0$ , then values of b are



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117. If  $A + B + C = \pi$ , then find the minimum value of  $\cot^2 A + \cot^2 B + \cot^2 C$



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118. If  $y = \frac{\sqrt{1 - \sin 4A} + 1}{\sqrt{1 + \sin 4A} - 1}$  then one if the values of  $y$  is (A)  $-\tan A$  (B)  $\cot A$  (C)  $\tan\left(\frac{\pi}{4} + A\right)$  (D)  $-\cot\left(\frac{\pi}{4} + A\right)$



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119. If  $\cos(\theta - \alpha), \cos \theta, \cos(\theta + \alpha)$  are in H.P. then  $\cos \theta \cdot \frac{\sec(\alpha)}{2} =$



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120. If  $f(x) = \cos[\pi^2]x$ , where  $[x]$  stands for the greatest integer function, then (a)  $f\left(\frac{\pi}{2}\right) = -1$  (b)  $f(\pi) = 1$  (c)  $f(-\pi) = 0$  (d)  $f\left(\frac{\pi}{4}\right) = 1$



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121. If  $\sec \theta + \tan \theta = 1$ , then one root of the equation  $a(b - c)x^2 + b(c - a)x + c(a - b) = 0$  is (A)  $\tan \theta$  (B)  $\sec \theta$  (C)  $\cos \theta$  (D)  $\sin \theta$



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122. If  $\cos x + \sec x = -2$  then for a positive integer  $n$ ,  $\cos^n x + \sin^n x$  is



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123. let  $0 < \phi < \frac{\pi}{2}$ ,  $x = \sum_{n=0}^{\infty} \cos^{2n} \phi$ ,  $y = \sum_{n=0}^{\infty} \sin^{2n} \phi$  and  $z = \sum_{n=0}^{\infty} \cos^{2n} \phi \sin^{2n} \phi$



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124. The equation  $\sin^6 + \cos^6 = a^2$  has real solution if

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125.

$$2\tan^2 \alpha \tan^2 \beta \tan^2 \gamma + \tan^2 \alpha \tan^2 \beta + \tan^2 \beta \tan^2 \gamma + \tan^2 \gamma \tan^2 \alpha = 1$$

find the value of  $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma$

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126. If  $\tan \theta = \frac{\sin \alpha - \cos \alpha}{\sin \alpha + \cos \alpha}$ , then (A)  $\sin \alpha - \cos \alpha = \pm \sqrt{2} \sin \theta$  (B)

$\sin \alpha + \cos \alpha = \pm \sqrt{2} \cos \theta$  (C)  $\cos 2\theta = \sin 2\alpha$  (D)  $\sin 2\theta + \cos 2\alpha = 0$

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127. If  $\tan A$  and  $\tan B$  are the roots of the quadratic equation

$$x^2 - px + q = 0$$
 then value of  $\sin^2(A + B)$



128. Statement 1. If  $p = 7 + \tan \alpha \cdot \tan \beta$ ,  $q = 5 + \tan \beta \cdot \tan \gamma$  and  $r = 3 = \tan \gamma \cdot \tan \alpha$  then the maximum value of  $\sqrt{p} + \sqrt{q} + \sqrt{r}$  is 4.,  
Statement 2.  $\tan \alpha \cdot \tan \beta + \tan \beta \cdot \tan \gamma + \tan \gamma \cdot \tan \alpha = 1$



129. Statement 1.  $\alpha$  and  $\beta$  are two distinct solutions of the equations  $a \cos x + b \sin x = c$ , then  $\tan\left(\frac{\alpha + \beta}{2}\right)$  is independent for  $c$ ,  
Statement 2. Solution  $a \cos x + b \sin x = c$  is possible, if  $-\sqrt{a^2 + b^2} \leq c \leq \sqrt{a^2 + b^2}$  (A) Both Statement 1 and Statement 2 are true and Statement 2 is the correct explanation of Statement 1 (B) Both Statement 1 and Statement 2 are true and Statement 2 is not the correct explanation of Statement 1 (C) Statement 1 is true but Statement 2 is false. (D) Statement 1 is false but Statement 2 is true



130. Statement 1.  $2^{\sin x} + 2^{\cos x} \geq 2^{1 - \frac{1}{\sqrt{2}}}$  for all real  $x$ , Statement 2. For positive numbers,  $AM \geq G.M.$  (A) Both Statement 1 and Statement 2 are true and Statement 2 is the correct explanation of Statement 1 (B) Both Statement 1 and Statement 2 are true and Statement 2 is not the correct explanation of Statement 1 (C) Statement 1 is true but Statement 2 is false. (D) Statement 1 is false but Statement 2 is true



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131.  $\frac{\tan x}{\tan 3x}$  wherever defined cannot lie between  $\frac{1}{3}$  and 3.



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132. Let  $\alpha$  be a root of the equation  $(2 \sin x - \cos x)(1 + \cos x) = \sin^2 x$   $\beta$  is a root of the equation  $3 \cos^2 x - 10 \cos x + 3 = 0$   $\gamma$  be a root of the equation  $1 - \sin 2x = \cos x - \sin x$   $0 \leq \alpha, \beta, \gamma \leq \frac{\pi}{2}$   $\cos \alpha + \cos \beta + \cos \gamma$  can be equal to (A)  $3\sqrt{6} + 2\sqrt{2} + 6\sqrt{2}$  (B)  $\frac{3\sqrt{3} + 8}{12}$  (C)  $\frac{3\sqrt{3} + 2}{6}$  (D) none of these



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133. Let  $\alpha$  be a root of the equation  $(2 \sin x - \cos x)(1 + \cos x) = \sin^2 x$   
 $\beta$  is a root of the equation  $3 \cos^2 x - 10 \cos x + 3 = 0$   $\gamma$  be a root of the  
equation  $1 - \sin 2x = \cos x - \sin x$   $0 \leq \alpha, \beta, \gamma \leq \frac{\pi}{2}$   
 $\sin \alpha + \sin \beta + \sin \gamma$  can be equal to (A)  $\frac{14 + 3\sqrt{2}}{6}$  (B) 43226 (C)  
 $\frac{3 + 4\sqrt{2}}{6}$  (D)  $\frac{1 + \sqrt{2}}{2}$



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134. Let  $\alpha$  be a root of the equation  $(2 \sin x - \cos x)(1 + \cos x) = \sin^2 x$   
 $\beta$  is a root of the equation  $3 \cos^2 x - 10 \cos x + 3 = 0$   $\gamma$  be a root of the  
equation  $1 - \sin 2x = \cos x - \sin x$   $0 \leq \alpha, \beta, \gamma \leq \frac{\pi}{2}$  The value of  
 $\sin(\alpha - \beta)$  is equal to (A) 1 (B) 0 (C)  $\frac{1 - 2\sqrt{6}}{6}$  (D)  $\frac{\sqrt{3} - 2\sqrt{2}}{6}$



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135. If alpha is a root of equation (1) and beta is a root of (2), then

$$\tan \alpha + \tan \beta \text{ may be equal to } (\text{A}) 1 + \frac{\sqrt{69}}{6} \quad (\text{B}) 1 + 2 \frac{\sqrt{69}}{6} \quad (\text{C})$$

$$\frac{3 + \sqrt{69}}{6} \quad (\text{D}) (-3 - \sqrt{69})/3$$



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136. If  $\tan \alpha, \tan \beta$  satisfy equation (1) and  $\cos \gamma, \cos \delta$  satisfy (2), then

$$\tan \alpha + \tan \beta + \cos \gamma + \cos \delta \text{ may be equal to } (\text{A}) -1 \quad (\text{B}) -\frac{5}{3} + \frac{2}{\sqrt{13}} \quad (\text{C})$$

$$\frac{5}{3} - \frac{1}{\sqrt{13}} \quad (\text{D}) -\frac{5}{3} - \frac{2}{\sqrt{13}}$$



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137. The number of solutions common to equations (1) and (2) is (A) 0 (B)

1 (C) finite (D) infinite



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**138.** Prove that  $\tan 70^0 = 2\tan 50^0 + \tan 20^0$



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**139.** If  $0 < \alpha < \frac{\pi}{4}$  then the range of  $\csc 2\alpha - \cot 2\alpha$  is (A)  $(0,1)$  (B)  $[1, \infty)$  (C)  $\mathbb{R}$  (D)  $[0, \infty)$



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**140.** If a line makes an angle of  $\pi/4$  with the positive directions of each of x-axis and y-axis, then the angle that the line makes with the positive direction of the z-axis is



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**141.**  $\tan^2\left(\frac{\pi}{16}\right) + \tan^2\left(\frac{2\pi}{16}\right) + \tan^2\left(\frac{3\pi}{16}\right) + \dots + \tan^2\left(\frac{7\pi}{16}\right) = 35$



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**142.** If  $\sec A \tan B + \tan A \sec B = 91$ , then the value of  $(\sec A \sec B + \tan A \tan B)^2$  is equal to....



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**143.** If  $9 \frac{x}{\cos \theta} + 5 \frac{y}{\sin \theta} = 56$  and  $9x \frac{\sin \theta}{\cos^2 \theta} - 5y \frac{\cos \theta}{\sin^2 \theta} = 0$  then value of  $\frac{[(9x)^{\frac{2}{3}} + (5y)^{\frac{2}{3}}]^3}{784}$  is



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**144.** If  $\alpha + \beta = \gamma$  and  $\tan \gamma = 22$ ,  $a$  is the arithmetic and  $b$  is the geometric mean respectively between  $\tan \alpha$  and  $\tan \beta$ , then the value of  $\left( \frac{a^3}{(1 - b^2)^3} \right)$  is equal to



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**145.** If  $\cos x = \tan y$ ,  $\cos y = \tan z$  and  $\cos z = \tan x$ , prove that  
 $\sin x = \sin y = \sin z = \sin 18^\circ$

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**146.** Prove that,  $\sin x \cdot \sin y \cdot \sin(x - y) + \sin y \cdot \sin z \cdot \sin(y - z) + \sin z \cdot \sin x \cdot \sin(z - x) + \sin(x - y) \cdot \sin(y - z) \cdot \sin(z - x) = 0$

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**147.** If  $\tan \alpha = \frac{m}{m+1}$  and  $\tan \beta = \frac{1}{2m+1}$ , then  $\alpha + \beta$  is equal to

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**148.** If  $\cos(\alpha + \beta) = \frac{4}{5}$ ;  $\sin(\alpha - \beta) = \frac{5}{13}$  and  $\alpha, \beta$  lie between  $0 & \frac{\pi}{4}$   
then find the value of  $\tan 2\alpha$

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**149.** Prove that  $5 \cos \theta + 3 \cos\left(\theta + \frac{\pi}{3}\right) + 3$  lies between  $-4$  and  $10$ .



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**150.** Find the area of the smaller portion of a disc of radius  $10$  cm cut off by a chord  $AB$  which subtends an angle of  $\left(22\frac{1}{2}\right)^\circ$  at the circumference.



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**151.** If  $\tan \theta = -\frac{4}{3}$ , then  $\sin \theta$  is  $-\frac{4}{5}$  but  $-\frac{4}{5}$  (b)  $-\frac{4}{5}$  or  $\frac{4}{5}$   
 $\frac{4}{5}$  but  $-\frac{4}{5}$  (d) none of these



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**152.** If  $\alpha + \beta + \gamma = 2\pi$ , then (A)

$$\tan\left(\frac{\alpha}{2}\right) + \tan\left(\frac{\beta}{2}\right) + \tan\left(\frac{\gamma}{2}\right) = \tan\left(\frac{\alpha}{2}\right)\tan\left(\frac{\beta}{2}\right)\tan\left(\frac{\gamma}{2}\right) \quad (\text{B})$$

$$\tan\left(\frac{\alpha}{2}\right)\tan\left(\frac{\beta}{2}\right) + \tan\left(\frac{\beta}{2}\right)\tan\left(\frac{\gamma}{2}\right) + \tan\left(\frac{\gamma}{2}\right)\tan\left(\frac{\alpha}{2}\right) = 1 \quad (\text{C})$$

$$\tan\left(\frac{\alpha}{2}\right) + \tan\left(\frac{\beta}{2}\right) + \tan\left(\frac{\gamma}{2}\right) = \tan\left(\frac{\alpha}{2}\right)\tan\left(\frac{\beta}{2}\right)\tan\left(\frac{\gamma}{2}\right)$$

(D) none

of these



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153. For all real value of  $\theta$ ,  $A = \sin^2 \theta + \cos^4 \theta$



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154. Given  $\alpha + \beta - \gamma = \pi$ , prove that  
 $\sin^2 \alpha + \sin^2 \beta - \sin^2 \gamma = 2 \sin \alpha \sin \beta \cos \gamma$



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155. For all values of  $\theta \in \left[0, \frac{\pi}{2}\right]$ , show that  $\cos(\sin \theta) \geq \sin(\cos \theta)$



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**156.** Without using tables, prove that  $(\sin 12^\circ)(\sin 48^\circ)(\sin 54^\circ) = \frac{1}{8}$



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**157.**  $\tan A = \frac{1 - \cos B}{\sin B} \Rightarrow \tan 2A - \tan B =$



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**158.** The larger of  $\cos(\ln \theta)$  and  $\ln(\cos \theta)$  if  $\theta \in [e^{-\pi/2}, e^{\pi/2}]$



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**159.** Prove that:  $\cos\left(\frac{2\pi}{15}\right) \cdot \cos\left(\frac{4\pi}{15}\right) \cdot \cos\left(\frac{8\pi}{15}\right) \cdot \cos\left(\frac{16\pi}{15}\right) = \frac{1}{16}$



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160.

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



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161.

The

expression

$$3 \left[ \sin^4\left(\frac{3}{2}\pi - \alpha\right) + \sin^4(3\pi + \alpha) \right] - 2 \left[ \sin^6\left(\frac{1}{2}\pi + \alpha\right) + \sin^6(5\pi - \alpha) \right]$$

is equal to



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162. The number of all triplets  $(a_1, a_2, a_3)$  such that

$$a_1 + a_2 \cos 2x + a_3 \sin^2 x = 0 \text{ for all } x \text{ is : (A) 0 (B) 1 (C) 3 (D) Infinite}$$



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163. The sides of a triangle inscribed in a circle subtend angles  $\alpha, \beta, \gamma$  at the centre. The minimum value of the arithmetic mean of  $\cos\left(\alpha + \frac{\pi}{2}\right), \cos\left(\beta + \frac{\pi}{2}\right), \cos\left(\gamma + \frac{\pi}{2}\right)$  is equal to



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164. prove that :  $\tan(\alpha) + 2\tan(2\alpha) + 4(\tan 4\alpha) + 8 \cot(8\alpha) = \cot(\alpha)$



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165. Show that  $\sqrt{3} \cos ec 20^\circ - \sec 20^\circ = 4$



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166. If  $f(x) = \cos[\pi^2]x$ , where  $[x]$  stands for the greatest integer function, then (a)  $f\left(\frac{\pi}{2}\right) = -1$  (b)  $f(\pi) = 1$  (c)  $f(-\pi) = 0$  (d)  $f\left(\frac{\pi}{4}\right) = 1$



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**167.** Prove that  $\frac{\tan 3x}{\tan x}$  never lies between  $\frac{1}{3}$  and 3.



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**168.** let  $0 < \phi < \frac{\pi}{2}$ ,  $x = \sum_{n=0}^{\infty} \cos^{2n} \phi$ ,  $y = \sum_{n=0}^{\infty} \sin^{2n} \phi$  and  
 $z = \sum_{n=0}^{\infty} \cos^{2n} \phi \sin^{2n} \phi$



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**169.** If  $K = \sin\left(\frac{\pi}{18}\right) \sin\left(\frac{5\pi}{18}\right) \sin\left(\frac{7\pi}{18}\right)$ , then the numerical value of  $K$  is \_\_\_\_\_



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**170.** For all values of  $A, B, C$  and  $P, Q, R$  show that  
 $|\cos(A - P)\cos(A - Q)\cos(A - R)\cos(B - P)\cos(B - Q)\cos(B - R)\cos(C - P)\cos(C - Q)\cos(C - R)|$



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171. The number of points of intersection of two curves

$$y = 2 \sin x \text{ and } y = 5x^2 + 2x + 3 \text{ is}$$

- a. 0
- b. 1
- c. 2
- d.  $\infty$



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172. Let '0



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



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174. The minimum value of the expression  $\sin \alpha + \sin \beta + \sin \gamma$ , where

$\alpha, \beta, \gamma$  are real numbers satisfying  $\alpha + \beta + \gamma = \pi$  is



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175.  $\sec^2 \theta = \frac{4xy}{(x+y)^2}$  is true if and only if  $x + y \neq 0$  (b)  $x = y, x \neq 0$

x = y (d)  $x \neq 0, y \neq 0$



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176. If  $\cos(x - y)$ ,  $\cos x$  and  $\cos(x + y)$  are in H.P., are in H.P., then

$$\cos x \cdot \sec\left(\frac{y}{2}\right) =$$



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177. The graph of the function  $y = \cos x \cos(x + 2) - \cos^2(x + 1)$  is:

- (A) A straight line passing through  $(0, \sin^2 1)$  with slope 2
- (B) A straight line passing through  $(0, 0)$
- (C) A parabola with vertex  $(1, -\sin^2 1)$



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178. 9 Prove that the values of the function  $\frac{\sin x \cos 3x}{\sin 3x \cos x}$  cannot lie between  $\frac{1}{3}$  and 3 for any real  $x$

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179. For each natural number  $k$ , let  $C_k$  denotes the circle radius  $k$  centimeters in the counter-clockwise direction. After completing its motion on  $C_k$ , the particle moves to  $C_{k+1}$  in the radial direction. The motion of the particle continues in this manner. The particle starts at  $(1,0)$ . If the particle crosses the positive direction of the  $x$ -axis for first time on the circle  $C_n$ , then  $n$  equal to

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180. The number of values of  $x$  where the function  $f(x) = \cos x + \cos(\sqrt{2}x)$  attains its maximum value is

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- 181.** Which of the following number (s) is/are rational number? (A)  $\sin 15^\circ$   
(B)  $\cos 15^\circ$  (C)  $\sin 15^\circ \cos 15^\circ$  (D)  $\sin 15^\circ \cos 75^\circ$



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- 182.** Let  $f(\theta) = \sin \theta (\sin \theta + \sin 3\theta)$ , then  $f(\theta)$  (A)  $\geq 0$  only when  $\theta \geq 0$   
(B)  $\geq 0$  for all real  $\theta$  (C)  $\geq 0$  for all real  $\theta$  (D)  $\leq 0$  only when  $\theta \leq 0$



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- 183.** If  $\alpha + \beta = \frac{\pi}{2}$  and  $\beta + \gamma = \alpha$  then  $\tan \alpha$  equals (A)  
2( $\tan \beta + \tan \gamma$ ) (B)  $\tan \beta + \tan \gamma$  (C)  $\tan \beta + 2 \tan \gamma$  (D)  $2 \tan \beta + \tan \gamma$



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184. The length of the longest interval, in which the function  $3 \sin x - 4 \sin^3 x$  is increasing is

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185. Let '0< alpha

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186. If  $\alpha \in \left(0, \frac{\pi}{2}\right)$ , then  $\sqrt{x^2 + x} + \frac{\tan^2 \alpha}{\sqrt{x^2 + x}}$  is always greater than or equal to  $2 \tan \alpha 1 2 \sec^2 \alpha$

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187. If  $\frac{\sin^4 x}{2} + \frac{\cos^4 x}{3} = \frac{1}{5}$  then  $\tan^2 x = \frac{2}{3}$  (b)  
 $\frac{\sin^8 x}{8} + \frac{\cos^8 x}{27} = \frac{1}{125}$   $\tan^2 x = \frac{1}{3}$  (d)  $\frac{\sin^8 x}{8} + \frac{\cos^8 x}{27} = \frac{2}{125}$

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**188.** Two parallel chords of a circle of radius 2 are at a distance  $\sqrt{3} + 1$  apart. If the chords subtend at the centre, Angles of  $\frac{\pi}{k}$  and  $2\frac{\pi}{k}$ , where  $k > 0$  then the value of [k] is :



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**189.** The maximum vale of the expression  $\frac{1}{\sin^2 \theta + 3 \sin \theta \cos \theta + 5 \cos^2 \theta}$  is



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**190.** A triangle  $PQR$ ,  $\angle R = 90^\circ$  and  $\tan\left(\frac{P}{2}\right)$  and  $\tan\left(\frac{Q}{2}\right)$  roots of the  $ax^2 + bx + c = 0$  then prove that  $a + b = c$



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**191.** The value of  $\frac{1 - \tan^2 15^\circ}{1 + \tan^2 15^\circ}$  is (A) 1 (B)  $\sqrt{3}$  (C)  $\frac{\sqrt{3}}{2}$  (D) 2



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**192.** If  $\sin(\alpha + \beta) = 1$ ,  $\sin(\alpha - \beta) = \frac{1}{2}$  where  $\alpha, \beta \in [0, \frac{\pi}{2}]$ , then  $\tan(\alpha + 2\beta)\tan(2\alpha + \beta)$  is equal to



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



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**194.**  $\pi < \alpha - \beta < 3\pi$ ,  $\sin \alpha + \sin \beta = -\frac{21}{65}$ ,  $\cos \alpha + \cos \beta = -\frac{27}{65}$ , then  $\cos\left(\frac{\alpha - \beta}{2}\right) =$  (A)  $-\frac{6}{65}$  (B)  $-\frac{3}{\sqrt{130}}$  (C)  $\frac{3}{\sqrt{130}}$  (D)  $\frac{6}{65}$



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195. Let A and B denote the statements A:  $\cos a + \cos b + \cos g = 0$  B :  $\sin a + \sin b + \sin g = 0$  If  $\cos(bg) + \cos(ga) + \cos(ab) = 3/2$ , then (1) A is true and B is false (2) A is false and B is true (3) both A and B are true (4) both A and B are false



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196. Let  $\cos(\alpha + \beta) = \frac{4}{5}$  and let  
 $\sin(\alpha - \beta) = \frac{5}{13}$ , where  $0 \leq \alpha, \beta \leq \frac{\pi}{4}$ . Then  $\tan 2\alpha =$  a.  $\frac{56}{33}$  b.  $\frac{19}{12}$  c.  $\frac{20}{7}$  d.  $\frac{25}{16}$



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197. For a regular polygon, let r and R be the radii of the inscribed and the circumscribed circles. A false statement among the following is There is a regular polygon with  $\frac{r}{R} = \frac{1}{\sqrt{2}}$  (17) There is a regular polygon with

$\frac{r}{R} = \frac{2}{3}$  (30) There is a regular polygon with  $\frac{r}{R} = \frac{\sqrt{3}}{2}$  (47) There is a regular polygon with  $\frac{r}{R} = \frac{1}{2}$  (60)



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