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MATHS

BOOKS - KC SINHA MATHS (HINGLISH)

INVERSE TRIGONOMETRIC FUNCTIONS - FOR BOARDS

Solved Examples

1. Evaluate : $\tan^{-1}(-1)$

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2. Evaluate : $\cot^{-1}(-1)$

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3. Evaluate : $\sin^{-1}\left(-\frac{\sqrt{3}}{2}\right)$

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4. Find the value of $\sin\left[\frac{\pi}{3}-\sin^{-1}\left(-\frac{1}{2}\right)\right]$

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5. Find the value of $\sin\left[arc\cos\left(-\frac{1}{2}\right)\right]$

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6. Find the value of $\sin\left[\tan\tan^{-1}(-\sqrt{3})+\cos^{-1}\left(\frac{\sqrt{3}}{-2}\right)\right]$

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7. Evaluate: $\left\{\frac{2\tan^{-1}1}{5}-\frac{\pi}{4}\right\}$ (ii) $\tan\left\{\frac{1}{2}\frac{\cos^{-1}\left(\sqrt{5}\right)}{3}\right\}$

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8. Find the angle $\sin^{-1}\sin\left(\frac{2\pi}{3}\right)$

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9. Evaluate : $\sin\left[\frac{\pi}{2}-\sin^{-1}\left(-\frac{\sqrt{3}}{2}\right)\right]$

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10. Write the following function in the simplest form: `tan^(-1)x/(sqrt(a^2-x^2)),|x|

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11. convert in the simplest form: $\tan^{-1}\left(\sqrt{\frac{1-\cos x}{1+\cos x}}\right), x < \pi$

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12. Write the following function in the simplest form: $\tan^{-1}\left(\frac{3a^2x - x^3}{a^3 - 3ax^2}\right), a > 0; \frac{-a}{\sqrt{3}} \leq x \leq \frac{a}{\sqrt{3}}$

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13. Write the following function in the simplest form: `tan^(-1)((cosx-sinx)/(cosx+sinx)), x

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14. Prove that $\tan^{-1}\left[\frac{\sqrt{1+x^2}+\sqrt{1-x^2}}{\sqrt{1+x^2}-\sqrt{1-x^2}}\right] = \frac{\pi}{4} + \frac{1}{2}\cos^{-1}x^2$

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15. Prove that: $\tan^{-1}\sqrt{x} = \frac{1}{2}\cos^{-1}\left(\frac{1-x}{1+x}\right), x \in [0, 1]$

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16.

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

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17. Find the value of: $\cot\left(\tan^{-1}a + \cot^{-1}a\right)$

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18. Find the value of : $\sin\left(\sin^{-1}x + \cos^{-1}x\right)$

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19. Find the value of:

$$\frac{\tan 1}{2}\left[\frac{\sin^{-1}(2x)}{1+x^2}+\frac{\cos^{-1}(1-y^2)}{1+y^2}\right], |x|<1, y>0 \text{ and } xy<1$$

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20. $\tan^{-1}\left(\frac{1}{4}\right)+\tan^{-1}\left(\frac{2}{9}\right)=\frac{1}{2}\tan^{-1}\left(\frac{4}{3}\right)$

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21. Prove that: $\tan^{-1}\left(\frac{1}{4}\right)+\tan^{-1}\left(\frac{2}{9}\right)=\frac{1}{2}\cos^{-1}\left(\frac{3}{5}\right)$.

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22. prove that $2\frac{\tan^{-1}1}{3}+\frac{\tan^{-1}1}{7}=\frac{\pi}{4}$

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23. Prove that $tan^{-1}\frac{1}{3}+tan^{-1}\frac{1}{5}+tan^{-1}\frac{1}{7}+tan^{-1}\frac{1}{8}=\frac{\pi}{4}$

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24. Prove that: $\sin^{-1}\left(\frac{4}{5}\right)+\sin^{-1}\left(\frac{5}{13}\right)+\sin^{-1}\left(\frac{16}{65}\right)=\frac{\pi}{2}$

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25. Prove the following: $4\frac{\tan^{-1}1}{5}-\frac{\tan^{-1}1}{70}+\frac{\tan^{-1}1}{99}=\frac{\pi}{4}$

$2tan^{-1}\frac{1}{5}+sec^{-1}\frac{5\sqrt{2}}{7}+2\frac{\tan^{-1}1}{8}=\frac{\pi}{4}$

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26. Prove that $\cot^{-1}9+\cos ec^{-1}\frac{\sqrt{41}}{4}=\frac{\pi}{4}$

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27. $4\left(\cot^{-1}3 + cosec^{-1}\sqrt{5}\right) = \pi$

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28. Prove the following:

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

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29. Prove that :

$$\tan^{-1}\left(\frac{x-y}{1+xy}\right) + \tan^{-1}\left(\frac{y-z}{1+yz}\right) + \tan^{-1}\left(\frac{z-x}{1+zx}\right) = \tan^{-1}\left(\frac{x^2-y^2}{1+x^2y^2}\right) + \tan^{-1}\left(\frac{y^2-z^2}{1+y^2z^2}\right) + \tan^{-1}\left(\frac{z^2-x^2}{1+z^2x^2}\right)$$

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30. Prove that

$$\tan\left(\frac{\text{pi}}{4} + \frac{1}{2}\cos^{-1}\backslash\backslash\ \frac{\text{a}}{\text{b}}\right) + \tan\backslash\ \left(\frac{\text{pi}}{4} + \frac{1}{2}\cos^{-1}\backslash\backslash\ \frac{\text{a}}{\text{b}}\right) = \frac{2\text{b}}{\text{a}}.$$

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31. Prove that : $\sin \cot^{-1} \tan \cos^{-1} x = x$

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32. In any triangle ABC, if $A = \tan^{-1} 2$ and $B = \tan^{-1} 3$. Prove that $C = \frac{\pi}{4}$.

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33. If $\cos^{-1} x + \cos^{-1} y + \cos^{-1} = \pi, provethatx^2 + y^2 + z^2 + 2xyz = 1.$

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34. If $\frac{\cos^{-1} x}{a} + \frac{\cos^{-1} y}{b} = \alpha,$ prove that $\frac{x^2}{a^2} - 2\frac{xy}{ab}\cos \alpha + \frac{y^2}{b^2} = \sin^2 \alpha$

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35. Solve : $2\tan^{-1}(\cos x) = \tan^{-1}(2\cos ecx)$

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36. Solve the equations. $\frac{\tan^{-1}(1-x)}{1+x} = \frac{1}{2}\tan^{-1}x, (x > 0)$

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37. Solve : $\sin^{-1}(x) + \sin^{-1}(2x) = \sin^{-1}\left(\frac{\sqrt{3}}{2}\right).$

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38. $\cos^{-1}x\sqrt{3} + \cos^{-1}x = \frac{\pi}{2}$

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Exercise

1. Find the value of : $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$

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2. Find the value of : $\tan^{-1}\left(-\frac{1}{\sqrt{3}}\right)$

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3. Find the principal values of each of the following: $\cot^{-1}(-\sqrt{3})$ (ii) $\cot^{-1}(\sqrt{3})$

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4. Find the value of : $\cot^{-1}\cot\left(\frac{5\pi}{4}\right)$

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5. Find the value of $\tan^{-1}\left(\frac{\tan(3\pi)}{4}\right)$

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6. Find the value of : $arc\sin\left(\frac{1}{2}\right) + arc\cos\left(\frac{1}{2}\right)$

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7. Find the value of the following: $\tan^{-1}\left(\frac{\tan(7\pi)}{6}\right)$

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8. Find the value of the following: $\cos^{-1}\left(\frac{\cos(13\pi)}{6}\right)$

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9. Find the value of $\sin^{-1}\left(\frac{\sin(3\pi)}{5}\right)$.

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10. Find the principal value of : $\tan^{-1}\sqrt{3}$

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11. Find the principal value of: $\sin^{-1}\left(-\frac{1}{2}\right)$

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12. Find the principal value of: $\tan^{-1}(-1)$

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13. Find the principal values of $\operatorname{cosec}^{-1}(2)$ and $\operatorname{cosec}^{-1}\left(-\frac{2}{\sqrt{3}}\right)$

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14. Find the principal value of: $\cos^{-1}\left(-\frac{1}{2}\right)$

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15. Find the principal value of: $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$

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16. What is the principal value of $\cos^{-1}\left(\frac{\cos(2\text{pi})}{3}\right)+\sin^{-1}\left(\frac{\sin(2\pi)}{3}\right)$?

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17. Evaluate the following: $\cos\left(\tan^{-1}3/4\right)$

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18. Evaluate that : $\cos\left[\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)+\frac{\pi}{6}\right]$

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19. Evaluate that : $2arc\sin\left(\frac{1}{2}\right)+3arc\tan(-1)+2arc\cos\left(-\frac{1}{2}\right)$

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20. Write the simplest form : $\tan^{-1}\left(\frac{1}{\sqrt{x^2-1}}\right), |x|>1$

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21. Write the following function in the simplest form: $\frac{\tan^{-1}\left(\sqrt{1+x^2}-1\right)}{x}, x\neq 0$

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22. Write the simplest form : $\tan^{-1}\left(\frac{\cos x}{1+\sin x}\right)$

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23. Write the simplest form : $\cot^{-1}\left[\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right], x\varepsilon\left[0, \frac{\pi}{4}\right]$

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24. Write the simplest form : $\cos^{-1}\left(\sqrt{\left(\frac{\sqrt{1+x^2}+1}{2\sqrt{1+x^2}}\right)}\right.$

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25. Write the simplest form :

$$\tan^{-1}\left(\frac{\sqrt{1+x}-\sqrt{1-x}}{\sqrt{1+x}+\sqrt{1-x}}\right); \frac{-1}{\sqrt{2}} \leq x \leq 1$$

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26. Prove that: $\frac{\tan^{-1}2}{11}+\frac{\tan^{-1}7}{24}=\frac{\tan^{-1}1}{2}$

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27. Prove that :

$$\tan^{-1}\left(\frac{1}{2}\right)+\tan^{-1}\left(\frac{1}{3}\right)=\tan^{-1}\left(\frac{3}{5}\right)+\tan^{-1}\left(\frac{1}{4}\right)=\frac{\pi}{4}$$

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28. Prove that : $\tan^{-1}\left(\frac{2a-b}{b\sqrt{3}}\right)+\tan^{-1}\left(\frac{2b-a}{a\sqrt{3}}\right)=\frac{\pi}{3}$

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29. $2\tan^{-1}\frac{1}{5}+\tan^{-1}\frac{1}{4}=\tan^{-1}\frac{32}{43}$

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30. Prove that: $2\frac{\tan^{-1}1}{2}+\frac{\tan^{-1}1}{7}=\frac{\tan^{-1}(31)}{17}$

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31. Prove that :

$\tan^{-1}1+\tan^{-1}2+\tan^{-1}3=\pi=2\left(\tan^{-1}1+\tan^{-1}\left(\frac{1}{2}\right)+\tan^{-1}\left(\frac{1}{3}\right.\right.$

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32. Prove that : $\tan^{-1}\left[2\cos\left(2\sin^{-1}\left(\frac{1}{2}\right)\right)\right]=\frac{\pi}{4}$

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33. Prove that : $\tan\left(\sin^{-1}\left(\frac{3}{5}\right)+\cot^{-1}\left(\frac{3}{2}\right)\right)=\frac{17}{6}$

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34. Prove that : $\tan^{-1}x+\cot^{-1}y=\tan^{-1}\left(\frac{xy+1}{y-x}\right)$

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35. Prove that : $\tan^{-1}x+\cot^{-1}(1+x)=\tan^{-1}(1+x+x^2)$

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36. $\tan^{-1}\left(\frac{1}{x+y}\right)+\tan^{-1}\left(\frac{y}{x^2+xy+1}\right)=\cot^{-1}x$

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37. $2\cot^{-1}5+\cot^{-1}7+2\cot^{-1}8=\frac{\pi}{4}$

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38. Prove that $\tan^{-1}\left(\frac{a-b}{1+ab}\right)+\tan^{-1}\left(\frac{b-c}{1+bc}\right)+\tan^{-1}\left(\frac{c-a}{1+ca}\right)=0,$ $ab>(-1), bc>(-1), ca>(-1)$

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39. Prove that :

$$\tan^{-1}\left(\frac{a^3-b^3}{1+a^3b^3}\right)+\tan^{-1}\left(\frac{b^3-c^3}{1+b^3c^3}\right)+\tan^{-1}\left(\frac{c^3-a^3}{1+c^3a^3}\right)=0$$

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40. Prove that $\sin^{-1}\left(\frac{8}{17}\right)+\sin^{-1}\left(\frac{3}{5}\right)=\sin^{-1}\left(\frac{77}{85}\right)$

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41. Prove that $\cos^{-1}\left(\frac{3}{5}\right)+\cos^{-1}\left(\frac{12}{13}\right)+\cos^{-1}\left(\frac{63}{65}\right)=\frac{\pi}{2}$

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42. Prove that $\sin^{-1}\left(\frac{8}{17}\right)+\sin^{-1}\left(\frac{3}{5}\right)=\sin^{-1}\left(\frac{77}{85}\right)$

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43. Prove that: $\frac{\cos^{-1}(12)}{13}+\frac{\sin^{-1}3}{5}=\frac{\sin^{-1}(56)}{65}$

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44. Prove that: $\frac{\tan^{-1}4}{5}+\frac{\cos^{-1}(12)}{13}=\frac{\cos^{-1}(33)}{65}$

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45. Show that $\frac{\sin^{-1}3}{5} - \frac{\sin^{-1}8}{17} = \frac{\cos^{-1}(84)}{85}$.

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46. Prove that : $\frac{\tan^{-1}(63)}{16} = \frac{\sin^{-1}5}{13} + \frac{\cos^{-1}3}{5}$

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47. Prove that: $\frac{\sin^{-1}(12)}{13} + \frac{\cos^{-1}4}{5} + \frac{\tan^{-1}(63)}{16} = \pi$

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48. Prove that :$2\sin^{-1}\left(\frac{3}{5}\right) = \tan^{-1}\left(\frac{24}{7}\right)$

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49. Prove that: $\frac{9\pi}{8} - \frac{9}{4}\frac{\sin^{-1}1}{3} = \frac{9}{4}\frac{\sin^{-1}\left(2\sqrt{2}\right)}{3}$

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50. $\sin^{-1}x + \sin^{-1}y = \cos^{-1}\left(\sqrt{1-x^2}\sqrt{1-y^2} - xy\right)$ if $x \in [0, 1], y \in [0, 1]$

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51. Prove that : $4\left(\sin^{-1}\left(\frac{1}{\sqrt{10}}\right) + \cos^{-1}\left(\frac{2}{\sqrt{5}}\right)\right) = \pi$

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52. Prove that : $\cos\left(2\sin^{-1}x\right) = 1 - 2x^2$

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53. Prove that : $\cos\left(\sec^{-1}x + \cos ec^{-1}x\right) = 0, |x| \geq 1$

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54.

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

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55. Prove that $\sin^{-1}x + \cos^{-1}y = \dfrac{\tan^{-1}\left(xy + \sqrt{(1-x^2)(1-y^2)}\right)}{y\sqrt{1-x^2} - x\sqrt{1-y^2}}$

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56. $\tan^{-1}x + \tan^{-1}y = \dfrac{1}{2}\dfrac{\sin^{-1}(2(x+y)(1-xy))}{(1+x^2)(1+y^2)}$

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57. Prove that : $2\tan^{-1}\left(\cos ec\tan^{-1}x - \tan\cot^{-1}x\right) = \tan^{-1}x$

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58. Prove that $\cos\tan^{-1}\sin\cot^{-1}x = \sqrt{\frac{x^2+1}{x^2+2}}$

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59. If $\tan^{-1}x + \tan^{-1}y + \tan^{-1}z = \frac{\pi}{2}$ then prove that $yz + zx + xy = 1$

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60. If $\tan^{-1}x + \tan^{-1}y + \tan^{-1}z = \pi$ prove that $x + y + z = xyz$

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61. If $\sin^{-1} x + \sin^{-1} y = \frac{\pi}{2}$, prove that $x\sqrt{1-x^2} + y\sqrt{1-y^2} = 1$.

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62. If $\tan^{-1} x, \tan^{-1} y$ and $\tan^{-1} z$ are in A.P. then find the algebraic relation between x,y and z. If x, y, z are also in A.P. then show that $x = y = z$ and $y \neq 0$

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63. Solve for $x : \cot^{-1} x + \sin^{-1}\left(\frac{1}{\sqrt{5}}\right) = \frac{\pi}{4}$

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64. Solve for $x : \sin\left(\sin^{-1}\left(\frac{1}{5}\right) + \cos^{-1} x\right) = 1$

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65. Solve : $\tan^{-1} 2x + \tan^{-1} 3x = \frac{\pi}{4}$

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66. Solve : $\tan^{-1} x + \tan^{-1}\left(\frac{2x}{1-x^2}\right) = \frac{\pi}{3}$

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67. Solve : $\tan^{-1}\left(\frac{1}{2}\right) = \cot^{-1} x + \tan^{-1}\left(\frac{1}{7}\right)$

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68. Solve : $\tan^{-1}(x-1) + \tan^{-1} x + \tan^{-1}(x+1) = \tan^{-1} 3x$

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69. Solve : $\tan^{-1}\left(\frac{x+1}{x-1}\right) + \tan^{-1}\left(\frac{x-1}{x}\right) = \pi + \tan^{-1}(-7)$

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70. Solve the equation $\frac{\tan^{-}(x-1)}{x-2}+\frac{\tan^{-1}(x+1)}{x+2}=\frac{\pi}{4}$

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71. Solve :

$$\sin^{-1}\left(\frac{2\alpha}{1+\alpha^2}\right)+\sin^{-1}\left(\frac{2\beta}{1+\beta^2}\right)=2\tan^{-1}x, |\alpha|\leq 1, |\beta|\leq 1$$

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72. Solve :

$$\sin^{-1}\left(\frac{2a}{1+a^2}\right)+\cos^{-1}\left(\frac{1-b^2}{1+b^2}\right)=2\tan^{-1}x, |a|\leq 1, |b|\geq 0.$$

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73. $\tan^{-1}ax+\frac{1}{2}\sec^{-1}bx=\frac{\pi}{4}$

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74. Solve : $\tan\left(\cos^{-1} x\right) = \sin\left(\tan^{-1} 2\right)$

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75. $\tan\left(\sec^{-1} x\right) = \sin\left(\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)\right)$

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