



MATHS

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INVERSE TRIGONOMETRIC FUNCTIONS

Part I Sample Question

1. Find the principal value of the following

$$\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$$



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2. Find the principal value of the following

$$\cot^{-1}\left(\frac{-1}{\sqrt{3}}\right)$$



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3. Find the value of $\tan^{-1}(-1)$ in the interval $\left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$.

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4. Evaluate $\cos^{-1}\left(\frac{1}{2}\right) + 2\sin^{-1}\left(\frac{1}{2}\right)$.

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5. Find the value of

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

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6. Find the principal value of $\cos^{-1}\left(-\frac{1}{2}\right)$ and find the value of $\cos^{-1}\left(-\frac{1}{2}\right) + \tan^{-1}(-\sqrt{3}) - \operatorname{cosec}^{-1}(2)$.



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Part I Questions For Practice

1. Find the domain of the function defined by $f(x) = \sin^{-1}\sqrt{x-1}$.



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2. Find two branches other than the principal value branch of $\tan^{-1}x$.



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3. Direction (Q.Nos. 3 to 5) Find the principal value of the following

$$\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$$



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4. Direction (Q.Nos. 3 to 5) Find the principal value of the following

$$\operatorname{cosec}^{-1}(-1)(-\sqrt{2})$$

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5. Direction (Q.Nos. 3 to 5) Find the principal value of the following

$$\operatorname{cosec}^{-1}\left(\frac{2}{\sqrt{3}}\right)$$

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

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7. What is the principal value of $\tan^{-1}(0)$ and $\tan^{-1}(-1)$

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8. Write the principal value of $\sin^{-1}\left(-\frac{1}{2}\right) + \cos^{-1}(1)$.

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9. Find the value of $\tan^{-1}\sqrt{3} - \sec^{-1}(-2)$.

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10. Find the value of

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

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Part II Sample Question

1. Evaluate each of the following

$$\cos\left(\cos^{-1}\frac{1}{2}\right)$$



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2. Evaluate each of the following

$$\tan^{-1}\left(\tan\frac{\pi}{4}\right)$$



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3. Evaluate each of the following

$$\sin^{-1}\left(\sin\frac{2\pi}{3}\right)$$



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4. Evaluate each of the following

$$\cos^{-1}\left(\cos\frac{7\pi}{6}\right)$$



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5. What is the principal value of

$$\cos\left(\cos\frac{2\pi}{3}\right) + \sin^{-1}\left(\sin\frac{2\pi}{3}\right)?$$

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6. Evaluate $\cos\left(\tan^{-1}\frac{3}{4}\right)$

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

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

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9. Simplify $\operatorname{cosec}\left(\sin^{-1}\frac{1}{5}\right) + \sec\left(\cos^{-1}\frac{1}{3}\right)$.

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10. Evaluate $\cot(\tan^{-1}a + \cot^{-1}a)$.

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11. Evaluate $\cos(2\cos^{-1}x + \sin^{-1}x)$ at $x = \frac{1}{5}$, where $0 \leq \cos^{-1}x \leq \pi$ and $-\frac{\pi}{2} \leq \sin^{-1}x \leq \frac{\pi}{2}$.

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

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13. Evaluate $\tan\left(\sin^{-1}\frac{3}{5} + \cot^{-1}\frac{3}{2}\right)$.

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14. Write the value of $\tan\left(2\tan^{-1}\frac{1}{5}\right)$.

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15. Solve $\sin^{-1}\left(\frac{3}{5}\right) + \sin^{-1}\left(\frac{8}{17}\right)$.

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16. Find the value of

$$\cos^{-1}\left(\frac{-7}{25}\right) + \cos^{-1}\left(\frac{3}{5}\right).$$

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17. Evaluate $\sin(3\sin^{-1}0.4)$



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18. Find the value of

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



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19. Show 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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20. Write the simplest form of $\sec^{-1}(\sqrt{1+x^2})$.



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21. Express the expression in simplest form $\cos^{-1}\left(\frac{\sqrt{4-x^2}}{2}\right)$, where $|x| \leq 2$.

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22. Express the expression in simplest form $\tan^{-1}\left[\frac{x}{\sqrt{a^2-x^2}}\right]$.

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23. Write 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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24. Show that $\sin^{-1}\left(2x\sqrt{1-x^2}\right) = 2\cos^{-1}x$, $\frac{1}{\sqrt{2}} \leq x \leq 1$.

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25.

Prove

that

$$\cot^{-1} \left(\frac{\sqrt{1 + \sin x} + \sqrt{1 - \sin x}}{\sqrt{1 + \sin x} - \sqrt{1 - \sin x}} \right) = \frac{x}{2}, 0 < x < \frac{\pi}{2}, \text{ or } x \in \left(0, \frac{\pi}{4} \right)$$


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26. Prove that $\cos^{-1}(x) + \cos^{-1} \left\{ \frac{x}{2} + \frac{\sqrt{3 - 3x^2}}{2} \right\} = \frac{\pi}{3}$.


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27. If $\sin \left(\sin^{-1} \frac{1}{5} + \cos^{-1} x \right) = 1$, then find the value of x .


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28. Solve the following equation:

$$\cos(\tan^{-1} x) = \sin \left(\cot^{-1} \frac{3}{4} \right).$$



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29. Solve for x , $\tan^{-1}3x + \tan^{-1}2x = \frac{\pi}{4}$.

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Part II Questions For Practice

1. Write the principal value of $\tan^{-1}\left[\sin\left(-\frac{\pi}{2}\right)\right]$.

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2. Write the principal value of $\cos^{-1}(\cos 680^\circ)$.

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3. Evaluate $\cos\left(\operatorname{cosec}^{-1}\frac{13}{12}\right)$.

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4. Write the value of $\tan\left(2\tan^{-1}\frac{1}{3}\right)$.

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

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6. Write the value of $\tan^{-1}\left(\frac{a}{b}\right) - \tan^{-1}\left(\frac{a-b}{a+b}\right)$.

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7. Simplify $\tan^{-1}\left[\sqrt{\frac{1-\cos x}{1+\cos x}}\right], x < \pi$.

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8. Write $\tan^{-1}\left(\frac{\cos x - \sin x}{\cos x + \sin x}\right)$, $x < \pi$ in the simplest form.

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9. Write $\cot^{-1}\left(\frac{1}{\sqrt{x^2 - 1}}\right)$, $|x| > 1$ in simplest form.

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

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11. Show that $\sin^{-1}\left(\frac{8}{17}\right) + \sin^{-1}\left(\frac{3}{5}\right) = \cos^{-1}\left(\frac{36}{85}\right)$.

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12. If $\tan^{-1}x + \tan^{-1}y = \frac{\pi}{4}$, $xy < 1$,

then write the value of $x + y + xy$.

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13. Prove that $\tan^{-1}\frac{1}{2} + \tan^{-1}\frac{1}{5} + \tan^{-1}\frac{1}{8} = \frac{\pi}{4}$.

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14. Show that $\tan\left(\frac{1}{2}\sin^{-1}\frac{3}{4}\right) = \frac{4 - \sqrt{7}}{3}$.

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15. Solve for x , $\cos(2\sin^{-1}x) = \frac{1}{9}$, $x > 0$.

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16. If $\sin^{-1}(1-x) - 2\sin^{-1}x = \frac{\pi}{2}$, then find the value of x .

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17. If $\tan^{-1}\left(\frac{x-2}{x-4}\right) + \tan^{-1}\left(\frac{x+2}{x+4}\right) = \frac{\pi}{4}$, then find the value of x .

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18. Solve for x ,

$$\tan^{-1}\left(\frac{2x}{1-x^2}\right) + \cot^{-1}\left(\frac{1-x^2}{2x}\right) = \frac{\pi}{3}, \quad -1 < x < 1.$$

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19. Find the value of expression

$$\sin\left(2\tan^{-1}\frac{1}{3}\right) + \cos(\tan^{-1}2\sqrt{2}).$$

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20. Solve for x , $2 \tan^{-1}(\cos x) = \tan^{-1}(2\operatorname{cosec}x)$.

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21. If $\tan^{-1}a + \tan^{-1}b + \tan^{-1}c = \pi$, then prove that $a + b + c = abc$.

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22. Solve for x , $\tan^{-1}x + 2\cot^{-1}x = \frac{2\pi}{6}$.

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

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24. Prove that following

$$\cot^{-1}\left(\frac{xy+1}{x-y}\right) + \cot^{-1}\left(\frac{yz+1}{y-z}\right) + \cot^{-1}\left(\frac{zx+1}{z-x}\right) = 0, \quad (0 < xy, yz,$$

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25. If $\cos^{-1}\alpha + \cos^{-1}\beta + \cos^{-1}\gamma = 3\pi$, then find

$$\alpha(\beta + \gamma) + \beta(\gamma + \alpha) + \gamma(\alpha + \beta).$$

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26. 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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27. Prove that $2\tan^{-1}\left(\frac{1}{5}\right) + \sec^{-1}\left(\frac{5\sqrt{2}}{7}\right) + 2\tan^{-1}\left(\frac{1}{8}\right) = \frac{\pi}{4}$.

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28.

If

$$\cos^{-1}\left(\frac{x}{a}\right) = \cos^{-1}\left(\frac{y}{b}\right) = \theta, \text{ prove that } \frac{x^2}{a^2} - \frac{2xy}{ab}\cos\theta + \frac{y^2}{b^2} = \sin^2\theta.$$

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29. Solve for x , $\tan^{-1}(x + 1) + \tan^{-1}(x - 1) = \tan^{-1}\frac{8}{31}$ [$0 < x < 1$].

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30. Express $\sin^{-1}\left[\frac{\sqrt{1+x} + \sqrt{1-x}}{2}\right]$, $0 < x < 1$ in the simplest form.

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31. If $(\tan^{-1} x)^2 + (\cot^{-1} x)^2 = \frac{5\pi^2}{8}$, then find x .

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1. Fill in the blanks choosing correct answer from the brackets.

If $A = \tan^{-1}x$, then the value of $\sin 2A = \dots$.

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

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2. Fill in the blank choosing correct answer from the brackets if the value of $\sin^{-1}x = \frac{\pi}{5}$ for some $x \in (-1, 1)$ then the value of $\cos^{-1}x$ is \dots .

$$\left(\frac{3\pi}{10}, \frac{5\pi}{10}, \frac{7\pi}{10} \right)$$

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3. Fill in the blanks choosing correct answer from the brackets.

The value of $\tan^{-1}\left(2\cos\frac{\pi}{3}\right)$ is

$$\left(1, \frac{\pi}{4}, \frac{\pi}{3}\right)$$



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4. Fill in the blanks choosing correct answer from the brackets.

If $x + y = 4$, $xy = 1$, then $\tan^{-1}x + \tan^{-1}y = \dots$.

$$\left(\frac{3\pi}{4}, \frac{\pi}{4}, \frac{\pi}{2}\right)$$



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5. Fill in the blanks choosing correct answer from the brackets.

The value of $\cot^{-1}2 + \tan^{-1}\frac{1}{3} = \dots$.

$$\left(\frac{\pi}{4}, 1, \frac{\pi}{2}\right)$$



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6. Fill in the blanks choosing correct answer from the brackets.

The principal value of $\sin^{-1}\left(\sin\frac{2\pi}{3}\right)$ is

$$\left(\frac{2\pi}{3}, \frac{\pi}{3}, \frac{4\pi}{3}\right)$$



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7. Fill in the blank choosing correct answer from the brackets if

$\sin^{-1}\frac{x}{5} + \operatorname{cosec}^{-1}\frac{5}{4} = \frac{\pi}{2}$, then the value of $x =$ _____

(2,3,4)



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8. Fill in the blanks choosing correct answer from the brackets.

The value of $\sin\left(\tan^{-1}x + \tan^{-1}\frac{1}{x}\right), x > 0 =$

(0, 1, 1/2)



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9. Fill in the blank choosing correct answer from the brackets

$$\cot^{-1} \left[\frac{\sqrt{1 - \sin x} + \sqrt{1 + \sin x}}{\sqrt{1 - \sin x} - (\sqrt{1 + \sin x})} \right] = \dots$$
$$\left(2\pi - \frac{x}{2}, \frac{x}{2}, \pi - \frac{x}{2} \right)$$



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10. Fill in the blanks choosing correct answer from the brackets.

$$2\sin^{-1} \frac{4}{5} - \sin^{-1} \frac{24}{25} = \dots$$

$$(\pi, -\pi, 0)$$



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11. Fill in the blank choosing correct answer from the brackets if

$$\theta = \cos^{-1} x + \sin^{-1} x - \tan^{-1} x, x \geq 0, \text{ then the smallest interval in}$$

which θ lies is ___.

$$\left(\left(\frac{\pi}{2}, \frac{3\pi}{4} \right), \left[0, \frac{\pi}{2} \right), \left(0, \frac{\pi}{2} \right] \right)$$



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12. Fill in the blank choosing correct answer from the brackets

$$\sec^2(\tan^{-1} 2) + \operatorname{cosec}^2(\cot^{-1} 3) = _ _ _ .$$

(16, 14, 15)



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13. Write whether the following statements are true or false.

$$\sin^{-1} \frac{1}{x} \operatorname{cosec}^{-1} x = 1$$



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14. Write whether the following statements are true or false.

$$\cos^{-1} \frac{4}{5} + \tan^{-1} \frac{2}{3} = \tan^{-1} \frac{17}{6}$$



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15. Write whether the following statements are true or false.

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

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16. Write whether the following statements are true or false.

$$\sec^{-1} \frac{1}{2} + \operatorname{cosec}^{-1} \frac{1}{2} = \frac{\pi}{2}$$

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17. Write whether the following statements are true or false.

$$\sec^{-1} \left(-\frac{7}{15} \right) = \pi - \cos^{-1} \frac{5}{7}$$

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18. Write whether the following statements are true or false.

$$\tan^{-1}(\tan 3) = 3$$



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19. Write whether the following statements are true or false.

The principal value of $\tan^{-1}\left(\tan\frac{3\pi}{4}\right)$ is $\frac{3\pi}{4}$



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20. Write whether the following statements are true or false.

$\cot^{-1}(-\sqrt{3})$ is in the second quadrant.



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21. Write whether the following statements are true or false.

$3\tan^{-1}3 = \tan^{-1}\frac{9}{13}$



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22. Write whether the following statements are true or false.

$$2\sin^{-1}\frac{4}{5} = \sin^{-1}\frac{24}{25}$$

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23. Write whether the following statements are true or false.

$$\tan^{-1}2 + \tan^{-1}3 = -\frac{\pi}{4}$$

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24. Write whether the following statements are true or false.

The equation $\tan^{-1}(\cot x) = 2x$ has exactly two real solutions.

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25. Express the value of $\sin(2\sin^{-1}0.6)$ in simplest form.

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26. Express the value of the following in simplest form.

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

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27. Express the value of the following in simplest form.

$$\cos(2\sin^{-1}x)$$

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28. Express the value of $\tan(\cos^{-1}x)$ in simplest form.

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29. Express the value of $\tan^{-1}\left(\frac{x}{y}\right) - \tan^{-1}\frac{(x-y)}{(x+y)}$ in simplest form.

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30. Express the value of $\operatorname{cosec}\left(\cos^{-1}\frac{3}{5} + \cos^{-1}\frac{4}{5}\right)$ in simplest form.

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31. Express the value of $\sin^{-1}\frac{1}{\sqrt{5}} + \cos(-1)\frac{3}{\sqrt{10}}$ in simplest form.

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32. Express the value of the following in simplest form.

$$\sin\left(\cos^{-1}\left(\tan\left(\sec^{-1}(\sqrt{2})\right)\right)\right)$$

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33. Express the value of the following in simplest form.

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

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34. Express the value of the following in simplest form.

$$\tan \left\{ \frac{1}{2} \sin^{-1} \frac{2x}{1+x^2} + \frac{1}{2} \cos^{-1} \frac{1-y^2}{1+y^2} \right\}$$



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35. Express the value of the following in simplest form.

$$\sin \left(\cot^{-1} \left(\cos \left(\tan^{-1} x \right) \right) \right)$$



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36. Express the value of the following in simplest form.

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



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37. Prove statement $\sin^{-1} \frac{3}{5} + \sin^{-1} \frac{8}{17} = \cos^{-1} \frac{36}{85}$



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38. Prove statement $\sin^{-1} \frac{3}{5} + \cos^{-1} \frac{12}{13} = \cos^{-1} \frac{33}{65}$



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39. Prove statement $\tan^{-1} \frac{1}{7} + \tan^{-1} \frac{1}{13} = \tan^{-1} \frac{2}{9}$



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40. Prove that $\tan^{-1} \frac{1}{2} + \tan^{-1} \frac{1}{5} + \tan^{-1} \frac{1}{8} = \frac{\pi}{4}$.



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41. Prove statement $\tan \left(2 \tan^{-1} \frac{1}{5} - \frac{\pi}{4} \right) + \frac{7}{17} = 0$



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42. Prove the following statements

$$\cot^{-1}9 + \operatorname{cosec}^{-1}\frac{\sqrt{41}}{4} = \frac{\pi}{4}$$

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43. Show that $\sin^{-1}\frac{4}{5} + 2\tan^{-1}\frac{1}{3} = \frac{\pi}{2}$.

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44. Prove statement $4\tan^{-1}\frac{1}{5} - \tan^{-1}\frac{1}{70} + \tan^{-1}\frac{1}{99} = \frac{\pi}{4}$

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45. Prove that $2\tan^{-1}\left(\frac{1}{5}\right) + \sec^{-1}\left(\frac{5\sqrt{2}}{7}\right) + 2\tan^{-1}\left(\frac{1}{8}\right) = \frac{\pi}{4}$.

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46.

Prove

statement

$$\cos^{-1} \frac{12}{13} + 2\cos^{-1} \sqrt{\frac{64}{65}} + \cos^{-1} \sqrt{\frac{49}{50}} = \cos^{-1} \frac{1}{\sqrt{2}}$$


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47. Prove statement $\tan^2 \cos^{-1} \frac{1}{\sqrt{3}} + \cot^2 \sin^{-1} \frac{1}{\sqrt{5}} = 6$


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48. Prove the following statements

$$\cos \left(\tan^{-1} \left(\cot \left(\sin^{-1} x \right) \right) \right) = x$$


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49. Prove statement $\cot^{-1}(\tan 2x) + \cot^{-1}(-\tan 2x) = \pi$


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50. Prove statement $\tan^{-1}x + \cot^{-1}(x + 1) = \tan^{-1}(x^2 + x + 1)$

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51. Prove statement $\tan^{-1}\left(\frac{a-b}{1+ab}\right) + \tan^{-1}\left(\frac{b-c}{1+bc}\right)$
 $= \tan^{-1}a - \tan^{-1}c.$

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52. Prove statement $\cot^{-1}\frac{pq+1}{p-q} + \cot^{-1}\frac{qr+1}{q-r} + \cot^{-1}\frac{rp+1}{r-p} = 0$

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53. Prove statement $\tan^{-1}\frac{a-b}{1+ab} + \tan^{-1}\frac{b-c}{1+bc} + \tan^{-1}\frac{c-a}{1+ca}$
 $= \tan^{-1}\frac{a^2-b^2}{1+a^2b^2} + \tan^{-1}\frac{b^2-c^2}{1+b^2c^2} + \tan^{-1}\frac{c^2-a^2}{1+c^2a^2}$

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54. Prove the following

$$\tan^{-1} \frac{2a - b}{b\sqrt{3}} + \tan^{-1} \frac{2b - a}{a\sqrt{3}} = \frac{\pi}{3}$$

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55. Prove the $\tan^{-1} \frac{1}{x + y} + \tan^{-1} \frac{y}{x^2 = xy + 1} = \tan^{-1} \frac{1}{x}$

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56. Prove the $\sin^{-1} \sqrt{\frac{x - q}{p - q}} = \cos^{-1} \sqrt{\frac{(p-x)/(p-q)}{(x-q)}}$

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57. Prove the $\sin^2(\sin^{-1} x + \sin^{-1} y + \sin^{-1} z)$
 $= \cos^2(\cos^{-1} x + \cos^{-1} y + \cos^{-1} z)$

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58. Prove the

$$\tan(\tan^{-1}x + \tan^{-1}y + \tan^{-1}z) = \cot(\cot^{-1}x + \cot^{-1}y + \cot^{-1}z)$$

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59. If $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \pi$, show that

$$x\sqrt{1-x^2} + y\sqrt{1-y^2} + z\sqrt{1-z^2} = 2xyz$$

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

show that $x+y+z=xyz$.

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61. If $\tan^{-1}x + \tan^{-1}y + \tan^{-1}z = \frac{\pi}{2}$, show that $xy + yz + zx = 1$



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62. If $r^2 = x^2 + y^2 + z^2$, Prove that

$$\tan^{-1} \frac{yz}{xr} = \tan^{-1} \frac{zx}{yr} + \tan^{-1} \frac{xy}{zr} = \frac{\pi}{2}$$



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63. In a $\triangle ABC$, if $m\angle A = 90^\circ$, prove that

$$\tan^{-1} \frac{b}{a+c} + \tan^{-1} \frac{c}{a+b} = \frac{\pi}{4}, \text{ where } a, b, c \text{ are sides of the triangle.}$$



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64. Solve for x , $\cos(2 \sin^{-1} x) = \frac{1}{9}$, $x > 0$.



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65. Solve $\sin^{-1} x + \sin^{-1}(1-x) = \frac{\pi}{2}$.

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66. If $\sin^{-1}(1-x) - 2\sin^{-1}x = \frac{\pi}{2}$, then find the value of x .

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67. Solve for x , $\cos^{-1}x + \sin^{-1}\left(\frac{x}{2}\right) = \frac{\pi}{6}$.

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

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

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



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71. Solve: $\cot^{-1}\frac{1}{x-1} + \cot^{-1}\frac{1}{x} + \cot^{-1}\frac{1}{x+1} = \cot^{-1}\frac{1}{3x}$



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72. Solve: $\cot^{-1}\frac{1-x^2}{2x} = \operatorname{cosec}^{-1}\frac{1+a^2}{2a} - \sec^{-1}\frac{1+b^2}{1-b^2}$



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73. Solve for x,

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



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74. Solve

$$\sin^{-1}x - \cos^{-1}x = \cos^{-1}\frac{\sqrt{3}}{2}$$

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75. Solve: $\sin^{-1}2x + \sin^{-1}x = \frac{\pi}{3}$.

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76. Rectify the error if any in the following

$$\begin{aligned} & \sin^{-1}\frac{4}{5} + \sin^{-1}\frac{12}{13} + \sin^{-1}\frac{33}{65} \\ &= \sin^{-1}\left[\frac{4}{5}\sqrt{1-\frac{44}{169}} + \frac{12}{13}\sqrt{1-\frac{16}{25}}\right] + \sin^{-1}\frac{33}{65} \\ &= \sin^{-1}\left(\frac{56}{65}\right) + \cos^{-1}\sqrt{1-\left(\frac{33}{65}\right)^2} \\ &= \sin^{-1}\left(\frac{56}{65}\right) + \cos^{-1}\left(\frac{56}{65}\right) = \frac{\pi}{2} \end{aligned}$$

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77. Prove that :

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



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78.

Prove

that

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



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79.

Prove

that

:

$$\tan^{-1}\sqrt{\frac{xr}{yz}} + \tan^{-1}\sqrt{\frac{yr}{yx}} + \tan^{-1}\sqrt{\frac{zr}{xy}} = \pi \text{ where } r = x + y + z.$$



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80.

If

$$\cos^{-1}\left(\frac{x}{a}\right) = \cos^{-1}\left(\frac{y}{b}\right) = \theta, \text{ prove that } \frac{x^2}{a^2} - \frac{2xy}{ab}\cos\theta + \frac{y^2}{b^2} = \sin^2\theta.$$



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81.

If

$$\cos^{-1}\left(\frac{x}{y}\right) + \cos^{-1}\left(\frac{y}{3}\right) = \theta, \text{ prove that } 9x^2 - 12xy\cos\theta + 4y^2 = 36\sin^2\theta$$



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82. If $\sin^{-1}\left(\frac{x}{a}\right) + \sin^{-1}\left(\frac{y}{b}\right) = \sin^{-1}\left(\frac{c^2}{ab}\right)$,

then prove that $b^2x^2 + 2xy\sqrt{a^2b^2 - c^4} + a^2y^2 = c^4$



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83.

If

$$\sin^{-1}\left(\frac{x}{a}\right) + \sin^{-1}\left(\frac{y}{b}\right) = \alpha \text{ prove that } \frac{x^2}{a^2} + \frac{2xy}{ab}\cos\alpha + \frac{y^2}{b^2} = \sin^2\alpha$$

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84.

If

$$\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \pi \text{ prove that } x^4 + y^4 + z^4 + 4x^2y^2z^2 = 2(x^2y^2 + y^2z^2 + z^2x^2)$$

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85. Solve equation $\tan^{-1}\frac{x-1}{x+1} = \tan^{-1}\frac{2x-x}{2x+1} = \tan^{-1}\frac{23}{36}$

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86. Solve the following equations

$$\tan^{-1}\frac{1}{3} + \tan^{-1}\frac{1}{5} + \tan^{-1}\frac{1}{7} + \tan^{-1}x = \frac{\pi}{4}$$

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87. Solve the following equations Evaluate $\sin^{-1}\left(\frac{-1}{2}\right) + \sin^{-1}\left(\frac{-1}{2}\right)$.

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88. Solve equation $3\tan^{-1}\frac{1}{(2 + \sqrt{3})} - \tan^{-1}\frac{1}{x} = \tan^{-1}\frac{1}{3}$

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Chapter Practice

1. Evaluate $\cot^{-1}(-\sqrt{3})$.

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2. Evaluate $\tan^{-1}(1) + \cos^{-1}\left(\frac{-1}{2}\right)$.

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3. Write the value of $\sin^{-1}(\sin 1550^\circ)$.

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4. Write the value of $\tan^{-1}\left[\tan\left(\frac{15\pi}{4}\right)\right]$.

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5. Find the domain of the function $\cos^{-1}(2x - 1)$.

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6. Write the principal value of $\cos^{-1}\left(\cos\frac{11\pi}{6}\right)$.

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

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8. If $\tan^{-1}x + \tan^{-1}y = \frac{4\pi}{5}$, then find $\cot^{-1}x + \cot^{-1}y$.

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9. If $\tan^{-1}(\sqrt{3}) + \cot^{-1}x = \frac{\pi}{2}$, then find x .

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10. If $\tan^{-1}x + \tan^{-1}y = \frac{\pi}{4}$, $xy < 1$,

then write the value of $x + y + xy$.

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11. Simplify $2\tan^{-1}x + \sin^{-1}\left(\frac{2x}{1+x^2}\right)$ in terms of $\tan^{-1}x$.

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

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13. Find the value of $2\sec^{-1}2 + \sin^{-1}\left(\frac{1}{2}\right)$.

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14. Solve for x ,

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

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15. Show that $\sin^{-1}\left(2x\sqrt{1-x^2}\right) = 2\sin^{-1}x$.



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16. Directions (Q. Nos. 16-25) Prove the following

$$\cos^{-1}x = \tan^{-1}\left[\frac{\sqrt{1-x^2}}{x}\right].$$



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17. Directions (Q. Nos. 16-25) Prove the following

$$2\tan^{-1}\frac{1}{2} + \tan^{-1}\frac{1}{7} = \sin^{-1}\left(\frac{31}{25\sqrt{2}}\right).$$



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18. Prove that

$$\tan^{-1}\left(\frac{1}{5}\right) + \tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{1}{8}\right) = \frac{\pi}{4}.$$



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19. Directions (Q. Nos. 16-25) Prove the following

$$\sin^{-1}\left(\frac{5}{13}\right) + \cos^{-1}\left(\frac{3}{5}\right) = \tan^{-1}\left(\frac{63}{16}\right).$$

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20. Directions (Q. Nos. 16-25) Prove the following

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

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21. Directions (Q. Nos. 16-25) Prove the following

$$\cos\left[\sin^{-1}\left(\frac{3}{5}\right) + \cot^{-1}\left(\frac{3}{2}\right)\right] = \frac{6}{5\sqrt{13}}.$$

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22. Directions Prove the following

$$\tan^{-1} \frac{1}{4} + \tan^{-1} \frac{2}{9} = \frac{1}{2} \cos^{-1} \frac{3}{5} = \frac{1}{2} \sin^{-1} \frac{4}{5}.$$



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23. Directions Prove the following

$$\tan^{-1} \left(\frac{\sqrt{1 + \cos x} + \sqrt{1 - \cos x}}{\sqrt{1 + \cos x} - \sqrt{1 - \cos x}} \right) = \frac{\pi}{4} + \frac{x}{2}, \text{ if } \pi < x < \frac{3\pi}{2}.$$



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24. Prove the following

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



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25. Directions (Q. Nos. 16-25) Prove the following

$$\cos\left(2\tan^{-1}\frac{1}{7}\right) = \sin\left(4\tan^{-1}\frac{1}{3}\right).$$

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26. Simplify the following:

$$\tan^{-1}\left[\frac{x}{\sqrt{a^2 - x^2}}\right], |x| < a.$$

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27. Solve the following equation:

$$\cos(\tan^{-1}x) = \sin\left(\cot^{-1}\frac{3}{4}\right).$$

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28. Directions (Q. Nos. 27 and 28) Solve the following equations:

$$\tan^{-1}\frac{x}{2} + \tan^{-1}\frac{x}{3} = \frac{\pi}{4}, \sqrt{6} > x > 0$$



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29. Prove that

$$\tan^{-1}\left(\frac{\cos x}{1 + \sin x}\right) = \frac{\pi}{4} - \frac{x}{2}, x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right).$$



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30.

Prove

that

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



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31. Find the value of $4\tan^{-1}\frac{1}{5} - \tan^{-1}\frac{1}{239}$.



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32. Find the value of $\tan^{-1}\left(\tan\frac{5\pi}{6}\right) + \cos^{-1}\left(\cos\frac{13\pi}{6}\right)$.



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33. Prove that

$$2 \tan^{-1} \left(\sqrt{\frac{a-b}{a+b}} \tan \frac{\theta}{2} \right) = \cos^{-1} \left(\frac{a \cos \theta + b}{a + b \cos \theta} \right).$$



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34. If $\sin^{-1} \frac{2a}{1+a^2} - \cos^{-1} \frac{1-b^2}{1+b^2} = \tan^{-1} \frac{2x}{1-x^2}$, then prove that

$$x = \frac{a-b}{1+ab}.$$



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35. Evaluate $\tan^{-1} \left(\frac{3 \sin 2\alpha}{5 + 3 \cos 2\alpha} \right) + \tan^{-1} \left(\frac{1}{4} \tan \alpha \right)$, where,

$$-\frac{\pi}{2} < \alpha < \frac{\pi}{2}.$$



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