



MATHS

BOOKS - NAGEEN MATHS (HINGLISH)

INVERES TRIGONOMETRIC FUNCTIONS

Solved Examples

1. Find the principal value of the following

(i) $\sin^{-1} \cdot \frac{1}{2}$

(ii) $\tan^{-1} \cdot \frac{1}{\sqrt{3}}$

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



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$$\begin{aligned} 2. \tan^{-1} \frac{x(x+1)+1}{(x+1)-x} \\ = \tan^{-1}(x^2+x+1) \end{aligned}$$

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3. If $\sin^{-1} x = \frac{\pi}{4}$, find the value of $\cos^{-1} x$.

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

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5. If $\tan^{-1} x = \theta$, find the value of $\sin^{-1} \frac{2x}{1+x^2}$

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6. Evaluate $\tan^{-1} \frac{1}{2} + \tan^{-1} \frac{1}{3}$.

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

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8. 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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9. Prove that $\tan(2 \tan^{-1} x) = 2 \tan(\tan^{-1} x + \tan^{-1} x^3)$.

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10. Prove that $\sec^2(\tan^{-1} 3) + \operatorname{cosec}^2(\cot^{-1} 2) = 15$

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

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12. Prove that $\cos^{-1} x = 2 \sin^{-1} \frac{\sqrt{1-x}}{2}$

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13. Prove that $\sin^{-1} \frac{3}{5} = \tan^{-1} \frac{3}{4}$.

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14. If $\cos^{-1} \frac{x}{a} + \cos^{-1} \frac{y}{b} = \theta$ then prove that

$$\frac{x^2}{a^2} - \frac{2xy}{ab} \cos \theta + \frac{y^2}{b^2} = \sin^2 \theta.$$

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15. If $\sin^{-1} x + \tan^{-1} x = \frac{\pi}{2}$, then prove that

$$2x^2 + 1 = \sqrt{5}$$

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16. Solve the following equation: $\sin^{-1} x + \sin^{-1}(1 - x) = \cos^{-1} x$

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

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1. Find the principal values of the following :

(i) $\sin^{-1}(\sqrt{3})$

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

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

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

(v) $\tan^{-1}(-1)$

(vi) $\operatorname{cosec}^{-1}(-1)$.



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2. Find the principal values of the following :

(i) $\sin^{-1}\left(\frac{-\sqrt{3}}{2}\right)$ (ii) $\cot^{-1}\sqrt{-3}$ (iii) $\cos^{-1}\left(-\frac{1}{2}\right)$ (iv) $\operatorname{cosec}^{-1}(\sqrt{2})$

(v) \tan^{-1} (vi) $\operatorname{cosec}^{-1}(-1)$



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3. Find the principal values of the following :

(i) $\sin^{-1}\left(\sin \frac{5\pi}{3}\right)$ (ii) $\cos^{-1}\cos\left(\frac{4\pi}{3}\right)$ (iii) $\cos\left[\frac{\pi}{3} + \cos^{-1}\left(-\frac{1}{2}\right)\right]$

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4. If $\cos^{-1}x = \frac{\pi}{3}$, the find the value of $\sin^{-1}x$.

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5. If $\tan^{-1}\frac{3}{4} = x$, the find the value of $\sec x$.

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6. (i) Evaluate : $\sec\left(\cos^{-1}\frac{1}{2}\right)$

(ii) solve the equations $\sin^{-1}x + \sin^{-1}y = \frac{2\pi}{3}$ and

$$\cos^{-1}x - \cos^{-1}y = \frac{\pi}{3}$$

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7. If $\sin^{-1} x = \frac{1}{3}$, then evaluate $\sin^{-1} (2x\sqrt{1-x^2})$

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8. prove that: $2 \tan^{-1} x = \frac{1}{3} \tan^{-1} \frac{1}{7} = \frac{\pi}{4}$

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9. Prove that : $\tan^{-1} 1 + \tan^{-1} 2 + \tan^{-1} 3 = \pi$

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10. Prove that:

$$\tan^{-1} \left(\frac{m}{n} \right) + \tan^{-1} \left(\frac{n-m}{n+m} \right) = \left[\frac{\pi}{4} \frac{m}{n} > 1 - \frac{3\pi}{4} \frac{m}{n} < -1 \right]$$

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11. Prove that : $\tan^{-1} \frac{x}{x+1} - \tan^{-1}(2x+1) = \frac{3\pi}{4}$

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

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13. Prove that : $\cot^{-1} 3 + \cot^{-1} \frac{3}{4} = \cot^{-1} \frac{1}{3}$

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14. Prove that :

$$\cot^{-1} \left(\frac{1+ab}{a-b} \right) + \cot^{-1} \left(\frac{1+bc}{b-c} \right) + \cot^{-1} \left(\frac{1+ca}{c-a} \right) = \pi, (a > b > c > 0)$$

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15.

If

$$\cos^{-1} x + \cos^{-1} y + \cos^{-1} z = \pi, \text{ provethat } x^2 + y^2 + z^2 + 2xyz = 1.$$

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$$16. 4 \tan^{-1} \left(\frac{1}{5} \right) = \tan^{-1} \left(\frac{1}{70} \right) + \tan^{-1} \left(\frac{1}{99} \right) + \frac{\pi}{4}$$

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$$17. \text{ Prove that : } \cos^{-1} \left(\frac{1 - a^2}{1 + a} \right) + \cos^{-1} \left(\frac{1 - b^2}{1 + b} \right) = 2 \tan^{-1} \cdot \frac{a + b}{1 - ab}$$

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$$18. \tan \left[\frac{1}{2} \sin^{-1} \left(\frac{2a}{1 + a^2} \right) + \frac{1}{2} \cos^{-1} \left(\frac{1 - a^2}{1 + a^2} \right) \right] =$$

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19. Prove that : $\cos^{-1} \cdot \frac{3}{5} + \cos^{-1} \cdot \frac{12}{13} = \sin^{-1} \left(\frac{12}{5} \right)$

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20. Prove that: $\sin^{-1} \left(\frac{3}{5} \right) - \cos^{-1} \left(\frac{12}{13} \right) = \sin^{-1} \left(\frac{16}{65} \right)$

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21. If $\cos^{-1} \left(\frac{x}{2} \right) + \cos^{-1} \left(\frac{y}{3} \right) = \theta$, prove that

$$9x^2 - 12xy \cos \theta + 4y^2 = 36 \sin^2 \theta$$

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22. If $\sin^{-1} a + \sin^{-1} b + \sin^{-1} c = \pi$, then the value of $a\sqrt{(1-a^2)} + b\sqrt{(1-b^2)} + \sqrt{(1-c^2)}$ will be $2abc$ (b) abc (c) $\frac{1}{2}abc$ (d) $\frac{1}{3}abc$

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

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24. (i) Solve : $4 \sin^{-1} \frac{5}{x} + \sin^{-1} \frac{12}{x} = \frac{\pi}{2}$

(ii) solve : $\sin^{-1} \frac{5}{x} + \sin^{-1} \frac{12}{x} = \frac{\pi}{2}$

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25. (i) Slove : $\tan^{-1}(x + 1) + \tan^{-1}(x - 1) = \tan^{-1} \frac{8}{31}$

(ii) Slove : $\tan^{-1} \frac{1}{a - 1} = \tan^{-1} \frac{1}{x} + \tan^{-1} \frac{1}{a^2 - x + 1}$

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26. The value of $\tan^{-1} \left[\frac{\sqrt{1+x^2} + \sqrt{1-x^2}}{\sqrt{1+x^2} - \sqrt{1-x^2}} \right]$, $|x| < \frac{1}{2}$, $x \neq 0$, is equal

to:



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27. Solve $\tan^{-1}\left(\frac{1}{1+2x}\right) + \tan^{-1}\left(\frac{1}{1+4x}\right) = \tan^{-1}\left(\frac{2}{x^2}\right)$



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28. If $\sin(\pi \cos \theta) = \cos(\pi \sin \theta)$, then show that, $\theta = \pm \frac{1}{2} \sin^{-1}\left(\frac{3}{4}\right)$



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29. If $\tan^{-1} \frac{a+x}{a} + \tan^{-1} \left(\frac{a-x}{a} \right) = \frac{\pi}{6}$ then prove that $x^2 = 2\sqrt{3}a^2$



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30. Prove that : $\tan^{-1} a - \tan^{-1} b = \cos^{-1} \left[\frac{1+ab}{\sqrt{(1+a^2)(1+b^2)}} \right]$





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Exercice 2 B

1. The Principal value of $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$ is :

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

B. $\frac{\pi}{6}$

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

D. None of these

Answer: B



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

A. $\frac{\pi}{3}$

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

C. $\frac{2\pi}{3}$

D. None of these

Answer: A



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3. If $\tan^{-1} 2x + \tan^{-1} 3x = \frac{\pi}{4}$, then $x = ?$

A. 1

B. -1

C. $-\frac{1}{6}$

D. $\frac{1}{6}$

Answer: D



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4. If $\sin^{-1} \frac{2a}{1+a^2} + \operatorname{cosec}^2(\cot^{-1} 3) = ?$

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

B. $\frac{a+b}{1+ab}$

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

D. None of these

Answer: A



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5. $\sec^2(\tan^{-1} 4) + \operatorname{cosec}^2(\cot^{-1} 3) = ?$

A. 30

B. 29

C. 27

D. 25

Answer: C



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6. If $\sin^{-1} x + \sin^{-1} y = \frac{\pi}{6}$, then $\cos^{-1} x + \cos^{-1} y = ?$



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7. $\sin\left(2 \tan^{-1} \frac{4}{5}\right) = ?$

A. $\frac{40}{41}$

B. $\frac{9}{41}$

C. $\frac{16}{25}$

D. None of these

Answer: A



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8. $\sin \left[\sin^{-1} \left(-\frac{1}{2} \right) + \frac{\pi}{3} \right] = ?$

A. $-\frac{\sqrt{3}}{2}$

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

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

D. $\frac{\sqrt{3}}{2}$

Answer: C



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9. If $\sin^{-1}(x) + \sin^{-1}(2x) = \frac{\pi}{3}$ then $x =$

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

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

C. $\pm \sqrt{\frac{3}{28}}$

D. None of these

Answer: C



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10. If $\tan^{-1}\left(\frac{1-x}{1+x}\right) = \frac{1}{2}\tan^{-1}x$, $x > 0$, then $x = ?$

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

B. $-\frac{1}{\sqrt{3}}$

C. $-\sqrt{3}$

D. None of these

Answer: A



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Exercise 2 C

1. Prove: $4 \tan^{-1}\left(\frac{1}{5}\right) - \tan^{-1}\left(\frac{1}{239}\right) = \frac{\pi}{4}$

A. $\frac{\pi}{6}$

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

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

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

Answer: B



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2. Solution of $\tan^{-1}(1+x) + \tan^{-1}(1-x) = \frac{\pi}{2}$ is:

A. 0

B. 1

C. -1

D. 2

Answer: A



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3. If $x^2 + y^2 + z^2 = r^2$, then

$$\tan^{-1}\left(\frac{xy}{zr}\right) + \tan^{-1}\left(\frac{yz}{xr}\right) + \tan^{-1}\left(\frac{zx}{yr}\right) = ?$$

A. $\frac{\pi}{4}$

B. $\frac{\pi}{6}$

C. $\frac{\pi}{2}$

D. π

Answer: C



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4. The value of $\cos(2 \cos^{-1} 0.8)$ is

A. 0.28

B. 0.48

C. 0.6

D. None of these

Answer: A



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5. If $\sin\{\cot^{-1}(x + 1)\} = \cos(\tan^{-1} x)$, then find x .

A. $\sqrt{\frac{x^2 + 2}{x^2 + 1}}$

B. $\frac{x}{\sqrt{x^2 + 1}}$

C. $\frac{x}{\sqrt{x^2 + 2}}$

D. $\sqrt{\frac{x^2 + 1}{x^2 + 2}}$

Answer: D



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

A. 1

B. -1

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

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

Answer: B



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7. If $a_1, a_2, a_3, \dots, a_n$ is an A.P. with common difference d , then prove that

$$\tan \left[\tan^{-1} \left(\frac{d}{1 + a_1 a_2} \right) + \tan^{-1} \left(\frac{d}{1 + a_2 a_3} \right) + \tan^{-1} \left(\frac{d}{1 + a_{n-1} a_n} \right) \right] =$$

A. $\frac{(n-1)d}{1 + a_1 a_n}$

B. $\frac{nd}{1 + a_1 a_2}$

C. $\frac{(n+1)d}{1 + a_1 a_n}$

D. None of these

Answer: A



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8. If $\sin^{-1}(1-x) - 2\sin^{-1}x = \frac{\pi}{2}$ then $x = ?$

A. $0, \frac{1}{2}, 1$

B. $0, \frac{1}{2}$

C. 0

D. None of these

Answer: C



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9. If x_1, x_2, x_3, x_4 are the roots of the equation $x^4 - x^3 \sin 2\beta + x^2 \cdot \cos 2\beta - x \cos \beta - \sin \beta = 0$, then $\tan^{-1} x_1 + \tan^{-1} x_2 + \tan^{-1} x_3 + \tan^{-1} x_4$ is equal to

A. α

B. $90^\circ - \alpha$

C. $180^\circ - \alpha$

D. $270^\circ - \alpha$

Answer: B



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10. If $\cos^{-1} \frac{x}{a} + \cos^{-1} \frac{y}{b} = \theta$, then $\frac{x^2}{a^2} + \frac{y^2}{b^2} = ?$

A. $\frac{xy}{ab} \cos \theta + \cos^2 \theta$

B. $\frac{2xy}{ab} \cos \theta + \cos^2 \theta$

C. $\frac{2xy}{ab} \cos \theta + \sin^2 \theta$

D. $\frac{xy}{ab} \cos \theta + \sin^2 \theta$

Answer: C



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Exercice 2 1

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

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2. $\cos^{-1}\left[\frac{\sqrt{3}}{2}\right]$

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

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4. Find the principal value of $\tan^{-1}(-\sqrt{3})$

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



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6. $\tan^{-1}(-1) = -\tan^{-1}(1)$



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7. $\theta = \sec^{-1}\left(\frac{2}{\sqrt{3}}\right)$



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



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9. $\cos^{-1}(-\sqrt{2})$

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10. $\cos ec^{-1}(-\sqrt{2})$

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

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13. If $\sin^{-1} x = y$, then :

A. $0 \leq y \leq \pi$

B. $-\frac{\pi}{2} \leq y \leq \frac{\pi}{2}$

C. $0 < y < \pi$

D. $-\frac{\pi}{2} < y < \frac{\pi}{2}$

Answer: B

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14. $\tan^{-1} \sqrt{3} - \sec^{-1}(-2)$ is equal to

A. π

B. $-\frac{\pi}{3}$

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

D. $\frac{2\pi}{3}$

Answer: B

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Exercise 2 2

1. Prove that: $3 \sin^{-1} x = \sin^{-1}(3x - 4x^3)$, $x \in \left[-\frac{1}{2}, \frac{1}{2}\right]$

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2. Prove that: $3 \cos^{-1} x = \cos^{-1}(4x^3 - 3x)$, $x \in \left[\frac{1}{2}, 1\right]$

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

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

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5. 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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6. $\tan^{-1}\left(\frac{1}{\sqrt{x^2-1}}\right), |x| > 1$

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7. Express each of the following in the simplest form: $\tan^{-1}\left\{\frac{\sqrt{(1-\cos x)}}{(1+\cos x)}\right\}, -\pi$

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



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9. $\tan^{-1} \frac{x}{\sqrt{a^2 - x^2}}, |x| < a$



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10. 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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11. For the principal values, evaluate each of the following:

$$\tan^{-1} \left\{ 2 \cos \left(2s \in^{-1} \frac{1}{2} \right) \right\} \cot \left[\sin^{-1} \{ \cos(\tan^{-1} 1) \} \right]$$



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

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

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15. $\frac{\tan^{-1}(x-1)}{x-2} + \frac{\tan^{-1}(x+1)}{x+2} = \frac{\pi}{4}$. find

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





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17. $\tan^{-1}\left(\tan \frac{3\pi}{4}\right)$



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18. Find the value of $\tan\left(\frac{\sin^{-1} 3}{5} + \frac{\cot^{-1} 3}{2}\right)$



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19. $\cos^{-1}\left(\cos\left(\frac{7\pi}{6}\right)\right)$ is equal to

A. $\frac{7\pi}{6}$

B. $\frac{5\pi}{6}$

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

D. $\frac{\pi}{6}$

Answer: B

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20. $\sin\left(\frac{\pi}{3} - \sin^{-1}\left(-\frac{1}{2}\right)\right)$ is equal to

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

B. $\frac{1}{3}$

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

D. 1

Answer: D

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21. $\tan^{-1}\sqrt{3} - \cot^{-1}(-\sqrt{3})$ is equal to (A) π (B) $-\frac{\pi}{2}$ (C) 0 (D) $2\sqrt{3}$

A. π

B. $-\frac{\pi}{2}$

C. 0

D. $2\sqrt{3}$

Answer: B



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Miscellaneous Exercise

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



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



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

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4. Prove that: $\frac{\sin^{-1} 8}{17} + \frac{\sin^{-1} 3}{5} = \frac{\tan^{-1}(77)}{36}$

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

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6. Prove the following: $\cos^{-1} \left(\frac{12}{13} \right) + \sin^{-1} \left(\frac{3}{5} \right) = \sin^{-1} \left(\frac{56}{65} \right)$

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7. Prove that: $\sin^{-1} \left(\frac{63}{65} \right) = \sin^{-1} \left(\frac{5}{13} \right) + \cos^{-1} \left(\frac{3}{5} \right)$

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

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Miscellaneous Exercise Prove That

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

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3.

Prove

that

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


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$$4. \frac{9\pi}{8} - \frac{9}{4} \sin^{-1} \frac{1}{3} = \frac{9}{4} \sin^{-1} \frac{2\sqrt{2}}{3}$$


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$$5. \text{ Solve the equations. } 2 \tan^{-1}(\cos x) = \tan^{-1}(2 \cos ex)$$


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$$6. \text{ Solve the equations. } \frac{\tan^{-1}(1-x)}{1+x} = \frac{1}{2} \tan^{-1} x, \quad (x > 0)$$


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7. $\sin(\tan^{-1} x)$, $|x| \leq 1$ is equal to :

A. $\frac{x}{\sqrt{1-x^2}}$

B. $\frac{1}{\sqrt{1-x^2}}$

C. $\frac{1}{\sqrt{1+x^2}}$

D. $\frac{x}{\sqrt{1+x^2}}$

Answer: D



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8. If $\sin^{-1}(1-x) - 2\sin^{-1}x = \frac{\pi}{2}$, then x is equal to

A. $0, \frac{1}{2}$

B. $1, \frac{1}{2}$

C. 0

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

Answer: C



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9. $\tan^{-1}\left(\frac{x}{y}\right) - \frac{\tan^{-1}(x - y)}{x + y}$ is equal to (A) $\frac{\pi}{2}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{4}$ (D) $\frac{-3\pi}{4}$

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

B. $\frac{\pi}{3}$

C. $\frac{\pi}{4}$

D. $\frac{-3\pi}{4}$

Answer: C



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