MATHS

BOOKS - NAGEEN MATHS (HINGLISH)

INVERES TRIGONOMETRIC FUNCTIONS

Solved Examples

1. Find the principal value of the following

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

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

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

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2. $\tan^{-1}.\ \dfrac{x(x+1)+1}{(x+1)-x}$

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

= R.H.S

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

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

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

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

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10. Prove that $\sec^2\left(\tan^{-1}3\right)+\cos ec^2\left(\cot^{-1}2\right)=15$

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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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Exericse 2 A

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 sex x.

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

(ii) slove 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 $\sin^{-1}\left(2x\sqrt{1-x^2}\right)$

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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:

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

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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 :

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

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15. If

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

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

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

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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 $a\sqrt{\left(1-a^2\right)}+b\sqrt{\left(1-b^2\right)}+\sqrt{\left(1-c^2\right)}$ 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) slove : $\sin^{-1}.\frac{5}{x}+\sin^{-1}.\frac{12}{x}=\frac{\pi}{2}$

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

A. 1

B. -1

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

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

Answer: D

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4. If $\sin^{-1}.\frac{2a}{1+a^2} + \cos ec^2\left(\cot^{-1} 3\right) = ?$

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. $\sec^2\left(\tan^{-1} 4\right) + \cos ec^2\left(\cot^{-1} 3\right) = ?$

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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Exericse 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 $\cos\left(2\cos^{-1}0.8\right)$ 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 $a_1, a_2, a_3, , a_n$ is an A.P. with common difference d, then prove that $\tan\left[\tan^{-1}\left(\frac{d}{1+a_1a_2}\right)+\tan^{-1}\left(\frac{d}{1+a_2a_3}\right)+\tan^{-1}\left(\frac{d}{11+a_{n-1}a_n}\right)\right]=$

A. $\frac{(n-1)d}{1+a_1a_n}$

B. $\frac{nd}{1+a_1a_2}$

C. $\frac{(n+1)d}{1+a_1a_n}$

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 $x^4 - x^3 \sin 2\beta + x^2 . \cos 2\beta - x\cos\beta - \sin\beta = 0,$ 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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Exericse 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. $\text{cosec}^{-1}(2)$

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

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

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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. $o \leq y \leq \pi$

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

C. $o < y < \pi$

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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Exericse 2 2

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

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

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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){sqrt((1-cosx)/(1+cosx))},\ -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: $\tan^{-1}\left\{2\cos\left(2s \in^{-1} \frac{1}{2}\right)\right\} \cot\left[\sin^{-1}\left\{\cos\left(\tan^{-1}1\right)\right\}\right]$

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

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

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

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

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7. $\sin\left(\tan^{-1} x\right), |x| \leq 1$ 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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