

1. Show that $\tan^{-1} \frac{1}{2} + \tan^{-1} \frac{2}{11} = \tan^{-1} \frac{3}{4}$
2. Express $\tan^{-1} \left(\frac{\cos x}{1 - \sin x} \right)$, $\frac{-3\pi}{2} < x < \frac{\pi}{2}$ in the simplest form.
3. Express $\tan^{-1} \left(\frac{3a^2x - x^3}{a^3 - 3ax^2} \right)$, $a > 0$; $\frac{a}{\sqrt{3}} < x < \frac{a}{\sqrt{3}}$ in the simplest form.

Find the values of each of the following:

4. $\tan^{-1} \left[2 \cos \left(2 \sin^{-1} \frac{1}{2} \right) \right]$
5. $\cot (\tan^{-1} a + \cot^{-1} a)$
6. $\sin^{-1} \left(\sin \frac{2\pi}{3} \right)$
7. If $\tan^{-1} \frac{x-1}{x-2} + \tan^{-1} \frac{x+1}{x+2} = \frac{\pi}{4}$, then find the value of x.