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Differential Coefficient Using Inverse Trigonometrical Substitutions

Sometimes the given function can be deducted with the help of inverse Trigonometrical substitution and then to find the differential coefficient is very easy.

(i) $2\sin^{-1}x = \sin^{-1}(2x\sqrt{1-x^2})$

(ii) $2\cos^{-1}x = \cos^{-1}(2x^2-1)$ or $\cos^{-1}(1-2x^2)$

(iii) $2\tan^{-1}x = \begin{cases} \sin^{-1}\left(\dfrac{2x}{1+x^2}\right) \\ \tan^{-1}\left(\dfrac{2x-x^2}{1}\right) \\ \cos^{-1}\left(\dfrac{1-x^2}{1+x^2}\right) \end{cases}$

(iv) $3\sin^{-1}x = \sin^{-1}(3x-4x^3)$

(v) $3\cos^{-1}x = \cos^{-1}(4x^3-3x)$

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

(vii) $\cos^{-1}x + \sin^{-1}x = \pi/2$

(viii) $\tan^{-1}x + \cot^{-1}x = \pi/2$

(ix) $\sec^{-1}x + \operatorname{cosec}^{-1}x = \pi/2$

(x) $\sin^{-1}x \pm \sin^{-1}y = \sin^{-1}\left[x\sqrt{1-y^2} \pm y\sqrt{1-x^2}\right]$

(xi) $\cos^{-1}x \pm \cos^{-1}y = \cos^{-1}\left[xy \mp \sqrt{(1-x^2)(1-y^2)}\right]$

(xii) $\tan^{-1}x \pm \tan^{-1}y = \tan^{-1}\left[\dfrac{x \pm y}{1 \mp xy}\right]$