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

where $|x| < \frac{1}{\sqrt{3}}$. Then a value of y is : **[JEE M 2015]**

(a) $\frac{3x - x^3}{1+3x^2}$ (b) $\frac{3x + x^3}{1+3x^2}$

(c) $\frac{3x - x^3}{1-3x^2}$ (d) $\frac{3x + x^3}{1-3x^2}$

Sol- Let $x = \tan\theta$ as $\frac{-1}{\sqrt{3}} < x < \frac{1}{\sqrt{3}} \Rightarrow \frac{-\pi}{6} < \theta < \frac{\pi}{6}$

A/Q, $\tan^{-1} y = \tan^{-1} x + \tan^{-1}\left(\frac{2x}{1-x^2}\right)$

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

$= \theta + \tan^{-1}(\tan 2\theta)$

$= \theta + 2\theta = 3\theta$

$\Rightarrow \tan^{-1} y = 3\theta$

$\Rightarrow y = \tan 3\theta = \frac{3\tan\theta - \tan^3\theta}{1 - 3\tan^2\theta}$

$\Rightarrow \boxed{y = \frac{3x - x^3}{1-3x^2}}$ Ans (c)