

5. Find $\int \cot^3 x \, dx = \int \cot x (csc^2 x - 1) \, dx = \int \cot x csc^2 x - \frac{\cos x}{\sin x} \, dx$

$$= \frac{-\cot^2 x}{2} - \ln|\sin x| + C$$

$$\checkmark \therefore \frac{d}{dx}(PA) = \cot x csc^2 x - \frac{\cos x}{\sin x}$$

$$\begin{aligned} & \cot x (csc^2 x - 1) \\ &= \cot^3 x \checkmark \end{aligned}$$

6. Find $\int x \arctan x \, dx = \frac{x^2}{2} \arctan x - \frac{1}{2} \int \frac{x^2}{1+x^2} \, dx = \frac{x^2}{2} \arctan x - \frac{1}{2} \int 1 \frac{+1}{1+x^2}$

$$\begin{aligned} u &= \arctan x & v &= \frac{x^2}{2} \\ du &= \frac{1}{1+x^2} dx & dv &= x dx \end{aligned}$$

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

$$\checkmark \frac{d}{dx}(PA) = \frac{x^2}{2} \frac{1}{1+x^2} + x \tan^{-1} x - \frac{1}{2} + \frac{1}{2} \frac{1}{1+x^2}$$

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

$$= x \tan^{-1} x \checkmark$$