



## Integration by Substitution :-

Ex:-

التكامل بالقيود

$$\int (x^2+1)^3 (2x) dx$$

$$\text{let } u = x^2 + 1 \rightarrow du = 2x dx$$

$$\begin{aligned} \int \frac{(x^2+1)^3}{u} \frac{2x dx}{du} &\rightarrow \int u^3 du = \frac{u^4}{4} + C \\ &= \frac{(x^2+1)^4}{4} + C \end{aligned}$$

$$\text{Ex:- } \int \sin^3 x \cos x dx$$

$$\text{let } u = \sin x$$

$$du = \cos x dx$$

$$\int u^3 du \Rightarrow \frac{u^4}{4} + C \Rightarrow \frac{\sin^4 x}{4} + C$$

"indefinite integral and substitution Methods"

التكامل المحدد مع طريقة التعويض

$$\text{Ex:- } \int_{-1}^1 3x^2 \sqrt{x^3+1} dx$$

$$\text{let } u = x^3 + 1, du = 3x^2 dx$$

$$= \int_0^2 \sqrt{u} du$$

$$\text{when } x = -1 \Rightarrow u = (-1)^3 + 1 = 0$$

$$\text{when } x = 1 \Rightarrow u = (1)^3 + 1 = 2$$

$$\begin{aligned} &= \left[ \frac{u^{\frac{3}{2}}}{\frac{3}{2}} \right]_0^2 \Rightarrow \frac{2}{3} \left[ 2^{\frac{3}{2}} - 0^{\frac{3}{2}} \right] = \frac{2}{3} [2\sqrt{2}] \\ &= \frac{4\sqrt{2}}{3} \end{aligned}$$



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Ex:  $\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \cot \theta \csc^2 \theta d\theta$

let  $u = \cot \theta \Rightarrow du = -\csc^2 \theta d\theta \Rightarrow -du = \csc^2 \theta d\theta$

when  $\theta = \frac{\pi}{4} \Rightarrow u = \cot \frac{\pi}{4} = 1$

when  $\theta = \frac{\pi}{2} \Rightarrow u = \cot \frac{\pi}{2} = 0$

$= -\int_1^0 u du \Rightarrow -\left[\frac{u^2}{2}\right]_1^0$

$= -\left[\frac{0^2}{2} - \frac{1^2}{2}\right] = \frac{1}{2}$