

$$\cdot \cos x \sin^3 x.$$

$$\int \cos(x) \sin^3(x) dx$$

$$\text{Sub. } u = \sin(x) \rightarrow \frac{du}{dx} = \cos(x)$$

$$dx = \frac{1}{\cos(x)} du$$

$$= \int u^3 du.$$

$$\int u^n du = \frac{u^{n+1}}{n+1} \quad \text{Apply Power rule}$$

$$= \frac{u^4}{4}$$

Undo sub $u = \sin(x)$

$$\Rightarrow \frac{\sin^4(x)}{4}$$

$$\therefore \int \cos(x) \sin^3(x) dx$$

$$\frac{2 \sin^4(x)}{4} + C$$

2

let $\sin^6 x = R$

$$R \Rightarrow \frac{1}{32} \int (10 - (5 \cos 2x + 6 \cos 4x - \cos 6x)) dx$$

$$R \Rightarrow \frac{1}{32} \left(10x - \frac{5 \sin 2x}{2} + \frac{6 \cos 4x}{4} - \frac{\cos 6x}{6} \right) + C$$

$$\sin^6 x = \frac{10x}{32} - \frac{5 \sin 2x}{64} + \frac{6 \cos 4x}{128} - \frac{\cos 6x}{142} + C$$

2. $\cos^4 x \sin^3 x$

$$\int \cos^4 x \sin^3 x dx$$

$$\Rightarrow \int -\cos^4(x) (\cos^2(x) - 1) \cdot \sin(x) dx$$

Sub. $u = \cos(x) \rightarrow \frac{du}{dx} = -\sin(x)$

$$\rightarrow dx = \frac{1}{\sin(x)} du$$

$$= \int u^4 (u^2 - 1) du$$

$$\Rightarrow \int (u^6 - u^4) du$$

$$\Rightarrow \int u^6 du - \int u^4 du$$

$$\Rightarrow \int u^6 du$$

$$\Rightarrow \int u^2 du = \frac{u^{n+1}}{n+1} \text{ with } n = 6$$

$$\Rightarrow \frac{u^7}{7}$$

$$\Rightarrow \int u^6 du - \int u^4 du$$

$$= \frac{u^7}{7} - \frac{u^5}{5}$$

$$\Rightarrow \frac{\cos^7(x)}{7} - \frac{\cos^5(x)}{5}$$

$$\therefore \int \cos^4(x) \sin^3(x) dx$$

$$\Rightarrow \frac{\cos^7(x)}{7} - \frac{\cos^5(x)}{5} + C$$

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ASSIGNMENT.

Integrate the following functions.

1. $\sin^6 x$.

$\int \sin^6 x \, dx$

$$\sin^6 x = (\sin^2 x)^2 (\sin^2 x)$$
$$= \left(\frac{1 - \cos 2x}{2} \right)^2 \left(\frac{1 - \cos 2x}{2} \right)$$

$$\Rightarrow \frac{1}{8} (1 - 2\cos 2x + \cos^2 2x) (1 - \cos 2x)$$

$$\Rightarrow \frac{1}{8} (1 - 2\cos 2x + \frac{1 + \cos 4x}{2}) (1 - \cos 2x)$$

$$\Rightarrow \frac{1}{16} (2 - 4\cos 2x + 1 + \cos 4x) (1 - \cos 2x)$$

$$\Rightarrow \frac{1}{16} (3 - 4\cos 2x + \cos 4x) (1 - \cos 2x)$$

$$\Rightarrow \frac{1}{16} (3 - 4\cos 2x + \cos 4x - 3\cos 2x + 4\cos^2 2x - \cos 4x \cos 2x)$$

$$\Rightarrow \frac{1}{16} [3 - 7\cos 2x + \cos 4x + 2(2\cos^2 2x) - \frac{1}{2} 2\cos 4x \cos 2x]$$

$$\Rightarrow \frac{1}{16} [3 - 7\cos 2x + \cos 4x + 2(1 + \cos 4x) - \frac{1}{2} (\cos 6x + \cos 2x)]$$

$$\Rightarrow \frac{1}{16} [3 - 7\cos 2x + \cos 4x + 2 + 2\cos 4x - \frac{1}{2} (\cos 6x + \cos 2x)]$$

$$\Rightarrow \frac{1}{32} [6 - 14\cos 2x + 2\cos 4x + 4 + 4\cos 4x - \cos 6x - \cos 2x]$$

$$\Rightarrow \frac{1}{32} [10 - 15\cos 2x + \cos 4x - \cos 6x].$$