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

$\int (\sin^2 x)^3 \, dx$

$\int (1-\cos^2 x)^3 dx$

$= \int (1-\cos^2 x)(1 - 2\cos^2 x + \cos^4 x) \, dx$

$= \int (1 - 3\cos^2 x + \cos 4x - \cos^6 x) \, dx$

$= \int 1 - 3\int \cos^2 x + \int \cos 4x - \int \cos 6$

$= x - 3\left(\frac{\cos 3x}{3}\right) + \frac{\cos 5x}{5} - \frac{\cos 7x}{7}$

$= x - \cos 3x + \frac{\cos 5x}{5} - \frac{\cos 7x}{7}$

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

let $u = \cos x$

$\frac{du}{dx} = -\sin x$

$dx = \frac{-du}{\sin x}$

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

$= \int u^4 \cdot \sin^3 x \cdot \frac{-du}{\sin x}$

$= \int u^4 \cdot \sin^2 x \cdot -du$

$= -\int u^4 \cdot (1 - \cos^2 x) \, du$

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

$$= -\int u^4 - u^6 \, du$$

$$= -\left(\frac{u^5}{5} - \frac{u^7}{7}\right)$$

$$= -\frac{\cos^5 x}{5} + \frac{\cos^7 x}{7}$$

$$\therefore = \frac{\cos^7 x}{7} - \frac{\cos^5 x}{5} //$$

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

Let $u = \cos x$

$$\frac{du}{dx} = -\sin x$$

$$dx = \frac{-du}{\sin x}$$

$$\therefore \int \cos x \sin 3x \, dx$$

$$\therefore \int u \cdot \sin 3x \cdot \frac{-du}{\sin x}$$

$$-\int u \sin^2 x \, du$$

$$-\int u(1-\cos^2 x)\, du$$

$$-\int u(1-u^2)\, du$$

$$-\int (u - u^3)\, du$$

$$-\left(\frac{u^2}{2} - \frac{u^4}{4}\right)$$

$$= \frac{-u^2}{2} + \frac{u^4}{4}$$

$$= \frac{\cos^4 x}{4} - \frac{\cos^2 x}{2}$$