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

$u = \cos x$

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

$\sin^2 x = 1 - \cos^2 x$

$\int \cancel{\sin x} \sin^2 x \cdot u \frac{-du}{\cancel{\sin x}}$

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

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

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

$-\left[\frac{u^5}{5} - \frac{u^7}{7}\right] + C$

$\frac{u^7}{7} - \frac{u^5}{5} + C$

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

(3) $\cos x \sin^3 x$; $dx = du/\cos x$

$u = \sin x$; $du/dx = \cos x$;

$\int \cancel{\cos x} \cdot u^3 \cdot \frac{du}{\cancel{\cos x}} = \int u^3 \cdot du = \frac{u^4}{4} + C$

$\frac{\sin^4 x}{4} + C$

① $\int \sin^6 x \, dx$

$$\sin^6 x = (\sin^2 x)^2 (\sin^2 x)$$

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

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

$$= \frac{1}{8}\left(1 - 2\cos 2x + \frac{1+\cos 4x}{2}\right)(1 - \cos 2x)$$

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

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

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

$$= \frac{1}{16}\left[3 - 7\cos 2x + \cos 4x + 2(2\cos^2 2x) - \frac{1}{2} 2\cos 4x \cos 2x\right.$$

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

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

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

$$= \frac{1}{32}\left[10 - 15\cos 2x + 6\cos 4x - \cos 6x\right]$$

Let $\sin^6 x = R$

$$R = \frac{1}{32}\int (10 - 15\cos 2x + 6\cos 4x - \cos 6x)\, dx$$

$$R = \frac{1}{32}\left(10x - \frac{15\sin 2x}{2} + \frac{6\cos 4x}{4} - \frac{\cos 6x}{6}\right) + C$$

$$\int \sin^6 x = \frac{10x}{32} - \frac{15\sin 2x}{64} + \frac{6\cos 4x}{128} - \frac{\cos 6x}{192} + C$$