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

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

$\sin^2 x = \frac{1-\cos 2x}{2}$

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

$\frac{1}{8}\int (1-\cos 2x)(1-2\cos 2x+\cos^2 2x)\,dx$

$\frac{1}{8}\int (1-2\cos 2x+\cos^2 2x-\cos 2x+2\cos^2 2x-\cos^3 2x)$

$\frac{1}{8}\int (1-3\cos 2x+3\cos^2 2x-\cos^3 2x)$

$\int \cos^3 2x\,dx = \int \cos 2x \cos^2 2x\,dx$

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

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

let $u = \sin 2x$, $\frac{du}{dx} = 2\cos 2x$ $dx = \frac{du}{2\cos 2x}$

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

$\int \cos^3 2x\,dx = \frac{\sin 2x}{2} - \frac{u^3}{6} = \frac{\sin 2x}{2} - \frac{\sin^3 2x}{6}$

$\int \sin^6 x\,dx = \frac{1}{8}\int (1-3\cos 2x+3\cos^3 2x-\cos^3 2x)$

$= \frac{1}{8}\left(x - \frac{3\sin 2x}{2} + \left(\frac{3x}{2}+\frac{3\sin^2 x}{4}\right) - \left(\frac{\sin 2x}{2} - \frac{\sin^3 2x}{6}\right)\right)+C$

$= \frac{1}{8}\left(x - \frac{3\sin 2x}{2} + \frac{3x}{2} + \frac{3\sin^2 x}{4} - \frac{\sin 2x}{2} + \frac{\sin^3 2x}{6}\right)+C$

$= \frac{1}{8}\left(\frac{5x}{2} - \frac{4\sin 2x}{2} + \frac{3\sin^2 x}{4} + \frac{\sin^3 2x}{6}\right)+C$

$\int \sin^6 x\,dx = \frac{5x}{16} - \frac{\sin 2x}{4} + \frac{3\sin^2 x}{32} + \frac{\sin^3 2x}{48} + C$

2. $\int \cos$

3.

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

$u = \cos x$

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

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

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

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

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

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

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

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

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

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

$\therefore \int \cos^4 x \sin^3 x \, dx = \frac{\cos^7 x}{7} - \frac{\cos^5 x}{5} + C$

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

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

$\int \cos x \sin^3 x \, dx = \int \cos x \cdot \sin x (1 - \cos^2 x) \, dx$

$= \int \cos x \cdot \sin x - \sin x \cos^2 x \, dx$

$= \sin x \cdot -\cos x + \frac{\cos^3 x}{3} + C$

$\int \cos x \sin^3 x \, dx = -\sin x \cos x + \frac{\cos^3 x}{3} + C$