

$$\textcircled{2} \cos^4 x \sin^3 x$$

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

$$\begin{aligned} \sin^3 x \cos^4 x &= (1 - \cos^2 x)(\cos^4 x \sin x) \\ &= \cos^4 x \sin x - \cos^6 x \sin x \\ &= \int (\cos^4 x \sin x - \cos^6 x \sin x) dx \\ &= \frac{1}{5} \cos^5 x + \frac{1}{7} \cos^7 x + C \end{aligned}$$

$$\textcircled{3} \cos x \sin^3 x$$

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

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

$$\text{let } u = \sin x \rightarrow \frac{du}{dx} = \cos x$$

$$du = \cos x dx$$

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

$$= \int u^3 du$$

Using reverse power rule

$$u^3 du = \frac{u^{3+1}}{3+1} + C = \frac{u^4}{4} + C$$

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

$$\int \sin^3 x \cos x dx = \frac{\sin^4 x}{4} + C$$

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$$= \frac{1}{16} (8 - 2 \cos 2x + \cos 4x + 2 + 2 \cos 4x)$$

$$4x - \frac{1}{2} (\cos 6x + \cos 2x)$$

$$= \frac{1}{32} (6 - 14 \cos 2x + 2 \cos 4x + 4 + 4 \cos 4x)$$

$$4x - (\cos 6x - \cos 2x)$$

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

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

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

② ~~$\frac{1}{32} (10x - \frac{15 \sin 2x}{2} + \frac{3 \sin 4x}{2} - \frac{\sin 6x}{6}) + C$~~
 ~~$\frac{1}{192} (60x - 15 \sin 2x + 9 \sin 4x - \sin 6x) + C$~~

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

$$\left. - \frac{\sin 6x}{6} \right) + C$$

$$= \frac{1}{32} \left(10x - \frac{15 \sin 2x}{2} + \frac{3 \sin 4x}{2} \right.$$

$$\left. - \sin 6x \right) + C$$

$$= \frac{1}{192} (60x - 15 \sin 2x + 9 \sin 4x - \sin 6x) + C$$

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① $\int \sin^6 x$

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

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

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

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

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

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

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

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

$$= \frac{1}{16} (2 - 7\cos 2x + \cos 4x + 2 \times 2 \cos^2 2x$$

$$- \frac{1}{2} - 2\cos 4x \cos 2x)$$

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

$$- \frac{1}{2} (\cos 6x + \cos 2x))$$