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1. $2x^2 \ln x$

$u = \ln x$ $\qquad dv = 2x^2$

$\frac{du}{dx} = \frac{1}{x}$ $\qquad v = \frac{2x^3}{3}$

$du = \frac{1}{x} dx$

$\int u\,dv = uv - \int v\,du$

$= \ln x \times \frac{2x^3}{3} - \int \frac{2x^3}{3} \times \frac{1}{x} \cdot dx$

$= \frac{2x^3}{3} \times \ln x - \int \frac{2x^2}{3} \cdot dx$

$= \frac{2x^3}{3} \times \ln x - \frac{2x^3}{3} \times \frac{1}{3} + c$

$= \frac{2x^3}{3} \cdot \ln x - \frac{2x^3}{9} + C$

$\int 2x^2 \ln x = \frac{2x^3}{3} [\ln x - \frac{1}{3}] + c$

2. $\int 3t e^{2t}\, dt$

Solution

$u = 3t$ $\qquad dv = e^{2t}$

$\frac{du}{dt} = 3$ $\qquad v = \frac{1}{2} e^{2t}$

$du = 3dt$

$\int u\,dv = uv - \int v\,du$

$= 3t \times \frac{1}{2} e^{2t} - \int \frac{1}{2} e^{2t} \times 3\, dt$

$= \frac{3te^{2t}}{2} - \int \frac{3}{2} e^{2t}\, dt$

$= \frac{3}{2} t e^{2t} - \frac{3}{2} \int e^{2t}\, dt$

$= \cancel{\frac{3}{2}t} \quad \frac{3t}{2} e^{2t} +$

$$= \frac{3}{2}te^{2t} - \frac{3}{2} \times \frac{1}{2}e^{2t} + C$$

$$\int 3te^{2t} = \frac{3}{2}te^{2t} - \frac{3e^{2t}}{4} + C$$

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

$u = x^2 \qquad dv = \sin x$

$du = 2x\,dx \qquad v = \cos x$

$$\int u\,dv = uv - \int v\,du$$

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

$$= -\cos x\,(x^2) + \int 2x\cos x\,dx \quad \text{----} \quad (1)$$

$$\int 2x\cos x\,dx \left[\begin{array}{ll} u = 2x & dv = \cos x \\ du = 2dx & v = \sin x \end{array}\right]$$

$$= 2x\sin x - \int \sin x - 2\,dx \quad \text{——} \quad (2)$$

Put (2) into (1)

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

$$= -x^2\cos x + 2x\sin x - 2x - \cos x + C$$

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

4 $\int \cos 5x \cos 6x\,dx$

Solution

$A = 5x \quad , \quad B = \cancel{\cos}\,6x$

Recall that:-

$$\cos A \cos B = \tfrac{1}{2}[\cos(A+B) + \cos(A-B)]$$

$$= \frac{1}{2}[\cos(5x + 6x) + \cos(5x - 6x)]$$

$$= \frac{1}{2}[\cos 11x - \cos x]$$

$$\int \cos 5x \cos 6x\,dx = \frac{1}{2}\int \cos 11x - \cos x\,dx$$

$$= \frac{1}{2}\left[\frac{\sin 11x}{11} - \sin x\right] + C$$

$$\int \cos 5x \cos 6x\,dx = \frac{\sin 11x}{22} - \frac{\sin x}{2} + C$$

5 $\int \sin 7x \cos 2x \, dx$

<u>solution</u>

$A = 7x, \quad B = 2x$

$\sin 7x \cos 2x = \frac{1}{2}\left[\sin 9x + \sin 5x\right].$

$\int \sin 7x \cos 2x \, dx = 1/2 \int \sin 9x + \sin 5x \, dx$

$= \frac{1}{2}\left[-\frac{\cos 9x}{9} - \frac{\sin 5x}{5}\right] + c$

$\int \sin 7x \cos 2x \, dx = -\frac{\cos 9x}{18} - \frac{\cos 5x}{10} + c.$