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1. $2x^2 \ln x$

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

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

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

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

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

$= \frac{2x^3}{3} \ln x - \frac{2x^3}{3x3} + c$

$\therefore \int 2x^2 \ln x\,dx = \frac{2x^3}{3} \ln x - \frac{2x^3}{9} + c$

OR

$\frac{2x^3}{3}\left(\ln x - \frac{1}{3}\right) + c$ //

2. $3te^{2t}$

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

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

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

$\int 3te^{2t} = 3t \cdot \frac{1}{2}e^{2t} - \int \frac{1}{2}e^{2t} \cdot 3dx$

$\int 3te^{2t} = \frac{3te^{2t}}{2} - \int \frac{3}{2}e^{2t} \cdot dx$

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

$\therefore \int 3te^{2t}dt = \left[\frac{3te^{2t}}{2} - \frac{3e^{2t}}{4}\right] + C$

3. $x^2 \sin x$

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

$\frac{du}{dx} = 2x$ $\quad v = -\cos x$

$du = 2x\,dx$

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

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

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

$= -x^2 \cos x + \begin{bmatrix} u = 2x & dv = \cos x \\ du = 2dx & v = \sin x \end{bmatrix}$

$= -x^2 \cos x + uv - \int v\,du$

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

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

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

2.

4. $\cos 5x \cos 6x$

$A = 5x \quad ; \quad B = 6x$

Recall that;

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

$= \frac{1}{2}\int \cos 11x + \cos A$

$\int \cos 5x \cos 6x \, dx = \frac{1}{2}\left[\frac{\sin 11x}{11} + \sin x\right] +$

5. $\sin 7x \cos 2x$

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

Recall that;

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

$\int \sin 7x \cos 2x \, dx = \frac{1}{2}\int \sin 9x + \sin 5x$

$\int \sin 7x \cos 2x \, dx = \frac{1}{2}\left[\frac{-\cos 9x}{9} - \frac{\cos 5x}{5}\right.$

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