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(1) $\int 2x^2 \ln x \, dx$

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

$\frac{du}{dx} = 4x \quad v = \frac{1}{x}$

$du = 4x \, dx$

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

$= 2x^2 \times \frac{1}{x} - \int \frac{1}{x} \times 4x \, dx$

$= \frac{2x^2}{x} - \int 4 \, dx$

$= 2x - \frac{4x}{1} + c$

$\int 2x^2 \ln x \, dx = -2x + c$

2) $\int 3te^{2t}\,dt$

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

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

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

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

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

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

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

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

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

$u = 2t \quad \frac{du}{dt} = 2$

$dt = \frac{du}{2}$

$$= \frac{3te^{2t}}{2} - \frac{3}{2}\int e^{u}\frac{du}{2}$$

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

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

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

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

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

$du = 2x\,dx$

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

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

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

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

$\int x\cos x$

$u = x \quad dv = \cos x$

$du = dx \quad v = \sin x$

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

$= x\sin x - \int \sin x\,dx$

$= x\sin x - \cos x$

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

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

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

(4) $\int \cos 5x \cos 6x$

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

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

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

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

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

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

$= \frac{\sin 11x}{22} - \frac{\sin x}{2} + C$

(5) $\int \sin 7x \cos 2x$

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

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

$= \frac{1}{2}[\sin(7x+2x) + \sin(7x-2x)]$

$= \frac{1}{2}[\sin 9x + \sin 5x]$

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

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

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