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① $\int 2x^2 \ln x \, dx$

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

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

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

$= \ln x \left(\frac{2x^3}{3}\right) - \int \frac{2x^3}{3} \cdot \frac{1}{x} dx$

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

$= \frac{2x^3}{3} (\ln x) - \frac{2x^3}{9} + c$

$\int 2x^2 \ln x \, dx = \frac{2x^3}{3} (\ln x - 1/3) + c$

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

solution

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

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

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

$= 3t \left(1/2 e^{2t} \right) - \left(\frac{1}{2} e^{2t} \cdot 3t^2/2 \, dx \right.$

$= - \cancel{3/2} \; 3te^{2t} - \int \frac{3}{4} t^2 e^{2t} dx$

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

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

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

solution

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

$du = \frac{x^3}{3} \, d\cancel{x}$ $\quad$ $v = -\cos x$

$\therefore uv - \int v \, du$

$x^2 \cdot -\cos x - \int -\cos x \cdot \frac{x^2}{3} \, dx$

$= -\cos x (x^2) - (-\sin x \cdot \frac{x^4}{12} + C$

$= -\cos x (x^2) + \sin x \left(\frac{x^4}{12}\right) + C$

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

solution

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

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

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

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

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

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

$\int \cos 5x \cos 6x \, dx = \frac{\sin 11x}{22} - \frac{\sin x}{\cancel{4} 2} + C$

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

solution

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

$\therefore \int \sin 7x \cos 2x \, dx = \frac{1}{2} (\sin(7x + 2x) + \sin(7x - 2x)$

$= \frac{1}{2} (\sin 9x + \sin 5x) \, dx$

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

$= \frac{1}{2} - \frac{\cos 9x}{9} + (- \frac{\cos 5x}{5}) \, dx$

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