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3. $x^2 \sin x$

$u = x^2$, $dv = \sin x$, $v = -\cos x$, $du/dx = 2x$

$du = 2x\,dx$

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

$\int u\,dv = [x^2 \cdot -\cos x] - \int (-\cos x \cdot 2x\,dx)$

$\int u\,dv = -x^2 \cos x - \int -2x \cos x$

$\int u\,dv = -x^2 \cos + 2\int x \cos x$

$u = x \qquad dv = \cos x$

$\frac{du}{dx} = 1 \qquad v = \sin x$

$du = dx$

$\int u\,dv = x \cdot \sin x - \int \sin x \cdot dx$

$\int u\,dv = x \sin x + \cos x$

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

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

1) $\int 2x^2 \ln x = 2\int x^2 \ln x$

$v = \frac{x^3}{3}$ $\quad dv = x^2$ $\quad u = \ln x$ $\quad \frac{du}{dx} = \frac{1}{x}$, $du = \frac{dx}{x}$

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

$\int u\,dv = (\ln x \cdot x^3/3) - \int x^3/3 \cdot dx/x$

$\int u\,dv = \frac{x^3}{3}\ln x - \int \frac{x^2}{3}$

$\int u\,dv = x^3/3 \ln x - x^3/9$

$2\int x^2 \ln x = 2\left(\frac{x^3}{3}\ln x - \frac{x^3}{9}\right)$

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

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

$u = t$, $dv = e^{2t}$, $V = \frac{e^{2t}}{2}$, $\frac{du}{dt} = 1$, $du = dt$

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

$= (t \cdot e^{2t}/2) - \int (e^{2t}/2 \cdot dt)$

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

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

$\int 5te^{2t} = 3\left(\frac{te^{2t}}{2} - \frac{e^{2t}}{4}\right) + C$

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

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

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

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

$\cos 5x \cos 6x = \frac{1}{2}[\cos 11x + \cos -x]$

$\cos 5x \cos 6x = \frac{1}{2}\left[\frac{\cos 11x}{11} + \frac{\cos(-x)}{11}\right]$

$\cos 5x \cos 6x = \frac{\cos 11x}{22} + \frac{\cos(-x)}{-2} + C$

$\cos 5x \cos 6x = \frac{\cos 11x}{22} - \frac{\cos(-x)}{2} + C$

5) $\int \sin 7x \cos 2x \quad A = 7x, \; B = 2x$

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

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

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

$= \frac{\sin 9x}{18} + \frac{\sin 5x}{10} + C$