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1 $\int 2x^2 \ln x$, let $u = \ln x$ $\quad dv/dx = 2x^2$

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

$\Rightarrow \int 2x^2 \ln x\,dx = 2\int x^2 \ln x\,dx$

Using the formula: $u\,dv = uv - v\,du$

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

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

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

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

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

$= \frac{2x^3 \ln x}{3} - \frac{2x^3}{9}dx$

$= \frac{3x2x^3 \ln x - 2x^3 dx}{9}$

$= \frac{2x^3(3\ln x - 1)}{9} + C$

$= \frac{2x^3(\ln x - 1)}{3} + C$

$\therefore \int 2x^2 \ln x = \frac{2x^3(\ln x - 1)}{3} + C$

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

let $u = 3t$, $dv/dt = e^{2t}$

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

Using the formula: $\int u\,dv = uv - \int v\,du$

$\int 3te^{2t}dt = \left[3t \cdot \frac{1}{2}e^{2t} - \int \frac{1}{2}e^{2t} \cdot 3\right] dx$

$\int 3te^{2t}dt = \left[\frac{3te^{2t}}{2} - \frac{1}{4}e^{2t} \cdot 3\right] dx$

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

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

3 $\int x^2 \sin x$

let $u = x^2$ $dv/dx = \sin x$

$du/dx = 2x$; $v = \int \sin x = -\cos x$

Using the formula; $\int u\,dv = uv - \int v\,du$

$\int x^2 \sin x\,dx = \left[x^2 \cdot -\cos x - \int -\cos x \cdot 2x\right] dx$

$\int x^2 \sin x\,dx = \left[-x^2\cos x - \int -2x\cos x\right] dx$

Using integration by parts: $u = x$, $dv/dx = \cos x$

$du/dx = 1$ $v = \int \cos x = \sin x$

$\int x^2 \sin x\,dx = \left[-x^2\cos x + 2\int x\cos x\right] dx$

$\int x^2 \sin x\,dx = \left[(-x^2\cos x + 2(x\sin x + \cos x)\right] dx$

$\int x^2 \sin x\,dx = \left[(-x^2\cos x + 2x\sin x + 2\cos x\right] dx$

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

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

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

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

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

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

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

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

$= \frac{1}{2}[-\sin 11x/11 - \frac{(-\sin x)}{1}]dx$

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

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

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

$A = 7x, B = 2x$

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

$\sin A \cos B$

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

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

$= \frac{1}{2}[-\cos 9x + (-\cos 5x]$

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

$= \frac{-\cos 9x}{18} - \frac{\cos 5x}{10}$