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MAT104

1) $U = \ln x$ $\quad dv = 2x^2$

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

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

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

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

$= \frac{2x^3}{3} \ln x - \frac{2x^3}{3\times3} + c$

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

2) $3te^{2t}$

Soln

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

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

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

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

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

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

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

3) $x^2 \sin x$

Soln

$U = x^2 \qquad dv = \sin x$

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

$du = 2x\,dx$

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

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

2) $3te^{2t}$

Soln

~~Q(x)~~ $U = 3t$ $\quad dv = e^{2t}$

$du = 3dx$ $\quad V = \frac{1}{2} e^{2t}$

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

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

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

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

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

3) $x^2 \sin x$

Soln

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

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

$du = 2x\, dx$

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

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

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

$= -x^2 \cos x + \int \Big[u = 2x \quad dv = \cos x$

$du = 2\, dx \quad V = \sin x \Big]$

$= -x^2 \cos x + \int u = 2x$
$= -x^2 \cos x + uv - \int v\,du$
$= -x^2 \cos x + 2x \sin x - \int \sin x \cdot 2dx$
$= -x^2 \cos x + 2x \sin x - \int 2 \sin x$
$\therefore \int x^2 \sin x\,dx = -x^2 \cos x + 2x \sin x + 2\cos$

4 $\cos 5x \cos 6x$

soln

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

Recall that:

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

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

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

$\therefore \int \cos 5x \cos 6x\,dx = \frac{\sin 11x}{22} + \frac{\sin x}{2} + c$

5 $\sin 7x \cos 2x$

soln

$A = 7x, B = 2x$

Recall that

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

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

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

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