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19/MHS01/075.

MBBS
MATS 104.

(1) $2x^2 \ln x$

Solution

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

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

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

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

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

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

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

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

2. $3te^{2t}$

Solution

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

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

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

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

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

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

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

(3). $x^2 \sin x$.

Solution

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

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

$du = 2x\,dx$

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

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

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

$$= -x^2 \cos x + \left[\begin{array}{ll} u = 2x & dv = \cos x \\ du = 2dx & v = \sin x \end{array}\right]$$

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

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

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

4. $\cos 5x \cos 6x$

Solution

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

but,

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

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

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

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

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

Solution

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

Recall that:

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

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

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

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