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QUESTION 1

Integrate $2x^2 \ln x$

SOLUTION

$$\int 2x^2 \ln x \, dx = \int u \, dv$$

$$\text{Let } u = \ln x \quad ; \quad du = \frac{1}{x} \, dx$$

and,

$$dv = 2x^2 \quad ; \quad v = \frac{2}{3} x^3$$

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

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

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

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

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

QUESTION 2

Integrate $3t e^{2t}$

$$\text{Let } u = 3t \quad ; \quad du = 3 \, dt$$

and,

$$dv = e^{2t} \quad ; \quad v = \frac{e^{2t}}{2}$$

$$\int 3t e^{2t} = uv - \int v \, du$$

$$= 3t \left(\frac{e^{2t}}{2} \right) - \frac{3}{2} \int e^{2t}$$

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

$$\therefore \int 3te^{2t} = \frac{3e^{2t}}{2} \left[t - \frac{1}{2} \right] + C$$

QUESTION 3

Integrate $x^2 \sin x$

SOLUTION

let $u = x^2$; $du = 2x dx$

and

$dv = \sin x$; $v = -\cos x$

$$\int x^2 \sin x = uv - \int v du$$
$$= x^2 \cdot -\cos x - \int (-\cos x) \cdot 2x dx$$

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

integrating $x \cos x$ by parts

$$= -x^2 \cos x + 2 \left\{ x(\sin x) - \int 1 \cdot (\sin x) \right\}$$

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

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

QUESTION 4

Integrate $\cos 5x \cos 6x$

SOLUTION

$$\int \cos 5x \cos 6x = \frac{1}{2} \int 2 \cos 5x \cos 6x dx$$

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

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

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

$$\int \cos 5x \cos 6x = \frac{\sin 11x}{22} + \frac{\sin x}{2} + C$$

QUESTION 5

$\sin 7x \cos 2x$

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

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

$$= \frac{1}{2} \left(-\frac{\cos 9x}{9} - \frac{\cos 5x}{5} \right) + C$$

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