MATHS 104

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DEPARTMENT: MEDICINE AND SURGERY

SOLUTIONS

1 $\int 2x^2 \ln x \, dx$

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

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

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

$\int u dv = \ln x \cdot \frac{2x^3}{3} - \int \frac{2x^3}{3} \cdot \frac{1}{x} dx$

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

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

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

$\int u dv = \frac{2x^3}{3} \left[\ln x - \frac{1}{3} \right] + c$

2 $\int 3t e^{2t} dt$

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

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

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

$\int u dv = 3t \cdot \frac{1}{2} e^{2t} - \int \frac{1}{2} e^{2t} \cdot 3 dt$

$\int u dv = \frac{3}{2} t e^{2t} - \frac{3}{2} \int e^{2t} dt$

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

$$\int u\,dv = \frac{3}{2}te^{2t} - \frac{3e^{2t}}{4} + c$$

3. $\int x^2 \sin x\,dx$

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

$du = 2x\,dx$, $v = -\cos x$

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

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

$= -\cos x\, x^2 + \int \cos x\, 2x\,dx$ —— (i)

from $\int \cos x\, 2x\,dx$

$u = 2x$ $\qquad dv = \cos x$

$du = 2dx$ $\qquad v = \sin x$

$\Rightarrow 2x\sin x - \int \sin x\, 2dx$ —— (ii)

Equ (ii) to (i)

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

$= -x^2\cos x + 2x\sin x - 2(-\cos x) + c$

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

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

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

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

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

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

$\int \cos 5x \cos 6x = \frac{\sin 11x}{22} + \left(\frac{\sin -x}{-2}\right) + c$

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

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

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

$$= \frac{1}{2}\int\left[\sin 9x + \sin 5x\right]$$

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

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