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maths 104 assignment
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Integrate the following with respect to their variables -

1) $\int x^{1/2} \ln x \, dx$

$u = \ln x \qquad dv = x^{1/2}$

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

$du = dx/x$

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

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

$= \frac{2x^{3/2} \ln x}{3} - \int \frac{2x^{1/2}}{3} dx$

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

$\therefore \int x^{1/2} \ln x \, dx = \frac{2x^{3/2} \ln x}{3} - \frac{4x^{3/2}}{9} + c$

2) $\int 2\cos 6t \cos t \, dt$

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

$A = 6t \qquad B = t$

$\cos 6t \cos t = \frac{1}{2}[\cos 7t + \cos 5t]$

$\int 2 \cdot \frac{1}{2}[\cos 7t + \cos 5t]\,dt$

$= \int \cos 7t + \cos 5t\,dt$

$= \int \cos 7t\,dt \quad \int \cos 5t\,dt$

$= \left[\frac{\sin 7t}{7} + \frac{\sin 5t}{5}\right] + C$

$\therefore \int 2\cos 6t \cos t\,dt = \frac{\sin 7t}{7} + \frac{\sin 5t}{5} + C$

3) $\int \sin^3 x \cos^4 x\,dx$

$u = \cos x$

$du/dx = -\sin x \Rightarrow du = -\sin x\,dx$

$dx = \frac{du}{-\sin x}$

$\sin^2 x + \cos^2 x = 1 \quad \therefore \sin^2 x = 1 - \cos^2 x$

$= \int \sin x \sin^2 x\, u^4 \cdot du/-\sin x$

$= \int u^4 \cdot -\sin^2 x\,du$

$= -\int u^4 \sin^2 x\,du$

$= -\int (1 - \cos^2 x)\, u^4\,du$

$= -\int (1 - u^2)\, u^4\,du$

$= \int (u^6 - u^4)\,du$

$= \int u^6\,du - \int u^4\,du$

$= \frac{u^7}{7} - \frac{u^5}{5} + C$

$$= \frac{(\cos x)^7}{7} - \frac{(\cos x)^5}{5} + C$$

$$\therefore \int \sin^3 x \cos^4 x \, dx = \frac{(\cos x)^7}{7} - \frac{(\cos x)^4}{4} + C$$