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Question

(a) Integrate the following with respect to their variables.

i) $x^{1/2}\ln x$ (ii) $2\cos 6t \cos t$ (iii) $\sin^3 x \cos^4 x$

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

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

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

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

$\therefore dx =$

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

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

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

$= \frac{2x^{3/2}\ln x}{3} - \frac{2x^{3/2}}{9/2} + c$

$= \frac{2x^{3/2}\ln x}{3} - \frac{4x^{3/2}}{9} + c$

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

where $\cos A + \cos B$

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

$= \frac{2}{2}[\cos(6t+t) + \cos(6t-t)]$

$= \cos 7t + \cos 5t$

Integrating $\cos 7t$

Let $7t = u$

$du/dt = 7 \; ; \; dt = du/7$

$\int \cos 7t \, dt = \frac{\sin u \cdot du}{7}$

where $u = 7t$

$= \frac{\sin 7t}{7}$

$\therefore \int \cos 5t = \frac{\sin 5t}{5}$

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

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

since m is odd

$u = \cos x$

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

and $\sin^2 x = 1 - \cos^2 x$

$= \int \sin x \cdot \sin^2 x \cdot u^4 \cdot \frac{-du}{\sin x}$

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

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

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

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

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

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