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

$u = \cos x$ (since the power is odd)

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

recall: $\sin^2 x + \cos^2 x = 1$

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

$$\int \sin^3 x \cos^4 x\,dx = \int \sin x . \sin^2 x . u^4 . -\frac{du}{\sin x}$$

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

$$= -\int (1-\cos^2 x) . u^4\,\cancel{dx}$$

$$= \int (u^2 - \cancel{1}) . u^4\,du$$

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

$$= \left(\frac{u^7}{7} - \frac{u^5}{5}\right) + C$$

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

$$\therefore \int \sin^3 x \cos^4 x\,dx = \frac{(\cos x)^7}{7} - \frac{(\cos x)^5}{5} + C$$

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MAT 104

1.) $x^{1/2} \ln x$

let $u = \ln x$, $dv = x^{1/2} dx$

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

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

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

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

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

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

$A = 6t$, $B = t$

recall:

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

$$= \frac{1}{\cancel{2}}[\cancel{2}(\cos 7t + \cos 5t)]$$

$$= \int(\cos 7t + \cos 5t)$$

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