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

Solution

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

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

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

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

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

$$= \frac{2x^{3/2}\ln x}{3} - \frac{2x^{5/2}}{15/2} \ln x + C$$

$$= \frac{2x^{3/2}\ln x}{3} - \frac{4x^{5/2}}{15} \ln x + C$$

$$= \ln x \left[\frac{2x^{3/2}}{3} - \frac{4x^{5/2}}{15} \right] + C$$

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

Solution

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

$A = 6t \quad B = 1t$

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

$= \frac{1}{2}\left[\frac{\sin 7t}{7} + \frac{\sin 5t}{5}\right] + C$

$= \frac{\sin 7t}{7} + \frac{\sin 5t}{5} + C$

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

Solution

$\sin^3 x = \sin x \cdot \sin^2 x$

i.e $\int \sin x \sin^2 x \cos^4 x \, dx$

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

$= \int \sin x \cdot [1 - \cos^2 x] \cos^4 x \, dx$

Let $\cos x = u$

$du = -\sin x \, dx$

$= \int \cancel{\sin x} [1 - u^2] u^4 \cdot \frac{du}{-\cancel{\sin x}}$

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

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

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

$= \frac{1}{7}\cos^7 x - \frac{1}{5}\cos^5 x + C$