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MAT 104

1. $x^{\frac{1}{2}} \ln x$

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

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

$\frac{du}{dx} = \frac{1}{2} x^{-1/2}$

$\int \frac{v\,du}{dx} + \int \frac{u\,dv}{dx}$

$\ln x \int \frac{x^{1/2}}{dx} + x^{1/2} \int \frac{d \ln x}{dx}$

$\ln x \left[\frac{x^{3/2}}{3/2} \right] + x^{1/2} \left[\frac{1}{x} \right] + C$

$\frac{2 \ln x}{3} \cdot x^{3/2} + \frac{x^{1/2}}{x} + C$

$\frac{2x^{3/2} \ln x}{3} + \frac{\sqrt{x}}{x} + C$

2. $2\cos 6t \quad \cos t$

$\int 2\cos 6t \quad \cos t \, dt = 2 \int \cos 6t \cos t \, dt$

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

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

$= \frac{2}{2} [\cos(6+1) + \cos(6-1)]$

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

$\int 2 \cos 6t \cos t \, dt = \frac{1}{2} \int (2 \cos 7t + \cos 5t)$

$= \cancel{\frac{2}{2}} \left[\frac{\sin 7t}{7} - \frac{\sin 5t}{5} \right]$

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

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

$u = \cos x$

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

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

$\cancel{\int u^4 \sin^2 x \, du}$ $\int u^4 \sin^2 x \; -\frac{du}{\sin x}$

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

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

Recall that

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

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

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

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

but $(1 - \cos x)$

but $u = \cos x$

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

$-(u^4 - u^6) du$

$-\left[\frac{u^{4+1}}{4+1} - \frac{u^{6+1}}{6+1}\right] + c$

$-\left[\frac{u^5}{5} - \frac{u^7}{7}\right] + c$

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