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

$u = \cos x$

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

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

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

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

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 $u \cdot \cos x$

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

$-(u^4 - u^6] \, du$

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

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

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

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

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

$u = x^{\frac{1}{2}}$

$d = \ln x$

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

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

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

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

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

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

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

$12 \int \cos 6t \cos t \, dt$

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

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

$= \frac{2}{3} \left[\cos (6+1) + \cos (6-1) \right]$

$= \frac{2}{3} \left[\cos 7t + \cos 5t \right]$

$\int 2\cos 6t \cos t \, dt = \frac{1}{2} \left[(2\cos 7t + \cos 5t \right]$

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

$\frac{\sin 7t}{7} - \frac{\sin 5t}{5} + c$