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MATRIC NO: 19/MHS02/027.

1. $\int 2x^2 \ln x \, dx$.

Let $u = \ln x$ $\quad dv = 2x^2$

$\frac{du}{dx} = \frac{1}{x}$

$v = \frac{2x^3}{3}$

$du = \frac{1}{x} dx$

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

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

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

$\int 2x^2 \ln x \, dx = \frac{2x^3}{3} \ln x - \frac{2}{3} \left(\frac{x^3}{3} \right) + C$.

$\int 2x^2 \ln x \, dx = \frac{2x^3}{3} \left[\ln x - \frac{1}{3} \right] + C$

2. $\int 3te^{2t} dt$

Let $u = 3t$ $\quad dv = e^{2t}$

$\frac{du}{dt} = 3$ $\quad v = \frac{1}{2} e^{2t}$

$du = 3dt$

$\int 3te^{2t} dt = 3t \cdot \frac{1}{2} e^{2t} - \int \frac{1}{2} e^{2t} \cdot 3 dt$

$\int 3te^{2t} dt = \frac{3}{2} te^{2t} - 3 \int \frac{1}{2} e^{2t} dt$

$\int 3te^{2t} dt = \left(\frac{3t}{2} e^{2t} - \frac{3}{4} e^{2t} \right) + C$

3 $\int x^2 \sin x \, dx$

Let $u = x^2$ $\quad dv = \sin x$

$\frac{du}{dx} = 2x$ $\quad v = -\cos x$

$du = 2x\,dx$

$\int x^2 \sin x \, dx = -x^2 \cos x - \int -\cos x \cdot 2x\,dx$

$\int x^2 \sin x \, dx = -x^2 \cos x + 2\int \cos x \cdot x\,dx$ — eq ①

$\int \cos x \cdot x \, dx$

Let $u = x$, $dv = \cos x$

$\frac{du}{dx} = 1$ $\quad v = \sin x$

$du = dx$

$\int \cos x \cdot x\,dx = x\sin x - \int \sin x \cdot dx$ — eq ②

Putting eq ② into eq ①

$\int x^2 \sin x\,dx = -x^2 \cos x + 2\left[x\sin x - \int \sin x \cdot dx\right]$.

$\int x^2 \sin x\,dx = -x^2 \cos x + 2\left[x\sin x - \{-\cos x\}\right] + c$

$\int x^2 \sin x\,dx = -x^2 \cos x + 2\left[x\sin x + \cos x\right] + c$.

$\int x^2 \sin x\,dx = -x^2 \cos x + 2x\sin x + 2\cos x + c$

4 $\int \cos 5x \cos 6x \, dx$

Let $A = 5x \quad B = 6x$

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

$\int \cos 5x \cos 6x \, dx = \frac{1}{2}\int \cos(5x+6x) + \cos(5x-6x)$

$\int \cos 5x \cos 6x \, dx = \frac{1}{2}\int \cos 11x \; - \cos x$

$\int \cos 5x \cos 6x \, dx = \frac{1}{2}\left[\frac{\sin 11x}{11} - \sin x\right] + C$

$\int \cos 5x \cos 6x \, dx = \frac{\sin 11x}{22} - \frac{\sin x}{2} + C$

5 $\int \sin 7x \cos 2x \, dx$

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

$\int \sin 7x \cos 2x \, dx = \frac{1}{2}\left\{\sin\{7x+2x\} + \sin[7x-2x]\right\}$

$\int \sin 7x \cos 2x \, dx = \frac{1}{2}\int\{\sin 9x + \sin 5x\}$

$\int \sin 7x \cos 2x \, dx = \frac{1}{2}\int[\sin 9x + \sin 5x$

$\int \sin 7x \cos 2x \, dx = \frac{1}{2}\left[-\frac{\cos 9x}{9} - \frac{\cos 5x}{5}\right] + C$

$\int \sin 7x \cos 2x \, dx = -\frac{\cos 9x}{18} - \frac{\cos 5x}{10} + C$