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2) $\int 3te^{2t}\,dt$

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

$u = 3t, \quad du = 3 \quad dv = e^{2t}\,dt \quad v = \frac{e^{2t}}{2}$

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

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

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

$\int 3te^{2t}\,dt = \frac{3te^{2t}}{2} - \frac{3e^{2t}}{4}$.

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

$u = x^2 \quad du = 2x \quad dv = \sin x\,dx \quad v = -\cos x$

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

$\int x^2 \sin x\,dx = x^3 \times -\cos x - \int -\cos x \times 2x$

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

$\int 2x\cos x = 2x \times \sin x - \int \sin x \times 2$

$\int 2x\cos x = 2x\sin x - 2\int \sin x$

$\int 2x\cos x = 2x\sin x + 2\cos x$

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

=2.

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

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

$u = 2x^2, \; du = 4x$

$dv = \ln x\,dx \quad v = x\ln x - x$

$\int 2x^2 \ln x\,dx = 2x^2 \times (x\ln x - x) - \cancel{\int x\ln x - x \times 4x}$

$-\int x\ln x - x \times 4x\,dx$

$\int 2x^2 \ln x\,dx = 2x^3 \ln x - 2x^3 - \int 4x^2 \ln x - 4x^2$

$\int 2x \ln x\,dx = 2x^3 \ln x - 2x^3 - \int 4x^2(\ln x - 1)$

$\int 2x^2 \ln x\,dx = 2x^3 \ln x - 2x^3 - \frac{4x^3}{3} \int \ln x - 1$

$\int 2x^2 \ln x\,dx = 2x^3 \ln x - 2x^3 - \frac{4x^3}{3} \, ((x\ln x - 2x$

$\int 2x^2 \ln x\,dx = 2x^3 \ln x - 2x^3 - \frac{4x^4 \ln x}{3} - \frac{8x^4}{3}$

$\int 2x^2 \ln x\,dx = 2x^3 (\ln x - \frac{2x\ln x}{3} = \frac{4}{3}x \cdot 1 + c.$

4) $\int \cos 5x \cos 6x \, dx = \frac{1}{2}\int [\cos(A+B) + \cos(A-B)]$

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

$\frac{1}{2}[\cos 11x + \cos x$

$= \frac{1}{2}\left[\frac{\sin 11x}{11} - \sin x\right]$

$= \frac{\sin 11x}{22} - \frac{\sin x}{2}.$

where $A = 5x, \; B = 6x.$

5) $\sin 7x \cos 2x \, dx \quad \frac{1}{2}[\sin(7x+2x + \sin(7x-2x)]$

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

$= \frac{1}{2}\left[-\frac{\cos 9x}{9} - \frac{\cos 5x}{5}\right]$

$= -\frac{\cos 9x}{18} - \frac{\cos 5x}{10}$