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Maths 104 assignment.

Integrate the following with respect to their variable.

1. $3te^{2t}$

Solution.

$\int 3te^{2t}$

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

$du/dt = 3 \qquad dv/dt \; e^{2t}/2 = v$

$du = 3\,dt$

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

$\int u\,dv = 3t\left(\frac{e^{2t}}{2}\right) - \int \frac{e^{2t}}{2} \cdot 3\,dt$

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

$\int u\,dv = \frac{3te^{2t}}{2} - \frac{3}{2}\left[\frac{e^{2t}}{2}\right] + c$

$\therefore \int 3te^{2t} = \frac{3te^{2t}}{2} - \frac{3e^{2t}}{4} + c$

2. $\int x^2 \sin x$

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

$du = 2x\,dx$

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

$\int u\,dv = x^2(-\cos x) - \int -\cos x \cdot 2x\,dx$

$\int u\,dv = -x^2\cos x - \int -2x\cos x\,dx$

$\int -2x\cos x\,dx$

$u = -2x$, $dv = \cos x$

$du = -2dx$, $v = \sin x$

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

$\int u\,dv = -2x\sin x - \int \sin x \cdot -2dx$

$\int u\,dv = -2x\sin x - \int -2\sin x\,dx$

$\int u\,dv = -2x\sin x + 2\int \sin x\,dx$

$\int u\,dv = -2x\sin x + 2[-\cos x) + C$

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

$\int x^2 \sin x = -x^2\cos x - (-2x\sin x - 2\cos x) + C$

$= \int x^2 \sin x = -x^2\cos x + 2x\sin x + 2\cos x + C$

3. $\int \sin 7x \cos 2x$

$= \frac{1}{2}[\sin 9x + \sin 5x]$

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

$= \int \frac{\sin 9x}{2} + \int \frac{\sin 5x}{2}$

$= \frac{1}{2}\int \sin 9x + \frac{1}{2}\int \sin 5x$

$= -\frac{1}{2}\left(\frac{\cos 9x}{9}\right) + \frac{1}{2}\left(\frac{-\cos 5x}{5}\right) + c$

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

4. $\int \frac{2x - 3x^2}{1 - x}$

$3x + 1$

$-x + 1 \;\big|\; -3x^2 + 2x$

$-3x^2 + 3x$

$-x$

$-x + 1$

-1

$\int 3x + 1 - \frac{1}{1-x} = \int 3x + \int 1 - \int \frac{1}{1-x}$

$\frac{3}{2}x^2 + x - [-\ln(1-x)] + C$

$\therefore \int \frac{2x - 3x^2}{1-x} = \frac{3x^2}{2} + x + \ln(1-x) + C$