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1) $3te^{2t}$

let $u = 3t$ and $dv = e^{2t}$

$\int dv = \int e^{2t}$

$\frac{du}{dt} = 3$

$v = \frac{e^{2t}}{2}$

$du = 3dt$

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

$= 3t\left(\frac{e^{2t}}{2}\right) - \int \frac{e^{2t}}{2} \times 3dt$

$3t\left(\frac{e^{2t}}{2}\right) - \frac{1}{2}\int 3e^{2t}\,dt$

$3t\left(\frac{e^{2t}}{2}\right) - \frac{1}{2}\int 3e^{2t}\,dt$

$3t\left(\frac{e^{2t}}{2}\right) - \frac{1}{2} \times \frac{3e^{2t}}{2} + c$

$\left[\frac{3}{2}te^{2t} - \frac{3e^{2t}}{4}\right] + c$

2) $\int x^2 \sin x$

let $u = x^2$ and $dV = \sin x$

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

using $uv - \int v\,du$

$(x^2)(-\cos x) - \int(-\cos x)(2x\,dx)$

$-\cancel{x^2 dx}$ $-x^2\cos x - \int -2x\cos x\,dx$

$\left[\begin{array}{l} \text{let } u = -2x \text{ and } du = \cos x \\ \frac{du}{dx} = -2x \text{ and } V = \sin x \end{array}\right]$

$\therefore (-2x)(\sin x) - \int(\sin x)(-2]\,dx$

$-2x\sin x - (-2)\int \sin x\,dx$

$-2x\sin x - (-2) - \cos x + c$

$-2x\sin x - 2\cos x + c$

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

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

Let $A = 7x$, $B = 2x$

$\int \sin 7x \cos 2x = \frac{1}{2}\left(\sin(7x + 2x) + \sin(7x - 2x)\right)$

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

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

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

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

$$\begin{array}{r|l} & 2x - x^2 \\ 1 - x & 2x - 3x^2 \\ - & \underline{2x - 2x^2} \\ & -x^2 \\ - & \underline{-x^2 + x^3} \\ & -x^3 \end{array}$$

Which can now be

$\int (2x - x^2)\,dx + \int \frac{x^3}{1 - x}\,dx$

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