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MAT 104 Assignment 19/ENG04/018.

① $\int 3t e^{2t} \, dt$.

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

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

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

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

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

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

$\int \frac{e^{2t}}{2} dt$.

$u = 2t \quad \frac{du}{dt} = 2$.

$dt = \frac{1}{2} du$.

$= \frac{1}{4} \int e^u du$.

$\int a^u du = \frac{a^u}{In(a)}$ with $a = e$.

$= e^u$.

$\therefore \frac{1}{4} \int e^u du$

$= \frac{e^u}{4}$

undo substitution $u = 2t$:

$= \frac{e^{2t}}{4}$.

$\therefore \frac{te^{2t}}{2} - \frac{e^{2t}}{4}$

The 3 will come in

$$\frac{3te^{2t}}{2} - \frac{3e^{2t}}{4}$$

$$= \frac{3te^{2t}}{2} - \frac{3e^{2t}}{4} + C$$

$$= \frac{3(2t-1)e^{2t}}{4} + C$$

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

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

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

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

$$= \cancel{x^2(2x) - \int(-\cos x)(\sin x)}$$

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

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

Now solving

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

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

Now soloing

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

$u = x$ $\quad dv = \cos x$

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

$du = dx$

$$= x\sin(x) - \int \sin(x)dx$$

$$= x\sin x \pm \cos x$$

Pluged in solved integrals

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

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

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

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

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

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

$\cancel{u = \sin 7x}$ $\qquad \cancel{du = \cos 2x}$

$\cancel{\frac{du}{dx} = \cos 7x}$ $\qquad \cancel{v = -\sin 2x}$. $\quad \cancel{v = \frac{\sin 2x}{2}}$

$\cancel{v = +2\sin 2x}$.

$\cancel{\int u\,dv = uv - \int v\,du}$

$\cancel{= (\sin 7x)\left(\frac{\sin 2x}{2}\right)}$

$\sin(x)\cos(y) = \frac{1}{2}(\sin(y+x) - \sin(y-x))$.

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

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

$\int \sin(9x)\,dx$

$u = 9x \quad \frac{du}{dx} = 9 \quad dx = \frac{1}{9}du$.

$$= \frac{1}{9}\int \sin u\,du$$

$$= \frac{-\cos 9x}{9}$$

$\int \sin 5x\,dx$

$u = 5x \quad \frac{du}{dx} = 5 \quad dx = \frac{1}{5}du$.

$$= -\frac{\cos 5x}{5}$$

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

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

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

Rewrite.

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

$u = x-1 \quad \frac{du}{dx} = 1$

$x = u+1 \quad du = dx \quad x^2 = (u+1)^2.$

$$= \int \frac{(u+1)(3u+1)}{u}$$

$$= \int \frac{3u^2+4u+1}{u}\,du.$$

$$= \int \left(3u + \frac{1}{u} + 4\right) du.$$

$$= 3\int u\,du + \int \frac{1}{u}\,du + 4\int 1\,du.$$

$$= 3\left(\frac{u^2}{2}\right) + \ln u + 4(u).$$

$$= \ln(u) + \frac{3u^2}{2} + 4(u)$$

$u = x-1$

$$= \ln(x-1) + \frac{3(x-1)^2}{2} + 4(x-1).$$

$\therefore \quad -\int \frac{3x^2-2x}{x-1}\,dx$

$$= -4(x-1) - \frac{3(x-1)^2}{2} - \ln(x-1).$$

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

$$= -4(x-1) - \frac{3(x-1)^2}{2} - \ln(|x-1|) + C$$