OMUNIE [illegible] MICHEAL
CHEMICAL ENGINEERING
19/engo1/011

1) Find dy/dx if $y = 2\cos 3x / x^3$

solution

$$y = \frac{2\cos 3x}{x^3}$$

Using quotient rule

$u = 2\cos 3x$; $du = -6\sin 3x$

$v = x^3$, $dv = 3x^2$

$$\frac{dy}{dx} = \frac{(-6\sin 3x)x^3 - (2\cos 3x)(3x^2)}{(x^3)^2}$$

$$= -6x^3 \sin 3x - 6x^2 \cos 3x$$

$$= \frac{-6x^2(x\sin 3x + \cos 3x)}{x^6}$$

$$= \frac{-6(x\sin 3x + \cos 3x)}{x^4}$$

~~$\Rightarrow -6\sin 3x - 6x\cos 3x$~~

~~x^4~~

$$= \frac{-6\sin 3x - 6x\cos 3x}{x^4}$$

2) If $y = xe^{2x}$, show that the differential equation $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$

$y = xe^{2x}$

$\frac{dy}{dx} = 2xe^{2x}$

$\frac{d^2y}{dx^2} = 4xe^{2x}$

$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y$

$4xe^{2x} - 4(2xe^{2x}) + 4(xe^{2x})$

$4xe^{2x} - 8xe^{2x} + 4xe^{2x}$

$8xe^{2x} - 8xe^{2x} = 0$ //

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4) $\int e^x \sin 2x \, dx$

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

$u = \sin(2x)$; $dv = e^{2x}$

$du = 2\cos 2x$ $v = e^{2x}$

$\int e^x \sin 2x = e^x \sin 2x - 2\int e^x \cos 2x \, dx = e^x \sin 2x - 2\left(e^x \cos 2x - (-2)\int e^x \sin 2x \, dx\right)$

$= e^x \sin 2x - 2e^x \cos 2x - 4\int e^x \sin 2x$

$\int e^x \sin 2x + 4\int e^x \sin 2x = e^x \sin 2x - 2e^x \cos 2x$

$5\int e^x \sin 2x = e^x \sin 2x - 2e^x \cos 2x + C$

$\Rightarrow \int e^x \sin 2x = \frac{e^x}{5}(\sin 2x - 2\cos 2x) + C$ //