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MAT 10~~2~~4.

1.) Find $\frac{dy}{dx}$ if $y = \left(\frac{2\cos 3x}{x^3}\right)$; where $U = 2\cos 3x$

$\therefore \frac{du}{dx} = -6\sin 3x$

$\therefore \frac{dy}{dx} = \frac{V\frac{du}{dx} - U\frac{dv}{dx}}{V^2}$

$V = x^3 \therefore \frac{dv}{dx} = 3x^2.$

$\Rightarrow \left(\frac{(x^3)\cancel{+}(-6\sin 3x) - (2\cos 3x)(3x^2)}{(x^3)^2}\right)$

$\Rightarrow \frac{-6x^3 \sin 3x - 6x^2 \cos 3x}{x^6}$

$\Rightarrow \frac{\cancel{x^2}(-6x\sin 3x - 6\cos 3x)}{\cancel{x^6}\, x^4}.$

$\frac{dy}{dx} \Rightarrow \frac{-6(x\sin 3x - \cos 3x)}{x^4}.$

2.) $y = xe^{2x}$ $\Rightarrow U = x$ $V = e^{2x}$

$\therefore \frac{d^2y}{dx^2} \cancel{*} - \left(\frac{4dy}{dx}\right) + 4y = 0$

$\therefore \frac{dy}{dx} = U\frac{dV}{dx} + V\frac{du}{dx}$ where $\frac{dv}{dx} = 2e^{2x}$;

$\frac{du}{dx} = 1$

$u = 2x \quad v = e^{2x}$

$\Rightarrow x(2e^{2x}) + e^{2x}$

$\frac{d^2y}{dx^2} = u\frac{dv}{dx} + v\frac{du}{dx} + 2e^{2x}$

$\Rightarrow 2x(2e^{2x}) + e^{2x}(2).$

$\Rightarrow \frac{d^2y}{dx^2} = 4xe^{2x} + 2e^{2x} + 2e^{2x}.$

$\Rightarrow 4xe^{2x} + 4e^{2x}.$

$\therefore \frac{d^2y}{dx^2} - 4\left(\frac{dy}{dx}\right) + 4(y) = 0.$

$\Rightarrow 4xe^{2x} + 4e^{2x} - 4(2xe^{2x} + e^{2x}) + 4(xe^{2x}).$

$\Rightarrow 4xe^{2x} + 4xe^{2x} - 8xe^{2x} + 4e^{2x} - 4e^{2x}$

$\Rightarrow 0.$


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4.) $\int e^x \sin 2x$

let $u = \sin 2x \quad dV = e^x$

$du = 2\cos 2x \quad dv = e^x$

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

$\Rightarrow e^x \sin 2x - \left( \begin{array}{ll} u = 2\cos 2x & dv = e^x \\ du = -4\sin 2x & V = e^x. \end{array} \right.$

$\Rightarrow e^x \sin 2x - \left(e^x 2\cos 2x - \left(-\int e^x 4\sin 2x\right.\right.$

$$\Rightarrow \int e^{x}\sin 2x = e^{x}\sin 2x - (e^{x}2\cos 2x) - (4\int e^{x}\sin 2x$$

let $\int e^{x}\sin 2x = I$.

$$\Rightarrow I = e^{x}\sin 2x - e^{x}2\cos 2x - 4I.$$

$$\Rightarrow \frac{5I}{5} = \frac{e^{x}\sin 2x - e^{x}2\cos 2x}{5}.$$

$$\therefore I = \frac{e^{x}\sin 2x - e^{x}2\cos 2x}{5}.$$

remember $I = \int e^{x}\sin 2x$

$$\therefore \int e^{x}\sin 2x = \frac{e^{x}\sin 2x - e^{x}2\cos 2x}{5} + C$$