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

Solution

$\ln(y) = \ln(2\cos 3x) - \ln(x^3)$

$$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{1}{2\cos 3x} \cdot -6\sin 3x - \frac{1}{x^3} \cdot 3x^2$$

$$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{-6\sin 3x}{2\cos 3x} - \frac{3x^2}{x^3}$$

$$\frac{dy}{dx} = y\left[\frac{-6\sin 3x}{2\cos 3x} - \frac{3x^2}{x^3}\right]$$

$$\frac{dy}{dx} = \frac{2\cos 3x}{x^3}\left[\frac{-6\sin 3x}{2\cos 3x} - \frac{3x^2}{x^3}\right]$$

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

Solution

$y = xe^{2x}$

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

$du = 1 \quad dv/dx = 2e^{2x}$

$u\frac{dv}{dx} + v\frac{du}{dx}$

$= x(2e^{2x}) + e^{2x}(1)$

$= x2e^{2x} + e^{2x}$

$\frac{dy}{dx} = 2x + 1(e^{2x})$

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

$4dy/dx = 8xe^{2x} + 4e^{2x}$

$4y = 4xe^{2x}$

$= 4xe^{2x} + \cancel{4e^{2x}} - 8xe^{2x} + \cancel{4e^{2x}} + 4xe^{2x} = 0$

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