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MAT 104

$y = (2\cos 3x)/x^3$

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

$\frac{d}{dx}(\ln y) = \frac{d}{dx}(\ln 2\cos 3x) - \frac{d}{dx}(\ln x^3)$

$1/y\left(\frac{dy}{dx}\right) = 1/2\cos 3x(-6\sin 3x) - 1/x^3(3x^2)$

$d/y\, dy/dx = \frac{-6\sin 3x}{2\cos 3x} = \frac{3x^2}{x^3}$

$\frac{dy}{dx} = y\left(\frac{-3\sin 3x}{\cos 3x} - 3/x\right)$

$dy/x = \frac{2\cos 3x}{x^3}\left(\frac{-3\sin 3x}{\cos 3x} - 3/x\right)$

$y = xe^{2x}$

Let $u = x$ $v = e^{2x}$

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

$= x \cdot e^{2x} \cdot 2 + e^{2x} \times 1$

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

$d^2y/dx^2 = 2x\, de^{2x}/dx + e^{2x} d2x/dx + de^{2x}/dx$

$= 4xe^{2x} + 2e^{2x} + 2e^{2x}$

$4xe^{2x} + 4e^{2x}$

$\frac{2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$

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

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

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

$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} = 4y = 0$

* $\int e^x \sin 2x \, dx$

$u = \sin 2x \quad dx = e^x$

$du = 2\cos 2x \, dx \quad Y = ex$

$\int u \, dy = uv - \int u \, du$

$\sin 2x(e^x) \int e^x 2\cos 2x \, dx$

$e^x \sin 2x - \int e^x 2\cos 2x \, dx$

$\int u = 2\cos 2x \quad dv = ex$

$[2\cos x(x) - \int e^x (-2\sin 2x)$

$[e^x 2\cos 2x + 2\sin 2x \, ex \, dx\}$

$\int \sin 2x - e^x 2\cos 2x - \int ex 2\sin 2x \, dx$

$\int e^x \sin 2x \, dx = e^x 2\sin 2x \cdot \int ex 2\cos 2x -$

$\int ex 2\sin 2x$

Let $I = \int e^x 2\sin 2x - e^x 2\cos 2x = I$

$$I = e^x \sin 2x - e^x 2\cos 2x - I$$

$$2I = e^x 2\sin 2x - e^x 2\cos 2x$$

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

$$\therefore \int e^x \sin 2x \, dx = \tfrac{1}{2}\left[2\sin 2x - e^x 2\cos 2x\right] + c$$