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MATRIC NO: 16/ENG02/020
COURSE: MAT 104

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

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

$d/dx\,(\ln y) = d/dx\,(\ln 2\cos 3x) - d/dx\,(\ln x^3)$

$1/y\,(dy/dx) = 1/2\cos 3x\,(-6\sin 3x) - 1/x^3\,(3x^2)$

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

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

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

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

Let $U = x \quad V = e^{2x}$

$dy/dx = U\frac{dv}{dx} + V\frac{du}{dx}$

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

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

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

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

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

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

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

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

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

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

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

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

$du = 2\cos^{2x} \quad dx \; v = ex$

$\int u dv = uv - \int u dv$

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

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

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

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

$[e^x 2\cos 2x + 2\sin 2x e^x dx]$

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

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

Let $I = \int e^x 2\sin 2x dx$

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

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

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

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