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Matric No: 19/ENG02/004

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

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

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

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

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

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

2 $y = xe^{2x} \qquad u = x, \; v = e^{2x}$

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

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

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

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

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

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

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

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

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

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

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

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

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4 $\int e^{x} \sin 2x \, dx$

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

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

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

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

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

$\int u = 2\cos 2x \quad dv = e^{x}$

$du = -2\sin 2x \quad v = e^{x}$

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

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

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

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

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

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

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

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