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Maths 104 assignment.

1. Find dy/dx if $y = \frac{2\cos 3x}{x^3}$

solution.

$u = 2\cos 3x$ $\quad v = x^3$

$du/dx = -6\sin 3x$ $\quad dv/dx = 3x^2$

$$\frac{dy}{dx} = \frac{v\,du/dx - u\,dv/dx}{v^2}$$

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

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

$$= \frac{-6x^2(x\sin 3x - \cos 3x)}{x^4}$$

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

Q1. If $y = xe^{2x}$, show that the differential equation

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

solution

$y = xe^{2x}$

$dy/dx = 2xe^{2x}$ $\quad 4\,dy/dx = 8xe^{2x}$

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

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

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

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

$8xe^{2x} - 8xe^{2x} = 0$

∴ If $y = xe^{2x}$, then

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

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Find the integral of $e^x \sin 2x$ with respect to x.

Solution

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

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

$du/dx = 2\cos 2x$ $\quad v = e^x$

$du = 2\cos 2x\,dx$

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

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

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

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

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

$du/dx = -4\sin 2x$ $\quad v = e^x$

$du = -4\sin 2x\,dx$

$$\int e^x 2\cos 2x\,dx = 2e^x \cos 2x - \int e^x \cdot -4\sin 2x\,dx$$

$$\int e^x 2\cos 2x\,dx = 2e^x \cos 2x + 4\int e^x \sin 2x\,dx$$

$$\therefore \int \sin 2x\, e^x\,dx = e^x \sin 2x - 2e^x \cos 2x + 4\int e^x \sin 2x\,dx$$

$$\int \sin 2x\, e^x\,dx - 4\int \sin 2x\, e^x\,dx = e^x(\sin 2x - 2\cos 2x)$$

$$+3\int \sin 2x\, e^x\,dx$$

$$-3\int \sin 2x\, e^x\,dx = e^x(\sin 2x - 2\cos 2x)$$

$$\therefore \int \sin 2x\, e^x\,dx = \frac{e^x(\sin 2x - 2\cos 2x)}{-3}$$