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Math 104 152.

(1)

$y = \frac{2\cos 3x}{x^3}$ is a quotient

$\therefore$ let $u = 2\cos 3x$ $\frac{du}{dx} = -6\sin 3x$

$v = x^3$ $\frac{dv}{dx} = 3x^2$

quotient rule = $\frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

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

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

$= \frac{-6x^2}{x^6}\left[x\sin 3x + \cos 3x\right] = \frac{-6}{x^4}\left[x\sin 3x + \cos 3x\right]$

(2)

$y = xe^{2x}$ Show that the differential equations d^2y/dx^2

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

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

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

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

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

$\frac{d^2y}{dx^2}\left[2xe^{2x} + e^{2x}\right]$

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

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

$= \left[4xe^{2x} + 4e^{2x}\right] - 4\left[2xe^{2x} + e^{2x}\right] + 4\left[xe^{2x}\right]$

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

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

$= 0$

(3)

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(4)

$\int e^x \sin 2x \cdot dx$.

Solu

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

$du = e^x dx$ $\quad V = -2\cos 2x$

$\therefore$ Using $\int u \cdot dv = uv - \int v \cdot du$

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

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

(4)

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

$= \int u \cdot du = uv - \int v\, du$ $\quad du/dx = 2\cos 2x \quad v = e^x$

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

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

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

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

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

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

$I = e^x \sin 2x - 2e^x \cos 2x - 4I$

$5I = e^x \sin 2x - 2e^x \cos 2x$

$$I = \frac{e^x \sin 2x - 2e^x \cos 2x}{5}$$

$$\therefore \int e^x \sin 2x = \frac{1}{5}\left[e^x \sin 2x - 2e^x \cos 2x\right] + C$$