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MAT 104

1. $y = (2\cos 3x)/x^3$. Find dy/dx

Using Quotient Rule: $\frac{dy}{dx} = \frac{V\,du/dx - u\,dv/dx}{V^2}$

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

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

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

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

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

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

2. $y = xe^{2x}$ $\quad u = x$ $\quad V = e^{2x}$

$dy/dx = u\,dv/dx + V\,du/dx$

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

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

$d^2y/dx^2 = 4xe^{2x} + 2e^{2x} + 2e^{2x}$

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

Given:

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

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

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

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

$= 0$

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

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

$v = e^x dx \qquad du = 2\cos 2x$

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

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

$= \sin 2x\, e^x - u = 2\cos 2x \qquad dv = e^x$

$du = -2\sin 2x \qquad v = e^x$

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

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

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

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

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

$5\int e^x \sin 2x = e^x(\sin 2x - 2\cos 2x)$

$\int e^x \sin 2x = \frac{e^x(\sin 2x - 2\cos 2x)}{5} + C$