

3. If $y = \cos(5x^2 + 6x)$ find $\frac{dy}{dx}$

Solution

using the chain rule

$$y = \cos(5x^2 + 6x)$$

$$\frac{dy}{dx} = \sin(5x^2 + 6x) \cdot (10x + 6)$$

4. Find the integral of

a) $\int \frac{3 dx}{4x+1}$

b) $\int \frac{dx}{x^2+49}$

c) $\int (e^{6x} + 9x^3 - \sin 7x + \cos 8x) dx$

d) $\int (x\sqrt{9+x^2}) dx$

Solution

a) $\int \frac{3}{4x+1} dx$

$$\text{let } u = 4x + 1$$

$$\frac{du}{dx} = 4$$

$$\frac{du}{4} = 4 \frac{dx}{4}$$

$$dx = \frac{du}{4}$$

$$\int \frac{3}{u} \frac{du}{4}$$

$$\frac{3}{4} \int \frac{1}{u} du$$

Remember $\int \frac{1}{u} du = \ln(u)$

$$\therefore \frac{3}{4} \ln(u) = \frac{3}{4} \ln(4x+1)$$

$$b) \int \frac{dx}{(x^2+49)} = \int \frac{1}{49(1+\frac{x^2}{49})} dx = \frac{1}{49} \int \frac{dx}{1+(\frac{x}{7})^2}$$

$$\text{let } u = \frac{2x}{7}$$

$$\frac{du}{dx} = \frac{1}{7}$$

$$\therefore du = 7 du$$

$$\frac{1}{49} \int \frac{7 du}{1+u^2} = \frac{1}{49} \int \frac{du}{1+u^2} = \frac{1}{7} \int \frac{du}{1+u^2}$$

$$\text{Recall! } \int \frac{1}{1+u^2} du = \arctan u$$

$$= \frac{1}{7} \int \frac{1}{1+u^2} du = \frac{\arctan(\frac{x}{7})}{7}$$

$$c) \int e^{6x} + 9x^3 - \sin 7x + \cos 8x dx$$

$$\left[\frac{e^{6x}}{6} + \frac{9x^{3+1}}{3+1} - \left(\frac{-\cos 7x}{7} \right) + \frac{\sin 8x}{8} \right] + C$$

$$= \frac{e^{6x}}{6} + \frac{9x^4}{4} + \frac{\cos 7x}{7} + \frac{\sin 8x}{8} + C$$

$$d) \int x \sqrt{9+x^2} dx$$

$$\text{let } u = 9+x^2$$

$$\frac{du}{dx} = 2x$$

$$dx = \frac{du}{2x}$$

$$\int x \sqrt{\frac{du}{2x}} = \int u^{1/2} \frac{du}{2} = \frac{1}{2} \int u^{1/2} du$$

$$= \frac{1}{2} \frac{u^{3/2}}{3/2} = \frac{u^{3/2}}{2 \cdot 3/2} = \frac{u^{3/2}}{3} = \frac{(9+x^2)^{3/2}}{3}$$

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Math 104 Assignment

1. $\lim_{x \rightarrow 0} \left(\frac{4x^2 - \sin x}{x^3} \right)$

Using L'Hospital's rule

$\lim_{x \rightarrow 0} \left(\frac{8x - \cos x}{3x^2} \right)$ for the 1st derivative

$\lim_{x \rightarrow 0} \left(\frac{8 + \sin x}{6x} \right)$ for the 2nd derivative

$\lim_{x \rightarrow 0} \left(\frac{\cos x}{6} \right) = \frac{\cos(0)}{6} = \frac{1}{6} //$

2) If $y = \left(\frac{7x^2 \cos 8x}{e^{3x}} \right)$ find the derivative of y w.r.t

respect to x

Solution

$y = \frac{uv}{w}$

$u = 7x^2, v = \cos 8x, w = e^{3x}$

$\frac{du}{dx} = 14x, \frac{dv}{dx} = -8 \sin 8x, \frac{dw}{dx} = 3e^{3x}$

$\frac{dy}{dx} = y \left[\frac{1}{u} \frac{du}{dx} + \frac{1}{v} \frac{dv}{dx} - \frac{1}{w} \frac{dw}{dx} \right]$

$= y \left[\frac{1}{7x^2} (14x) + \frac{1}{\cos 8x} (-8 \sin 8x) - \frac{1}{e^{3x}} (3e^{3x}) \right]$

$= y \left[\frac{14x}{7x^2} + \frac{(-8 \sin 8x)}{\cos 8x} - \frac{3e^{3x}}{e^{3x}} \right]$

$\frac{dy}{dx} = \frac{7x^2 \cos 8x}{e^{3x}} \left[\frac{2}{x} - 8 \tan 8x - 3 \right]$