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MAT 104

1) Find the unit of the functions.

$$\frac{(4x^2 - \sin x)}{x^2} \quad as \quad x \longrightarrow 0$$

Solution

$$\lim_{x \to 0} \left[\frac{4x^2 - \sin x}{x^3} \right]$$

$$\lim_{x \to 0} \left[\frac{8x - (-\sin x}{6x} \right]$$

$$\lim_{x \to 0} \left[\frac{x \times \sin x}{6x} \right]$$

$$\lim_{x \to 0} \left[\frac{0 \times \cos x}{6} \right]$$

$$= \frac{\cos x}{6} = \frac{\cos(0)}{6} = \frac{1}{6}$$

$$24 = \frac{9x^2 \cos 8x}{2^{3x}}$$

$u = 9x^2 \quad v = \cos 8x \quad w = 2^{3x}$

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

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

$$y = \left[\frac{1}{9x^2}[14x] + \frac{1}{\cos 8x}(-8\sin 8x) - \frac{1}{2^{3x}}[3e^{3x}]\right]$$

$$y = \left[\frac{1}{x} - 8\tan 8x - 1\right]$$

$$\frac{dy}{dx} = \frac{9x^2\cos 8x}{2^{3x}}\left[\frac{1}{x} - 8\tan 8x - 1\right]$$

3) If $y = \cos(3x^2 + 6x)$. Find dy/dx

solution

$y = \cos(3x^2 + 6x)$

let $u = 3x^2 + 6x$

$y = \cos u$

$\frac{dy}{dx} = 10x + 6$ $\quad$ $\frac{dy}{du} = -\sin u$

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

$10x + 6(-\sin u)$

$= 10x + 6 \sin(-3x^2 + 6x)$

$= -10x + 6 \sin(3x^2 + 6x)$ //

4) Find the integral of the following as $\frac{3dx}{4x+1}$

solution

$$\int \frac{3dx}{4x+1} \qquad 3\int \frac{1}{4x+1}\,dx$$

$u = 4x+1 \qquad \frac{du}{dx} = 4 \qquad dx = \frac{1}{4}\,dx$

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

$$\frac{3}{4}\ln(4x+1)+c$$

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

$$\int \frac{dx}{x^2+49} = \frac{dx}{x^2+7^2}$$

$x = 7\tan\theta$

$$\frac{dx}{d\theta} = 7\sec^2\theta$$

$$x^2+7^2 = 7^2\tan^2\theta + 7^2$$
$$= 49\sec^2\theta$$

$$= \int \frac{\sec^2\theta\, d\theta}{49\sec^2\theta} = \int \frac{d\theta}{7} = \frac{1}{7}$$

$$= \frac{1}{7}[\theta] + c$$

$$= \frac{1}{7}\tan^{-1}\frac{x}{7} + c$$

c $\int e^{6x} + 9x^2 - \sin 9x + \cos 8x \, dx$

$= \int 2^{6x} + \int 9x^3 - \int \sin 9x + \int \cos 8x$

$= \int \frac{1}{6}^{26x} + \frac{9x^{3+1}}{3+1} - \left[-\frac{\cos 7x}{7}\right] + \frac{\sin 8x}{8} + c$

$= \left[\frac{1}{6} e^{6x} + \frac{9x^4}{4} + \frac{\cos 7x}{7} + \frac{\sin 8x}{8} + c\right]$ //

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

$u = 29$

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

$\frac{1}{2} \int \sqrt{u} \, du$

$= \frac{1}{2}\left[\frac{2u^{3/2}}{3}\right] du$

$= u^{3/2}$

$= \frac{(x^2-9)^{3/2} + c}{3}$ //