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19/ENG05/1007
MAT104
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1. Find the limit of the function $(4x^2 - \sin x)/x^3$ as $x \to 0$

Solution

$$\lim_{x \to 0} = \frac{4x^2 - \sin x}{x^3}$$

$$\frac{dy}{dx} = \frac{8x - \cos x}{3x^2}$$

$$\frac{d^2y}{dx^2} = \frac{8 + \sin x}{6x}$$

$$d^3y = 0 - \cos x$$

$$\frac{d^3}{dx^3} \quad 6$$

$$\lim_{x \to 0} = \frac{-\cos 0}{6} = \frac{-1}{6}$$

2. If $y = (7x^2 \cos 8x)/e^{3x}$ find dy/dx

Soln

$7x^2 . \cos 8x . e^{-3x}$

$$\frac{dy}{dx} = y\left(\frac{1}{u}\cdot\frac{du}{dx} + \frac{1}{v}\cdot\frac{dv}{dx} + \frac{1}{w}\cdot\frac{dw}{dx}\right)$$

$$\frac{dy}{dx} = \left(\frac{1}{7x^2} \cdot 14x + \frac{1}{\cos 8x} \cdot -8\sin 8x + \frac{1}{e^{-3x}} \cdot -3e^{-3x}\right)$$

$$= 2x^{-1} - 8\tan 8x - 3$$

3. $y = \cos(5x^2 + 6x)$ find dy/dx

let $u = (5x^2 + 6x)$

$y = \cos u$

$\frac{du}{dx} = (10x + 6)$

$\frac{dy}{du} = \sin u - \sin u$

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

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

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

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

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

Let $u = 4x + 1$

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

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

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

$= \frac{3}{4} \int u^{-1} \, du = \frac{3}{4} \int \frac{1}{u} \, du = \frac{3}{4} \ln u$

$3/4 \ln u + C$

$3/4 \ln(4x+1) + C$

⑤ $\int \frac{dx}{x^2+49} = \int \frac{dx}{x^2+7^2}$

$\tan x = 7 \tan\theta$

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

$dx = 7\sec^2\theta\, d\theta$

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

$= 7^2(1+\tan\theta)$

$= 7^2\sec^2\theta$

$\int \frac{7\sec^2\theta}{7^2\sec^2\theta}$

$\frac{1}{7}\int d\theta$

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

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

$= \frac{1}{6}e^{6x} + \frac{9x^4}{4} + \frac{1}{7}\cos 7x + \frac{1}{8}\sin 8x + C$

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

Let $u = 9 + x^2$

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

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

$$\int x \cdot u^{1/2}\,dx$$

$$\int x \cdot u^{1/2}\,\frac{du}{2x}$$

$$\frac{1}{2}\int u^{1/2}\,du$$

$$\frac{1}{2}\cdot\frac{u^{3/2}}{\frac{3}{2}} + C$$

$$\frac{1}{2}\cdot\frac{2u^{3/2}}{3} + C$$

$$\frac{u^{3/2}}{3} + C$$

$$\frac{(9+x^2)^{3/2}}{3} + C$$