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MATHS 104
AERONAUTICAL ENGINEERING
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* Find the Derivative of the following using First Principle

a $$Y = \sin\left(\frac{3}{x^3}\right)$$

Solution

$$\frac{d \sin u}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

$$\frac{dy}{dx} = \cos u; \quad \frac{dy}{dx} = -6x^{-3}$$

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

$$= \frac{-6}{x^3} \cos\left(\frac{3}{x^3}\right)$$

b $$y = \frac{4}{x^3}$$

Solution

$$f(y) = \frac{f(x+h) - f(x)}{h}$$

$$= \frac{\frac{4}{(x+\Delta x)^3} - \frac{4}{x^3}}{\Delta x}$$

$$= \frac{\frac{4x^3 - 4(x+\Delta x)^3}{x^3(x+\Delta x)^3}}{\Delta x}$$

$$= \frac{\frac{4x^3 - 4x^3 - 12x^2\Delta x - 12x\Delta x^2 - 4\Delta x^3}{x^3(x^3 + 3x^2\Delta x + 3x(\Delta x)^2 + \Delta x^3}}{\Delta x}$$

$$\lim_{\Delta x \to 0} = \frac{-12x^2 - 12x\Delta x - 4\Delta x^2}{x^3(x^3 + 3x^2\Delta x + 3x(\Delta x)^2 + \Delta x^3} = \frac{-12x^2}{x^6} = \frac{-12}{x^4}$$

Find the Integral of the following

a $\frac{d}{(x^2+36)}$

Solution

$$\int \frac{1}{x^2+36} \cdot dx \quad \int \frac{dx}{x^2+36} = \frac{1}{6} \tan^{-1}\left(\frac{x}{6}\right) + c$$

b $dx(x^2+13)$

$$\int \frac{dx}{x^2+13} = \int \frac{dx}{x^2+(\sqrt{13})^2} = \frac{1}{\sqrt{13}} \tan^{-1}\left(\frac{x}{\sqrt{13}}\right) + c$$