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MATRIC NO: 19/ENG02/036
COURSE CODE: MAT 104

01. Differentiate $y = \sin(6/x^2)$ from the first principle

Solution: using chain rule

$$\frac{d}{dx}(f(g)) = \frac{d}{dg}(f(g)) \times \frac{d}{dx}(g)$$

where $g = \frac{6}{x^2}$

$$\therefore \frac{d}{dx}\sin\left[\frac{6}{x^2}\right] = \frac{d}{dg}(\sin(g)) \times \frac{d}{dx}\left[\frac{6}{x^2}\right]$$

Solve $\frac{d}{d^2}\left[\frac{6}{x^2}\right]$ Using quotient Rule

$$= \frac{-6 \times 2x}{(x^2)^2} = \frac{-12x}{x^4}$$

and $\frac{d}{dg}(\sin(g)) = \cos(g)$

$$\cos\left[\frac{6}{x^2}\right] \times \left[\frac{-12x}{x^4}\right]$$

$$\cos\left[\frac{6}{x^2}\right] \times \left[-12 \times \frac{x}{x^4}\right]$$

$$\cos\left[\frac{6}{x^2}\right] \times \left[-12 \times \frac{1}{x^3}\right]$$

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$$= \frac{-12\cos(6/x^2)}{x^3}$$

2. $x = 4t^3 - t^2$ and $y = t^4 + 2t^2$ at $t=1$ and $t=3$

$$A = \int_a^b y\,dx \qquad y = t^4 + 2t^2$$

$$A = \int_1^3 t^4 + 2t^2$$

Given $x = 4t^3 - t^2$

$$\frac{dx}{dt} = 12t^2 - 2t$$

$$dx = 12t^2 - 2t \cdot dt$$

$$A = \int_1^3 (t^4 + 2t^2) \times (12t^2 - 2t)$$

$$A = \int_1^3 t^4(12t^2 - 2t) + 2t^2(12t^2 - 2t)$$

$$12t^6 - 2t^5 + 24t^4 - 4t^3$$

$$A = \int_1^3 (12t^6 - 2t^5 + 24t^4 - 4t^3)\,dt$$

$$A = \int_1^3 \frac{12t^7}{7} - \frac{2t^6}{6} + \frac{24t^5}{5} - \frac{4t^4}{4}$$

$$A \left[\frac{12(3)^7}{7} - \frac{2[3]^6}{6} + \frac{24(3)^5}{5} - \frac{4(3)^4}{4}\right] - \left[\frac{12}{7} - \frac{2}{6} + \frac{2^4}{5} - \frac{4}{4}\right]$$

$$A = \left[\frac{26244}{7} - 243 + 1166.4 - 81\right] - \left[\frac{544}{105}\right]$$

$$A = 2420.74 - 5.1809$$

$$A = 2,815.5591$$

$A = \simeq 2,815.6$ square units

03. If $x = 4t^3 - t^2$ and $y = t^4 + 2t^2$. find dy/dx

$$\frac{dx}{dt} = 12t^2 - 2t \quad , \quad dy/dt = 4t^3 + 4t$$

$$\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt} = \frac{dy}{dt} \times \frac{dt}{dx}$$

$$= \frac{4t^3 + 4t}{12t^2 - 2t} //$$