Badeyo Sathadat Oyunnansola
Mechanical Engineering
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MAT 104
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1) $y = \frac{(2x^2+3)}{\ln 2x}$

let $u = 2x^2+3$ $\quad v = \ln 2x$

$\frac{du}{dx} = 4x$ $\quad \frac{dv}{dx} = \frac{1}{x}$

$$\frac{dy}{dx} = \frac{V(du/dx) - U(dv/dx)}{V^2}$$

$$\frac{dy}{dx} = \frac{4x(\ln 2x) - \frac{1}{x}(2x^2+3)}{(\ln 2x)^2}$$

$$\frac{dy}{dx}\Big|_{x=2.5} = \frac{4(2.5)[\ln 2(2.5)] - \frac{1}{2.5}[2(2.5)^2+3]}{[\ln 2(2.5)]^2}$$

$$\frac{dy}{dx}\Big|_{x=2.5} = \frac{16.094 - 6.2}{2.5903}$$

$$= 3.8196$$

$$\approx 3.82 \text{ (3 s.f)}$$

2 $y = \frac{2x}{x^2-5}$

$u = 2x$ $\quad v = x^2-5$

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

$$\frac{dy}{dx} = \frac{V(du/dx) - U(dv/dx)}{V^2}$$

$$\frac{dy}{dx} = \frac{2(x^2-5) - (2x)(2x)}{(x^2-5)^2}$$

$$= \frac{2x^2 - 10 - 4x^2}{(x^2-5)^2}$$

$$= \frac{2x^2 - 4x^2 - 10}{(x^2-5)^2}$$

$$= \frac{-2x^2 - 10}{(x^2-5)^2}$$

$$\left.\frac{dy}{dx}\right|_{(2,-4)} = M = \frac{-2(2)^2 - 10}{[2^2-5]^2}$$

$$= \frac{-2(4) - 10}{[4-5]^2}$$

$$= \frac{-8-10}{-1^2}$$

$$= \frac{-18}{1} = -18$$

∴ Gradient = −18

3 $Z = 2x^3 \ln y$.

$u = 2x^3$ $\quad v = \ln y$.

$\frac{du}{dy} = 6x^2$ $\quad \frac{dv}{dy} = \frac{1}{y}$

$$\frac{dz}{dy} = 2x^3 \cdot \frac{1}{y} + \ln y \cdot 6x^2 \frac{dx}{dy}$$

$$\frac{dz}{dy} = \frac{2x^3}{y} + 6x^2 \ln y \frac{dx}{dy}$$

4. $\int_0^2 x(2x^2+1)^{1/2}\,dx$

let $u = 2x^2 + 1$

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

$du = 4x\,dx$

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

$= \int_0^2 x\,u^{1/2} \cdot \frac{du}{4x}$

$= \frac{1}{4}\int_0^2 x\,u^{1/2} \cdot du$

$= \frac{1}{4}\left[\frac{x^2 \cdot u^{3/2}}{2 \quad 3/2}\right]\Big|_0^2$

$= \frac{1}{4}\left[\frac{x^2 \cdot 2u^{3/2}}{2 \quad 3}\right]\Big|_0^2$

$= \frac{1}{4}\left[x^2 \cdot \frac{u^{3/2}}{3}\right]\Big|_0^2$

$= \frac{1}{4} \times \frac{1}{3}\left[x^2 \cdot u^{3/2}\right]\Big|_0^2$

$= \frac{1}{12}\left[x^2 \cdot (2x^2+1)^{3/2}\right]\Big|_0^2$

$= \frac{1}{12}\left[\left[2^2 \cdot [2(2)^2+1]^{3/2}\right] - \left[0^2 \cdot [2(0)^2+1]^{3/2}\right]\right]$

$= \frac{1}{12}\left[4 \cdot [2(4)+1]^{3/2} - [0]\right]$

$= \frac{1}{12}\left[4 \cdot [8+1]^{3/2}\right]$

$= \frac{1}{12}\left[4 \cdot 9^{3/2}\right]$

$= \frac{1}{12}[4 \cdot 27] = \frac{108}{12} = 9.$