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Mechanical Engineering
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MAT 104
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1. $y = \frac{(2x^2+3)}{\ln 2x}$ $\quad x = 2.5$

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

$\frac{du}{dx} = 4x$ $\quad \frac{dv}{dx} = \frac{1}{2x} \cdot 2 = \frac{1}{x}$

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

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

$$dy/dx \text{ at } x = 2.5 = \frac{\ln 2(2.5)(4\times 2.5) - (2(2.5)^2+3)\left(\frac{1}{2.5}\right)}{(\ln 2(2.5))^2}$$

$$= \frac{16.0943 - 6.2}{2.5902}$$

dy/dx at $x = 2.5 = 3.8199$

≈ 3.820 (to 3 s.f)

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

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

$du/dx = 2$ $\quad dv/dx = 2x$

$$\frac{dy}{dx} = \frac{V\,du/dx - U\,dv/dx}{V^2} = \frac{(x^2-5)(2) - 2x(2x)}{(x^2-5)^2}$$

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

$\left.\frac{dy}{dx}\right|_{(2,-4)}$

$$m = \frac{-2(2)^2 - 10}{(2^2-5)^2} = -18$$

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

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

$du/dx = 6x^2 \quad dv/dy = 1/y$

$\frac{dz}{dy} = u \cdot \frac{dv}{dy} + v \cdot \frac{du}{dx}$

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

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

4. $\int_2^0 x(2x^2+1)^{1/2} dx$

let $u = 2x^2 + 1$

$du/dx = 4x$

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

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

$\frac{1}{4}\int_0^2 u^{1/2} du$

$\frac{1}{4}\left[\frac{u^{3/2}}{3/2}\right]_0^2 = \frac{1}{4}\left[\frac{(2x^2+1)^{3/2}}{3/2}\right]_0^2$

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

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

$= \frac{1}{4}\left[\frac{27}{3/2} - \frac{1}{3/2}\right]$

$= \frac{1}{4}\left[27 \times \frac{2}{3} - 1 \times \frac{2}{3}\right]$

$= \frac{1}{4}\left[18 - \frac{2}{3}\right]$

$= \frac{1}{4} \times \frac{52}{3} = 4.33$