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MAT104

$$1) \quad y = \frac{(2x^2+3)}{\ln 2x}$$

$$\ln y = \ln(2x^2+3) - \ln(\ln 2x)$$

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

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

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

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

$$\rightarrow \underline{\underline{3.82}}$$

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

$$\ln y = \ln 2x - \ln x^2 - 5$$

$$\frac{1}{y} \frac{dy}{dx} = \frac{1}{2x} \cdot 2 - \frac{1}{x^2-5} \cdot 2x$$

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

$$= \frac{2x}{x^2-5} \left(\frac{1}{x} - \frac{2x}{x^2-5} \right)$$

$$\therefore \text{at } x=2.4, \frac{dy}{dx} = \underline{\underline{-37.26}}$$

$$3) \quad z = 2x^3 \ln y$$

$$\frac{dz}{dy} = \frac{1}{y}$$

$$4) \int_0^2 x (2x^2+1)^{\frac{1}{2}} dx = \int_0^2 x \sqrt{2x^2+1} dx$$

$$\text{let } u = 2x^2+1$$

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

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

$$\therefore \int_0^2 x \sqrt{2x^2+1} dx = \int_0^2 x \sqrt{u} \frac{du}{4x} = \frac{1}{4} \int_0^2 \sqrt{u} du$$

$$= \frac{1}{4} \left[\frac{u^{\frac{3}{2}}}{\frac{3}{2}} + C \right]$$

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

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

$$= \frac{1}{4} \left[\frac{52}{3} \right] = \frac{13}{3}$$