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

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

$du/dx = 4x$ $\quad dv/dx = 1/x$

$$\frac{dy}{dx} = \frac{v \cdot du/dx - u \cdot dv/dx}{v^2}$$

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

~~$\frac{dy}{dx}\Big|_{x=2.5} = 4(2.5)\ln 2(2.5) - 1/2.5$~~

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

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

$$= 3.8196 \approx \cancel{3.8263}$$

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

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

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

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

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

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

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

$$\left.\frac{dy}{dx}\right|_{(2,-4)} = M = \frac{-2(2)^2 - 10}{[(2)^2-5]^2} = \frac{-18}{1}$$

Gradient $= -18$

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

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

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

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

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

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

let $u = 2x^2+1$

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

$$du = 4x\,dx$$

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

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

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

$$\frac{1}{4}\left[\frac{u^{3/2}}{3/2}\right]_0^2 = \frac{1}{6}\left[u^{3/2}\right]_0^2$$

$$= 1/6\left[(2x^2+1)^{3/2}\right]_0^2$$

$$= 1/6\left[(2(2^2)+1)^{3/2} - (2(0)+1)^{3/2}\right.$$

$$= \frac{1}{6}[27-1]$$

$$= \frac{1}{6}[26]$$

$$= 4.3333 \approx 4.33$$