NAME: AMADIKE CHIDERA LILIAN
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DEPARTMENT :- COMPUTER ENGINEERING

1) Find $\frac{dy}{dx}$ at $x = 2.5$ when $y = \frac{(2x^2+3)}{\ln 2x}$

Using Quotient Rule

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

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

$\frac{v\, du/dx - u\, dv/dx}{v^2} = \frac{(\ln 2x)(4x) - (2x^2+3)(1/x)}{(\ln 2x)^2}$

at $x = 2.5$

$\frac{\ln 2(2.5)(4 \times 2.5) - (2(2.5)^2+3)(1/2.5)}{[(\ln 2(2.5))]^2}$

$\frac{(1.609 \times 10) - (15.5 \times 0.4)}{2.590} = \frac{9.89}{2.590}$

Ans $= 3.82$ (3 s.f)

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

let $u = 2x$, $v = x^2 - 5$

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

$\frac{v\, du/dx - u\, dv/dx}{v^2} = \frac{(x^2-5)(2) - (2x)(2x)}{(x^2-5)^2}$

$$y = \frac{-2x^2-10}{(x^2-5)^2} \quad \text{at } (2,-4)$$

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

$$\frac{df}{dy} = 0$$

$\therefore$ The gradient of the curve $= (-18, 0)$

3) If $z = 2x \ln y$ find dz/dy

Solution

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

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

$$\frac{1}{z} \cdot \frac{dz}{dy} = \left[\frac{3}{x} + \frac{1}{y \ln y}\right.$$

$$\frac{dz}{dy} = z \left[\frac{3}{x} + \frac{1}{y \ln y}\right]$$

$$\frac{dz}{dy} = 2x^3 \ln y \left[\frac{3}{x} + \frac{1}{y \ln y}\right]$$

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

let $u = 2x^2+1$

$du/dx = 4x \quad . \quad dx = du/4x$

$\therefore \frac{1}{4}\int \sqrt{u}\, du$

$\int u^{1/2} = \frac{2u^{3/2}}{3}$

$\therefore \frac{1}{4}\int \sqrt{u}\, du = \frac{u^{3/2}}{6}$

$u = (2x^2+1) = \frac{[2x^2+1]^{3/2}}{6}$

$\int_0^2 x\sqrt{2x^2+1} = \int_0^2 \frac{(2x^2+1)^{3/2}}{6}$

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

$= \frac{[9]^{3/2}}{6} - \frac{[1]^{3/2}}{6} = 4.33$ //