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Course: MAT104 Serial no: 3

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

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

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

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

at $x = 2.5$

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

$$\frac{[1.609 \times 10] - [15.5 \times 0.4]}{2.590} = \frac{9.89}{2.590}$$

$$= 3.8185 \approx 3.82 \text{ (3 s.f.)}$$

2) $y = \frac{2x}{x^2 - 5}$ Using Quotient Rule $\left[\frac{df}{dx}, \frac{df}{dy} \right]$

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

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

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

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 is $(-18, 0)$

3) If $z = 2x^3 \ln y$ find $\frac{dz}{dy}$

solution

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

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

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

~~$$\frac{1}{z} \cdot \frac{dz}{dy}$$~~

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

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

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

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

Let $u = 2x^2 + 1$

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

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

$$\int u^{1/2} = \frac{2u^{3/2}}{3} \quad \therefore \left[\frac{1}{4} \int \sqrt{u} du \right] = \frac{u^{3/2}}{6}$$

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

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

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

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