

$$① \frac{d}{dx} (2x^2+3) \ln(x)$$

$$\frac{d}{dx} [2x^2+3] \cdot \ln(x) + (2x^2+3) \cdot \frac{d}{dx} [\ln(x)]$$

$$[2 \cdot \frac{d}{dx} [x^2] + \frac{d}{dx} [3]] \ln(x) + (2x^2+3) \cdot \frac{1}{x} \cdot \frac{d}{dx} [x]$$

$$(2 \cdot 2x + 0) \ln(x) + \frac{(2x^2+3) \cdot 1}{x}$$

$$4x \ln(x) + \frac{(2x^2+3) \cdot 1}{x}$$

$$= 4x \ln(x) + \frac{(2x^2+3) \cdot 1}{x}$$

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$$= 4x \ln(x) + \frac{2x^2+3}{x}$$

at $x=2.5$

$$\frac{4(2.5)}{\ln(2(2.5))} + \frac{2(2.5)^2+3}{(2.5)\ln^2(2(2.5))}$$

$$= 3.8192 \approx 3.82 \log 19$$

$$② \frac{d}{dx} \left[\frac{x}{x^2-5} \right]$$

$$= 2 \cdot \frac{d}{dx} \left[\frac{x}{x^2-5} \right]$$

$$= 2 \cdot \frac{\frac{d}{dx} [x] \cdot (x^2-5) - x \cdot \frac{d}{dx} [x^2-5]}{(x^2-5)^2}$$

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

$$= \frac{2(2x^2 - 5) - (2x + 0)x}{(x^2 - 5)^2}$$

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

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

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

$$= \frac{-18}{1}$$

$$\text{Gradient} = -18$$

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

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

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

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

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

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

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

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

$$du = 4x dx$$

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

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

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

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

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

$$= \frac{1}{6} [27 - 0]$$

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

$$= 4.5 \approx 4.5$$