(1) $dy/dx\ (2x^2+3)/\ln(2x)$

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

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

$$\frac{(2\cdot 2x+0)\ln(2x) - \frac{(2x^2+3)\cdot 2\cdot\frac{d}{dx}[x]}{2x}}{\ln^2(2x)}$$

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

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

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

at $x = 2\cdot5$

$$\frac{4(2\cdot5)}{\ln(2(2\cdot5))} - \frac{2(2\cdot5)^3+3}{(2\cdot5)\ln^2(2(2\cdot5))}$$

$= 3\cdot8198 \doteq 3\cdot82$ to 3 s.f.

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

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

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

$$\frac{2\left(1(x^2-5) - \left(\frac{d}{dx}[x^2] + \frac{d}{dx}[-5]\right)x\right)}{(x^2-5)^2}$$

$$= \frac{2\left(1(x^2-5) - \left(\frac{d}{dx}[x^2] + \frac{d}{dx}[-5]\right)x\right)}{(x^2-5)^2}.$$

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

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

$=$

$$m = \cancel{2(2)} \quad \cancel{-18} \quad \frac{-2(2)^2 - 10}{[(2)^2-5]^2}$$

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

Gradient $= -18$.

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

$u = 2x^3 \quad v = \ln y$.

$$\frac{du}{dy} = 6x^2\, dx/dy \qquad \frac{dv}{dy} = 1/y.$$

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

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

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

let $u = 2x^2+1$

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

$du = dx\, 4x$

$dx = du/4x$.

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

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

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

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

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

$$\frac{1}{6} \left[26 \right].$$

$$= 4.333 \simeq 4.33.$$