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Civil Engineering

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

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

$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{1}{2x^2+3} \cdot 4x - \frac{1}{\ln 2x} \cdot \frac{2}{2x}$

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

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

When $x = 2.5$

$\frac{dy}{dx} = \frac{2(2.5)^2+3}{\ln 2(2.5)}\left(\frac{4(2.5)}{2(2.5)^2+3} - \frac{1}{2.5 \ln(2 \times 2.5)}\right)$

$\frac{dy}{dx} = 3.82$

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

$\ln y = \ln 2x - \ln x^2 - 5$

$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{1}{2x} \cdot 2 - \frac{1}{x^2-5} \cdot 2x$

$\frac{dy}{dx} = y\left(\frac{2}{2x} - \frac{2x}{x^2-5}\right)$

$= \frac{2x}{x^2-5} \cdot \left(\frac{1}{x} - \frac{2x}{x^2-5}\right)$

When $x = 2.4$

$\frac{dy}{dx} = \frac{2(2.4)}{(2.4)^2-5} \cdot \left(\frac{1}{2.5} - \frac{2(2.5)}{(2.5)^2-5}\right)$

$\frac{dy}{dx} = -37.26$

3 $z = 2x^5 \ln y$

$\frac{dz}{dy} = \frac{1}{y}$

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

$= \int_0^2 x\sqrt{2x^2+1}\,dx$

let $u = 2x^2+1$

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

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

$\therefore \int_0^2 x\sqrt{2x^2+1}\,dx$

$= \int_0^2 x\sqrt{u}\frac{du}{dx} \Rightarrow \frac{1}{4}\int_0^2 \sqrt{u}\,du \Rightarrow \frac{1}{4}\int_0^2 u^{1/2}\,du$

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

$= \frac{1}{4}\left[\frac{2(2x^2+1)^{3/2}}{3}\right]$

$= \frac{1}{4}\left[\frac{2(2(2)^2+1)^{3/2}}{3} - \frac{2(2(0)^2+1)^{3/2}}{3}\right]$

$= \frac{1}{4}\left[18 - \frac{2}{3}\right]$

$= \frac{1}{4}\left[\frac{52}{3}\right]$

$= \frac{13}{3}$