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18/ENG02/007

Maths 106 (CO)

COMPUTER ENGINEERING

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

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

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

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

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

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

$\therefore \frac{dy}{dx}$ at $x = 2.5$

$\cancel{\frac{dy}{dx} = \frac{2x^2+3}{\ln 2x}\left[\frac{4x}{2x^2+3} - \frac{1}{x\ln 2x}\right]}$

$\cancel{\frac{dy}{dx} = \frac{2x^2+3}{\ln 2x}\left[\frac{4x}{2x^2+3} - \frac{1}{x\ln 2x}\right]}$

$\cancel{\frac{dy}{dx}}$

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

$\frac{dy}{dx} = \frac{15.5}{1.609}\left[\frac{10}{15.5} - \frac{1}{4.024}\right]$

$\frac{dy}{dx} = \frac{15.5}{1.609}\left[0.397\right]$

$\frac{dy}{dx} = \frac{6.1535}{1.609}$

$\frac{dy}{dx} = 3.8244$

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

$\frac{dy}{dx}$ at $x = 2.5 = 3.82$

2.) Gradient $= dy/dx$

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

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

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

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

$\frac{dy}{dx} = y\left[\frac{1}{x} - \frac{2x}{x^2-5}\right]$

$\frac{dy}{dx} = \frac{2x}{x^2-5}\left[\frac{1}{x} - \frac{2x}{x^2-5}\right]$

$\frac{dy}{dx} = 6$

$\therefore$ ln at point $(2, -4)$

$y = \frac{2(2)}{2^2-5}\left[\frac{1}{2} - \frac{2(2)}{2^2-5}\right]$

$y = \frac{4}{-1}\left[\frac{1}{2} - \left(\frac{4}{-1}\right)\right]$

$y = -4\left[0.5 + 4\right]$

$y = -4 \times 4.5$

$y = -18$

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

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

$\frac{dz}{dy} = \frac{2x^3}{y}$

4.) $\int_0^2 x\sqrt{2x^2+1}\,dx$

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

$u^2 = 2x^2+1$

$2x^2 = u^2-1$

$x^2 = \frac{u^2-1}{2}$

$x = \frac{(u^2-1)^{1/2}}{2}$

let $y = \left(\frac{u^2-1}{2}\right)$, $\frac{dy}{du} = u$

$x = \sqrt{y}$, $\frac{dx}{dy} = \frac{1}{2\sqrt{y}}$

$\frac{dx}{dy} = \frac{1}{2\sqrt{\left(\frac{u^2-1}{2}\right)}}$

$$\frac{dx}{dy} = 1 \times \frac{\sqrt{2}}{2\sqrt{u^2-1}} = \frac{\sqrt{2}}{2\sqrt{u^2-1}}$$

$$\frac{dx}{du} = \frac{dy}{du} \times \frac{dx}{dy}$$

$$\frac{dx}{du} = \frac{u\cdot\sqrt{2}}{2\sqrt{u^2-1}}$$

$$\frac{dx}{du} = \frac{u\sqrt{2}}{2\sqrt{u^2-1}} \quad , \quad dx = \frac{u\sqrt{2\cdot du}}{2\sqrt{u^2-1}}$$

$$\int x\sqrt{(2x^2+1)}\,dx$$

$$\int \sqrt{\frac{u^2-1}{2}} \cdot u \cdot \frac{u\sqrt{2\cdot du}}{2\sqrt{u^2-1}}$$

$$\int \frac{u^2\,du}{2} = \left[\frac{u^3}{6}\right] + C$$

$$y = \sqrt{2x^2+1}$$

$$\left[\frac{\left(\sqrt{2x^2+1}\right)^3}{6}\right] + c$$

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

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

$$= \frac{\left(\sqrt{9}\right)^3}{6} - \frac{\left(\sqrt{1}\right)^3}{6}$$

$$= \frac{3^3}{6} - \frac{1^3}{6}$$

$$= \frac{27}{6} - \frac{1}{6} = \frac{27-1}{6}$$

$$= \frac{13}{3}$$

$$\therefore \int_0^2 x\left(2x^2+1\right)^{1/2}\,dx = \frac{13}{3} \text{ square units.}$$