



$$Q1 \ a) \ \lim_{x \rightarrow 0} \frac{\sin 3x}{x}$$

$$\lim_{x \rightarrow 0} \frac{\sin 3x}{3x} \times 3$$

$$= 1 \times 3$$

$$= 3$$

$$b) \ \frac{d}{dx} (3x^2 \ln x) \quad x > 0$$

$$= \frac{6x \ln x + 3x^2}{x}$$

$$= 6x \ln x + 3x$$

$$= 3x(2 \ln x + 1)$$

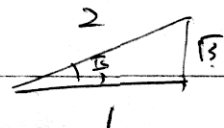
$$c) \ \int_0^{\frac{\pi}{6}} \sec 2x \tan 2x \, dx$$

$$= \left[\frac{1}{2} \sec 2x \right]_0^{\frac{\pi}{6}}$$

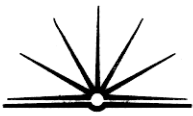
$$= \frac{1}{2} \left(\sec 2\left(\frac{\pi}{6}\right) - \sec 2(0) \right)$$

$$= \frac{1}{2} \left(\sec \frac{\pi}{3} - \sec 0 \right)$$

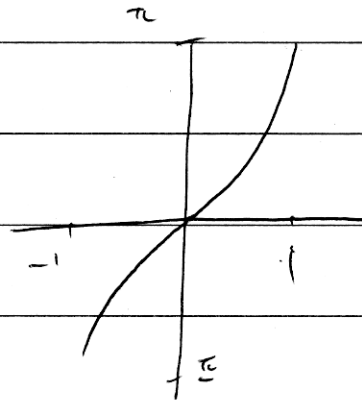
$$= \frac{1}{2} (2 - 1) = \frac{1}{2}$$



$$\begin{aligned} & \perp \\ & \cos \frac{\pi}{3} = \frac{1}{2} \end{aligned}$$



$$d) f(x) = 3 \sin^{-1}\left(\frac{x}{2}\right)$$



$$\text{Domain: } -1 \leq \frac{x}{2} \leq 1$$

$$\therefore -2 \leq x \leq 2$$

$$\text{Range: } -\pi \leq \frac{f(x)}{3} \leq \pi$$

$$\therefore -3\pi \leq f(x) \leq 3\pi$$

$$e) \quad x^2 = 4ay \quad x = 3t, \quad y = 2t^2$$

$$\frac{x^2}{4a} = y \quad \frac{x}{3} = t$$

$$y' = \frac{2x}{4a}$$

$$y = 2 \cdot \left(\frac{x}{3}\right)^2$$

$$\text{When } x = 3t$$

$$y = 2 \left(\frac{x^2}{9}\right)$$

$$y' = 6t$$

$$y = \frac{2x^2}{9}$$

$$A) \quad u = 1 - x^2$$

$$\frac{du}{dx} = -2x$$

$$\text{When } x = 3$$

$$u = 1 - 9 \\ = -8$$

$$\int_2^3 \frac{2x}{(1-x^2)^2} dx$$

$$du = -2x dx$$

$$\text{When } x = 2$$

$$u = 1 - 4$$

$$= -3$$

$$= \int_{-3}^{-8} \frac{du}{u^2}$$

$$u^{-2}$$

$$-1 u^{-1}$$

$$\int_{-8}^{-3} \frac{1}{u^2} du$$

$$-u$$

$$-u^{-1}$$

$$u^{-2}$$

~~$$\left[\frac{1}{-u} \right]_{-8}^{-3}$$~~

$$\left[-\frac{1}{u} \right]_{-8}^{-3}$$

$$= \left(-\frac{1}{-3} \right) - \left(-\frac{1}{-8} \right)$$

$$= \frac{1}{3} - \frac{1}{8}$$

$$= \frac{8}{24} - \frac{3}{24}$$

$$= \frac{5}{24}$$