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19/EN006/042 Mechanical engineering

$$1.) \quad y = t^3 - \frac{t^2}{2} - 2t + 4.$$

$$\therefore \frac{dy}{dt} = 3t^2 - t - 2 = 0$$

At stationary point,  $\frac{dy}{dt} = 0$

$$\therefore 3t^2 - t - 2 = 0$$

$$3t^2 - 3t + 2t - 2 = 0$$

$$3t(t-1) + 2(t-1) = 0$$

$$(3t+2)(t-1) = 0$$

$$\therefore t = -\frac{2}{3} \text{ or } 1.$$

When  $t = -\frac{2}{3}$

$$\left(-\frac{2}{3}\right)^3 - \left(\frac{\left(-\frac{2}{3}\right)^2}{2}\right) - 2\left(-\frac{2}{3}\right) + 4$$

$$-\frac{8}{27} - \left(\frac{4/9}{2}\right) + \left(\frac{4}{3}\right) + 4$$

$$\Rightarrow -\frac{8}{27} - \frac{2}{9} + \frac{4}{3} + 4$$

$$\Rightarrow \frac{130}{27}$$

When  $t = 1$

$$(1)^3 + \frac{(1)^2}{2} - 2(1) + 4$$

$$\Rightarrow 1 - \frac{1}{2} - 2 + 4$$

$$\Rightarrow \frac{5}{2}$$

$\therefore$  The co-ordinates are  $\left(-\frac{2}{3}, \frac{130}{27}\right)$  and  $\left(1, \frac{5}{2}\right)$ .

(ii)  $\frac{d^2y}{dt^2} = 6t - 1$

When  $t = -\frac{2}{3}$

When  $t = 1$

$$\Rightarrow 6\left(-\frac{2}{3}\right) - 1$$

$$6(1) - 1$$

$$\Rightarrow -4 - 1$$

$$6 - 1$$

$$\Rightarrow -5$$

or

$$5$$

$\therefore$  at  $\left(-\frac{2}{3}, \frac{130}{27}\right)$ ,

at  $\left(1, \frac{5}{2}\right)$ , we

we have a maximum point

have a minimum point.

2)  $2y^2 - 5x^4 - 2 - 7y^3 = 0$  Find  $\frac{dy}{dx}$ .

$$4y \frac{dy}{dx} - 20x^3 - 21y^2 \frac{dy}{dx} = 0$$

$$\Rightarrow 4y \frac{dy}{dx} - 21y^2 \frac{dy}{dx} = 20x^3$$

$$\therefore \frac{dy}{dx} = \frac{20x^3}{4y - 21y^2}$$

$$\frac{dy}{dx} (4y - 21y^2) = 20x^3$$

$$27) \quad 4x^2 + 2xy^3 - 5y^2 = 0 \quad \text{find } \frac{dy}{dx}.$$

$$8x + 2y^3 + 2x \left( \frac{3y^2 dy}{dx} \right) - 10y \frac{dy}{dx} = 0$$

$$8x + 2y^3 + 6xy^2 \frac{dy}{dx} - 10y \frac{dy}{dx} = 0.$$

$$\therefore 8x + 2y^3 = 10y \frac{dy}{dx} - 6xy^2 \frac{dy}{dx}$$

$$\therefore 8x + 2y^3 = \frac{dy}{dx} (10y - 6xy^2).$$

$$\therefore \frac{dy}{dx} = \frac{8x + 2y^3}{10y - 6xy^2} \Rightarrow \frac{2(4x + y^3)}{2(5y - 3xy^2)}$$

$$\Rightarrow \frac{dy}{dx} = \frac{4x + y^3}{5y - 3xy^2}$$

$$\text{When } x = 1, y = 2.$$

$$\frac{dy}{dx} \Rightarrow \frac{4(1) + (2)^3}{5(2) - 3(1)(2)} \Rightarrow \frac{4 + 8}{10 - 6} \Rightarrow \frac{12}{4} \Rightarrow 3.$$