

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

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

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

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

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

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$t = \frac{2 \pm \sqrt{4 + 24}}{6}$$

$$t = \frac{2 \pm \sqrt{28}}{6}$$

$$t = \frac{2 \pm 5.29}{6}$$

$$t = \frac{2 + 5.29}{6} \quad \text{or} \quad t = \frac{2 - 5.29}{6}$$

$$t = \frac{7.29}{6}$$

$$t = \frac{-3.29}{6}$$

$$t = 1.22$$

$$t = -0.55$$

ii) When  $t = 1.22$

$$y = (1.22)^3 - \frac{(1.22)^2}{2} - 2(1.22) + 4$$

$$y = 1.82 - 0.74 - 2.44 + 4$$

$$y = 2.64$$

When  $t = -0.55$

$$y = (-0.55)^3 - \frac{(-0.55)^2}{2} - 2(-0.55) + 4$$

$$y = -0.17 - 0.15 + 1.1 + 4$$

$$y = 4.78$$

The co-ordinates are (1.22, 2.64) or (-0.55, 4.78)

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

When  $t = 1.22$

$$\frac{d^2y}{dt^2} = 6(1.22) - 2$$

$$= 7.32 - 2$$

$$= 5.32$$

At (1.22, 2.64) we have a minimum point

When  $t = -0.55$

$$\frac{d^2y}{dt^2} = 6(-0.55) - 2$$

$$= 3.3 - 2$$

$$= -1.3$$

$\therefore$  At (-0.55, 4.78) we have a maximum point

$$2) \quad 2y^2 - 5x^4 - 2 - 7y^3 = 0$$

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

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

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

$$3) \quad 4x^2 + 2xy^3 - 5y^2 = 0$$

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

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

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

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

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

$$i) \frac{dy}{dx} = \frac{4x - y^2}{3(1)y^2 - 5y}$$

ii) When  $x = 1$

$$\begin{aligned} \frac{dy}{dx} &= \frac{-4(1) - y^2}{3(1)y^2 - 5y} \\ &= \frac{-4 - y^2}{3y^2 - 5y} \end{aligned}$$

iii) When  $y = 2$

$$\begin{aligned} \frac{dy}{dx} &= \frac{-9x - (2)^2}{3x(2)^2 - 5(2)} \\ &= \frac{-9x - 8}{12x - 10} \\ &= \frac{2(-2x - 4)}{2(6x - 5)} \\ &= \frac{-2x - 4}{6x - 5} \end{aligned}$$