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

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

At stationary point, $dy/dt = 0$

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

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

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

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

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

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

$t = \frac{2 + 5.29}{6}$ or $t = \frac{2 - 5.59}{6}$

$t = \frac{7.29}{6}$ $\qquad$ $t = \frac{-3.29}{6}$

$t = 1.22$ $\qquad$ $t = -0.55$

ii) When $t = 1.22$

$y = (1.22)^3 - \frac{(1.2)^2}{2} - 2(1.22) + 4$

$y = 1.82 - 0.74 - 2.44 + 4$

$y = 2.64$

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 $(-0.55, 4.78)$

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

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 $t = -0.55$

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

$= 3.3 - 2$

$= -5.3$

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

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

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

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

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

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

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

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

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

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

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

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

ii) When $x = 1$

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

$$= \frac{-4 - y^3}{3y^2 - 5y}$$

iii) When $y = 2$

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

$$= \frac{-4x - 8}{12x - 10}$$

$$= \frac{2(-2x - 4)}{2(6x - 5)}$$

$$= \frac{-2x - 4}{6x - 5}$$