Oluntan Olaniyi Olabayo
Mechanical Engineering
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MAT104
S/N 205

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

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

At stationary point, $dy/dt = 0$

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

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

$t = \frac{1 \pm \sqrt{1^2 - 4(3)(-2)}}{2(3)}$

$t = \frac{1 \pm \sqrt{25}}{6}$

$t = \frac{1+5}{6}$ or $\frac{1-5}{6}$

$t = 1$ or $-4/6$ $\quad t = 1$ or $-2/3$

when $t = 1$

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

when $t = -2/3$

$y = (-2/3)^3 - \frac{(-2/3)^2}{2} - 2(-2/3) + 4 = \frac{-8}{27} - \frac{2}{9} + \frac{4}{3} + 4$

$y = 4.812$

The coordinates are $(1, 3/2)$, $(-2/3, 4.812)$

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

when $t = 1$,

$\frac{d^2y}{dt^2} = 6 - 1 = 5$

At $(1, 3/2)$ we have a minimum point

when $t = -1/3$

$\frac{d^2y}{dt^2} = 6(-1/3) - 1$

$= -4 - 1 = -5$

At $(-1/3, 4.812)$ the have a maximum point.

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

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

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

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

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

$8x + 2x \cdot 3y^2\frac{dy}{dx} + 2y^5 - 10y\frac{dy}{dx} = 0$

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

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

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

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

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

when $x = 1, y = 2$

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

$\frac{dy}{dx} = \frac{-4 - 8}{12 - 10} = \frac{-12}{2}$

$dy/dx = -6$