1. **(3points)**Find the length of the curve $x = 1 + 3t^2, y = 4 + 2t^3,\ 0 \le t \le 1$.

   $x' = 6t, \quad y' = 6t^2$.

   $L = \int_0^1 \sqrt{36t^2 + 36t^4}dt = 6\int_0^1 t\sqrt{1+t^2}dt$

   put $u = 1 + t^2$, and $du = 2tdt$. Then

   $L = \frac{1}{2}\int_1^2 \sqrt{u}du = \frac{2}{3}\sqrt{2} - \frac{1}{3}$.

2. **(4points)** Find$\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for the parametric curve $x = t + \ln t,\ y = t - \ln t$.

   $dy/dx = \frac{dy/dt}{dx/dt} = \frac{1-\frac{1}{t}}{1+\frac{1}{t}} = \frac{t-1}{t+1}$.

   $d^2y/dx^2 = \frac{\left(1+\frac{1}{t}\right)\frac{1}{t^2}+\frac{1}{t^2}\left(1-\frac{1}{t}\right)}{\left(1+\frac{1}{t}\right)^3} = \frac{2t}{(t+1)^3}$.

3. **(3points)** Eleminate t to find the Cartesian equation of the curve $x = t^2 - 1, y = t^2 - 2t + 3,\ -1 \le t \le 0$.

   From the equation for x, $t = -\sqrt{x+1}$ (observe that t is negative). Substituting into the equation for y we gat

$$y = x + 1 + 2\sqrt{x+1} + 3.$$