Tutorial 1

Problem 1. We consider the motion of a point particle in two spatial dimensions. The trajectory of the particle for time $t \in [0, \infty)$ is given by

$$\boldsymbol{r}(t) = \left(3(t^2+1), \frac{2}{t^2+1}\right). \tag{1}$$

1. Determine the velocity and acceleration as function of t for this point particle.

2. The equation of the trajectory is an equation of the form:

$$f(x, y) = 0,$$

   where $f(x, y)$ is a function of x and y, but *not* of t. Determine $f(x, y)$ for the trajectory given by equation (1).

3. Make a plot of the trajectory in the xy-plane.

Problem 2. (K. & K., Ex. 1.13) At, $t = 0$ an elevator departs from the ground floor with uniform vertical speed u. At time T_1 a child drops a marble though the floor. The marble falls with uniform acceleration $g = 9.8\, m/s^2$ and hits the ground T_2 seconds later.

1. Give the height of the marble for $t \in [0, T_1]$ and $t \in [T_1, T_1 + T_2]$ as function of time t, the speed u, the acceleration g and/or time T_1.

2. Determine the height of the elevator at time T_1 as function of g, T_1 and T_2.