1. The "catch-a-ruler” demo is used to find the reaction time $t$.

(a) Derive a formula relating $t$ to $h$, the vertical displacement of the ruler.
(b) Do several experiments and find the average $t$.

2. (*) A train starts leaving the platform with $a = 0.5 \text{ m/s}^2$. A passenger comes $\delta = 4 \text{ s}$ later. With what minimal speed $V$ she should run to catch up?

3. For
   \[ x(t) = 7 + 4t - 5t^2 \]
   \((x \text{ in meters, } t \text{ in seconds}) \text{ find} \)

   (a) instantaneous velocity $v(t)$
   (b) acceleration $a$
   (c) average velocity $v_a$ between $t = 1 \text{ s}$ and $t = 2 \text{ s}$

4. Two trains leave two stations separated by 100 km at the same time and move towards each other. The speeds of trains A and B is 30 km/h and 70 km/h, respectively. Plot the position vs. time graphs for both trains on the same plot and determine the meeting point.

5. The same, but the A train with $v_0 = 30 \text{ km/h}$ also has acceleration of $60 \text{ km/h}^2$. (You do not have to change units in this problem.)

6. A car accelerates from rest for $t = 10 \text{ s}$ with acceleration $a_1 = 1 \text{ m/s}^2$ and then slows down with $a_2 = -4 \text{ m/s}^2$ until it stops. Find the total distance.
7. The same if the car accelerates from rest for \( x_1 = 312.5 \, m \)