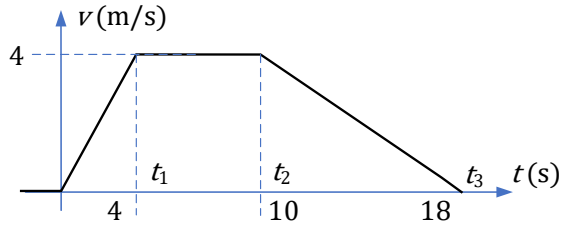
Homework Assignment 1 - Kinematics

Problem 1 (25 pts) – Fun with Trapezoids

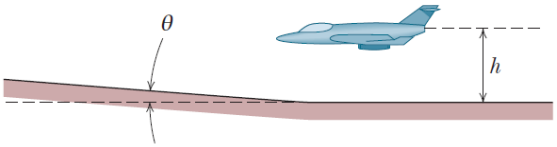
The figure below shows the time dependence of velocity. Do the following:

1.1. (15 pts) Plot the acceleration and displacement with respect to time.
1.2. (10 pts) Determine the displacement and the average velocity over time interval $[0, t_3]$



Problem 2 (25 pts) – Collision Course

A pilot flies horizontally at 1300 km/h, at height h = 35 m above initially level ground. However, at time t = 0, the pilot begins to fly over ground sloping upward at angle θ = 4.3° (see figure below). If the pilot does not change the airplane's heading, at what time t does the plane strike the ground?



Problem 3 (25 pts) – Projectile Range

Assuming that a motion of a projectile can be described by a set of equations

$$R = (v_0 \cos\theta_0)t$$
$$0 = (v_0 \sin\theta_0)t - {}^1\!/_2\, g t^2,$$

show that $R = \frac{{v_0}^2}{g} \sin 2\theta_0$.

Problem 4 (25 points) – Ball Speed

A ball is thrown horizontally from a height of $y_0 = 20$ m and hits the ground with a speed v_f that is three times its initial speed v_i. What is the initial speed v_i? Assume that there is no air drag and therefore acceleration in the horizontal direction is zero.