General Physics A (I) – Fall Semester 2018

Homework Set 1

Due: 10/05/2018 (Fri.)

Problems 1, 2, & 3 (60 pts)

[Benson] Ch 4: P21, Ch 5: P9, Ch 6: P5. (P=Problem)

Python exercise (40 pts)

In this exercise, we are going to simulate the motion of a point projectile ejected from a launcher on the ground subjected to the air drag force. Suppose the mass of the projectile is m, and its initial speed is v at an angle θ to the ground. The air drag force is always opposing the direction of motion, and the magnitude is given by $D = kv^2$, where k is the air drag coefficient. $g = 9.8$ m/s^2 is the gravitational field intensity on earth. Do the following:

1. Write a python program that demonstrates the motion of a function of time with v, θ, and k as variable parameters.

2. In the following, we set $m = 0.1$ kg, $v = 100$ m/s, $\theta = 75^\circ$, and $k = 1.0 \times 10^{-3}$ N·s^{2}m^{-2}. Show the trajectory of the motion.

3. Use your program to determine the maximal height that the projectile can reach. Compare your result with the case with no air.

4. Use your program to determine the maximal horizontal distance when the projectile hits the ground. Compare your result with the case with no air.

5. Suppose the projectile is launched towards the east while the wind is blowing from the north to south at speed of 20 m/s. Make a plot of its trajectory projected on the ground (viewed from top). Determine the landing location, including the distance and direction from where the projectile hits the ground to the location of the launcher.