Set up the problem with a Free-Body-Diagram.  Use Newton’s Laws as needed to solve for the acceleration.  (Consider this the first problem.)

Now incorporate a line of code which will calculate the new acceleration for each iteration of your calculation loop.

We are going to use a constant air density, ρair=1.29 kg/m3.  (Our final modification for another day will be to allow for an air density which depends upon height.)

We want to run the code for four situations.  Track the height, velocity, and acceleration.  We particularly want the final velocity and total time of fall.  (Eventually we will want to graph our results when we include the air density changing.)  You need only validate the code for the first case.  You validate the code by doing calculations by hand for the first five iterations using a time interval or time step of 0.01seconds.

Case I.

A 1 kg stone sphere, whose density is 3200kg/m3, dropped from a height of 600 meters.  (This is a pretty average density for rocks in the earth’s crust.

Case II.

A tennis ball (look up the details) is dropped from the same height of 600 meters.

Case III.

A 5.5 kg payload falls from 100,000 feet on a parachute which is 1.5 meters in diameter.

Case IV.

Felix Baumgartner, jumps out of a balloon wearing a space suit and oxygen tank, falling from a height of 100,000 feet.  (He nearly broke the speed of sound!)  A study of the data of his fall shows that about half the time his drag coefficient was nearly 2.0, and half the time about 1.0.  With the suit and oxygen his mass was 118kg.

We will assume that the density of air is constant and is 1.29kg/m3.