1. (10) When the velocity of an object is very large, the magnitude of the force due to air resistance is proportional to the square of the velocity and in opposition to the motion of the body. A shell of mass 3 kg is shot upward from the ground with an initial velocity of 500 meters per second. Suppose the magnitude of the force due to air resistance is \((0.1)v^2\). The value of acceleration due to gravity, \(g\), in the meter, kilogram, second system of units is \(g = 9.81\).

(a) Derive a differential equation for the velocity of the object. Assume that the shell’s motion is entirely vertical.

(b) When will the shell reach its maximum height? What is the maximum height?