Math 2080: Differential Equations
Worksheet 2.3: Falling objects with air resistance

NAME:

1. A parachutist of mass 60 kg free-falls from an airplane at an altitude of 5000 meters. He is subjected to an air resistance force proportional to his speed. Assume that the constant of proportionality is $r = 10$ kg/sec.

   (a) Find and solve the ODE for velocity of the parachuter at time t seconds after the start of his free-fall.

   (b) Assuming he does not deploy his parachute, find his limiting velocity and how much time will elapse before he hits the ground (you may need to use a computer for this last part, a visual approximation from the appropriate graph is fine).

2. In our model of air resistance, the resistance force $R(v)$ depends only on velocity. However, for an object that drops a considerable distance, there is a dependence on the altitude as well. It is reasonable to assume that the resistance force $R(v, x)$ is proportional to air pressure, as well as to velocity. Furthermore, to a first-order approximation, air pressure varies exponentially with altitude (i.e., it is proportional to e^{-ax}, where a is a constant and x is altitude). Propose and justify (*but do not solve!*) a differential equation model for the velocity of a falling object subject to such a resistance force.