1. If air resistance is proportional to the square of the instantaneous velocity, then the velocity v of a mass m dropped from a given height is determined from

   $m\dfrac{dv}{dt} = mg - kv^2,\ k > 0.$

   Let:

   $v(0) = 0,\ k = 0.125,\ m = 5\,slugs,\ and\ \ g = 32\ ft/s^2.$

   (a) Use a fourth-order Runge-Kutta (RK4) method with $h = 1$ to approximate the velocity $v(5)$.

   (b) Use Excel to graph the solution of the IVP on the interval [0, 6].

   (c) Use separation of variables to solve the IVP and then find the actual value.

2. Find the analytic solution of the initial-value problem (IVP)

   $y' = -y + 10\sin(3x),\ y(0) = 0,$ on the interval [0, 2].

   (a) Graph the solution and find its positive roots.

   (b) Use Runge-Kutta (RK4) method with $h = 0.1$ to approximate a solution of the initial-value problem (IVP) $y' = -y + 10\sin(3x),\ y(0) = 0.$