MATH-UA.251.001: Introduction to Mathematical Modeling
Recitation 2: The Shuttle Problem MATLAB component
2/8/13

Name:

1. When deriving the shuttle's escape speed, you must first find the shuttle's general speed, v, as a function of position, x (in the homework, x is represented as r). For this exercise, x is vertical position only (height), not a vector. Write a function that takes a vector of equally spaced position values and outputs the shuttle speed for each position and plots the speed versus the position. Make sure to use the value for v_0 that you obtained in Homework 2, as well as the values for G, R and M_e.

2. Recall that the other day in class I derived an approximation for projectile position, x, (for a given projectile shot from an angle of 90 degrees, so the same as the shuttle problem) as a function of time, t, for $x(t) \ll R$. Use this approximation to find speed as a function of time. Also output position as a function of time. Add a vector of equally spaced time points to your program from part 1 to find and plot speed as a function of time. Use $g = 9.8\ m/s^2$. Note that g and G are not the same thing - G is a planet's unique gravitational constant, while g is **barycentric acceleration** due to gravity. Normally, g is defined as

$$g = \frac{GM}{x^2}$$

   but for our purposes, we consider it approximately constant.

3. Plot both the vertical position and speed of the projectile on the same graph as functions of time.

4. Modify your function to take in 5 different planetary masses, radii and gravitational constants and plot the speed versus the position, the speed versus the time and position versus time for each. Use the subplot command to put the three graphs for each planet in their own window.

5. What are the benefits, if any, of visualizing speed as a function of position rather than speed as a function of time?