Math 3280 Worksheet 35

Group members (2 to 4): _____

(1) Suppose a rocket from Earth is launched by a railgun from a height $h = 0$, and after its initial burn it is at an altitude of $h = 5$ km with a velocity of 10 km/s straight up.

(a) If we use an approximation of a constant gravitational acceleration $g = 0.0098$ km/s^2 (and no air resistance), how high will the rocket be after 100 seconds?

(b) A more realistic approximation would use the Newtonian gravitational acceleration of the Earth:

$$\frac{d^2h}{dt^2} = -\frac{gR^2}{(h+R)^2}$$

where $R = 6378$ km is the radius of the Earth. Write this as a first-order system with variables h and $v = \frac{dh}{dt}$, and use Euler's method to estimate the height of the rocket after 100 seconds with two steps. Is this new estimate an over-estimate or under-estimate?