ASTRONOMY 105 HOMEWORK #2 DUE: WED JAN 20 IN CLASS

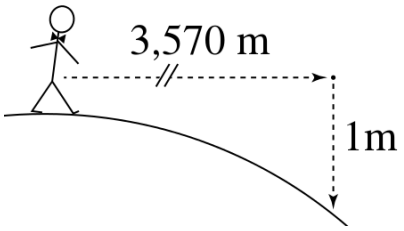
Answer all question on the back of this page (or on a separate sheet). Please be as neat as you can. Show all work, including units. Circle your final answer clearly.

STAYING IN SPACE.

Getting to space is easy(ish). Staying in space is hard.

The Earth is a sphere (almost). This means that as you travel horizontally across the surface, the surface continuously curves downwards. The Earth is really big so the curve is very slight.

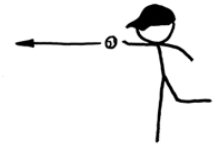
For every 3,570 meters you walk, the Earth curves downward by 1 meter.



The time is takes an object to fall from a height **h** is: $t = \sqrt{2h/g}$

where **t** is measured in seconds (s), **h** is in meters (m), and **g** is 9.8 m/s^2. Again, air resistance is ignored.

1 (5 pts) Calculate how long is takes an object to fall from a height of 1 meter.



If you can throw an object horizontally, fast enough, so that is goes 3,570 meters before it falls 1 meter, that object will never hit the surface of the Earth. This is the definition of an object in orbit.

2 (10 pts) Calculate how fast you have to throw a person horizontally, so that they are in orbit around the Earth.

3 (3 pts) Express your answer in miles per hour

4 (2 pts) Can the X-15 go into orbit? (top speed of about 4,000 mph.)

5 (5 pts) How does the speed needed to orbit compare to the speed needed to get a person to space?

6 (5 pts) Calculate the Payload Fraction of a rocket that is just able to make a person **orbit** the Earth. Assume that $u = 2{,}300$ m/s.

$$\text{Payload Fraction} = e^{-\Delta V/u} = \exp(-\Delta V/u)$$

Astronomy 105 Homework #2 Name:_____