Homework #4

Due at 5pm on Wednesday, October 11

You may submit Parts 1, 3 and 4 either (a) electronically via Moodle or (b) on paper to my mailbox outside Merrill 213. Do NOT leave under my door or in the boxes outside my office.

Part 1 – Questions

1. The diameter of the Earth is 7926 miles at its equator. The highest point on Earth (Mt. Everest) is 5.5 miles above sea level; the lowest point (Mariana Trench in the Pacific Ocean) is 6.8 miles below sea level. Hence, the "roughness" of the Earth's surface is 5.5+6.8 = 12.3 miles. What is the ratio of the roughness of the Earth's surface to the Earth's diameter? Express this ratio as a fraction, decimal and percentage.

2. A basketball has a diameter of about 25 centimeters (cm). The bumps on a basketball's surface are about 1 millimeter (mm) high. What is the ratio of the roughness of the basketball to the diameter of the basketball? Express this ratio as a fraction, decimal and percentage.

3. Based on your answers to questions #1 and 2, would you characterize the Earth as lumpy or smooth in comparison to a basketball? Justify your answer in ***one or two*** sentences by discussing the numbers in the first two questions.

4. The distance between the Sun and Earth is 1.5×10^8 (or 150 million) km.
   The diameter of the Earth is 1.3×10^4 (or 13,000) km.
   (a) If you could line up a series of Earths side-by-side, how many Earths would fit between the Sun and Earth? Give the answer rounded to the nearest single earth (no decimal point)
   (b) Explain why you think the distance between Earth-Sun seems either crowded or empty by ***discussing*** your answers to parts (a) and (b). Use only one or two sentences. Be sure you think carefully about the meaning of the word "crowded."

Part 2 – Mastering Astronomy

Please complete this part through the course Moodle page. It's due at the same time as the rest of the assignment.

Part 3 – Checking in

Answer this portion on the same sheet of paper as Part 1.

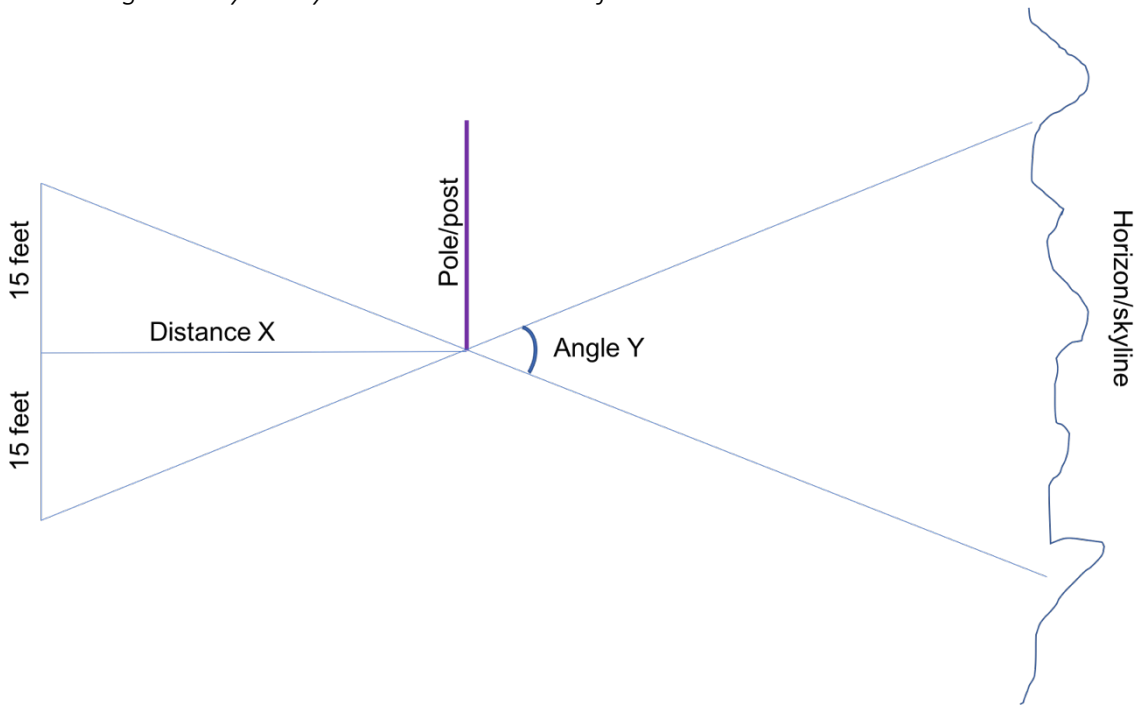
a) What was the most interesting concept that you learned in class last week?
b) What was the most difficult concept that you learned in class last week? What is still confusing about it?

Part 4 – Observing Parallax

To do this observation, you need to find a flagpole or lamp post (something tall and skinny) that you can see against a much more distant backdrop, preferably the mountains/hills or a distant sky/tree line. Complete the following steps to do the observation:

1) *Sketch the distant horizon that you see (mountains or skyline) with enough detail that you will be able to identify one location along it relative to another.*
2) *Stand with you back against the lamp post, and take 20 paces away from it in a straight line opposite the direction to the mountains or skyline that you've sketched. When you are 20 paces away, turn around and face the lamp post again. Drop something on the ground to mark your location.*
3) *Now, turn 90 degrees to your right (so your left shoulder is pointed at the lamp post) and move 15 feet away (use a ruler, yardstick, tape measure, or your own body lying down to approximate this).*
4) *At 15 feet away from your marker, stop and face the lamp post. Mark the location of the lamp post on the horizon on your drawing.*
5) *Go back to the marker that you dropped on the ground and face the flag pole again. Turn 90 degrees to your left (so your right shoulder is pointed at the lamp post) and move 15 feet away in a straight line.*
6) *At 15 feet, stop and face the lamp post. Mark the location of the lamp post on the horizon on your drawing.*
7) *Move back to your marker. Facing the lamp post, its current location on the skyline should be roughly in the middle of your two marked locations on the skyline from when you were 15ft to either side. If it's not, try repeating the process.*
8) *Once you're satisfied with your marked locations, return to your marker on the ground and use fist and finger measurements to estimate the angle between your two marked locations on the skyline. Be sure to record this angle (including how you got it) somewhere on your drawing of the skyline.*
9) *Repeat steps 2 through 8 from 40 paces away from the flagpole (double the first distance). Mark the locations on the horizon with a different color or label them.*

The basic geometry that you've measured is as follows:



Where you have measured the distances labeled 15 feet and the angle Y for two instances of the unknown distance X.

Observing Questions:

1) Using the geometry above, find the unknown distance X in feet for both of your measurements (20 paces and 40 paces).
2) Divide each of your measurements for the distance X by the number of paces that it corresponds to. This will give you two estimates for the length of your pace in feet. Average them together to get a better estimate for your pace length (average of A and B = (A + B)/2).
3) Discuss in words how ***and why*** the angular distances that the flagpole appeared to move along the skyline were different.
4) Describe in several sentences and a diagram that includes the Earth's orbit around the sun how this technique can be used to measure the distances to nearby stars.