Atoms to Universe
Physics 340
Assignment 1

1. How for away must I stand from you so that my fist (diameter about 10 cm) just covers the rising full moon?

2. Draw a diagram. On the left side of the page draw a dot. 5 cm horizontally from the dot draw a vertical line 0.5 cm high so the centre of the line is on the horizontal line through the dot. 20 cm from the dot draw a vertical line 1.5 cm long centred on the same horizontal. The dot is your eye. The second vertical line is hidden behind the first. How far do you have to move your eye vertically so that is just starts to see one edge of the second line? How far do you have to move your eye vertically so it can see the whole of the second line? (You may do this with the diagram, and with measurement rather than with arithmetic)

This is supposed to crudely represent a solar eclipse where the second line represents the diameter of the sun, and the first line is the diameter of the moon. If the distance you move your eye is half the width of the full eclipse shadow. is that distance half the length of the first line? Anaxagoras deduced that the diameter of the moon equalled the width of the eclipse shadow. From this exercise does that make sense? (The full eclipse shadow is the region where the moon completely hides the sun).

(Note that the proportions in this exercise are not correct for the moon and sun. The distance from us to the moon is about 100 times the moon's diameter, which would be really hard to draw.)

3. Anaxagoras thought that the diameter of the moon was about the same as the Peloponnese because that was the was the area covered by the total eclipse. The Peloponnese is about 100 km across. How far away would the moon be in that case? If one travelled from Athens to Macedonia (about 600km) by how much would the location of the moon in the sky change due to parallax?

4. If the earth (diameter about 6400 km) rotates, and the moon is 60 earth diameters away (Hipparchus's figure), what would the change in parallax of the moon be between the beginning to the end of the night? How far would the moon have travelled through its orbit during that time? (take a lunar month as 28 days)

5. Eratosthenes was the first to measure the size of the earth. Tell me how he did it. What kinds of error could have crept into his result? (You may use whatever sources you wish, but try to make sure that they are reputable, and tell me what they are.) What is the circumference of the earth? This figure was well known in 15th century Italy. It was also known that the overland route to China was about 10000km, from traders along the silk Route. Thus how far would Columbus have had to sail to get to China if the Americas were not in the

way? At a speed of about 4 knots (about 7km/hr) how long would the Journey have taken?

One of Columbus' "contributions" to science was to insist that the earth was less than half of Eratosthenes' figure. He was lucky!

[Brief table of commonly used prefixes: n = nano = 10^{-9} = 1/1,000,000,000
μ = micro = 10^{-6} = 1/1,000,000
m = milli = 10^{-3} = 1/1,000
c = centi = 10^{-2} = 1/100
d = deci = 10^{-1} = 1/10
h = hecta= 10^{2} = 100
K = kilo = 10^{3} = 1000
M = Mega = 10^{6} = 1,000,000
G = giga = 10^{9} = 1,000,000,000]

It is interesting that in scientific notation, names are given only up to Y= Yotta= 10^{24}, whereas in classical Japanese there are names for numbers at least all the way up to 10^{52}.

http://en.wikipedia.org/wiki/Japanese_numerals.

(The Japanese use 10000=10^4 as the multiple for names, rather than our 1000.) Why in the 16th century anyone would need to give such a large number a name I do not know. This aside is of course totally irrelevant to the course.