

**Homework 4 = Lab 2** Due in class, Wednesday, October 11, or before that in my mailbox.

1) Motion of the Moon: Nightly Observation, September 27 – October 11, 2006.

The goal of this exercise is to watch and chart the moon's motion. Choose a regularly convenient time shortly after sunset: between 7:30 and 8:30pm. Now go outside and find a nearby place from which you have a good view to the *east, south, and west*. *On the first clear night* between September 17 and October 11, draw a sketch of features on the horizon, as for the first observing homework, and **write where you were standing**. Find the moon in the sky and draw it on your sketch, taking some care as to its shape. Be careful to mark the position of the moon with respect to the features on the horizon reasonably accurately, since you'll be watching its position change in the sky. **Write the time and date beside your moon.**

Repeat this observation of the moon's shape and position on clear nights until October 11, being sure to make the observation at the same time each night. Try to get an observation at least every other night. Use the *same sketch* (i.e., the same piece of paper) each time, adding a drawing of the moon with each observation, and write the time and date. Mark the position of Mercury if you see it; later in this period it should be low in the sky between the moon and where the Sun just went down. Turn in your sketch and answers to the questions below.

- a) Why is it important that each observation be made at the same time in the evening?  
(Remember Homework 2)
  
- b) Choose any three observations, preferably distributed evenly through your two weeks of observing. Based on your observations, what were the phases of the moon for each one?
  
- c) Draw a diagram like the one on the website under "class 3", showing where the moon is with respect to the Earth and Sun on these three dates. Also show where Madison is on the Earth at the time when you make your observations.

Mark on your sketch where you expect to see the moon at this same time on October 27. On what basis have you made your prediction?

e) Explain why we never see the full moon in the sky in the middle of the day.

2. Aliens have transported the Earth to an orbit at four times our present distance from the Sun: how long will our “year” be?

How fast (in km/sec) will we be moving around the Sun? (Look back at Q5 of Homework 1.)

3. Suppose the Sun were 9 times as massive as it is now, and the Earth still orbits at the same distance. Would our year be longer or shorter? By how many times? Explain why.

4. The frequency of an FM station is 100 MHz (MHz or 1 megahertz is one million wavecrests per second). What is the wavelength in centimeters of the signal transmitted by this station? (Microwaves used for cooking are only a little shorter.)

An AM station transmits at 1 MHz: is its wavelength longer or shorter than that of the FM station? Explain, and calculate how many times longer or shorter.

How many times more energy does a single photon of the FM frequency carry, compared to one of the AM frequency?

The shortest wavelength of ultraviolet light that comes through the Earth’s atmosphere is about 330nm (nanometers). How much more energy does a photon of this light carry, compared to one at the FM frequency?

Explain why you can’t get a suntan from microwaves, or even from red light.