Physics 55
Homework Set 1

Due 1/18/11

1. Here are some applications of the small-angle formula. It is actually a useful tool to
carry around, astronomy aside.

(a) The Duke Chapel tower stands 210 ft. tall. How far from the tower would you
have to stand in order for the tower to subtend the same angle (about 10°) as
the width of your palm held at arm’s length?

(b) For small angles we use smaller units of measure subdividing a degree. Confus-
ingly, these are given the same names as subdivisions of an hour, though so far
as I know none of the relations between angles and times (e.g. using the Earth’s
rotation) are compatible with these coincident names. Thus, one degree is divided
into 60 minutes of arc or arc-minutes; one arc-minute is further divided into 60
arc-seconds. The notation for these subdivisions is

\[ 1^\circ = 60' = 3600'' \]
\[ 1' = 60''. \]

Thus the Moon subtends an angle of 0° 30’ 0'' . The resolution of a telescope, as
we will learn, is the minimal angular size of features it can resolve. If we have a
telescope with a resolution of 2'' (2 arc-seconds) what is the size of the smallest
crater we can make out on the moon? (The Moon’s diameter is 3480 km.)

2. Install the “Starry Night” software. You will need to set your observing coordinates.
Durham is at 36° 0.839’ N; 79° 0.225’ W (actually, these are the precise coordinates of
our observatory). Now play with the program a little to learn how it works; you’ll need
to learn how to change the observation time and direction, how to open an information
window on an object (right-click on the object and select from the pop-up menu), and
how to change the settings so that planets, constellations, etc. are labeled. Use the
software to answer the following questions:

(a) Which planets will be visible in the sky at sunset on January 24? In what direction
should I look for each of them? Which are likely to be visible with the naked eye?
(b) Will the Orion nebula (Messier 42) be visible at this time? List some other Messier objects that you might want to look at and briefly describe what they are.

(c) Which other planets will be visible later that night? When and where would you look for them?

3. Use the software to find which constellations will be visible at 7:00 pm on January 24. Choose one to study.

(a) Learn to identify it in the sky (turn off the labels and memorize the look of the surrounding stars, also figure out in what direction to look). You will be asked to find that constellation when we are out observing.

(b) Find the brightest star in your constellation (the brightest star in constellation X is called α X). Find its celestial coordinates, Declination and Right Ascension. Use a calculation like the one we did in class to estimate at what time it will reach its highest point in the sky on the night of January 21. Use the software to check your prediction. How accurate were you?

(c) Summarize the myth associated to this constellation. Note that many constellations are recognized (though not always as representing the same thing) by different cultures, so you can choose your favorite myth, be it Native American, Greek, Polynesian, or other. Can you make out the shape the stars suggested to whoever invented the myth?

4. Please introduce yourself to me in an email message to plesser@cgtp.duke.edu. Explain briefly why you are taking this class (hoping for an easy way to satisfy a science requirement is a legitimate, though possibly misguided, reason). Science is all about being curious, and most people have at some time wondered about something in the sky. Name one astronomy-related question to which you do not know the answer and which you have thought about or would like to. At the end of the term we will review these to see how many of them we managed to address.