1. Imagine a telescope located in Durham (36° N, 79° W) and pointed straight up at the zenith. You may use Starry Night to answer the following questions “experimentally” but at the end you should understand the answers!

   (a) As the Earth rotates, what path on the celestial sphere is traced by the point at which the telescope is aimed? How does the celestial latitude (declination) of the aim point change with time? How does celestial longitude (right ascension) change with time?

   (b) Sidereal time in Durham is best thought of as the celestial longitude (right ascension) of the point in the sky at which such a telescope is pointed. On March 21 (the spring, or vernal, equinox), at midnight, what will this be?

   (c) 24 hours later, midnight on March 22, what will the right ascension of the telescope’s aim point be? What will the sidereal time be? (You may find it helpful to find first what the aimpoint will be 23 hours, 56 minutes, and four seconds later, at four minutes before midnight.) You have essentially derived the approximate formula for sidereal time that we wrote in class. Do you see how this works?

   (d) Where on Earth does this definition of sidereal time fail? Describe the apparent daily motion of the sky as observed from these locations. Describe the motion of the Sun at these locations.

2. Describe how you would go about finding the star Mirfak (in the constellation Andromeda at Decl. 49° 51’ 40”’; R.A. 3h 24m 20s in the sky in Durham on February 3 at 7 pm. Try to estimate the Azimuth and Altitude at which you will find the star, and compare your estimate with the answer you can find on Starry Night.

3. One of the first applications of understanding the sky was to navigation at sea. Can you explain how measuring the altitude (above the horizon) of Polaris can determine one’s latitude? In what regions of the world is this possible? Can we use the sky to measure our longitude? (HINT: Doing this requires an accurate and independent measurement of time. This is easy for us, but in the eighteenth century was the object
of a famous and fierce competition when a prize was offered for a solution.) For more on this see http://en.wikipedia.org/wiki/History_of_longitude.

4.

(a) About how many more sidereal days are there in a year than solar days (tropical or sidereal year is immaterial here)?

(b) About how many more sidereal months are there in a year than synodic months?

(c) Can you explain this?

5. Imagine that you live in a lunar colony located on the lunar equator, on the near side of the Moon.

(a) Describe the apparent motion of the celestial sphere as you would see it. How long are your days and nights?

(b) Describe the apparent motion of the Sun on the celestial sphere as seen from your lunar home. Would you observe seasonal variations in the length of day and night?

(c) Describe the apparent motion of Earth on the celestial sphere.

(d) What would you observe from your lunar home during a lunar eclipse? Would this occur during your day or night? What phase would Earth display? Would you notice the eclipse?

(e) What would you observe during a solar eclipse? Would this occur during your day or night? What phase would Earth display? Would you notice the eclipse?

6. In a lunar eclipse, you see the Earth’s shadow creep across the Moon. Will the shadow start covering the Moon from the East or from the West? Will this seem like the right or the left if you are observing in Durham? How about if you are observing in Melbourne, Australia?