1. Viewing the celestial sphere from northern Alaska.

(a) Draw the celestial sphere in an “edge-on view” showing the NCP, SCP and celestial equator. (Please use a separate sheet of paper and make the Celestial Sphere nice and big so details can be seen.)

(i) Add a small Earth to your sketch.
(ii) Add an observer at a latitude of 70° North (e.g., northern Alaska).
(iii) Add a horizon appropriate for your observer at 70° North.
(iv) Indicate the observer’s zenith
(v) Using basic geometry (as done in class for the latitude of San Francisco), determine:
   A. where this observer should look to see Polaris (cardinal direction and altitude in degrees)
   B. how high the celestial equator is in the sky (altitude) when this observer looks due south
   C. what the Declination is on the celestial sphere at this observer’s zenith
   D. how far below the celestial equator this observer can see (Dec. at southern horizon)
   E. Which stars are circumpolar (never set). Express as a range of Dec. values
(vi) Indicate and label all the angles clearly on your sketch

(b) Draw the “observer’s view” for an observer at 70° North (i.e., draw only the portion of the celestial sphere that this person can see, and orient his/her horizon at the bottom of the sketch, horizontally)

(i) Indicate the observer’s zenith
(ii) Indicate N, S, E, and W along the observer’s horizon
(iii) Indicate on the sketch the location of the NCP
(iv) Add the celestial equator to your sketch
(v) Indicate the value of the Declination at the observer’s zenith and at the NCP
(vi) Indicate the value of the Declination at the observer’s southern horizon and northern horizon

2. Repeat problem 1 for a latitude of +20 degrees (e.g., Hawaii).

3. Repeat problem 1 for a latitude of –30 degrees (e.g., Australia).

4. The Ring Nebula, M57

The parallax of the central star in the planetary nebula known as M57 has been measured to be $1.42 \pm 0.55$ milliarcseconds (mas).

(i) What is the range of likely distances to the Ring Nebula?

(ii) The angular diameter of the Ring Nebula along its long axis is roughly 1 arcminute. Given the range of possible distances in part (i), what range of physical sizes you can deduce for this object?

(iii) The Sun is expected to produce a planetary nebula in another 5 billion years. If the resulting nebula is like the Ring Nebula, what fraction of the way to alpha Centauri will it extend? Don’t forget to draw a picture and label it.