Introduction to Astrophysics 0321.3108
Exercise 1

1. **a.** Calculate the best angular resolution that can, in principle, be achieved with the human eye. Assume a pupil diameter of 0.5 cm and the wavelength of green light, $\gg 0.5\mu$m. Express your answer in arcminutes, where an arcminute is 1/60 of a degree. (In practice, the human eye does not achieve diffraction limited performance, because of imperfections in the eye's optics and the coarse sampling of the retina by the light-sensitive "rod" and "cone" cells that line it.)

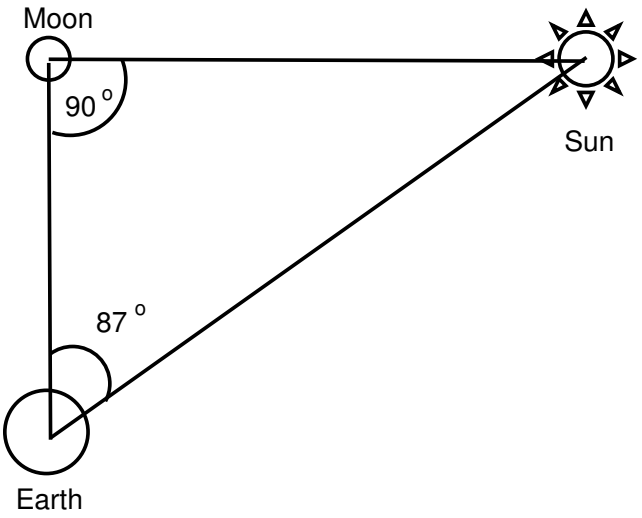
   b. What is the angular resolution, in arcseconds (1/3600 of a degree), of the Hubble Space Telescope (with an aperture diameter of 2.4 m) at a wavelength of 0.5μm?

   c. What is the angular resolution, expressed as a fraction of an arcsecond, of the Very Long Baseline Interferometer (VLBI)? VLBI is an network of radio telescopes (wavelengths $gg1100$ cm), spread over the globe, that combine their signals to form one large interferometer.

   d. From the Table of Constants and Units, find the distances and physical size of the Sun. Calculate the angular size of the sun, and compare to the angular size of a Sun-like star 10 light years away. Compare these angular sizes to the angular resolutions you found above.

2. What is the distance to a star with a parallax of 1 milli-arcsecond

3. In class we mentioned that Aristarchus found that when the Moon is hulf-full the angle between the Moon an the Sun is 87°. For this angle, what is the ratio of the distances to the Sun and Moon? Given the *true* distances (which you can find on the net) what is a more precise value for this critical angle?



4. A binary star system in the star forming region of Taurus (at a distance of 150 pc) has a separation between the two stars of 50 AU. Can we resolve the binary (i.e., detect the two stars individually) using a ground-based telescope with a resolution of 1 arcsecond?

5. **A simple estimate for the particle density in the inter stellar medium.** Assume that one solar mass of hydrogen is spread uniformly in a volume with radius equal to *half* the distance from the Sun and to Alpha Centauri $d_\alpha = 1.33$ pc. What is the particle density?

6. Banard's star has a proper motion of 10.3 arc-seconds per year. It lies at a distance of 1.8pc. What is this star transverse velocity (in km $\sec^{-1}$)?

7. What is the flux of radiation (erg $\sec^{-1}$ cm^{-2}) on Earth from a Sun like star (i.e., with the same luminosity) at a distance of 10 pc?