1.8 PROBLEMS

Problem 1.8.1. In Astronomy, a unit of distance, called parsec (pc), is in common use. It is defined to be the distance at which an object of size 1 Astronomical Units (AU) ($\approx 150 \times 10^6$ km) will subtend an angle of 1 arc-second, which is equal to 1/3600 of one degree. Two stars in a binary star system separated by 8.6×10^{14} m are seen to subtend an angle of 0.2 arcsec. How far away are the stars (a) in pc, and (b) in meters.

Problem 1.8.2. A boat is seen to be 2 meters under water when it is 4 km from the shore. Use this data to estimate the radius of earth.

Problem 1.8.3. The British physicist G. I. Taylor argued that the radius R of a spherically symmetric nuclear explosion must depend on the energy E, the initial density of air D, and time t since explosion. Using dimensional analysis, find a formula for the radius at time t after the explosion. [Challenging problem]

Problem 1.8.4. By dimensional analysis, find a formula for the oscillation frequency of a star of radius R and density D. Note that you will also need the dimensions of Newton's gravitational constant, which is $[G_N] = [L]^3[T]^{-2}[M]^{-1}$. Skip this problem if you do not know Newton's gravitational force and G_N. You will learn about this force in a coming chapter.