Astronomy 1143 Homework 1

September 28, 2015

1. Two Martian astronomers, Marvin and Marla, are located due north and south of each other on the planet Mars. Marvin sees the Sun directly overhead (at the zenith) at noon. At the same time, Marla sees the Sun 5 degrees away from the zenith. Marla is 295 kilometers north of Marvin. Using this information, compute the circumference of the planet Mars.

2. Suppose that Aristarchus had measured an angle of 45 degrees between the Sun and the Moon when the Moon was in its first quarter phase. Draw an accurate diagram of the positions of Earth, Moon, and Sun necessary for this measurement to be correct. In this case, what is the ratio of the Earth-Sun distance to the Earth-Moon distance?

3. (a) The Lyman series of hydrogen spectral lines are due to the decay of an electron's orbit from a higher-energy level to which lower-energy level? (i.e. What is n?)

   (b) If a photon is emitted by an electron transitioning from an energy level with $E_2 = 10.2$ electronvolts (eV) to an energy level with $E_1 = 0$ eV, what is the energy of the photon emitted, in eV?

   (c) What is the wavelength of the emitted photon in nanometers? Hint: Planck's constant in units of electronvolts-seconds is $h = 4.1 \times 10^{-15}$ eV s.

4. At its closest approach, the planet Saturn is 8 astronomical units (AU) from the Earth. When Saturn is this close, how long does it take light to travel from Saturn to the Earth? The Suns nearest neighbor among the stars, a dim little star called Proxima Centauri, is 1.295 parsecs (pc) from the Earth. How long does it take light to travel from Proxima Centauri to the Earth?

5. As we have seen in lecture, if the Hubble constant is $H_0 = 71$ km/sec/Mpc, then the Hubble time is $\frac{1}{H_0} = 14$ billion years. Edwin Hubble himself, because he grossly underestimated the distance to galaxies, believed that the Hubble constant was $H_0 = 500$ km/sec/Mpc. For $H_0 = 500$ km/sec/Mpc, what is $\frac{1}{H_0}$, in billions of years?