AST 301 Homework #9 (revised version) Due Friday Nov. 14

Note about revised version: I have changed some of the numbers in question 1 to simplify it some. (It's still not simple.) You can do either this version or the original one.

Note: We have used the rule that if a star is one magnitude brighter than another, it is 2.5 times as bright. An easier rule to use for this problem is that if a star is 5 magnitudes brighter than another, it is 100 times as bright. So a star with a magnitude of 0 is 100 times as bright as a star with a magnitude of 5, and a star with a magnitude of -5 is 100 times as bright as a star with a magnitude of 0. (Magnitudes can be negative, and a negative magnitude star is brighter than a positive magnitude star.)

1. I have found a Type I Cepheid variable star with a period of 20 days.

a) What is the luminosity (in solar luminosities) of the star? (Hint: see Figure 12-4)

b) The flux of a star is proportional to its luminosity and inversely proportional to the square of its distance, so if the star I found were at a distance of 1 pc how would its flux compare to that of the Sun if the Sun were also at a distance of 1 pc?

c) If the Sun were at a distance of 1 pc, it would have an apparent magnitude of 0. The star I found has an apparent magnitude of 0, so it has the same flux as the Sun would have at a distance of 1 pc. But in part b) you concluded that my star would be brighter than the Sun if they were both 1 pc away. So my star must be at a greater distance to make it appear to be as faint as the Sun would appear at a distance of 1 pc. How many times farther than 1 pc would my star have to be to decrease its brightness by the factor you found in part b)? (Remember that flux is inversely proportional to distance squared.)

d) What is the distance to my star?

2. I have observed an emission line from gas in a distant galaxy. I know that line would be a wavelength of 500 nm if the gas were not moving. I observe the wavelength to be 505 nm.

a) Is the galaxy moving toward me or away from me, and how fast is it moving? Give your answer in km/s.

b) Using the Hubble law, figure out the distance to the galaxy. Give your answer in parsecs. Assume the value of the Hubble constant is 70 km/s/Mpc.

Hint: The Hubble law is discussed in chapter 13-2.