General Astronomy - Spring 2007
Home work #8 - Due March 26

1. List three different types of galaxies and describe their stellar orbits and gas content.

Elliptical - random orbits, little or no gas.
Irregular - random orbits, very high gas content.
Spiral - disk with organized, circular orbits and also bugle and halo with random orbits, moderately high gas content.

2. How do astronomers measure distances of hundreds to thousands of Mpc?

Measurement of such large distances are done mainly using supernovae. The supernovae distance scale is calibrated with distances measured using Cepheids, which in turn are calibrated by distances measured using spectroscopic parallax, which in turn are calibrated by direct distance measurements using parallax.

3.Describe how an observer at a distance of 7 billion light years away from us would see the expansion of the Universe.

The observer should the expansion of the Universe centered on his/her own position. The expansion would look identical to the expansion that we observe from our position.

4. Assuming the Hubble constant is 60 km/s/Mpc, estimate the age of the Universe.

The age of the Universe is the time at which all the galaxies would occupy the same position if we ran the expansion of the Universe in reverse. This age is $1/H$. To use H in this equation we need to convert Mpc to km, 1 Mpc $= 3.086 \times 10^{19}$ km, and $H = 60\,\mathrm{km/s/Mpc} = 1.94 \times 10^{-18}\,\mathrm{s}^{-1}$. So, the age of the Universe would be $1/H = 5.14 \times 10^{17}\,\mathrm{s} = 1.6 \times 10^{10}\,\mathrm{years}$ or about 16 billion years.

5. A galaxy has a measured recession velocity of 8,000 km/s. How far away is it? (Assume that the Hubble constant is 71 km/s/Mpc.)

Use the Hubble expansion law, $v = Hd$, where v is the recession velocity of the galaxy, and d is its distance. Solve for d and insert numbers,

$$d = \frac{v}{H} = \frac{8000\,\mathrm{km/s}}{71\,\mathrm{km/s/Mpc}} = 113\,\mathrm{Mpc}$$

The galaxy is 113 Mpc away.