AST 308, Homework Set 4
Due Monday, Oct. 26 at start of class.

1. The Andromeda Galaxy M31 is located 0.89 Mpc from us and is approaching the Milky Way with a radial velocity of -100 km s$^{-1}$. Suppose that this radial velocity represents the entire “peculiar” velocity (the velocity not due to the Hubble flow) of M31. How far away would a galaxy having the same peculiar velocity as M31 need to be so that if we used only that one galaxy to determine the Hubble constant, the error due to its peculiar velocity would cause an error of 5% in the derived value of $H_0$? Use the value of $H_0$ found by the HST key project.

2. Do the following CO problems:
   - 29.7 Max size and lifetime of a closed universe. 
     *Hint:* An approach for doing part (b) is to use the parametric solutions to the Friedmann eqn, found on [CO pg. 1156].
   - 29.9 Show that all universes are flat at small $t$.
   - 29.12 Derive the acceleration equation. 
     *Hint:* you will need to use eqns: [29.10] and [29.50].
   - 29.21 Dipole anisotropy in CMB.
     *Hint:* There is a sneaky 180° difference between the zero points for the directions used in eqns [4.32] and [29.61].

I will (try to) remind you of each of the above CO problems as we reach the related material in the lectures. I recommend that you actually do each problem at the time we come to it in class. You could do Problem 1 right away.

*Warning:* In addition to the above homework assignment, I may also ask a few additional single homework questions one at a time, each of which will be due at the start of the next class meeting after the meeting in which it is asked. But they will be about General Relativity [Ch. 17] and material that we reach after that.