Study Questions for Lecture of April 24

1) What are the three possible shapes of the universe?

2) We know that a star or a galaxy will curve the space-time around it. That means that there could be bumps anywhere in the space of the universe, depending on the particular locations of all the stars and the galaxies. Reconcile that fact with the statement that there are only three possible shapes of the universe.

3) Measurements seem to show that our observable universe is flat. What does that tell us about the energy density in the observable universe?

4) What is "inflation" and when do we think it took place?

5) How does inflation help explain the flatness of our observable universe?

6) According to current hypothesis, roughly how is the energy of the observable universe divided among various types? (Use the categories (a) luminous baryonic matter, (b) non-luminous baryonic matter, (c) Cold Dark Matter, and (d) vacuum energy.)

7) Why do graphs of the revolution speed of objects around the center of the galaxy show that there is extra (non-baryonic) matter in the galaxy? Why do similar graphs for planetary speed in the solar system show that there is no (or not much) extra matter in the solar system?

8) Why do we think "Cold Dark Matter" is cold?

9) What observational evidence suggests that there is a significant amount of vacuum energy in the observable universe? Do we have a good theory that explains the origin and amount of vacuum energy?