AY5 Homework for Quiz 5: Spring 2015

1. **In the spectrum of a distant galaxy the absorption line of hydrogen that in the lab is at a wavelength of 656.3 nm is measured at 690.3 nm.**
    a. **What is the redshift, z, of this galaxy?**

    b. **What is the recession velocity, v, of the galaxy?**

    c. **By what factor has the size of the Universe changed since the light left the galaxy?**

    d. **For a Hubble Constant of 72 (km/sec)/Mpc, what is the distance to the galaxy?**

2. **For many years, the value of the Hubble Constant was the subject of many studies and some controversy. The values from different studies clustered around two values: 50 $km \cdot s^{-1} \cdot Mpc^{-1}$ and 100 $km \cdot s^{-1} \cdot Mpc^{-1}$. For each of these values calculate the expansion age of the Universe assuming no acceleration or deceleration.**

3. **Dark matter has been invoked to explain three observations on very different spatial scales. What are these observations?**

4. **A period of rapid inflation in the size of the Universe at very early times can be used to resolve four problems associated with non-inflation cosmologies. What are these four problems?**

5. **What is the evidence for an acceleration of the expansion of the Universe?**

6. **Based on our current data and models, what is the most likely long-term fate of the Universe?**

___ Eventual slowing of the expansion and a recollapse and "Big Crunch"

___ Ever-increasing expansion rate and cold, dark Universe

___ Radioactive decay of matter will light up the Universe for as long as we can predict

___ Star formation in galaxies will keep the Universe heated and light for at least the next 10^{20} years

7. Which of the following best describes the large-scale distribution of galaxies in the Universe?

____ Uniform in all directions

____ Clusters of galaxies, filaments and voids

____ Uniform except for small density variations at the level of ~1 in 100,000

____ completely random

8. Which of the following are thought to be properties of or true of Dark Matter?

____ it is "cold" (i.e. moves slowly compared to the speed of light)

____ it does not readily interact directly with photons or other matter (i.e. it has a small cross-section for interations)

____ it does not emit or absorb electromagnetic radiation

____ it is primarily inferred by its gravitational effect on other matter

9. Which of the following are true (T), which false (F)?

____ the total star formation rate in the Universe has been relatively steady since about 1 billion years after the Big Bang

____ Quasars were much more common in the period between 1 and 3 billion years after the Big Bang than they were before or after that time

____ the merger rate of galaxies has been steadily increasing over time as the Universe expands

____ Dark Matter is much more common than the type of matter that makes up stars, planets and humans

10. Which of the following is true of the Cosmic Microwave Background?

____ It originates from radiation during the Big Bang immediately after the era of nucleosynthesis

____ It shows the redshifted spectrum of a 3000K hot plasma

____ It is uniform over the entire sky

____ it shows variations at the level of one part in 100,000

11. The observed distribution of galaxies in the universe can be matched to models that include which of the following ingredients?

___ significant amounts of cold dark matter

___ "hot" dark matter in the form of neutrinos

___ initial density fluctuations imprinted on the Universe at the time of decoupling

___ quark-gluon interactions

12. What is the current thinking about the origin of temperature fluctuations in the cosmic microwave background?

___ variations in the He^4 to Hydrogen abundance at the time of decoupling

___ quantum fluctuations that grew in size during the period of inflation

___ uncertainty in the measurements

___ the presence of protogalaxies