

**Sample Exam type questions**  
to be addressed in Discussion Sections

Equations that may or may not be useful:

$$F = ma; E = mc^2; T = T_o(1 + z); D = v/H_0; F = L/(4\pi D^2)$$

$$H_0 = \dot{R}_0/R; \dot{R}_0^2/R_0^2 + kc^2/R_0^2 = G8\pi\rho_0/3$$

$$H_0^2 + kc^2/R_0^2 = G8\pi\rho_0/3$$

$$\dot{R}_0^2/R_0^2 + kc^2/R_0^2 = G8\pi\rho_0/3 + \Lambda/3$$

$$\rho_c = 3H_0^2/G8\pi; d\tau^2 = (cdt)^2 - R^2dr^2/(1 - kr^2)$$

$$q = \Omega_m/2 - \Omega_\Lambda; p \rightarrow p - c\Lambda/8\pi G$$

$$dU = -pdV$$

1. Starting with  $KE + kc^2/R^2 = PE + \Lambda$  explain how inflation produces a flat universe?
2. The Brane model says it is better than Inflation because (what) and the Brane theory “predicts” what in terms of observable compared to inflation, and predicts a different future from inflation which is?? The philosophy behind this predicted future is based on what principle?
3. Based on the discussion in class about decisions for designing experiments, what 2 key issues would argue against putting a space craft in the orbit of Pluto to get a really, really long lever arm for parallax measurements.
4. Suppose we observe an object whose apparent motion with respect to the background distant stars is 0.05 arc seconds over 1/4 of a year. How far away is this star from the sun? Hint we would say the parallax of the star is 0.05 arc seconds. Now suppose we observe the same parallax of another star but now we’re observing this apparent motion for a satellite that is 10 times further from the sun than the Earth. What is the distance of this star? Hint draw a diagram with triangles.
5. The Brane model predicts we will be able to detect only a negligible amount of WIMPs. Suppose I go look for WIMPs and don’t see them. Will this be proof of Brane model and disprove Inflation?
6. Give a few reasons for cosmology that make it important to know the Hubble Constant and in a general way describe how to we determine  $H_0$ ?
7. How does determining the cosmic distance ladder relate to  $H_0$ ?
8. If you were going to demonstrate the concept of parallax to a friend and you had a piece of paper and a pencil what would you do to reproduce the demo we did in class?

9. About how far can the human eye determine, via binocular vision, distances?
10. How do we “climb” the cosmic distance ladder?
11. Once we get beyond the Virgo cluster we have to stop using Cepheid variables. Give some reasons why this happens.
12. Hubble over corrected for dust and he thought he was looking at type IIs Cepheid when he was in fact looking at type Is. This had what effect on his distance estimates to these objects and what was the net effect on his derivation of the Hubble constant?
13. a parsec = ? cm
14. HIPPARCOS was designed to do what?
15. How did astronomers manage to infer that Cepheids are expanding and contracting stars rather than eclipsing binary systems?
16. How would you determine if dust were reducing the apparent brightness of your observed objects?
17. How do we use Cepheid to determine distances?
18. Why is there a maximum distance for determining  $H_0$ ?
19. The Jackson-Fiber Relation, the Tully-Fisher Relation, and the Fundamental Plane” relations all are used for what?
20. Surface brightness: I have an object with surface brightness “A” which is at distance “D.” I now move the object a distance  $2D$ , what is its surface brightness (assume we are so close in both cases that we can ignore “curvature” of the Universe).
21. If an object has a surface brightness “A” produces an observed flux “B” and “subtends” a solid angle “C.” How are “A,” “B, and “C” related?
22. Why does Tully-Fisher only work for spiral galaxies, and why does it work best if galaxies we use are observed edge on?
23. The Jackson-Faber Relation works on what kind of galaxies?
24. What is the “theory” behind the Tully-Fisher and the Jackson-Faber Relations in terms of mass, light and velocity.
25. Radians are nice to use for “small” angles (less than 1 degree works very well) because: