

Astronomy 123
Test 1, 22 October, 2010
Fall 2010

NAME _____

There are five (5) equally-weighted multipart questions. Each question is worth 10 points.

Question 1:

(2 points) a) State the Cosmological Principle, the Perfect Cosmological Principle, and the Anthropic Principle.

(2 points) b) Define homogeneity and isotropy. Include a sketch to illustrate your explanation.

(6 points) c) Explain how Einstein's consideration of the Perfect Cosmological Principle led to the suggestion of a universal repulsive force included in his model for the Universe as the *Cosmological Constant*. What caused Einstein to withdraw his suggestion of a *Cosmological Constant*?

Question 2:

(2 points) a) In essence, give the basic ideas of the *Big Bang Theory*.

(3 points) b) Cite the observations upon which the Big Bang Theory is based.

(5 points) c) Is the *Big Bang Theory* considered to be on secure ground by cosmologists? Explain why it is or is not considered to be on firm ground. In particular, point out the reasons why the evidence which supports the *Big Bang* cited in b) offer strong support for the *Big Bang* theory or why they do not offer strong support for the *Big Bang* theory.

Question 3:

- (2 points) a) Give a working definition for a black hole. When was the concept of a black hole first developed?
- (3 points) b) Describe a nonrotating black hole, a Schwarzschild black hole. In your description, indicate the physical significance of the *Event Horizon*, what is meant by the *singularity*, and *Schwarzschild Radius*.
- (2 points) c) State the *Cosmic Censorship* theorem. Why did Penrose propose the *Cosmic Censorship* theorem?
- (3 points) d) A black hole of mass _____, lurks at the center of the Milky Way galaxy and is thought to power the high energy activity seen in the core of the galaxy. Describe how rotating (Kerr) black holes and/or nonrotating (Schwarzschild) black holes can act as energy engines.

Question 4:

(2 points) a) What is meant by the term *Dark Matter*?

(6 points) b) Describe one observational results which suggests that *Dark Matter* dominates luminous (*normal*) matter in the Universe.

(2 points) c) Roughly, what fraction of the Universe is *Dark Matter*? What fraction of the matter in the Universe is *Dark Matter*?

Question 5:

- (4 points) a) Sketch the Hubble Tuning Fork diagram. Describe how the general properties of galaxies vary along the Hubble Tuning Fork diagram (consider gas and dust, stellar populations, Pop I and Pop II stars, star formation, flattening, bulges, and winding of spiral arms).
- (1 points) b) Did Hubble consider his Tuning Fork diagram to represent a galactic evolutionary sequence? Is it currently believed to be an evolutionary sequence?
- (3 points) c) What are the results of collisions between similar mass disk galaxies, between galaxies of greatly differing masses? Are collisions between galaxies likely to be rare occurrences? Present an argument which supports your answer concerning the probability of galaxy collisions.
- (2 points) Cite evidence and indicate why the evidence suggests that galactic collisions have played an important role in how galaxies evolve.