

**29:50 Stars, Galaxies, and the Universe**

**Instructor: Spangler**

**Homework Assignment # 10**

**November 16, 2010**

**Note:** Corresponding quiz on ICON must be completed by 8AM, Monday, November 29

1. Consider two galaxies, A and B (imaginative, eh?). The rotation curve for A rises from 0 km/sec at  $R=0$  kpc, reaches 220 km/sec at  $R=5$  kpc, and stays constant at 220 km/sec to  $R=20$  kpc and beyond. The rotation curve for B rises from 0 km/sec at  $R=0$  kpc, reaches 220 km/sec at  $R=5$  kpc, and stays at 220 km/sec out to  $R=10$  kpc. For distances greater than 10 kpc, the orbital speed gradually drops off and will approach zero as  $R$  goes to infinity. What can you say about galaxies A and B? **Hint:** Draw a graph containing the information given above.
  - (a) Galaxy A is more massive than galaxy B.
  - (b) Galaxy B is more massive than galaxy A.
  - (c) Galaxy A is more distant than galaxy B
  - (d) Galaxy B is more distant than galaxy A
  - (e) Galaxy A is older than galaxy B
2. What is the length of the “galactic year”, or the time it takes the Sun to complete an orbit around the Milky Way?
  - (a) 5400 years
  - (b) 37,000 years
  - (c) 4.5 million years
  - (d) 18 million years
  - (e) 238 million years
3. What terrestrial phenomenon is similar to the extinction of starlight in the interstellar medium ?
  - (a) rising and falling of the ocean level during the tides
  - (b) the rapid fading of lightning after a strike
  - (c) dim, red sunsets after large volcanic eruptions
  - (d) the decreasing brightness of skylight as the altitude angle increases
4. With radio telescopes we can see the objects at the galactic center, but we cannot see them with observations in visible light. Why is this?
  - (a) gas in the interstellar medium amplifies the radio waves, but not visible

radiation

- (b) the galactic center is too far to be seen in visible light
  - (c) the objects in the center of the Galaxy emit only radio waves, not visible light
  - (d) the interstellar dust extinguishes visible light but not radio waves
5. The star Arcturus is approximately 10 billion years old. Which of the following statements about its chemical composition would you expect to be true?
- (a) it has a higher abundance of elements heavier than helium than the Sun
  - (b) it has a lower abundance of elements heavier than helium than the Sun
  - (c) it should be primarily composed of carbon, oxygen, and heavier elements
  - (d) it should have no hydrogen in it
6. Look at Figure 23.20 of your book. Think about the galaxies in the left panel (i.e. NGC 1417 - NGC 3200). Based on what we have discussed in lecture and read in the book, what can you say about these galaxies?
- (a) a lot, but I'd rather not discuss it
  - (b) all of them are elliptical galaxies
  - (c) they are all smaller (less massive) than the Milky Way
  - (d) they all contain large amounts of Dark Matter
  - (e) they are all within the Local Group
7. What causes the Sun to move within the Milky Way?
- (a) it is falling directly into the black hole at the galactic center
  - (b) pulsars exert strong electric and magnetic forces on the Sun and move it
  - (c) gravitational forces exerted by rest of the matter in the Milky Way
  - (d) the Sun moves on a straight line determined by its motion when it formed
8. The Milky Way is a spiral galaxy. Where is the Sun located relative to the spiral arms of our Galaxy? **Note:** we didn't talk about this in lecture; read the book.
- (a) on the inner edge of the Orion-Cygnus arm
  - (b) in the middle of the Sagittarius arm
  - (c) the Sun is in the central bulge, inside the part of the Galaxy with spiral arms
  - (d) the Sun is high above the galactic plane, and not associated with spiral arms
  - (e) on the extreme outer edge of the Perseus arm

9. The spiral galaxy M81 (I showed a picture of it in class) is bright enough to be seen in binoculars. How far away is it?
- (a) 15 parsecs
  - (b) 8.5 kiloparsecs
  - (c) 50 kiloparsecs
  - (d) 3.6 Megaparsecs
  - (e) 65 Megaparsecs
10. The spiral galaxy M81 (I showed a picture of it in class) is bright enough to be seen in binoculars. How many times further away is it than the Galactic Center (in other words, if the distance to the center of the Milky Way were 1 unit, how many units away would M81 be)?
- (a) 3 times further
  - (b) 15 times further
  - (c) 420 times further
  - (d) 5800 times further
  - (e) 4,700,000 times further