Questions

1. The sun's location in the Milky Way Galaxy is ___.
2. The disk of the Milky Way appears in the sky as ___.
3. Elements besides hydrogen and helium constitute about ___ of the mass of the gas in the Milky Way Galaxy.
4. Most of the stars in the halo of the Milky Way are ___.
5. Consider this hypothetical discovery: A new star is found. It is an O star, and its orbit is highly elliptical. This star is part of ___.
6. Which type of galaxies has no young stars?
7. Which type of galaxy has the most gas?
8. Consider this hypothetical discovery: A new galaxy is found that looks the same as the Milky Way and has the same size. The stars, however, are moving more slowly. Does this galaxy have more or less mass than the Milky Way?
9. Why do we believe that most of the mass of galaxies is in the form of dark matter?
10. Which galaxy is an ellipitical galaxy? [Pictures of several galaxies will be on the screen.]
11. Penzias & Wilson observed radiation that was isotropic. S1: As viewed from Earth, the radiation from the Milky Way Galaxy is isotropic. S2: As viewed from Earth, the radiation from the Big Bang is isotropic. Statements 1 and 2 are ___.
12. A 2L bottle of the universe has 0.8 million photons. How many photons were in a 2L bottle back when the universe was half the present size?
13. A 2L bottle of the universe has 3e-34 kg of photons. How much mass in the form of light was there in a 2L bottle back when the universe was half the present size?
14. The mass of the black hole in M87 is ___ times the mass of the sun.
15. A star orbits the black hole in the center of the Milky Way. Its period is 10 years and the distance between it and the black hole is 1,000 AU. The mass of the black hole is ___ times the mass of the sun. (The numbers are chosen to make the calculation easier; they do not represent the actual case.)
16. Simplicio says, "Material falling toward a black hole cannot be seen." An example that contradicts Simplicio's statement is___.
17. In an average 200,000-km sphere (same size as moon's orbit), there is ___.
18. You and I are made of ___.
19. Decoupling occurs at a temperature of 3000 K. At that time, how far was the material that eventually became Hoag’s Galaxy, which is now at 900Mly.
20. In which case does the universe have the most mass? The fluctuations in the cosmic background radiation occur at an angular scale of a) 0.5º, b) 1º, c) 2º, d) 10º.

21. Hydrogen in a quasar emits light at a wavelength of 91 nm, and we observe the light at a wavelength of 364 nm. The scale of the universe was ___ when the quasar emitted the light.

22. SN 2002ki emits light with Fe absorption at 380 nm. We observe the wavelength of the Fe absorption at 800 nm. The U has expanded by a factor of ___.

23. A supernova emitted some light when the scale of the universe was 0.6. The supernova is brighter than expected for a model with density parameter 0.2. Is the density parameter of the universe higher or lower than 0.2?

24. Newton and Einstein disagreed on the source of gravity. Einstein said that in addition to mass, ___ causes gravity.

25. The WMAP satellite measured ___.

26. The first stars and galaxies formed ___ after the Big Bang.

27. What is evidence from the formation of the first stars and galaxies?.

Questions with Answers

1. The sun's location in the Milky Way Galaxy is ___. in the disk, roughly halfway between the center and outer edge of the disk.

2. The disk of the Milky Way appears in the sky as ___. a band of light that goes all of the way across the sky.

3. Elements besides hydrogen and helium constitute about ___ of the mass of the gas in the Milky Way Galaxy. 2 percent.

4. Most of the stars in the halo of the Milky Way are ___. very old.

5. Consider this hypothetical discovery: A new star is found. It is an O star, and its orbit is highly elliptical. This star is part of ___. Unable to answer. The evidence is contradictory.

6. Which type of galaxies has no young stars? Elliptical

7. Which type of galaxy has the most gas? Elliptical

8. Consider this hypothetical discovery: A new galaxy is found that looks the same as the Milky Way and has the same size. The stars, however, are moving more slowly. Does this galaxy have more or less mass than the Milky Way? The new galaxy has more mass.

9. Why do we believe that most of the mass of galaxies is in the form of dark matter? The orbital speed of stars is high. which means the stars feel the gravity of something besides the stars and gas.

10. Which galaxy is an ellipitical galaxy? [Pictures of several galaxies will be on the screen.]

11. Penzias & Wilson observed radiation that was isotropic. S1: As viewed from Earth, the radiation from the Milky Way Galaxy is isotropic. S2: As viewed from Earth, the radiation from the Big Bang is isotropic. Statements 1 and 2 are ___. FT.

12. A 2L bottle of the universe has 0.8 million photons. How many photons were in a 2L bottle back when the universe was half the present size? 6 Million

13. A 2L bottle of the universe has 3e-34 kg of photons. How much mass in the form of light was there in a 2L bottle back when the universe was half the present size? 48e-34 kg

14. The mass of the black hole in M87 is ___ times the mass of the sun. 3 billion

15. A star orbits the black hole in the center of the Milky Way. Its period is 10 years and the distance between it and the black hole is 1,000 AU. The mass of the black hole is ___ times the mass of the sun. (The numbers are chosen to make the calculation easier; they do not represent the actual case.) 10,000,000

16. Simplicio says, "Material falling toward a black hole cannot be seen." An example that contradicts Simplicio's statement is the radio source Cygnus A.

17. In an average 200,000-km sphere (same size as moon's orbit), there is 3 lb of dark energy, 1 lb of dark matter, and 3 oz of ordinary matter.

18. You and I are made of ___. ordinary matter.

19. Decoupling occurs at a temperature of 3000 K. At that time, how far was the material that eventually became Hoag's Galaxy, which is now at 900Mly. About 1 Mly.
20. In which case does the universe have the most mass? The fluctuations in the cosmic background radiation occur at an angular scale of a) 0.5º, b) 1º, c) 2º, d) 10º. 10º

21. Hydrogen in a quasar emits light at a wavelength of 91 nm, and we observe the light at a wavelength of 364 nm. The scale of the universe was ___ when the quasar emitted the light. 0.25

22. SN 2002ki emits light with Fe absorption at 380 nm. We observe the wavelength of the Fe absorption at 800 nm. The U has expanded by a factor of ___. 2.1

23. A supernova emitted some light when the scale of the universe was 0.6. The supernova is brighter than expected for a model with density parameter 0.2. Is the density parameter of the universe higher or lower than 0.2? Higher

24. Newton and Einstein disagreed on the source of gravity. Einstein said that in addition to mass, ___ causes gravity. pressure

25. The WMAP satellite measured ___. the temperature and polarization of the cosmic background radiation over the entire sky.

26. The first stars and galaxies formed ___ after the Big Bang. 300 Myr

27. What is evidence from the formation of the first stars and galaxies? Polarization of the cosmic background radiation.