Chapter 9 Review

Make Your Own Summary

Summarize the key concepts of this chapter using a graphic organizer. The Chapter Summary on the previous page will help you identify the key concepts. Refer to Study Toolkit 4 on pages 566–567 to help you decide which graphic organizer to use.

Reviewing Key Terms

Match each key term listed below to its definition.

a. big bang

b. cosmic microwave background

c. cosmology

d. dark energy

e. dark matter

f. galaxy

g. Milky Way galaxy

1. A(n) _____ is a huge collection of stars, planets, gas, and dust held together by gravity. (9.1)

2. The galaxy that includes our solar system is called the _____. (9.1)

3. The study of how the universe began and evolved is called _____. (9.2)

4. According to the _____ theory, the universe began from an incredibly dense state. (9.2)

5. The universe has cooled to a chilly –270°C during its billions of years of expansion. The leftover radiation from the big bang is called the _____ radiation. (9.2)

6. Stars in the outer regions of galaxies are revolving around the centre faster than expected. This evidence suggests that much of the matter within each galaxy must be in the form of _____. (9.3)

7. Recent observations have revealed the presence of a mysterious energy that is causing increased expansion of the universe. This energy is called _____. (9.3)

Knowledge and Understanding K/U

8. Arrange the following objects in order of size, from smallest to largest: galaxy cluster, universe, star, galaxy, globular cluster.

9. What led William Herschel to conclude that the Sun is part of a huge galaxy of stars?

10. Identify each celestial object below.

11. Which type of galaxy do astronomers consider to be the oldest?

12. What surprising discovery was made by Edwin Hubble?

13. What conclusion can be drawn from the fact that the universe is observed to be expanding?

14. List two spinoff technologies from the exploration of space.

15. What prediction was made by George Gamow and subsequently verified by Robert Wilson and Arno Penzias?

16. Arrange the following statements in order of time, from earliest to most recent.

a. The Sun and solar system formed.

b. The cosmic microwave background radiation cooled to –270°C.

c. The Milky Way galaxy formed.

d. The earliest stars formed.

e. The big bang happened.

17. If dark matter cannot interact with ordinary matter, how do scientists know that it exists?

18. How is dark matter distributed in galaxies?

19. Why do astronomers think that the universe must have started from something compact and dense?

Thinking and Investigation T/I

20. The sphere of stars around a galaxy is made exclusively of old stars. What does that tell you about galaxy formation?

21. Use **Figure 9.9** on page 371 to calculate the rate of the expansion of the universe.

22. Consider three identical galaxies. Galaxy A is coming toward us, galaxy B is going away from us, and galaxy C is not moving, relative to the Milky Way galaxy. How will their line spectra be different?

23. Make a concept map showing the life history of a massive star.

Communication C

24. BIG IDEAS Different types of celestial objects in the solar system and universe have distinct properties that can be investigated and quantified. Explain how the properties of globular clusters were investigated and how the resulting discoveries led to further understanding of the Milky Way galaxy.

25. BIG IDEAS Astronomers use observational evidence of the properties of the solar system and universe to develop theories that explain their formation and evolution. Explain how astronomers used observational evidence to support the big bang theory.

26. BIG IDEAS Space exploration has generated valuable knowledge, but at an enormous cost. Research rechargeable tools. Describe how and when rechargeable tools became a spinoff technology from NASA's space program.

27. NASA usually allows shuttle missions to take place if the chance of a catastrophic collision with space junk is not greater than one in 200. Do you think space missions with a greater chance of a catastrophic collision are worth the risk to human life or the huge expense? Work with a partner to complete a chart outlining the costs and benefits of space exploration that carries a risk of collision with space junk.

28. Organize the evidence that supports the big bang theory in a graphic organizer.

Application A

29. Identify three careers related to astronomy and space exploration in this chapter.

30. Why do celestial objects that are farther away sometimes look younger than if they were closer to us?

31. In the science fiction television series *Star Trek*, the writers felt that the crew of the starship *Enterprise* would grow bored if they had to wait decades between adventures. So, the writers invented "warp drive" to get the crew around the galaxy much faster. Warp 9.9 is about 3000 times faster than the speed of light. In reality, this is impossible. In science fiction, however, it is fun. Calculate how long it would take the crew of the *Enterprise*, at warp 9.9, to

a. reach the nearest star, about 4 light-years away

b. reach the centre of the Milky Way galaxy

c. go to the far side of the galaxy

d. go around the galaxy at the Sun's distance from the centre of the galaxy