

CHAPTER 1: Thinking Like an Astronomer

MULTIPLE CHOICE

1. The word *astronomy*:
- a. means “patterns among the stars.”
 - b. means “to study the stars.”
 - c. means “discovering the universe.”
 - d. has nothing to do with stars.

ANS: A DIF: Easy REF: 1.1

OBJ: Define the bold-faced vocabulary terms within the chapter.

MSC: Remembering

2. Our place in the universe is:
- a. a location and a time.
 - b. at its center.
 - c. at its edge.
 - d. unknown because there is no center to the universe.

ANS: A DIF: Easy REF: 1.1

OBJ: List our cosmic address.

MSC: Remembering

3. We are located approximately:
- a. at the center of the Milky Way.
 - b. near the center of the Milky Way.
 - c. halfway out from the center of the Milky Way.
 - d. at the farthest outskirts of the Milky Way.

ANS: C DIF: Easy REF: 1.1

OBJ: Differentiate the various components of our cosmic address.

MSC: Remembering

4. Light from the Sun takes about _____ to reach Earth.
- a. 8 seconds
 - b. 8 minutes
 - c. 8 hours
 - d. 8 years

ANS: B DIF: Easy REF: 1.1

OBJ: Relate astronomical distances with the travel time of light.

MSC: Remembering

5. If an event were to take place on the Sun, how long would it take for the light to reach us?
- a. 8 minutes
 - b. 11 hours
 - c. 1 second
 - d. 1 day

ANS: A DIF: Easy REF: 1.1

OBJ: Relate astronomical distances with the travel time of light.

MSC: Applying

6. After the Sun, the next nearest star to us is approximately _____ away.
- a. 4 light-seconds
 - b. 4 light-minutes
 - c. 4 light-hours
 - d. 4 light-years

ANS: D DIF: Easy REF: 1.1

OBJ: Relate astronomical distances with the travel time of light.

MSC: Remembering

7. One of the nearest stars is Alpha Centauri, whose distance is 4.4 light-years. The time it takes light to travel from Alpha Centauri to us is:
- a. 1.25 seconds.
 - b. 8.3 minutes.
 - c. 4.4 years.
 - d. 600 years.

ANS: C DIF: Easy REF: 1.1
OBJ: Relate astronomical distances with the travel time of light.
MSC: Applying

8. The distance to the nearest, large, spiral galaxy, Andromeda, is 2.5 million light-years. How long does it take light to travel from us to Andromeda?
- a. 360 years
 - b. 1.2 thousand years
 - c. 4.5 billion years
 - d. 2.5 million years

ANS: D DIF: Easy REF: 1.1
OBJ: Relate astronomical distances with the travel time of light.
MSC: Applying

9. The early universe was composed mainly of which two elements?
- a. hydrogen and helium
 - b. carbon and oxygen
 - c. hydrogen and oxygen
 - d. carbon and iron

ANS: A DIF: Easy REF: 1.1
OBJ: Differentiate the various components of our cosmic address.
MSC: Remembering

10. Our universe is approximately _____ years old.
- a. 14 million
 - b. 14 billion
 - c. 14 trillion
 - d. 14 thousand

ANS: B DIF: Easy REF: 1.1
OBJ: List the types of objects found in our Solar System. MSC: Remembering

11. The number of planets in the Solar System is
- a. 8
 - b. 9
 - c. 12
 - d. 6

ANS: A DIF: Medium REF: 1.1
OBJ: List the types of objects found in our Solar System. MSC: Remembering

12. Which of the following most closely approximates the number of stars in the Milky Way?
- a. 10 million
 - b. 100 million
 - c. 10 billion
 - d. 100 billion

ANS: D DIF: Medium REF: 1.1
OBJ: Differentiate the various components of our cosmic address.
MSC: Remembering

13. The speed of light is about:
- a. 20 km/s.
 - b. 30,000 km/s.
 - c. 300,000 km/s.
 - d. 5 million km/s.

ANS: C DIF: Medium REF: 1.1
OBJ: Relate astronomical distances with the travel time of light.
MSC: Remembering

14. A light-year is a unit of measurement for:

- a. time.
- b. speed.
- c. mass.
- d. distance.

ANS: D DIF: Medium REF: 1.1

OBJ: Relate astronomical distances with the travel time of light.

MSC: Remembering

15. The most massive elements (such as those of the rocky planets like Earth) were formed

- a. in the early universe.
- b. inside stars and supernovae.
- c. through meteor collisions.
- d. in the core of Earth.

ANS: B DIF: Medium REF: 1.1

OBJ: List the types of objects found in our Solar System. MSC: Remembering

16. If you were to specify your address in the universe, listing your membership from the smallest to largest physical structures, it would be:

- a. Earth, Local Group, Solar System, Andromeda, the universe.
- b. Earth, Solar System, Local Group, Milky Way, the universe.
- c. Earth, Solar System, Milky Way, Local Group, Virgo Supercluster, the universe.
- d. Earth, Solar System, Milky Way, Fornax Supercluster, the universe.

ANS: C DIF: Difficult REF: 1.1

OBJ: Differentiate the various components of our cosmic address.

MSC: Applying

17. If the diameter of our galaxy is approximately 100,000 light-years, our galaxy is _____ times larger than our Solar System.

- a. 100
- b. 10^4
- c. 10^6
- d. 10^8

ANS: C DIF: Difficult REF: 1.1

OBJ: Differentiate the various components of our cosmic address.

MSC: Applying

18. The Local Group is the environment around:

- a. the Sun that contains about a dozen stars.
- b. the Milky Way that contains a few dozen galaxies.
- c. the Sun that contains more than a billion stars.
- d. the Milky Way that contains a few thousand galaxies.

ANS: B DIF: Difficult REF: 1.1

OBJ: Differentiate the various components of our cosmic address.

MSC: Remembering

19. Which of the following is FALSE?

- a. The Local Group is a member of the Virgo Supercluster, which contains thousands of galaxies.
- b. The Local Group contains two large spiral galaxies and a few dozen dwarf galaxies.
- c. Our Solar System has eight planets.
- d. The Milky Way Galaxy contains approximately 100 million stars.

ANS: D DIF: Difficult REF: 1.1

OBJ: Differentiate the various components of our cosmic address.

MSC: Remembering

20. Measuring distances in the amount of time it takes light to travel, if the circumference of Earth is a snap of your fingers, the diameter of the Solar System is approximately equal to:
- a. the length of a quick lunch.
 - b. the time to turn a page in a book.
 - c. the time between sunrise and sunset.
 - d. the time you spent in high school.

ANS: C DIF: Difficult REF: 1.1
OBJ: Relate astronomical distances with the travel time of light.
MSC: Applying

21. Scientific notation allows us to:
- a. write very large and very small numbers in a convenient way.
 - b. talk about science in an easy way.
 - c. change easy calculations into hard calculations.
 - d. explain science to engineers.

ANS: A DIF: Easy REF: Working It Out 1.1
OBJ: Write numbers in both scientific and standard notation. MSC: Remembering

22. Approximately how many feet are in 4 meters?
- a. 1.3
 - b. 4
 - c. 8
 - d. 12

ANS: D DIF: Medium REF: Working It Out 1.1
OBJ: Convert between different units of length, time, and speed.
MSC: Applying

23. How many nanometers are in a millimeter?
- a. 100
 - b. 1,000
 - c. 1,000,000
 - d. 1,000,000,000

ANS: C DIF: Medium REF: Working It Out 1.1
OBJ: Differentiate between the metric units nano, micro, milli, centi, and kilo.
MSC: Applying

24. How many orders of magnitude does the size of the visible universe span (in light years)?
- a. 13.8
 - b. 1 billion
 - c. 9
 - d. 10

ANS: D DIF: Medium REF: Working It Out 1.1
OBJ: Write numbers in both scientific and standard notation. MSC: Applying

25. Approximately how many meters are in 12 ft?
- a. 3
 - b. 4
 - c. 12
 - d. 36

ANS: B DIF: Difficult REF: Working It Out 1.1
OBJ: Convert between different units of length, time, and speed.
MSC: Applying

26. A scientific theory can be proved wrong if:
- a. cultural beliefs evolve to contradict it.
 - b. scientists gather new data that disprove its predictions.
 - c. it cannot explain all phenomena.
 - d. it is based only on conjecture.

ANS: B DIF: Easy REF: 1.2
OBJ: Explain what makes a scientific theory falsifiable.

MSC: Remembering

27. A hypothesis may become a theory:
- after many repeated attempts to falsify it fail.
 - if a majority of scientists agree on its propositions.
 - after it has been logically proved.
 - if it makes at least one verifiable prediction.

ANS: A DIF: Easy REF: 1.2
MSC: Remembering

OBJ: Define scientific theory.

28. Which of the following is FALSE?
- A scientific theory is an undisputed fact.
 - If continual testing of a hypothesis shows it to be valid, it may become an accepted theory.
 - A hypothesis must always have one or more testable predictions.
 - A scientific theory may eventually be proved wrong when scientists acquire new data.

ANS: A DIF: Medium REF: 1.2
MSC: Evaluating

OBJ: Define scientific theory.

29. The scientific method is a process by which scientists:
- prove theories to be known facts.
 - gain confidence in theories by failing to prove them wrong.
 - show all theories to be wrong.
 - test the ideas of Aristotle.

ANS: B DIF: Medium REF: 1.2
OBJ: Describe the steps of the scientific method.

MSC: Remembering

30. A _____ becomes a _____ when repeated testing of its predictions does not disprove it.
- hypothesis; scientific method
 - theory; scientific revolution
 - phenomenon; theory
 - hypothesis; theory

ANS: D DIF: Medium REF: 1.2
OBJ: Describe the steps of the scientific method.

MSC: Remembering

31. The cosmological principle states that:
- the universe is expanding in all directions at the same rate.
 - a unique center of the universe exists.
 - the universe looks the same everywhere as long as you look on large enough spatial scales.
 - physical laws may change from place to place in the universe.

ANS: C DIF: Medium REF: 1.2
OBJ: Compare an idea with a hypothesis.

MSC: Remembering

32. _____ is the idea that the simplest explanation for a phenomenon is usually the correct one.
- Newton's hypothesis
 - Occam's razor
 - Aristotle's test
 - Einstein's excuse

ANS: B DIF: Difficult REF: 1.2
OBJ: Describe the steps of the scientific method.

MSC: Remembering

33. One of the central assumptions in astronomy is that the physical laws of nature:
- change when objects move at high speed.
 - change throughout the age of the universe.

- c. depend on the mass of the objects involved.
- d. are the same everywhere in the universe.

ANS: D DIF: Difficult REF: 1.2

OBJ: Compare an idea with a hypothesis.

MSC: Remembering

34. The statement “our universe is but one of a multitude of isolated universes” is best characterized as a:
- a. speculative but unscientific idea because it is not testable and therefore not falsifiable.
 - b. scientific fact.
 - c. physical law.
 - d. hypothesis that is currently being tested.

ANS: A DIF: Difficult REF: 1.2

OBJ: Assess whether a given idea or explanation is scientific.

MSC: Applying

35. The language of science is:

- a. Greek.
- b. mathematics.
- c. calculus.
- d. Java.

ANS: B DIF: Easy REF: 1.3

OBJ: Determine the relation of mathematics and science.

MSC: Remembering

36. What are the speeds of the car at points a, b, and c indicated by the graph of Figure 1.10 of the textbook?

- a. 0.5 miles per minute, 0.5 miles per minute, 0 miles per minute
- b. 0.5 miles per minute, 0.5 miles per minute, 0.25 miles per minute
- c. 0.5 miles per minute, 0.6 miles per minute, 0.56 miles per minute
- d. 0.5 miles per minute, 0.6 miles per minute, 0 miles per minute

ANS: D DIF: Medium REF: 1.3

OBJ: Read data from a graph.

MSC: Applying

37. The kind of mathematics that deals with change is called:

- a. algebra.
- b. calculus.
- c. arithmetic.
- d. geometry.

ANS: B DIF: Medium REF: 1.3

OBJ: Define slope on a graph.

MSC: Remembering

38. Write 3,800,000,000 in scientific notation.

- a. 3.8×10^8
- b. 3.8×10^9
- c. 3.8×10^{-8}
- d. 3.8×10^{-9}

ANS: B DIF: Medium REF: 1.3

OBJ: Write numbers in both scientific and standard notation.

MSC: Applying

39. Write 0.00000037 in scientific notation.

- a. 3.7×10^{-7}
- b. 37×10^{-6}
- c. 37×10^6
- d. 3.7×10^7

ANS: A DIF: Medium REF: 1.3

OBJ: Write numbers in both scientific and standard notation.

MSC: Applying

SHORT ANSWER

1. What is the ONLY thing that makes the Sun an exceptional star?

ANS:

The fact that it is *our* star!

DIF: Easy REF: 1.1

OBJ: Differentiate the various components of our cosmic address.

MSC: Understanding

2. If the elements that make up Earth and our bodies were not present in the early universe, where did they come from?

ANS:

They were formed by nuclear fusion inside stars.

DIF: Easy REF: 1.1

OBJ: List the types of objects found in our Solar System. MSC: Applying

3. Why might the universe be described as a sort of “time machine”?

ANS:

The finite speed of light means that objects observed at larger distances are observed as they existed further in the past.

DIF: Easy REF: 1.1

OBJ: Relate astronomical distances with the travel time of light.

MSC: Remembering

4. What is the Local Group?

ANS:

The group of a dozen or so galaxies including the Milky Way that are within a few million light-years of each other.

DIF: Easy REF: 1.1

OBJ: Differentiate the various components of our cosmic address.

MSC: Remembering

5. Describe how talking about time can give us a feeling for distance.

ANS:

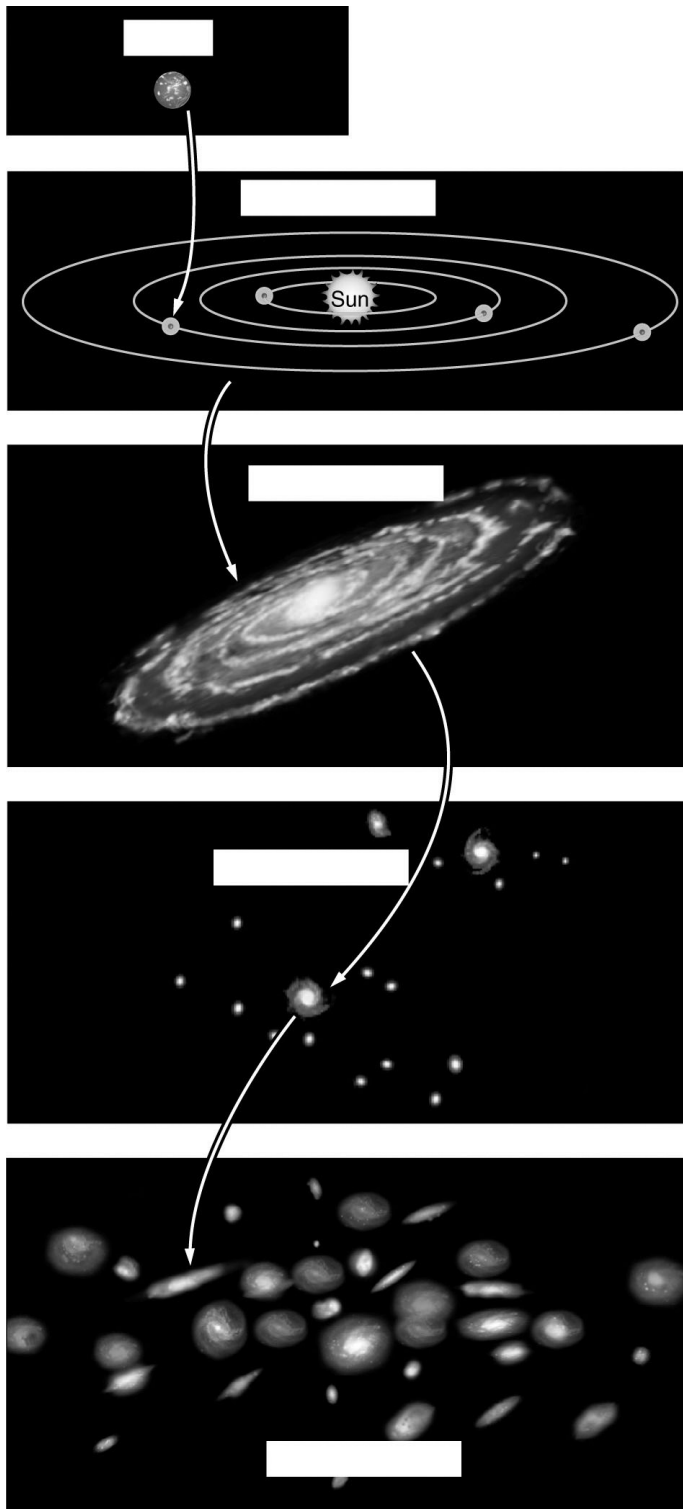
If speed is constant, a difference in time is directly related to a difference in distance. A time difference is easier to conceptualize.

DIF: Medium REF: 1.1

OBJ: Relate astronomical distances with the travel time of light.

MSC: Understanding

6. The figure below shows images representing our place in the universe. Label each box with its appropriate location.



ANS:

Top to bottom: Earth, Solar System, Milky Way Galaxy, Local Group, Virgo Supercluster.

DIF: Medium

REF: 1.1

OBJ: List our cosmic address.

MSC: Remembering

7. Suppose you were writing to a pen pal across the universe. What address would you put on the envelope that included all the major structures in which we reside? (Hint: Your cosmic address should begin with “Earth” and end with “the universe.”)

ANS:

The address would be: “Earth, the Solar System, the Milky Way, the Local Group, Virgo Supercluster, the universe.”

DIF: Medium REF: 1.1 OBJ: List our cosmic address.
MSC: Remembering

8. Name three dwarf planets.

ANS:

Pluto, Ceres, Eris.

DIF: Medium REF: 1.1
OBJ: List the types of objects found in our Solar System. MSC: Remembering

9. Describe briefly why the phrase “we are stardust” is literally true.

ANS:

Massive stars make heavy elements during their lifetimes. When they eventually explode in a supernova, some of these heavy elements, as well as additional ones that are created in the explosion itself, are ejected into space, where they eventually cool and form new star systems (and everything in them, including, in the specific example of the SOLAR system, us!).

DIF: Medium REF: 1.1
OBJ: List the types of objects found in our Solar System. MSC: Understanding

10. Describe the two main aspects of the cosmological principle.

ANS:

- (1) What we see around us is representative of what the universe is like in general.
(2) The physical laws valid on Earth are valid everywhere.

DIF: Easy REF: 1.2
OBJ: Define the bold-faced vocabulary terms within the chapter.
MSC: Remembering

11. In pre-Renaissance times, it was believed that celestial objects were made of a different substance than Earth and obeyed different rules. Which modern scientific principle is a better description of the universe?

ANS:

The cosmological principle.

DIF: Medium REF: 1.2
OBJ: Define the bold-faced vocabulary terms within the chapter.
MSC: Applying

12. Why does a theory that continues to be supported by the results of experimental tests need further tests?

ANS:

There may be observational tests or measurements that might be performed with greater precision for which the predictions of the theory might fail.

DIF: Medium REF: 1.2

OBJ: Explain what makes a scientific theory falsifiable.

MSC: Remembering

13. Describe the main steps involved in the scientific method.

ANS:

First you make a hypothesis; then you make a prediction based on your hypothesis. Finally, you test your prediction through experimentation or observation, prove or disprove your original hypothesis, and revise your hypothesis if necessary.

DIF: Difficult REF: 1.2

OBJ: Describe the steps of the scientific method.

MSC: Remembering

14. Referring to Figure 1.10 of the textbook, what is the relationship between the speed of the car and the slope of the graph?

ANS:

The speed of the car at a particular point in time is the slope of the graph at that particular point in time.

DIF: Medium REF: 1.3

OBJ: Define slope on a graph.

MSC: Applying

15. What is the main reason why a comet should not be considered a type of planet?

ANS:

Comets do not orbit the sun in a cleared, isolated path, i.e., their orbits intersect the orbits of the planets.

DIF: Difficult REF: Reading Astronomy News

OBJ: List the types of objects found in our Solar System.

MSC: Understanding