21st Century Astronomy 5th Edition Kay Test Bank

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21st Century Astronomy

FIFTH EDITION

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21st Century Astronomy

FIFTH EDITION

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BLOOM'S TAXONOMY

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Remembering
Understanding
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Analyzing
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Chapter 1: Thinking Like an Astronomer

LEARNING OBJECTIVES

1.1 Earth Occupies a Small Place in the Universe

Define the bold-faced vocabulary terms within the chapter.
Multiple Choice: 1, 9, 14, 21, 29, 31, 36, 37, 40, 42, 43, 44
Short Answer: 11, 17, 18

List our cosmic address.
Multiple Choice: 22
Short Answer: 5

Differentiate the various components of our cosmic address.
Multiple Choice: 2, 6, 23
Short Answer: 1, 3

Relate the different sizes of, or the different distances between, the components of our cosmic address.
Multiple Choice: 10, 11, 15, 24, 25
Short Answer: 16

Relate astronomical distances with light-travel time.
Multiple Choice: 4, 7, 16, 17, 18, 19, 20, 26, 27, 28
Short Answer: 2, 4, 6, 10

Illustrate the size or history of the universe with scaled models.
Multiple Choice: 3, 5, 8, 12, 13
Short Answer: 7, 8, 9

1.2 Science Is a Way of Viewing the Universe

Compare the everyday and scientific meanings of *theory*.
Multiple Choice: 33, 35, 39
Short Answer: 23

Compare an *idea* with a *hypothesis.*
Multiple Choice: 32, 34
Short Answer: 12

Describe the steps of the scientific method.
Multiple Choice: 38, 41
Short Answer: 14, 20

Assess whether a given idea or explanation is scientific.
Multiple Choice: 45, 46
Short Answer: 13

Establish why all scientific knowledge is provisional.
Multiple Choice: 30
Short Answer: 15, 19, 21, 22

1.3 Astronomers Use Mathematics to Find Patterns

Identify patterns in nature.
Multiple Choice: 47, 48, 51
Short Answer: 24, 25, 26

Summarize the evidence for the statement "We are actually made of recycled stardust."
Multiple Choice: 50, 52, 54
Short Answer: 27, 29, 30

Identify fields of science that relate to the study of origins.
Multiple Choice: 53
Short Answer: 28

Working It Out 1.1

Write numbers in both scientific and standard notation.
Multiple Choice: 49, 55, 57, 58, 68

Describe characteristics of real-world objects in terms of ratios.
Multiple Choice: 56, 59, 60

Determine the mathematical behavior of proportional systems.
Multiple Choice: 61, 62, 63, 64

Working It Out 1.2

Identify the *x* and *y* axes on a graph.
Define *slope* on a graph.
Read data from linear and logarithmic graphs.
Multiple Choice: 65, 66, 69, 70

Distinguish between linear and exponential curves on a graph.
Multiple Choice: 67

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MULTIPLE CHOICE

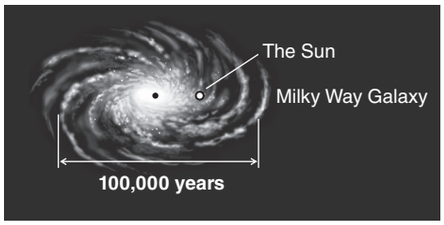
1. The word *astronomy* means
   a. "patterns among the stars."
   b. "to study the stars."
   c. "discovering the universe."
   d. "the movement of the stars."
   e. "personality traits set by the stars."

   ANS: A DIF: Easy REF: Section 1.1
   MSC: Remembering
   OBJ: Define the bold-faced vocabulary terms within the chapter.

2. The number of planets in our Solar System is
   a. six.
   b. eight.
   c. nine.
   d. twelve.

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

3. According to the figure below, Earth is located approximately



   a. at the center of the Milky Way.
   b. near the center of the Milky Way.
   c. about halfway out from the center of the Milky Way.
   d. at the farthest outskirts of the Milky Way.
   e. outside the Milky Way, which is why we can see it as a band across the night sky.

   ANS: C DIF: Easy REF: Section 1.1
   MSC: Understanding
   OBJ: Illustrate the size or history of the universe with scaled models.

4. The average distance between Earth and the Sun is 1.5×10^{11} m, and light from the Sun takes approximately _____ to reach Earth.
   a. 8 seconds
   b. 8 minutes
   c. 8 hours
   d. 8 days
   e. 8 years

   ANS: B DIF: Easy REF: Section 1.1
   MSC: Applying
   OBJ: Relate astronomical distances with light-travel time.

5. Our universe is approximately 13.7 _____ years old.
   a. thousand
   b. million
   c. billion
   d. trillion

   ANS: C DIF: Easy REF: Section 1.1
   MSC: Remembering
   OBJ: Illustrate the size or history of the universe with scaled models.

6. Milky Way is the name of
   a. our solar system.
   b. the galaxy in which we live.
   c. the local group of galaxies we are in.
   d. the supercluster of galaxies we are in.

   ANS: B DIF: Easy REF: Section 1.1
   MSC: Understanding
   OBJ: Differentiate the various components of our cosmic address.

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: Section 1.1
   MSC: Applying
   OBJ: Relate astronomical distances with light-travel time.

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8. The time it takes light to cross Neptune's orbit is closest to which of the following?
   a. a second
   b. a quick meal
   c. a night's sleep
   d. the time between presidential elections

   ANS: C DIF: Easy REF: Section 1.1
   MSC: Remembering
   OBJ: Illustrate the size or history of the universe with scaled models.

9. A light-hour is a measure of
   a. time.
   b. distance.
   c. speed.
   d. acceleration.

   ANS: B DIF: Easy REF: Section 1.1
   MSC: Remembering
   OBJ: Define the bold-faced vocabulary terms within the chapter.

10. If one thinks about the distance between Earth and the Moon, 384,400 km, approximately how much of that distance would Saturn and its rings take up?
    a. much more than this distance
    b. less than half this distance
    c. more than half this distance
    d. exactly equal to this distance

    ANS: B DIF: Medium REF: Section 1.1
    MSC: Remembering
    OBJ: Relate the different sizes of, or the different distances between, the components of our cosmic address.

11. The diameter of the Moon is
    a. larger than the distance across the continental United States.
    b. roughly equal to the longest distance across Texas.
    c. more than half the distance across the continental United States.
    d. less than half the distance across the continental United States.

    ANS: C DIF: Medium REF: Section 1.1
    MSC: Remembering
    OBJ: Relate the different sizes of, or the different distances between, the components of our cosmic address.

12. 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
    e. nitrogen and oxygen

    ANS: A DIF: Easy REF: Section 1.1
    MSC: Remembering
    OBJ: Illustrate the size or history of the universe with scaled models.

13. What is the approximate number of stars in the Milky Way?
    a. 10 million
    b. 300 million
    c. 10 billion
    d. 300 billion
    e. 1 trillion

    ANS: D DIF: Medium REF: Section 1.1
    MSC: Remembering
    OBJ: Illustrate the size or history of the universe with scaled models.

14. The Local Group is the environment around
    a. the Earth-Moon system.
    b. the Sun that contains about a dozen stars.
    c. the Sun that contains over a million stars.
    d. the Milky Way that contains a few dozen galaxies.
    e. the Milky Way that contains a few thousand galaxies.

    ANS: D DIF: Medium REF: Section 1.1
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

15. The majority of the mass in our universe is made up of
    a. planets.
    b. stars.
    c. galaxies.
    d. dust.
    e. dark matter.

    ANS: E DIF: Medium REF: Section 1.1
    MSC: Remembering
    OBJ: Relate the different sizes of, or the different distances between, the components of our cosmic address.

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16. The speed of light is approximately
    a. 3,000 km/s.
    b. 30,000 km/s.
    c. 300,000 km/s.
    d. 3 million km/s.
    e. 3 billion km/s.

    ANS: C DIF: Easy REF: Section 1.1
    MSC: Remembering
    OBJ: Relate astronomical distances with light-travel time.

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

    ANS: A DIF: Easy REF: Section 1.1
    MSC: Applying
    OBJ: Relate astronomical distances with light-travel time.

18. One of the nearest stars is Alpha Centauri, whose distance is 4.2×10^{16} m. How long does it take light to travel from Alpha Centauri to us?
    a. 1.25 seconds
    b. 8.3 minutes
    c. 4.4 years
    d. 560 years
    e. 6,200 years

    ANS: C DIF: Medium REF: Section 1.1
    MSC: Applying
    OBJ: Relate astronomical distances with light-travel time.

19. The distance to the nearest large spiral galaxy, the Andromeda Galaxy, is 2.4×10^{22} m. How long does it take light to travel from Andromeda to us?
    a. 4.4 years
    b. 360 years
    c. 1.2 thousand years
    d. 2.5 million years
    e. 4.5 billion years

    ANS: D DIF: Medium REF: Section 1.1
    MSC: Applying
    OBJ: Relate astronomical distances with light-travel time.

20. The distance to the center of the Laniakea cluster of galaxies is 5×10^{23} m. How long does it take light to travel from these galaxies to us?
    a. 7,000 years
    b. 54,000 years
    c. 120,000 years
    d. 12 million years
    e. 54 million years

    ANS: E DIF: Medium REF: Section 1.1
    MSC: Applying
    OBJ: Relate astronomical distances with light-travel time.

21. A light-year is a unit commonly used in astronomy as a measure of
    a. time.
    b. speed.
    c. mass.
    d. distance.
    e. acceleration.

    ANS: D DIF: Medium REF: Section 1.1
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

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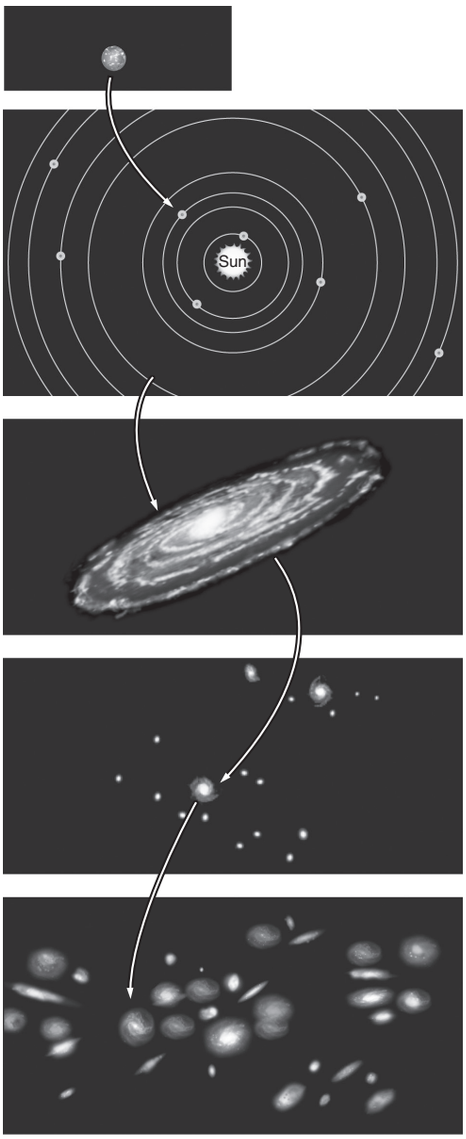
22. According to the figure below, if you were to specify your address in the universe, listing your membership from the smallest to largest physical structures, it would be



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, Laniakea Supercluster, the universe.
d. Earth, Solar System, Milky Way, Laniakea Supercluster, the universe.
e. Earth, Laniakea Supercluster, Milky Way, Solar System, the universe.

ANS: C DIF: Difficult REF: Section 1.1
MSC: Understanding
OBJ: List our cosmic address.

23. Which of the following is *false*?
a. The Local Group is a member of the Laniakea 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 classical planets.
d. The Milky Way Galaxy contains approximately 100 million stars.
e. The Laniakea Supercluster is one of many superclusters in the universe.

ANS: D DIF: Difficult REF: Section 1.1
MSC: Understanding
OBJ: Differentiate the various components of our cosmic address.

24. If the diameter of the Milky Way is approximately 100,000 light-years, then our galaxy is _____ times larger than our Solar System. For reference, Pluto's orbit has an approximate diameter of 80 astronomical units (AU).
a. 100
b. 1,000
c. 10,000
d. 10^6
e. 10^8

ANS: E DIF: Difficult REF: Section 1.1
MSC: Applying
OBJ: Relate the different sizes of, or the different distances between, the components of our cosmic address.

25. The majority of the energy in our universe is
a. radiated by stars from the nuclear fusion going on in their cores.
b. the kinetic energy found in the collisions of galaxies.
c. the gravitational potential energy of superclusters.
d. emitted in radioactive decays of unstable elements.
e. made up of dark energy that permeates space.

ANS: E DIF: Difficult REF: Section 1.1
MSC: Remembering
OBJ: Relate the different sizes of, or the different distances between, the components of our cosmic address.

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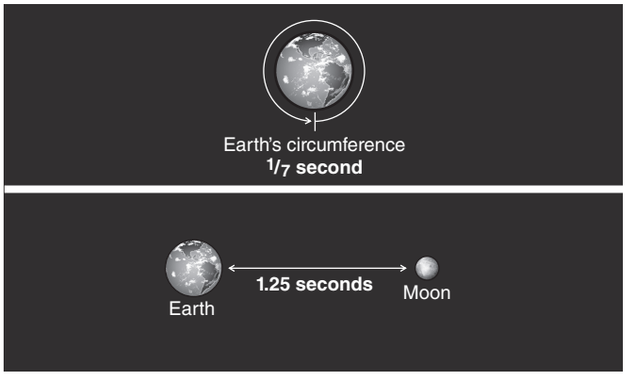
26. After the Sun, the next nearest star to us is approximately _____ away.
    a. 8 light-seconds
    b. 80 light-minutes
    c. 40 light-hours
    d. 4 light-years
    e. 200 light-years

    ANS: D DIF: Medium REF: Section 1.1
    MSC: Remembering
    OBJ: Relate astronomical distances with light-travel time.

27. The figure below measures distances in the amount of time it takes light to travel. If the circumference of Earth is a snap of your fingers (1/7 second), 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 length of the work day.
    d. the time you spent in high school.
    e. a human lifetime.

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

28. If you compared the diameter of Earth, which is 13,000 km, to 1 second, then what unit of time would be equivalent to the size of the Milky Way, whose diameter is 10^{21} m, and what significant milestone would this time correspond to in our evolution?
    a. 2 million years, the length of time humans have existed on Earth
    b. 30,000 years, the length of time humans have lived in North America
    c. 400 years, the length of time humans have been exploring the skies with telescopes
    d. 4 billion years, the age of the Solar System
    e. 14 billion years, the age of the universe

    ANS: A DIF: Difficult REF: Section 1.1
    MSC: Applying
    OBJ: Relate astronomical distances with light-travel time.

29. _____ is the idea that the simplest explanation for a phenomenon is usually the correct one.
    a. Newton's hypothesis
    b. Occam's razor
    c. Aristotle's test
    d. Einstein's excuse
    e. The Copernican principle

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

30. A scientific theory can be shown to be wrong if
    a. cultural beliefs evolve to contradict it.
    b. scientists gather new data that contradict its predictions.
    c. it cannot explain all phenomena.
    d. it was first proposed as a conjecture.
    e. a majority of people do not accept it.

    ANS: B DIF: Easy REF: Section 1.2
    MSC: Understanding
    OBJ: Establish why all scientific knowledge is provisional.

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31. Albert Einstein is best known for his revolutionary theory of
    a. relativity.
    b. quantum mechanics.
    c. astronomy.
    d. electricity.
    e. mathematics.

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

32. In science an idea that cannot be tested is
    a. a hypothesis.
    b. not a scientific idea.
    c. a theory.
    d. a principle.

    ANS: B DIF: Easy REF: Section 1.2
    MSC: Remembering
    OBJ: Compare an *idea* with a *hypothesis.*

33. A theory is
    a. tied to known physical laws.
    b. able to make testable predictions.
    c. a hypothesis that has withstood many attempts to falsify it.
    d. all of the above

    ANS: D DIF: Easy REF: Section 1.2
    MSC: Remembering
    OBJ: Compare the everyday and scientific meanings of *theory*.

34. A hypothesis is an idea that is
    a. falsifiable with current technology only.
    b. potentially falsifiable with future technology.
    c. not falsifiable.
    d. both a and b

    ANS: D DIF: Easy REF: Section 1.2
    MSC: Understanding
    OBJ: Compare an *idea* with a *hypothesis.*

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

    ANS: A DIF: Easy REF: Section 1.2
    MSC: Remembering
    OBJ: Compare the everyday and scientific meanings of *theory*.

36. A theoretical model is
    a. a made-up explanation.
    b. a detailed description in terms of known physical laws or theories.
    c. a testable assumption.
    d. a scientific law.

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

37. A scientific principle is
    a. a scientific law.
    b. a detailed description in terms of known physical laws or theories.
    c. a general idea or sense about the universe.
    d. a testable statement.

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

38. In the scientific method, if an observation does not support the hypothesis, what possible actions should happen next?
    a. Make additional predictions.
    b. Make more observations.
    c. Choose a new hypothesis or revise the current one.
    d. Both b and c

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

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39. Which of the following is *false*?
    a. A scientific theory is an undisputed fact.
    b. If continual testing of a hypothesis shows it to be valid, it may become an accepted theory.
    c. A hypothesis must always have one or more testable predictions.
    d. A scientific theory may eventually be proven wrong when scientists acquire new data.
    e. Scientific observations are used to test a hypothesis.

    ANS: A DIF: Medium REF: Section 1.2
    MSC: Analyzing
    OBJ: Compare the everyday and scientific meanings of *theory*.

40. The scientific method is a process by which scientists
    a. prove theories to be known facts.
    b. gain confidence in theories by failing to prove them wrong.
    c. show all theories to be wrong.
    d. test the ideas of Aristotle.
    e. survey what the majority of people think about a theory.

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

41. A _____ becomes a _____ when repeated testing of its predictions does not disprove it.
    a. hypothesis; scientific method
    b. theory; scientific revolution
    c. phenomenon; theory
    d. hypothesis; theory
    e. law; theory

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

42. The cosmological principle states that
    a. the universe is expanding in all directions at the same rate.
    b. a unique center of the universe exists.
    c. the universe looks the same everywhere and in all directions as long as you look on large enough spatial scales.
    d. physical laws change from place to place in the universe.
    e. the universe is in a "steady state."

    ANS: C DIF: Medium REF: Section 1.2
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

43. Because of _____, we can conclude that gravity works the same way on Earth as it does on Mars.
    a. Newton's theory of relativity
    b. Einstein's special theory of relativity
    c. Sagan's planetary principle
    d. the cosmological principle
    e. the hypothetical statute

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

44. If you have a stuffy nose, a fever, chills, and body aches and a doctor treats you for the flu rather than four separate diseases that account for each of your symptoms, this is an application of
    a. Newton's hypothesis
    b. Occam's razor
    c. Aristotle's test
    d. Einstein's relativity
    e. Copernican principle

    ANS: B DIF: Difficult REF: Section 1.2
    MSC: Applying
    OBJ: Define the bold-faced vocabulary terms within the chapter.

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45. One of the central assumptions in astronomy is that the physical laws of nature
    a. change when objects move at high speed.
    b. 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: Medium REF: Section 1.2
    MSC: Remembering
    OBJ: Assess whether a given idea or explanation is scientific.

46. 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: Section 1.2
    MSC: Applying
    OBJ: Assess whether a given idea or explanation is scientific.

47. The language of science is
    a. Greek
    b. mathematics
    c. calculus
    d. Java
    e. Latin

    ANS: B DIF: Easy REF: Section 1.3
    MSC: Remembering
    OBJ: Identify patterns in nature.

48. When you see a pattern in nature, it is usually evidence of
    a. a theory being displayed.
    b. quantum mechanics in action.
    c. a breakdown of random clustering.
    d. an underlying physical law.
    e. A decrease in entropy.

    ANS: D DIF: Easy REF: Section 1.3
    MSC: Understanding
    OBJ: Identify patterns in nature.

49. Scientific notation is used in astronomy primarily because it 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. change hard calculations into easy calculations.
    e. explain science to engineers.

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

50. Which is an important element in the composition of your body that was produced by nuclear fusion inside a star or an explosion of a star?
    a. iron
    b. calcium
    c. oxygen
    d. carbon
    e. all of the above

    ANS: E DIF: Easy REF: Section 1.3
    MSC: Remembering
    OBJ: Summarize the evidence for the statement "We are actually made of recycled stardust."

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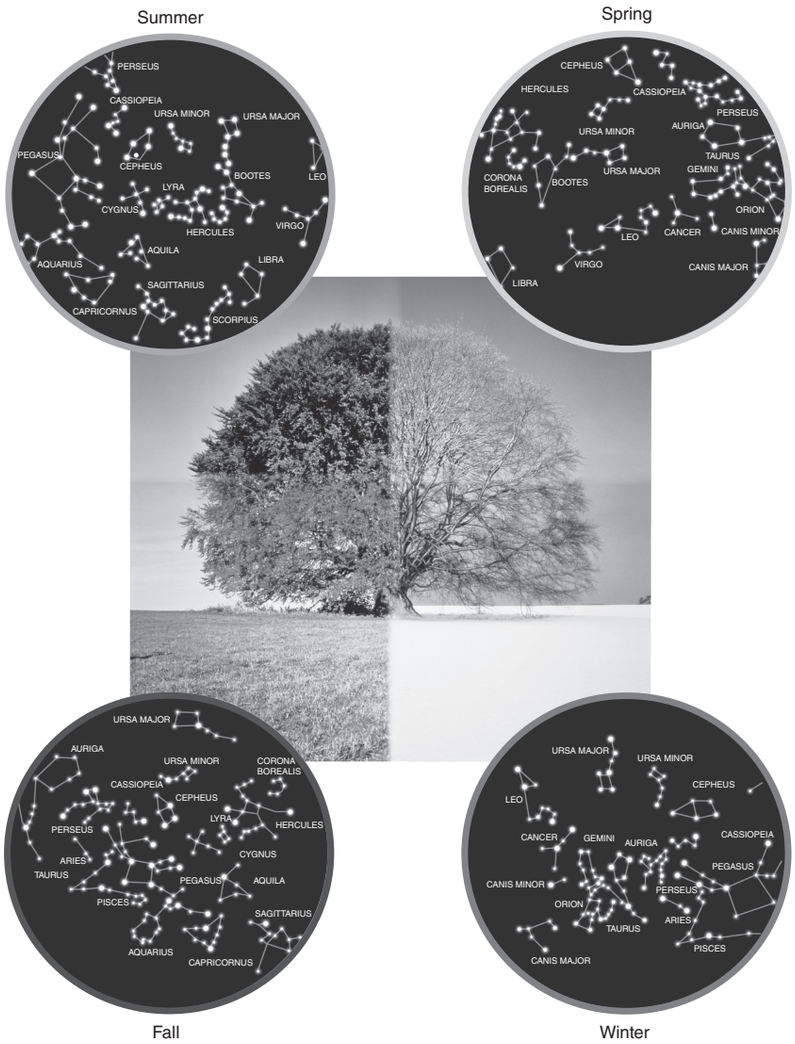
51. The figure below shows the night sky as it appears for an observer in the United States at the same time of the night but at four different seasons of the year. Which conclusion below is *not* reasonable based on these observations?



a. Constellations do not change their location relative to one another, but which constellations appear in the night sky does change from season to season.
b. There are some constellations such as Ursa Minor, Ursa Major, Cassiopeia, and Cephus that are always seen in the night sky.
c. Some constellations such as Capricornus and Sagittarius are only visible during summer and fall.
d. A good time to harvest crops would be when the constellation Pegasus is directly overhead.
e. A good time to plant crops would be when the constellation Sagittarius is directly overhead.

ANS: E DIF: Medium REF: Section 1.3
MSC: Applying
OBJ: Identify patterns in nature.

52. Which presently observed element or isotope was *not* produced in appreciable amounts in the very early universe shortly after the Big Bang?
a. hydrogen
b. helium-4
c. deuterium
d. carbon
e. helium-3

ANS: D DIF: Medium REF: Section 1.3
MSC: Applying
OBJ: Summarize the evidence for the statement "We are actually made of recycled stardust."

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53. The study of whether or not life exists elsewhere in the Solar System and beyond is called
    a. origins.
    b. biochemistry.
    c. cosmology.
    d. astrobiology.
    e. exoplanetology.

    ANS: D DIF: Medium REF: Section 1.3
    MSC: Remembering
    OBJ: Identify fields of science that relate to the study of origins.

54. The most massive elements such as those that make up terrestrial 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.
    e. during the formation of the Solar System.

    ANS: B DIF: Medium REF: Section 1.3
    MSC: Remembering
    OBJ: Summarize the evidence for the statement "We are actually made of recycled stardust."

55. The number 123,000 written in scientific notation is
    a. 1.23×10^{6}
    b. 1.23×10^{5}
    c. 1.23×10^{3}
    d. 1.23×10^{-6}
    e. 1.23×10^{3}

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

56. If the radius of circle *B* is twice the radius of circle *A*, and the area of a circle is proportional to the radius squared ($A \propto r^2$), then the ratio of the area of circle *B* to that of circle *A* is
    a. 4.
    b. 0.5.
    c. 0.25.
    d. 2.
    e. 1.414.

    ANS: A DIF: Easy REF: Working It Out 1.1
    MSC: Applying
    OBJ: Describe characteristics of real-world objects in terms of ratios.

57. $(6 \times 10^{5}) \times (3 \times 10^{-2}) =$
    a. 1.8×10^{3}
    b. 1.8×10^{4}
    c. 1.8×10^{6}
    d. 1.8×10^{8}
    e. 1.8×10^{-3}

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

58. $(1.2 \times 10^{9}) \div (4 \times 10^{-3}) =$
    a. 3×10^{6}
    b. 3×10^{5}
    c. 3×10^{10}
    d. 3×10^{11}
    e. 3×10^{12}

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

59. If the radius of circle *B* is 5 times the radius of circle *A*, then the ratio of the area of circle *B* to that of circle *A* is
    a. 25.
    b. 5.
    c. 0.2.
    d. 0.04.
    e. 0.025.

    ANS: A DIF: Medium REF: Working It Out 1.1
    MSC: Applying
    OBJ: Describe characteristics of real-world objects in terms of ratios.

60. If the radius of sphere *B* is 5 times the radius of sphere *A*, then the ratio of the volume of sphere *B* to the volume of sphere *A* is
    a. 0.008.
    b. 0.2.
    c. 5.
    d. 25.
    e. 125.

    ANS: E DIF: Medium REF: Working It Out 1.1
    MSC: Applying
    OBJ: Describe characteristics of real-world objects in terms of ratios.

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61. The area of a circle is related to its diameter by the formula $A = \frac{1}{4}\pi D^2$. Using algebra to solve for D, we find that

a. $D = \left(\frac{4A}{\pi}\right)^2$.

b. $D = \left(\frac{\pi}{4A}\right)^2$.

c. $D = \left(\frac{\pi}{4A}\right)^{1/2}$.

d. $D = \left(\frac{4A}{\pi}\right)^{1/2}$.

e. $D = \left(\frac{4A}{\pi}\right)$.

ANS: D DIF: Medium REF: Working It Out 1.1
MSC: Applying
OBJ: Determine the mathematical behavior of proportional systems.

62. The volume of a sphere is related to its radius by the formula $V = \frac{4}{3}\pi R^3$. Using algebra to solve for R, we get

a. $R = \left(\frac{4\pi V}{3}\right)^{1/3}$.

b. $R = \left(\frac{3V}{4(\pi)}\right)^{1/3}$.

c. $R = \left(\frac{4\pi}{3V}\right)^{1/3}$.

d. $R = \frac{3}{4(V)^3}$.

e. $R = \left(\frac{4\pi V}{3}\right)^3$.

ANS: B DIF: Difficult REF: Working It Out 1.1
MSC: Applying
OBJ: Determine the mathematical behavior of proportional systems.

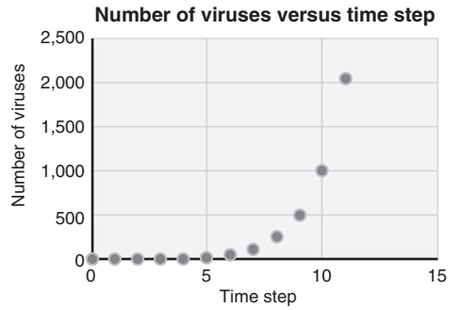
63. If the speed of light is 3×10^5 km/s and 1 km = 0.62 mile, what is the speed of light in miles per hour (mph)?
a. 670 million mph
b. 670 thousand mph
c. 186 mph
d. 186 thousand mph
e. 3.2 billion mph

ANS: A DIF: Difficult REF: Working It Out 1.1
MSC: Applying
OBJ: Determine the mathematical behavior of proportional systems.

64. The orbital period of Mercury is 88 days. What is its orbital period in units of seconds?
a. 76000 seconds
b. 7.6 million seconds
c. 7.6 billion seconds
d. 760 billion seconds
e. 76 million seconds

ANS: B DIF: Difficult REF: Working It Out 1.1
MSC: Applying
OBJ: Determine the mathematical behavior of proportional systems.

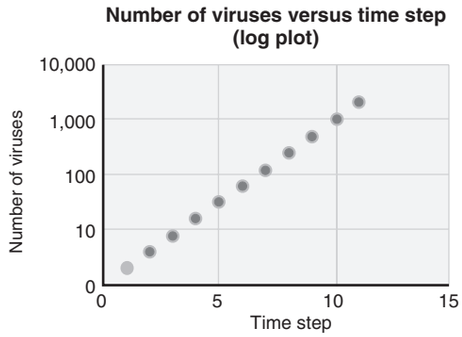
65. At a time step of 10 shown in the figure below, how many viruses are there?



a. 500
b. 1000
c. 1500
d. 2000

ANS: B DIF: Easy REF: Working It Out 1.2
MSC: Understanding
OBJ: Read data from linear and logarithmic graphs.

66. Approximately how many viruses are at time step 5 in the figure below?



a. 10
b. 30
c. 50
d. 90
e. 100

ANS: C DIF: Difficult REF: Working It Out 1.2
MSC: Understanding
OBJ: Read data from linear and logarithmic graphs.

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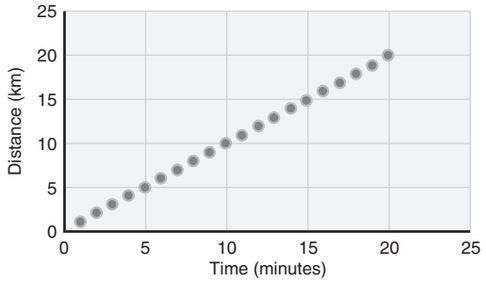
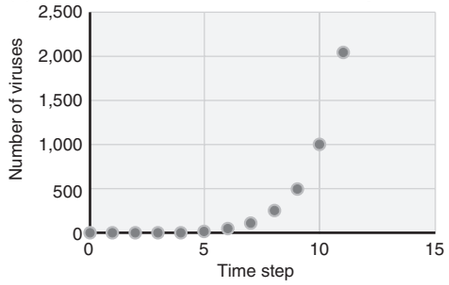
67. Which graph (a), (b), or (c) in the figures below is a plot of an exponential behavior?

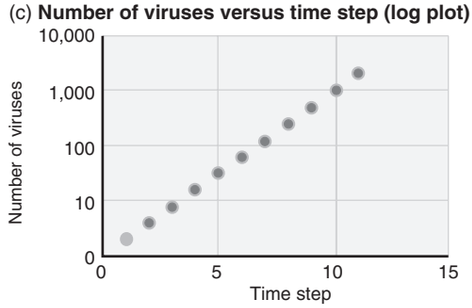
(a) **Distance versus time for a car**



(b) **Number of viruses versus time step**



(c) **Number of viruses versus time step (log plot)**



a. figure (a)
b. figure (b)
c. figure (c)
d. both a and c
e. both b and c

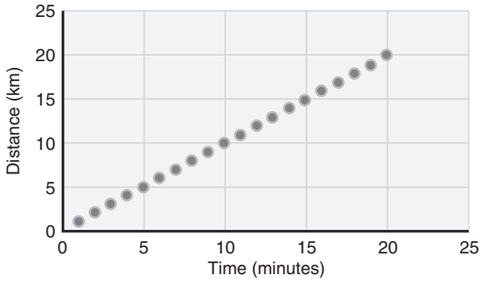
ANS: E DIF: Medium REF: Working It Out 1.2
MSC: Understanding
OBJ: Distinguish between linear and exponential curves on a graph.

68. The number 1.5×10^4 is:
a. 0.00015
b. 0.0015
c. 1500
d. 15000
e. 150000

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

69. What are the units of the vertical axis?

(a) **Distance versus time for a car**

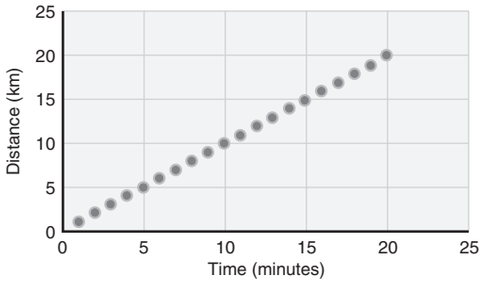


a. km
b. hour
c. km/hour
d. hour/km

ANS: B DIF: Easy REF: Working It Out 1.2
MSC: Understanding
OBJ: Identify the x and y axes on a graph.

70. What is the slope of line?

(a) **Distance versus time for a car**



a. 1 km/hour
b. 1 hour/km
c. 10 km/hour
d. 10 hour/km

ANS: D DIF: Easy REF: Working It Out 1.2
MSC: Understanding
OBJ: Define slope on a graph.

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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: Section 1.1 MSC: Remembering
   OBJ: Differentiate the various components of our cosmic address.

2. 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: Section 1.1 MSC: Remembering
   OBJ: Relate astronomical distances with light-travel time.

3. 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: Section 1.1 MSC: Remembering
   OBJ: Differentiate the various components of our cosmic address.

4. 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: Section 1.1
   MSC: Understanding
   OBJ: Relate astronomical distances with light-travel time.

5. Suppose you were writing to a pen pal in another 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, Solar System, Milky Way, Local Group, Laniakea Supercluster, the universe.
   DIF: Medium REF: Section 1.1
   MSC: Remembering
   OBJ: List our cosmic address.

6. What would you say to someone who said, "It would take light-years to get to the Andromeda Galaxy"?

   ANS: You would have to tell them that light-years is a unit of distance not time.
   DIF: Medium REF: Section 1.1 MSC: Applying
   OBJ: Relate astronomical distances with light-travel time.

7. If you compare the diameter of Earth to 1 minute of time, then what interval of time would represent the diameter of the Solar System? Assume the diameter of the Solar System is approximately 80 AU.

   ANS: The diameter of Earth is $2 \times 6{,}378$ km $= 1.3 \times 10^7$ m, and 80 AU $= 80 \times 1.5 \times 10^{11}$ m $= 1.2 \times 10^{13}$ m. Thus, the diameter of the Solar System would be represented by 1.2×10^{13} m $\times$ (1 minute)/$(1.3 \times 10^7$ m$) = 9.4 \times 10^5$ minutes $= 1.8$ years.
   DIF: Difficult REF: Section 1.1 MSC: Analyzing
   OBJ: Illustrate the size or history of the universe with scaled models.

8. Using the method of comparing times to get a handle on the large distances in astronomy, compare the size of Earth to the size of the visible universe. Start by making the size of Earth comparable to a snap of your fingers, which lasts about 1/7 second. Show your computation.

   ANS: If the size of Earth is like a snap of your fingers (1/7 second), the size of the visible universe would be 13.7 billion years $\approx 3 \times 4.5$ billion years $= 3$ times the age of the Solar System.
   DIF: Medium REF: Section 1.1 MSC: Analyzing
   OBJ: Illustrate the size or history of the universe with scaled models.

9. Using the method of comparing distances to time intervals to get a handle on the large distances in astronomy, compare the diameter of our Solar System, which is 6×10^{12}, to the diameter of the galaxy, which is 1.2×10^{21}, by calculating the time it would take for light to travel these diameters. For reference, the speed of light is 3×10^8 m/s.

   ANS: The time it takes light to travel across the diameter of the Solar System is t 5 d/v 5 6 3 1012 m/(3 3 108 m/s) 5 20,000 s 3 (1 h/3600 s) 5 5.5 h. The time it takes light to travel across the diameter of the galaxy is t 5 1.2 3 1021 m/(3 3 108 m/s) 5 4 3 1012 s 3 (1 h/3600 s) 3 (1 day/24 h) 3 (1 y/365 day) 5 130,000 y.
   DIF: Difficult REF: Section 1.1 MSC: Analyzing
   OBJ: Illustrate the size or history of the universe with scaled models.

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10. What implication does the finite speed of light have on what we observe in the universe?

    ANS: It means we see objects as they were when the light left them. Looking further away from Earth is also looking further back in time.
    DIF: Difficult REF: Section 1.1 MSC: Applying
    OBJ: Relate astronomical distances with light-travel time.

11. 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, and (2) the physical laws valid on Earth are valid everywhere.
    DIF: Easy REF: Section 1.2
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

12. What makes an idea a hypothesis?

    ANS: A hypothesis must be a falsifiable idea.
    DIF: Easy REF: Section 1.2
    MSC: Remembering
    OBJ: Compare an *idea* with a *hypothesis*.

13. Why is the statement "The Big Bang was caused by a collision between other universes" not scientific?

    ANS: The statement is not scientific because it is not testable.
    DIF: Easy REF: Section 1.2
    MSC: Applying
    OBJ: Assess whether a given idea or explanation is scientific.

14. An observation does not support your hypothesis. What do you do next?

    ANS: Make more observations, revise the hypothesis, or choose a new hypothesis.
    DIF: Easy REF: Section 1.2
    MSC: Understanding
    OBJ: Describe the steps of the scientific method.

15. Before 2014 the supercluster we resided in was called the Virgo Supercluster. Based on a new way of classifying superclusters we are now a member of the Laniakea Supercluster. What is this change an example of?

    ANS: The provisional nature of scientific knowledge.
    DIF: Easy REF: Section 1.2
    MSC: Understanding
    OBJ: Establish why all scientific knowledge is provisional.

16. What accounts for 95 percent of the mass of the universe?

    ANS: Dark matter and dark energy, the latter having an equivalent mass are related by $E = mc^2$.
    DIF: Easy REF: Section 1.1
    MSC: Remembering
    OBJ: Relate the different sizes of, or the different distances between, the components of our cosmic address.

17. What is a theoretical model?

    ANS: A theoretical model is a detailed description of the properties of a particular system in terms of known physical laws or theories, which can be used to make predictions.
    DIF: Easy REF: Section 1.2
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

18. 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: Section 1.2 MSC: Applying
    OBJ: Define the bold-faced vocabulary terms within the chapter.

19. 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: Section 1.2
    MSC: Remembering
    OBJ: Establish why all scientific knowledge is provisional.

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

    ANS: First you make a hypothesis and then you make a prediction based on your hypothesis. Finally, you test your prediction through experimentation to prove or disprove your original hypothesis. You revise your hypothesis, if necessary, when the experiments disagree with your hypothesis.
    DIF: Medium REF: Section 1.2
    MSC: Understanding
    OBJ: Describe the steps of the scientific method.

21. What two pre-Renaissance beliefs are contradicted by the cosmological principle?

    ANS: (1) Earth is at the center of our universe, and (2) celestial objects are made of a different substance than Earth and obey different rules.
    DIF: Medium REF: Section 1.2
    MSC: Remembering
    OBJ: Establish why all scientific knowledge is provisional.

22. Describe two ways in which Einstein's new theories changed commonly accepted scientific views of his time.

    ANS: Mass and energy are manifestations of the same phenomenon. Thus, you can convert one into the other. Time and space are not separable but are intimately related to one another. Thus, Newton's law of gravity is only a special case of a more general law Einstein called general relativity. However, Newton's law of gravity is much easier for most calculations in our day-to-day lives.
    DIF: Medium REF: Section 1.2
    MSC: Understanding
    OBJ: Establish why all scientific knowledge is provisional.

23. How would you respond to someone who stated that "Evolution is not proven; it is just a theory"?

    ANS: You would need to explain that in science, a theory is not something that is proven; rather it our best explanation based on available data. Thus, calling something a theory does not diminish its importance.
    DIF: Difficult REF: Section 1.2 MSC: Applying
    OBJ: Compare the everyday and scientific meanings of *theory*.

24. There are many different areas of science, but a common factor in each is the evaluation and analysis of patterns. What patterns does astronomy deal with? (Describe it in general and give at least one concrete example.)

    ANS: Astronomy deals with patterns related to celestial objects. One example is that patterns in the sky mark the changing of seasons, the coming of rains, the movement of herds, and the planting and harvesting of crops. An additional example is that the Sun rises and sets at a specific time because Earth orbits the Sun.
    DIF: Easy REF: Section 1.3
    MSC: Understanding
    OBJ: Identify patterns in nature.

25. An observed pattern in nature is usually a sign of some underlying physical reason. Give an example of this in astronomy, citing the pattern and the reason behind it.

    ANS: The Sun rises and sets each day. This pattern is due to Earth's daily rotation on its axis. The stars visible in the sky at a given time of day change throughout the year, but the pattern repeats every year. This is due to Earth's orbital motion around the Sun in 1 year.
    DIF: Easy REF: Section 1.3 MSC: Applying
    OBJ: Identify patterns in nature.

26. It is often said that "mathematics is the language of science." Explain why this is true.

    ANS: Math is a formal system used when describing and analyzing patterns, and explaining the reasons for patterns is the heart of science. Thus, math is the language of science.
    DIF: Easy REF: Section 1.3
    MSC: Understanding
    OBJ: Identify patterns in nature.

27. 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: Section 1.3 MSC: Applying
    OBJ: Summarize the evidence for the statement "We are actually made of recycled stardust."

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28. What is the field of science that relates to the study of origin of life?

    ANS: Astrobiology. DIF: Easy REF: Section 1.3
    MSC: Remembering
    OBJ: Identify fields of science that relate to the study of origins.

29. Describe briefly why the phrase "we are stardust" is literally true.

    ANS: Massive stars make heavy elements during their lifetime. 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 condense to form new solar systems and everything in them, including us.
    DIF: Medium REF: Section 1.3
    MSC: Understanding
    OBJ: Summarize the evidence for the statement "We are actually made of recycled stardust."

30. Life as we know it requires the heavy elements made in stars. Could life as we know it have existed when the first stars in the universe formed?

    ANS: The heavy elements that make up our bodies were not yet formed, so life as we know it would have been impossible.
    DIF: Difficult REF: Section 1.3
    MSC: Understanding
    OBJ: Summarize the evidence for the statement "We are actually made of recycled stardust."

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Chapter 2: Patterns in the Sky—Motions of Earth and the Moon

LEARNING OBJECTIVES

Define the bold-faced vocabulary terms within the chapter.
Multiple Choice: 1, 3, 4, 5, 6, 10, 26, 44, 50, 64, 69
Short Answer: 16, 22

2.1 Earth Spins on Its Axis

Identify the locations of the north celestial pole, south celestial pole, celestial equator, zenith, meridian, and horizon on the celestial sphere.
Multiple Choice: 2, 8, 14
Short Answer: 3, 4

Show the path that a star follows on the sky, from the time it rises until it sets.
Multiple Choice: 9, 15, 16
Short Answer: 1

Illustrate how the motion and visibility of stars change with the one's location on Earth.
Multiple Choice: 33, 34
Short Answer: 2, 5, 7

Demonstrate how knowledge of the sky permits one to know latitude and direction on Earth.
Multiple Choice: 7, 11, 12, 13
Short Answer: 6

Illustrate how one event will look in two different frames of reference.
Short Answer: 8

2.2 Revolution around the Sun Leads to Changes during the Year

Identify the path of the ecliptic, the solstices, and the equinoxes on the celestial sphere.
Multiple Choice: 17, 19
Short Answer: 10, 11, 12, 15

Relate Earth's position around the Sun to the zodiacal constellations we observe in the night-time sky.
Multiple Choice: 18, 36, 37, 38, 39, 40, 41

Explain why Earth's axial tilt causes seasons.
Multiple Choice: 20, 21, 24, 25, 29, 30, 31, 35, 42
Short Answer: 9, 13

Illustrate how the height of the Sun and the length of a day vary with the season and your latitude.
Multiple Choice: 22, 23, 27, 28, 32
Short Answer: 14

2.3 The Moon's Appearance Changes as It Orbits Earth

Define the phases of the moon.
Multiple Choice: 45
Short Answer: 18

Explain what causes us to observe moon phases.
Multiple Choice: 47, 48, 49, 52
Short Answer: 17, 20

Illustrate the Sun-Moon-Earth geometry needed to produce each Moon phase.
Multiple Choice: 43, 46, 51, 53, 54
Short Answer: 19, 21

2.4 Calendars Are Based on the Day, Month, and Year

Compare and contrast solar and lunar calendars.
Multiple Choice: 58
Short Answer: 23, 24

Illustrate the need for our current pattern of leap years.
Multiple Choice: 55, 56, 57

2.5 Eclipses Result from the Alignment of Earth, Moon, and the Sun

Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.
Multiple Choice: 59, 60, 61, 62, 68, 70
Short Answer: 25, 26, 28

Relate the geometry of solar and lunar eclipses to their visibility across Earth.
Multiple Choice: 63, 65, 66, 67
Short Answer: 27, 29

Working It Out 2.1

Use proportional reasoning to estimate a characteristic of the whole based on measurement of a part.
Short Answer: 30

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MULTIPLE CHOICE

1. There are _____ constellations in the entire sky.
   a. 12
   b. 13
   c. 88
   d. hundreds of
   e. thousands of

   ANS: C DIF: Easy REF: Section 2.1
   MSC: Remembering
   OBJ: Define the bold-faced vocabulary terms within the chapter.

2. What defines the location of the equator on Earth?
   a. the axis around which Earth rotates
   b. where the ground is the warmest
   c. the tilt of Earth's rotational axis relative to its orbit around the Sun
   d. the orbit of Earth around the Sun
   e. all of the above

   ANS: A DIF: Easy REF: Section 2.1
   MSC: Remembering
   OBJ: Identify the locations of the north celestial pole, south celestial pole, celestial equator, zenith, meridian, and horizon on the celestial sphere.

3. Circumpolar stars are stars that are
   a. always below the horizon.
   b. always on the celestial equator.
   c. always at the north celestial pole.
   d. sometimes above the horizon.
   e. always above the horizon.

   ANS: E DIF: Easy REF: Section 2.1
   MSC: Remembering
   OBJ: Define the bold-faced vocabulary terms within the chapter.

4. The point directly below your feet is called the
   a. meridian.
   b. celestial pole.
   c. nadir.
   d. circumpolar plane.
   e. zenith.

   ANS: C DIF: Medium REF: Section 2.1
   MSC: Remembering
   OBJ: Define the bold-faced vocabulary terms within the chapter.

5. Declination is a measure of a star's location relative to
   a. zenith.
   b. ecliptic.
   c. nadir.
   d. celestial equator.
   e. line of nodes.

   ANS: D DIF: Medium REF: Section 2.1
   MSC: Remembering
   OBJ: Define the bold-faced vocabulary terms within the chapter.

6. Right ascension is a measure of a star's location on the celestial sphere that is most closely similar to which measurement of location on Earth?
   a. meters
   b. longitude
   c. latitude
   d. degrees
   e. radians

   ANS: B DIF: Medium REF: Section 2.1
   MSC: Remembering
   OBJ: Define the bold-faced vocabulary terms within the chapter.

7. If the star Polaris has an altitude of 35°, then we know that
   a. our longitude is +55°.
   b. our latitude is +55°.
   c. our longitude is −35°.
   d. our longitude is +35°.
   e. our latitude is +35°.

   ANS: E DIF: Easy REF: Section 2.1
   MSC: Applying
   OBJ: Demonstrate how knowledge of the sky permits one to know latitude and direction on Earth.

8. The direction directly overhead of an observer defines his or her
   a. meridian.
   b. celestial pole.
   c. nadir.
   d. circumpolar plane.
   e. zenith.

   ANS: E DIF: Easy REF: Section 2.1
   MSC: Remembering
   OBJ: Identify the locations of the north celestial pole, south celestial pole, celestial equator, zenith, meridian, and horizon on the celestial sphere.

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9. No matter where you are on Earth, stars appear to rotate about a point called the
   a. zenith.
   b. celestial pole.
   c. nadir.
   d. meridian.
   e. equinox.

   ANS: B DIF: Easy REF: Section 2.1
   MSC: Remembering
   OBJ: Show the path that a star follows on the sky, from the time it rises until it sets.

10. The apparent path of the Sun across the celestial sphere over the course of a year is called the
    a. prime meridian.
    b. ecliptic.
    c. circumpolar plane.
    d. celestial equator.
    e. eclipse.

    ANS: B DIF: Easy REF: Section 2.1
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

11. At a latitude of +50°, how far above the horizon is the north celestial pole located?
    a. 0°
    b. 40°
    c. 50°
    d. 90°
    e. It is not visible at that latitude.

    ANS: C DIF: Medium REF: Section 2.1
    MSC: Applying
    OBJ: Demonstrate how knowledge of the sky permits one to know latitude and direction on Earth.

12. At what latitude is the north celestial pole located at your zenith?
    a. 0°
    b. +30°
    c. +60°
    d. +90°
    e. This occurs at every latitude.

    ANS: D DIF: Medium REF: Section 2.1
    MSC: Applying
    OBJ: Demonstrate how knowledge of the sky permits one to know latitude and direction on Earth.

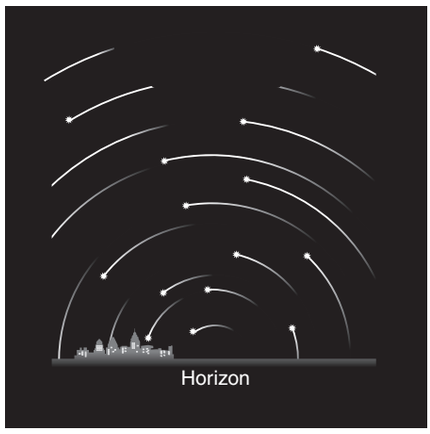
13. At what latitude is the north celestial pole at your horizon?
    a. 0°
    b. +30°
    c. +60°
    d. +90°
    e. This can never happen.

    ANS: A DIF: Medium REF: Section 2.1
    MSC: Applying
    OBJ: Demonstrate how knowledge of the sky permits one to know latitude and direction on Earth.

14. The meridian is defined as an imaginary circle on the sky on which lie the
    a. celestial equator and vernal equinox.
    b. north and south celestial poles.
    c. zenith and the north and south celestial poles.
    d. zenith and east and west directions.
    e. celestial equator and summer solstice.

    ANS: C DIF: Medium REF: Section 2.1
    MSC: Remembering
    OBJ: Identify the locations of the north celestial pole, south celestial pole, celestial equator, zenith, meridian, and horizon on the celestial sphere.

15. A friend takes a time-lapse picture of the sky, as shown in the figure below. What direction must your friend have been facing when the picture was taken?



    a. north
    b. east
    c. south
    d. west
    e. directly overhead

    ANS: A DIF: Medium REF: Section 2.1
    MSC: Applying
    OBJ: Show the path that a star follows on the sky, from the time it rises until it sets.

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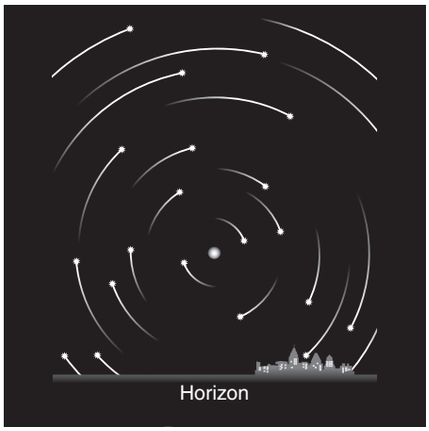
16. A friend takes a time-lapse picture of the sky, as shown in the figure below. What direction must your friend have been facing when the picture was taken?



a. north
b. east
c. south
d. west
e. directly overhead

ANS: C DIF: Medium REF: Section 2.1
MSC: Applying
OBJ: Show the path that a star follows on the sky, from the time it rises until it sets.

17. How far away on average is Earth from the Sun?
a. 1 light-second
b. 1 light-minute
c. 1 astronomical unit
d. 1 light-hour
e. 1 light-year

ANS: C DIF: Easy REF: Section 2.2
MSC: Remembering
OBJ: Identify the path of the ecliptic, the solstices, and the equinoxes on the celestial sphere.

18. If you go out at exactly 9 P.M. each evening over the course of 1 month, the position of a given star will move westward by tens of degrees. What causes this motion?
a. Earth's rotation on its axis
b. the revolution of Earth around the Sun
c. the revolution of the Moon around Earth
d. the revolution of the Sun around Earth
e. the speed of the star through space

ANS: B DIF: Easy REF: Section 2.2
MSC: Applying
OBJ: Relate Earth's position around the Sun to the zodiacal constellations we observe in the night-time sky.

19. The ecliptic is defined by the motion of _____ in the sky.
a. the Moon
b. the Sun
c. the planets
d. Polaris
e. the stars

ANS: B DIF: Easy REF: Section 2.2
MSC: Remembering
OBJ: Identify the path of the ecliptic, the solstices, and the equinoxes on the celestial sphere.

20. When the northern hemisphere experiences fall, the southern hemisphere experiences
a. spring.
b. summer.
c. fall.
d. winter.

ANS: A DIF: Easy REF: Section 2.2
MSC: Applying
OBJ: Explain why Earth's axial tilt causes seasons.

21. When the northern hemisphere experiences summer, the southern hemisphere experiences
a. spring.
b. summer.
c. fall.
d. winter.

ANS: D DIF: Easy REF: Section 2.2
MSC: Applying
OBJ: Explain why Earth's axial tilt causes seasons.

22. The day with the smallest number of daylight hours over the course of the year for a person living in the *northern* hemisphere is the
a. summer solstice (June 1)
b. vernal equinox (March 21)
c. winter solstice (Dec. 22)
d. autumnal equinox (Sept. 23)
e. The number of daylight hours is always the same.

ANS: C DIF: Easy REF: Section 2.2
MSC: Applying
OBJ: Illustrate how the height of the Sun and the length of a day vary with the season and your latitude.

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23. On which day of the year does the Sun reach its northernmost point in the sky?
    a. vernal equinox
    b. summer solstice
    c. autumnal equinox
    d. winter solstice
    e. The sun always reaches the same altitude.

    ANS: B DIF: Easy REF: Section 2.2
    MSC: Remembering
    OBJ: Illustrate how the height of the Sun and the length of a day vary with the season and your latitude.

24. Earth's rotational axis precesses in space and completes one revolution every
    a. 200 years.
    b. 1,800 years.
    c. 7,300 years.
    d. 26,000 years.
    e. 51,000 years.

    ANS: D DIF: Easy REF: Section 2.2
    MSC: Remembering
    OBJ: Explain why Earth's axial tilt causes seasons.

25. Which of the following stars will be the North Star in 12,000 years?
    a. Polaris
    b. Deneb
    c. Vega
    d. Thuban
    e. Sirius

    ANS: C DIF: Medium REF: Section 2.2
    MSC: Remembering
    OBJ: Explain why Earth's axial tilt causes seasons.

26. The latitude of the Antarctic Circle is
    a. 23.5° N.
    b. 66.5° N.
    c. 23.5° S.
    d. 66.5° S.
    e. 90° S.

    ANS: D DIF: Medium REF: Section 2.2
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

27. During summer above the Arctic circle
    a. the Moon cannot be seen.
    b. the Sun can always be seen.
    c. the Sun cannot be seen.
    d. the Sun is always in the southern part of the sky.
    e. the Sun is always directly overhead.

    ANS: B DIF: Medium REF: Section 2.2
    MSC: Understanding
    OBJ: Illustrate how the height of the Sun and the length of a day vary with the season and your latitude.

28. The day with the smallest number of daylight hours over the course of the year for a person living in the *southern* hemisphere is the
    a. summer solstice (June 1)
    b. vernal equinox (March 21)
    c. winter solstice (Dec. 22)
    d. autumnal equinox (Sept. 23)
    e. The number of daylight hours is always the same.

    ANS: A DIF: Medium REF: Section 2.2
    MSC: Applying
    OBJ: Illustrate how the height of the Sun and the length of a day vary with the season and your latitude.

29. If Earth's axis were tilted by 5° instead of its actual tilt, how would the seasons be different than they are currently?
    a. The seasons would remain the same.
    b. Summers would be warmer.
    c. Winters would last longer.
    d. Winters would be warmer.
    e. Summers would last longer.

    ANS: D DIF: Medium REF: Section 2.2
    MSC: Remembering
    OBJ: Explain why Earth's axial tilt causes seasons.

30. If Earth's axis were tilted by 35° instead of its actual tilt, how would the seasons be different than they are currently?
    a. The seasons would remain the same.
    b. Summers would be colder.
    c. Winters would be shorter.
    d. Winters would be colder.
    e. Summers would be shorter.

    ANS: D DIF: Medium REF: Section 2.2
    MSC: Understanding
    OBJ: Explain why Earth's axial tilt causes seasons.

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31. We experience seasons because
    a. Earth's equator is tilted relative to the plane of the solar system.
    b. Earth is closer to the Sun in summer and farther from the Sun in the winter.
    c. the length of the day is longer in the summer and shorter in the winter.
    d. Earth moves with a slower speed in its orbit during summer and faster during winter.
    e. one hemisphere of Earth is closer to the Sun than the other hemisphere during the summer.

    ANS: A DIF: Medium REF: Section 2.2
    MSC: Applying
    OBJ: Explain why Earth's axial tilt causes seasons.

32. During which season (in the Northern Hemisphere) could you see the Sun rising from the furthest north?
    a. winter
    b. spring
    c. summer
    d. fall
    e. The Sun always rises directly in the east.

    ANS: C DIF: Medium REF: Section 2.2
    MSC: Applying
    OBJ: Illustrate how the height of the Sun and the length of a day vary with the season and our latitude.

33. For a person who lives at a latitude of +40°, when is the Sun directly overhead at noon?
    a. only on the summer solstice
    b. only on the winter solstice
    c. only on the vernal and autumnal equinoxes
    d. never
    e. always

    ANS: D DIF: Medium REF: Section 2.2
    MSC: Applying
    OBJ: Illustrate how the motion and visibility of stars change with the one's location on Earth.

34. For a person living in Vancouver, Canada, at latitude of +49°, the maximum altitude of the Sun above the southern horizon on the day of the Winter Solstice is:
    a. 41.0°.
    b. 17.5°.
    c. 25.5°.
    d. 37.0°.
    e. 64.5°.

    ANS: B DIF: Difficult REF: Section 2.2
    MSC: Applying
    OBJ: Illustrate how the motion and visibility of stars change with the one's location on Earth.

35. Earth is closest to the Sun when the Northern Hemisphere experiences
    a. spring.
    b. summer.
    c. fall.
    d. winter.

    ANS: D DIF: Difficult REF: Section 2.2
    MSC: Remembering
    OBJ: Explain why Earth's axial tilt causes seasons.

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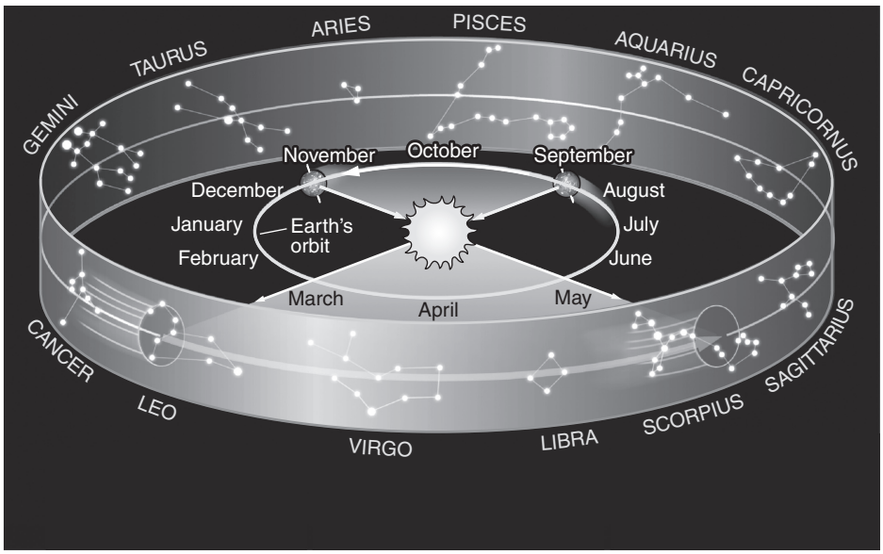
36. Assume you are observing the night sky from a typical city in the United States with a latitude of +40°. Using the figure below, which constellation of the zodiac would be nearest to the meridian at midnight in mid-September?



a. Scorpius
b. Taurus
c. Pisces
d. Aquarius
e. Leo

ANS: D DIF: Medium REF: Section 2.2
MSC: Applying
OBJ: Relate Earth's position around the Sun to the zodiacal constellations we observe in the night-time sky.

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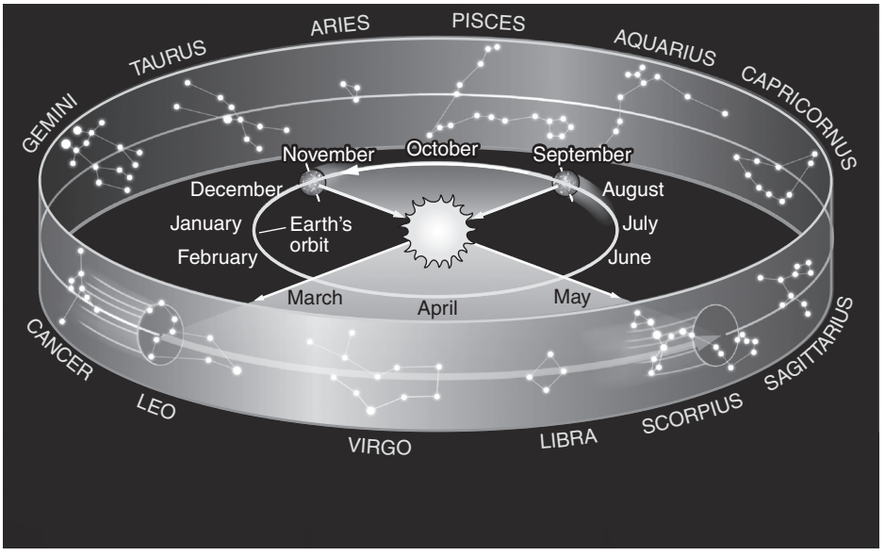
37. Assume you are observing the night sky from a typical city in the United States with a latitude of +40°. Using the figure below, which constellation of the zodiac would be nearest to the meridian at 6 P.M. in mid-September?



a. Scorpius
b. Taurus
c. Pisces
d. Aquarius
e. Leo

ANS: A DIF: Difficult REF: Section 2.2
MSC: Applying
OBJ: Relate Earth's position around the Sun to the zodiacal constellations we observe in the nighttime sky.

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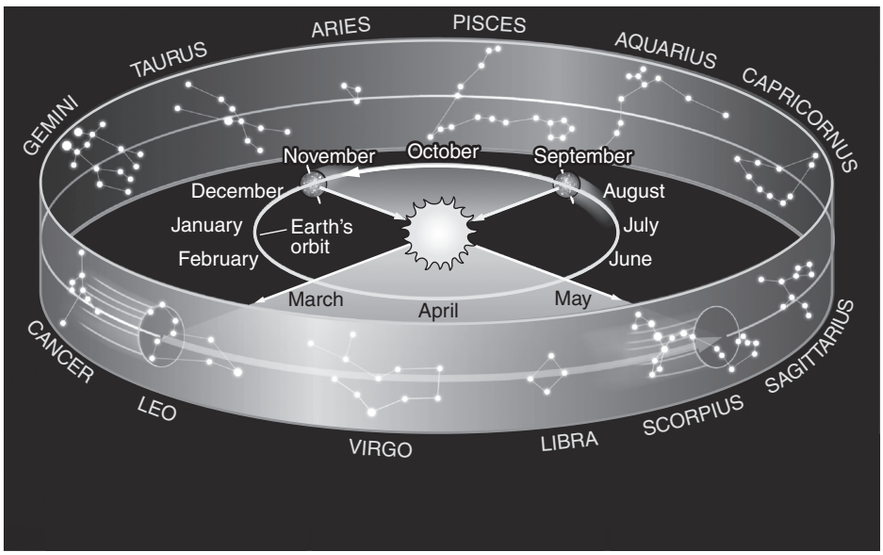
38. Assume you are observing the night sky from a typical city in the United States with a latitude of +40°. Using the figure below, which constellation of the zodiac would be nearest to the meridian at 10 P.M. in mid-May?



a. Scorpius
b. Taurus
c. Pisces
d. Aquarius
e. Leo

ANS: A DIF: Difficult REF: Section 2.2
MSC: Applying
OBJ: Relate Earth's position around the Sun to the zodiacal constellations we observe in the night-time sky.

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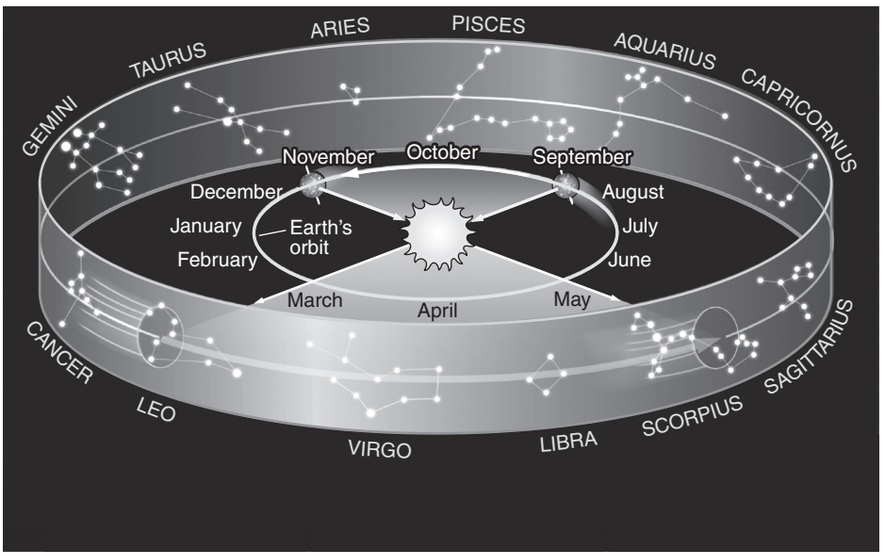
39. Using the figure below, what time of the day or night will the zodiac constellation Gemini rise in March?



a. 2 P.M.
b. 8 P.M.
c. 2 A.M.
d. 8 A.M.
e. noon

ANS: A DIF: Difficult REF: Section 2.2
MSC: Applying
OBJ: Relate Earth's position around the Sun to the zodiacal constellations we observe in the night-time sky.

40. You and a friend go outside to view the stars at midnight tonight. Six months later, you go outside to find the stars in exactly the same position in the sky as when you and your friend viewed them. What time is it? Assume you can see the stars at any time, day or night.
a. 6 A.M.
b. noon
c. 6 P.M.
d. midnight
e. This can never happen.

ANS: B DIF: Difficult REF: Section 2.2
MSC: Applying
OBJ: Relate Earth's position around the Sun to the zodiacal constellations we observe in the night-time sky.

41. The brightest star in the constellation Canis Major can be referred to as
a. Alpha Canis Majoris
b. Beta Canis Majoris
c. Beta Canis
d. Alpha Majoris
e. Alpha Canis

ANS: A DIF: Difficult REF: Section 2.2
MSC: Remembering
OBJ: Relate Earth's position around the Sun to the zodiacal constellations we observe in the night-time sky.

42. At which of the following latitudes is it possible for the Sun's rays to hit the ground perpendicular to the ground at some point during the year?
a. 87°
b. 55°
c. 42°
d. 33°
e. 20°

ANS: E DIF: Difficult REF: Section 2.2
MSC: Applying
OBJ: Explain why Earth's axial tilt causes seasons.

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43. At approximately what time does a full Moon rise?
    a. 12 midnight
    b. 12 noon
    c. 6 A.M.
    d. 6 P.M.
    e. 3 P.M.

    ANS: D DIF: Easy REF: Section 2.3
    MSC: Applying
    OBJ: Illustrate the Sun-Moon-Earth geometry needed to produce each Moon phase.

44. In regard to the phase of the Moon, the term *waxing* means
    a. less than half-illuminated.
    b. more than half–illuminated.
    c. becoming smaller.
    d. illuminated area increasing.
    e. illuminated area decreasing.

    ANS: D DIF: Easy REF: Section 2.3
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

45. If tonight the Moon is in the waxing gibbous phase, in 3 days what is the most likely phase of the Moon?
    a. new phase.
    b. full phase.
    c. third quarter phase.
    d. first quarter phase.
    e. waxing crescent phase.

    ANS: B DIF: Easy REF: Section 2.3
    MSC: Applying
    OBJ: Define the phases of the moon.

46. If there is a full Moon out tonight, approximately how long from now will it be in the third quarter phase?
    a. 3 to 4 days
    b. 1 week
    c. 2 weeks
    d. 3 weeks
    e. 1 month

    ANS: B DIF: Easy REF: Section 2.3
    MSC: Applying
    OBJ: Illustrate the Sun-Moon-Earth geometry needed to produce each Moon phase.

47. Which of the following is *false*?
    a. Everyone on Earth observes the same phase of the Moon on a given night.
    b. The phases of the Moon cycle with a period that is longer than its sidereal period.
    c. In some phases, the Moon can be observed during the day.
    d. The observed phase of the Moon changes over the course of one night.
    e. A full Moon can be seen on the eastern horizon at sunset.

    ANS: D DIF: Easy REF: Section 2.3
    MSC: Applying
    OBJ: Explain what causes us to observe moon phases.

48. If you see a full Moon tonight, approximately how long would you have to wait to see the next full Moon?
    a. 1 week
    b. 2 weeks
    c. 3 weeks
    d. 4 weeks
    e. 5 weeks

    ANS: D DIF: Easy REF: Section 2.3
    MSC: Remembering
    OBJ: Explain what causes us to observe moon phases.

49. The Moon undergoes synchronous rotation, and as a consequence the
    a. rotational period of the Moon equals the orbital period of the Moon around Earth
    b. rotational period of the Moon equals the rotational period of Earth
    c. rotational period of the Moon equals the orbital period of Earth around the Sun
    d. orbital period of the Moon around Earth equals the rotational period of Earth
    e. Moon does not rotate as it orbits Earth

    ANS: A DIF: Easy REF: Section 2.3
    MSC: Understanding
    OBJ: Explain what causes us to observe moon phases.

50. The sidereal period of the moon is
    a. 1 month.
    b. 27.32 days.
    c. 28 days.
    d. 29.53 days.
    e. 30 days.

    ANS: B DIF: Medium REF: Section 2.3
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

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51. What time does a third quarter Moon rise?
    a. 12 midnight
    b. 12 noon
    c. 3 P.M.
    d. 6 A.M.
    e. 6 P.M.

    ANS: A DIF: Medium REF: Section 2.3
    MSC: Applying
    OBJ: Illustrate the Sun-Moon-Earth geometry needed to produce each Moon phase.

52. The Moon's sidereal period is 2.2 days shorter than the period during which the Moon's phases change because
    a. the Moon always keeps the same side turned toward Earth.
    b. Earth must rotate so an observer can see the Moon.
    c. the Moon's orbit is tilted with respect to Earth's rotational axis.
    d. Earth moves significantly in its orbit around the Sun during that time.
    e. the Moon's orbital speed varies.

    ANS: D DIF: Medium REF: Section 2.3
    MSC: Understanding
    OBJ: Explain what causes us to observe moon phases.

53. At which of the possible times below could the waxing gibbous moon be seen rising?
    a. 3 P.M.
    b. 9 A.M.
    c. 11 P.M.
    d. 5 A.M.
    e. 8 P.M.

    ANS: A DIF: Difficult REF: Section 2.3
    MSC: Applying
    OBJ: Illustrate the Sun-Moon-Earth geometry needed to produce each Moon phase.

54. If a person on Earth currently views the Moon in a waxing crescent phase, in what phase would Earth appear to a person on the Moon?
    a. waxing crescent
    b. waxing gibbous
    c. waning gibbous
    d. waning crescent
    e. New

    ANS: C DIF: Difficult REF: Section 2.3
    MSC: Applying
    OBJ: Illustrate the Sun-Moon-Earth geometry needed to produce each Moon phase.

55. Leap years occur because
    a. Earth's orbital period around the Sun is decreasing.
    b. Earth's orbital period is 365.24 days.
    c. the Gregorian calendar contains only 11 months.
    d. Earth speeds up in its orbit when it comes closest to the Sun.
    e. a calendar month is not the same as a lunar month.

    ANS: B DIF: Easy REF: Section 2.4
    MSC: Understanding
    OBJ: Illustrate the need for our current pattern of leap years.

56. How often do leap years occur?
    a. almost every 3 years
    b. almost every 4 years
    c. almost every 5 years
    d. almost every 8 years
    e. almost every 10 years

    ANS: B DIF: Easy REF: Section 2.4
    MSC: Remembering
    OBJ: Illustrate the need for our current pattern of leap years.

57. How often would we have leap years if Earth's orbital period were 365.1 days?
    a. every year
    b. every 2 years
    c. every 4 years
    d. every 10 years
    e. We would not need to have leap years.

    ANS: D DIF: Medium REF: Section 2.4
    MSC: Applying
    OBJ: Illustrate the need for our current pattern of leap years.

58. A purely lunar calendar is not ideal for our modern world because
    a. leap years are more frequent.
    b. the months line up with the phases of the moon.
    c. the seasons don't occur in the same month every year.
    d. high and low tides occur at different times.
    e. leap year are less frequent.

    ANS: C DIF: Difficult REF: Section 2.4
    MSC: Applying
    OBJ: Compare and contrast solar and lunar calendars.

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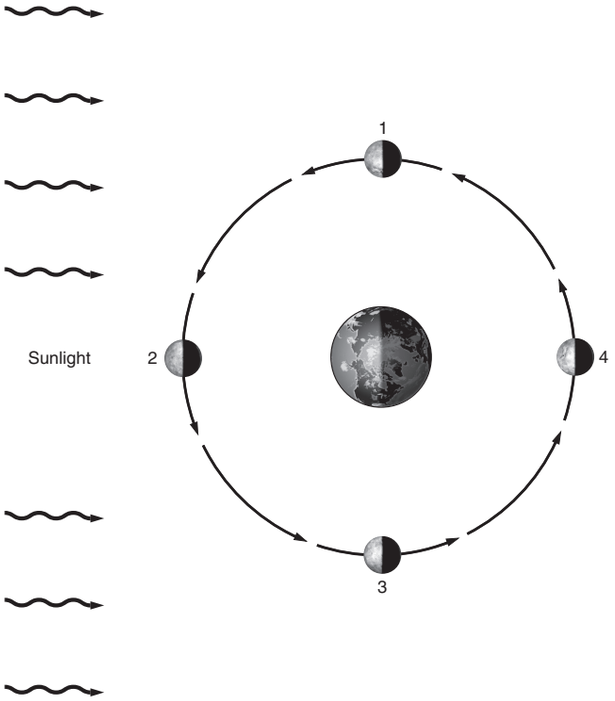
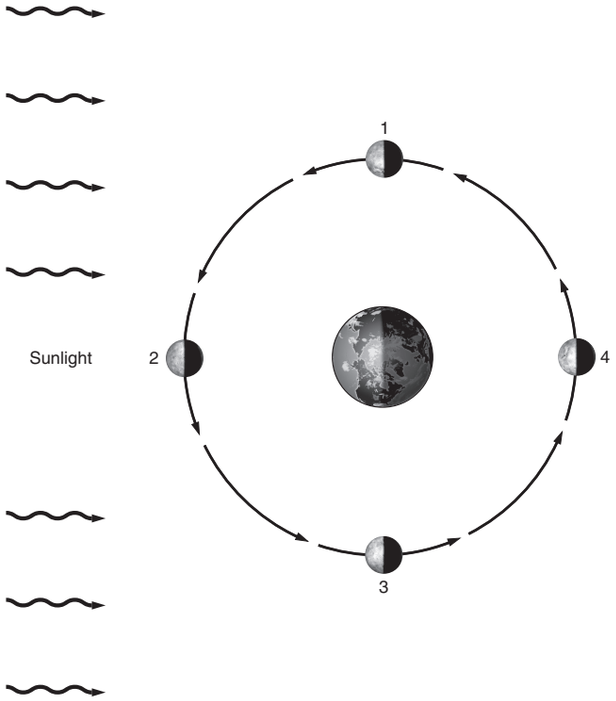
59. In the figure below, at which position must the Moon be located in order for a lunar eclipse to occur?



a. 1
b. 2
c. 3
d. 4

ANS: D DIF: Easy REF: Section 2.5
MSC: Understanding
OBJ: Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.

60. In the figure below, at which position must the Moon be located in order for a solar eclipse to occur?



a. 1
b. 2
c. 3
d. 4

ANS: B DIF: Easy REF: Section 2.5
MSC: Understanding
OBJ: Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.

61. During which lunar phase do solar eclipses occur?
a. new
b. first quarter
c. full
d. third quarter

ANS: A DIF: Easy REF: Section 2.5
MSC: Remembering
OBJ: Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.

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62. A partial lunar eclipse occurs when
    a. the Sun appears to go behind the Moon.
    b. the Moon passes through part of the Earth's shadow.
    c. the Moon shadows part of the Sun.
    d. The Earth passes through part of the Moon's shadow.
    e. the Moon passes through part of the Sun's shadow.

    ANS: B DIF: Easy REF: Section 2.5
    MSC: Remembering
    OBJ: Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.

63. If you are lucky enough to see a total solar eclipse, you must be standing in the
    a. Moon's umbra.
    b. Moon's penumbra.
    c. Earth's umbra.
    d. Earth's penumbra.
    e. Sun's umbra.

    ANS: A DIF: Medium REF: Section 2.5
    MSC: Applying
    OBJ: Relate the geometry of solar and lunar eclipses to their visibility across Earth.

64. The darkest part of the Moon's shadow is the
    a. partial shadow.
    b. penumbra.
    c. umbra.
    d. annular.

    ANS: C DIF: Easy REF: Section 2.5
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

65. During a lunar eclipse the Moon can appear red. This is caused by
    a. the moon glowing red.
    b. oxidation of the lunar crust.
    c. solar flares.
    d. light traveling through Earth's atmosphere.

    ANS: D DIF: Medium REF: Section 2.5
    MSC: Remembering
    OBJ: Relate the geometry of solar and lunar eclipses to their visibility across Earth.

66. If you are observing a partial solar eclipse, you must be standing in the
    a. Moon's umbra.
    b. Moon's penumbra.
    c. Earth's umbra.
    d. Earth's penumbra.
    e. Sun's umbra.

    ANS: B DIF: Medium REF: Section 2.5
    MSC: Applying
    OBJ: Relate the geometry of solar and lunar eclipses to their visibility across Earth.

67. A solar-powered spacecraft is traveling through the Moon's shadow. Which part(s), if any, of the Moon's shadow will cause the spacecraft to completely lose power?
    a. umbra
    b. penumbra
    c. annulus
    d. both umbra and penumbra
    e. The spacecraft will never lose power.

    ANS: A DIF: Medium REF: Section 2.5
    MSC: Applying
    OBJ: Relate the geometry of solar and lunar eclipses to their visibility across Earth.

68. Solar and lunar eclipses are rare because
    a. the Moon's orbital plane is tipped by 5.2° relative to the plane defined by Earth's equator.
    b. the Moon's orbital plane is tipped by 5.2° relative to Earth's orbital plane.
    c. the Moon's orbital plane is tipped by 23.5° relative to the plane defined by Earth's equator.
    d. the Moon's orbital plane is tipped by 23.5° relative to Earth's orbital plane.
    e. the Moon's orbital plane is tipped by 5.2° relative to the galactic plane.

    ANS: B DIF: Medium REF: Section 2.5
    MSC: Understanding
    OBJ: Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.

69. A type of eclipse in which the Sun appears as a bright ring is called a
    a. total solar eclipse.
    b. partial solar eclipse.
    c. annular solar eclipse.
    d. lunar eclipse.
    e. umbral eclipse.

    ANS: C DIF: Medium REF: Section 2.5
    MSC: Remembering
    OBJ: Define the bold-faced vocabulary terms within the chapter.

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70. Approximately how often do lunar eclipses occur?
    a. twice every year
    b. three times every year
    c. once per month
    d. twice every 11 months
    e. once every 11 years

    ANS: D DIF: Difficult REF: Section 2.5
    MSC: Remembering
    OBJ: Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.

SHORT ANSWER

1. Consider an observer located on the equator. If the observer sees a star directly overhead at 10 P.M., where will that star be located in the night sky at 3 A.M.?

   ANS: The star will be visible low on the western horizon.
   DIF: Easy REF: Section 2.1 MSC: Applying
   OBJ: Show the path that a star follows on the sky, from the time it rises until it sets.

2. Consider an observer located on the equator. If the observer sees a star directly overhead at 8 P.M., where will that star be located in the night sky at midnight? How far above the horizon will it be or will it have set?

   ANS: The star will move westward by an amount that is equal to (12 hours − 8 hours) × 360°/24 hours = 60°, and the star will be 90° − 60° = 30° above the western horizon.
   DIF: Medium REF: Section 2.1 MSC: Applying
   OBJ: Illustrate how the motion and visibility of stars change with the one's location on Earth.

3. On what place(s) on Earth can you stand and have the celestial equator be at the same altitude for all 360 degrees of its circumference?

   ANS: You can stand at either the North Pole or the South Pole.
   DIF: Medium REF: Section 2.1 MSC: Applying
   OBJ: Identify the locations of the north celestial pole, south celestial pole, celestial equator, zenith, meridian, and horizon on the celestial sphere.

4. Draw a dome representing the visible sky. Label the horizon, meridian, zenith, and each of the four cardinal directions (north, east, south, and west).

   ANS: The drawing should look like a dome, with the ground portion labeled as the horizon, the topmost part of the dome labeled as the zenith, and the cardinal directions labeled on the horizon with north, east, south, and west at 90 degrees from each other, clockwise. Finally, the meridian should be a line drawn from the north, through the zenith, to the south.
   DIF: Medium REF: Section 2.1
   MSC: Understanding
   OBJ: Identify the locations of the north celestial pole, south celestial pole, celestial equator, zenith, meridian, and horizon on the celestial sphere.

5. The center of the Milky Way lies approximately 30° south of the celestial equator. From what latitudes on Earth is it impossible to view the center of our galaxy?

   ANS: At latitudes greater than 90° − 30° = 60°, it would be impossible to see the center of our galaxy because it would lie below the horizon.
   DIF: Medium REF: Section 2.1 MSC: Applying
   OBJ: Illustrate how the motion and visibility of stars change with the one's location on Earth.

6. How is the observed height of Polaris above the horizon related to an observer's latitude? (Hint: Consider three cases of observers located at the equator, the North Pole, and latitude = +45°.)

   ANS: The observed height of Polaris above the horizon is equal to an observer's latitude. For an observer at the equator (latitude = 0°), Polaris is on the horizon. For an observer at the North Pole (latitude = +90°), Polaris is at the zenith or 90° above the horizon. For an observer at latitude = +45°, Polaris is 45° above the horizon.
   DIF: Medium REF: Section 2.1 MSC: Applying
   OBJ: Demonstrate how knowledge of the sky permits one to know latitude and direction on Earth.

7. What latitude on Earth would be the best for observing as much of the celestial sphere as possible over the course of a year?

   ANS: The equator, 0° latitude, is best because over the course of the year you would be able to see all of the northern and southern hemispheres of the celestial sphere.
   DIF: Medium REF: Section 2.1 MSC: Applying
   OBJ: Illustrate how the motion and visibility of stars change with the one's location on Earth.

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8. If you are standing on the equator and shoot a cannonball directly north, where would you expect it to land?

   ANS: The cannonball would land to the northeast of your position. Because you are standing on the equator, you have the fastest ground speed of any location on Earth. Once the cannonball is fired, it is given a velocity in the northern direction. However, the cannonball retains the ground speed of the equator also. Because the ground speed of the northern latitudes is lower than that of the equator, the cannonball will appear to travel northeast instead of straight north!
   DIF: Difficult REF: Section 2.1
   MSC: Understanding
   OBJ: Illustrate how one event will look in two different frames of reference.

9. What would be the effect on the seasons if the tilt of Earth's axis were 10° rather than 23.5°?

   ANS: If the tilt of Earth's axis were smaller, there would be a less dramatic temperature shift between the seasons because the angle of the Sun's rays would vary less and the length of day/night would be more equal throughout the year.
   DIF: Easy REF: Section 2.2 MSC: Applying
   OBJ: Explain why Earth's axial tilt causes seasons.

10. What is the point on the celestial sphere where the ecliptic crosses from below to above the celestial equator called?

    ANS: The vernal or spring equinox.
    DIF: Medium REF: Section 2.2
    MSC: Remembering
    OBJ: Identify the path of the ecliptic, the solstices, and the equinoxes on the celestial sphere.

11. What makes the equinoxes and solstices special?

    ANS: The equinoxes occur when the Sun is directly above the equator; the entire world experiences a 12-hour day and a 12-hour night. The solstices occur when the Sun is farthest from the equator (north or south). On these days, one hemisphere experiences its longest day and shortest night, while the other hemisphere experiences its shortest day and longest night.
    DIF: Medium REF: Section 2.2
    MSC: Understanding
    OBJ: Identify the path of the ecliptic, the solstices, and the equinoxes on the celestial sphere.

12. On what day(s) of the year does the Sun set due west?

    ANS: The Sun will set due west on the vernal and autumnal equinoxes.
    DIF: Medium REF: Section 2.2 MSC: Applying
    OBJ: Identify the path of the ecliptic, the solstices, and the equinoxes on the celestial sphere.

13. Earth experiences seasons due to the tilt of its axis. What are two consequences of this tilt that contribute to the seasons?

    ANS: (1) Variation in the length of daylight, and (2) variation in the directness of the Sun's rays.
    DIF: Medium REF: Section 2.2 MSC: Applying
    OBJ: Explain why Earth's axial tilt causes seasons.

14. For an observer in Seattle, Washington, which is located at latitude = +47°, what is the lowest possible altitude one might see the Sun on the meridian over the course of the year? Approximately what time of the day and year will this occur?

    ANS: For an observer in Seattle, Washington, the celestial equator will be at an altitude of 90° − 47° = 43° above the southern horizon. The Sun will be located at its southernmost position on the celestial sphere on the winter solstice, which is 23.5° south from the celestial equator. Therefore, the Sun will be on the meridian at noon on the winter solstice with an altitude of 43° − 23.5° = 19.5° above the southern horizon.
    DIF: Difficult REF: Section 2.2 MSC: Applying
    OBJ: Illustrate how the height of the Sun and the length of a day vary with the season and your latitude.

15. The position of the autumnal equinox lies at the intersection of which two great celestial circles on the celestial sphere?

    ANS: The autumnal equinox lies at the intersection of the celestial equator and the ecliptic.
    DIF: Difficult REF: Section 2.2
    MSC: Remembering
    OBJ: Identify the path of the ecliptic, the solstices, and the equinoxes on the celestial sphere.

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16. Why does the Moon always show the same face to Earth?

ANS: The Moon's rotation and orbital period (revolution) are the same. The Moon experiences synchronous rotation.
DIF: Easy REF: Section 2.3
MSC: Remembering
OBJ: Define the bold-faced vocabulary terms within the chapter.

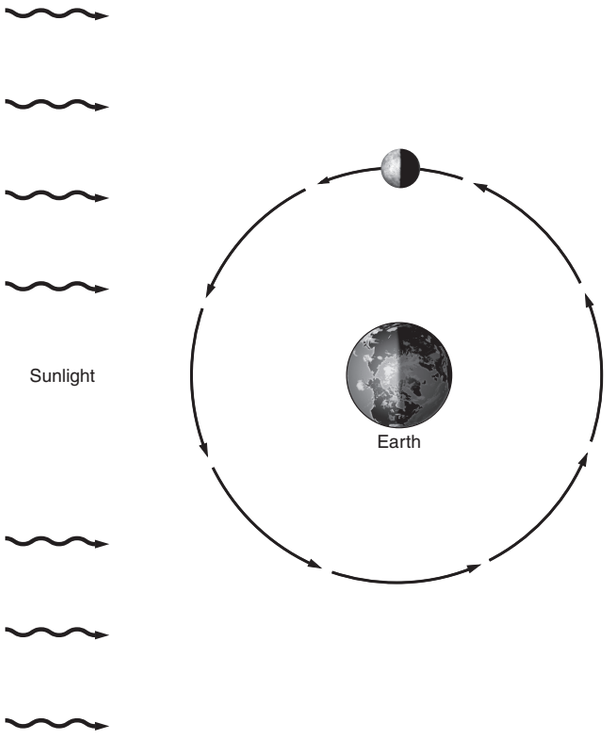
17. Explain why we always see the same side of the Moon from Earth.

ANS: The amount of time it takes for the Moon to rotate once about its axis is exactly equal to the amount of time it takes to orbit once around Earth.
DIF: Easy REF: Section 2.3 MSC: Understanding
OBJ: Explain what causes us to observe moon phases.

18. If the Moon was full 3 days ago, what phase will it be in tonight, and when will it rise and set?

ANS: The Moon's phase cycles on a 29.5-day period. Therefore, the Moon tonight will be approximately halfway between the full and third quarter phases, and thus it will be in the waning gibbous phase. It will be on an observer's eastern horizon and rising halfway between 6 P.M. and midnight, which is 9 P.M. It will set 12 hours later at 9 A.M.
DIF: Medium REF: Section 2.3 MSC: Applying
OBJ: Define the phases of the moon.

19. Based on the location of the Moon shown in the figure below, draw a picture of how the moon would appear to an observer located on Earth.



ANS: The drawing should show a third quarter moon, where the left half of the Moon's face will be lit up and the right half will be in darkness.
DIF: Medium REF: Section 2.3
MSC: Understanding
OBJ: Illustrate the Sun-Moon-Earth geometry needed to produce each Moon phase.

20. As the month passes, the Moon appears to rise later in the day or night when compared to the previous day. Explain why this happens.

ANS: In general, objects appear to rise and set due to Earth's rotation. Whereas Earth rotates once every 24 hours, the Moon also orbits around Earth roughly once a month in the same direction as Earth's rotation. Therefore, over 24 hours, the Moon has moved slightly from its original position, and Earth has to rotate a little more before the Moon appears to rise again the next day.
DIF: Medium REF: Section 2.3 MSC: Applying
OBJ: Explain what causes us to observe moon phases.

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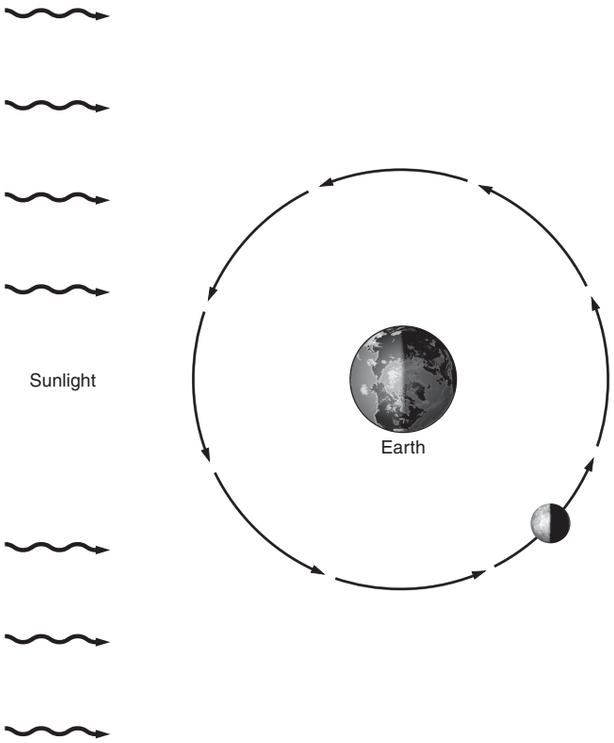
21. Based on the location of the Moon shown in the figure below, draw a picture of how the Moon would appear to an observer located on Earth.



ANS: The drawing should show a waxing gibbous moon, where more than half of the Moon's right face will be lit up and less than half of the left face will be in darkness. DIF: Difficult REF: Section 2.3
MSC: Understanding
OBJ: Illustrate the Sun-Moon-Earth geometry needed to produce each Moon phase.

22. What is the difference between the terms solar day and sidereal day?

ANS: A solar day is the time it takes for the Sun to come back to the same local meridian. A solar day is 24 hours long. A sidereal day is the time it takes for Earth to complete one full rotation relative to the distant stars; this takes 23 hours 56 minutes.
DIF: Easy REF: Section 2.4
MSC: Remembering
OBJ: Define the bold-faced vocabulary terms within the chapter.

23. How does today's Gregorian calendar differ from the calendars of more ancient civilizations, such as the Chinese, the Egyptians, and the Babylonians?

ANS: The Gregorian calendar is based on the tropical year, based on the motion of Earth around the Sun. The others are lunar calendars based on the motion of the Moon around Earth. The Gregorian calendar also includes leap years to avoid the shifting of the seasons due to the fact that Earth orbits the Sun in 365.24 days.
DIF: Medium REF: Section 2.4
MSC: Remembering
OBJ: Compare and contrast solar and lunar calendars.

24. Why do some years in certain lunar calendars have 13 months?

ANS: A lunar calendar can have 13 months, which act to keep the lunar calendar in sync with the seasons. These are like leap years, but not every year will have 13 months.
DIF: Difficult REF: Section 2.4
MSC: Understanding
OBJ: Compare and contrast solar and lunar calendars.

25. Draw a picture below showing the Moon's location relative to Earth and the Sun during a lunar eclipse.

ANS: The Moon, Earth, and Sun should all be drawn in a straight line with Earth in between the Moon and the Sun.
DIF: Medium REF: Section 2.5 MSC: Applying
OBJ: Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.

26. Draw a picture below showing the Moon's location relative to Earth and the Sun during a solar eclipse.

ANS: The Moon, Earth, and Sun should all be drawn in a straight line with the Moon in between Earth and the Sun.
DIF: Medium REF: Section 2.5 MSC: Applying
OBJ: Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.

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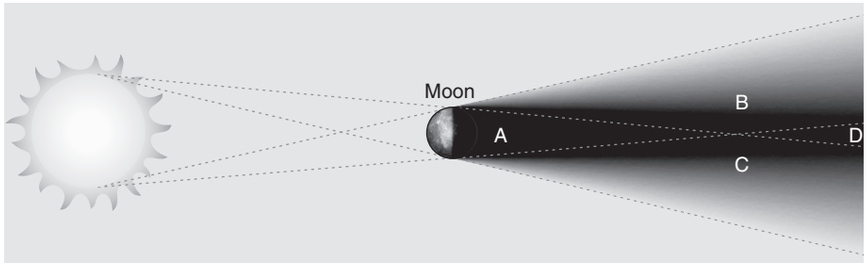
27. Explain the type of solar eclipse that would be observed by an observer on Earth if they were in each respective part (A, B, C, and D) of the shadow of the moon, shown in the figure below.



ANS: An observer in part A would observe a total solar eclipse. An observer in parts B and C would observer a partial solar eclipse. An observer in part D would observe an annular eclipse.
DIF: Medium REF: Section 2.5 MSC: Applying
OBJ: Relate the geometry of solar and lunar eclipses to their visibility across Earth.

28. Explain why the eclipse seasons occur roughly twice every 11 months, rather than twice per year.

ANS: This happens because the plane of the Moon's orbit slowly wobbles, completing one full "wobble" every 18.6 years. Because the wobble is in the opposite direction from the Moon's orbit, the eclipse seasons occur less than 6 months apart.
DIF: Difficult REF: Section 2.5 MSC: Applying
OBJ: Illustrate the Sun-Moon-Earth geometries needed to produce solar and lunar eclipses.

29. Approximately how large is the umbra on the surface of Earth?

ANS: The largest it can be is when Earth and the Moon are closest together, which makes the umbra approximately 270 km wide. The shadow is on the order of hundreds of kilometers.
DIF: Difficult REF: Section 2.5
MSC: Understanding
OBJ: Relate the geometry of solar and lunar eclipses to their visibility across Earth.

30. Earth has an average radius of approximately 6.4×10^3 km. What is the average speed, in units of km/s, of the ground at Earth's equator due to the daily rotation of Earth if there are 8.64×10^4 seconds per day?

ANS: Here the students need to convert the radius of Earth to its circumference: $C = 2\pi r = 2 \times 3.14159 \times 6.4 \times 10^3 = 4.02 \times 10^4$ km. Divide this distance by 8.64×10^4 s, and we get a speed of 0.465 km/s = 1,676 km/h.
DIF: Difficult REF: Working It Out 2.1
MSC: Applying
OBJ: Use proportional reasoning to estimate a characteristic of the whole based on measurement of a part.

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21st Century Astronomy 5th Edition Kay Test Bank

Chapter 3: Motion of Astronomical Bodies

LEARNING OBJECTIVES

Define the bold-faced vocabulary terms within the chapter.
Multiple Choice: 2, 3, 18, 22, 37, 43, 44, 46, 47, 50, 51, 52

3.1 The Motions of Planets in the Sky

Distinguish the geocentric and heliocentric models of the Solar System.
Multiple Choice: 1, 4, 8, 13, 20
Short Answer: 6, 12

Illustrate the cause of retrograde motion in the heliocentric model.
Multiple Choice: 6, 7, 10, 11, 15
Short Answer: 4, 5, 11

Summarize how Copernicus determined the correct order of the planets around the Sun.
Multiple Choice: 5, 9, 12, 14, 16, 17, 19
Short Answer: 1, 2, 3, 7, 8, 9, 10, 13

3.2 Kepler's Laws Describe Planetary Motion

State Kepler's three laws.
Multiple Choice: 21, 24, 30, 31, 32, 34
Short Answer: 17

Illustrate the important features of an ellipse that relate to Kepler's first law.
Multiple Choice: 23, 33, 35, 36, 38, 39
Short Answer: 15

Explain Kepler's second law in terms of orbital speeds and distances.
Multiple Choice: 25, 26, 27, 28, 29
Short Answer: 14, 16

3.3 Galileo's Observations Supported the Heliocentric Model

Explain how Galileo applied the scientific method to geocentric and heliocentric models.
Multiple Choice: 40, 41
Short Answer: 18, 19, 20, 21

3.4 Newton's Three Laws Help to Explain the Motion of Celestial Bodies

Describe the difference between empirical and physical laws.
Multiple Choice: 45

Relate inertia and mass.
Multiple Choice: 48
Short Answer: 24

Illustrate Newton's first law by considering how objects move in different physical situations.
Short Answer: 23

Describe the difference between speed and acceleration.
Short Answer: 22

Apply Newton's second law to establish whether or not objects will accelerate in different physical situations.
Multiple Choice: 34, 42, 49

Illustrate Newton's third law by considering action-reaction pairs in different physical situations.
Multiple Choice: 53
Short Answer: 25, 26

Working It Out 3.1

Use synodic and Earth's sidereal periods to calculate the orbital periods of planets.
Multiple Choice: 54, 55, 56, 58
Short Answer: 27, 28

Working It Out 3.2

Use Kepler's third law to compute the period or semimajor axis of a planet.
Multiple Choice: 59, 60, 61, 62, 63, 64, 65
Short Answer: 29

Working It Out 3.3

Use Newton's second law to calculate acceleration.
Multiple Choice: 57, 66, 67, 68, 69, 70
Short Answer: 30

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