Directions

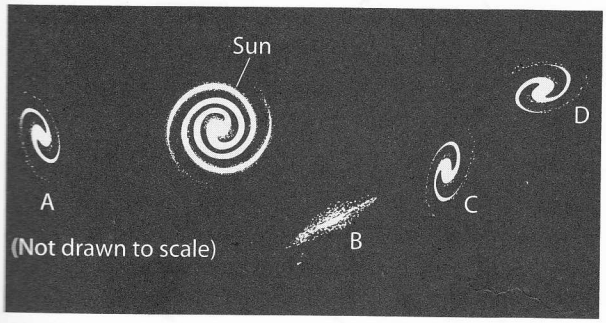
Review the Test-Taking Strategies section of this book. Then answer the following questions. Read each question carefully. Decide which choice is the correct answer.

Part A

1 Which theory is best supported by a Doppler shift of spectral lines toward the red end of the spectrum?
(1) creation of the solar system
(2) expanding universe
(3) nature of light energy
(4) formation of impact craters

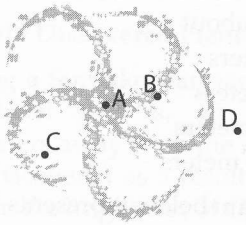
2 According to the Big Bang theory, the universe began as an explosion and is still expanding. This theory is supported by observations that the stellar spectra of distant galaxies show a
(1) concentration in the yellow portion of the spectrum
(2) concentration in the green portion of the spectrum
(3) shift toward the blue end of the spectrum
(4) shift toward the red end of the spectrum

3 The following diagram shows the home galaxy of our sun and solar system and four other galaxies that are trillions of miles away.



Which galaxy is most likely moving away from the sun at the greatest velocity?
(1) A
(2) B
(3) C
(4) D

4 The following diagram represents the Milky Way Galaxy.



Which letter best represents the location of Earth's solar system?
(1) A (2) B (3) C (4) D

5 A star of high surface temperature and low luminosity (relative absolute magnitude) is most likely a
(1) giant star (3) supergiant star
(2) main sequence star (4) white dwarf star

6 Why does a star with a high amount of matter tend to have a short life?
(1) It rotates rapidly.
(2) It consumes its fuel rapidly.
(3) It has a core of heavy elements.
(4) It collapses to form a white dwarf.

7 What is the single most important factor controlling the evolution of a star?
(1) mass (3) element composition
(2) rotation rate (4) temperature

8 Which of the following pairs of characteristics is most important in determining the type of a planet's atmosphere?
(1) orbital speed and volume
(2) rate of rotation and diameter
(3) mass of the planet and distance from the sun
(4) density of the planet and the number of moons

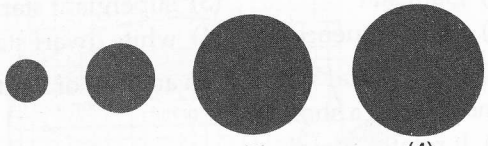
9 Which planet has traveled around the sun more than once in your lifetime?
(1) Mars (3) Neptune
(2) Uranus (4) Jupiter

10 As the distance from the sun increases, the diameter of the planets
(1) increases only
(2) decreases only
(3) both increases and decreases
(4) remains the same

11 In a scale model of the solar system, if Earth's diameter were 1 meter, the sun's diameter would be about
(1) 10 meters
(2) 100 meters
(3) 1,000 meters
(4) 10,000 meters

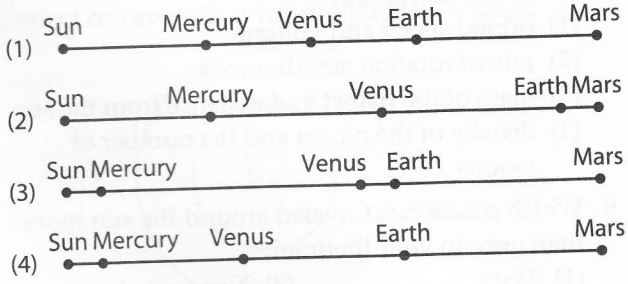
12 The diagram below represents Earth.

Which diagram best represents Mars, drawn to the same scale?

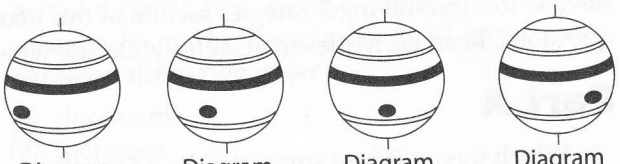


(1) (2) (3) (4)

13 If the planets were all on the same side of the sun, which line best shows the correct spacing between the inner planets and their distances from the sun at a scale of 1 centimeter = 0.2 AU? (An AU or astronomical unit is Earth's average distance from the sun; the sun and planets are represented by points of identical sizes, but distances between them are drawn to scale.)



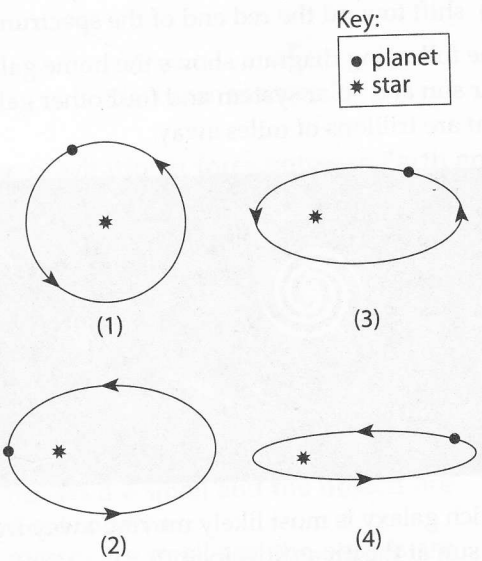
14 A planet was viewed from Earth for several hours. The following diagrams represent the appearance of the planet at four different times.



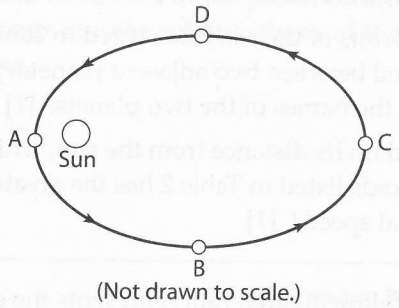
The inference that can be made based on the diagrams is that this planet is
(1) tilted on its axis
(2) changing seasons
(3) revolving
(4) rotating

15 The period of time a planet takes to make one revolution around the sun is most dependent on what other characteristic of the planet?
(1) rotation rate
(2) mass
(3) diameter
(4) distance from the sun

16 Which diagram shows a planet with the least eccentric orbit?



17 The following diagram shows a planet's orbit around the sun.

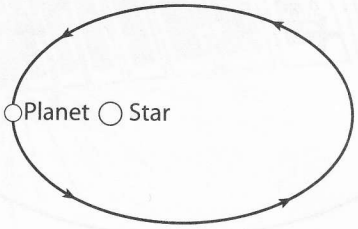


(Not drawn to scale.)

At which location is the planet's orbital speed greatest?

(1) A (2) B (3) C (4) D

18 The diagram below represents a planet revolving in an elliptical orbit around the star.



As the planet makes one complete revolution around the star, starting at the position shown, the gravitational attraction between the star and the planet will

(1) decrease, then increase
(2) increase, then decrease
(3) continually decrease
(4) remain the same

19 Planet A has a greater mean distance from the sun than planet B. On the basis of this fact, which further comparison can be correctly made between the two planets?

(1) Planet A is larger.
(2) Planet A's revolution period is longer.
(3) Planet A's speed of rotation is greater.
(4) Planet A's day is longer.

Part B

20 What is the difference between a galaxy and a constellation? [1]

21 How is a planet different from a moon? [1]

Base your answers to questions 22 through 24 on the passage below and on your knowledge of Earth science.

A Newly Discovered Planet

Scientists studying a Sun-like star named *Ogle-Tr-3* discovered a planet that is, on the average, 3.5 million kilometers away from the star's surface. The planet was discovered as a result of observing a cyclic decrease in the brightness of *Ogle-Tr-3* every 28.5 hours. The changing brightness is the result of the planet blocking some of the starlight when it is between *Ogle-Tr-3* and Earth. This observation allowed scientists to find not only the planet, but also to determine the planet's mass and density. The mass has been calculated to be approximately 159 times the mass of Earth. The planet is only 20% as dense as Jupiter. Scientists think that this low density is the result of being very close to *Ogle-Tr-3*.

22 Compared to the periods of revolution of Mercury and Venus, this newly discovered planet's period of revolution is

(1) shorter than both Mercury's and Venus's
(2) longer than both Mercury's and Venus's
(3) shorter than Mercury's but longer than Venus's
(4) longer than Mercury's but shorter than Venus's

23 The density of the discovered planet has been estimated to be approximately

(1) 5.5 g/cm^3 (3) 1.3 g/cm^3
(2) 2.0 g/cm^3 (4) 0.3 g/cm^3

24 The planet was discovered when it passed between Earth and the star *Ogle-Tr-3*. Which event in our solar system results from a similar type of alignment of the Moon between Earth and the Sun?

(1) summer solstice (3) solar eclipse
(2) winter solstice (4) lunar eclipse

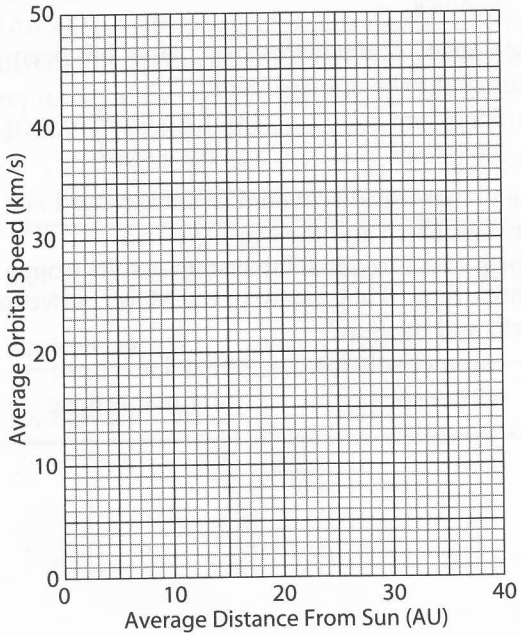
Base your answers to questions 25 through 28 on Table 1 and Table 2 that follow.

Table 1		
Planet	**Average Distance From the Sun (AU)**	**Average Orbital Speed (km/s)**
Mercury	0.4	48.0
Venus	0.7	35.0
Earth	1.0	30.0
Mars	1.5	24.0
Jupiter	5.2	13.0
Saturn	9.6	10.0
Uranus	19.0	7.0
Neptune	30.0	5.1
Pluto	39.0	4.7

Table 2	
Asteroid	**Average Distance From Sun (AU)**
Ceres	2.8
Pallas	2.8
Vesta	2.4
Hygiea	3.2
Juno	2.7

25 On the following grid, plot the average distance from the sun and the average orbital speed for each of the eight planets and the dwarf planet Pluto listed in Table 1. Connect the nine points with a line. [2]

Planet's Average Orbital Speed Versus Average Distance From Sun (Au)



26 Describe the relationship between a planet's average distance from the sun and the planet's average orbital speed. [1]

27 The orbits of the asteroids listed in Table 2 are located between two adjacent planetary orbits. State the names of the two planets. [1]

28 Based on its distance from the sun, which of the asteroids listed in Table 2 has the greatest average orbital speed? [1]

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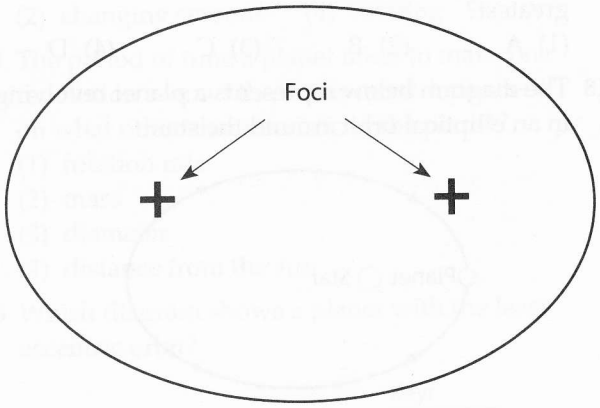
29 The following diagram represents the elliptical orbit of a spacecraft around the sun.



(Drawn to scale.)

Calculate the eccentricity of the spacecraft's orbit following these directions:

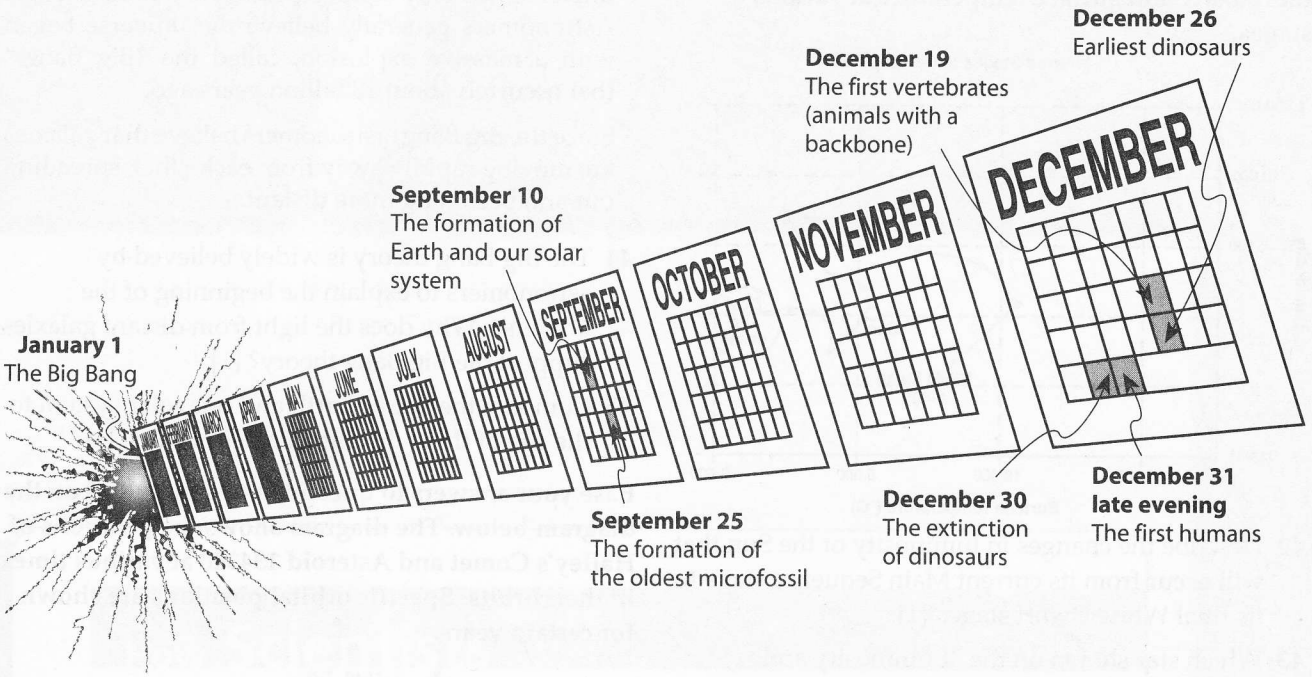
(a) Write the equation for eccentricity. [1]

(b) Subsitute measurements of the diagram into the equation. [1]

(c) Calculate the eccentricity and record your answer in decimal form. [1]

(d) State how the eccentricity of this elliptical orbit compares to the eccentricity of Earth's orbit. [1]

Base your answers to questions 30 and 31 on the calendar model shown below of the inferred history of the universe and on your knowledge of Earth science. The 12-month time line begins with the Big Bang on January 1 and continues to the present time, which is represented by midnight on December 31. Several inferred events and the relative times of their occurrence have been placed in the appropriate locations on the time line.



30 State *one* piece of evidence used by scientists to support the theory that the Big Bang event occurred. [1]

31 How many millions of years of Earth's geologic history elapsed between the event that occurred on September 10 and the event that occurred on September 25 in the model? [1]

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32 Using the "Luminosity and Temperature of Stars" graph in the *Earth Science Reference Tables*, list the five stars below in order of *decreasing* relative luminosity, with letter *a* being the brightest. [1]

Aldebaran, Betelgeuse, Polaris, Sirius, the Sun

Part C

33 Describe how the Big Bang theory can explain the observed Doppler effect of most galaxies. [1]

Use the following information and your knowledge of earth science to answer questions 34 through 41.

A tenth planet, called Thelma, is located exactly between the orbits of Earth and Mars. Its density and diameter are halfway between those of Earth and Mars.

34 State a probable distance of the planet Thelma from the sun in kilometers. [1]

35 State a probable period of revolution of the planet Thelma using proper units. [1]

36 What is the most likely shape of the planet Thelma? [1]

37 In years, what is the oldest possible rock that would likely be found on planet Thelma? [1]

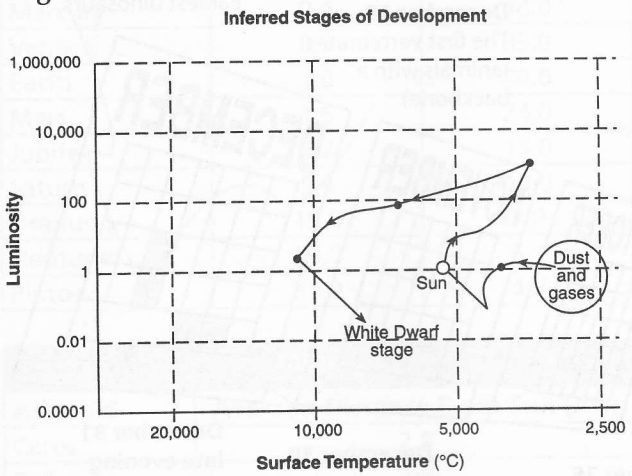
38 What information would you need to know to be able to determine the length of a day on the planet Thelma? [1]

39 Explain why the planet Thelma would likely be considered a terrestrial planet and NOT a Jovian planet. [1]

40 Explain how the magnitude of gravitation between the sun and planet Thelma compares to the gravitation between the sun and Mars. State a reason for the difference in the gravitations. [2]

41 Describe the landscape feature you would expect to find on the solid surface of the planet Thelma if a 5-mile-wide asteroid had recently collided with the planet. [1]

Base your answers to questions 42 and 43 on the graph below and on the "Luminosity and Temperature of Stars" graph in the *Earth Science Reference Tables*. The graph below shows the inferred stages of development of the Sun, showing luminosity and surface temperature at various stages.



42 Describe the changes in luminosity of the Sun that will occur from its current Main Sequence stage to its final White Dwarf stage. [1]

43 Which star shown on the "Luminosity and Temperature of Stars" graph in the *Earth Science Reference Tables* is currently at the Sun's final predicted stage of development? [1]

Base your answers to questions 44 and 45 on your knowledge of Earth science and on the newspaper article shown below, written by Paul Recer and printed in the *Times Union* on October 9, 1998.

Astronomers peer closer to Big Bang

WASHINGTON—The faintest and most distant objects ever sighted—galaxies of stars more than 12 billion light years away—have been detected by an infrared camera on the Hubble Space Telescope.

The sighting penetrates for the first time to within about one billion light years of the very beginning of the universe, astronomers said, and shows that even at that very early time there already were galaxies with huge families of stars.

"We are seeing farther than ever before," said Rodger I. Thompson, a University of Arizona astronomer and the principal researcher in the study.

Thompson and his team focused an infrared instrument on the Hubble on a narrow patch of the sky that had been previously photographed in visible light. The instrument detected about 100 galaxies that were not seen in the visible light and 10 of these were at extreme distance.

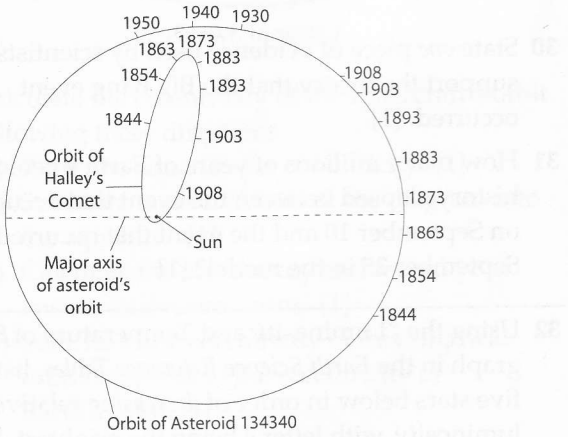
He said the galaxies are seen as they were when the universe was only about 5 percent of its present age. Astronomers generally believe the universe began with a massive explosion, called the "Big Bang," that occurred about 13 billion years ago.

Since the Big Bang, astronomers believe that galaxies are moving rapidly away from each other, spreading out and becoming more distant.

44 The Big Bang theory is widely believed by astronomers to explain the beginning of the universe. Why does the light from distant galaxies support the Big Bang theory? [1]

45 Compare the age of Earth and our solar system to the age of these distant galaxies of stars. [1]

Base your answers to questions 46 through 48 on the diagram below. The diagram shows the positions of Halley's Comet and Asteroid 134340 at various times in their orbits. Specific orbital positions are shown for certain years.



46 The eccentricity of the asteroid's orbit is 0.250. On the orbital diagram above mark the position of the second focus of the asteroid's orbit by placing an **X** on the major axis at the proper location. [1]

47 Determine which was traveling faster, Halley's Comet or the asteroid, between the years 1903 and 1908. State *one* reason for your choice. [1]

48 Explain why Halley's Comet is considered to be part of our solar system. [1]