

AIM 3: What is the solar system?

HW

- Read “The Solar System” p233-235
- Do all questions on Part A&B-1 on p235-238

The universe was created about 15 billion years ago (the big bang) and the solar system came 10 billion years after.

All planetary and stellar systems are born from the collapse of dense interstellar clouds originated in the explosive deaths of giant stars (supernovae).

See reference table “Solar System Data” for information about the planets of the solar system.

Asteroids are thousands of rocky objects located for the most part in a belt between the orbits of Mars and Jupiter. A few asteroids have orbits that can cross Earth's orbit.

Meteors are relatively small objects (meteoroids) from space that are attracted by Earth's gravity. As they fall through the atmosphere they burn producing streaks of light known as shooting stars. When they survive their fall and hit the ground they are called meteorites.

Comets are icy objects, most of which originate in a region outside the planets. When heated by the sun they partially vaporize, producing a tail.

Ex: Halley's Comet has a period of approximately 75 years.

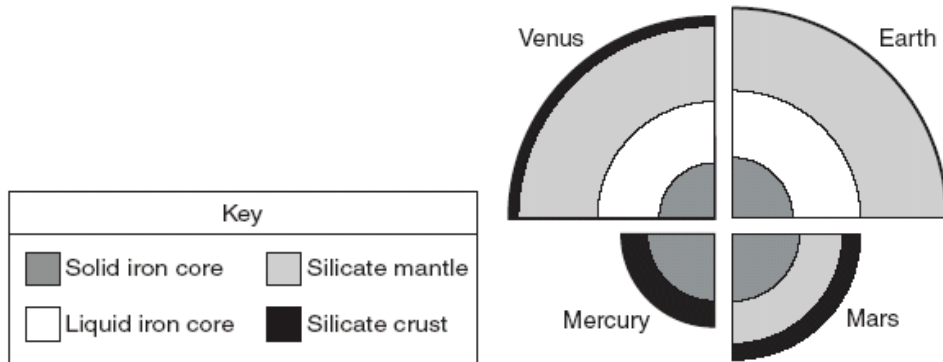
TEST YOUR UNDERSTANDING

8/07

5 Compared with our Sun, the star *Betelgeuse* is

- (1) smaller, hotter, and less luminous
- (2) smaller, cooler, and more luminous
- (3) larger, hotter, and less luminous
- (4) larger, cooler, and more luminous

Base your answers to questions 51 through 53 on the diagram below, which shows the inferred internal structure of the four terrestrial planets, drawn to scale.



51 How are the crusts of Mars, Mercury, Venus, and Earth similar in composition?

52 Identify the *two* planets that would allow an *S*-wave from a crustal quake to be transmitted through the core to the opposite side of the planet.

53 Explain why the densities of these terrestrial planets are greater than the densities of the Jovian planets.

6/07

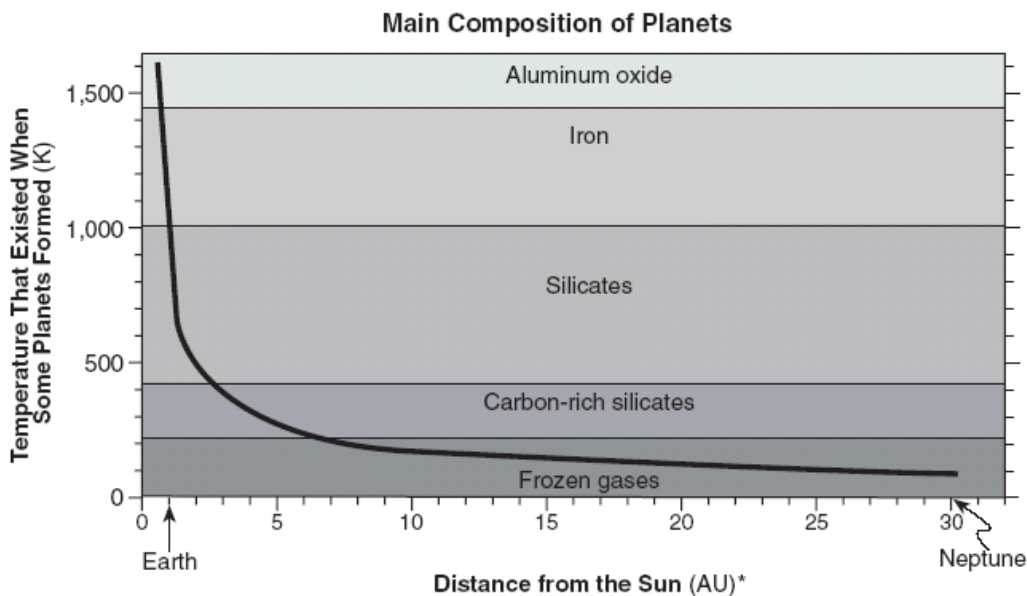
Base your answers to questions 39 through 42 on the table below, which shows eight inferred stages describing the formation of the universe from its beginning to the present time.

Data Table

Stage	Description of the Universe	Average Temperature of the Universe (°C)	Time From the Beginning of Universe
1	the size of an atom	?	0 second
2	the size of a grapefruit	?	10 ⁻⁴³ second
3	"hot soup" of electrons	10 ²⁷	10 ⁻³² second
4	Cooling allows protons and neutrons to form.	10 ¹³	10 ⁻⁶ second
5	still too hot to allow the forming of atoms	10 ⁸	3 minutes
6	Electrons combine with protons and neutrons, forming hydrogen and helium atoms. Light emission begins.	10,000	300,000 years
7	Hydrogen and helium form giant clouds (nebulae) that will become galaxies. First stars form.	-200	1 billion years
8	Galaxy clusters form and first stars die. Heavy elements are thrown into space, forming new stars and planets.	-270	13.7 billion years

- 39 How soon did protons and neutrons form after the beginning of the universe?
 (1) 10⁻⁴³ second (2) 10⁻³² second (3) 10⁻⁶ second (4) 13.7 billion years
- 40 What is the most appropriate title for this table?
 (1) The Big Bang Theory (2) The Theory of Plate Tectonics
 (3) The Law of Superposition (4) The Laws of Planetary Motion
- 41 According to this table, the average temperature of the universe since stage 3 has
 (1) decreased, only (2) increased, only (3) remained the same (4) increased, then decreased
- 42 Between which two stages did our solar system form? (1) 1 and 3 (2) 3 and 5 (3) 6 and 7 (4) 7 and 8
- 1/07
 1 Which object in our solar system has the greatest density? (1) Jupiter (2) Earth (3) the Moon (4) the Sun

Base your answers to questions 66 through 69 on the graph below, which shows two conditions responsible for the formation and composition of some planets in our solar system. The distances of Earth and Neptune from the Sun, in astronomical units (AU), are shown beneath the horizontal axis. (1 AU = 149.6 million kilometers). The plotted line on this graph shows the relationship between a planet's distance from the Sun and the inferred temperature at its formation. The regions within the graph indicate the composition of planets formed within these zones.



- 66 According to the graph, Neptune was mainly composed of which material at the time of its formation?
 67 Saturn is located 9.5 AU from the Sun. State the approximate temperature at which Saturn formed.
 68 State the relationship between a planet's distance from the Sun and the temperature at which that planet formed.

69 What is Jupiter's distance from the Sun, in astronomical units? Express your answer to the *nearest tenth*.

8/06

Base your answers to questions 38 through 40 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*.

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

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

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

- (1) 5.5 g/cm³ (3) 1.3 g/cm³
(2) 2.0 g/cm³ (4) 0.3 g/cm³

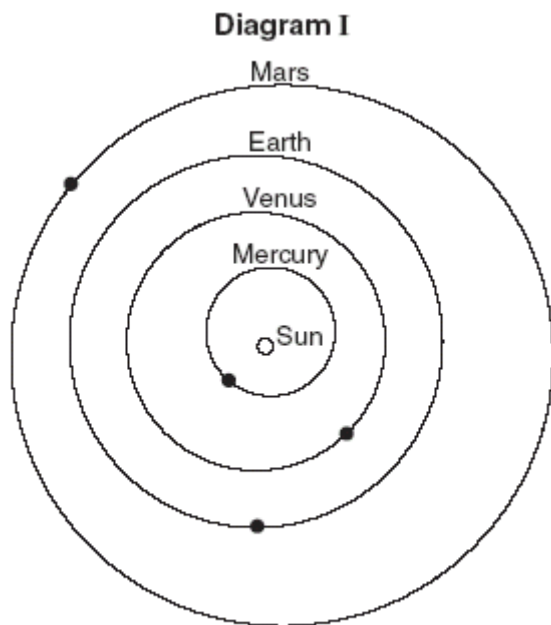
40 The planet was discovered when it passed between Earth and the star *Ogle-Tr-3*. Which event in our solar system results from a similar type of alignment of the Moon between Earth and the Sun?

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

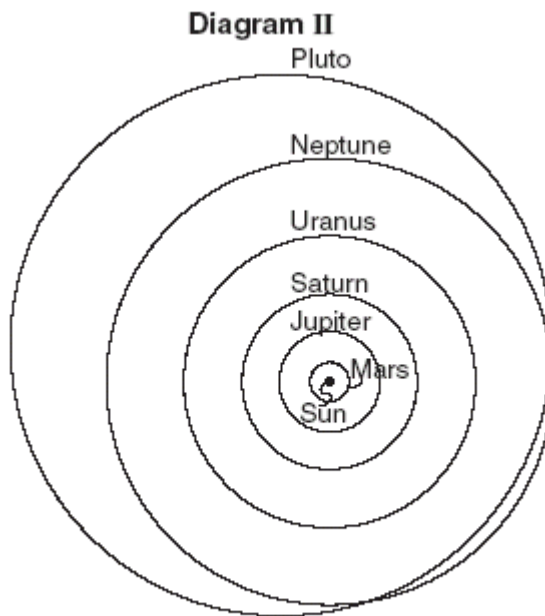
6/06

1 Which object is closest to Earth? (1) the Sun (2) Venus (3) the Moon (4) Mars

Base your answers to questions 56 through 60 on the two diagrams below. Diagram I shows the orbits of the four inner planets. Black dots in diagram I show the positions in the orbits where each planet is closest to the Sun. Diagram II shows the orbits of the six planets that are farthest from the Sun. The distance scale in diagram II is different than the distance scale in diagram I.



(Not drawn to scale)



(Not drawn to scale)

56 On diagram I, place the letter **W** on Mars' orbit to represent the position of Mars where the Sun's gravitational force on Mars would be *weakest*.

57 On diagram II, circle the names of the *two* largest Jovian planets.

58 How long does it take the planet Uranus to complete one orbit around the Sun? Units must be included in your answer.

59 Describe how the orbits of each of the nine planets are similar in shape.

60 Pluto's orbital speed is usually slower than Neptune's orbital speed. Based on diagram II, explain why Pluto's orbital speed is sometimes faster than Neptune's orbital speed.

1/06

1 Which event takes the most time?

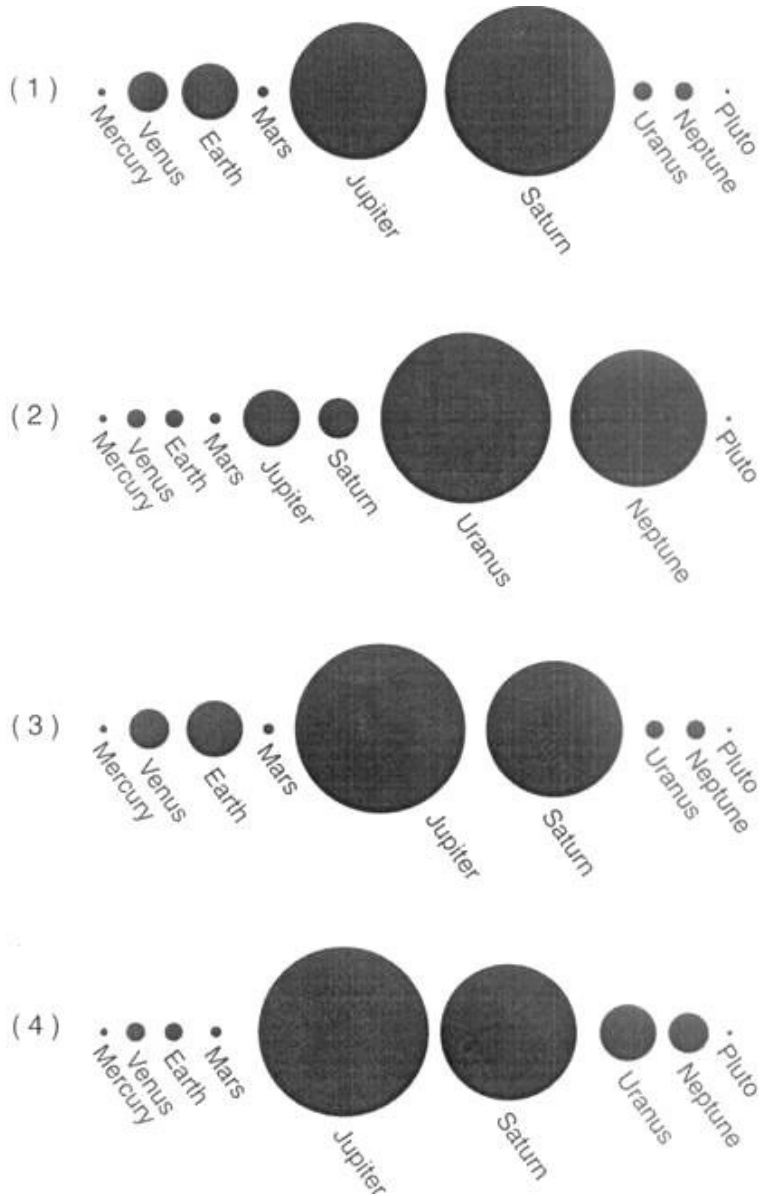
- (1) one revolution of Earth around the Sun (2) one revolution of Venus around the Sun
(3) one rotation of the Moon on its axis (4) one rotation of Venus on its axis

2 Compared to the Jovian planets in our solar system, Earth is

- (1) less dense and closer to the Sun (2) less dense and farther from the Sun
(3) more dense and closer to the Sun (4) more dense and farther from the Sun

6/04

10 Which sequence correctly shows the relative size of the nine planets of our solar system?



1/04

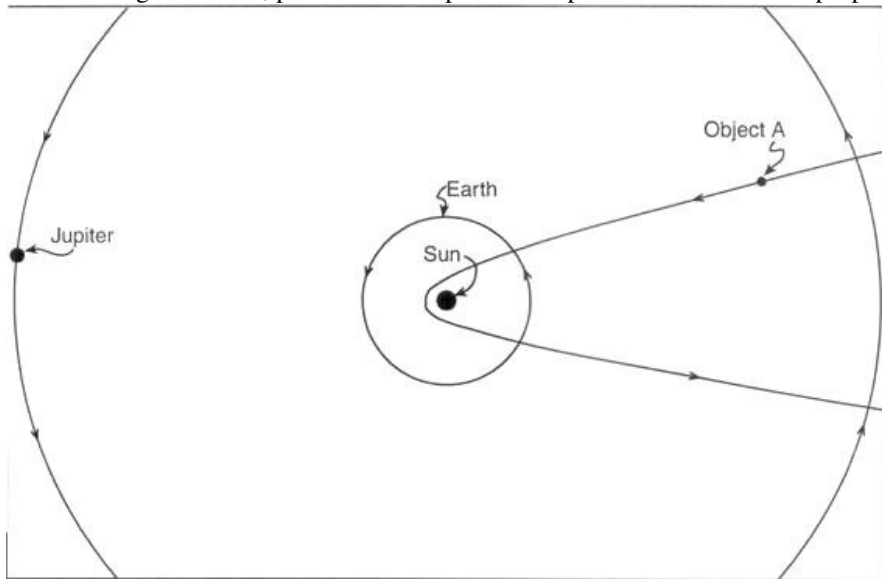
4 How do Jupiter's density and period of rotation compare to Earth's?

- (1) Jupiter is less dense and has a longer period of rotation.
- (2) Jupiter is less dense and has a shorter period of rotation.
- (3) Jupiter is more dense and has a longer period of rotation.
- (4) Jupiter is more dense and has a shorter period of rotation.

Base your answers to questions 68 through 70 on the diagram provided in your answer booklet, which shows a model of the orbital path of Earth and the partial orbital path of Jupiter around the Sun. A partial orbit of another celestial object, labeled object A, is also shown. Celestial object A is a natural object that is part of our solar system. [All distances are measured to scale from the center of the Sun in this model.]

68

a On the diagram below, place an **X** to represent the position of Mars at the properly scaled distance from the Sun in this model.



Distance scale 1 cm = 100 million kilometers

(Object size not drawn to scale)

b On the diagram provided in your answer booklet, starting at your plotted position of Mars, draw a scale model of Mars' orbital path. Be careful to show the correct shape of the orbit.

69 Identify what type of solar-system object is most probably represented by celestial object A.

70 State one reason why determining the exact orbital path and period of revolution of celestial object A might be important to the continued existence of life on Earth.

8/03

1 Which statement correctly compares the size, composition, and density of Neptune to Earth?

- (1) Neptune is smaller, more gaseous, and less dense.
- (2) Neptune is larger, more gaseous, and less dense.
- (3) Neptune is smaller, more solid, and more dense.
- (4) Neptune is larger, more solid, and more dense.

1/03

3. Three planets that are relatively large, gaseous, and of low density are

- (1) Mercury, Jupiter, and Saturn
- (2) Venus, Jupiter, and Neptune
- (3) Mars, Jupiter, and Uranus
- (4) Jupiter, Saturn, and Uranus

Base your answers to questions 64 and 65 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.

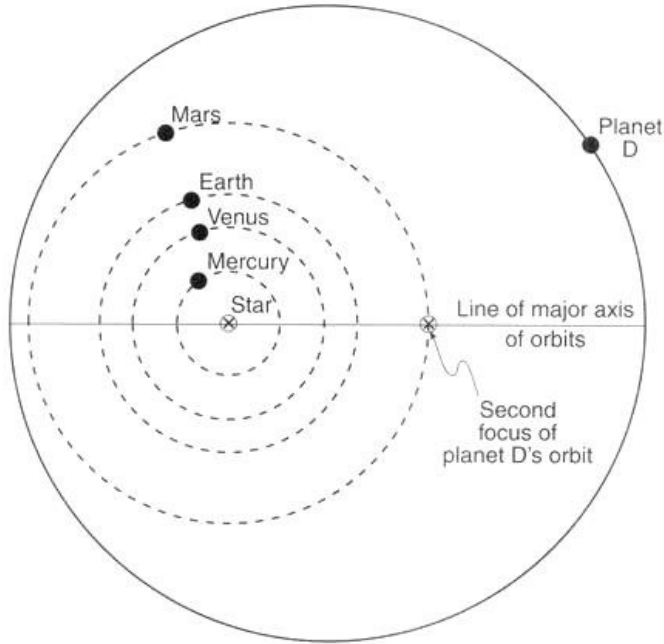
Astronomers peer closer to big bang

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.

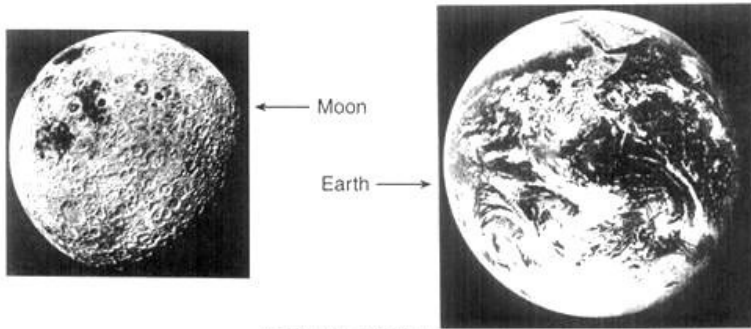
64 The big-bang theory is widely believed by astronomers to explain the beginning of the universe. Why does the light from distant galaxies support the big-bang theory?

65 Compare the age of Earth and our solar system to the age of these distant galaxies of stars.

Base your answers to questions 66 and 67 on the diagram below, which shows the orbit of planet D around the star Upsilon Andromedae. The dashed lines show where the paths of the first four planets of our solar system would be located if they were going around Upsilon Andromedae instead of the Sun. All distances are drawn to scale.



- 66 Describe the eccentricity of planet D's orbit relative to the eccentricities of the orbits of the planets shown in our solar system.
- 67 Describe the changes in gravitational force between planet D and the star Upsilon Andromedae during one complete orbit around the star. Be sure to describe where the force is greatest and where the force is least.
- 68 The photographs below show the Moon and Earth as viewed from space. It is inferred that Earth had many impact craters similar to those shown on the Moon.



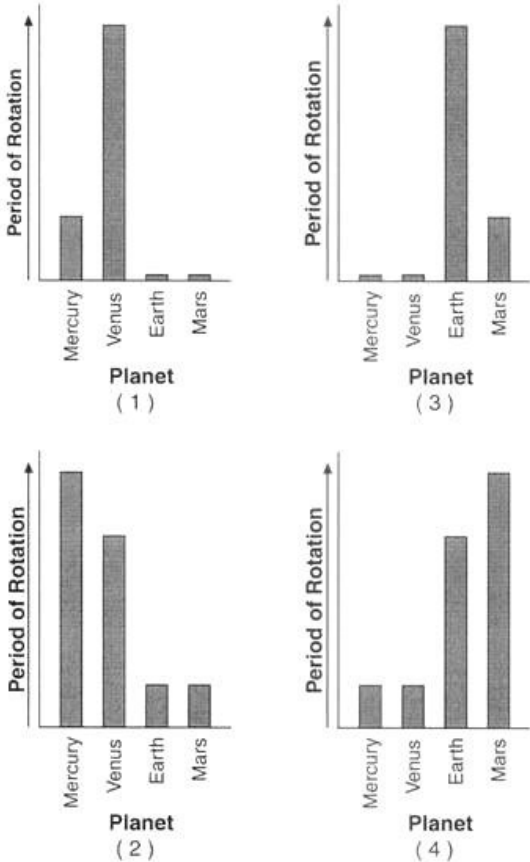
(Not drawn to scale)

Describe one process that has destroyed many of the impact craters that once existed on Earth.

8/02
5 A major belt of asteroids is located between Mars and Jupiter. What is the approximate average distance between the Sun and this major asteroid belt?

- (1) 110 million kilometers (2) 220 million kilometers (3) 390 million kilometers (4) 850 million kilometers

9 Which graph best represents the relative periods of rotation of Mercury, Venus, Earth, and Mars?



6/02
35 Compared to the average density of the terrestrial planets (Mercury, Venus, Earth, and Mars), the average density of the Jovian planets (Jupiter, Saturn, Uranus, and Neptune) is (1) less (2) greater (3) the same

Base your answers to questions 52 through 54 on the data table below, which shows one cycle of equinoxes and solstices for the northern hemispheres of several planets in the solar system and the tilt of each planet's axis. Data for the planets are based on Earth's time system.

Data Table

Planet	Spring Equinox	Summer Solstice	Autumn Equinox	Winter Solstice	Tilt of Axis (degrees)
Venus	June 25	August 21	October 16	December 11	3.0
Earth	March 21	June 21	September 23	December 22	23.5
Jupiter	1997	2000	2003	2006	3.0
Saturn	1980	1987	1995	2002	26.8
Uranus	1922	1943	1964	1985	82.0
Neptune	1880	1921	1962	2003	28.5

52 State the length, in years, of the spring season on Uranus.

53 Describe the relationship between a planet's distance from the Sun and the length of a season on that planet.

54 Identify two factors that cause seasons on Earth.

1/02

2 Which planet takes more time to complete one rotation on its axis than to complete one revolution around the Sun?

- (1) Mercury (2) Venus (3) Mars (4) Jupiter

25 Which planet has an orbit with an eccentricity most similar to the eccentricity of the Moon's orbit around Earth?

- (1) Earth (2) Jupiter (3) Pluto (4) Saturn

6/01

3 Compared to Pluto, Mercury moves more rapidly in its orbit because Mercury

- (1) is larger (2) is more dense (3) is closer to the Sun (4) has a more elliptical orbit