CHAPTER 28

Study Guide

STUDY TO GO

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BIG Idea Using the laws of motion and gravitation, astronomers can understand the orbits and the properties of the planets and other objects in the solar system.

Section 28.1 Formation of the Solar System

Vocabulary

- astronomical unit (p. 800)
- eccentricity (p. 801)
- ellipse (p. 800)
- planetesimal (p. 798)
- retrograde motion (p. 799)

Key Concepts

MAIN Idea The solar system formed from the collapse of an interstellar cloud.

- A collapsed interstellar cloud formed the Sun and planets from a rotating disk.
- The inner planets formed closer to the Sun than the outer planets, leaving debris to produce asteroids and comets.
- Copernicus created the heliocentric model and Kepler defined its shape and mechanics.
- Newton explained the forces governing the solar system bodies and provided proof for Kepler's laws.
- Present-day astronomers divide the solar system into three zones.

Section 28.2 The Inner Planets

Vocabulary

- scarp (p. 805)
- terrestrial planet (p. 804)

Key Concepts

MAIN Idea Mercury, Venus, Earth, and Mars have high densities and rocky surfaces.

- Mercury is heavily cratered and has high cliffs. It has a hot surface and no real atmosphere.
- Venus has clouds containing sulfuric acid and an atmosphere of carbon dioxide that produces a strong greenhouse effect.
- Earth is the only planet that has all three forms of water on its surface.
- Mars has a thin atmosphere. Surface features include four volcanoes and channels that suggest that liquid water once existed on the surface.

Section 28.3 The Outer Planets

Vocabulary

- belt (p. 812)
- gas giant planet (p. 811)
- liquid metallic hydrogen (p. 812)
- zone (p. 812)

Key Concepts

MAIN Idea Jupiter, Saturn, Uranus, and Neptune have large masses, low densities, and many moons and rings.

- The gas giant planets are composed mostly of hydrogen and helium.
- The gas giant planets have ring systems and many moons.
- Some moons of Jupiter and Saturn have water and experience volcanic activity.
- All four gas giant planets have been visited by space probes.

Section 28.4 Other Solar System Objects

Vocabulary

- comet (p. 819)
- dwarf planet (p. 816)
- Kuiper belt (p. 818)
- meteor (p. 818)
- meteorite (p. 818)
- meteoroid (p. 818)
- meteor shower (p. 819)

Key Concepts

MAIN Idea Rocks, dust, and ice compose the remaining 2 percent of the solar system.

- Dwarf planets, asteroids, and comets formed from the debris of the sola system formation.
- Meteoroids are planetesimals that enter Earth's atmosphere.
- Mostly rock and ice, the Kuiper belt objects are currently being detected and analyzed.
- Periodic comets are in regular, permanent orbit around the Sun, while others might pass this way only once.
- The outermost regions of the solar system house the comets in the Oort cloud.

CHAPTER 28 Assessment

Vocabulary Review

Each of the following sentences is false. Make each sentence true by replacing the italicized words with terms from the Study Guide.

1. Rapid shrinkage of Mercury's crust produced features on its surface called *rilles*.
2. The pattern of light and dark bands on Jupiter's surface are called belts and *flows*.
3. A *meteor* is a rocky object that strikes Earth's surface.
4. A *meteorite* formed as particles of dust and gas stuck together in the early solar system.
5. The apparent backward movement of Mars as Earth passes it in its orbit is *synchronous rotation*.
6. A *light-year* is a unit of measurement used to measure distances within the solar system.

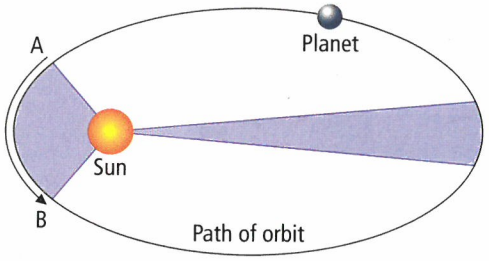
Match each phrase below with the correct term from the Study Guide.

7. a small icy object having a highly eccentric orbit around the Sun
8. Mercury, Venus, Earth, and Mars
9. multiple streaks of light caused by dust particles burning in Earth's atmosphere
10. a measure of orbital shape
11. a new solar system body classification

Understand Key Concepts

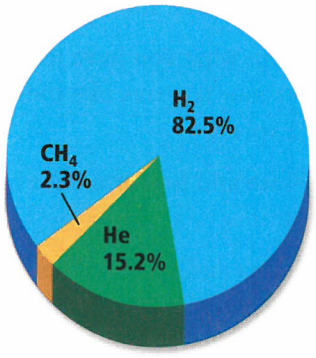
12. Who first proposed the heliocentric model of the solar system?
    - **A.** Copernicus
    - **B.** Galileo
    - **C.** Kepler
    - **D.** Newton

Use the diagram below to answer Question 13.



13. Which law of planetary motion does this diagram demonstrate?
    - **A.** Kepler's first law
    - **B.** Kepler's second law
    - **C.** Kepler's third law
    - **D.** Newton's law of universal gravitation
14. Which best describes a planet's retrograde motion?
    - **A.** apparent motion
    - **B.** orbital motion
    - **C.** real motion
    - **D.** rotational motion
15. Which scientist determined each planet orbits a point between it and the Sun, called the center of mass?
    - **A.** Copernicus
    - **B.** Galileo
    - **C.** Kepler
    - **D.** Newton

Use the diagram below to answer Question 16.



16. The atmospheric composition of which planet is shown above?
    - **A.** Jupiter
    - **B.** Mars
    - **C.** Neptune
    - **D.** Venus

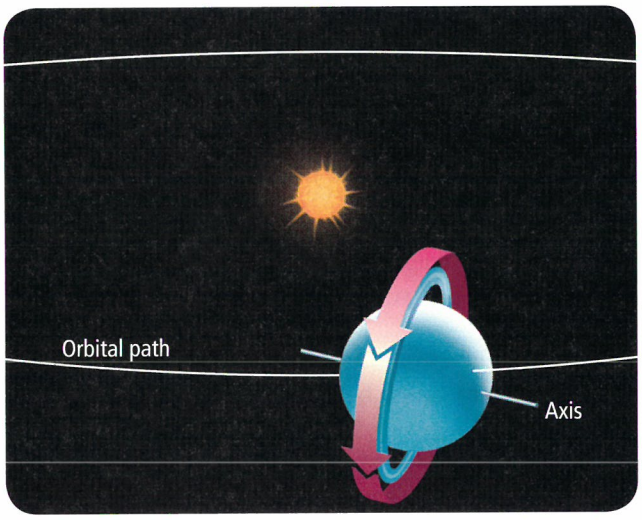
17. Where do most meteorites originate?
    - **A.** asteroid belt
    - **B.** Kuiper belt
    - **C.** Oort cloud
    - **D.** Saturn's rings

Constructed Response

Use the photo below to answer Questions 18 and 19.

18. **Identify** these features shown on the surface of Mars and explain what most likely caused them.
19. **Infer** Based on what you have learned about Mars, state whether new features like these could be made now. Explain.
20. **Compare** Pluto and Eris and determine their common features.
21. **Compare** Sedna and EL61 to the dwarf planets and determine which features are common to each.
22. **Explain** why probes do not survive on the surface of Venus.
23. **Compare** the pivot point on a seesaw and a center of mass between two orbiting bodies.
24. **Calculate** Find the shape of an ellipse having an eccentricity of 0.9.

Use the diagram below to answer Questions 25 and 26.



25. **Identify** the planet shown here and explain why scientists think its rotational axis is like this.
26. **Infer** how the seasons would be affected if Earth had an axis tilt similar to Uranus.

Think Critically

27. **Explain** The atmospheres of Mars and Venus contain similar percentages of CO_2, but Venus has a much higher surface temperature because of the greenhouse effect. Why doesn't this happen on Mars?
28. **CAREERS IN EARTH SCIENCE** Most astronomers do not spend long hours peering through telescopes. They operate telescopes remotely using computers and spend most of their time analyzing data. What subjects would astronomers find most useful in addition to astronomy?
29. **Discuss** the theory of formation of the rings of Saturn and the other gas giant planets.
30. **Infer** the role gravity plays in the formation of the rings of the gas giant planets.
31. **Infer** what might happen to Halley's comet as it continues to lose mass with each orbit of the Sun.
32. **Explain** why scientists think Jupiter's moon Europa might have liquid water beneath its surface.

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Use the table below to answer Questions 33 to 35.

Planet	Radius (km)	Orbital Eccentricity	Semimajor Axis (AU)
Mercury	2439.7	0.2056	0.39
Venus	6051.8	0.0067	0.72
Earth	6378.1	0.0167	1.00
Mars	3397	0.0935	1.52
Jupiter	71,492	0.0489	5.20
Saturn	60,298	0.0565	9.54
Uranus	25,559	0.047	19.19
Neptune	24,766	0.009	30.07

33. Interpret Which of the planets has an orbit that most closely resembles a perfect circle?

34. Compare Which two planets have the most similar radii?

35. Evaluate Which two planets' orbits are separated by the greatest distance?

36. Discuss the relationship between asteroids and planetesimals.

37. Explain Why were Ceres and Pluto identified as the first dwarf planets?

38. Compare and contrast the asteroid belt and the Kuiper belt.

Concept Mapping

39. Create a concept map using the following terms: *interstellar cloud, gas, dust, disk, particles, planetesimals, terrestrial planets, gas giant planets, satellites, debris, asteroids, meteoroids,* and *comets.*

Challenge Question

40. Consider Pluto's orbit sometimes brings it within the orbit of Neptune. Why is it unlikely that the two will collide? Explain.

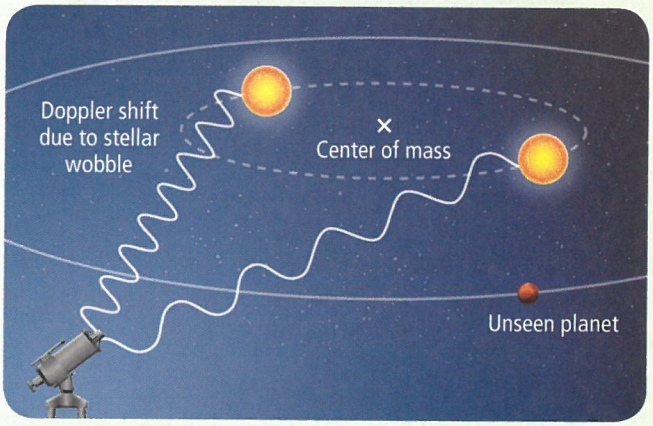
Additional Assessment

41. WRITING in Earth Science Write a paragraph to explain to a friend how science develops over time. Discuss the relationship between Kepler's laws and Newton's law of universal gravitation.

DBQ Document–Based Questions

Data obtained from: *Physics World.* 2001. (January): 25.

Astronomers have detected planets around more than 200 stars. Although the planets themselves are too small to see directly, astronomers can detect them by measuring the Doppler shift in the star's light as it orbits its common center of mass with the unseen planet. The diagram below shows how this works.



42. Based on the diagram, what is the rotational direction of the star? Explain.

43. Based on what you know about the center of mass, which planet in our solar system would be most likely to be detectable from other star systems using this method?

Cumulative Review

44. Name an example of a felsic, igneous rock. **(Chapter 5)**

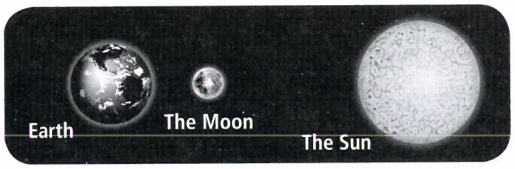
45. Describe the relationship between ejecta and rays on the Moon's surface. **(Chapter 27)**

Standardized Test Practice

Multiple Choice

1. When foxes reach the brink of extinction in an area, what happens to the population of rabbits in the area?
   - **A.** The rabbit population also becomes extinct.
   - **B.** The rabbit population increases indefinitely.
   - **C.** The rabbit population increases beyond the carrying capacity of the area, then decreases.
   - **D.** The rabbit population decreases beyond the carrying capacity of the area, and then quickly increases.

Use the diagram below to answer Questions 2 and 3.



2. What results on Earth when the Sun and the Moon are aligned along the same direction?
   - **A.** spring tides
   - **B.** neap tides
   - **C.** the autumnal equinox
   - **D.** the summer solstice

3. If the Moon in this diagram were passing directly between the Sun and Earth, blocking the view of the Sun, what would you experience on Earth?
   - **A.** a lunar eclipse
   - **B.** a solar eclipse
   - **C.** umbra
   - **D.** penumbra

4. Earth's main energy source is
   - **A.** fossil fuels
   - **B.** hydrocarbons
   - **C.** the Sun
   - **D.** wind

5. Which describes life during the early Proterozoic Era?
   - **A.** simple, unicellular life forms
   - **B.** complex, unicellular life forms
   - **C.** simple, multicellular life forms
   - **D.** complex, multicellular life forms

6. Which is not considered a biomass fuel?
   - **A.** peat
   - **B.** coal
   - **C.** fecal material
   - **D.** wood

Use the illustration below to answer Questions 7 and 8.

7. Which type of fossil preservation is shown?
   - **A.** trace fossil
   - **B.** original remains
   - **C.** carbon film
   - **D.** altered hard parts

8. By studying the fossils, which is not something scientists can learn about the organism that left these prints?
   - **A.** movement
   - **B.** size
   - **C.** habitat
   - **D.** walking characteristics

9. When minerals in rocks fill a space left by a decayed organism, what type of fossil is formed?
   - **A.** trace fossil
   - **B.** cast fossil
   - **C.** petrified fossil
   - **D.** amber-preserved fossil

10. How are Mercury and the Moon similar?
    - **A.** Both are covered with craters and plains.
    - **B.** Both have the same night-to-day temperature difference.
    - **C.** They have the same strength of surface gravity.
    - **D.** Both have an extensive nickel-iron core.

Short Answer

Use the table below to answer Questions 11 to 13.

Apparent Temperature Index					
	Relative Humidity (%)				
Air Temperature (F°)		80	85	90	95
	85	97	99	102	105
	80	86	87	88	89
	75	78	78	79	79
	70	71	71	71	71

11. If the air temperature is 24°C and the relative humidity is 85%, what would the apparent temperature feel like?

12. What can be inferred about the effect relative humidity has on apparent temperature as the air temperature increases?

13. In the fall, when temperatures are moderate, how should a person plan for temperature with relative humidity factored in?

14. Although a hybrid car still requires fuel to run, why is it considered a better use of energy resources?

15. What are some steps mining companies are taking to be less destructive to the environment?

Reading for Comprehension

Tau Gruis, The Newest Planet

An international team of researchers has discovered the 100th "extrasolar" planet. This newest planet orbits the star Tau Gruis, 100 light-years from Earth, in the southern hemisphere's constellation Grus (the crane). In order to actually detect a planet, a planet must be seen going around its orbit at least once. Although scientists have been watching Tau Gruis since 1998, this is the first time that they have been able to confirm the presence of its large planet. This is an indication that there is a considerable distance between the star and the planet. Soon after the first extrasolar planets were found, beginning in 1995, most planets were found in orbit close to their host stars. Planets closer to their suns orbit at a much faster rate, and therefore take much less time to detect. Starting out, planets close in to their parent stars were found. But as the planet search program has matured, more planets farther out and in nearly circular orbits are being found. This means that scientists are getting closer to detecting more systems that are similar to our own solar system.

Article obtained from: Brendle, A. Hundredth planet outside solar system discovered. *National Geographic News.* September 17, 2002.

16. What can be inferred from this passage?

A. Our solar system is unique.
B. Detecting planets is virtually impossible.
C. As technology improves, more planets will be found.
D. Large planets are harder to find than small planets.

17. What must happen in order for an object to be considered a planet?

A. The object must go around its orbit at least once.
B. It must orbit its parent star at a particular speed.
C. It must be a particular size.
D. It must be within 100 light-years of Earth.

NEED EXTRA HELP?															
If You Missed Question . . .	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Review Section . . .	26.1	27.3	27.3	25.1	22.4	25.1	21.4	21.4	21.4	28.2	11.2	11.2	11.2	25.3	26.2