

CHAPTER

7

Study Guide

Gravitation

Vocabulary Review

Write the term that correctly completes the statement. Use each term once.

- | | |
|---------------------------------------|--------------------|
| Kepler's second law | gravitational mass |
| Newton's law of universal gravitation | inertial mass |
| gravitational field | |

- _____ describes the amount of resistance an object has to any application of force.
- _____ states that an imaginary line drawn between a planet and the Sun sweeps out equal areas in equal time periods.
- _____ If the _____ of an object is increased, the gravitational force it experiences will increase as a result.
- _____ The region around Earth in which objects experience a force due to Earth's gravity is called the _____.
- _____ _____ suggests that objects attract other objects with a force that is proportional to the product of their masses and inversely proportional to the square of the distance between them.

Section 7.1

Planetary Motion and Gravitation

In your textbook, read about planetary motion, Kepler's laws and Newton's law of universal gravitation on pages 171-176.

Match the name of the scientist with the correct contribution. Each name may be used more than once.

Nicholas Copernicus

Johannes Kepler

Tycho Brahe

Isaac Newton

- _____ was the first astronomer to propose that the Sun is the center of the solar system.
- _____ believed that all planets except Earth orbit the Sun.
- _____ used huge instruments he built himself to record the exact positions of the planets and stars.
- _____ used 30 years worth of observations made by other scientists and concluded that the planets orbit the Sun.
- _____ proposed that the force exerted on a planet by the Sun is inversely proportional to the distance between centers of the planet and the Sun.

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Answer the following questions. Use complete sentences or show your calculations.

24. Given the value of pi and the universal gravitational constant, what other information would you need to calculate the period of a planet orbiting the Sun?

25. Describe the balance Cavendish used to find an experimental value for the universal gravitational constant.

26. What is the gravitational force between two 1.00-kg masses that are placed 1.00 m apart? What is another name for this number?

Section 7.2**Using the Law of Universal Gravitation**

In your textbook, read about the orbits of planets and satellites on pages 179–180.

Write the term that correctly completes the statement.

- The motion of a projectile has both _____ and _____ components.
- A projectile fired horizontally will accelerate toward Earth at a rate of _____.
- If the magnitude of the _____ component of a projectile's motion is great enough, the projectile will fall to Earth at the same rate that Earth curves away from the projectile.
- A projectile fired horizontally from less than 150 km above the surface of Earth will fall back to Earth no matter how fast it is traveling because of _____.
- An object that falls to Earth at the same rate that Earth curves away from the object is said to be in _____.

In your textbook, read about the motion of satellites and acceleration due to gravity on pages 180–182. For each statement below, write true or rewrite the italicized part to make the statement true.

- _____ 6. The speed of a satellite orbiting Earth depends only on the mass of Earth and the *mass of the satellite*.
- _____ 7. The equations of motion are *different* for objects in orbit around Earth and for planets orbiting the Sun.
- _____ 8. Orbital speed and period are *independent* of the mass of the satellite.
- _____ 9. If the radius of Earth were changed but the mass remained the same, acceleration due to *gravity would not change*.
- _____ 10. As you move farther away from Earth's center, acceleration due to gravity changes according to a *direct* relationship.
- _____ 11. Even though astronauts on the space shuttle appear to be weightless, Earth's gravitational force on the space shuttle is *not zero*.

In your textbook, read about the gravitational field, inertial mass, and gravitational mass on pages 182–184.

Answer the following questions. Use complete sentences.

12. What units are used to measure the strength of gravitational fields?

13. In which direction does the force of Earth's gravitational field always act?

14. Describe the difference between gravitational and inertial mass.

15. Does the inertial mass depend on the distance between objects? Explain.

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Read about Einstein and his general theory of relativity on pages 184–185.

For each description on the left, write the letter of the matching term on the right.

- | | |
|---|---------------------------------|
| _____ 16. the effect of mass on space | a. gravitational field |
| _____ 17. effect of gravity on light | b. general theory of relativity |
| _____ 18. Einstein thought gravity was a(n) | c. curvature |
| _____ 19. an object so dense that light leaving the object is bent back on itself | d. effect of space |
| _____ 20. predicts the <i>effects</i> of gravity | e. deflection |
| _____ 21. allows us to picture gravity acting at a distance | f. black hole |

Complete each statement by writing the correct term in the blank provided.

22. Newton's law of universal gravitation allows us to calculate the _____ force that exists between two bodies because of their mass.
23. Einstein proposed that gravity is not a _____, but rather an effect of _____ itself.
24. According to Einstein, the mass of a body changes the _____ around it.
25. _____ causes space to be curved, and other bodies are accelerated because of the way they follow this curved space.
26. According to Einstein's theory of _____, if an object is massive and dense enough, any light it emits is actually bent back to the object.