Date _____ Period _____ Name _____

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	

1. Inertial mass describes the amount of resistance an object has to any application of force.
2. Kepler's 2nd law states that an imaginary line line drawn between a planet and the Sun sweeps out equal areas in equal time periods.
3. gravitational mass If the ____ of an object is increased, the gravitational force it experiences will increase as a result.
4. gravitational field The region around Earth in which objects experience a force due to Earth's gravity is called the ____.
5. Newton's Law of Universal gravitation ____ 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

1. Copernicus was the first astronomer to propose that the Sun is the center of the solar system.
2. Brahe believed that all planets except Earth orbit the Sun.
3. Brahe used huge instruments he built himself to record the exact positions of the planets and stars.
4. Kepler used 30 years worth of observations made by other scientists and concluded that the planets orbit the Sun.
5. Newton 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.

Name _____

7 Study Guide

6. Kepler discovered that the shape of a planet's orbit is an ellipse.

7. Newton was the first to theorize that the force that makes objects fall to Earth is the same force that the Sun exerts on the planets.

8. Kepler used geometry and mathematics to discover his three laws of planetary motion.

Write* first, second, *or* third *in the blanks to indicate which of Kepler's laws the statement is describing.

3rd **9.** relates the motion of more than one object about a single body

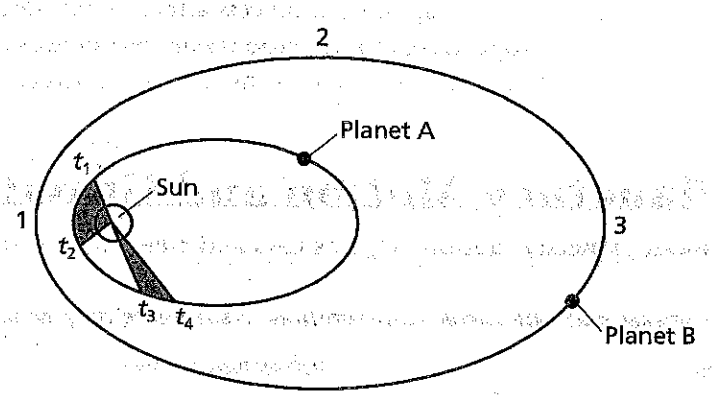
1st **10.** describes the shape of the planets' orbits

1st **11.** states that the Sun is located at one focus of a planet's orbit

3rd **12.** $\left(\frac{T_A}{T_B}\right)^2 = \left(\frac{r_A}{r_B}\right)^3$

2nd **13.** states that an imaginary line drawn from a planet to the Sun will sweep out equal areas in equal time intervals

In your textbook, read about Kepler's laws and Newton's law of universal gravitation on pages 172–176.
Refer to the diagram to answer questions 14–18.



14. The shaded portions of Planet A's orbit represent the area swept out by an imaginary line between the Sun and the planet between times t_1 and t_2 and between times t_3 and t_4. If the area of these shaded regions is equal, what must be true about the time intervals $t_2 - t_1$ and $t_4 - t_3$?

$(t_2 - t_1) = (t_4 - t_3)$

15. If you know the period of both Planets A and B, what other information would you need to determine Planet A's average distance from the Sun?

planet B's average distance from sun

16. The gravitational field of the Sun exerts a force on Planet B. At which point on the orbit of Planet B is this force at its least? At which point is it greatest?

least	most
least at pt 3	at pt 1

17. At point 3, Planet B is six times further from the Sun than it is at point 1. If the magnitude of the force exerted on Planet B by the gravitational field of the Sun at point 1 is F, what is the magnitude of the force at point 3?

1/36 the force

18. If the period of Planet A is T_A and the period of Planet B is T_B and Planet A's average distance from the Sun is r_A, write a formula that represents r_B, Planet B's average distance from the Sun.

$$r_B = \sqrt[3]{\frac{T_B^2}{T_A^2}\left(r_A^3\right)}$$

In your textbook, read about universal gravitation on pages 176–178.

Fill in the chart with the correct values of* F *for each change in the system described in questions 19–23.

The magnitude of the gravitational force between two masses, P and Q, is F.

Change in System	New Magnitude of Force
19. The mass of P is doubled.	2x the F
20. The distance between the masses is doubled.	1/4 the F
21. The mass of P is doubled and the mass of Q is tripled.	6x the F
22. The entire mass of the system is increased by a factor of four.	4 x the F
23. The distance between the masses is halved.	4 x the F

Name _____

7 Study Guide

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?

mass of Sun
planet's ave distance from Sun

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

Nah - don't bother

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?

6.67×10^{-11}

Its the grav. constant

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.

1. The motion of a projectile has both horizontal and vertical components.

2. A projectile fired horizontally will accelerate toward Earth at a rate of $9.80\ m/s^2$.

3. If the magnitude of the horizontal 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.

4. 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 air resistance.

5. An object that falls to Earth at the same rate that Earth curves away from the object is said to be in orbit.

Name _____

Study Guide 7

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.

F **6.** The speed of a satellite orbiting Earth depends only on the mass of Earth and the ~~*mass of the satellite.*~~ radius of the satellite's orbit

F **7.** The equations of motion are ~~*different*~~ for objects in orbit around Earth and for planets orbiting the Sun. the same

T **8.** Orbital speed and period are *independent* of the mass of the satellite.

F **9.** If the radius of Earth were changed but the mass remained the same, acceleration due to ~~*gravity would not change.*~~ would change

F **10.** As you move farther away from Earth's center, acceleration due to gravity changes according to a ~~*direct*~~ relationship. inverse square

T **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?

N/kg or m/s^2

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

toward Earth's center

14. Describe the difference between gravitational and inertial mass.

attraction between 2 masses

resistance to change in motion

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

NO

just resistance to a Force that causes a change in motion