Physics

Name: Key Period: _____

Gravity Unit Study Guide

$F_g = \frac{Gm_1m_2}{r^2}$ $g = \frac{Gm}{r^2}$ $Weight = mg$ $G = 6.67 \times 10^{-11}$

Planet	Radius (m)	Mass (kg)
Mercury	2.43×10^6	3.2×10^{23}
Venus	6.073×10^6	4.88×10^{24}
Earth	6.4×10^6	6.0×10^{24}
Mars	3.38×10^6	6.42×10^{23}
Jupiter	6.98×10^7	1.901×10^{27}
Saturn	5.82×10^7	5.68×10^{26}

1. The earth's gravitational force pulls on the moon, and the moon's gravitational force pulls on the earth. Which gravitational force is greater? Why?

Equal

The same

Newton's 3rd law equal + opposite

2. Your friend (mass of 100 kg) is hanging out in South America (at sea level). Calculate the force due to gravity between the earth and your friend.

$$\frac{(6.67 \times 10^{-11})(100)(6.0 \times 10^{24})}{(6.4 \times 10^6)^2}$$

3. Your friend's identical twin brother is vacationing in Europe (at sea level). Calculate the force due to gravity between the earth and this twin.

Same as #2 everything is the same

4. Give the equation for the Law of Universal Gravitation. State what each variable and unit stands for.

$F_g = \frac{Gm_1m_2}{r^2}$

F_G = force of Gravity (Newtons)

G = Gravitational constant

$m_1 m_2$ = masses (grams)

r^2 = distance (meters)

5. Give the equation for acceleration due to gravity. What are the units for gravity?

$g = \frac{Gm}{r^2}$ gravity = m/s^2 (acceleration)

6. Calculate the **force of gravity** acting on a 50 kg person standing on the surface of Mars.

$$F_g = \frac{Gm_1m_2}{r^2} = \frac{(6.67 \times 10^{-11})(50)(6.42 \times 10^{23})}{(3.38 \times 10^6)^2}$$

187.41 g

7. Calculate the **acceleration due to gravity** acting on a person standing on the surface of Mars. How does this value for ***g*** compare to Earth's value of 9.8 m/s²? Part 2: If the person has a mass of 65 kg, what is their weight?

$g = \frac{GM}{r^2}$ $\frac{(6.67 \times 10^{-11})(6.42 \times 10^{23})}{(3.38 \times 10^6)^2} = 3.75\ m/s^2$ less than earth

$F = mg$

$= 65(3.75)$

$= 243.75\ N$

8. Solve the Fg equation for radius.

$F_g = \frac{GmM}{r^2}$ $r^2 = \frac{GmM}{F_g}$ $r = \sqrt{\frac{Gm_1m_2}{F_g}}$

9. You are watching a movie about space with your friend, Derrick. Derrick notices the astronauts floating and says "you know the reason they are floating is because there is no gravity in space." You do a double take in shock. Why?

Because there is always gravity, even in space

10. The gravitational force between two large objects is 10 N. If the **distance between the two objects is doubled**, and **one mass gets doubled** what is the force between them?

$F_g = \frac{GMM}{r^2}$ $\frac{2}{2^2} = \frac{2}{4}$ $\frac{1}{2}(10) =$ **5 N**

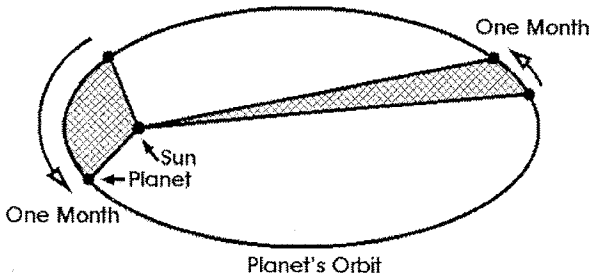
11. The gravitational force between two objects is 10 N. What would happen to the force if the distance was **cut in half**?

$\frac{1}{(\frac{1}{2})^2} = \frac{1}{1/4} = \times 4$ $4 \times 10 =$ **40 N**

Centripetal Force and Gravity

12. According to Kepler's 1st law, what sort of shape do planets and moons follow? What force is necessary for object to stay in a curved path?

elliptical centripetal force



Kepler's Laws. Use this diagram.

13. Where in the orbit will the planet have the strongest force of gravity on it? Where does it travel the slowest? What is true of the shaded areas?

- closer to sun
- farthest from sun
- equal areas, equal time

Kepler's Third Law

14. Planetary data is shown below. Radius and period data are expressed relative to the Earth's radius and period.

	Planet Period (Earth years) ^{2}	Ave. Radius (astron. units) ^{3}
Mercury	0.241	0.39
Venus	0.615	0.723
Earth	1.00	1.00
Mars	1.88	1.52
Jupiter	11.86	5.20
Saturn	29.5	9.54
Uranus	84.0	19.18
Neptune	164.81	30.06
Pluto	248	39.44

Calculate the missing variables using the formula provided in class. * Always use earth if possible

$\frac{T^2}{r^3} = \frac{T^2}{r^3}$ cross multiply

$\frac{1^2}{1^3} = \frac{(.615)^2}{r^3}$

$\sqrt[3]{.378} = \sqrt[3]{r^3}$

$.723 = r$

$\frac{1^2}{1^3} = \frac{t^2}{(5.20)^3}$

$\sqrt{t^2} = \sqrt{140.608}$

$t = 11.86$

$\frac{1^2}{1^3} = \frac{(29.5)^2}{r^3}$

$\sqrt[3]{870.25} = \sqrt[3]{r^3}$

$r = 9.54$

$\frac{1^2}{1^3} = \frac{t^2}{(30.06)^3}$

$\sqrt{t^2} = \sqrt{27162.32}$

$t = 164.81$