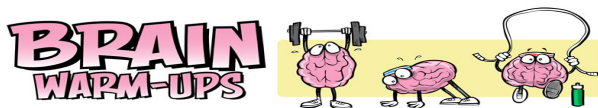
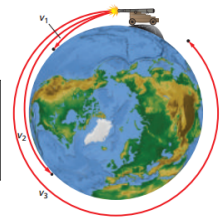


ANNOUNCEMENTS		
HOMEWORK	LABS	TEST
Unit 8 Practice Problems (1-9)	Gravitation Interactive (RSVCP)	Unit 8 Test Thursday Dec.20

# 8.2 Using the Law of Universal Gravitation

## LEARNING TARGETS

**8.2** I can define, explain, and apply Newton's Law of Universal Gravitation to solve problems.



- Two spheres are placed so that their centers are 2.6 m apart. The force between the two spheres is  $2.75 \times 10^{-12}$  N. What is the mass of each sphere if one sphere is twice the mass of the other sphere?
- What is the effective value of  $g$  on the International Space Station that orbits at an altitude of 254 miles above sea level.

## Gravitation

### Key Concepts

- Newton's law of universal gravitation states that the gravitational force between any two objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers. The force is attractive and along a line connecting their centers.

$$F = G \frac{m_1 m_2}{r^2}$$

- All objects have gravitational fields surrounding them.

$$g = \frac{Gm}{r^2}$$



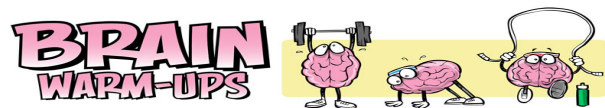
- Two spheres are placed so that their centers are 2.6 m apart. The force between the two spheres is  $2.75 \times 10^{-12}$  N. What is the mass of each sphere if one sphere is twice the mass of the other sphere?

$$2.75 \times 10^{-12} = G \frac{m_1 m_2}{r^2} = (6.67 \times 10^{-11}) \left( \frac{m \cdot 2m}{2.6^2} \right)$$

$$\sqrt{\frac{(2.7 \times 10^{-12})(2.6^2)}{2(6.67 \times 10^{-11})}} = m$$

$$m_1 = 0.37 \text{ kg}$$

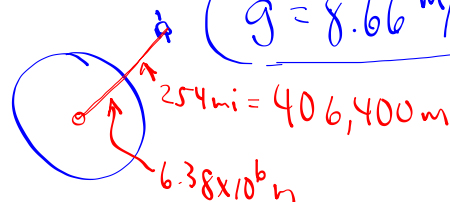
$$m_2 = 0.74 \text{ kg}$$



- What is the effective value of  $g$  on the International Space Station that orbits at an altitude of 254 miles above sea level.

$$g = G \frac{M_E}{r^2} = \frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})}{(6.38 \times 10^6 + 406,400)^2}$$

$$g = 8.66 \text{ m/s}^2$$



### What Do You Believe?

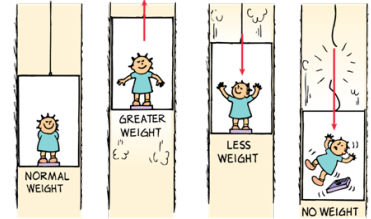
Astronauts on the orbiting space station are weightless because...

- a. the Shuttle is so far from the Earth, gravity is negligible
- b. the Shuttle's gravity balances the Earth's, so that the net gravity is zero
- c. the Shuttle is falling around the Earth (and everything aboard is in free fall)
- d. the Shuttle has an antigravity device on board, developed by NASA
- e. the rules Newton developed for gravity only hold on Earth, not once you get into space



### Weight and Weightlessness

The perception of weight is equal to the force that you exert against the supporting floor or scale.



### Scale Readings and Weight

The condition of **weightlessness** is not the absence of gravity, but rather the absence of a support force.

Both people are without a support force and therefore experience weightlessness.

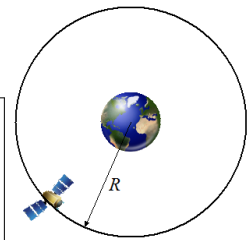


## 8.3 Satellite Motion

### LEARNING TARGETS

8.3

I can define, explain, and apply Kepler's laws to solve problems involving satellite motion.



### History of Orbital Motion

Nicholas Copernicus



Tycho Brahe

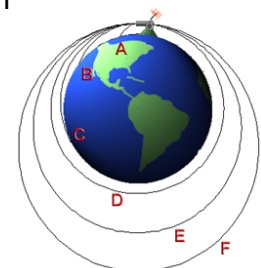


Johannes Kepler



### History of Orbital Motion

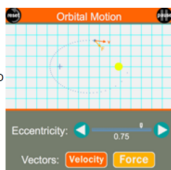
Isaac Newton



## ORBITAL MOTION INTERACTIVE

### Orbital Motion

Everyone knows that the planets orbit the Sun in a circular orbit, right? Well ... not exactly. A 17th century mathematician by the name of Johannes Kepler was able to show that the orbits of planets about the sun are elliptical in shape. In this Interactive, learners will investigate the nature of an elliptical orbit.



### Purpose:

The purpose of this activity is to investigate the nature of an elliptical orbit of a planet or other satellite about the Sun or some central body.