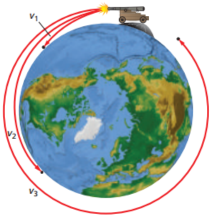
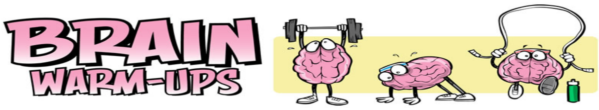
ANNOUNCEMENTS		
HOMEWORK	LABS	TEST
Unit 8 Practice Problems (1-8)	Gravitation Interactive (RSVCP)	Unit 8 Test Thursday Dec.20

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.





5) Two balls have their centers 2.0 m apart, as shown in **Figure 7-23.** One ball has a mass of 8.0 kg. The other has a mass of 6.0 kg. What is the gravitational force between them?

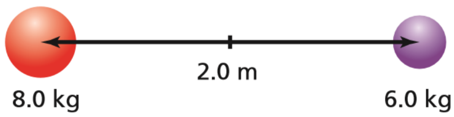


Figure 7-23

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.

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

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

BIG "G"

$$G = 6.67 \times 10^{-11}\ \frac{N \cdot m^2}{kg^2}$$

5) Two balls have their centers 2.0 m apart, as shown in **Figure 7-23.** One ball has a mass of 8.0 kg. The other has a mass of 6.0 kg. What is the gravitational force between them?

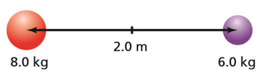


Figure 7-23

$$F = G\frac{m_1 m_2}{r^2} = (6.67\times10^{-11})\left(\frac{8 \cdot 6}{2^2}\right)$$

6.67E-11 x 8 x 6 ÷ (2²)

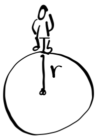
$$F = 8.0\times10^{-10}\ N$$

0.0000000008 N

Gravitational Field

$F_g = m_p g \qquad F_g = G\frac{m_1 m_2}{r^2}$

$m_p g = G\frac{m_p M_E}{r_E^2}$



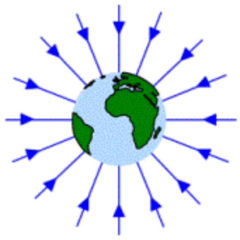
$M_E = 5.98 \times 10^{24}$ kg

$r_E = 6.38 \times 10^{6}$ m

Gravitational Field

Gravitational Field $g = \frac{GM}{r^2}$

The gravitational field is equal to the universal gravitational constant times the object's mass, divided by the square of the distance from the object's center. The direction is toward the mass's center.



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

Scale Readings and Weight

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

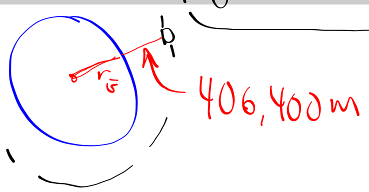
Both people are without a support force and therefore experience weightlessness.

International Space Station

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

$$g = G\frac{M_E}{r^2} = \frac{(6.67\times10^{-11})(5.98\times10^{24})}{(6.38\times10^{6} + 406{,}400)^2}$$

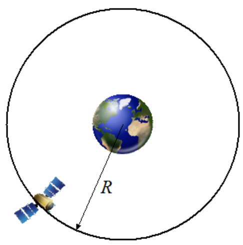
$$g = 8.66\ \mathrm{m/s^2}$$



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 Gravitation

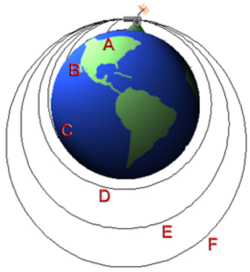
Nicholas Copernicus

Tycho Brahe

Johannes Kepler

History of Gravitation

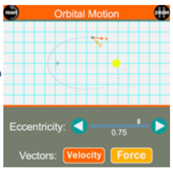
Isaac Newton



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.