Circular motion and Gravity objectives sheet **Name_____**
Honors physics

This unit will allow each student to:

a. gain a better understanding of the concepts of vectors and circular motion and gravity
b. continue making proper scientific measurements and calculations
c. define and properly use all vocabulary
d. properly apply all terms and concepts in describing/explaining real world examples
e. continue making and interpreting scientific graphs
f. teach someone else the concepts discussed
g. practice proper laboratory safety

This will be accomplished by each student that is able to:

1. recognize and relate SI and USCS units of time, distance, speed, velocity, and acceleration
2. recognize a time, distance, speed, velocity, and acceleration by the units only
3. distinguish between scalar and vector quantities
4. draw a vector to properly representing vector quantities (tangential velocity and centripetal acceleration) for an object going in a circle at any given point
5. perform calculations using proper problem solving techniques (K-U-E-S) to determine tangential velocity, centripetal acceleration, and centripetal force
6. explain the difference between centripetal force and centrifugal force
7. experimentally determine the centripetal force on an object
8. completely describe the motion of an object in a circular orbit
9. explain the concept of universal gravitation (Newtonian gravity)
10. perform calculations using proper problem solving techniques (K-U-E-S) to determine gravitational force, masses, and distances separating the masses
11. explain the concept of weightlessness
12. completely describe satellite motion as a special case of projectile motion and circular motion

Textbook Reference – Physics: Principles and Problems
Chapters: 6 (circular),7 (gravity), 8 (rotational)

Key Terms

scalar, vector, centripetal acceleration, centripetal force, angular velocity, tangential velocity, radius of curvature, centrifugal force, universal gravitation, satellite, projectile, general relativity, spacetime,

Circular motion (centripetal motion)

1. What is the difference between linear speed (tangential velocity) and rotational speed (angular velocity)?

2. A group of 20 roller skaters make a long chain (also called a whip) in the skating rink. Consider the 3rd person in the chain and the 20th person in the chain. How do their angular velocities compare? How do their tangential velocities compare?

3. A runner goes around a circular track that has a radius of 20 meters. She runs once around the track in 12 seconds. Calculate the tangential velocity of the runner. (Hint: remember…the runner is going around *a circle.)*

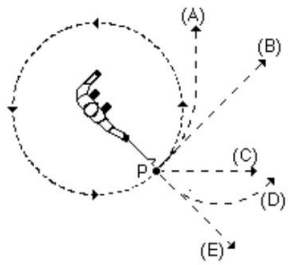
4. Calculate the centripetal acceleration and the centripetal force that acts on a 50 kg person going 20 m/s on an amusement park ride that has a radius of 8 meters. Calculate the centripetal force on the person.

5. When you whirl a can at the end of a string in a circular path, what is the direction of the force that acts on the can? What causes that force?

6. Does the force that holds the riders on the carnival ride act toward or away from the center?

7. Explain why there is no actual centrifugal force. Hint: Think Newton's third law and inertia

8. A steel ball is whirled around in a circle at the end of a string (shown in the diagram). Which path will the steel ball follow if it is released at point P? Explain why.



Gravity

9. What quantities affect the amount of gravitational force that exists between two objects?

10. Why do the astronauts experience "weightlessness" when they are orbiting the Earth in the space station?

11. In terms of centripetal force and gravity, explain why planet A that is closer to the Sun would orbit faster than planet B that is farther from the Sun, even if both planets had the same mass.

12. Explain why there is less surface gravity on the Moon than on Earth.

13. According to Newton's 3rd law, for every force, there is an equal and opposite force. If the Earth pulls on the Moon, what is the "opposite force?" Which object is pulled with a greater force? Greater acceleration? Why doesn't the Moon come crashing into the Earth?

14. Calculate the gravitational force that exists between the Sun (mass = 1.99×10^{30} kg) and Mercury (mass = 3.3×10^{23} kg) when they are separated by a distance of 6.98×10^{10} meters.

15. An 80 kg person is sitting on the Earth (m= 5.98×10^{24} kg) at a distance of 6400 km from the center of the Earth. What is the gravitational force between the Earth and the person? (Hint: convert to meters.)

16. An 80 kg astronaut is orbiting the Earth (m= 5.98×10^{24} kg) at a distance of 6,720,000 m from the center of the Earth. What is the gravitational force between the Earth and the astronaut? How does this compare to the force on the person in the previous problem? Is this enough to be "weightless?"

17. If the distance between the Sun (mass = 1.99×10^{30} kg) and Saturn (mass = 5.7×10^{26} kg) is 1.4×10^{12} m, then what is the gravitational force between these two objects? Which pulls more? Sun on Saturn? Saturn on Sun?

18. A person of mass m is on Earth, a distance D away from the center of the Earth, and experiences a gravitational force F. If the person were moved to a distance 4D away from the Earth, the new force on the person is____?