Universal Gravitation and Circular motion practice **Name**_____
Honors Physics

Universal Gravitation

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

2. 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.

3. 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.)

4. 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?"

5. 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?

6. 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____?

7. A truck of mass m is on Earth, a distance D away from the center of the Earth, and experiences a gravitational force F. If rocks were added to the bed of the truck so that the truck's mass were 2m, the new force on the truck would be ____?

Circular motion (centripetal motion)

8. 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 rotational velocities compare? How do their linear (tangential) velocities compare?p

9. A 46 kg runner goes around a circular track that has a radius of 20 meters. She runs once around the track in 12 s. Calculate the (a) rotational speed, (b) the linear (tangential) velocity, (c) the centripetal acceleration, and (d) the centripetal force that acts on the runner.

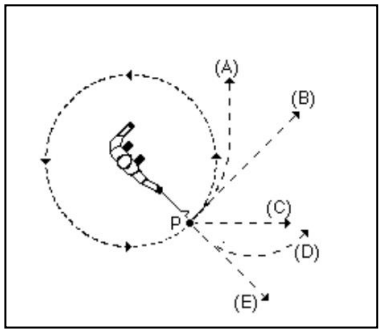
10. Calculate the (a) rotational speed, (b) the centripetal acceleration, and (c) the centripetal force that acts on a 50 kg person going 20 m/s on an amusement park ride that has a radius of 8 meters.

11. 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?

12. Does the force that holds the riders on a circular carnival ride act toward or away from the center of the ride?

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

14. 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.



15. 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?