Put these in your problem notebook! The first eight problems are from The Physics Classroom Calculator Pad **Problem Set: Circular Motion and Gravitation.** Solutions to these are online, and I'll have my own solutions posted online as a Pencast after they are due. The last two problems (DF 1 & DF2) are ones I came up with based on questions from previous AP Physics exams, and the short answers are at the end of each problem.

DUE: _____

3 SIG. FIG'S. IN GENERAL *REMEMBER: Centripetal forces are directed toward the center*

PC # 1. During their physics field trip to the amusement park, Sky, Aaron, and Claire took a ride on the Whirligig. The Whirligig ride consists of long swings which spin in a circle at relatively high speeds. As part of their lab, Sky and Claire estimate that the riders travel through a circle with a radius of 6.5 m and make one turn every 5.8 seconds. Determine the speed of the riders on the Whirligig.

PC # 3. During the spin cycle of a washing machine, the clothes stick to the outer wall of the barrel as it spins at a rate as high as 1800 revolutions per minute. The radius of the barrel is 26 cm.

a. Determine the speed of the clothes (in m/s) which are located on the wall of the spin barrel.
b. Determine the acceleration of the clothes and note the direction of the acceleration.

PC # 6. In the display window of the toy store at the local mall, a battery-powered plane is suspended from a string and flying in a horizontal circle. The 631-gram (0.631 kg) plane makes a complete circle every 2.15 seconds. The radius of the circle is 0.950 m. Determine the velocity of, acceleration of, and centripetal force acting upon the plane. (*The Physics Classroom* asks for net force, so as a thought question I'd ask – is that different than the centripetal force? Be prepared to answer this in class)

PC # 11. Jacob is in her Mercedes C250 and trying to make a turn off an expressway at 19.0 m/s. The turning radius of the level curve is 35.0 m. Her car has a mass of 1240 kg. Determine the acceleration, net force and minimum value of the coefficient of friction which is required to keep the car on the road.

PC # 14. Dani is driving his1500-kg Lexus RX through a horizontal curve on a level roadway at a speed of 23 m/s. The turning radius of the curve is 65 m. Determine the minimum value of the coefficient of friction which would be required to keep Dani's car on the curve.

PC #16. Alex and Lance have masses of 84 kg and 59 kg respectively. They sit 1.0 m apart in the front center of Mr. Forrest's physics class. For some time, they each have been sensing a sort of attraction in their relationship. And now, halfway through their physics course, they have learned that they are gravitationally attracted to each other. Determine the magnitude of this force of gravitational attraction.

PC # 17 (modified). The earth and the moon are gravitationally attracted. Their masses are 5.98×10^{24} kg and 7.26×10^{22} kg, respectively. The average distance separating the Earth and the moon is 3.84×10^{8} m.
a) Determine the force of gravitational attraction of the earth on the moon.
b) Determine the force of gravitational attraction of the moon on the earth.
c) Draw a Free Body diagram for the forces between the earth and the moon
d) Which of the two objects will be more <u>affected</u> by the force? Explain why.

PC # 21. Use Newton's law of gravitation to determine the acceleration of an 85-kg astronaut on the International Space Station (ISS) when the ISS is at a height of 350 km above Earth's surface.
The radius of the Earth is 6.37×10^{6} m. (GIVEN: Mass of Earth = 5.98×10^{24} kg)

OVER FOR FINAL TWO PROBLEMS → → →

DF1. Assume that on an alien world, the mass of the planet is twice that of the earth and the diameter is also twice that of the earth. In terms of *g*, the earth's gravitational acceleration of 9.8 m/s^2, what would be the acceleration on the surface of this alien planet? **Answer: *g*/2**

DF2. Hopefully, humans will be able to explore Mars in our lifetimes. One problem to overcome is that human muscle and bone mass decrease in the absence of a gravitational field. To overcome this, a rotating spaceship could be used to create artificial gravity. Assume NASA wants to have a spacecraft with a radius of 100 m develop an artificial gravity of 9.8 m/s^2 to mimic the earth.

a) How fast would the outside radius need to spin? **Answer: 31.0 m/s**
b) How many seconds to complete one full revolution? **Answer. 20.0 s**

Once the astronauts reach Mars, they'll find themselves on the surface of a planet with a mass of 6.39×10^{23} kg and a diameter of 6,780 km.
c) What is the gravitational acceleration on the surface of Mars, in m/s^2? **Answer: 3.7 m/s^2**