PHYSICS 230 LAB #5- Centripetal Force

You have gone through four labs – You probably see who is contributing and who is not. If a group member is not working for your group, do not hesitate to release him/her from the group. The student will find a group with the same philosophy. After going through four labs (that is, one third of total labs), you should know how to write a lab report by now. So, I will start grading more severely. Each member should be reading the procedure before actual lab period and each one should be checking others' work.

So far in the lab, we had two labs of static equilibrium cases, $\sum \vec{F} = 0$ (lab #1 &2), two cases of $\sum \vec{F} = m\vec{a}$ (lab #3 & 4). When there is non-zero net outside force acting on a system, the system will have acceleration. Acceleration causes velocity to change. Since "velocity" is a vector, the system will change its (a) speed, (b) direction, or (c) both. We examined the case (a) in the labs #3 and #4. In this lab, we are going to examine the case (b) – outside force is needed to make a circular motion – the force is used to change only direction without changing speed. The force is then called "Centripetal Force".

There are two setups, PSSC kit and Cenco kit. In case of PSSC kit, the centripetal force is achieved by the tension of the string (This is exactly like a homework question – if you have not done yet, do the homework first. Then, this will make perfect sense.), and Cenco kit, spring tension.

PSSC Apparatus

This is a very simple device – PVC pipe and a metal piece and a rubber stopper connected by a piece of string. Make sure to spin the rubber stopper, not the metal – before my time, someone span the metal part and string broke off. Let everyone spin the PSSC kit and decide who is the best swinger – the rubber stopper should be as horizontal as possible without changing its radius. Hold the pipe around your face, spin it without moving your wrist too much and keep the metal piece stay at the same height. If the rubber stopper sags too much, what should you do? Make it as horizontal as possible with what you are allowed to use. Take at least three measurements. Draw a force diagram, pick points, establish coordinate system, etc. Because of the nature of apparatus, you are allowed to have an error up to 15% (of course, the less the better.) If you have a high error, do not forget to discuss WHY you have a high error, which is not avoidable.

Cenco Apparatus

You need a pair of eye goggles. During the experiment, whoever is holding a counter does not wear goggle will lose five points for the group. Spring tension setting marker on the rotor does not mean anything. It is just a rough estimation – set it to low, middle, and high. Do not forget to measure each spring tension before going to the next tension setting. Also, do not forget to add the mass of rotating bob when you calculate the spring tension. This spring tension is the centripetal force. When the bob is rotating and is brought to the edge, the indicator will go up. You can change the speed of rotor – each motor is different so study how you can control the speed at the lab prep session. Notice that when the speed increases, the indicator stays up – this is the typical mistake students make - they over-estimate the speed. You must choose the speed so that the bob just barely touches the indicator, and it is not easy to get the correct speed. You will spend most of the time finding the correct speed for each setting in this lab. Once the speed is set, lock it, and start counting. Don't forget to indicate the counter numbers before and after for data. Do this for about 10 seconds X 3 times for each spring tension. Then, calculate the centripetal force from the average speed for each tension and compare it with the spring tension.

If you are smart, by measuring the spring tension, you can estimate speed you are looking for. If your speed is different, there must be something incorrect. Let the estimated speed be your guide.