PHYSICS 230 LAB #7- Ballistic Pendulum

In this lab, you are going to calculate initial velocity of the ball with two independent ways. The first way is to apply a newly learned concept of "momentum" and a semi-new idea of "energy". The second way is an old method of "projectile", which we know it works. On the lab report, create section of "**Prediction**" prior to the procedure section. Then, predict which method will result a faster initial speed and discuss the reasons why you think so. You must include frictions in both methods. On the conclusion, you can discuss your prediction versus the result. You need to be careful because the expected speed of the ball in this lab is about 6 m/sec, which is much faster than the previous lab. In this lab, you are using "Conservation of energy", "Conservation of momentum", and "projectile motion". Once again, make sure to understand why you can use a certain theory at a certain part AND why you can't use another theory at the same point, which is more important to know.

Initial setting

Set the apparatus so that you can clamp it down with two C-clamps diagonally. On your procedure, do not forget to put where the clamps were set. Adjust the clamps so that the apparatus is horizontal. If the rubber feet are flattened, you are clamping it too much. See the picture. This is what happens if you clamp it down too much. Not only do you damage the feet, but also damage screws.

Pendulum

Study the structure of the pendulum. Find the correct way to release the ball from the pendulum (without breaking it). Measure the masses of the pendulum and the ball. When you put the pendulum back to the apparatus, adjust the top screws so that the socket part of the pendulum aligns with the ball. If this is not done correctly, the ball will not be captured by the pendulum. There is an indicator on the pendulum. Measure the initial height, h_0 when the pendulum is hanging freely and not moving (Once is enough – so on the data section, write down once.). Think about where h_0 should be measured from. When the ball is fired, the pendulum-ball system will go up and the system will stop. Measure the height again from the indicator. The number on the grooves (the catcher) does not mean anything. So, don't use it. Do this six times at least. It's important to understand which theory can be applied, and more importantly, to understand why which theory cannot be applied. Make sure to understand at a certain point why you can use "conservation of energy", but not "conservation of momentum" and vice versa. After using those theories at appropriate places, you can derive the initial speed of the ball to be $v_0 = \frac{m_b + m_p}{m_b}\sqrt{2g\Delta h}$. You should be able to calculate the % energy lose upon the collision. Do this even though the manual does not indicate so. You can compare and discuss this energy loss with the energy loss you calculated in the lab #6, launching tube in the conclusion. Are they surprisingly different? Keep these separately for the next week's lab. We are going to the other extreme.

Projectile

Latch the pendulum so that when the ball is fired, it becomes a projectile motion. The initial angle is zero to make the calculation easier for this lab. Do a trial run to estimate where the ball lands, but be cautious about where the ball will impact. Make sure that the ball doesn't collide with any person and/or lab station. Place a piece of white paper and tape it down. Put a carbon paper over it (without tape it down), and start shooting the ball. Other measurements needed are initial height of the ball (from the bottom of the ball to the floor – to do this, you will have to break into portions since it is not an easy one measurement.) and ranges. For ranges, you will have to measure by breaking it into separate sections. A difference of 1 cm makes big difference in result. So, think very carefully as to how to measure the range – especially from the gun to the end of the table. Hint: you need to measure this distance when those equations you built become applicable. The starting point is when the ball starts dropping. Now, set a regular X-Y coordinate system to solve the initial speed. ($v_0 = R\sqrt{\frac{g}{2h}}$) Also, notice that the ball does not land at the same place every time – both in range and side way motion. Discuss why the ball lands at different distance as well as sideways. **Please do not throw the carbon paper away, but return to the front table.**

Even though this is not asked to do, but because you know the velocities before and after the collision, you should show % energy lost at the collision.