**name**________________________

**ID#** ________________________

**Experiment 5**

# The Ballistic Pendulum

**Method I**

**mass of ball (m)** __________

**mass of ball and catcher (m + M)** __________

**notch 1** _____ **notch 2** _____ **notch 3** _____

**average notch number**_____

**resting center of mass height** _______________

**raised center of mass height** _______________

**change in height** __________

$$U = \frac{(M + m)\sqrt{2gh}}{m} =$$

**Method II**

**Y** _______________

**R** _______________

$$U = R\sqrt{\frac{g}{2Y}} =$$

**% difference =** _______________

**(6 points)**

Momentum is always conserved in an isolated system where there are no other forces acting on the colliding bodies. If other forces are exerted on the objects momentum will be gained or lost. Consider what happens when two cars run into each other on a dry street. What other forces act on the cars? Is momentum conserved? Why or why not? What happens to the kinetic energy lost in the collision?

Compare this to a collision between two cars during a typical Atlanta ice storm. Is more or less force exerted on the cars? Is more or less momentum conserved? What about energy? If all other things were equal, in which collision would you expect to see more damage to the cars?

**Questions**

1. In the collision between the ball and the catcher momentum is conserved. Kinetic energy is not conserved; only a fraction, *F*, of the ball's kinetic energy is transferred to the ball and catcher during the collision:

$$F = \frac{1/2(M + m)\,V^2}{1/2\,m\,U^2}$$

Use conservation of momentum to solve for either *U* or *V*. Plug that value into the ratio of the final and initial kinetic energies and do the necessary algebra to show that: **(2 points)**

$$F = \frac{1/2(M + m)\,V^2}{1/2\,m\,U^2} = \frac{m}{M + m}\,.$$

2. What was the actual fraction of the kinetic energy transferred in your experiment? Use your values for *V* and *U* to calculate the actual kinetic energies. Does it equal $\frac{m}{M + m}$? **(2 points)**

3. Look at the equation above. What happens to the amount of kinetic energy transferred as the ball *(m)* gets bigger? What happens as the mass of the catcher *(M)* gets bigger? **(4 points)**

4. Why was the distance *Y* measured from the floor to the bottom of the ball rather than to the center of mass? **(2 points)**

5. In Method II, if the velocity of the ball had been doubled due to a stronger gun spring, how would the ball's time of flight have changed? Why? **(4 points)**