**Your Mission: The time has finally arrived to use the metal loop-the-loop in the back of the class. Your mission will be to use your new understanding of energy (kinetic, potential, and the conservation of both) to find the correct height from which to release the ball so that it *just* makes it around the loop.**

* **Groups whose ball successfully completes the loop with their measurements will receive 2 extra credit points.**
* **The group with the lowest height (IE, the one where it just makes it around the loop) will receive 5 extra credit points.**

**Step 1: Finding the velocity needed to complete the loop.**

**Measure the radius of the loop: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_m**

**Find the mass of the ball: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_kg**

**Remember that, at the top of the loop, gravity and the normal force both contribute to the centripetal force**

Fg

FN

**At the minimum velocity needed to travel around the circle, *only* gravity acts on the object at the top of the loop (normal force = 0).**

**Fg= \_\_\_\_\_\_\_\_\_\_\_\_\_\_N**

**ag= \_\_\_\_\_\_\_\_\_\_\_\_\_\_m/s2**

**Knowing this, we can find the minimum velocity to complete the top of the loop, because we know that for circular motion, a=v2/R**

**v = \_\_\_\_\_\_\_\_\_\_\_\_\_\_m/s**

**Step 2: Finding the mechanical energy of the system**

**Now – at the top of the loop, your ball will have some potential energy (mgh) and some kinetic energy (½mv2). Find the total mechanical energy at the top of the loop**

**PE = \_\_\_\_\_\_\_\_\_\_\_J**

**KE=\_\_\_\_\_\_\_\_\_\_\_\_J**

**ME=\_\_\_\_\_\_\_\_\_\_\_\_J**

**In a perfect world, with no external forces, mechanical energy is conserved. Find the total mechanical energy, potential energy, and kinetic energy at the bottom of the loop**

**ME=\_\_\_\_\_\_\_\_\_\_\_\_J**

**PE=\_\_\_\_\_\_\_\_\_\_\_\_\_J**

**K­E=\_\_\_\_\_\_\_\_\_\_\_\_\_J**

**Step 3: Finding the height**

**Using the kinetic energy for the bottom of the loop that your group found, find the velocity of the ball at the bottom of the loop.**

**v = \_\_\_\_\_\_\_\_\_\_\_\_\_m/s2**

**Using the conservation of energy, find the potential energy necessary to result in this velocity at the bottom of the loop.**

**PE = \_\_\_\_\_\_\_\_\_\_\_\_\_J**

**Find the height where the ball will have this potential energy. (PE=mgh)**

**h = \_\_\_\_\_\_\_\_\_\_\_\_\_\_m**

**This is the height where the ball will *just* make it around the loop in a perfect world, free of external forces.**

**Step 4: Accounting for external forces**

**What external forces might actually be working on the ball? (List any and all)**

**I am hoping you recognized *friction* and *air resistance*. The best way to measure the amount of energy lost is to do a trial run from a known height, and to measure the height it achieves on the other side. We will set up a proportion to relate the energy in our known heights to our unknown needed height.**

**ME1 (known release height)= \_\_\_\_\_\_\_\_**

**ME2 (known reached height) = \_\_\_\_\_\_\_\_**

**Your proportion should be as follows:**

**Solving for X, you will find the amount of energy needed to complete the loop: \_\_\_\_\_\_\_\_\_\_\_\_J**

**Now find your new projected height by finding the height necessary to achieve this amount of energy**

**h = \_\_\_\_\_\_\_\_\_\_\_\_\_m**

**Once your group has your final height, you get *one shot* at releasing the ball. If it makes it – congratulations! If not, better luck next time.**

**Once your group has released your ball, your group should create a one page (12pt, double space) analysis detailing:**

* **The steps you took to arrive at your final height (be specific!)**
* **If it worked or not**
* **Why you believe it did/did not work**
* **Suggestions for the next time you do this procedure.**

**Each group needs to hand in ONE of these packets, plus your analysis with all group member’s names.**