

## Conservation of Energy

Name: \_\_\_\_\_

### Pre-lab:

Have these questions completely filled out before you come to class on Monday.

**Part 1:** Re-write these questions and put their answers in your regular class notes. You may use your textbook (chapter 5) or any notes you find on the class website to help you. If you cannot find information in either of those two locations, you may search the internet—I recommend going to the “Hyperphysics” website for some good information.

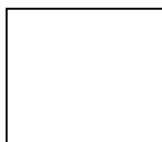
1. Define the following both with words and with an equation:
  - a. Energy (no equation necessary)
  - b. Total Mechanical Energy
  - c. Kinetic Energy
  - d. Potential Energy
  - e. Law of conservation of energy
2. What are the units for energy? How do these units break down into fundamental units?
3. A 1.50 kg flower pot is sitting on a shelf that is 2.32 m above the floor. How much potential energy does the flower pot have?
4. A curious cat knocks the flower pot off the shelf and it falls to the floor. Assuming that there is no energy lost due to air resistance, how fast will the flower pot be traveling the instant before it hits the ground?



### Part 2:

Answer these questions in your lab notebook

5. Describe the mechanical energy changes that take place when a ball rolls down a hill.
6. How can we apply the law of conservation of energy to systems where only mechanical energy is measured? (What assumptions must be made?)
7. Describe the changes in mechanical energy that occur while riding a roller coaster.
8. How will you calculate the speed of a marble as it rolls down the track if all you have is a photogate that gives you time?
9. Imagine a roller coaster. Where on the roller coaster will a rider have the largest potential energy? Where on the roller coaster will a rider have the largest kinetic energy?



## Lab: Conservation of Mechanical Energy

**Purpose:** To verify the law of conservation of mechanical energy by analyzing the potential energy and the kinetic energy of a marble as it moves along a rollercoaster track.

### Materials:

- 1 CPO Rollercoaster track
- 1 steel marble
- 1 CPO Photogate and Timer
- Meter stick

### Procedure:

1. Set up the equipment as demonstrated in class
2. Set the mode of the timer to “interval” and connect one photogate to input A.
3. Attach the photogate to the track approximately 5 cm from the starting peg at the top of the track.
4. Measure the height at this initial position of the photogate.
5. Set the marble on the track and hold it against the starting peg.
6. Release the marble and record the time it took for the marble to travel through the photogate.
7. Repeat steps 4-6 until you have done a sufficient number of trials for that position.
8. Move the photogate approximately 8 cm down the track.
9. Repeat steps 4-8 for positions along the entire length of the rollercoaster track. You should have room for at least 12 positions.
10. Measure the mass and the diameter of the marble you use for this exercise.

### Data Collection and Analysis:

- Create an appropriate data table for all raw data (**2 points**)
- Create a second data table for all calculated values: velocity, potential energy, kinetic energy, and total mechanical energy (**2 points**)
  - o Don't forget to show sample calculations and to propagate your errors
- Create a graph showing all three types of energy (potential, kinetic, and total mechanical) as a function of position along the track. You do not need a linear fit for the potential and kinetic energy graphs (as they are not linear functions), but you will need a linear fit on the total mechanical energy. (**1 point**)
- What percentage of the initial total mechanical energy was “lost” by the time the marble reached the end of the roller coaster track? (**1 point**)
- Create a second graph that shows how the height affects the velocity—you may need to make a second graph after manipulating either your x-axis or your y-axis values. Make sure it is linear; once it has been linearized, add your max and min slopes to this graph. (**2 points**)

**Conclusion and Evaluation (CE):** Please complete this according to the rubric (*6 points possible*)