*Energy Lab*
*PSI Physics*

Name_____

**Objectives:**

- To test conservation of energy.
- To apply conservation of energy to problem solving.

**Materials:**

- Dynamics Cart and Rail
- PASCO interface
- Motion sensor (if possible, set to wide beam)
- Computer with PASCO capstone software
- Meter stick and tape

**Preparing the PASCO Capstone Software:**

1. Connect the motion sensor to the PASCO interface (the yellow plug goes into digital input port 1, and the black plug goes into port 2). Turn on the interface.
2. Open the Capstone software on the computer. On the left sidebar, click "Hardware Setup." Then, click the yellow circle that represents the first digital port (where the yellow plug is), and select "Motion Sensor II."
3. On the right sidebar, double click the "Graph" icon. Make the x-axis measure position (in centimeters) and the y-axis measure velocity. Then, double click the "Table" icon. Make sure there is a column that measures position, and that another measures velocity.

**Procedure:**

1. Measure the mass of the dynamics cart in kg. Record this in the table on the next page.
2. Slide the motion sensor into the end of the dynamics rail that starts at 1cm. Place that end of the rail on an incline by placing books underneath it. Leave the other end of the rail unblocked so the cart can roll off of it.
3. Mark the starting point at 15 cm down from the motion sensor with a piece of tape. (This is due to the fact that the motion sensor has a 15cm "dead zone").
4. Pick 3 spots on the dynamics rail beyond the start point that are not close to each other. Mark these spots with tape, and record their position in the table.
5. Using the meter stick, record how high the top of the dynamics rail is in relation to the table top at each of these four points (the starting point and the three you chose).
6. Hold the dynamics cart with its rear at the 15 cm tape mark.
7. Start the PASCO Capstone recording software and release the cart. Stop the recording when the cart rolls off of the track.
8. Using the point tool, get the velocity, $v$, at each of the tape marks. Record your data in the chart below. Use the chart on the Capstone software to help you.

**Data Collection and Analysis:**

| Location | Cart Mass m (kg) | Position x (cm) | Height h (meters) | Velocity $v$ (m/s) | $GPE = mgh$ (J) | $KE = \frac{1}{2}mv^2$ (J) | $Total\ E = GPE + KE$ (J) |
|---|---|---|---|---|---|---|---|
| Top | | | | | | | |
| Mark 1 | | | | | | | |
| Mark 2 | | | | | | | |
| Mark 3 | | | | | | | |

**Data Analysis:**

Complete the table above by calculating

- GPE
- KE
- Total E

For each of the 4 positions

**Interpretation**:

1. Does your experiment demonstrate conservation of energy? Explain why it does or does not.

**Application Questions:**

2. As the cart moves down the inclined ramp, the initial Gravitational Potential Energy is converted to Kinetic Energy. Suppose instead that the ramp is horizontal and that the cart held next to a compressed spring.
    a. What is the initial energy type?

    b. When the cart and spring are released, what happens to this energy?

3. A 0.5 kg ball is dropped off of a 80 m tall building.
    a. Just before it is dropped, what are its:
        i. Potential energy

        ii. Kinetic energy

        iii. Total energy

    b. 20 meters above the ground, what are its:
        i. Total energy

        ii. Potential Energy

        iii. Kinetic Energy

        iv. velocity