Marshmallow Launcher Lab

PSI Physics

Name_____

Objective:

- To apply the conservation of energy
- To observe the relationship among the following energies: Kinetic Energy (KE), Gravitational Potential Energy (GPE), and Elastic Potential Energy (EPE).

Description:

In this lab, you will bend a plastic spoon in order to launch a marshmallow (or any other small object) into the air. A bent plastic spoon stores EPE. Releasing the spoon converts the spoons EPE into KE giving the object an initial velocity (v) and at the top of its trajectory (h); the KE is converted into GPE.

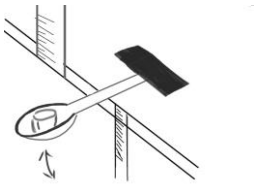
Materials:

- Plastic spoon
- Marshmallow (or any object of small mass)
- Tape
- Meter Sticks (2)
- Table
- Scale to measure the mass of the marshmallow (or other object)

Procedure:

Note: all data collection and analysis tables are on the last page of this handout.

1. Measure the mass of the object (marshmallow) and *record this in the 3rd column of the Data Analysis Table at the back of this handout*.
2. Place the spoon on a table so the handle is on the table, and the cup part of the spoon is off the edge. For best results, extend the spoon about half of its length over the table. Tape the handle in place on the table. Then, tape one meter stick from the table towards the floor.



3. Hold the second meter stick vertically on the table ready to measure the maximum height of the object (h).
4. Hold the spoon handle down while you pull the cup of the spoon down a distance (x) measured in cm on the meter stick you taped to the table. Practice launching the object a few times (2 or 3) to make sure that the object launches vertically.

For each of 3 different values of x, repeat the following 3 times:

5. Release the spoon cup and measure the height (h) the object goes. Record your value of x and h in the Data Collection Tables.

Data Analysis:

1. Record your average values of h for each value of x in the last row of the Data Collection Tables
2. Copy the each value of x with its associated average value of h in to the appropriate place in the Data Analysis Table.
3. Complete the Data Analysis Table by calculating the following values for each value of x:
   - Maximum Gravitational Potential Energy, using the average height, $GPE = mgh$
   - Maximum Kinetic Energy (from GPE)
   - Initial velocity of the object (from $KE = \frac{1}{2}mv^2$)
   - Elastic Potential Energy in the bent spoon (from KE)

Analysis:

1. As the distance is pulled down (x) increases, what happens to the maximum height of the released object (h)?

2. How does increasing the displacement of the spoon affect the EPE of the spoon?

3. If you placed the spoon from your experiment on the edge at the top of a building instead of a table, and launched the object straight up, which energies would the object have at the following: (Only consider EPE, GPE, and KE)
   a) Just before the object is released

   b) At its maximum height

   c) Half way to the ground

   d) Just before the object hits the ground

Application:

4. If a 0.4 kg baseball at 25 m/s straight into the air, how high does the ball go? (Use energy to find the answer)

5. A spring is compressed so that it has 7.2 J of elastic potential energy. A 0.3 kg ball is placed on top of the spring. When the spring is released, how high will the ball go?

Data Collection Tables:

x_1 = cm	
Trial #	h (m)
1	
2	
3	
Average	

x_2 = cm	
Trial #	h (m)
1	
2	
3	
Average	

x_3 = cm	
Trial #	h (m)
1	
2	
3	
Average	

Data Analysis Tables:

	h (m)	m (kg) (mass of object)	$\text{GPE} = \text{mgh}$ (J)	$\text{KE} = \frac{1}{2}\text{mv}^2$ (J)	$\text{v} = \sqrt{\frac{2(\text{KE})}{\text{m}}}$ (m/s)	EPE (J)
$x_1 =$						
$x_2 =$						
$x_3 =$						

*** **HINT:** The maximum EPE converts maximum KE and the maximum GPE.