Marble Launcher Lab

PSI Physics

Name:_____

Date:_____ Period:_____

Purpose

This lab will apply the law of conservation of energy to observe the relationship among Kinetic Energy (KE), Gravitational Potential Energy (GPE), and Elastic Potential Energy (EPE), using a marble launcher to launch an object into the air.

Materials

- Spring-loaded marble launcher
- 10 or 20 g ball bearing or marble
- Meter stick
- Scale

For reference, see http://njc.tl/17l

Procedure

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

1. Measure the mass of the marble and record this in the Data Analysis Table at the back of this handout.
2. Set up the marble launcher so that the marble is launched vertically into the air, at a 90^{o} angle.
3. Hold a meter stick vertically level with the middle of the marble, ready to measure the maximum height of the marble.
4. With the marble in the barrel of the launcher, place the handle of the launcher into the first (shortest) notch.
5. Release the handle, launching the marble upward. Measure how high the marble goes. Record this height in the first Data Collection table.
6. Repeat the launch two more times so that you have recorded three heights for the first notch.
7. Repeat steps 4 – 6 for the second and third notches on the launcher, so that you have three heights measured for each of the three notches.
8. Finally, for each of the three notches, measure how much the spring is compressed. Record the compression, x, in the Data Analysis Table.

Calculations

1. Calculate average values of h for each notch in the Data Collection Tables. Copy these values into the Data Analysis Table.
2. Complete the Data Analysis Table by calculating the following values for each notch:
   - 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 of spring in launcher (from KE or GPE)
   - The spring constant k of the spring in launcher

Analysis

1. As the notches on the launcher get farther down, what happens to the maximum height of the released object? Explain why this happens.

2. How does increasing the notch distance affect the EPE of the spring in the launcher?

3. Sketch the launcher and the path of the marble. Label where the EPE, GPE and KE have maximum values and label where they are zero.

4. Is the spring constant the same for each trial? Should it be the same? Why do you think it was different?

5. If a student were to launch a marble perfectly, so that it came down exactly on top of the spring that launched it, state how much the spring would compress and explain why this would be.

Application

6. 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)

7. 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

Notch 1	
Trial #	h (m)
1	
2	
3	
Average	

Notch 2	
Trial #	h (m)
1	
2	
3	
Average	

Notch 3	
Trial #	h (m)
1	
2	
3	
Average	

Data Analysis Table

Notch	Spring Compression **x (m)**	Average Height **h (m)**	Mass of Marble **m (kg)**	Gravitational Potential Energy **GPE (J)**	Kinetic Energy **KE (J)**	Velocity **v (m/s)**	Elastic Potential Energy **EPE (J)**	Spring Constant **k (N/m)**
1								
2								
3								

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