Name ______________________________ Class __________________ Period ____________

Spring Gun Lab 8.3

Purpose

To investigate the relationship between kinetic energy and potential energy.

Required Equipment

- PASCO cart and Track
- PASCO Launch setup
- Double photogate timer
- Spring scale

Discussion

The total mechanical energy of an object is the sum of its potential energy (PE) and its kinetic energy (KE). In the absence of friction, total energy is conserved. When a ball is shot straight up, the initial PE is defined to be zero and the KE = $(1/2)mv^2$, where m is the mass of the ball and v is the muzzle speed of the ball. When the ball reaches its maximum height, h, the final KE is zero and the PE = mgh, where g is the acceleration due to gravity. Conservation of energy gives that the initial KE is equal to the final PE.

The Setup

1. Obtain a spring gun from your teach and setup as demonstrated.
2. There are three position on the spring gun, short range, medium range, and long range. Only use the positions instructed.
3. Find the mass of your ball in kilograms.

   Mass of ball (kg): ______________________________

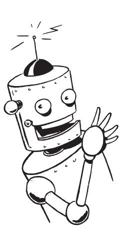
Finding Potential Energy

In this part of the activity you will be launching a ball vertically into the air and measuring its maximum height.

4. Using the plunger, depress the spring gun to the position instructed.
5. Measure the displacement of the spring and record in data table A in the box labeled Launch Position.

   Mass of ball (kg): ______________________________

6. Devise a way of measuring the maximum height.
7. Load the ball into the gun and perform a test run to see how high the ball will go.
8. When ready, carefully measure and record in data table A the maximum height the ball reaches when fired from the gun.



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Data Table A

Launch Position (m)	Height (m)				Potential Energy (J)	Kinetic Energy (J)	Initial Velocity (m/s)
	trial #1	trial #2	trial #3	Ave Height			

Calculate Potential Energy

9. Using the formula bellow, calculate the maximum potential energy of the ball and record in data table A.

$$PE = mg\Delta h$$

Show your work:

Kinetic Energy

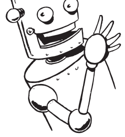
10. The kinetic energy was at a maximum as the ball let the gun and then converted into potential energy. From conservation of energy, the energy you start with is equal to the energy you end with; therefor, the kinetic energy at the gun is equal to the potential energy of the ball at its highest point. Record the kinetic energy in data table A

Calculating the Initial Velocity

11. Using the equation for kinetic energy, calculate the initial velocity of the ball as it left the gun and record in data table A.

$$KE = \frac{mv^2}{2}$$

Show your work:



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Calculating the Spring Constant

The energy to launch the ball was originally came from the potential energy stored in the gun's spring. Because of conservation of energy, at all points in it's travel the total energy kinetic and potential energy of the ball was equal to the original potential energy stored in the spring.

12. Using the displacement of the gun's spring (launch position) from data table A, calculate the spring constant for the spring gun.

$$PE_{spring} = PE_{gravity} \qquad \frac{kx^2}{2} = mg\Delta h$$

k = *spring constant* x = *displacement*

Show your work:

Spring Constant (N/m): ______________________

Predicted Height

Since the energy you start with will be equal to the energy you end with, you can predict the maximum height the ball will travel given the starting energy.

13. Using the plunger, depress the spring gun to the position instructed.

14. Measure the displacement of the spring.

Displacement of spring (m): ______________________

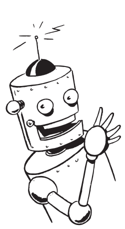
15. Use the formula bellow to calculate the predicted height of ball.

$$PE_{spring} = PE_{gravity} \qquad \frac{kx^2}{2} = mgh_{\max imum}$$

k = *spring constant* x = *displacement*

Show your work:

Predicted Height (m): ______________________



Test Your Prediction

16. Test your calculated prediction and record the actual height.

Actual Height (m): ______________________

Percent Error

17. Get the actual height(s) from your teacher and calculate the percent error. Record the percent error in your data table.

$$\%\ \text{error} = \left(\frac{\text{Calculated Height - Actual Height}}{\text{Actual Height}}\right) \times 100$$

Percent Error: ______________________