Name ________________________ Class ______________ Period _________

Spring Release Lab 8.25

Purpose

To investigate the relationship among mass, force, and acceleration

Required Equipment

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

Discussion

In this experiment you will investigate a cart will be launched with a spring. You will measure the starting potential energy and then find the ending kinetic energy. Finally you will compare how the starting and ending energies of the system and calculate the amount of friction on the system.

The Setup

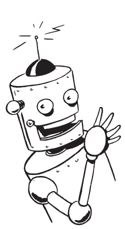
1. Set up the PASCO launch system as shown by your instructor.
2. Make sure the launch end stop is secured at the end of the track.
3. Place the cart on the track and place the launcher through the centering hole of the end stop.
4. Move the car on the track until the exact point where the spring is just touching the end stop and the cart at the same time but the spring is not compressed. At this point, attach the double photogate timer so that the first photogate is 2-3 cm in front of the cart.
5. Find the total mass of your cart with the launcher in kilograms.

   Total mass part A (kg): ________________________

Doing Work

In this part of the activity you are going to do work on a spring by applying a force through a distance in order store energy.

6. Place the cart against the launch setup so that the spring is just touching the cart and just touching end stop but is not compressing the spring. Looking at the back of the cart, record this position in table A as the starting point for all trials in data table A.
7. Attach a spring scale to the hook on the top of the cart.
8. Pull back on the cart back with a spring scale, compressing the spring on the cart, scale until the scale reads 1-N.



9. Look at the back of the cart and record this position in table A as the ending point.
10. Repeat steps 7-9 increasing the pulling force to 2-N. Again, record the ending position of the back of the cart in table A. Always make sure to keep the spring scale parallel to the track.
11. Continue to repeat steps 7-9 until you have completed your data table for all pulling forces.

Data Table A

Trial #	Pulling Force (N)	Starting Point (m)	Ending Point (m)	Displacement (m)	Spring Constant (N/m)
1	1 N				
2	2 N				
3	3 N				
4	4 N				
5	5 N				
				Ave Spring Constant	

Calculate Displacement

12. Using the formula bellow to calculate the displacement and record for each trail in data table A.

$$\Delta x = x_f - x_o \qquad \Delta x_{displacement} = x_{ending\ position} - x_{starting\ position}$$

Show your work on a your own piece of paper:

Calculate the Spring Constant

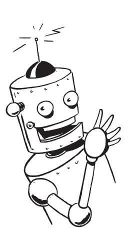
13. Using the formula bellow to calculate the spring constant for each trail in data table A.

$$F = k\Delta x$$

Show your work on a your own piece of paper:

14. Calculate the average spring constant and record in data table A.

Average Spring Constant (N/m): ______________



Name ______________ Class ______________ Period ______________

Launching the Cart

In this part of the activity you will launch your cart converting potential energy into kinetic energy. Using photogates you will time your carts motion in order to find the carts kinetic energy after the launch.

15. Place your cart in the launch setup and pull it back towards the end stop by hand until the back of the cart is at the first launch point. Note: the first launch point is how far the spring is compressed by a 1-N force.

16. Release the cart and record the time between photogates in data table B. Repeat three times for each trial.

17. Again, place your cart in the launch setup and pull it back towards the end stop by hand until the back of the cart is at the second launch point and release and record in data table B. Note: the second launch point is how far the spring is compressed by a 2-N force.

18. Repeat steps 15-16 for each launch point and record the results in data table B.

Data Table B

Launch Point	Time (s)				Velocity (m/s)
	trial #1	trial #2	trial #3	Ave Time	
1 N					
2 N					
3 N					
4 N					
5 N					

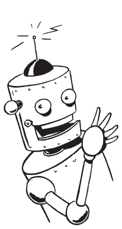
Calculating Velocity

The photogates are spaced 0.1-m (10-cm) apart, use this as the timing distance.

19. Use the formula bellow to calculate the velocity for each trail and complete data table B.

$$\bar{v} = \frac{\Delta d}{\Delta t} \qquad \bar{v} = \frac{d_{(\text{timing distance})}}{t_{(ave)}} \qquad \bar{v} = \frac{0.10}{t_{(ave)}}$$

Show your work on a your own piece of paper:



Conservation of Energy

Conservation of energy states that the energy you start with is always the energy you end with. In this part of the activity you will compute and compare the starting and ending energy.

Data Table C

Trial #	Potential Energy (J)	Kinetic Energy (J)	Heat - Sound (J)
1			
2			
3			
4			
5			

Calculating Potential Energy (starting energy)

20. Use the formula bellow to calculate the potential energy for each trial and record in data table C. You will need the average spring constant from data table A and the displacement for each trail also from data table A.

$$PE = \frac{kx^2}{2}$$

k = *spring constant* x = *displacement*

Show your work on a your own piece of paper:

Calculating Kinetic Energy (ending energy)

21. Use the formula bellow to calculate the kinetic energy for each trial. You will need to use the calculated velocity from data table B and the mass of the cart found in the first part of this activity.

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

Show your work on a your own piece of paper:

Calculating Heat and Sound (work done by friction)

22. Any missing energy can be accounted for as work done to overcome friction. Use the formula below to calculate any missing energy for each trail. Record in data table C as heat and sound.

$$E_i = E_f \qquad PE_i = KE_f + W \qquad W_{(\text{heat sound})} = PE - KE$$

Show your work on a your own piece of paper: