**Energy PHYS 201L**  **Name:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Partner(s):** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Day/Time:\_\_\_\_\_\_\_

1. DEMO: <http://www.youtube.com/watch?v=mhIOylZMg6Q&feature=related>

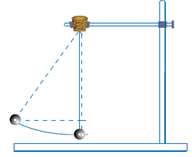
The wrecker ball didn't hit the chin of the professor, even though it broke the glass. Explain why?

1. Refer your textbook ([College Physics by OpenStax](http://www.saylor.org/site/wp-content/uploads/2013/02/PHYS101_OpenStaxCollege_College-Physics.pdf)) and answer the following questions:
2. Define kinetic energy (KE) using words and express it using an equation.

1. Define gravitational potential energy (PE) using words and express it using an equation.

1. What is mechanical energy (ME)?

1. State the principle of conservation of mechanical energy?
2. State the SI unit for energy and state whether energy a scalar or vector?
3. A pendulum bob (height h) is raised to a height H and released.   
   1. Show the heights and speed at the bottom of the swing in the diagram.   
   2. Calculate the speed of the bob at the bottom of the swing.



h =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

H =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Speed, Calculated =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
  
 Speed, Measured = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
  
 % Difference = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Purpose:** To investigate the motion of a cart down an inclined air-track and quantify its energy & acceleration.

**Apparatus:** Air-track, cart, electronic balance, metal can (to incline the air-track), photogate sensor w/cable, meter stick, transparent measuring tape with weight, lab stand, vernier-caliper, Pasco 850-interface, and PC.  
  
**Theory:**     Potential Energy =  Kinetic Energy =       
    Mechanical Energy = *ME = PE + KE.*  Energy is a scalar.   
**UNITS:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Time** | **Mass** | **Force** | **Distance** | **Velocity** | **Acceleration** | **Energy** |
| cgs | s | g | dyne | cm | cm/s | cm/s2 | erg |
| SI | s | kg | newton, N | m | m/s | m/s2 | joule, J |

cgs- centimeter, gram, second;     SI-International System;      
 **PROCEDURE**:

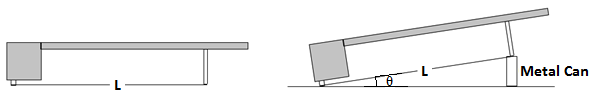
1. Incline the air-track using a metal can.    
2. Measure the mass (M) of the cart and the Flag-Width of the card on the cart.  
3. Pick a position close to the top of the track, 155 cm or 1.55 m, and measure the Height from the table-top.   
4. Repeat the height measurements for other positions: 1.45,1.35,1.25……0.25.  
5. Set up the photo-gate head at the first position, 1.55 m, so that the card will flag the photogate as it moves across the head.   
6. Connect the photogate cable to Digital Channel 1, of the PASCO 850 interface, which is turned on, and open PASCO Capstone software from the desktop.   
7. Click Hardware Setup under Tools on the left, click on the interface input where the sensor is connected, and select Photogate.   
8. Click Timer Setup under Tools, click Next (with Pre-Configured Timer), click Next (with Photogate Ch1), click the drop-down-menu for Select a Timer, and select One Photogate (Single Flag). Click Next (with Speed checked), enter the Flag-Width, click Next, and click Finish. Click Timer Setup again to close it.  
9. Double-Click Digits under Displays, click Select Measurement, and select speed.   
10. Keep the cart at the far-end of the track, and record the starting position. (Use the middle of the Flag-Width as the reference)  
11. Click Record and turn on the air in the air-track.   
12. Stop the Data collection after the cart passes through the photogate sensor and enter the velocity data.  
13. Repeat the velocity measurements for other photogate positions, starting with the cart at the far-end and complete the data table and data analysis.

**DATA** (Use SI units)

Mass of the cart = M = \_\_\_\_\_\_\_ Flag-Width of the card on the cart = \_\_\_\_\_\_\_\_\_\_  
 (This will be entered during Timer Set up with Capstone)  
Starting position = \_\_\_\_\_\_\_\_\_ Initial velocity = 0 Accel. due to gravity = g = 9.8 m/s2

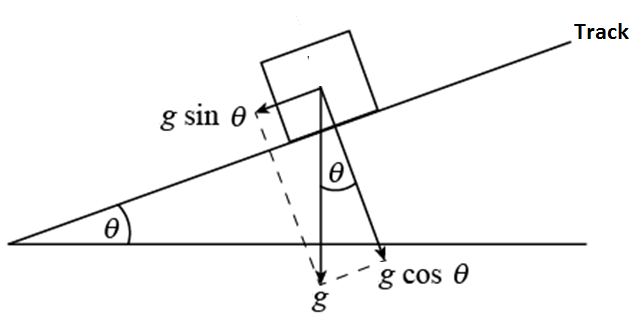
|  |  |  |
| --- | --- | --- |
| Photogate Position (m) | Height, *h* (m) | Velocity, *v* (m/s) |
| 1.55 |  |  |
| 1.45 |  |  |
| 1.35 |  |  |
| 1.25 |  |  |
| 1.15 |  |  |
| 1.05 |  |  |
| 0.95 |  |  |
| 0.85 |  |  |
| 0.75 |  |  |
| 0.65 |  |  |
| 0.55 |  |  |
| 0.45 |  |  |
| 0.35 |  |  |
| 0.25 |  |  |

**Angle of Incline** Collect the data necessary and calculate the angle of incline, θ.



θ = \_\_\_\_\_\_\_\_\_\_\_

**DATA ANALYSIS**  (Complete all except conclusion before leaving)  
1. Enter the above data in a spread sheet program and create four more columns for Displacement, PE, KE, and ME, and calculate them to 3 significant figures.   
  
2. Plot PE, KE, and ME VERSUS Displacement; in a single graph.   
  
3. Plot another graph, and obtain the acceleration along the track from the graph.

4. Also, obtain the acceleration along the track using the angle of incline and acceleration due to gravity, g.   


From the Excel data table, Mechanical energy = ME =\_\_\_\_\_\_\_\_\_\_\_

Acceleration along the track from Graph, a =\_\_\_\_\_\_\_\_\_\_

Acceleration along the track, using g and θ, a = \_\_\_\_\_\_\_\_\_\_\_%Difference =\_\_\_\_\_\_\_\_\_\_

Write a conclusion.