**Data Collection with a PC** PHYS 201L Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
 **A. Introduction:** PASCO’s 850 interface and Capstone software.



0. User name: visitor, Password: winthrop, for the PC’s in Sims 205-2071. Open PASCO Capstone software from the desktop.

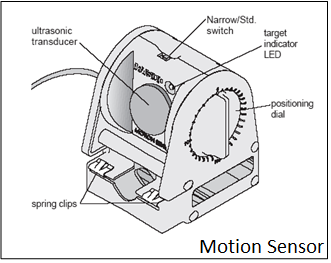
2. Double click “Graph” under Displays, on the far-right column.

Pasco Capstone display: [Video Description](https://www.youtube.com/watch?v=QuvmF7KS56w)

3. You will use some of the above (numbered) menus to manipulate the data. Describe the functions of the following menus:

|  |  |
| --- | --- |
| Menu | Description |
| 1 |  |
| 4 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |

**B. MOTION:**   
  
Purpose: To analyze the motion of a cart down an inclined track using   
a motion sensor.   
  
Apparatus: PC, Interface, Motion Sensor, Dynamics Track w/End Stop,   
Collision Cart, Brass Weight, and Wooden Block.



Procedure:

1. Look at the motion sensor and identify the smallest distance it can detect and record it in the data table.
2. Incline the Dynamics Track using the Wooden Block and attach the Motion Sensor at the 0-cm end. Set the beam to narrow, and make the detection-surface perpendicular to the track. [Video Description](https://www.youtube.com/watch?v=NrQPG_icx8g)
3. Place the Collision Cart so that the front of the cart is at least 15-cm from the motion sensor and use the Brass Weight to hold the cart in place.  
   
4. Connect the motion sensor to the interface (yellow-1, black-2),   
   
5. Open PASCO Capstone software from the desktop.
6. Click Hardware Setup under Tools on the left, click on the interface input where the sensor is connected, and select Motion Sensor. Click Hardware Setup again to close it.
7. Double-Click Graph under Displays on the right, click Select Measurement on the Y-axis, and choose Position.
8. Click Record, and after a while remove the Brass Weight in order for the cart to roll down and collide with the End Stop. [Video Description](https://www.youtube.com/watch?v=OM6peLeG5P4)
9. Stop the data collection and complete the data sheet.
10. Velocity and acceleration data can be obtained by clicking on position and selecting velocity and acceleration, respectively. [Video Description](https://www.youtube.com/watch?v=vloCb3Hv9wo)
11. Insert the screenshots of Position, Velocity, and Acceleration VS. time graphs below.

**DATA for MOTION:** Smallest distance the motion sensor can detect = \_\_\_\_\_\_\_\_\_

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Using *x* vs. *t* Graph | Using *v* vs. *t* Graph | Using *a* vs. *t* Graph | % Difference |
| Describe  the  Graph |  |  |  | XXXXXX XXXXXX XXXXXX XXXXXX |
| Initial/resting position |  | XXXXXX XXXXXX XXXXXX | XXXXXX XXXXXX XXXXXX | XXXXXX XXXXXX XXXXXX |
| Final position |  | XXXXXX XXXXXX XXXXXX | XXXXXX XXXXXX XXXXXX | XXXXXX XXXXXX XXXXXX |
| Distance Travelled |  |  | XXXXXX XXXXXX XXXXXX |  |
| Initial Velocity |  |  | XXXXXX XXXXXX | XXXXXX  XXXXXX |
| Final Velocity |  |  | XXXXXX XXXXXX XXXXXX |  |
| Acceleration | XXXXXX XXXXXX |  |  | XXXXXXXXX XXXXXXXXX |

**C. Acceleration due to gravity:**

Purpose: Determine the acceleration due to gravity.

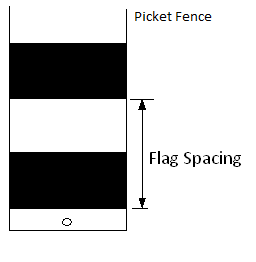
Apparatus: PC, interface (Pasco 850), photogate sensor (head, rod, and cable), stand, soft box, and picket fence.

1. Measure and record the Flag Spacing on the picket fence.
2. Make sure that the Pasco 850 interface is connected to the PC and it is turned on.
3. Assemble the photogate, plug it in to DIGITAL INPUT 1, attach the rod to a lab stand so that the head is horizontal, and place it on the lab table. Place the soft box, on the ground, below the photogate-head.

[Video Description](https://www.youtube.com/watch?v=AQsHsjOmFeA)  


1. Open PASCO Capstone software from the desktop.
2. Click Hardware Setup under Tools on the left, click on the interface input where the sensor is connected, and select Photogate.
3. 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 Picket Fence. Click Next (with Speed and Position checked), click Next and enter the Flag Spacing, and click Finish. Click Timer Setup again to close it.
4. Double-Click Graph under Displays on the right, click Select Measurement on the Y-axis, and choose speed.
5. Click Record in the bottom, and drop the picket fence through the photogate, onto the soft box.
6. Stop the data collection.
7. Re-scale the graph, by clicking the Scale Axis button, the first on top of the graph,   
   so that your graph takes up most of the space. [Video Description](https://www.youtube.com/watch?v=P1_lsvZBVyo)
8. From the Speed (or Velocity) VS. Time graph, obtain the acceleration due to gravity   
   by curve fitting the Speed/Velocity VS. Time data.
9. Insert a screenshot of the Speed/Velocity VS. Time graph below.
10. Click Speed, select the position, and obtain the acceleration due to gravity   
    by curve fitting the Position VS. Time data.   
    NOTE: Position VS Time is not linear, use a quadratic function fit.
11. Insert a screenshot of the Position VS. Time graph below.
12. Complete the data table for acceleration due to gravity in the data sheet.

**DATA:**



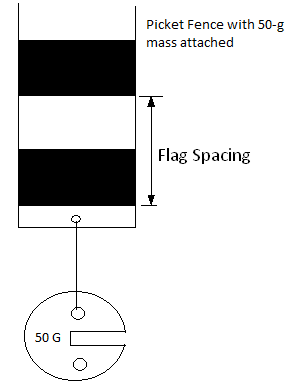


Flag Spacing on the picket fence = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Write down the kinematic equations below:  
  
*v* vs. *t*:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *x* vs. *t*:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Trial | Measured Acceleration due to gravity | | | Accepted (m/s2) | % Error |
| *v* vs. *t* (linear fit) | *x* vs. *t* (Quadratic fit) | Average |
| 1. |  |  |  | 9.8 |  |
| 2. |  |  |  | 9.8 |  |
| 3. |  |  |  | 9.8 |  |
| 4. |  |  |  | 9.8 |  |
| 5. With 50-g mass |  |  |  |  |  |

Extension: Find out, what will happen to the acceleration, when the mass of the picket fence is increased?   
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



Explain your observation:

D. Newton’s Second Law

Purpose: Verify Newton’s second law using Atwood’s Machine.

Apparatus: PC, interface, photogate sensor (head, rod, cable, and pulley), two mass sets, string, and lab stand.

Theory: Newton’s second law is: Net Force = Mass X Acceleration.

Procedure (Experimental Set-Up): [Video Description](https://www.youtube.com/watch?v=na3HUZSo7bU)

1)               Assemble the photogate with the pulley (Atwood's machine), plug it in to digital input 1 on the Interface, and attach the rod to a lab stand so that the head is horizontal. Place it on the lab table.

|  |  |
| --- | --- |
|  |  |

 2)               Cut a piece of string approximately a meter long. Place the string into the groove of the pulley. Tie the two mass sets (m1 and m2) to the ends of the string, as shown below.

|  |  |
| --- | --- |
| C:\Users\mahesp\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Word\IMG_1891.jpg |  |

3) Setting up the Interface:   
a. Make sure that the power for the interface is turned on.  
b. Open **PASCO Capstone** software from the desktop.   
c. Click Hardware Setup under Tools on the left, click on the interface input where the sensor is connected, and select **Photogate with Pulley**. Click Hardware Setup again to close it. d. Double-Click Graph under Displays on the right, click Select Measurement on the Y-axis, and choose Linear Speed.

4)  Data Collection  [Video Description](https://www.youtube.com/watch?v=FmkJwAkHoGw)  
a. Pull the lighter mass down to the table and hold it there.  
b. Click "Record" and release the mass. Stop recording data after the heavier mass reaches the table.   
c. Determine the experimental acceleration by finding the slope for the linear portion of the Linear Speed VS Time graph.  
d. Insert a screenshot of the Linear Speed VS. Time graph below.

5) Data

Keeping the total mass = M = m1+ m2 constant, measure the acceleration as you change the net force (m1-m2)g. Collect 8 sets of data, tabulate your data, and plot an appropriate graph to verify Newton’s second law.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| m1 (gram) | m2 (gram) | m1 + m2 (gram) | m1-m2 (gram) | a (m/s2) |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
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|  |  |  |  |  |
|  |  |  |  |  |

6) Write a conclusion for D.