**Data Collection with a PC-II** Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Partner(s):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Day/Time:\_\_\_\_\_\_
 **A. Introduction:** PASCO’s 850 interface and Capstone software.
1. Open PASCO Capstone software from the desktop.



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

Pasco Capstone display:



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. Equations of Kinematics for constant acceleration and Newton’s second law are given below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1. | 2. |  3. | 4. | 5. | Newton’s 2nd Law |
| $$y=\overbar{v} t$$ | $$y=\frac{1}{2}\left(v\_{0}+v\right)t$$ | $$v=v\_{0}+at$$ | $$y=v\_{0}t+\frac{1}{2}at^{2}$$ | $$v^{2}=v\_{0}^{2}+2ay$$ | $$\sum\_{}^{}\vec{F}=m\vec{a}$$ |

For the Atwood Machine experiment shown in the video, calculate the acceleration using,
a. Kinematic Equations b. Newton’s second law
<http://www.youtube.com/watch?v=4ovhEkSIqV0>

C. 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.

4. Open PASCO Capstone software from the desktop.
5. Click Hardware Setup under Tools on the left, click on the interface input where the sensor is connected, and select Photogate.
6. 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.
7. Double-Click Graph under Displays on the right, click Select Measurement on the Y-axis, and choose speed.
8. Click Record in the bottom, and drop the picket fence through the photogate, onto the soft box.
9. Stop the data collection.
10. 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.
11. From the Speed (or Velocity) VS. Time graph, obtain the acceleration due to gravity
by curve fitting the Speed/Velocity VS. Time data.
12. 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.
13. Complete the data table for acceleration due to gravity.

**DATA:**





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

Write down the kinematic equations, with acceleration 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. With 50-g mass |  |  |  | xxxxxxxxxxxx | xxxxxxxxxxxx |
| 5. With 50-g mass |  |  |  | xxxxxxxxxxxx | xxxxxxxxxxxx |
| 6. With 50-g mass |  |  |  | xxxxxxxxxxxx | xxxxxxxxxxxx |

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 (Conclusion is required for this part only)

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

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

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

 Procedure (Experimental Set-Up):

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
a. Pull the lighter mass down to the table and hold it there.
b. Place the soft pad on the table, below the heavier mass.
c. Click "Record" and release the mass. Stop recording data after the heavier mass reaches the soft pad on the table.
d. Determine the experimental acceleration by finding the slope for the linear portion of the Linear Speed VS Time graph.

Data A: Keeping the mass difference (m1-m2) constant, measure the acceleration as you change the total mass, starting from the lowest possible total mass, m1+ m2. Tabulate your data in excel, plot an appropriate graph to verify Newton’s second law.

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

Data B: Keeping the total mass = M = m1+ m2 constant, measure the acceleration as you change the net force (m1-m2)g. Collect multiple sets of data, starting from the lowest possible m1-m2. Tabulate your data in excel, plot an appropriate graph to verify Newton’s second law, and obtain the total mass from the graph.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| m1 (gram) | m2 (gram) | m1 + m2 (gram) | a (m/s2) | (m1-m2)\*9.8 (gram.m/s2) |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

6) Write a conclusion for D.