# D. Atwood’s Machine:

Apparatus: PC, interface, photogate sensor (head, rod, cable, and pulley), mass set w/hanger, 50-g big mass w/holes, string, and stand.

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

2)               Open DataStudio, select “Open Activity”, click "Library", click “P10 Atwood’s” in the Physics Lab folder, and open Velocity VS. Time graph display.

3)               Cut a piece of string approximately a meter long. Place the string into the groove of the pulley.

4)               Tie the 50-g mass, with holes, to one end of string, which will be M1.

5)               Tie the 50-g mass hanger to the other end of the string, which will be M2.

6)               On the hanger, add a 10-g mass to make M2 = 60-g. This should make the hanger rest on the table.

7)               Now, pull the M1 mass down until it touches the tabletop. Hold it there to keep it from moving up.

8)               Check to see whether the photogate beam is unblocked (so that the LED is not lit up). Turning the pulley a little will unblock the beam.

9)             Click "Start" and release the M1 mass. Stop recording data after M2 reaches the table.

10)           Determine the experimental acceleration by finding the slope for the linear portion of the Velocity VS Time graph.

11)           Repeat steps 6-10 for other masses.

DATA TABLE for Atwood's machine: (Include Units)

|  |  |  |  |
| --- | --- | --- | --- |
| **Run** | **M1**(kg) | **M2** (kg) | **aexp** |
| 1 | 0.050 | 0.060 |   |
| 2 | 0.050 | 0.070 |   |
| 3 | 0.050 | 0.080 |   |
| 4 | 0.050 | 0.090 |   |
| 5 | 0.050 | 0.100 |   |

12)           Enter the above data in Excel spread sheet and calculate the theoretical acceleration, **a**the, and the percent difference between the experimental acceleration and the theoretical acceleration for each run.

 

13)     Print a hard-copy of your Excel data table.

14)    Close DataStudio without saving.

# E. Distance measurement: Apparatus: PC, interface, motion sensor, and meter stick.



Procedure:

1. Connect the motion sensor to digital channels 1 & 2. (Yellow-1 and Black-2)
2. Open DataStudio, Click ‘Create Experiment’, Click ‘Add Sensor’, Select ‘Digital Sensors’, double-click ‘Motion Sensor’, Click ‘Digits Display’, and choose the position data source.
3. Place the motion sensor on the lab-table and set the sensor surface parallel to the lab-table surface.
4. Click ‘Start’ and record the sensor reading of the distance to ceiling.
5. Stop the data collection.
6. Measure the above distance with a meter stick and calculate the % difference.
7. Close DataStudio, by clicking the 'X' in the upper-right corner, and clicking 'NO' for the question, 'Do you want to save this activity?’.

DATA:

 Sensor reading of the distance to the ceiling =    \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

            Your measured reading of the distance to the ceiling = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

                                                               % Difference = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

F. 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. Incline the Dynamics Track using the Wooden Block.

2. Attach the Motion Sensor at the 0-cm.

3. Place the Collision Cart about 20-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), set the beam to narrow, and make the detection-surface perpendicular to the track.

5. Open DataStudio, click Create Experiment, scroll down the sensors, and double-click Motion Sensor.

6. Double-click the Graph display, O.K. position data source, and maximize the Position VS. Time graph display.

7. Click Start, and after a while remove the Brass Weight in order for the cart to roll down and collide with the End Stop.

8. Stop the data collection, and show your data to the instructor.\_\_\_\_\_\_\_\_\_\_\_

9. Maximize the Position VS. Time data and obtain the following:

    a. What is the initial/resting position of the cart?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

    b. What is the final position of the cart?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 c. Distance traveled by the cart?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

    d. Describe how the position changes with time between the initial and final positions? (linearly or non-linearly)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

    e. What is represented by the slope of the Position VS. Time graph?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

    f. What is the velocity of the cart just before the collision?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10. Double-click the Graph display, select Velocity data source, and complete the following:

   a. Describe the features of the Velocity versus Time graph.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

    b. What is the maximum velocity of the cart?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 c. How well the above velocity compares to the velocity from Procedure 9f?

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

    d. What is the acceleration of the cart down the track?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 e. Determine the distance traveled from the Velocity VS. Time graph.\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 f. How well the above distance compares to the distance from Procedure 9c?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

11. Double-click the Graph display, select Acceleration data source, and complete the following:

a. Describe the features of the Acceleration versus Time graph. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Double-click the Acceleration under the Data column, and change the precision to 3.

c. What is the acceleration of the cart down the track?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. How well the above acceleration compares to the acceleration from Procedure 10d?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

e. What is the maximum deceleration of the cart during the collision with the End stop?\_\_\_\_\_\_\_\_

f. If the mass of the cart is 0.5 kg, determine the maximum force exerted by the End stop in stopping the cart.
 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

12. Predictions:

a. What will happen to the acceleration down the track, when the mass of the cart is increased?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Check your prediction\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. What will happen to the acceleration down the track, when the angle of inclination is increased?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Check your prediction\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_