Speed & Acceleration Lab

HPS@SHS Name:_____per:

Discussion: Acceleration is a change in velocity over a measured period of time. To calculate acceleration you must know 3 variables:
original velocity , *final velocity* and the *time* it takes for this change to occur.
The formula for acceleration is final velocity - original velocity divided by time acceleration occurs. Using symbols it can be written as $a = \frac{v_f - v_o}{t}$
In this lab you will calculate the acceleration of a ball rolling down a ramp. To do so you will need to calculate three variables:

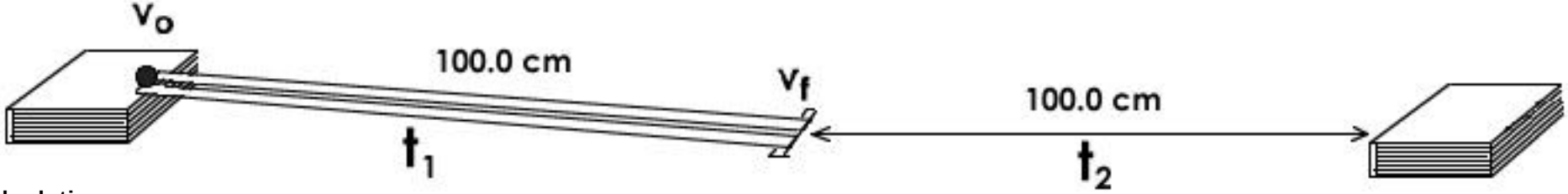
a. Final velocity (the velocity of the ball coming off the ramp). You will do this by letting the ball come off the ramp and travel 1.00 m across the table top at a constant speed. Speed is distance/time. By dividing the distance across the table top (1.00 m) by the time it takes to travel that distance (t2) you will calculate the final speed of the ball coming off the ramp.

b. Original velocity (the velocity of the ball at the top of the ramp - which is 0 cm/s.) *Do not use this for determining sig figs in your work*.

c. Time it takes this change to occur (time to go down the ramp)

Purpose: To gain experience in calculating and graphing speed and acceleration.
Materials: Textbooks (4), meter sticks (3), stopwatches (2), metal ball, tape, metric ruler, graph paper
Procedure:

1. Set up the lab as shown below. Separate the meter sticks so that the ball can roll down the ramp but not fall through.
2. Place a piece of tape on the table top at the end of the meter sticks. Measure out 100.0 cm further and place a piece of tape on the counter. Place a book on the piece of tape so that the distance between the end of the ramp and the book is 100.0 cm.
3. Starting with 1 book, measure the height of the ramp in cm. Be sure to measure from the table top to the top of the ramp.
4. Assign two members of your group to be timers. Record the times to the nearest 0.01 second. Other lab members should help and record data.
Timer One will record the time it takes the ball to roll down the ramp.
Timer Two will record the time it takes the ball to cross the 100.0 cm across the table.
5. With both timers ready, place the ball at the very top of the ramp and release it. *Do not push it*.
6. Timer One measures and records the time it takes the ball to accelerate down the ramp.
Timer Two measures and records the time it takes the ball to travel across the table at a constant velocity.
7. Repeat procedures 5 & 6 a total of 3 times being sure to record the times in the appropriate spaces on the data table.
8. Repeat procedures 5,6 & 7 with two, three and four books.



Calculations:

9. Average and record the three times for each timer for each trial. (Average by adding up the three times and dividing by 3.)
note: t_1 occurs during acceleration while t_2 occurs during final velocity
10. You can see that the ball came off the ramp and continued at a constant speed across the table top. To determine the final velocity of the ball off the ramp, divide the distance across the table (100.0 cm) by t_2.
11. Calculate the acceleration of the ball as it came down the ramp for each ramp height. (Show your work *neatly* on a separate sheet of paper.)
12. Graph the following variables. Use one graph for each of the following:
    a. Final Velocity (y) vs Ramp Height (x)
    b. Acceleration (y) vs Ramp Height (x)

Final Velocity Data Table

Books	Distance Across Table	Time2 Trial 1	Time2 Trial 2	Time2 Trial 3	Average Time Across Table	Original Velocity	Final Velocity
1							
2							
3							
4							

Acceleration Data Table

Books	Ramp Height	Ramp Distance	Time1 Trial 1	Time1 Trial 2	Time1 Trial 3	Average Time Down Ramp	Acceleration
1							
2							
3							
4							

Draw lines on your graph to show how you determined 1 and 2

1. Predict the V_f of the ball coming off a ramp height of: 2.00 cm:_____ 5.00 cm:_____ 9.50 cm:_____

2. Predict the acceleration of the ball rolling dow a ramp height of: 3.50 cm:_____ 7.00 cm:_____10.50 cm:_____

3. Calculate the slope of the curve: Final Velcoity vs. Ramp Height:_____ Acceleration vs Ramp Height:_____
Show you work on a separate sheet of paper.

4. Write a paragraph conclusion about the relationship between ramp height, final speed and acceleration. Be specific and don't list the obvious relationships such as the final velocity and acceleration increases as the ramp gets higher.