Labs: Trigonometry Based Physics Part I

EXP 3 – Pre-Lab

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PRE-LAB on Velocity and Acceleration Instructions:

Comment [O1]: If suggested point values followed, 100 points total for this assignment.

Print out these pages. Feel free to refer to the lab instructions and other materials, your physics textbook, other students, etc. to help you to ponder, understand, and work out answers to the following question(s). Attach additional pages to show your work and reference item numbers on your attached pages.

PRE-LAB Questions:

Comment [O2]: Suggested Rubric 2 point each for problems 1 to 5.

A car is driven along a straight road. Its distance relative to a cross street is graphed at right:

1) Draw CIRCLES around groups of points that indicate zero velocity for the car.
2) Draw PLUS symbols near points in groups that indicate a positive velocity.
3) Draw MINUS symbols near points in groups that indicate a negative velocity.
4) Draw BOXES around groups of points that indicate either positive or negative acceleration for the car.

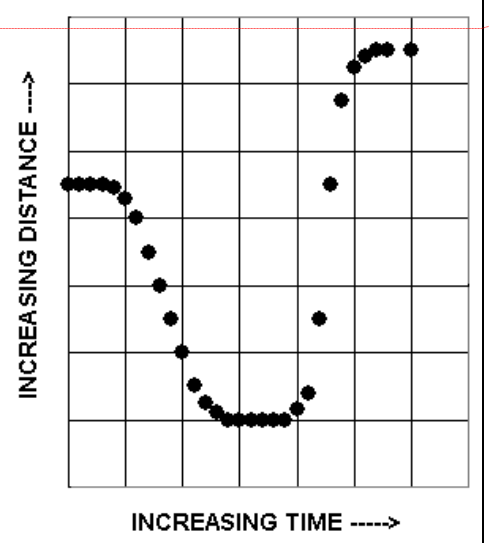

Figure 3P.1 – Distance vs. time sketch

5) In the space below, sketch a graph of the velocity vs. time that corresponds to the above chart.

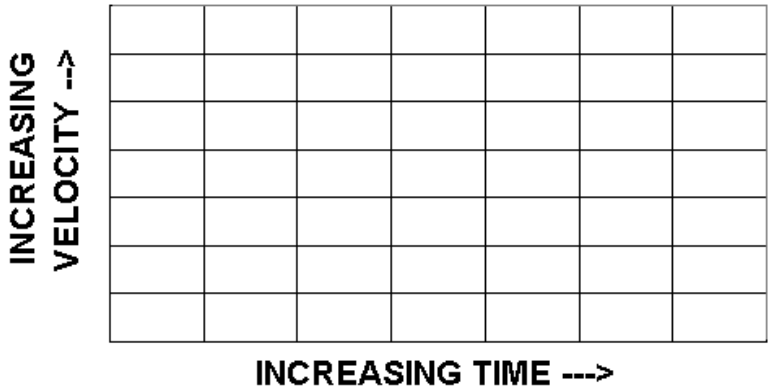

Figure 3P.2 – Velocity vs. time sketch

6) A ball is thrown up in the air. What is the acceleration acting on it when it reaches its maximum height (peak)? Do any work required on separate page and write answer below.

a =

a) What is the velocity when it reaches its peak? Do any work required on separate page and write answer below.

v =

b) If another ball (Ball 2) is dropped from the same height at the same instant the first ball (Ball 1) reaches the peak, which ball hits the ground first? Do any work required on separate page and write answer below.

7) A ball starting at rest is dropped from a height of 1.225 meter above the floor. The acceleration due to gravity is -9.8 m/sec^2 (the negative sign means acceleration acts downward).

a) Derive equations for x, y, v_x, v_y, a_x, and a_y, do any work required on separate page, and write answers below.

x =

y =

v_x =

v_y =

a_x =

a_y =

b) Sketch x, y, v_x, v_y, a_x, and a_y vs. time including axes labels and units on a separate page.

c) How would the plot in the previous step change if the mass of the ball were greater? Less? Explain on a separate page. Ignore air resistance.

d) It was stated that the ball in the previous steps was dropped from a height of 1.225 meter. How is this measured? Refer to the figure below right. Is it dimension A, B, C, or other? Explain on a separate page.

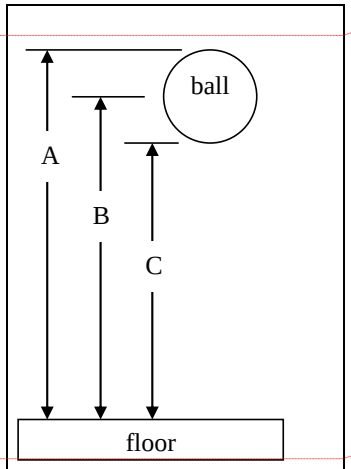

Figure 3P.3 – Measuring distance of fall

8) Different labs use different equipment for your experiment. You may use a cart on an inclined track, balls on an inclined plane, Hot Wheels cars, an airtrack, etc. You may also use photogates instead of stopwatches or other timing devices. Without going into details of how a photogate works, it is basically a sophisticated stopwatch. Time is recorded when the cart enters the photogate and a second time recorded when the cart leaves the photogate. If you were Supergirl and could trigger your stopwatch when the cart entered the photogate and left the photogate, you would get the same results as the photogates. While the principles are identical, refer to your lab instructor for specific operational details of the particular equipment used in your lab.

a) In Figure 2P.4 below, use your trigonometry to find vector components and derive a formula for acceleration, a, of the cart in the direction parallel to the inclined plane in terms of g and θ. Do any work required on separate page and write answer below.

$a_{||}$ =

Comment [O3]: 2 points

Comment [O4]: 2 points

Comment [O5]: 2 points

Comment [O6]: Suggested rubric 14 points for solving vy & y equations – 1 point for each of 5 steps in SOLVE method. 1 point each for correct values of x, v_x, a_x, & a_y.

Comment [O7]: Suggested rubric 10 points. 4 points for accurate graphing of v_y & y & 2 points total for the rest, 1 point for titles, 1 point for scales, 1 for labels, 1 for units.

Comment [O8]: Suggested rubric 5 points per Bloom – 1 points each for knowledge, comprehension, application, synthesis, and critical thinking (evaluation).

Comment [O9]: Suggested rubric 5 points per Bloom – 1 points each for knowledge, comprehension, application, synthesis, and critical thinking (evaluation).

Comment [O10]: Suggeste d rubric 10 points – 2 point for each of 5 steps in SOLVE method

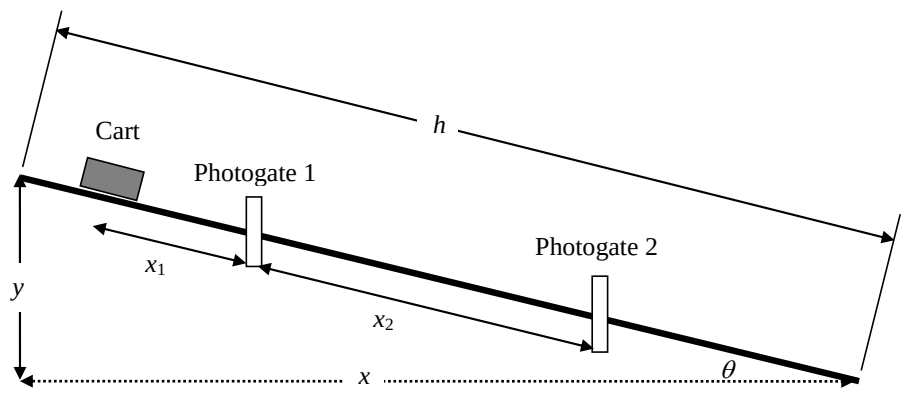

Figure 3P.4 – Diagram of cart rolling down inclined plane.

b) Now derive an equation for acceleration in terms of x, y, h, and g, do any work required on separate page, and write answer below. Note that not all variables may be required in your formula.

$a_{||}$ =

c) In ***Figure 3P.4***, the cart is released from rest at a distance x_1 from the first of two photogates. Assume a frictionless cart. Derive an equation for the instantaneous velocity, v_i, versus time, t, of the cart on this inclined plane in terms of x, y, h, and g, do any work required on separate page, and write answer below. Note that the subscript, i, refers to instantaneous and not average.

v_i =

d) If you were to plot v_i vs. t, would it have a y intercept of zero? Why or why not. Explain thoroughly on separate page.

e) Derive an equation of the instantaneous velocity, v_i, of the cart on an inclined plane from displacement down the plane, d, and time, t. Note that $d = x_1$ when the cart reaches the first photogate, and $d = x_1 + x_2$ when the cart reaches the second photogate, do any work required on separate page, and write answer below.

v_i =

f) Derive an equation of the average velocity, v_{ave}, of the cart released from rest on an inclined plane from displacement down the plane, d, and time, t. How is instantaneous velocity related to average velocity? In other words, what is the equation of average velocity in terms of instantaneous velocity? Do any work required on separate page and write answers below.

v_{ave} =

Comment [O11]: Suggested rubric 10 points – 2 point for each of 5 steps in SOLVE method

Comment [O12]: Suggested rubric 10 points – 2 point for each of 5 steps in SOLVE method

Comment [O13]: Suggested rubric 10 points per Bloom – 2 points each for knowledge, comprehension, application, synthesis, and critical thinking (evaluation).

Comment [O14]: Suggested rubric 5 points – 1 point for each of 5 steps in SOLVE method

Comment [O15]: Suggested rubric 5 points – 1 point for each of 5 steps in SOLVE method