Physics **Name _____**
Lab – Constant Acceleration with Ticker Tape Timer **Date _____**

Purpose –

1. Determine the mathematical relationship between change of position (displacement) and time for a cart traveling down an incline.
2. Determine the mathematical relationship between velocity and time for a cart traveling down an incline.

Set up –

- ❑ Stack 3-4 books under one end of the metal track so that an incline is created.
- ❑ Place the ticker tape timer behind the end stop so that it is stable for the trial.
- ❑ Weave the ticker tape under the carbon disk and attach it to the back of the metal carts with tape.
- ❑ Turn the timer on and release the metal cart – brace the cart at the end of the track.

Data Collection –

- ❑ Decide on a good starting point for your origin. Be sure that this dot is clearly visible and not in a cluster of dots.
- ❑ Count every 6 dots to make a mark (each hash mark is 0.1 s).
- ❑ Measure the position in meters of each mark.
- ❑ Enter these values for position (Y) and time (X) into logger pro. **Remember to change the labels for each column by double clicking on either X or Y. Be sure to also include units!**

Analysis –

1) Look at your ticker tape strip. What is happening to the spacing of the dots? What does this indicate about the motion of the cart?

- ❑ Based upon your entered data choose the proportionality (line of best fit) that most closely fits your data for *position vs. time*.

2) Draw a sketch of the resulting curve position vs. time graph and describe the chosen fit.

3) Is the velocity of this cart constant? How can you tell?

- ❑ Make a column for the cart's velocity. To do this, follow these steps:
  - ✧ Go to **data**, choose **new calculated column**.
  - ✧ Enter the name of the new column (**velocity**) and the appropriate units.
  - ✧ On the same window enter an equation you want the program to calculate by doing the following:
    a) Click **functions** and select **delta**.
    b) Click on **variables** and select **position**. Manually put in a / (**divided**)
    c) Repeat step a. Then repeat step b – now choose **time**.
    d) Select **done** when you have correctly defined the equation for velocity.

4) Switch the variable plotted on the y-axis so that it reads velocity. (**Hint**: *you might have to change the scales to see better*). Draw a sketch of the resulting velocity vs. time curve and describe the chosen fit.

velocity vs. time graph analysis continued on the back

5) What is the equation (general and translated) of this line?

6) What quantity is represented by the slope of the line of a velocity vs. time graph?
(**Hint:** *Look at the units to give you an indication of what this slope is a value for)*

7) Using your sketch of velocity vs. time and your answer to question 6, how can you describe the motion of the cart?

- Make a column for the cart's <u>acceleration</u>. To do this, follow these steps:
  - ✧ Go to **data**, choose **new calculated column**.
  - ✧ Enter the name of the new column (**acceleration**) and the appropriate units.
  - ✧ On the same window enter an equation you want the program to calculate by doing the following:
    a) Select **functions.** Choose **delta.**
    b) Add a quantity inside the (). Select **variables.** Choose **velocity.**
    c) Manually put in a **/ (divided)**.
    d) Repeat a-b, but this time you want to select **time** to be placed inside the ().
    c) Select **done** when you have correctly defined the equation for acceleration.

8) Switch the variable plotted on the y-axis so that it reads acceleration. (**Hint**: *you might have to change the scales to see better*). <u>Draw a sketch</u> of the resulting acceleration vs. time curve and <u>describe the chosen fit</u>.

9) What is the objects acceleration? How did you determine this from looking at the acceleration vs. time graph? (***Hint****: linear fit will get you started*)

10) Did the cart in this lab accelerate at a constant rate?

Conclusions –

11) What quantity can be read from the slope of a velocity vs. time graph?

12) How does the slope of a velocity vs. time graph relate to an acceleration vs. time graph?