G Moving Plots

Here you will use a 60Hz tape timer to make position and velocity v time graphs of a wind up car, and analyze them with tangent lines. There is a very helpful website with videos on how to gather and analyze this data.

Getting a Tape:

1. You and one partner will need a dynamics car, a tape timer kit and some masking tape. Two people can turn in one lab. If your group is three, you will need to analyze two tapes.
2. Get a carbon paper disk (New ones are in an envelope in the tape timer box if you need it) and put it black side down on the pin and under the hammer, so that it is free to rotate.
3. Attach a piece of timer tape about 2 meters long to the back of the car, and thread it through the staples but under the carbon paper.
4. Remove any slack from the tape, turn on the timer, and let go of the cart. With any luck, it will pull the tape through the timer - speeding up at first, as it rolls down the incline, and then slowing down when it reaches the level table. Your tape is a good one if you can see the marks on it, the first and last marks are separated by at least one meter of distance, and the tape stayed in the timer for the entire event. Mark the beginning of the tape. I will gladly give you an opinion about your tape before you spend 15 minutes taking data from it.

Analyzing the Tape:

1. Find a flat surface, and tape your timer tape next to two meter sticks that are also taped down so they won't move. Mark the first dot, and every sixth dot thereafter. Since the timer makes 60 dots per second, these marks you make represent the position of the car every tenth of a second.
2. Make a •table of elapsed time (by tenths of a second) and distance by measuring the distance each mark is from the first dot (t = 0 seconds, S = 0 cm).
3. Add a •column to the table whose contents are the difference between adjacent distances multiplied by 10. Start with zero velocity. You will have one less of these than you have distances, don't worry about it. (This is the velocity of the car in cm/s or in tens of cm/.1s Don't forget to label your columns with units and what they are)
4. Make a graph of position vs. time - it should be a smooth line graph, and give it its own sheet. Make sure it has proper gridlines so we can find the slope, and be sure to specify a min and a max for the horizontal axis.
5. Make a graph of the velocity vs. time - put it on its own sheet. Make sure it too has proper gridlines, and a proper right side by specifying the min an max for the horizontal axis.

Write up:

1. Pick a curvy part of the distance vs time graph. •**Draw a long tangent line with a ruler to the smooth curve you drew through the points.** The line should go off the plot frame at both ends. •By using the coordinates read from your axes of where your tangent line enters and exits the plot frame, **find the slope of the line you drew.** Show this calculation on the graph itself. •Your tangent line is tangent at a certain point in time. Read this from the axis of your graph. How does that slope compare the velocity at that time you calculated by subtracting distances? **(Compare the slope of the tangent line to the velocity at that time in your spreadsheet)** Have your partner repeat this for another point on the graph.
2. On your velocity graph draw two best fit lines, one representing the positive acceleration, and one the negative. ONe partner should draw one, the other the other. **•Find the slope of the lines you drew. Show this on the graph itself**. This slope is the acceleration.
3. Look at the velocity graph. Where is the acceleration positive? Where is it negative? **•Label these on the graph. •Which one is greater in magnitude, the positive, or the negative?**