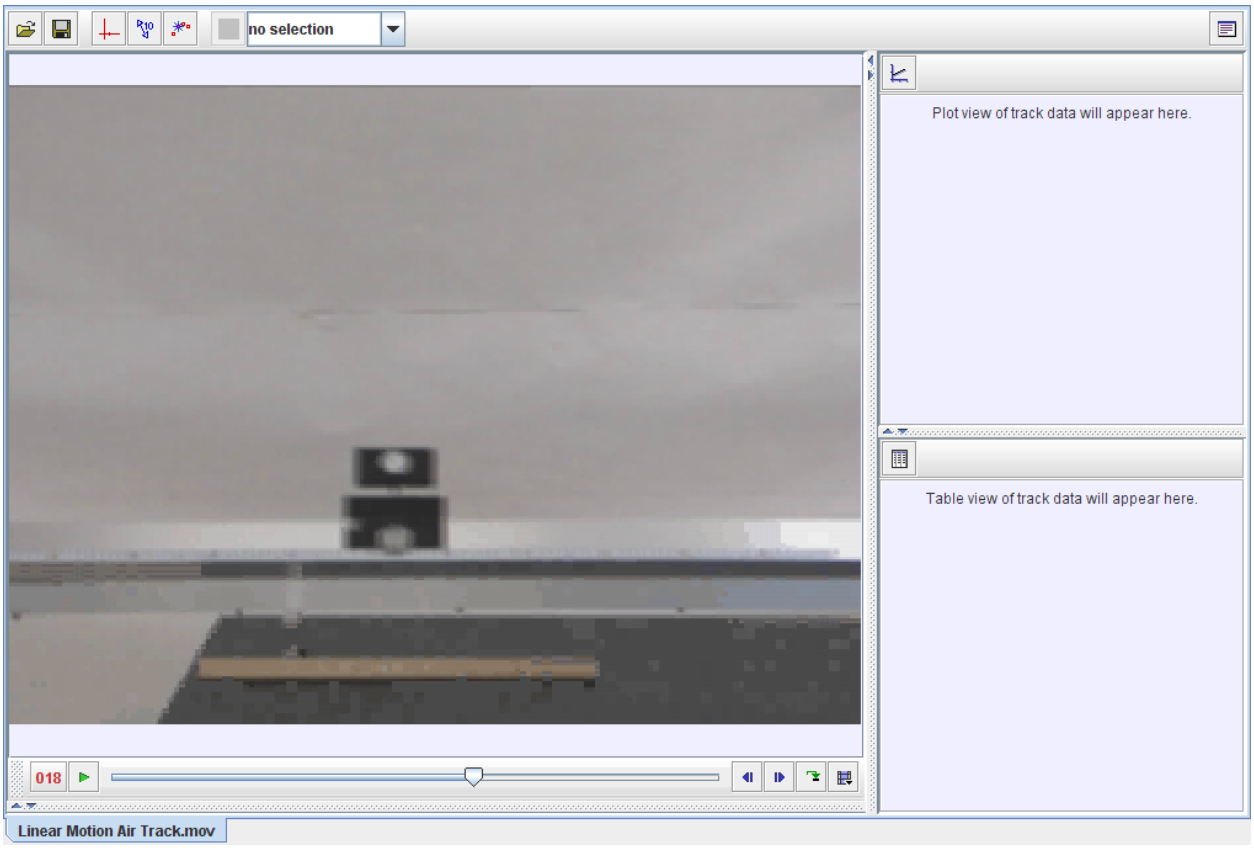
Lab – Linear Motion with Tracker



Purpose

In this lab you will be measuring some of the basic quantities of linear motion and seeing how well your data fits to the kinematic equations. You will do this by finding a video that involves someone doing something pertaining to linear motion, and then using the "Tracker" program to analyze that video and

take all of your data. You will then do some calculations and see how well the real world data you took matches the theoretical data you should have gotten.

**Important!! You should be familiar with the "Tracker" program by this point including how to load in a video and how to analyze it. If you are not…be sure to refer closely at the instruction manual handed out earlier in class.

Materials
- Computer with Tracker Installed
- Linear Motion video (from Website).

Procedure
Part 1 – Obtaining the Video
Begin the lab by making sure that Tracker is installed and working on the computer you are working with. If it is not then refer to the instruction manual handed out earlier and take the time to get it up and running.

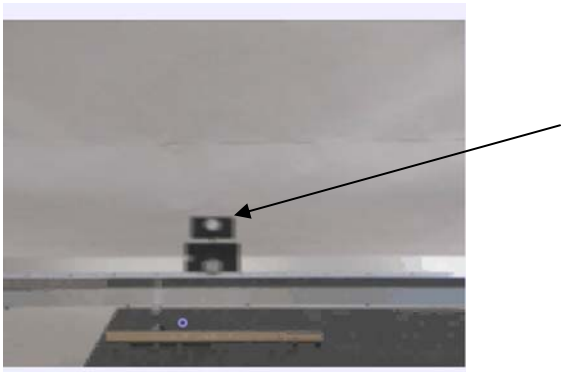
You will need to grab the video that you are going to want to analyze. Locate:

- " Linear Motion Air Track.mov"

And, download it to the desktop.

Part 2 – Using Tracker to Analyze the Video
Open the video in Tracker and setup the video for analysis. If you forget how to do this refer to the instruction manual again. For this video take data between frame 3 and frame 28 and set the axis origin to be located at the position of the air cart at frame 3 (so your data starts at x = 0). After you have everything setup (the length calibration and the axis) then track the main air cart in the video. Once that is done you should be able to view all of the data about it.

As you track the cart always mark the same spot, a good location to do this is the little white dot on the air cart (see below):



In your data section you need to graph the position vs. time graph, the velocity vs. time graph and the acceleration vs. time graph on the axes provided. You then also need to use the statistics functions in the Tracker program to take data on mean acceleration. We are going to use all of these functions in the next part of the lab.

Part 3 – Doing the Theoretical Calculations

Given that the air track starts at x = 0 and isn't moving (so v = 0) then calculate (using your mean acceleration for a) where the air cart should be located (and what its velocity should be) for the following times: 0.33s, 0.726s, 1.518s. Do this in the data and conclusions section (show four steps)!

The formulas you may need are included below.

$$\begin{cases} \mathbf{a} = \text{const.} \\ \mathbf{v}_f = \mathbf{v}_i + \mathbf{a}t \\ \mathbf{x}_f = \mathbf{x}_i + \mathbf{v}_i t + \frac{1}{2}\mathbf{a}t^2 \\ \mathbf{v}_f{}^2 = \mathbf{v}_i{}^2 + 2\mathbf{a}(\mathbf{x}_f - \mathbf{x}_i) \end{cases}$$

Finally, look at the data for these times that you got from your program, how close were they? Answer the remaining questions in the data and conclusions section.

Name: _____ 20 PTS

Period: _____

Lab: Linear Motion with Tracker - Data and Conclusions

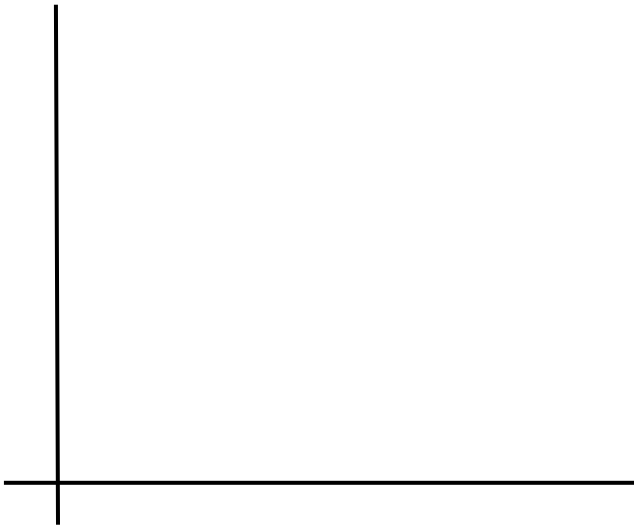
Part 2 – Using Tracker to Analyze the Video

After completing the track for the air cart draw in the three graphs below:

Show units and axis labels for full credit!

Displacement vs. Time

Velocity vs. Time



Acceleration vs. Time

Mean Acceleration: _____ meters per second squared

Part 3 – Doing the Theoretical Calculations
Show four steps and solve for position and velocity for each of the times: 0.33s, 0.726s, 1.518s

0.330s – Theoretical Position _____m Actual Position _____m/s

Theoretical Velocity _____m Actual Velocity _____m/s

0.726s – Theoretical Position _____m Actual Position _____m/s

Theoretical Velocity _____m Actual Velocity _____m/s

1.518s – Theoretical Position _____m Actual Position _____m/s

Theoretical Velocity _____m Actual Velocity _____m/s