Experiment 2

Motion: Uniform and Non-Uniform

Fig. 2-1

Equipment

Lab Pro Interface
Motion Detector
Power Supply
Basketball
Ramp and Block
Cart

Advance Reading: University Physics I by OpenStax, Ch. 3

Objective: Qualitative analysis of the kinematic equations by graphing a student in motion; enhance graph analysis skills.

Theory: Kinematics is the description of *how* objects move. An effective method of describing motion is to plot graphs of distance, velocity, and acceleration, vs. time. Using a motion detector and computer software, your motion as you move around the room will be graphed. Qualitative analysis of these graphs will help you to develop a better understanding of the concepts of kinematics and increase your graph analysis skills.

GETTING STARTED
Always connect the equipment before opening *Logger Pro* software.

Open the following folders:

Lab Software/
Experiments/
Motion Experiment/

Open the individual experiments as needed.

Click once on "**Collect**" each time you are ready to graph your motion; this will erase prior data. There is no need to open/close the graph window each time. When you are ready for the next experiment, such as "Exp 01b Distance Match One.mbl", **select** → File → Quit, "Don't Save", then open the next experiment.

You should be at least 0.4 m from the motion detector during all phases of this experiment. The motion detector "sees" a cone of about 20°, so you will need to choose your detector placement wisely! It will also "see" your arms swinging and movement of loose clothing and hair.

To set the parameters for printing: FILE → Printing Options, then enter the team names, "Exp 0x" in the "Comment" field, and select the date. Click on "Page Setup" then select Paper: Letter; Orientation: Landscape. Click "OK". Now go to VIEW → Graph Options. Be sure the following are checked: Legend, Connecting Line, Grid, and Title. Click "OK". To print: FILE → Print Window.

Procedure

(You are using the Gen 2 motion detector, remember to adjust the mode to "**basketball/person**" when doing Part 1 – Part 4 and adjust the mode to "**cart**" when doing Part 5)

PART 1: Distance
Open Exp 01a, click OK. Walk at a slow, constant, speed away from the motion detector when you hear it begin clicking. Sketch what the graph would look like if you walked faster. Test it. Switch jobs with your partner and repeat. Is the slope of your graph positive or negative as you

walk away from the motion detector? What is the slope when you walk towards the detector? Test it.

PART 2: Graph Matching
Open "Exp 01b", click OK. Match the graph by adjusting your position and speed. When you have succeeded, print window. Your partner should match, then print, "Exp 01c". What is the slope of the graph when you stand still? What does the slope on this graph represent?

PART 3: Velocity
Open "Exp 01d", click OK. Match this graph; print window. Your partner should match and print "Exp 01e". What is the slope of the graph when you moved at a constant velocity? When you changed your velocity? Were you able to reproduce the vertical lines? Is it possible to reproduce the vertical lines? Why or why not? What does the slope of this graph represent?

PART 4: Bouncing Ball
Open "Exp 02 Ball.MBL" and hold the detector up high, facing the floor, with the cord out of the way. Your partner will hold the basketball 0.4 m below it. Release the ball when you hear the detector start clicking. Take care that your arms aren't in the detectors "line of sight" and that the ball doesn't roll under the table. Let the ball bounce several times. Use the tangent button and the examine button to determine the slope at several points: on the way up, at the top, on the way down, and at the bottom. Was the velocity ever zero? Was acceleration ever zero? What does the slope of the distance vs time graph represent? What does the slope of the velocity vs time graph represent?

PART 5: Cart on an Incline
Open "Exp 02 Cart.MBL". Elevate one end of a board and position the detector at the top. Push the cart up the incline, taking care that it doesn't hit the detector or get any nearer than 0.40m; catch the cart when it returns to the bottom. Examine the slope of the freely rolling cart. Is the velocity ever zero? What does the slope represent? Is the slope ever zero? Is the acceleration ever zero? Is the acceleration constant or changing?