Name _____ Date _____

Experiment
33

Graphing Your Motion

Graphs made using a Motion Detector can be used to study motion. In this experiment, you will use a Motion Detector to make graphs of your own motion.

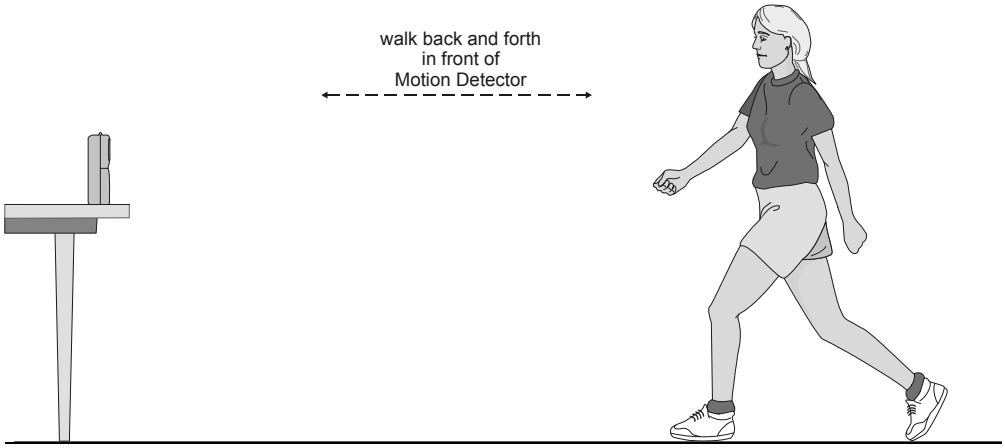
OBJECTIVES

In this experiment, you will

- use a Motion Detector to measure distance, velocity, and acceleration
- use a computer to produce graphs of your motion
- analyze the graphs you produce
- match distance *vs*. time and velocity *vs*. time graphs

MATERIALS

Laptop Computer
Vernier LabPro
Logger*Pro* 3.2.1
Vernier Motion Detector
masking tape
meter stick

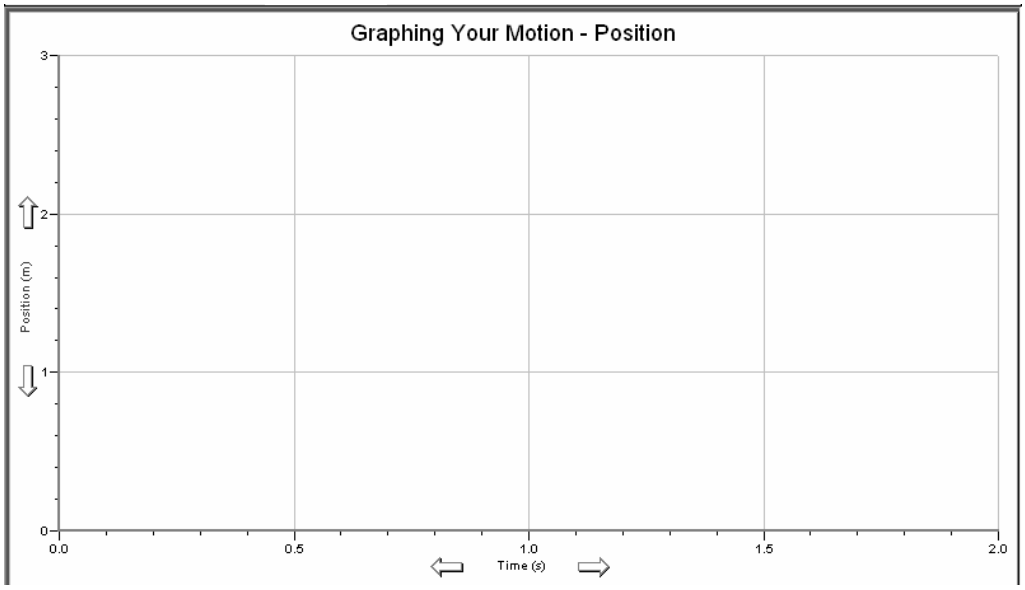


PROCEDURE

Part A Distance

1. Fasten a Vernier Motion Detector to a tabletop facing an aisle. Connect the Motion Detector to DIG/SONIC 2 of the LabPro.
2. Use short strips of masking tape on the floor to mark the 1-m, 2-m, 3-m, and 4-m distances from the Motion Detector.

3. Prepare the computer for data collection by opening the Experiment 33 folder of *Middle School Science with Computers*. Find this file by going to Vernier → LoggerPro 3.2.1. Then go to File → Open → Middle School Science With Computers. Click to open the folder. . Then open the file "Exp 33A" Graphing Motion. You should see the following position *vs*. time graph.



4. Stand at the 1-m mark on the tape line facing the Motion Detector and the computer screen. Have your partner click Collect. Slowly walk backwards away from the Motion Detector. Walk along the tape line and watch the screen.

5. Choose Store Latest Run on the Data menu. Repeat Step 4, moving faster this time.

6. Sketch your results on the above graph.

7. Open the file "Exp 33B". You should see the following position *vs*. time graph.

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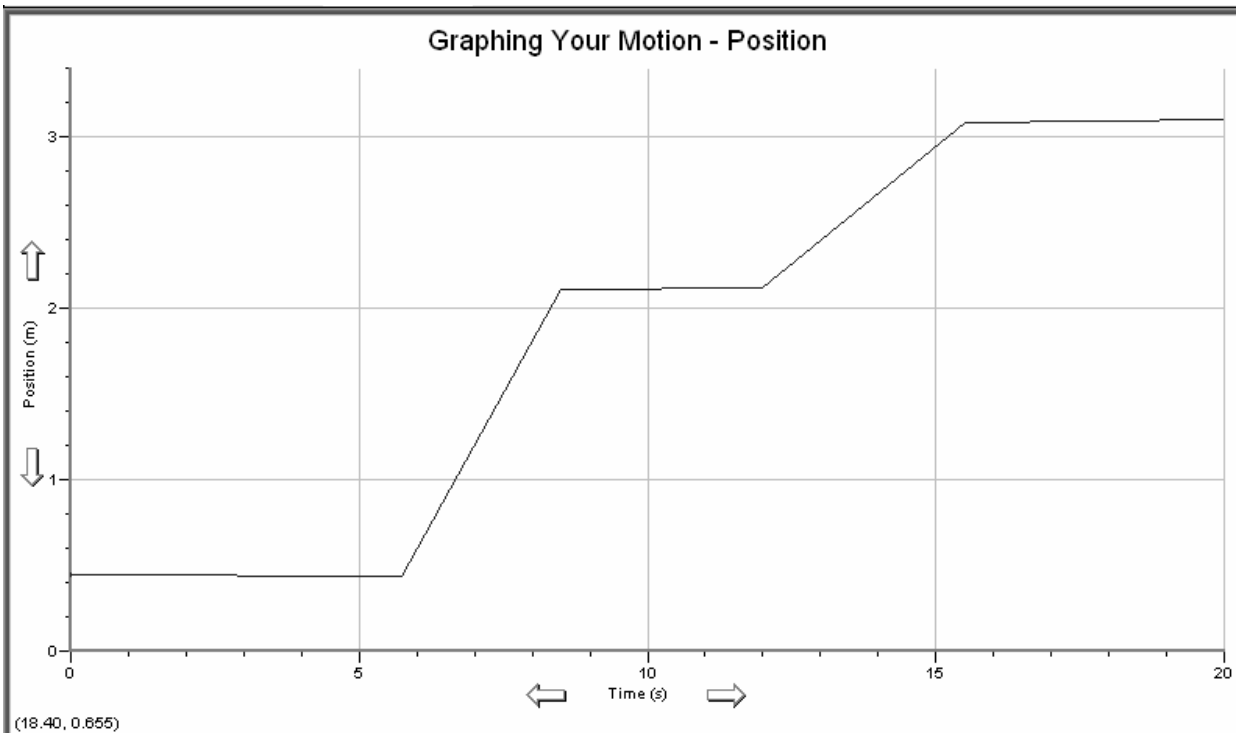


8. Try to match the line by moving toward or away from the Motion Detector. Sketch your results on the above graph. Have everyone in your group try to match the line.

PROCESSING THE DATA (Part A)

1. Describe the difference between the two lines on your graph made in Steps 4 and 5. Explain why the lines are different.

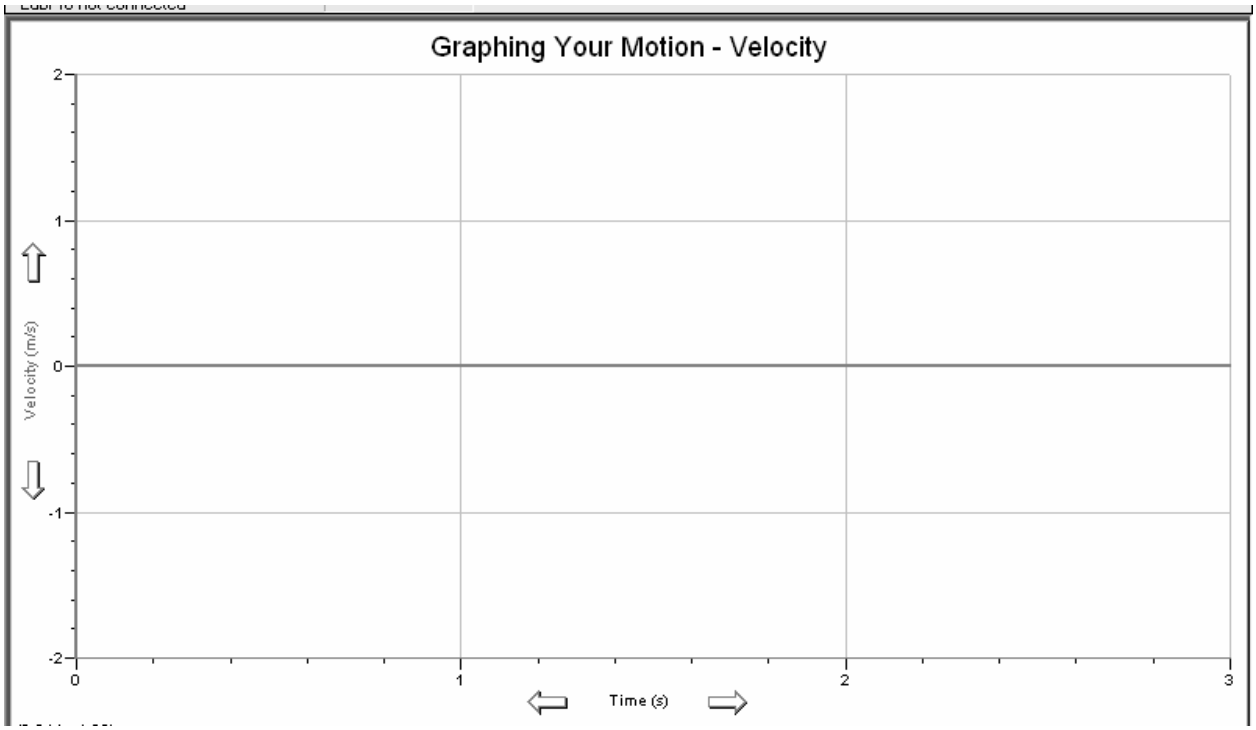
2. How would the graph change if you walked toward the Motion Detector rather than away from it? Test your answer.

3. What did you have to do to match the graph you were given in Step 7?

Part B Velocity

9. Open the file "Exp 33B1" from the Exp 33B Velocity folder. You should see the following velocity *vs*. time graph.

10. Stand at the 1-m mark on the tape line facing the Motion Detector and the computer screen.



Have your partner click Collect, then slowly walk backwards away from the Motion Detector.

11. Choose Store Latest Run on the Data menu. Repeat Step 10, moving faster this time.

12. Sketch your results on the graph above.

13. Open the file "Exp 33D". You should see the following velocity *vs*. time graph.

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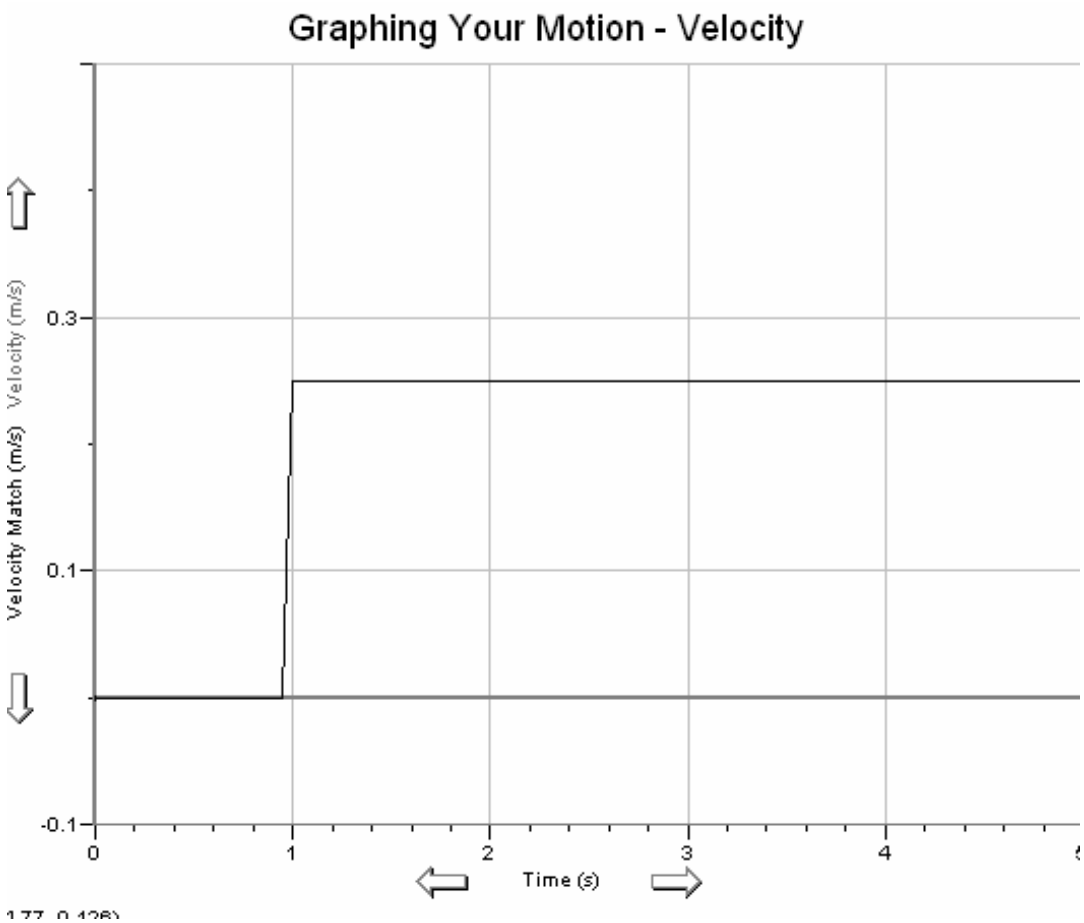


14. Try to match the line by moving toward or away from the Motion Detector. Sketch your results on the above graph. Have everyone in your group try to match the line.

PROCESSING THE DATA (Part B)

4. Describe the difference between the two lines on the graph made in Steps 10 and 11. Explain why the lines are different.

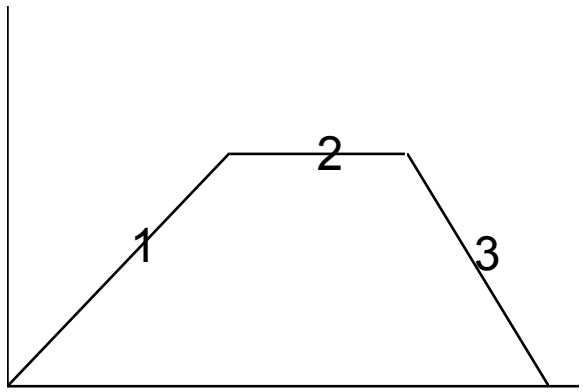
5. What is the definition of velocity?

6. What did you have to do to match the graph you were given in Step 13? How well does your graph match the given graph?

7. Describe the motion needed to make this graph:

   If it is a distance *vs*. time graph:

   If it is a velocity *vs*. time graph:



   You can check your answers using a Motion Detector.

Part C Acceleration

15. Open the file "Exp 33E". Three "empty" graphs should appear on the screen. The top one is a distance *vs*. time graph. The middle one is a velocity *vs*. time graph. The bottom graph is an acceleration *vs*. time graph.

16. Stand at the 1-m mark on the tape line, this time with your back to the Motion Detector. Have your partner click [Collect]. Pause for about one second and then walk rapidly to the 3-m mark and stop. Say "stop" when you have stopped. As you say "stop," your partner should click [Stop]. Print or sketch your results.

PROCESSING THE DATA (Part C)

8. How does the acceleration *vs*. time graph differ from the other two graphs?

9. On your velocity *vs*. time graph, label the acceleration and deceleration portions.

10. On your acceleration *vs*. time graph, label the acceleration and deceleration portions.

11. What is acceleration?

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