OBJECTIVES

• Analyze the motion of a student walking across the room.

• Predict, sketch, and test position vs. time kinematics graphs.

• Predict, sketch, and test velocity vs. time kinematics graphs.

MATERIALS

computer Vernier Motion Detector

Vernier computer interface meter stick

Logger Pro masking tape

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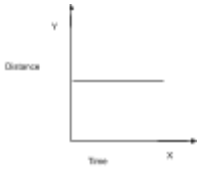
Computer 1

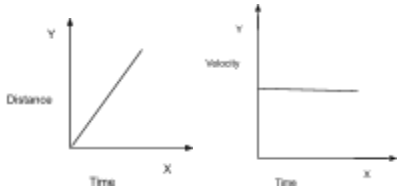
PRELIMINARY QUESTIONS

1. Use a coordinate system with the origin at far left and positive positions increasing to the right. Sketch the position vs. time graph for each of the following situations:

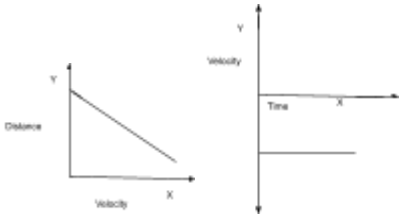
• An object at rest



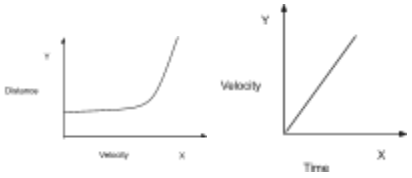
• An object moving in the positive direction with a constant speed



• An object moving in the negative direction with a constant speed



• An object that is accelerating in the positive direction, starting from rest



2. Sketch the velocity vs. time graph for each of the situations described above.
Shown above

PROCEDURE

Part I Preliminary Experiments

1. Connect the Motion Detector to the DIG/SONIC 1 channel of the interface.

If the Motion Detector has a sensitivity switch, set it to Normal.

2. Place the Motion Detector so that it points toward an open space at least 4 m long. Use short strips of masking tape on the floor to mark the 1 m, 2 m, 3 m, and 4 m positions from the Motion Detector.

3. Open the file “01a Graph Matching” from the Physics with Vernier folder.

4. Using Logger Pro, produce a graph of your motion when you walk away from the detector with constant velocity. To do this, stand about 1 m from the Motion Detector and have your lab partner click . Walk slowly away from the Motion Detector when you hear it begin to click.

5. Sketch what the position vs. time graph will look like if you walk faster. Check your prediction with the Motion Detector.

6. Try to match the shape of the position vs. time graphs that you sketched in the Preliminary Questions section by walking in front of the Motion Detector.

Part II Position vs. Time Graph Matching

7. Open the experiment file “01b Graph Matching.” A position vs. time graph will appear.

1. Describe how you would walk to produce this target graph.

2. To test your prediction, choose a starting position and stand at that point. Start data collection by clicking . When you hear the Motion Detector begin to click, walk in such a way that the graph of your motion matches the target graph on the computer screen.

10. If you were not successful, repeat the process until your motion closely matches the graph on the screen. If a printer is attached, print the graph with your best attempt.

11. Open the experiment file “01c Graph Matching” and repeat Steps 8–10, using a new target graph.

12. Answer the Analysis questions for Part II before proceeding to Part III.

Part III Velocity vs. Time Graph Matching

13. Open the experiment file “01d Graph Matching.” A velocity vs. time graph will appear.

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Graph Matching

14. Describe how you would walk to produce this target graph.
We will walk slower/faster and different distances to match the graphs.

15. To test your prediction, choose a starting position and stand at that point. Start by clicking of your motion matches the target graph on the screen. It will be more difficult to match the

velocity graph than it was for the position graph.

16. Open the experiment file “01e Graph Matching.” Repeat Steps 14–15 to match this graph.

17. Remove the masking tape strips from the floor.

ANALYSIS

Part II Position vs. Time Graph Matching

1. Describe how you walked for each of the graphs that you matched.
For position vs. time graphs (acceleration) we had to walk a certain distance in order to match the graph. For velocity vs. time graphs, we had to increase, and decrease the speed that we walked.

2. Explain the significance of the slope of a position vs. time graph. Include a discussion of The slope positive and negative slope.
The slope is the speed of which an object is moving, therefore if the slope is steeper (greater) then the speed is also greater.

3. What type of motion is occurring when the slope of a position vs. time graph is zero?
There is no motion occurring.

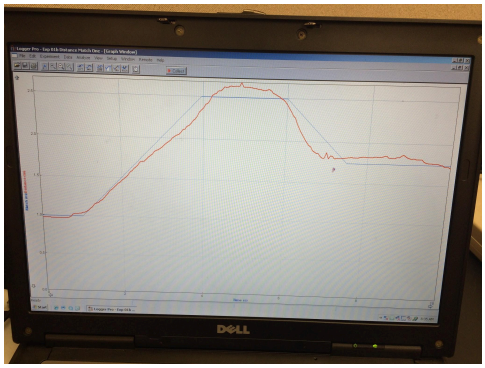
4. What type of motion is occurring when the slope of a position vs. time graph is constant?
A constant motion is occurring.

5. What type of motion is occurring when the slope of a position vs. time graph is changing?
The speed is changing. If the slope is larger, than the speed is greater. If the slope decreases, the speed also decreases.

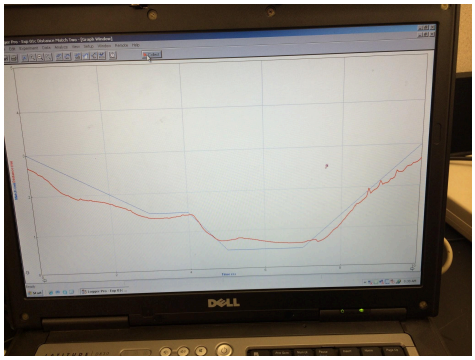
6. Return to the procedure and complete Part III.

Part III Velocity vs. Time Graph Matching

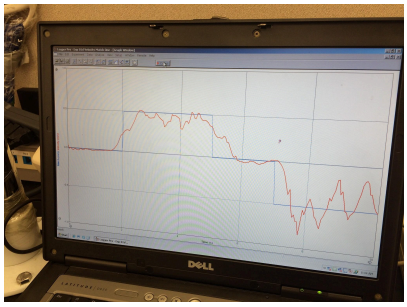
7. Describe how you walked for each of the graphs that you matched.



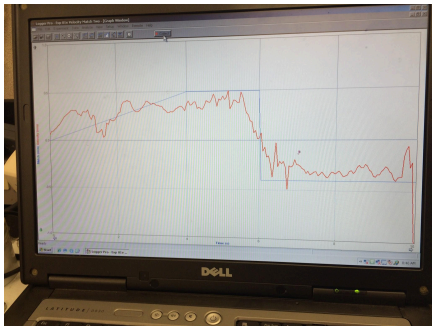
For this graph above, we stood still for the first portion. Then we walked at an increasing speed for 3 seconds then stood still for another 2 seconds. Then we walked back toward the monitor at a constant speed for 1.5 seconds, and stood at rest for the end.



For the graph above, we walked toward the monitor with a constant speed for 3 seconds, then stood at rest for 1 second. We then continued walking at a constant speed toward the monitor and stopped at distance=1. Then we walked at a constant speed until the end of the trial.



For this velocity versus time graph above, we walked at a constant speed for the first portion. Then we ran at an increasing speed, then we walked at a constant speed. Then we ran back toward the monitor at an increasing speed, followed by walking at a constant speed for the remainder of the time.



For this graph above, ran at an increasing speed for the first portion. Then we walked at a constant speed for 2 seconds. Then ran toward the monitor. Then we walked at a constant speed for the rest of the graph.

8. What type of motion is occurring when the slope of a velocity vs. time graph is zero?
The velocity is constant.

9. What type of motion is occurring when the slope of a velocity vs. time graph is not zero?
The velocity is changing (increasing or decreasing).