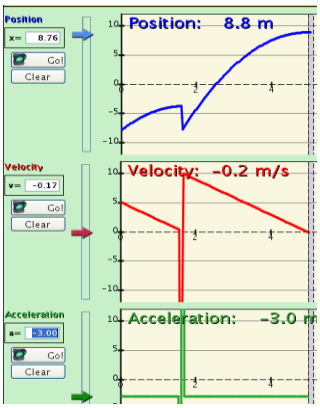
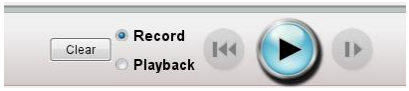
PhET Tips for Teachers **Moving Man**

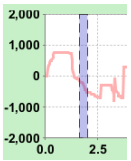
Tips for controls:



- Try all the different tabs at the top of the simulation. The tabs are designed to help teachers scaffold lessons or make lessons age appropriate by using only some tabs.
- If you want to make specific graphs to represent motion as students might see in a text, like the ones shown on the right: use **Pause,** then set the parameters using the sliders, then press **Play.**
- If you are doing a lecture demonstration, set your screen resolution to 1024x768 so the simulation will fill the screen and be seen easily.
- Use the controls on the bottom to **Pause, Step**, or **Record** and **Playback** the motion. You must select **Record** before you start an experiment if you want it saved.



- On the Introduction Tab, the is grabbable in **Playback** mode to help student to make sense of the man's motion.



- On the **Chart** tab, the vertical gray lines in the charts are grabbable in **Playback** mode to help students to relate the Man's motion to the graphs.
- Under the **Special Features** menu, Mathematical Expression and Reverse axis are advanced features. If the man stops at the wall, the function no longer applies, but is still visible.

Important modeling notes / simplifications:

- When dragging the mouse, samples are taken about 24 frames per second. Four samples are averaged to set the position of the man character; this creates a slight lag between the mouse location and the man location. To compute the velocity at time t-dt, a linear fit is made of the 3 points (t-2*dt, t-dt, t), and the slope is identified. The acceleration is computed as the first derivative of velocity using the same algorithm, not a direct second derivative of the position data. To compute integrals, such as position from a specified velocity, forward Euler integration is used.

Insights into student use/thinking:

- The Tree and House are included to help you ask questions to which students can easily relate like "Predict what the chart would look like if the man starts at the tree and moves toward the house with constant velocity."
- Some students may try to make changes while in the **Playback** mode and then hit **Play**; the sim will not run until **Record** is selected.

Suggestions for sim use:

- We designed the motion sims to be used in the following order: Moving Man, Forces & Motion, then The Ramp.
- Two related sims are Ladybug Revolution and Ladybug Motion 2D.
- For tips on using PhET sims with your students see: **Guidelines for Inquiry Contributions** and **Using PhET Sims**
- The simulations have been used successfully with homework, lectures, in-class activities, or lab activities. Use them for introduction to concepts, learning new concepts, reinforcement of concepts, as visual aids for interactive demonstrations, or with in-class clicker questions. To read more, see **Teaching Physics using PhET Simulations**
- For activities and lesson plans written by the PhET team and other teachers, see: **Teacher Ideas & Activities**

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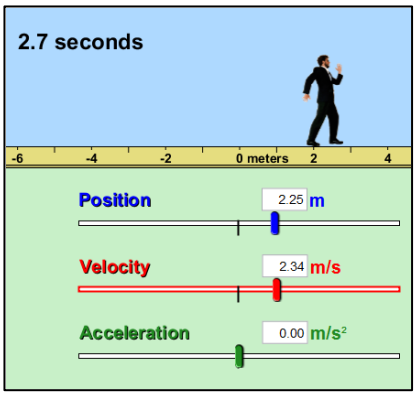
last updated July 17, 2010

Name _____ Period _____ Date _____

Motion Simulation: The Moving Man

Through a web browser, navigate to **http://phet.colorado.edu**. Click "Play with Sims," then "Physics," then "Motion," then choose the "Moving Man" simulation. Click "Run now" to start the simulation.



Object of the simulation

To explore position and velocity graphs of an object moving in different ways.

Familiarization

There are two tabs for this simulation, called "Introduction" and "Charts." For today's activity, you will need only the "Introduction" tab.

Play with the controls of the simulation to get used to the controls. Can you find...

- ❑ two ways to move the man around?
- ❑ how to make the man move automatically?
- ❑ how to record and playback the man's motion?
- ❑ how to playback the man's motion in slow motion?
- ❑ how to quickly reset the man to starting conditions?

Constant Velocity

1. Reset all of the man's values to zero.

2. Using the position slider, set the man to stand near the tree. Give him a velocity of 1.2 m/s (and an acceleration of 0).

3. Click ▶ to start the man in motion until he hits the wall, then hit ⏸ to stop recording.

4. Use the playback feature to answer these questions.
   a. What happened to the blue position slider as the man moved across the screen?

   b. What happened to the red velocity slider as the man moved across the screen?

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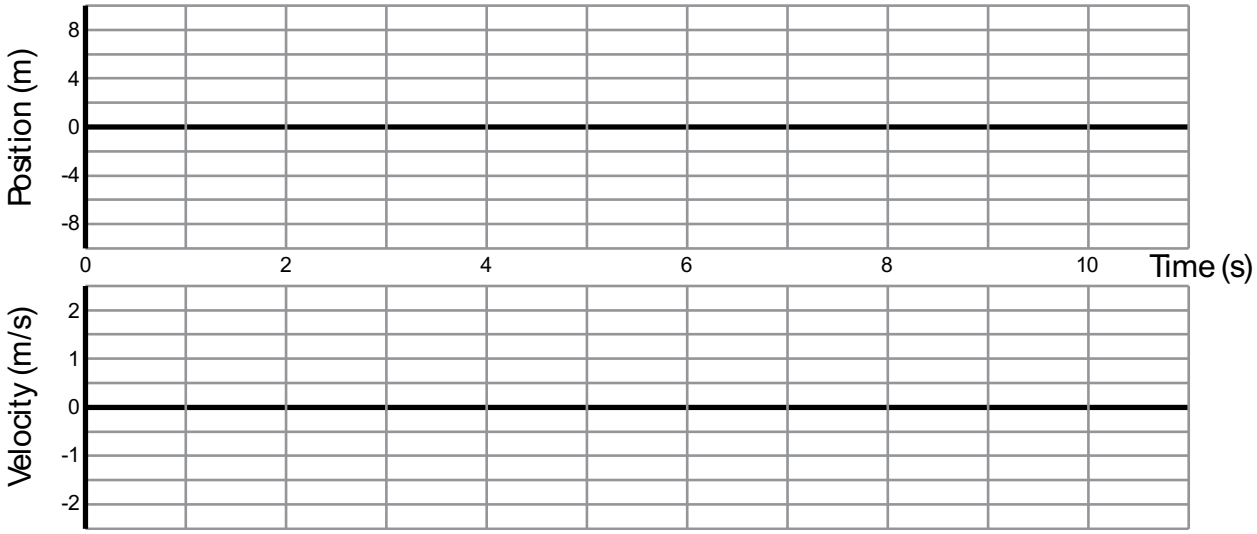
5. Use the playback feature to record the man's position and velocity data.

Time (s)	Position (m)	Velocity (m/s)
0.0		
1.0		
2.0		
3.0		
4.0		
5.0		
6.0		
7.0		
8.0		
9.0		
10.0		

6. Plot your data in the graphs below:



7. According to your graphs...
   a. What shape is your position graph?

   b. What is the slope of your position graph?

   c. Why does or doesn't your answer to b. make sense?

   d. What shape is your velocity graph? Is it horizontal, vertical, or diagonal?

   e. Why does or doesn't your answer to d. make sense?

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Constant Acceleration

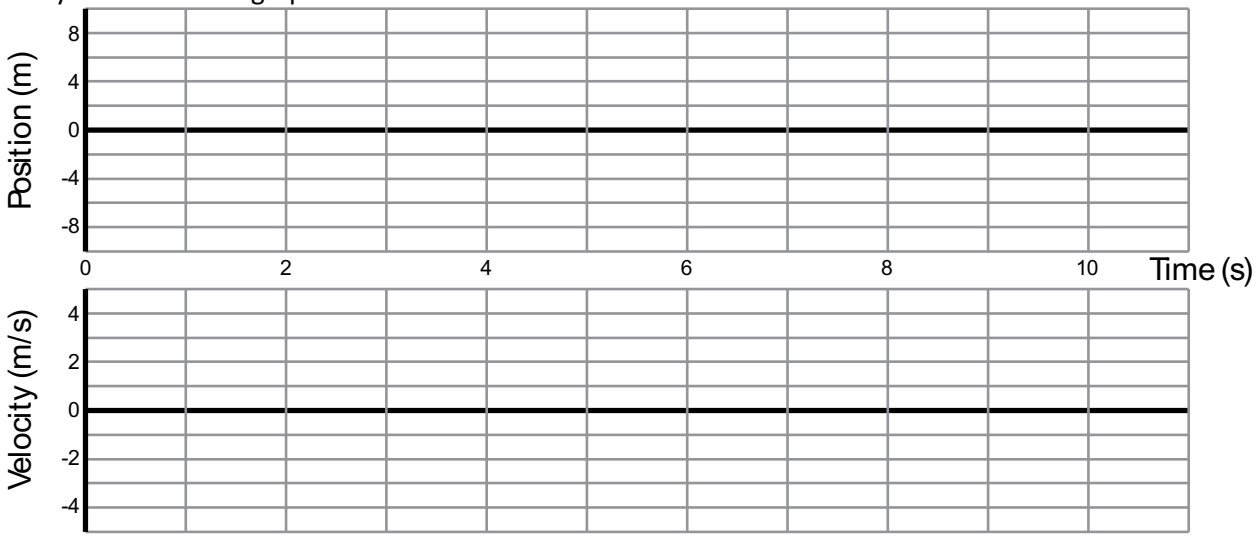
1. Reset all of the man's values to zero.
2. Using the position slider, set the man to stand near the tree. Give him a velocity of 0 m/s and an acceleration of 0.5 m/s^2.
3. Click ▶ to start the man in motion until he hits the wall, then hit ❚❚ to stop recording.
4. Use the playback feature to answer these questions.
    a. What happened to the blue position slider as the man moved across the screen?

    b. What happened to the red velocity slider as the man moved across the screen?

5. Use the playback feature to record the man's position and velocity data.

Time (s)	Position (m)	Velocity (m/s)
0.0		
1.0		
2.0		
3.0		
4.0		
5.0		
6.0		
7.0		
8.0		
9.0		
10.0		

6. Plot your data in the graphs below:



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7. According to your graphs...
    a. What shape is your position graph?

    b. Why does or doesn't your answer to a. make sense?

    c. What shape is your velocity graph?

    d. Why does or doesn't your answer to c. make sense?

    e. What is the slope of your velocity graph?

    f. What does the slope of the velocity graph represent?

Making Connections

1. What happens to the man when he is accelerating?

2. What is the difference between an object with constant acceleration and an object with constant speed?

3. Complete the following sentences:
    a. *"The slope of a linear position graph tells us the _____ of the object."*

    b. *"The slope of a linear velocity graph tells us the _____ of the object."*

    c. *"For an object moving at a constant speed, we would expect to see a position graph with a _____ shape and a velocity graph with a _____ shape."*

    d. *"For an object moving at a constant acceleration, we would expect to see a position graph with a _____ shape and a velocity graph with a _____ shape."*

Moving Man - Distance vs. Time Graphs

Teacher Pages

Prior Knowledge – The students should know:

- How to make a line graph
  - Label axis
  - Plot points and connect with a line
  - The difference between dependent and independent variables
- The basic unit of measure for distance is the meter and they should know approximately how large the meter is.
- a basic understanding of the term “slope of a line”.

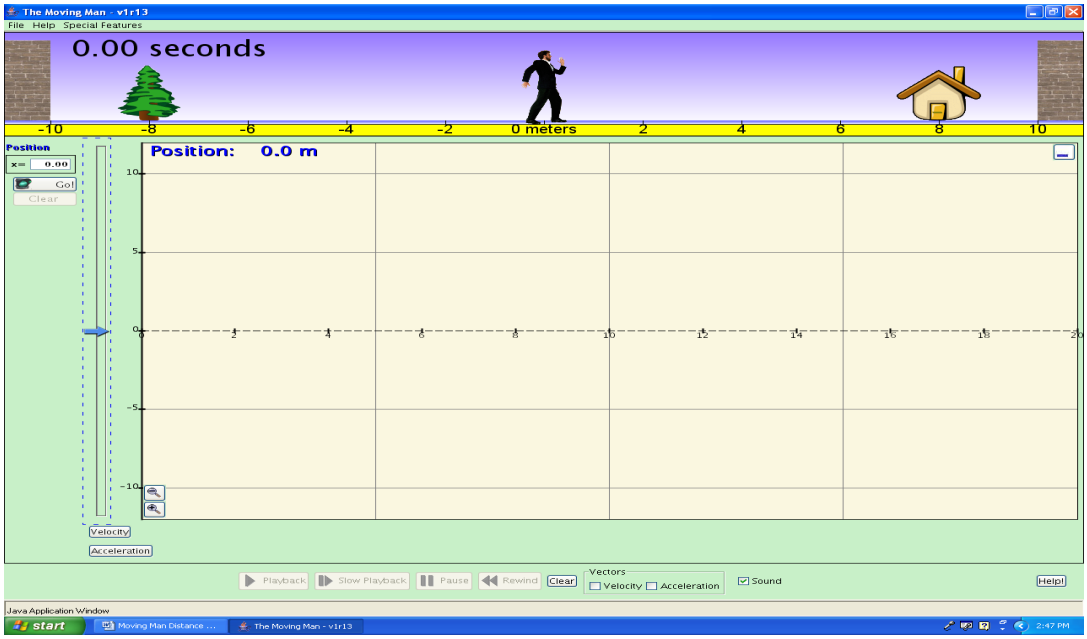
Activity & Simulation Instructions-

- This assignment is intended as an assignment the students will complete outside of class either at home or in a library.
- That the 0m point is an arbitrary point and all distance measurements will be made from that point.
- That the positive and negative values represent the direction the man moves from the 0m point.
- To close the velocity and acceleration graphs the students need to click on this symbol,  located in the upper right hand corner of the appropriate graph
- That the position graph is a distance vs. time graph
- Give the students a descriptive vocabulary to use in their description of a graph. For example;

Description of	Samples of descriptive phrases		
Direction	Moving from ____ to ___	Moving away from observer	Moving towards observer
Speed	Standing still	Moving slow	Moving fast

Learning Goals – The students will:

- Develop a general knowledge of distance time graphs.
  - What a graph of a person standing still would look like
  - What a graph of a person moving away from an observer would look like.
  - What a graph of a person moving towards an observer would look like.
  - How differences in speed appear on the graph



Moving Man - Distance vs. Time Graphs

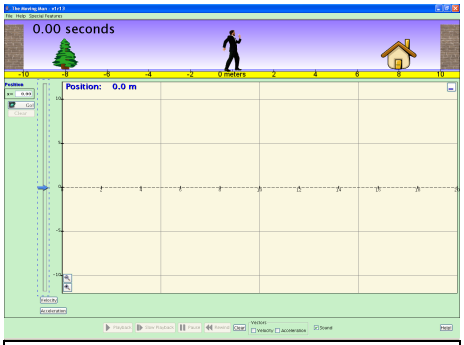
Student Pages

Background – Graphs are not just an evil thing your teacher makes you create, they are a means of communication. In this activity you will learn to speak and read "graph".

Learning Goals – The students will:

- Develop a general knowledge of distance time graphs.
  - What a graph of a person standing still would look like
  - What a graph of a person moving away from an observer would look like.
  - What a graph of a person moving towards an observer would look like.
  - How differences in speed appear on the graph

Procedure – do the following activity using this web site
http://www.colorado.edu/physics/phet/simulations-base.html
Then click on "The Moving Man"



Screen 1

1. **Getting started.** After "Moving Man" is open leave the position graph open but close all of the other graphs, velocity and acceleration. Your screen should look like screen 1.
2. **Making observations.** By either clicking on the man or the slider cause the man to move back and forth and observe what shows up on the graph. Using the axes provided below make a sketch of the graph that is produced by each action described next to each axis.

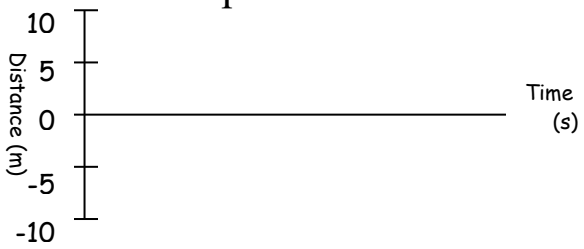
A man moving from 0m to 10m at a slow steady pace.

A man moving from 0m to 10m at a fast pace.

A man standing still at 4m.

Moving Man - Distance vs. Time Graphs

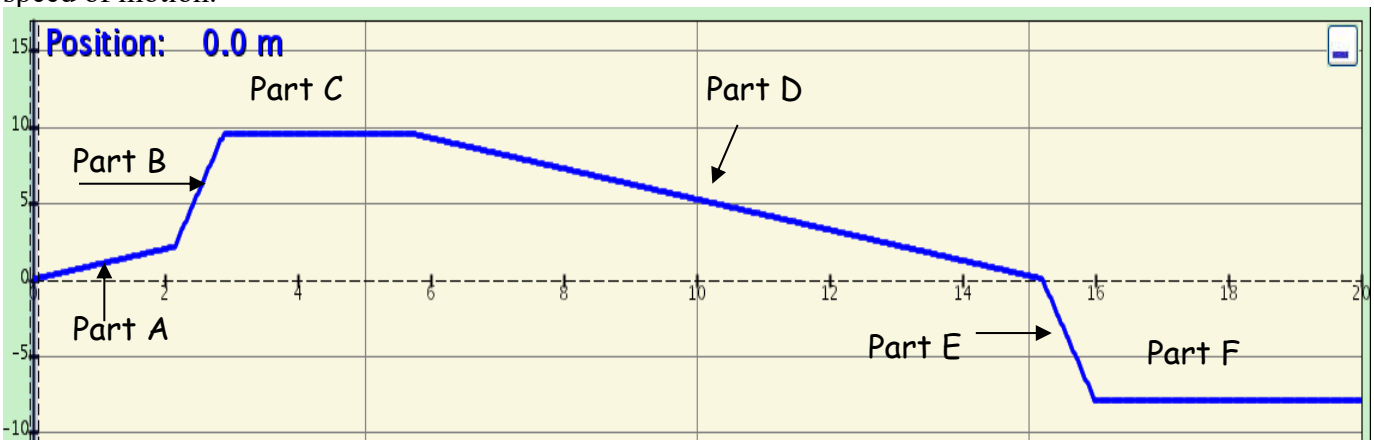
A man moving from 0m to 10m at a slow steady pace, then moving back to 0m at a fast pace.



A man moving from 0m to 5m at a slow steady pace, then moving back to 0m at a slow steady pace.

A man moving from 0m to -10m at a slow steady pace.

Apply what you learned. Look at the graph below and for the different parts of the graph that are marked write a statement about what is happening. Be sure to include the direction of motion and the speed of motion.



Part	Description of direction and speed
A	
B	
C	
D	
E	
F	

Moving Man - Distance vs. Time Graphs

Moving Man - Velocity vs. Time Graphs

Teacher Pages

Prior Knowledge – The students should know:

- How to make a line graph
- The basic unit of measure for distance is the meter and for speed it is meters per second.
- What is meant by the term "slope of a line".

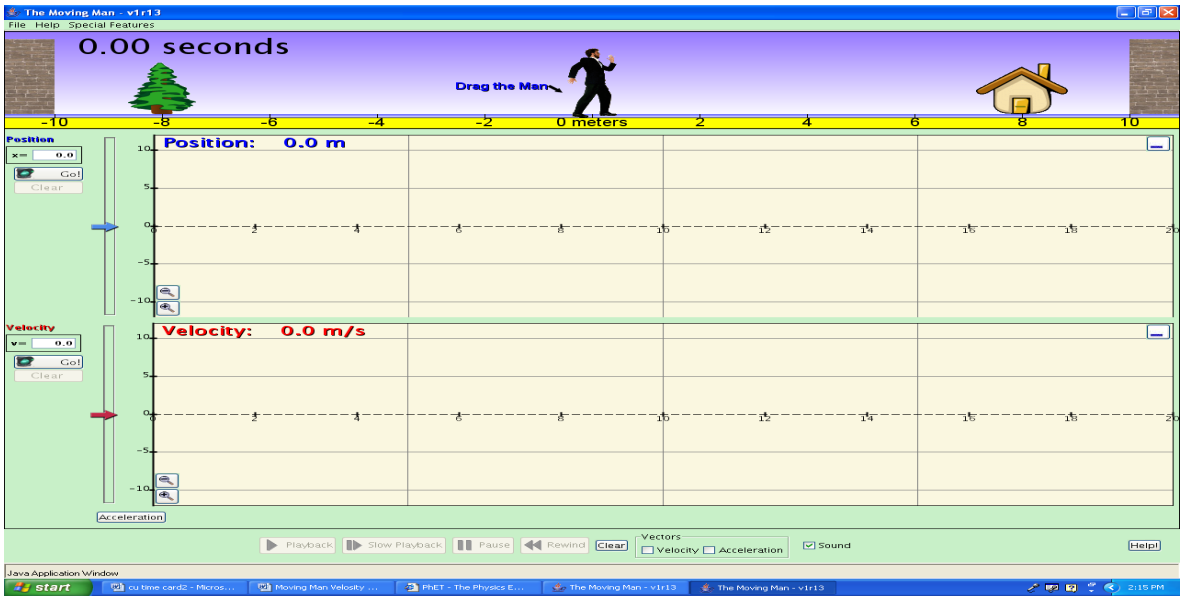
Activity & Simulation Instructions-

- This assignment is intended as an assignment the students will complete outside of class either at home or in a library.
- That the 0m point where the moving man is located is an arbitrary point and all distance measurements will be made from that point.
- That the positive and negative values on the position graph represent the direction the man moves from the 0m point.
- To close the acceleration graphs the students need to click on this symbol,  located in the upper right hand corner of the acceleration graph
- Give the students a descriptive vocabulary to use in their description of a graph. For example;

Description of	Samples of descriptive phrases		
Direction	Moving from ____ to ___	Moving away from observer	Moving towards observer
Speed	Standing still	Moving slow	Moving fast

Learning Goals – The students will:

- Develop a general knowledge of "Velocity vs. Time" graphs and "Distance vs. Time" graphs
  - What graphs of a person standing still would look like
  - What graphs of a person moving away from an observer at a constant speed would look like.
  - What graphs of a person moving towards an observer at a constant speed would look like.
  - How differences in speed appear on the graphs



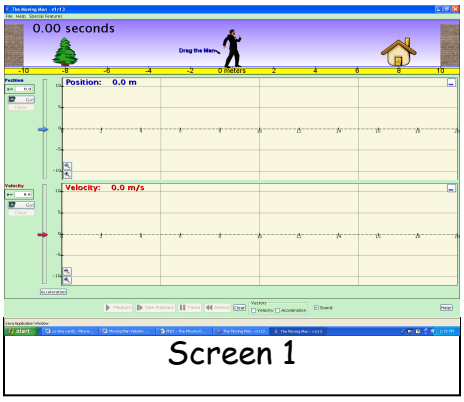
Moving Man - Velocity vs. Time Graphs

Student Pages

Background – Remember graphs are not just an evil thing your teacher makes you create, they are a means of communication. Graphs are a way of communicating by using pictures and since a picture is worth a thousand words knowing how to make and interpret graphs will save you a lot of writing.

Learning Goals – The students will:

- Develop a general knowledge of "Velocity vs. Time" graphs and "Distance vs. Time" graphs
  - What graphs of a person standing still would look like
  - What graphs of a person moving away from an observer at a constant speed would look like.
  - What graphs of a person moving towards an observer at a constant speed would look like.
  - How differences in speed appear on the graphs



Screen 1

Procedure – Do the following activity using this web site
http://www.colorado.edu/physics/phet/simulations-base.html
Then click on "The Moving Man"

1. **Getting started.** After "The Moving Man" is open leave the position graph and the velocity graph open but close the acceleration graph. Your screen should look like screen 1.
2. **Making observations.** By either clicking on the man or the slider cause the man to move back and forth and observe what shows up on the graphs. Using the axis provided below make sketches of Distance vs. Time and Velocity vs. Time graphs for the actions described next to each axis.

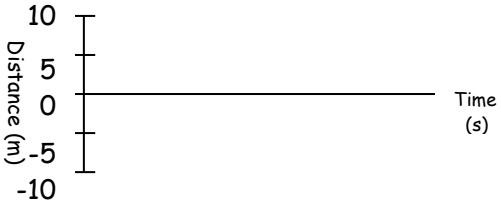
A man moving from 0 to 10 at a slow steady pace.

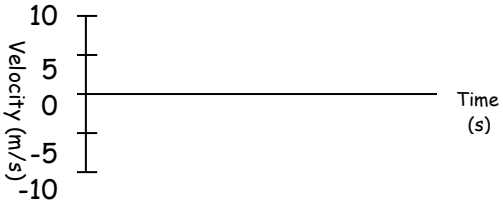
A man moving from 0 to 10 at a fast pace.

A man standing still at 4 m

Moving Man - Velocity vs. Time Graphs

A man moving from 0 to 10 at a fast pace the moving back to 0 at a slow pace.





A man moving from 0 to -10 at a fast pace the moving back to 0 at a slow pace.

A man moving from 10 to 0 at a fast pace.

Apply what you learned. Look at the Distance vs. Time graph below and for the different parts of the graph that are marked by the dotted lines make the corresponding Velocity vs. Time graph directly below each part.