Name____

Date__________ Pd____

UNIT 2 CP LAB 2 - The Moving Man

http://phet.colorado.edu/simulations/sims.php?sim=The_Moving_Man

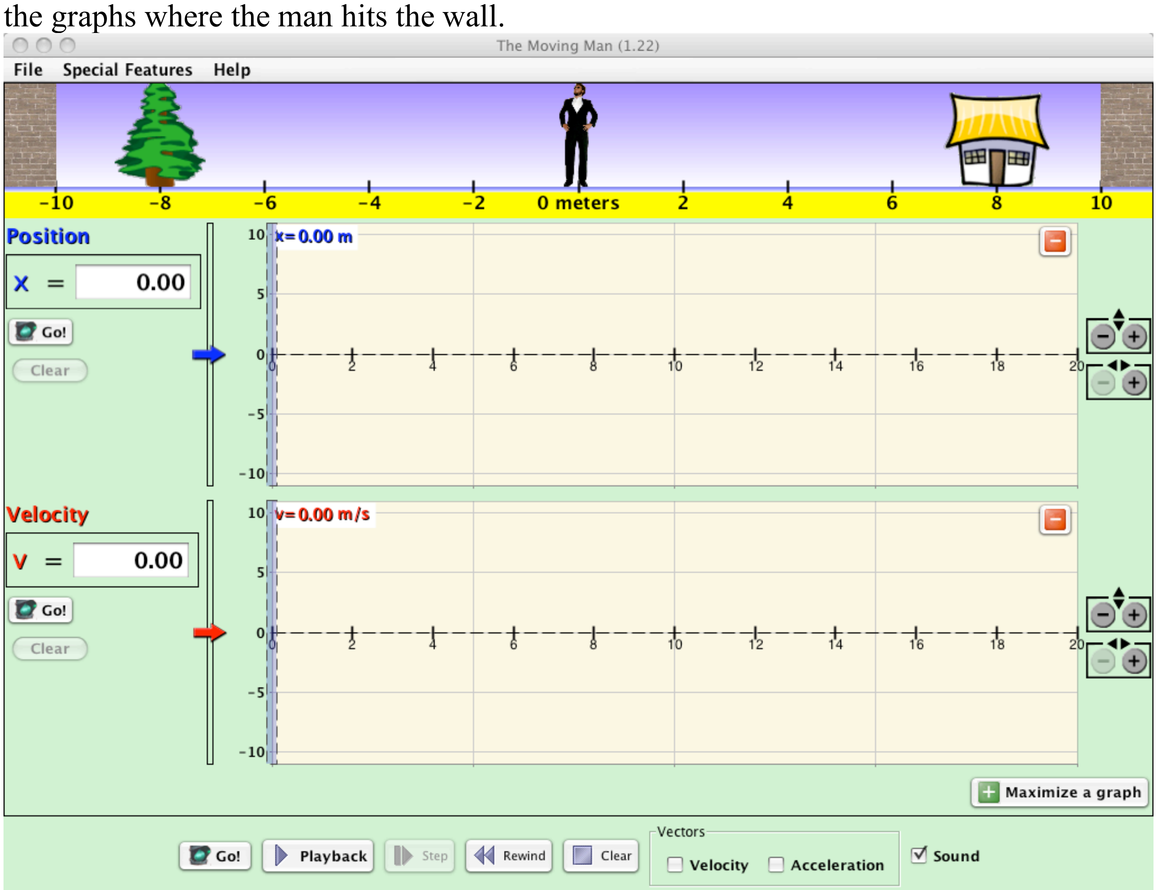
Purpose: To relate position vs time and velocity vs time graphs to the motion of a man walking in a straight line.

Getting Started:

Go to the website above and click "Run Now" to open the simulation. When the simulation opens, maximize the screen. Remove the acceleration graph by clicking . Your screen should look like the one below. NOTE: In this simulation, "Moving Man" can exceed normal human velocities! A fast walker moves at about 2 m/s.

Hypothesis:

Predict what the position vs time and velocity vs time graphs will look like if "Moving Man" moves slowly towards the house at a constant velocity until he hits the wall. Draw your prediction in red colored pencil on the graphs below. Check your hypothesis by clicking on "Motion Man" and moving him with your mouse until he hits the wall. Sketch the actual graphs over your prediction in blue colored pencil. Label the points on the graphs where the man hits the wall.



Determining a frame of reference:

When describing motion, it is helpful to set up a coordinate system. The origin corresponds to zero position.

1. For "Moving Man", where is the origin ($x = 0$) located with respect to the tree and the house?

Velocity and displacement (change in position) are vector quantities and must include a direction. Directions can be described in two dimensions by words like "north", "east", "south" and "west." In one dimension (along a straight line), we often describe direction with a positive sign (+) or a negative sign (–).

2. Move the blue sliding arrow next to "Position" so that "x" is a positive value. Is "Moving Man" to the right or the left of the origin?

3. Move the blue sliding arrow next to "Position" so that "x" is a negative value. Is "Moving Man" to the right or the left of the origin?

4. Move the red sliding arrow next to "Velocity" so that "v" is a positive value. Is "Moving Man" facing to the right (towards the house) or to the left (towards the tree)? Note that if you click 

, the man will move in the direction he was facing.

5. Move the red sliding arrow next to "Velocity" so that "v" is a negative value. Is "Moving Man" facing to the right (towards the house) or to the left (towards the tree)?

For each of the following situations, fill in the blank with "+" or "–" to show the direction of the starting position and velocity.

situation	starting position (x)	velocity (v)
man starts to the right of the origin and walks right		
man starts to the right of the origin and walks left		
man starts to the left of the origin and walks right		
man starts to the left of the origin and walks left		

Revisting your hypothesis:

You may have noticed when testing your hypothesis, that it was difficult to move your mouse smoothly at a constant velocity. In this simulation, you can produce a motion with constant velocity by filling a number into 

. Go back to the graphs in your hypothesis. Look only at the portion of the graph before the man hit the wall.

6. What was your initial position? x_i = __________ m

7. What was your final position? x_f = __________ m

8. What was your total time to go from x_i to x_f? __________ s

9. Calculate your displacement (don't forget direction, either + or –):

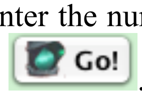
   $\Delta x = x_f - x_i$ = __________ m

10. Calculate your average velocity (don't forget direction, either + or –):

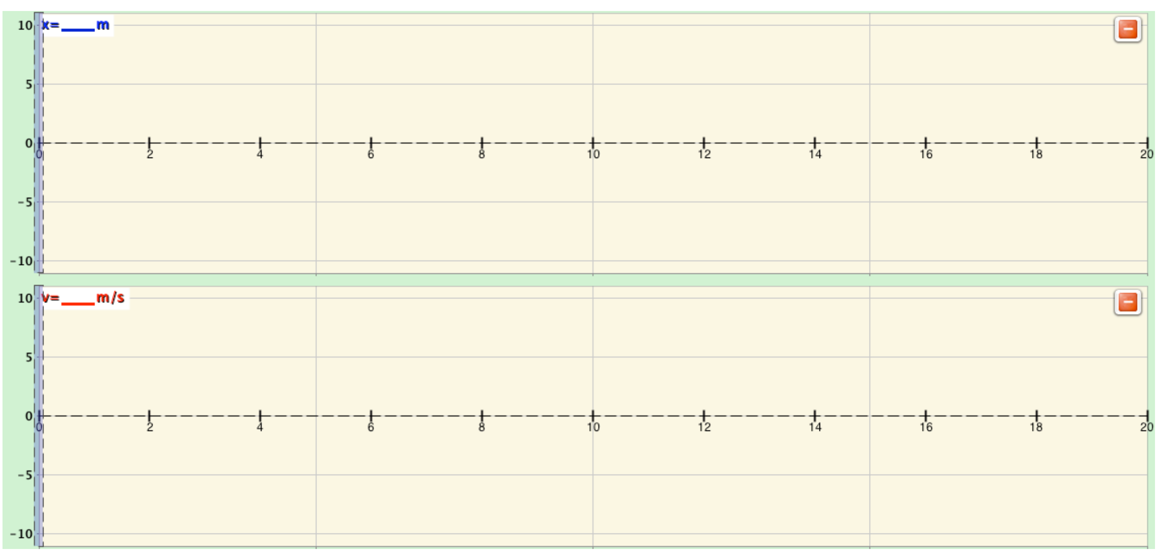
    $V_{ave} = \Delta x / t$ = __________ m/s

Let's try it out!

Hit 

and enter the number you calculated for average velocity. Also enter 0 for position (x=0). Hit 

. Draw the resulting graphs below. Label the points on the graphs where "Moving Man" hits the wall.



11. How are these graphs different from the ones you created when moving the man with the mouse? Why do you think this is so?

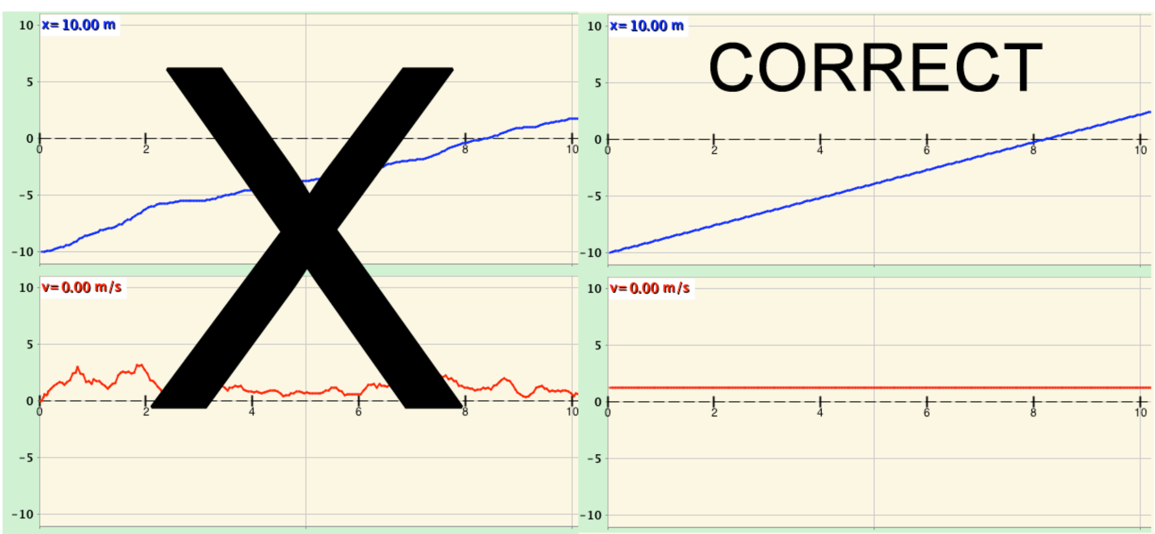
12. Why was the velocity graph so "jumpy" created when moving the man with the mouse?

13. How do you think the slope of the position vs time graph compares to the velocity?

Going further:

By either clicking on and dragging the man or the slider, cause "Moving Man" to move back and forth and observe what shows up on the graphs.

Using the axes provided on the next page make sketches of *Position vs. Time* and *Velocity vs. Time* graphs for the actions described next to each axis. Draw "best fit curve" graphs showing the general shape and not every bump and valley (see below).

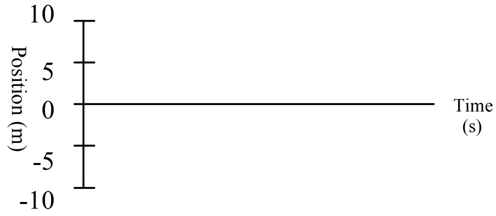


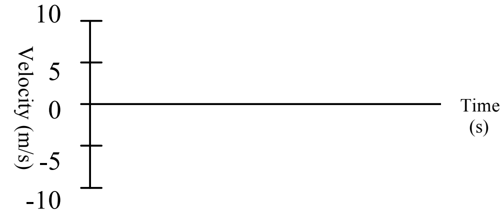
If you wish, you can double check your graphs by entering appropriate numbers for "x" and "v" to check what the graphs would look like for perfectly constant velocities (which can be hard to do with the mouse). Suggested values are given in italics. You can use the 

button to advance the man in 0.05 s intervals.

A man moving from 0 to +10 at a slow constant speed.

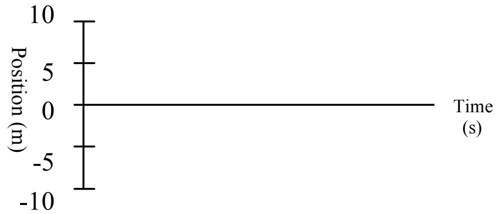
$x_i = 0\ m,\ v = +2\ m/s$

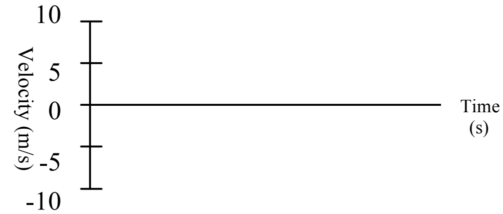




A man moving from 0 to +10 at a fast constant speed.

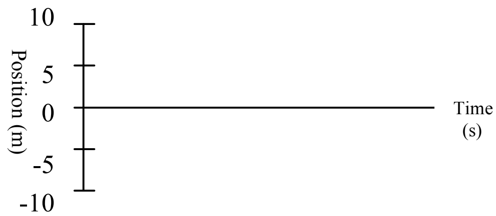
$x_i = 0\ m,\ v = +4\ m/s$

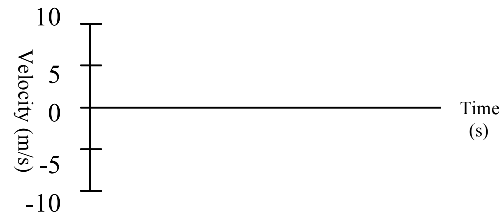




A man standing still at +4 m.

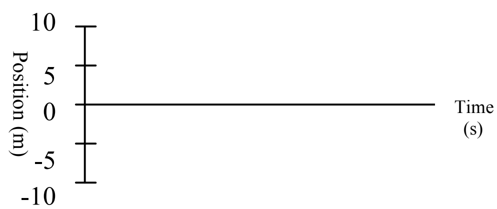
$x_i = +4\ m,\ v = 0\ m/s$

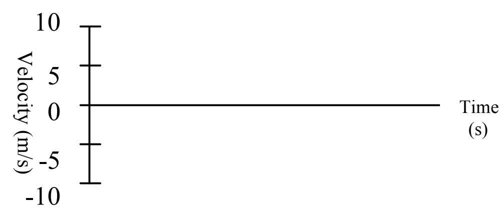




A man moving from 0 to +10 at a fast constant speed then moving back to 0 at a fast constant speed.

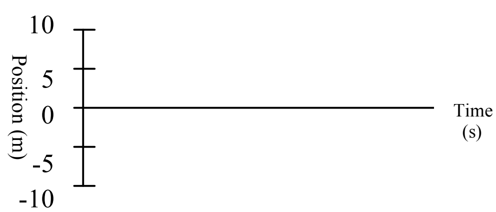
$x_i = 0\ m,\ v = +4\ m/s$
at +10 m, pause & set $v = -4\ m/s$

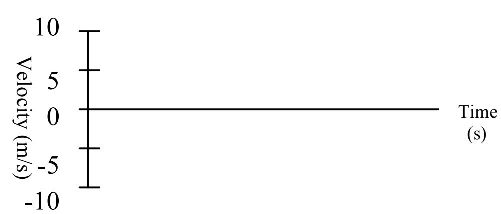




A man moving from 0 to –10 at a fast constant speed then moving back to 0 at a slow constant speed.

$x_i = 0\ m,\ v = -4\ m/s$
at –10 m, pause & set $v = +2\ m/s$



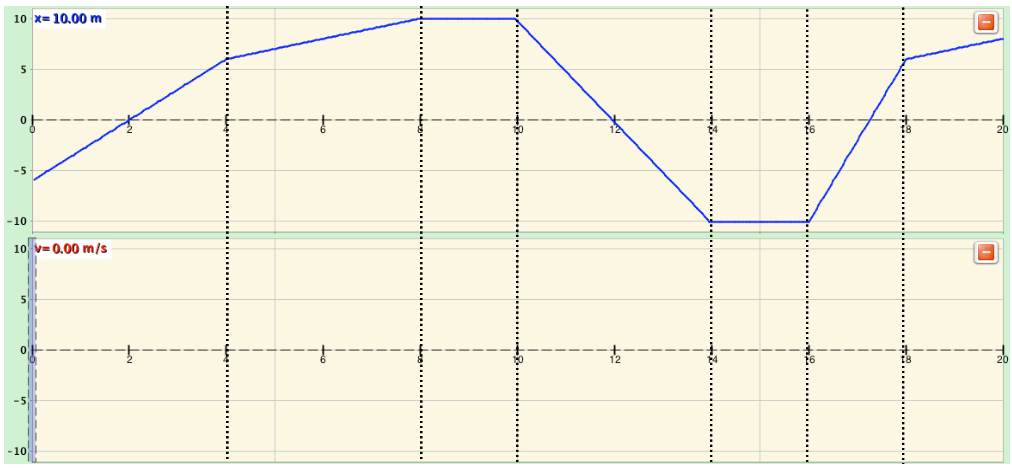


A man moving from +10 to 0 at a fast constant speed.

$x_i = +10\ m,\ v = -4\ m/s$

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.

Describe the motion of the man that produces this graph:



Discussion questions:

1. Describe how to calculate displacement from one time to another time from a *position vs time* graph.

2. How can you determine how fast “Moving Man” is going from a *position vs time* graph??

3. How can you tell from the slope of the *position vs time* graph if “Moving Man” is going to the right or left?

4. How can you tell from a *velocity vs time* graph if “Moving Man” is going to the right or left?

5. Can you determine “Moving Man’s” starting position from a *velocity vs time* graph? Why or why not?

BONUS: Describe how you could calculate displacement from one time to another time from a velocity vs time graph.