Position, Velocity, Acceleration Graphs

Goal: To be able to look at (distance vs. time), (*velocity vs. time*), and (*acceleration vs. time*) graphs and describe how an object is moving.

Part 1: *distance and velocity vs. time (This takes about 10-15 minutes)*

What to do:

- Go to Website: http://phet.colorado.edu/simulations/sims.php?sim=The_Moving_Man
- Change settings:
  - Click on the "Charts" tab at the top of the screen.
  - Click on the "show vector" box for *velocity* and *acceleration* boxes in the middle of the screen.
  - Uncheck the "*sound*" box at the bottom of the screen.
  - Click the button for the acceleration graph to minimize it so that it is not a distraction. We will get to that later.
- Get familiar with the program. Click on the man and drag him around to see how the graphs monitor his movements. Click stop, then *clear* (not reset) and try again. **Don't spend more than a couple of minutes doing this**.

- As you can tell by dragging the man around, the graphs are very sensitive. A better way to get more understandable graphs is to make him move by typing position and velocity values into the boxes on the left and then hitting play. For each of the following situations, type the numbers into the corresponding box, hit go, then click stop after 5 seconds or so. (There is no reason to let him walk into a wall for too long.)

Situation #1: (Position =-2m, Velocity = 0).

1. *Describe what happened* and explain why it happened:

   _____

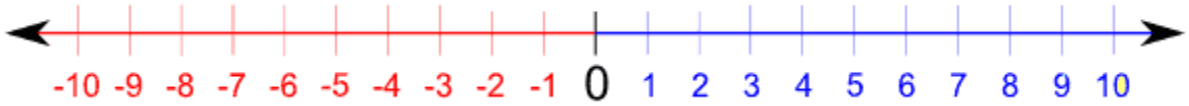
   _____

- Hit clear then do the next two situations:

Situation #2: (Position = -2m, Velocity = +5 m/s)
Situation #3: (Position = -2m, Velocity = -1 m/s)

2. Now, *make a prediction* for situation #4 **before** doing it. (**Situation #4**: (Position = **-**4m, Velocity = -2 m/s).Draw a stick figure on this number line showing his starting position and a vector representing the direction he will go.

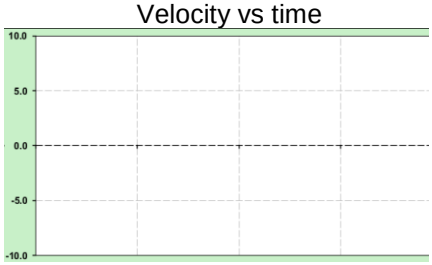
Prediction:



3. Draw a prediction for what each graph will look like.

Position vs time

Velocity vs time



Once you have made your predictions, try the simulation and see if you were correct.

4. *Consider the following statement and state whether you agree or disagree with it. Give a reason and some evidence from situations you just ran.*

   "In both graphs that we just learned, a flat line with no slope indicates that the object is stationary (as in it is not moving)."

I _____ (agree or disagree) because_____
_____
_____

When done, turn this in to Mr. Jones to check your work. Then get Part 2 and keep going.

Part 2: *Acceleration (This takes about 15-20 minutes)*

What to do:

- We are using the same website as before, just hit "reset" to get that acceleration box to reappear. Also make sure of these things:
    - Click on the "show vector" box for *velocity* and *acceleration* boxes on the left of the screen.

5. *You may have a feeling for what acceleration does to our dude. If not, I still want you to make a prediction. Based on the info in situation #5, prediction where he will start on the number line and which direction he will go. Also, make a prediction about what the acceleration will do to our fellow.*

   Situation #5: (Position = -9 m, Velocity= +2 m/s, Acceleration= +1 m/s^2)

   Prediction: _____

   _____

   _____

   _____

6. Hit "clear", make a prediction for what will occur in situation #6, then try it out.

   Situation #6: (Position = +9 m, Velocity = -5 m/s, Acceleration = -1 m/s^2)

   Prediction: _____

   _____

   _____

   _____

Now that you have experience with these graphs, let's see what you have learned. For each of the situations below, <u>before you run the situation</u>, sketch out what you think the shape of each graph will be with a **dashed line.** Focus on if the line will go up or down, be flat or curved. Also, answer the questions below the graph. Then have the computer run the situation and using a **solid line**, sketch the result.

7. **Situation #7**: (Position = 0m, Velocity = 0 m/s, and Acceleration = -2 m/s^2).
   When drawing these graphs, include axis labels, and sketch approximately what you see.

position vs Time

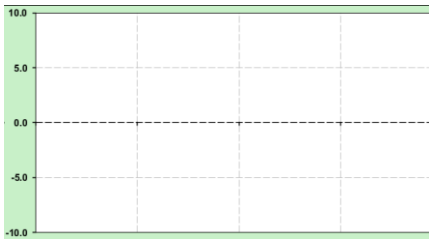
Velocity vs Time

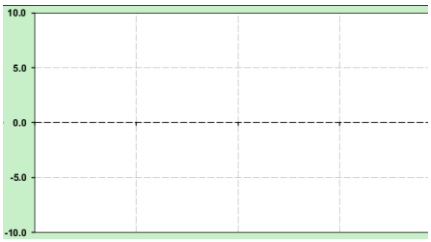
Acceleration vs Time

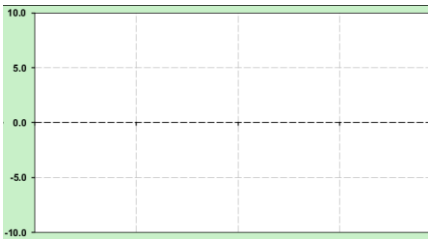
<u>Describe</u> what you will see: Will he move to the right or left initially? Will he speed up, slow down, move at a constant pace, or change direction?

8. **Situation #8**: (Position = -2m, Velocity = -3 m/s, Acceleration = +1 m/s^2)

position vs Time | Velocity vs Time | Acceleration vs Time







Describe what you will see: Will he move to the right or left initially? Will he speed up, slow down, move at a constant pace, or change direction?

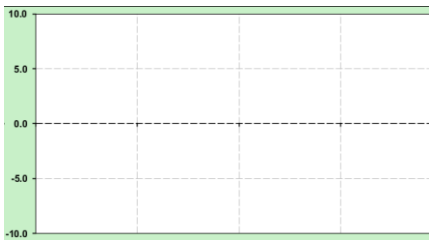
9. **Situation #9:** (Position = +7m, Velocity = -2 m/s, Acceleration = 0 m/s^2)

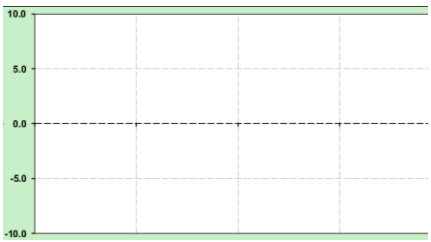
position vs Time | Velocity vs Time | Acceleration vs Time

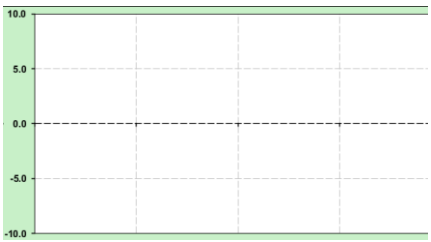
Describe what you will see: Will he move to the right or left initially? Will he speed up, slow down, move at a constant pace, or change direction?

10. **Situation #10**: (Position= 0 m, Velocity= -1 m/s, Acceleration= -1 m/s^2)

position vs Time | Velocity vs Time | Acceleration vs Time







Describe what you will see: Will he move to the right or left initially? Will he speed up, slow down, move at a constant pace, or change direction?

When done, turn this in to Mr. Jones to check your work. Then get Part 3 (your homework.)

Part 3: *Reflection*

1. On a *position (or distance) vs time* graph:
    a. a straight line with no slope illustrates what type of motion?
    _____

    b. a straight line with positive slope (upward) illustrates what type of motion?
    _____

    c. a straight line with negative slope (downward) illustrates what type of motion?
    _____

    d. an upward *curve* pattern illustrates what type of motion?
    _____

    e. a downward *curve* pattern illustrates what type of motion?
    _____

2. On a *velocity vs time* graph:
    a. Straight line with no slope illustrates what type of motion?
    _____

    b. Straight line with a positive slope illustrates what type of motion?
    _____

    c. Straight line with a negative slope illustrates what type of motion?
    _____

3. What does negative acceleration do to an object moving to the right?
    _____

4. What does zero acceleration do to an object

    a. at rest?
    _____

    b. that is moving? _____

5. Stepping on the brakes of a moving car produces what type of acceleration (+ or -)? _____

6. What are the <u>units</u> for: velocity? _____

    acceleration? _____