Moving Man – Activity for Algebra/Pre-Calculus Students
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Purpose: In this computer based activity, you will practice sketching position, velocity and acceleration time graphs and generating their function equations.

Materials needed: Graphing calculator, paper, pencil, and computer.

Procedure:

- Go to **http://phet.colorado.edu/web-pages/simulations-base.html**

- Click on the simulation: **The Moving Man**

- You should see a screen like the one shown below. There is a man on the top of the simulation who can move between 10-m to the right and 10-m to the left from the origin. The diagram (simulation) also includes) axes for position, velocity and acceleration graphs that will reflect his motion.

  Since initially you are not going to use the acceleration graph, then you might want to close it by clicking on the small window at the upper- right corner in the *acceleration* section.

Getting Familiar with the Simulation

The man shown on the top of the screen can be assigned a specific initial position (location) by filling the value for the position in the box on the left side. (**x =**0.0)
- Suppose you want him to be at the position of 6 m. You need to type 6 in the box.; **x = 6**
- Suppose you want him to move to the left with a speed of 2m/s. Since he will be moving to the left, his velocity is negative, thus you need to put – 2 for the velocity; **v = -2**
- If you want him to move with the assigned velocity and at the same time observe the graphs, click on Go! on any of the boxes either in position or velocity sections.

Since in the practice problems you will be asked to find function equations for his position and velocity, you need to review the techniques of constructing these functions.

For any motion that you will analyze in this activity, general position and velocity functions will be expressed in the forms: $x = x_i + v_i t + \dfrac{at^2}{2}$ and $v_f = v_i + at.$ respectively**.** You will need to identify given quantities (data values given in the specific problem) and respectively substitute them into these formulae. Referring to the above data, we learn that $x_i = 6$, and $v_i = -2$. Since there is no information about the acceleration, we consider it to be zero; a = 0

By substituting these values into the above formulae we receive that x = 6 – 2t, and v = -2. Once you have derived the position and velocity functions, now you can check if the graphs generated by the simulation program correspond to your equations.

In order to double check these formulae, is to enter them into a graphing calculator and generate respective graphs.

Problems on Motion

<u>General Comments</u>
In these problems you will practice constructing functions and sketching graphs according to the outlined conditions. You will then check your answers by producing respective graphs by using the simulations. You will also be asked to use a graphing calculator to check your function equations.

1. The man's initial position is 10m and he is moving to the left at 2m/s for 6s.

Part 1. <u>Building function equations and sketching graphs by hand.</u>

    a. Express the given quantities by respective symbols:_____

    b. Construct his position function: _____

    c. Construct the velocity function: _____

    d. Calculate the man's final position_____

    e. By using one of the functions derived, calculate the time when he passes through the <u>origin</u> (position of 0 m)

    f. Graph the position and velocity functions on the grid provided below.
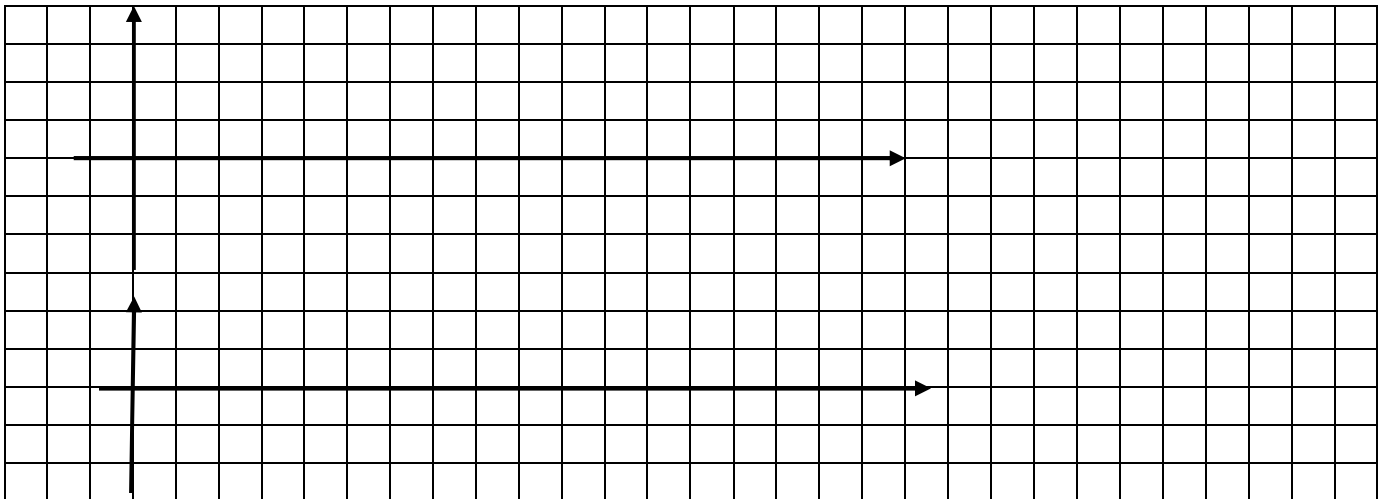
Part 2. <u>Using simulation program to verify constructed functions.</u>

- Enter given quantities in the respective boxes in the simulation and click Go! on any of the graphs.
- Do your graphs (from Part 1) correspond to the once produced by the simulation? If not - make respective corrections.

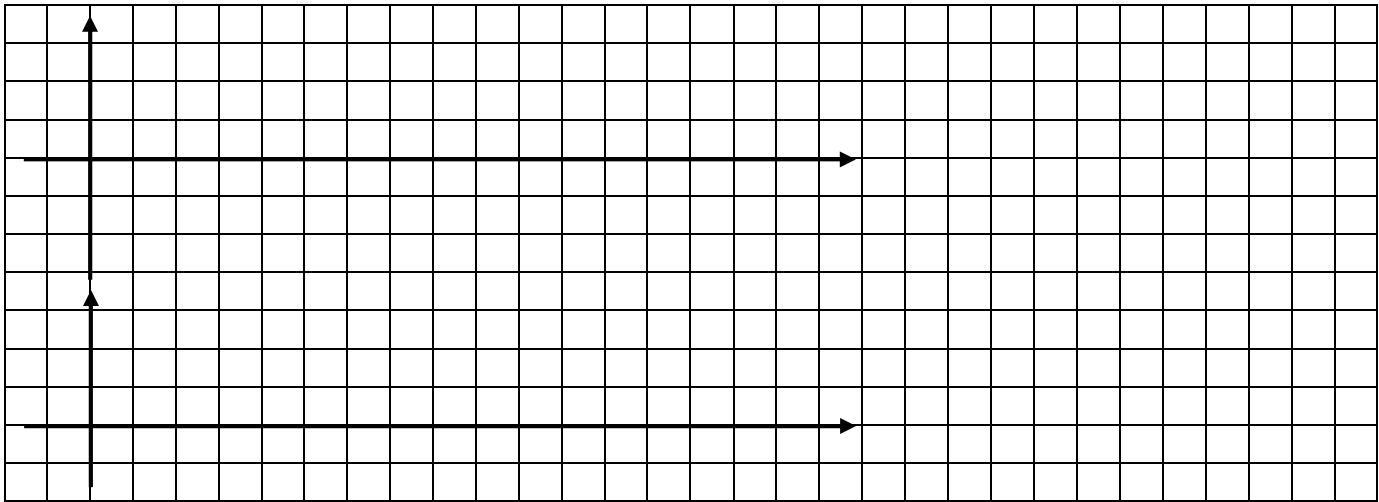Part 3. <u>Using a graphing calculator</u>

- Type derived functions into your graphing calculator**.** You might want to alter the window to the one (dimensions shown) in the simulation.
- Do the graphs produced by calculator correspond to these done by the simulation?

2. Suppose that the man is walking at 2 m/s towards his home starting from the position of 6 m to the left of the origin. He rests at his home for the next 4 s.
Hint: carefully convert his position!

Part 1. Building function equations and sketching graphs by hand.

    a. Given: _____

    b. Position function: _____

    c. Velocity function: _____

    d. Calculate the position of the man after 2 s.

    e. Sketch position and velocity functions below.

Part 2. Using simulation program to verifying constructed functions

- Enter given information into the simulation and check your graphs
- Do your graphs correspond to these produced by the simulation?
- Find the domain and range of the position function.   D = _____ R = _____

Part 3. Using a graphing calculator to verifying functions

- Type derived functions into your graphing calculator. You might want to alter the window to the dimensions shown in the simulation.
- Do graphs produced by calculator correspond to these done by the simulation?

Clear all entries to work on the next problem

In this problem, you will also use the acceleration graph and you will use the basic form of the acceleration function that is a(t) = constant. Click on the acceleration icon on the simulation to activate the graph.

3. Suppose that starting from the tree on the left side, the man accelerates at $2m/s^2$ for 4 seconds to the right. He accelerates from rest.

Part 1.

    a. Given: _____

    b. Man's position function: _____

    c. Man's velocity function: _____

    d. Man's acceleration function:_____

    e. Will he reach his home? Perform respective calculations. What velocity will he have at the 4th second of motion?
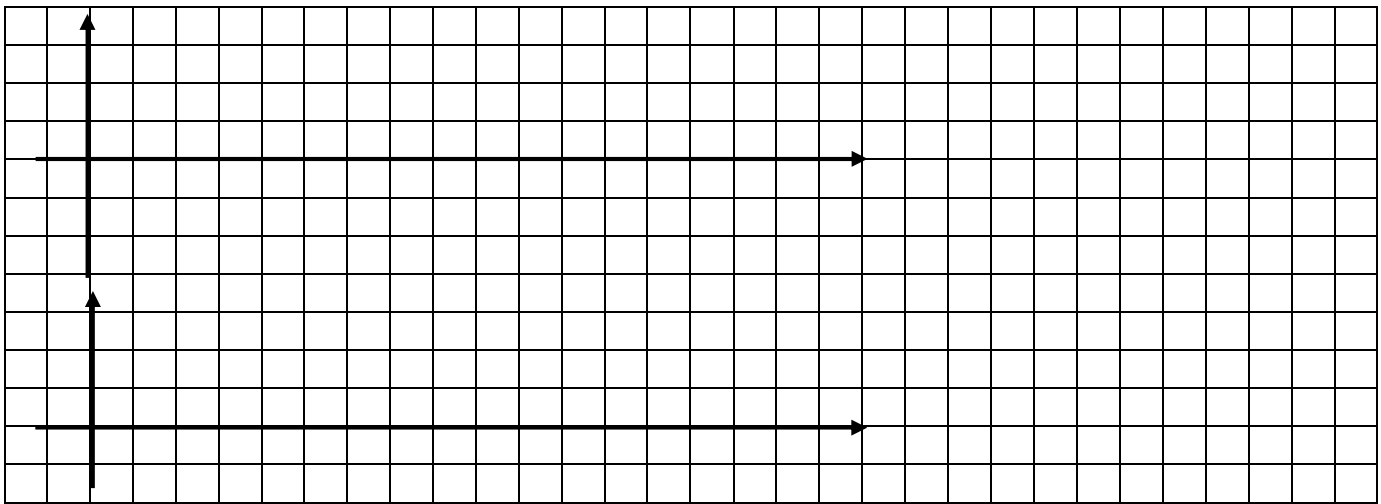
Part 2. Verifying function equations by using simulations.

- Enter given information into the simulation and check your graphs
- Do your graphs correspond to these produced by the simulation?
- What is the domain of the velocity function?   D=_____

Part 3. Using simulation program to verifying constructed functions.

- Type derived functions into your graphing calculator. You might want to alter the window to the one shown in the simulation.

- Do these graphs produced by calculator correspond to those done by the simulation?

Clear all entries to work on the next problem

4. The man planned to jog at 4:00 pm, but there was a heavy rain at that time. At 4:07 PM the rain
stopped so he started to jog with a steady speed of 4m/s toward the forest (represented by the tree)
After 5 seconds of motion he decided to take a rest.
Note: Consider 4:00 PM as the initial time to derive the functions.

Part 1.

a. Given: _____

b. Man's position function: _____

c. Man's velocity function: _____

d. Man's acceleration function:_____

d. Calculate his final position and velocity.

Sketch all three graphs.
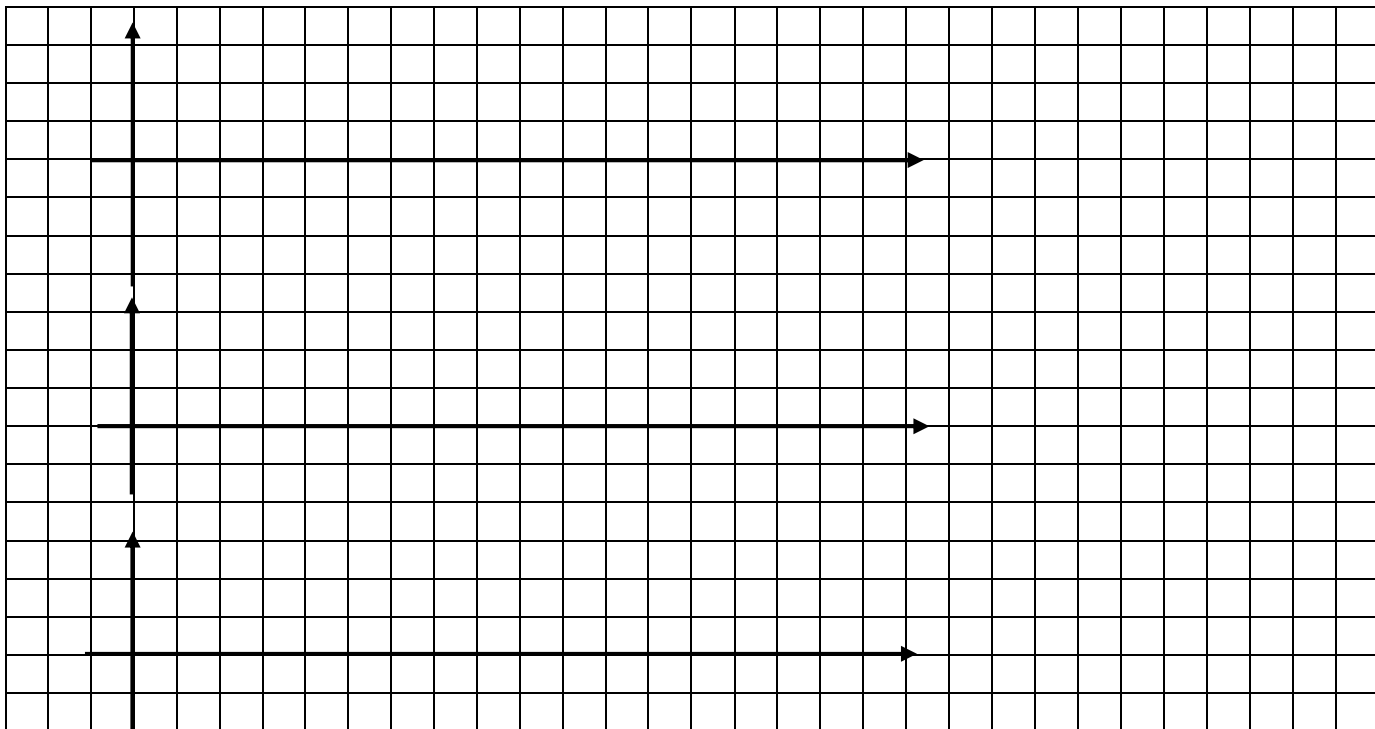
Part 2. Verifying function equations by using simulations.

- Enter given information into the simulation and check your graphs
- Do your graphs correspond to these produced by the simulation?
- What is the range of the acceleration function?

Part 3. <u>Using simulation program to verifying constructed functions.</u>

- Type derived functions into your graphing calculator. You might want to alter the window to the dimensions shown in the simulation.
- Do graphs produced by calculator correspond to these done by the simulation?

Clear all entries