Title: Position, Velocity, Acceleration

Purpose:

- to practice using an online Physics simulation
- to investigate factors associated with linear movement
- to investigate the relation among position, velocity and acceleration

Procedure:

- open Physics Exploration
- go to Motion…..Position, Velocity, Acceleration…..
- explore how the simulation works for about 10 minutes
- develop a hypothesis
- LIST/DESCRIBE YOUR SETTINGS
- PRINT OUT SAMPLE RESULTS/GRAPHS

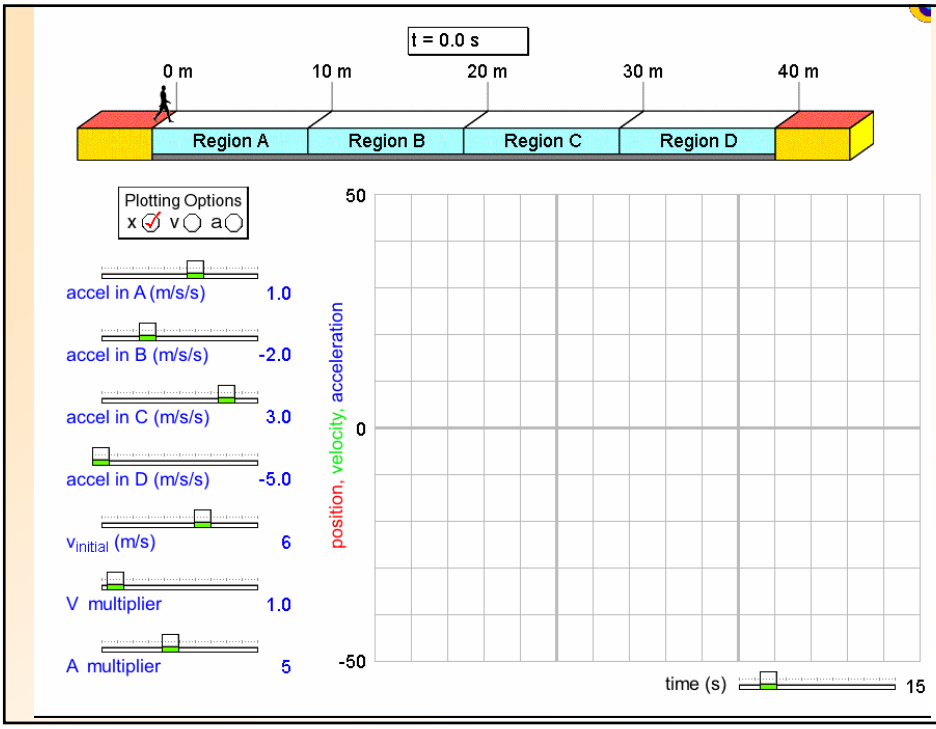
Discussion:

- Follow lab write-up guidelines

Conclusion:

- testable statement

Reflection: (personal statement)



For an object located at a location (x_i) and moving with an initial velocity (v_i) in a region of constant acceleration, we can describe its position (x) and velocity (v) with

$$x(t) = x_i + v_i t + \frac{1}{2} a t^2 \qquad v(t) = v_i + at$$

where x(t) and v(t) are the position and velocity at time t.

When looking at a graph, the slope of the distance vs. time provides you with the average velocity over that time interval, and the slope of the velocity vs. time plot gives you the average acceleration during the time interval since

$$v_{ave} = \frac{\Delta x}{\Delta t} \quad \text{and} \quad a_{ave} = \frac{\Delta v}{\Delta t}$$

where v_{ave} and a_{ave} are the average velocity and acceleration.

User Interface and Simulation Features.

If you want the person to begin from a location other than the origin, click and drag the person to any location when the simulation is not active.

The multiplier factors for velocity and acceleration allow you to choose a factor by which the plotted curve will be scaled. This may make a curve which is somewhat "compressed" easier to read. (i.e. If the scaling factor for acceleration is set to 5, the plotted curve for acceleration will be multiplied by this factor, however, the actual acceleration will remain unaffected.)

Motion with constant velocity.

Set the acceleration to zero in all the regions, and set the initial velocity to 5 m/s.

Does the velocity change at any time? From the theoretical formulae, should the velocity change? How long did it take for the object to travel 40 meters? On the graph, did the slope of the distance vs. time plot have a value of 5 m/s? What was the slope of the velocity vs. time plot, and what should the slope be when the acceleration is always zero?

Motion with constant acceleration.

Set the acceleration to 1 m/s/s in all four regions, with the initial velocity set to zero.

Did the slope of the velocity vs. time plot represent the acceleration? How long did it take to travel 40 meters, and what was the velocity at the end of the trip? Could you solve for the time using the theoretical equations? Do the equations correctly predict the velocity at the end of the trip?

Direction of velocity and acceleration.

Set the acceleration to 2 m/s^2 in Region A and B, and -3 m/s^2 in Region C and D. Set the initial velocity to zero.

In Region A and B is the velocity positive or negative? What about the acceleration? In Region C are the velocity and acceleration both positive? What happens in Region D? Are velocity and acceleration always in the same direction?