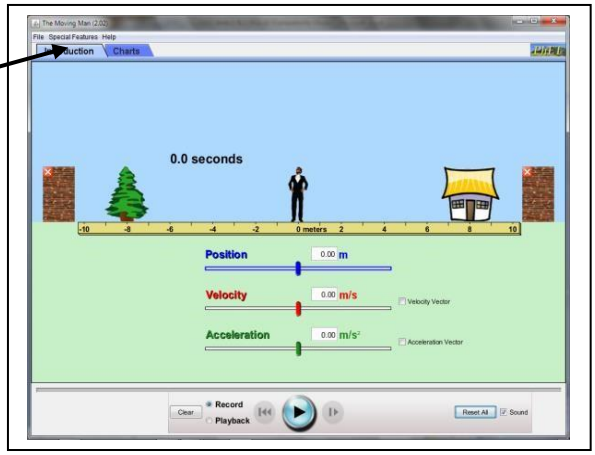
Virtual Laboratory

Topic 04 – Motion

			04
Name	Section #	Date	Topic #

Motion Simulation - The Moving Man Constant Velocity

Today you will learn how to get information from a simulation program. Our goal is to play with the simulation to find the rules that it follows. Simulations are designed to follow the rules that govern the rest of the universe. You will use the simulation called **PHET**: **The Moving Man**. Just google for the link. Click on the play button to start the program.



Part 1 – Introduction

Notice the two tabs at the top left of the screen. For now. leave it on Introduction. We will investigate only position and velocity for the first part. We will investigate the Acceleration (green) slider later.

1. How does the Moving Man react when you adjust the blue position slider? (You can also type a number into the box).

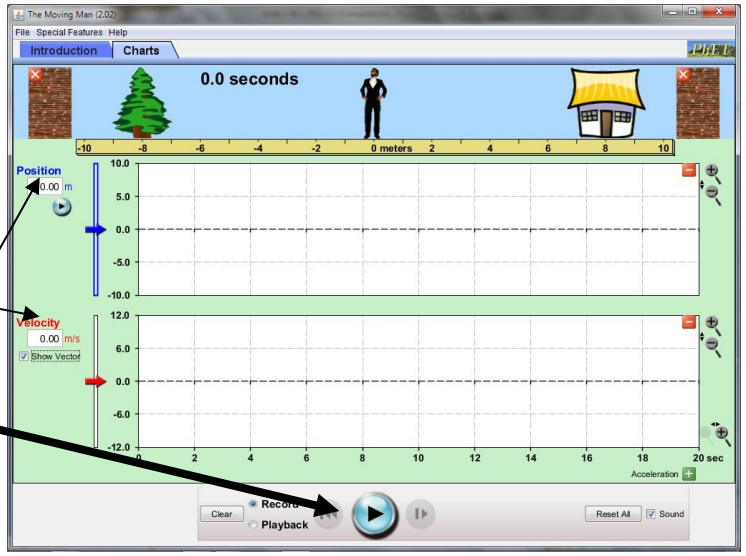
   _____

2. How does the Moving Man react when you adjust the red Velocity slider? (You can also type a number into the box).

   _____

3. How does time relate to velocity?

   _____



Part 2 _ Charts

Now click on Charts at the top left.

Click on the red Minus button on the top right of the bottom (acceleration) graph to remove it.

Now investigate the simulation by typing (or dragging the arrow) different numbers into the position or velocity boxes and pressing the Play button.

Notice the timer in the blue sky area.

Notice where positive and negative numbers are located on the charts.

Create simulations so that you can answer the following questions: (The following questions are asking you to describe the speed of the man and his direction of travel (e.g. moving Right. moving left. standing still. etc…)

4. The position graph line is on the positive side when the moving man is doing what? _____
5. The position graph line is on the negative side when the moving man is doing what? _____
6. The position graph line has a positive slope when the moving man is doing what? _____
7. The position graph line has a negative slope (this means the line is below the zero on the y axis – notice the numbers are negative there) when the moving man is doing what? _____

8. The position graph line has a slope of zero when the moving man is doing what? _____

9. The velocity graph line is on the positive side when the moving man is doing what? _____

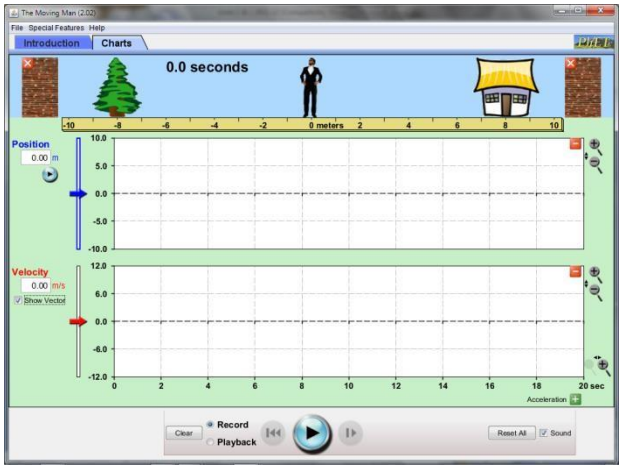
10. The velocity graph line is on the negative side when the moving man is doing what? _____

11. The velocity graph line is on zero when man is doing what? _____

12. The line on the velocity graph is closer to zero when the moving man is doing what? _____

13. The line on the velocity graph is far from zero when the moving man is doing what? _____

14. Draw an example (on the image provided on the right) of The Moving Man moving forward from 0 meters at a velocity of 2m/s for 4 seconds.



a. Calculate how far he would move? Show your work.

_____

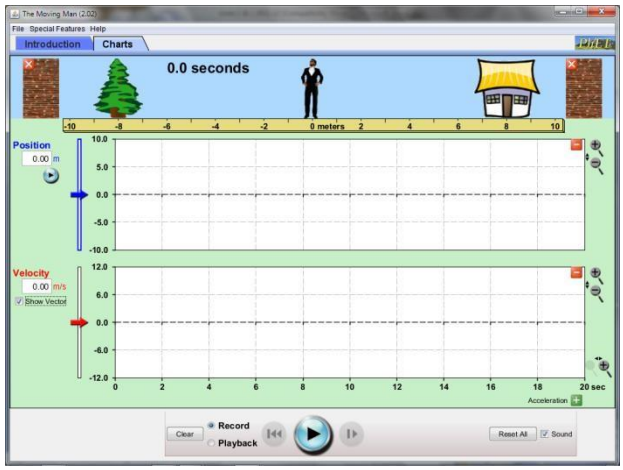
b. How far would he move if he went twice as fast? Show your work.

_____

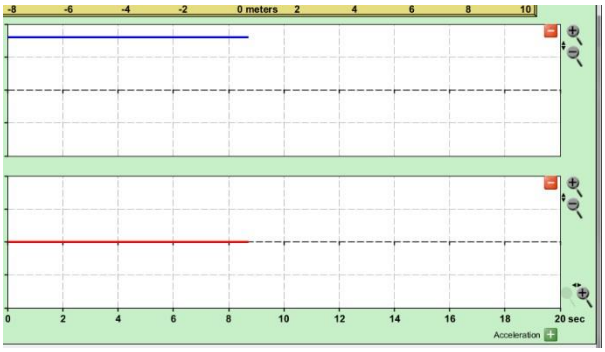
c. Calculate how far would he move if he went for twice as long from part a? Show your work.

_____

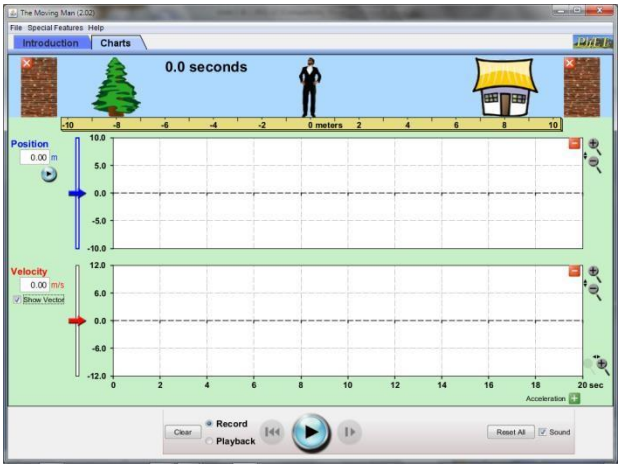
15. Draw an example of The Moving Man moving left from zero at a velocity of -5m/s.



16. What is The Moving Man doing according to this graph?



17. Click on the Clear button at the bottom. Make sure the program is paused. Type into the Position box **-10.** and **+4** into the Velocity box.



Draw what you think both graphs will look like in the picture.

Calculate how long it will take for the Moving Man to get to the other side. Show your work

_____

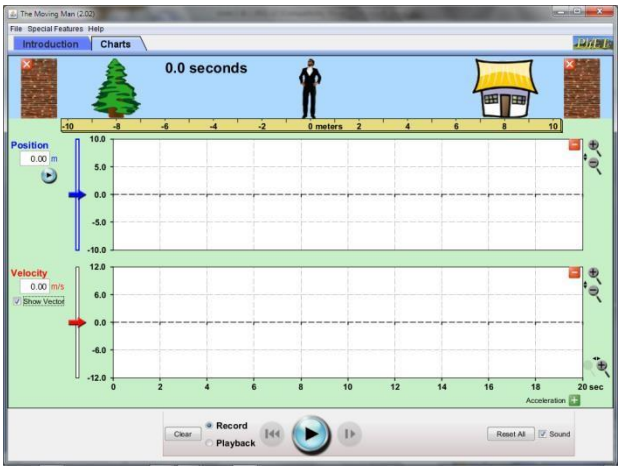
18. Now. click on the play button. What happened?

Draw the results on the diagram on the right.

Was your answer to 17 correct? _____

What physically could not happen to the man with these settings?

_____

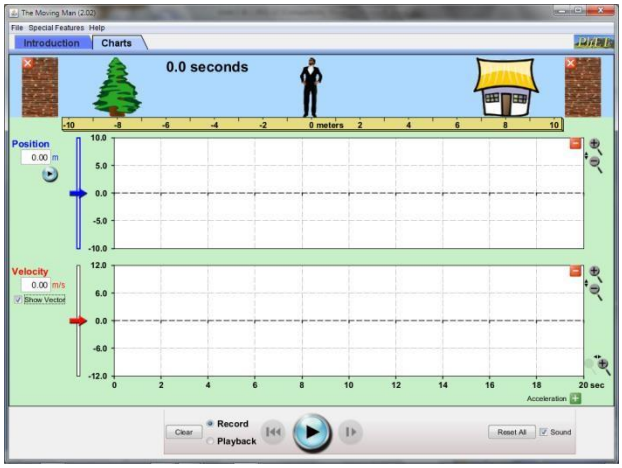


19. Click on the Clear button at the bottom. Make sure the program is paused. Type into the Position box **8.** and **-2** into the Velocity box.

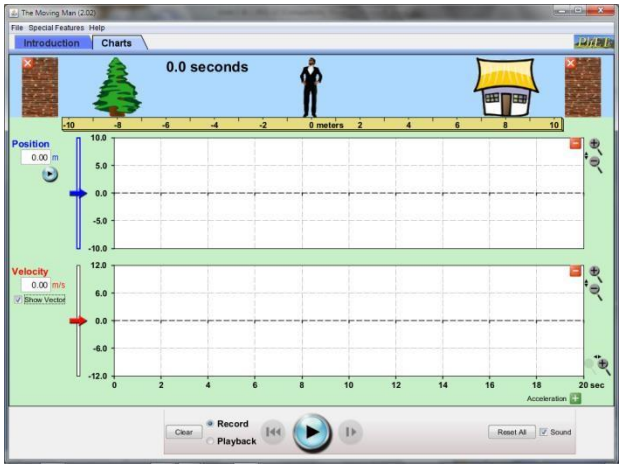
Draw what you think both graphs will look like in the picture on the right?

Calculate how long it will take for the Moving Man to get to the other side. Show your work.

_____



20. Now. click on the play button. What happened? Draw the results here on the diagram.



Is your answer to 19 correct?

_____

What cannot happen with these settings?

_____

21. Describe what happened to make this graph: Starting Position:

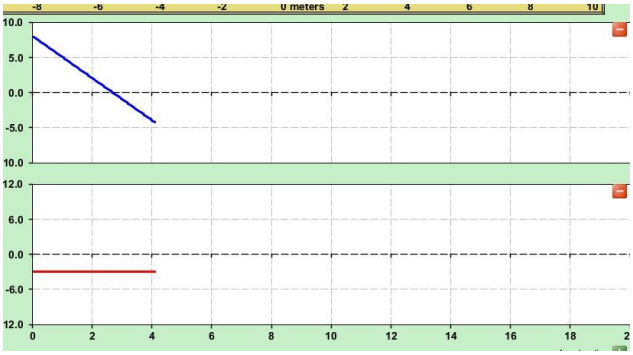
_____

Direction: _____

Velocity: _____

Time interval: _____

Distance traveled: _____

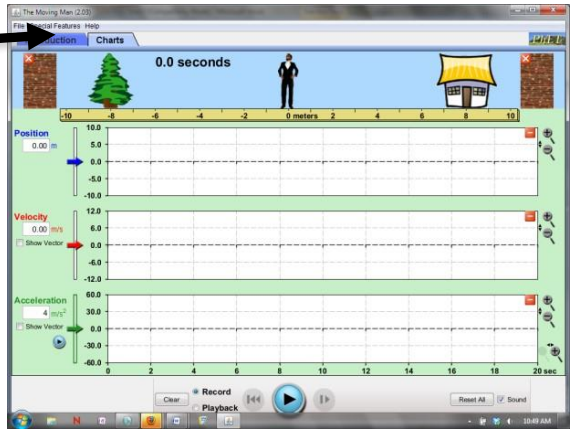


The Moving Man with Uniform Acceleration (acceleration that stays constant)

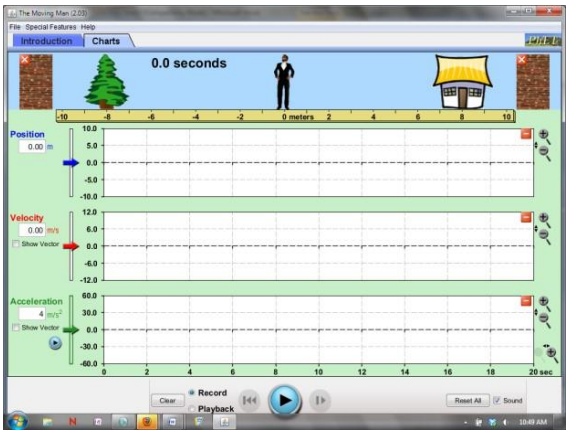
Click on the Charts tab at the top of the screen.

This works better if you type numbers into the box instead of moving the man with your mouse.

For all questions. answer **with both a sentence and a graph**.



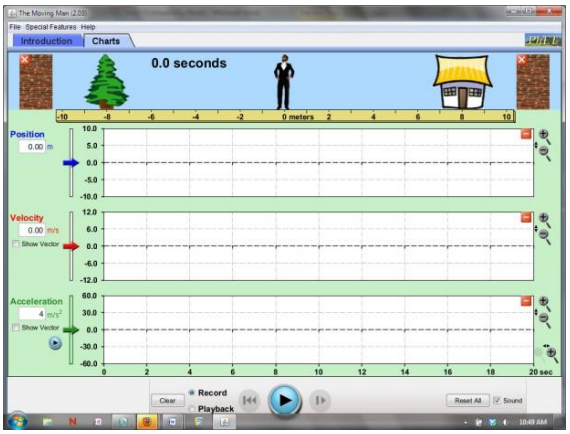
22. How do you know from the graphs if you have constant velocity? (What will the position. velocity. and acceleration graphs look like? Draw this on the graphs provided.)



23. How do you know if the moving man is moving left or right?

_____

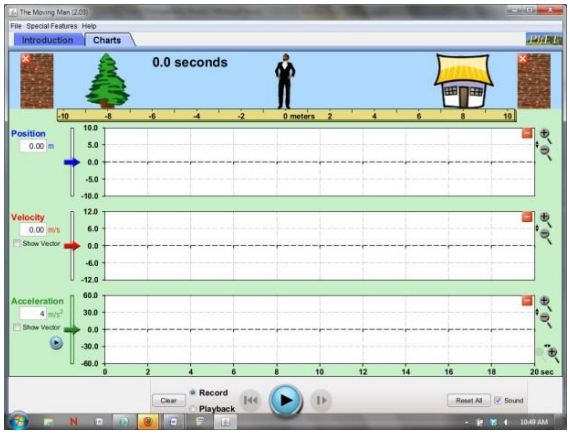
What will the position. velocity. and acceleration graphs look like? (Draw this on the graphs provided.)



24. How do you know on a velocity vs. time graph if the acceleration is positive or negative?

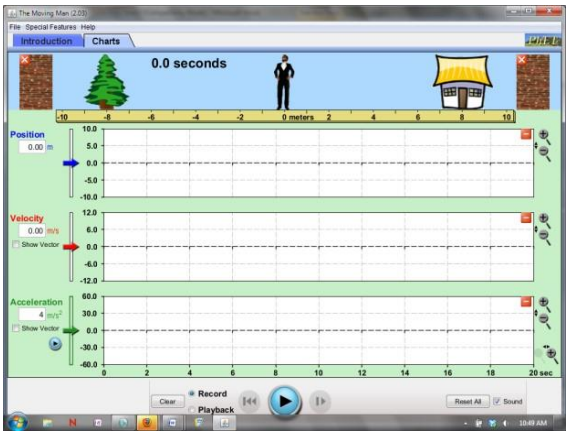
_____

What will the position. velocity. and acceleration graphs look like? (Draw this on the graphs provided.)



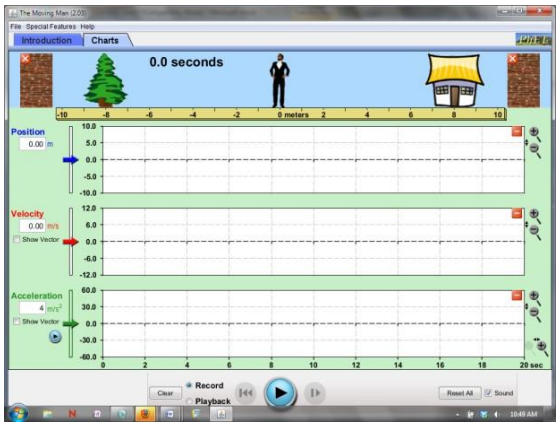
25. How do you know which way the position vs. time graph will curve? (What will the moving man be doing? Draw this on the graph provided.)

_____



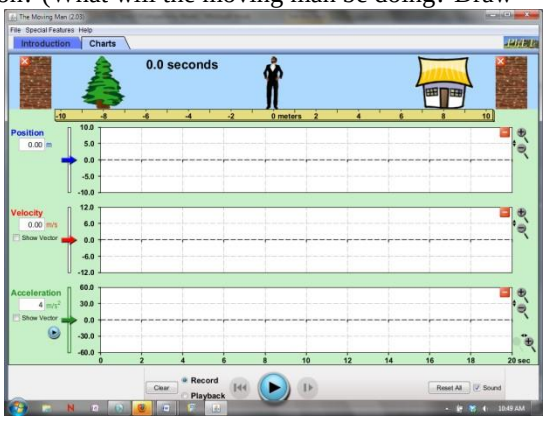
26. What happens when you have a positive velocity and a negative acceleration? (What will the moving man be doing? Draw this on the graph provided.)

_____



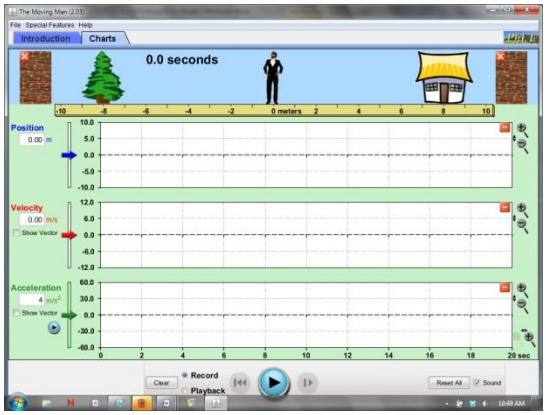
27. What happens when you have a negative velocity and a positive acceleration? (What will the moving man be doing? Draw this on the graph provided.)

_____



28. CHALLENGE: There are two ways to get positive acceleration. What are they? (How must he move? Draw this on the graph provided.)

_____



• 04 •
M O T I O N

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Name	Section #	Kit #	Topic #

Part A - Speed

Object	Distance traveled (meters)	Time (seconds)	Speed (m/s)	Mass (grams)	Mass (kg)
Tumble Buggy	1.0				
Pullback Car	1.0				
Runner	10.0				

Mass must be in kilograms and velocity must be in (meters / second) to use the following formulas:

momentum = mass x velocity K.**E. = 1/2 m x v2**

Calculate the following**:** **(Don't forget the units!)**

Energy	Tumble Buggy	Pull back car	Runner
Momentum			
Kinetic Energy			

1. Which object had more momentum? Explain why.

_____

_____

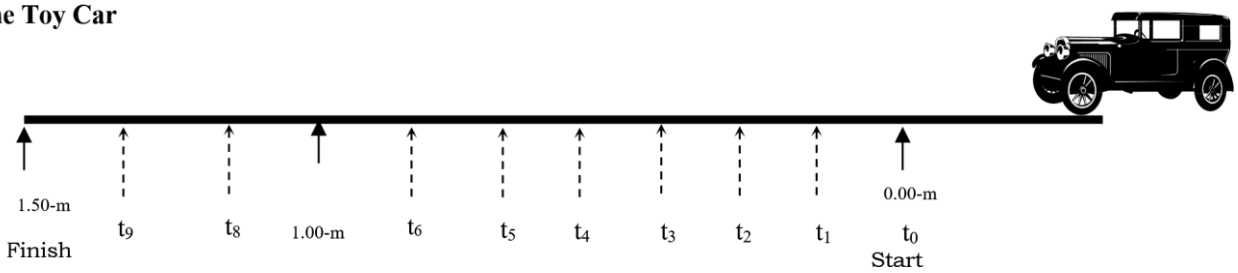
2. Which object had more kinetic energy? Explain why.

_____

_____

Part B- Speed and Acceleration Data (Do only section 1a or 1b as assigned by instructor)

1a. The Toy Car



Start car as far from 0 m as possible. Students must stand directly in front of position being timed. Make a few practice runs before collecting data.

	t_o	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}
Trial 1 Time (seconds)	0										
Trial 2 Time (seconds)	0										
Trial 3 Time (seconds)	0										
Average time (seconds)	0										
Distance (m)	0	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50
Speed (m/s)											

Graph the distance on the y axis. and average time on the x axis. Make sure to include the distance = 0 at time = 0 for this graph only. (Should be linear.)

1. Should you select a Best Fit Curve or a Best Fit Line for your graph? _____

2. Reading your graph. did your car travel with constant speed? ____

3. How do you know based on your graph? _____

4. The slope of the line from your graph (if it is a straight line) is the speed: _____ (don't forget to include units!)

Make a graph with speed on the y axis and average time on the x axis. Select Linear Fit. (Do not include 0.0.)

5. The slope of the line from your graph is the acceleration: _____ (don't forget to include units!)

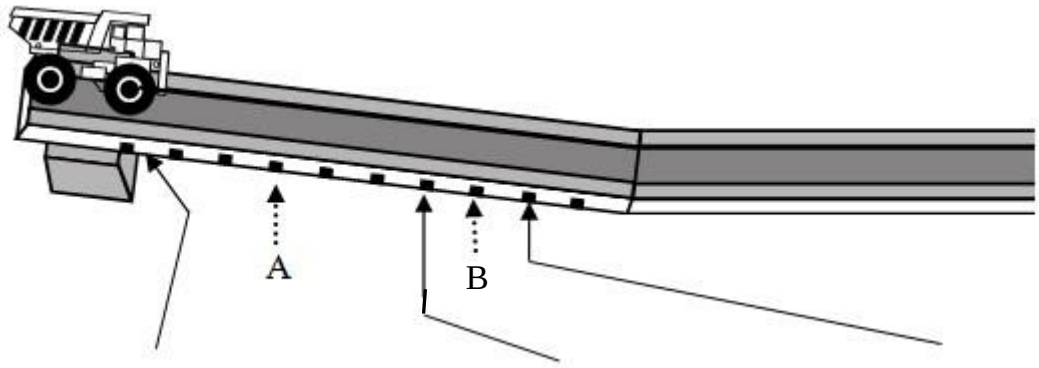
The answers to the following questions are **not** based on your graphs. Answer using complete sentences.

6. What is the difference between speed and acceleration? This question is testing your understanding of the definitions of these two concepts.

_____

_____

1b. The Truck



	t0	t1	t2
First time trial	0		
Second time trial	0		
Third time trial	0		
Average Time	0		

Time to travel the distance	$T_1 = t_1 - t_0$	$T_2 = t_2 - t_1$
Average velocity v = d/t	Position A $v_A = .300/T1$	Position B $v_B = 0.100/T2$
Time velocity actually occurred	Time at Position A or $T_A = t_1 / 2$	Time at Position B or $T_B = (t_1+t_2)/ 2$

□T = change in time between adjacent velocity	$\Delta T = T_B - T_A$
□v = change in adjacent velocity	$\Delta v = v_B - v_A$
a = □v / □T (acceleration between points A and B)	a = □v / □T

What is the acceleration from the starting point (t_0) to point B?