Name: ______________________________

Constant Velocity Model

The front of each model packet should serve as a storehouse for things you'll want to be able to quickly look up later. We will usually try to give you some direction on a useful way to organize this space (see the table below).

Physical Quantity	Description	Symbol	Units

Motorized Cart Experiment

Sketch and label the experiment setup:

What could we measure? How could we measure it?

The Objective:

Take data in an organized, labelled way:

Graph your data to see if there is a relationship:

If it is linear, find the...

equation of best fit line: ______________________________

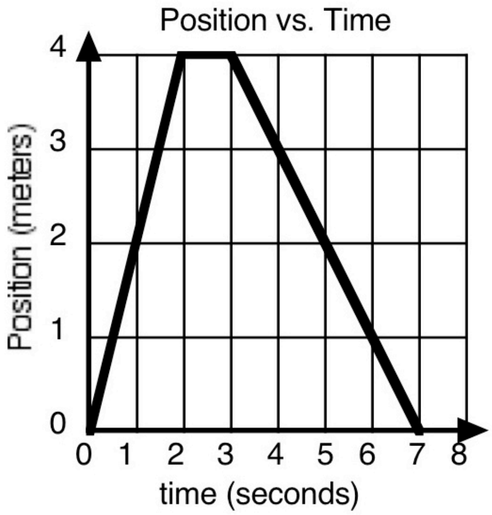
Be sure to:

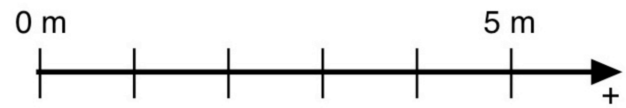
- Use pencil
- Label your axes with <u>symbols</u> and <u>units</u>
- Give the graph a title ("[vertical axis variable] vs. [horizontal axis variable]")
- Draw a best fit line (don't connect the dots).
- Find the slope using points on the line (not data points).
- Write the equation of the line using the variables from your axes (don't default to "y and x"); make sure the slope and intercept have the correct units attached to the numbers.
- Put units on numbers, but never on variables.

Practice 1: Graphical Representations of Motion

1.

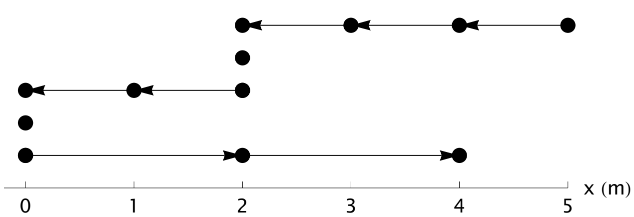
Given the following position vs. time graph, draw a motion map with one dot for each second.

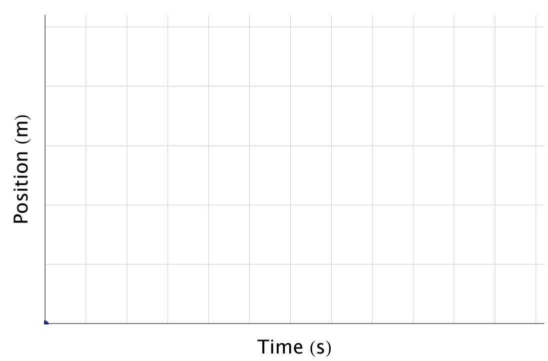




Describe the motion of the object in words:

2. Given the following motion map, where position were recorded with one dot each second, draw the corresponding position-vs-time graph.

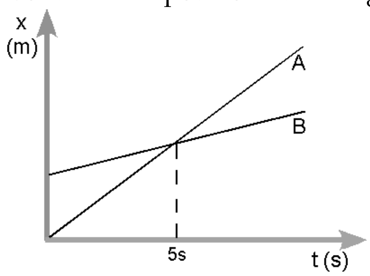




Describe the motion of the object in words:

Practice 2: Comparing Position-vs-Time Graphs

3. Consider the position vs. time graph below for cyclists A and B.



   a. Do the cyclists start at the same point? How do you know? If not, which is ahead?

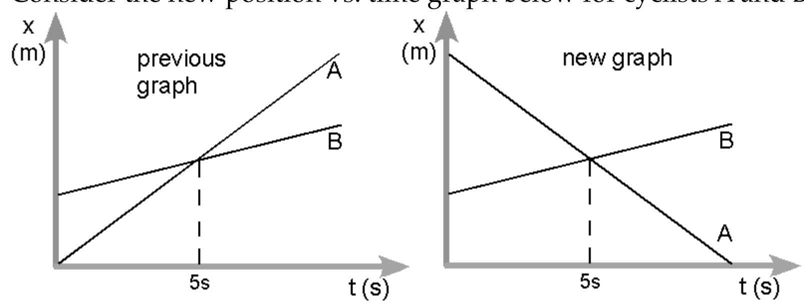
   b. At t = 7 s, which cyclist is ahead? How do you know?

   c. Which cyclist is traveling faster at t = 3 s? How do you know?

   d. Are their velocities equal at any time? How do you know?

   e. What is happening at the intersection of lines A and B?

4. Consider the new position vs. time graph below for cyclists A and B.



a. How does the motion of the cyclist A in the new graph compare to that of A in the previous graph from page one?

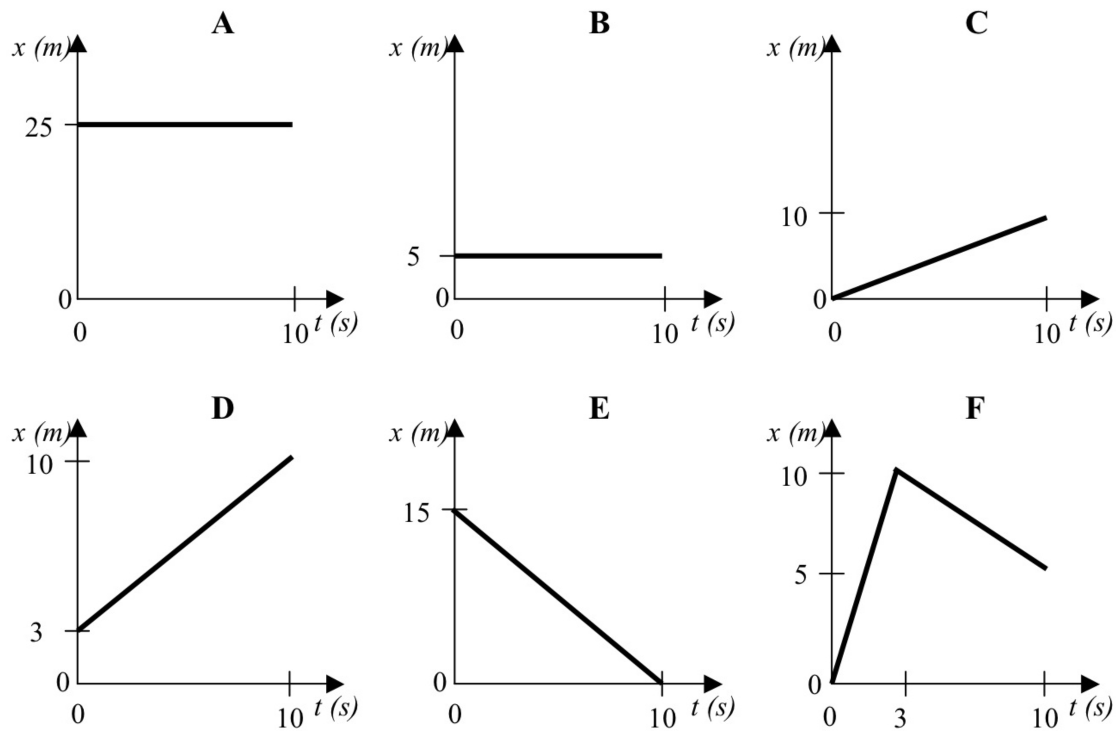
b. How does the motion of cyclist B in the new graph compare to that of B in the previous graph?

c. Which cyclist has the greater speed? How do you know?

d. Describe what is happening at the intersection of lines A and B.

e. Which cyclist traveled a greater distance during the first 5 seconds? How do you know?

5. Consider the following position-vs-time graphs:



a. Rank these situations from greatest to least based on which shows the greatest displacement during the time from 0 to 10 seconds. Use the > and = signs, but do not use the < sign.

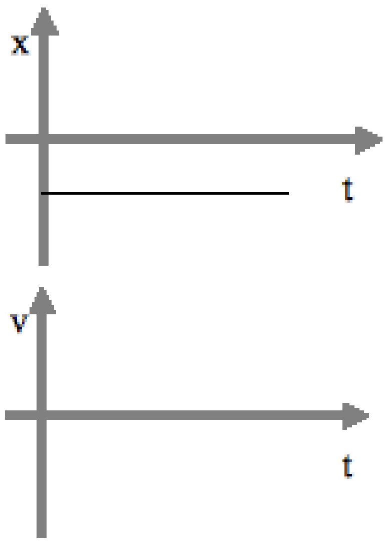
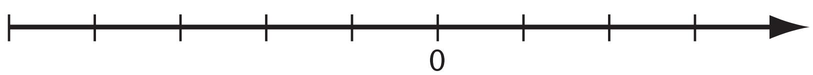
Briefly explain the reason for your ranking:

b. Rank these situations from greatest to least based on which shows the greatest distance traveled during the time from 0 to 10 seconds. Use the > and = signs, but do not use the < sign.

Briefly explain the reason for your ranking:

Practice 3: Multiple Qualitative Representations

6. In each table below, the motion is described by a position-vs-time graph, a velocity-vs-time graph, a verbal description or a motion map. The other three representations have been left blank.
   a. **Complete the missing representations.** DO THIS FIRST, BEFORE YOU USE THE MOTION SENSOR! Be sure to include each of the following in your verbal description: starting position, direction moved, type of motion, relative speed.
   b. Move, relative to the motion detector, so that you produce a graph that matches the given graph as closely as possible. Using a different colored pen/pencil, correct your predictions if necessary.

<table>
<tr><td rowspan="2">
</td><td>Written Description</td></tr>
<tr><td>Motion Map

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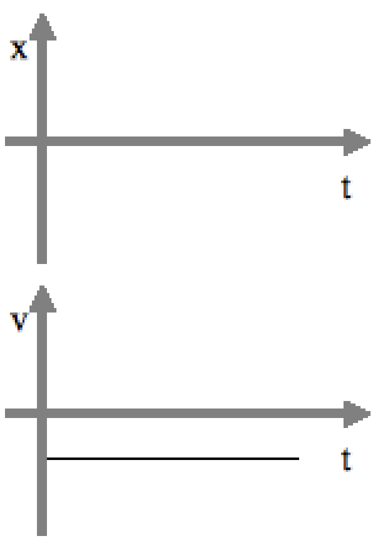
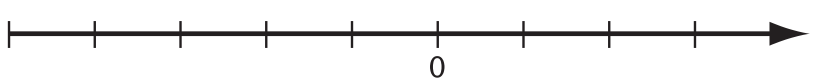
<tr><td rowspan="2">
</td><td>Written Description</td></tr>
<tr><td>Motion Map

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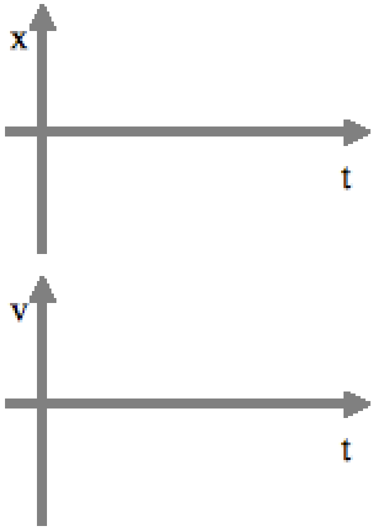
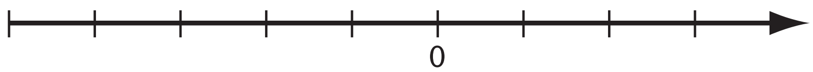
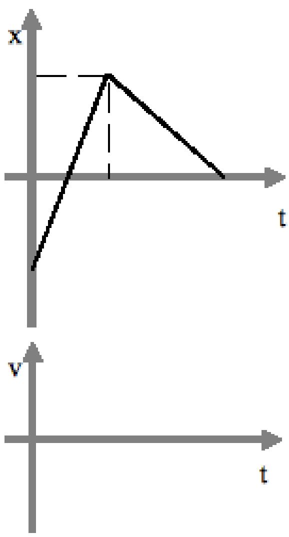


Written Description

The object starts close to the motion detector, and moves at a constant, moderate speed in the forward direction for several seconds. Then it stops for a few seconds before returning to its starting point, once again at a moderate speed.

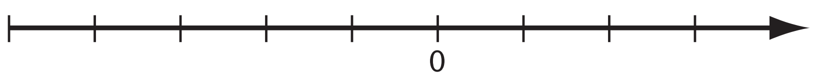
Motion Map

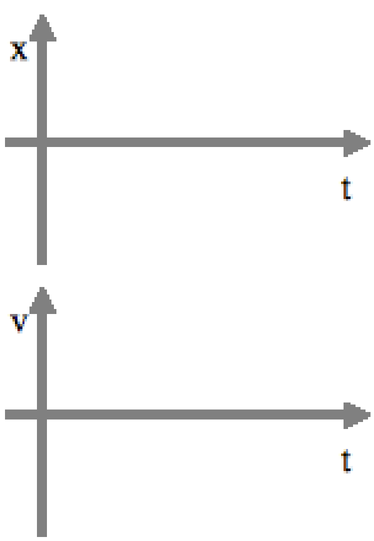




Written Description

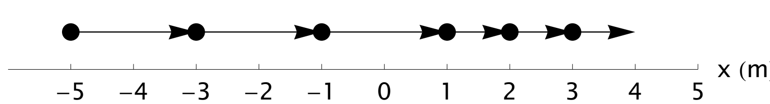
Motion Map





Written Description

Motion Map



Practice 4: Applying the Model

7. Read the following three problems and consider if the Constant Velocity Particle Model (CVPM) applies.
   I. A Mac Truck starts from rest and reaches a speed of 8.5 m/s in 20 seconds.
   II. A dune buggy travels for 20 seconds at a speed of 8.5 m/s.
   III. A driver sees a deer in the road ahead and applies the brakes. The car slows to a stop from 8.5 m/s in 20 seconds.

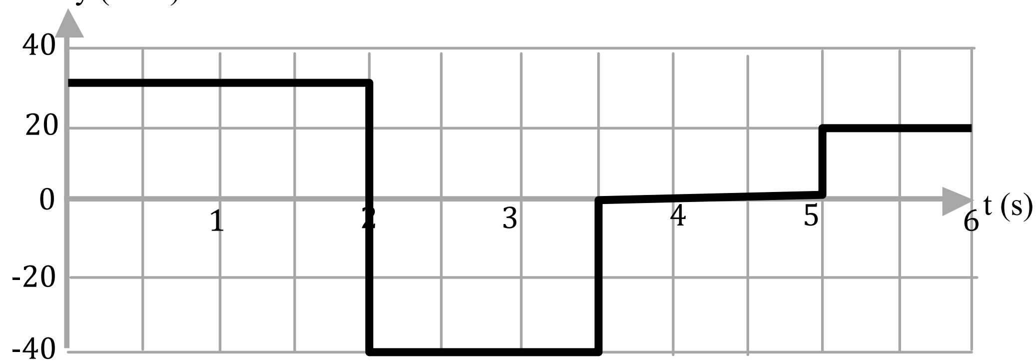
   a. For each of the three above problems, say whether CVPM applies and explain your reasoning.

   b. Choose one of the problems for which CVPM applies. For the problem you selected, draw *at least three* diagrams and/or graphs to illustrate the situation. Choose the diagrams and graphs that you find most useful.

   c. Using the constant velocity particle model, solve for any unknown quantities. Show your work and use units.

8. The graph below shows the velocity vs. time graph for a toy dune buggy <u>which started 20 cm from the edge of its track.</u> Assume that edge of the track is the origin.

Velocity (cm/s)

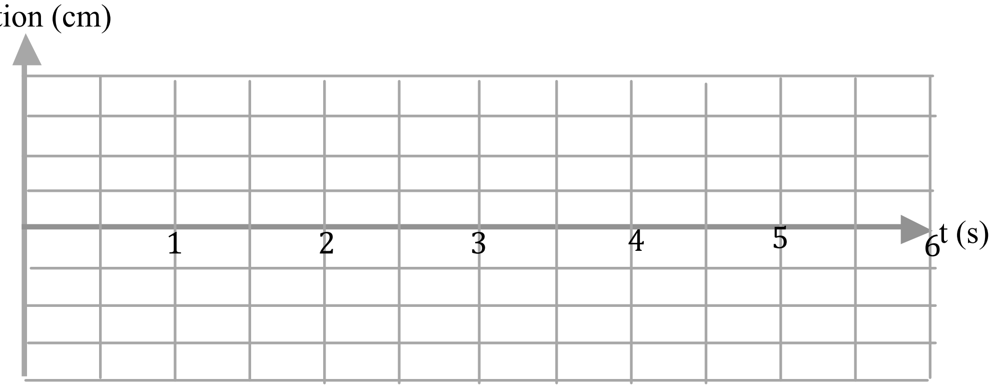


a. Determine the change in position from t = 2 sec to 3.5 sec. Clearly indicate how the change in position shows up on the velocity graph. Show your work and use units!

b. Determine the change in position from t = 5 sec to 6 sec. Clearly indicate how the change in position shows up on the velocity graph. Show your work and use units!

c. Construct a <u>quantitative</u> position-time graph for the motion. *Assume a position of 20 cm at t = 0.* **Be sure to accurately number the scale on the position axis.**

Position (cm)



d. Draw a motion map for this motion. On your motion map, clearly indicate the displacements determined in parts (a) and (b).

CVPM Model Summary

Save this space for the end of the unit when your teacher will give you directions as to how to make a model summary.