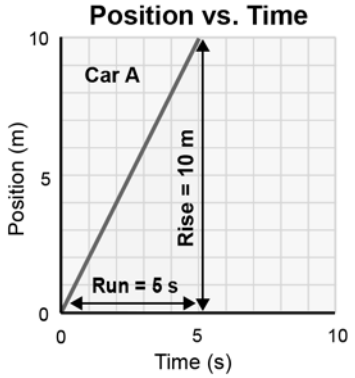
Name: _____ Date: _____ Skill and Practice

2J Slope and Motion Graphs

Read:

Slope and position vs. time graphs

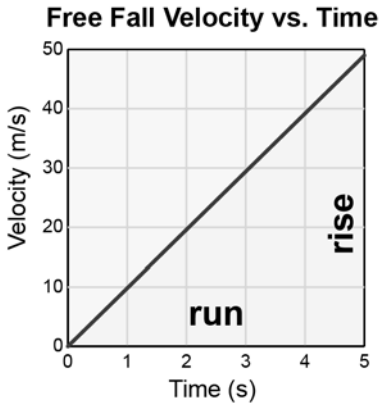


$$\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{10\text{ m}}{5\text{ s}} = 2\text{ m/s}$$

Velocity The slope of a position vs. time graph is the velocity

The slope of a line is the ratio of the "rise" or vertical change to the "run" or horizontal change. For a position vs. time graph, the slope of the line has a special meaning. Since the *y*-axis variable is position, and the *x*-axis variable is time, the slope corresponds to a change in position over a time interval, which is the definition of velocity. So, if you know the slope of a position vs. time graph, you know the object's velocity. Study the example above to see how to find the velocity of car A from its position vs. time graph. Car A is moving at a constant rate away from the origin. If the car were to move toward the origin, the line would slope down from left to right. If the car is at rest, the position vs. time graph is a horizontal line.

Slope and velocity vs. time graphs



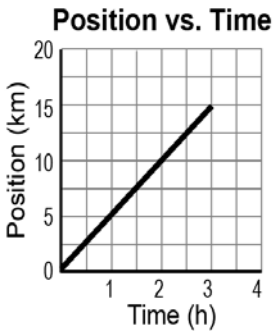
$$\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{49\text{ m/s}}{5\text{ s}} = 9.8\text{ m/s}^2$$

For a velocity vs. time graph, the slope of the line also has a special meaning. Since the *y*-axis variable is velocity, and the *x*-axis variable is time, the slope corresponds to a change in velocity over time, which is the definition of acceleration. So, if you know the slope of a velocity vs. time graph, you know the object's acceleration. Study the example above to see how to find the acceleration of an object from its velocity vs. time graph. The object above is speeding up and moving away from the origin. If this object were slowing down, the line would slope down from left to right. If the object were moving toward the origin, the line would be plotted with negative *y*-values.

Skill and Practice

Practice:

Graph 1

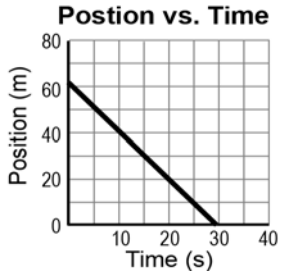


Answer the questions about each graph.

1. Graph 1 shows that the object (choose one):
   a. remains at rest.
   b. moves away from the origin at a constant rate.
   c. moves toward the origin at a constant rate.
   d. accelerates.
2. What is the object's velocity? Show your work, and don't forget to give the correct velocity unit.

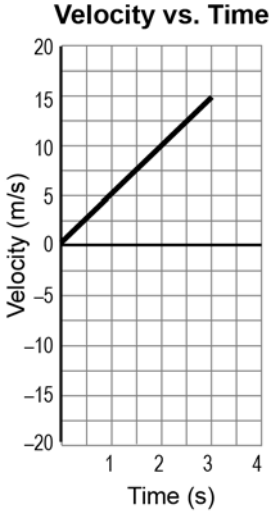
3. What is the object's acceleration? Explain.

Graph 2



4. Graph 2 shows that the object (choose one):
   a. remains at rest.
   b. moves away from the origin at a constant rate.
   c. moves toward the origin at a constant rate.
   d. slows down.
5. What is the object's velocity? Show your work.

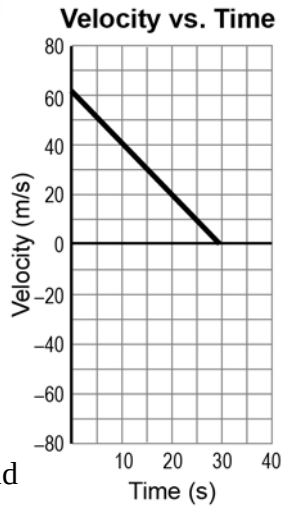
Graph 3



6. Graph 3 shows that the object (choose one):
   a. remains at rest.
   b. speeds up as it moves away from the origin.
   c. speeds up as it moves toward the origin.
   d. moves away from the origin at a constant rate.
7. What is the object's acceleration? Show your work.

Skill and Practice

Graph 4



8. Which of the following best describes Graph 4?
   a. The object moves away from the origin and speeds up.
   b. The object moves toward the origin and speeds up.
   c. The object moves away from the origin and slows down.
   d. The object moves toward the origin and slows down.
9. What is the acceleration of the object? Show your work.
10. Draw a line on Graph 4 that would represent an object with an initial velocity of -80 m/s that accelerates toward the origin at –2 m/s/s.
11. Using a different color or symbols, draw another line on Graph 4 that would represent an object moving at a constant velocity of –60 m/s.
12. Is the object in question 11 moving toward the origin or away from the origin? How do you know?

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13. Draw the velocity vs. time graph that shows the same motion as Graph 1 on the previous page.

14. Sketch a position vs. time graph that shows the same motion as Graph 3 on the previous page. You do not have to include a number scale on your graph. Hint: how do you show that an object accelerates on a position vs. time graph? You might need to review the motion graph summary page at the end of Section 2.3.