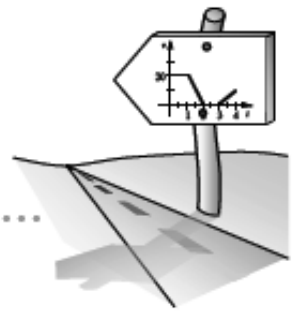
1.4.2 Where is average velocity on a position graph?

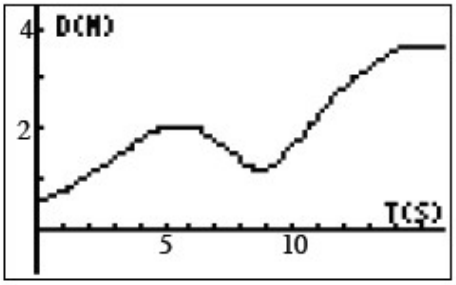


Average Velocity on a Position Graph

1-147. WEARY VERONICA, Part One

While exhausted, Veronica produced the distance graph below when walking the Slope Walk. Afterwards, her study team bombarded her with the questions below, to which she tiredly replied, "It's shown here in the graph." The motion detector was set to measure distance in meters and time in seconds.

Examine the graph carefully to find the answers for her teammate's questions.



a. Answer the following questions and justify your answers.

   i. "How much time did it take?"

   ii. "How far did you travel overall?"

   iii. "How far from your starting place did you end up?"

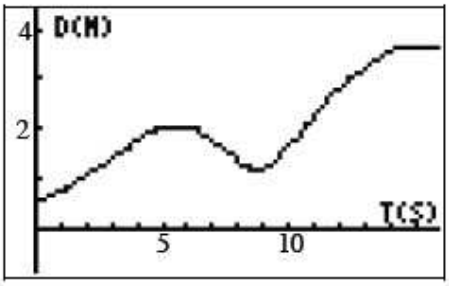
   iv. "Did you ever stop? If so, when?"

   v. "Did you only walk in one direction?"

b. Explain why the answers to parts (*ii*) and (iii) of the previous problem were not the same.

1-148. WEARY VERONICA, Part Two

While looking at the graph, Veronica's teammate pointed out that she could have saved her energy and walked from her starting place directly to her ending place instead.



a. On the Lesson 1.4.2 Resource Page: Weary Veronica provided by your teacher, find Veronica's graph. Using a different color, draw what the motion detector would have shown if she had walked directly from her starting position to her ending position at a constant rate taking the same amount of time.

b. What would Veronica's velocity have been had she taken this direct route? This rate is referred to as her **average velocity.**

c. Explain to an Algebra I student the relationship between the graph of Veronica's direct route and her average velocity?

MATH NOTES

Initial Postion, Final Position, Displacement, and Total Distance

Suppose that an object moves between times t_1 and t_2 (usually $t_1 = 0$). The**initial position** is the object's location at time t_1 .

The object's **final position** is its location at time t_2 .

The **displacement** of the object is the distance between the final position and the initial position.

The **total distance** and object travels is the total of all its motions both forward and back.

For example, suppose a bug begins at $x = 3$ on the number line, crawls forward 2 units and the backward 4 units. Then its initial position is 3, its final position is 1, its displacement is -2 (because it ended up at a lower number than where it started), and its total distance traveled is 6.

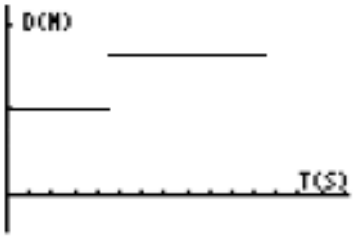
1-149. With your study team (or with the whole class), create a new Slope Walk graph with an average velocity of -2 ft/sec. The graph may not be linear. Copy a graph of the data on the blank axes of the resource page. Use a contrasting color to draw a direct path (secant line) from the starting position to the ending position.

a. With the new graph, answer the questions asked by Veronica's team members in problem 1-147.

b. "Walk" and sketch another non-linear graph that has an average velocity of 0 feet per second. Once again, answer the questions in problem 1-147.

1-150. Poor Agnalia! Her motion detector produced the graph below. "My calculator is broken," she cried jumping up and down, "This graph is physically impossible!" "No it's not," said Amanda, "It's just a piecewise

function." Who is correct, Agnalia or Amanda?



1-151. The table below represents the position of a bug crawling along the *x*-axis of your centimeter grid paper. Time is given in seconds.

time	0	2	5	6	8	10	11	15	16
position	(0, 0)	(2, 0)	(4, 0)	(6, 0)	(9, 0)	(8, 0)	(4, 0)	(4, 0)	(8, 0)

a. Describe the bug's motion. Does it always crawl in the same direction? Is its velocity constant?

b. Compute the bug's average velocity over the following intervals. Use correct units.

i. $0 < t < 16$

ii. $0 < t < 2$

iii. $8 < t < 11$

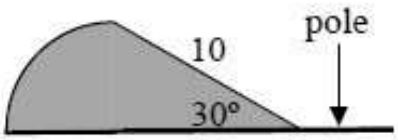
iv. $5 < t < 15$

c. Over $0 < t < 15$, will there be a time that the bug is at (5, 0)? Explain.

d. Over $0 < t < 16$, will there be a time at which the bug's average velocity is the same as its actual velocity? Explain.

1-152. The shaded region below represents a quarter circle combined with a right triangle "flag."

Homework Help ✎



a. Imagine rotating this flag about its "pole" and describe the resulting three-dimensional figure. Draw a picture of this figure on your paper.

b. Find the volume of the rotated flag.

1-153. For $f(x) = 3x \cos x$, approximate $A(f(x), 0 \le x \le \frac{\pi}{2})$ using two different methods. If the area is approximately 1.712 square units, which of your methods was most accurate? Analyze why that particular method was more accurate. Homework Help ✎

1-154. If $\sin x = \frac{1}{2}$ and if $0 \le x \le \frac{\pi}{2}$, then *without a calculator* evaluate: Homework Help ✎

a. $\cos x$

b. $\tan x$

c. $\sec x$

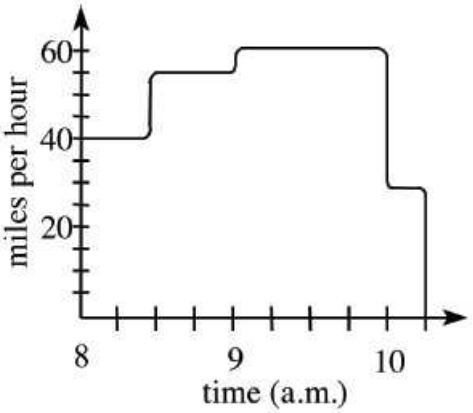
d. $\csc x$

1-155. After Theo used the motion detector, he used his distance-time graph to determine the following properties of his motion. However, he has lost a copy of his graph. Help him re-create a possible graph of his motion. Homework Help ✎

DETAILS:

- His average velocity was 0.5 feet per second.
- He turned around twice.
- He started while standing 3 feet from the motion detector and began to walk away from it at $t = 0$.
- He walked a total of 9 feet during the 10-second interval.

1-156. DO YOU KNOW THE WAY TO SAN JOSE?
Salima and Karim were driving from Sacramento to San Jose. Salima kept track of the rate as Karim drove. Below is a graph of their rate during the trip. Homework Help ✎



a. What is the driving distance between Sacramento and San Jose?

b. What was Karim's average speed?

1-157. Find the equation of the line parallel to $9y - 4x = 12$ through the point $(6, -7)$. Write the equation in point-slope form shown in the Math Notes box following problem 1-8. Homework Help

1-158. Without using a calculator, find the values of each of the following trig expressions. Homework Help

a. $\sin \frac{5\pi}{6}$

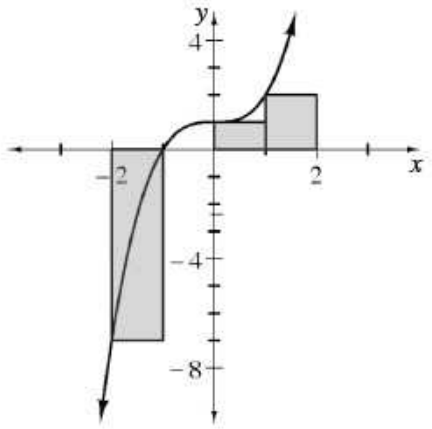
b. $\cos \frac{-3\pi}{4}$

c. $\tan \frac{\pi}{3}$

d. $\sec \frac{5\pi}{3}$

1-159. The height of a right circular cone is twice the radius. If the height of the cone is h, find the volume of the cone using only h. Homework Help

1-160. The function $y = x^3 + 1$ is graphed below, along with four left endpoint rectangles which approximate the area from $x = -2$ to $x = 2$. Homework Help



a. Why does it look like there are only three rectangles?

b. Recall that area under the x-axis is negative, while that above the x-axis is positive. Approximate $A(y, -2 \le x \le 2)$ using these four rectangles.

1-161. The parabola $y = -(x - 3)^2 + 4$ is graphed below. Use four trapezoids of equal width to approximate the area under the parabola for $1 \le x \le 5$. Is this area an over or an under estimate of the true area under the parabola? Homework Help