

REVIEW and REINFORCEMENT

Measuring Motion

KEY CONCEPTS

- ▲ A change in position in a certain amount of time is motion.
 - ▲ Speed is the rate at which an object moves.
 - ▲ Velocity is speed in a given direction.
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■ Building Vocabulary Skills: Relating Terms

For each group of terms, write a sentence that shows how the terms are related.

1. position: time: motion

2. speed: motion

3. speed: distance: time

4. velocity: speed

5. time: distance: direction: velocity

■ At a Snail's Pace: Applying the Main Ideas

A snail moves at an average speed of 5 centimeters per minute (5 cm/min). Individual snails, however, may move at somewhat faster or slower speeds. To prove this point, three snails decide to have a race. They agree to race the length of a meter stick from 0 cm to 100 cm. They line up the meter stick from east to west on a smooth patch of grass. At the finish line, they place some tasty lettuce leaves for the winning snail to eat.

The race begins at 10 AM sharp. Figure 1 shows the lineup of the snails.

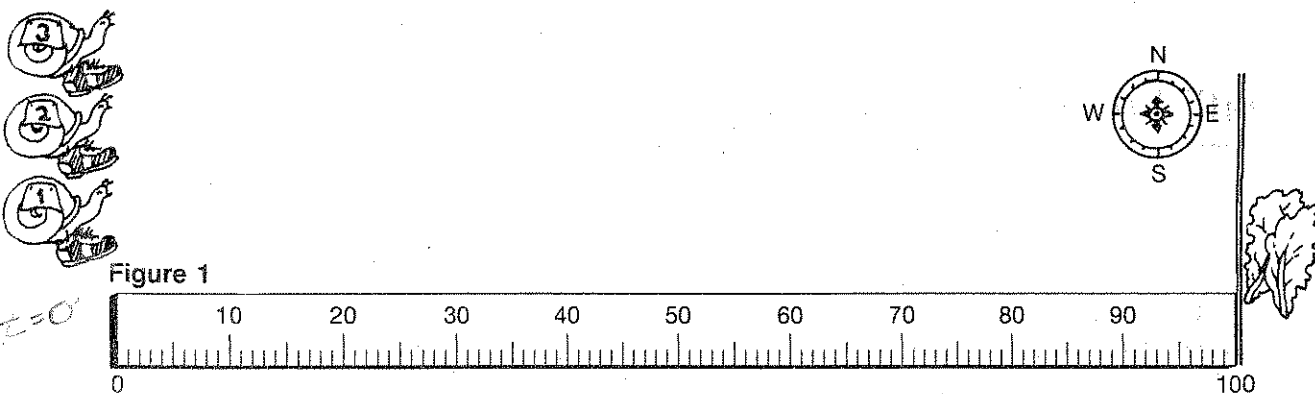
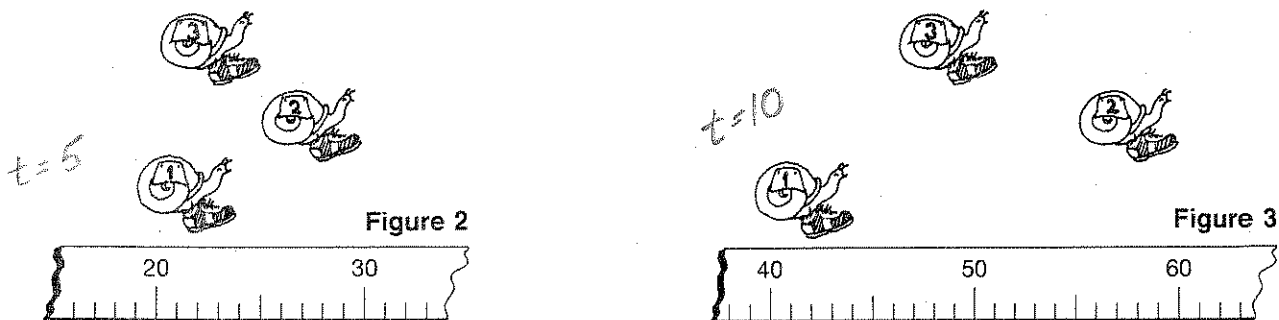


Figure 2 shows the positions of the snails after the first 5 minutes of the race.

Figure 3 shows their positions after the second 5 minutes.



1. Determine the distance that each snail traveled between 10:05 AM and 10:10 AM.

Snail 1: _____

Snail 2: _____

Snail 3: _____

2. Calculate the average speed for each snail.

Snail 1: _____

Snail 2: _____

Snail 3: _____

3. What is each snail's velocity during this time period?

Snail 1: _____

Snail 2: _____

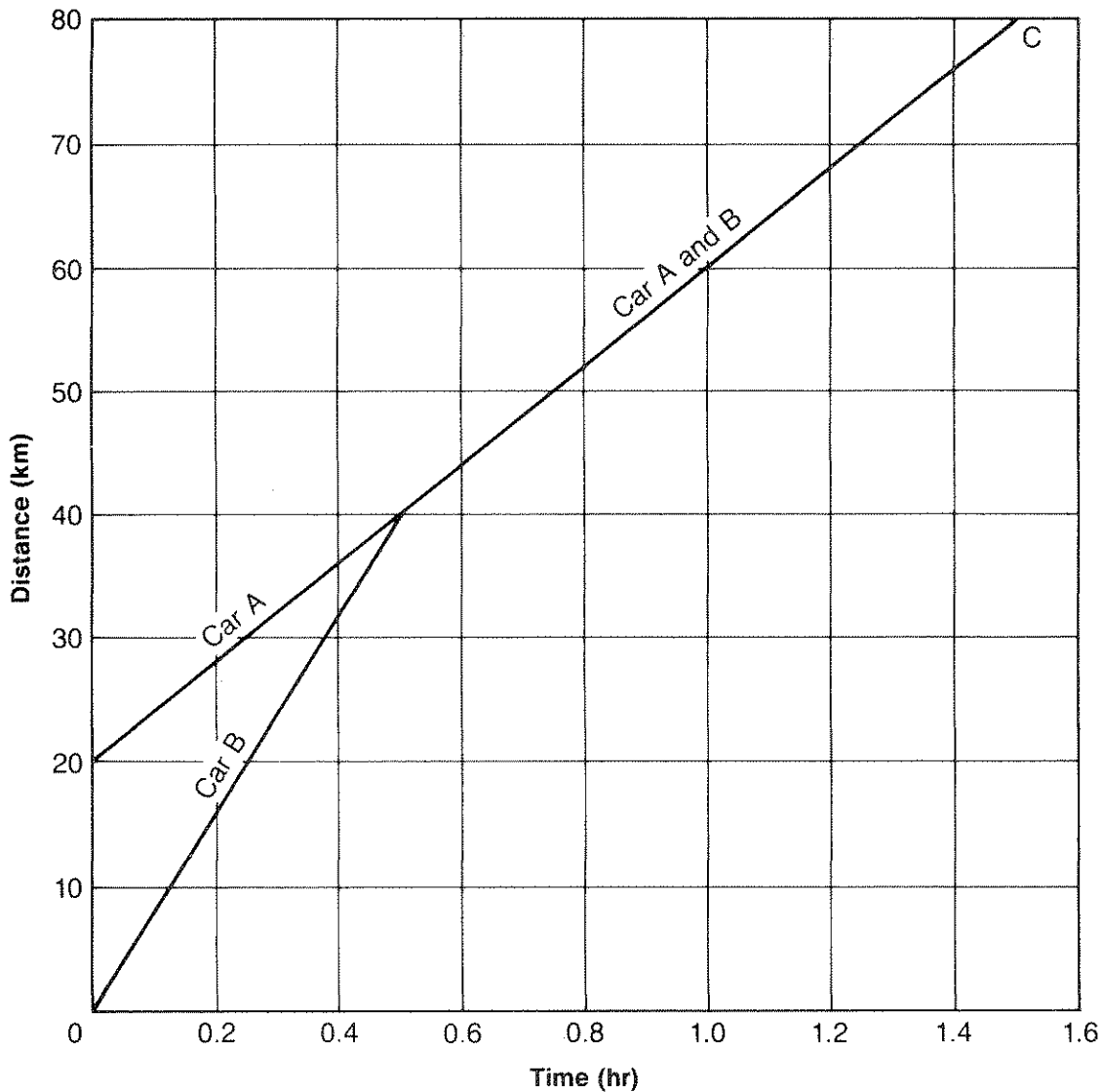
Snail 3: _____

4. A person watching the race noticed that at exactly 10:05 AM an ant wandered onto the snails meterstick. The ant crawled onto the 94-cm mark and reached the 50-cm mark at exactly 10:06 AM. What was the velocity of the ant?

ACTIVITY ■ What Is Motion?

A Speedy Journey

Use the graph below to answer the questions about the journeys of two cars.



1. How far did car A travel before it met car B? _____
2. How long had the two cars been traveling before they met? _____
3. How far did both cars travel at the same speed? _____
4. How long did it take both cars to get to point C? _____

5. Which car had constant speed? _____ ? What was its
speed? _____

6. What were the speeds of the other car? _____

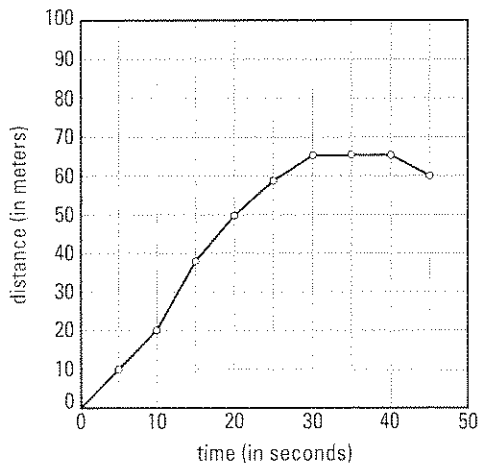
SECTION | SPEED MEASURES HOW FAST POSITION CHANGES.

1.2 Challenge and Extension**BIG IDEA** The motion of an object can be described and predicted.**KEY CONCEPT** Speed measures how fast position changes.

Calculating Average Speed If you know the total distance an object travels over a certain period of time, you can calculate the average speed of the object. To do so, you use the formula $\text{speed} = \text{distance}/\text{time}$.

The graph below shows data collected when a girl rode her bike down a hill. The girl's distance from her starting point at the top of the hill is shown on the y -axis. The time is shown on the x -axis.

Use the graph and the formula for speed to answer the following questions.



1. What is the girl's average speed between 10 seconds and 30 seconds?

2. What is the girl's average speed between 15 seconds and 25 seconds?

3. How might you approximate the girl's instantaneous speed 20 seconds after she starts down the hill?

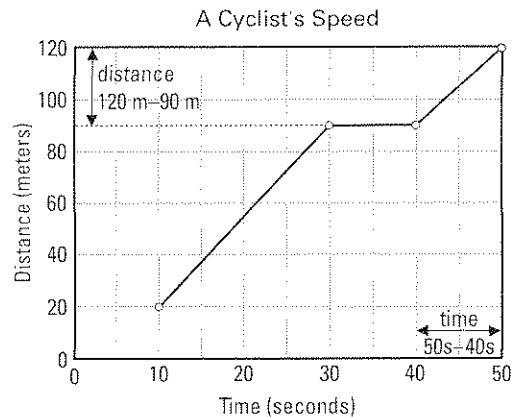
4. What is the girl doing between 40 and 50 seconds?

1 Math Support**Speed and Distance-Time Graphs**

The formula for speed is $S = \frac{d}{t}$

S is the speed of the object, d is the distance the object has moved, and t is the time it took the object to move that distance.

If information about distance and time is presented in a graph form, you can find the speed using the distance and time information given in the graph. Sometimes this involves subtracting one distance from another and subtracting one time from another.

**SAMPLE PROBLEM**

Using the graph above, find the bicyclist's speed between 40 s and 50 s.

Use the graph to find the distance at 50 s: 120 m.

Use the graph to find the distance at 40 s: 90 m.

Find the time interval between 40 s and 50 s: $50\text{ s} - 40\text{ s} = 10\text{ s}$.

Find the distance traveled between 40 s and 50 s: $120\text{ m} - 90\text{ m} = 30\text{ m}$.

Substitute the distance and the time into the formula for speed:

$$S = \frac{d}{t} = \frac{30\text{ m}}{10\text{ s}} = 3\text{ m/s}$$

Answer: Between 40 s and 50 s, the bicyclist's speed was 3 m/s.

EXERCISES

1. Using the graph above, find the bicyclist's speed between 10 s and 30 s.

Find distances from graph.

Calculate time interval.

Calculate distance traveled.

Substitute and solve.

Answer.

2. Using the graph above, find the bicyclist's speed between 30 s and 40 s.

Find distances from graph.

Calculate time interval.

Calculate distance traveled.

Substitute and solve.

Answer.

1 Math Practice**Speed and Distance-Time Graphs**

Solve the equations to find the value for each question. Include the appropriate units in your answer.

1. $S = 600 \text{ m} / 15 \text{ s}$

2. $S = 240 \text{ km} / 4 \text{ hr}$

3. $S = 75 \text{ mi} / 2.5 \text{ hr}$

4. $S = (35 \text{ m} - 20 \text{ m}) / (10 \text{ s} - 5 \text{ s})$

5. $S = (46 \text{ m} - 18 \text{ m}) / (10 \text{ s} - 3 \text{ s})$

6. $S = (49 \text{ m} - 21 \text{ m}) / (14 \text{ s} - 7 \text{ s})$

Use the graph or the formula for speed to answer questions 7–12.

7. A trucker made a delivery to a town 180 km from his start point. The graph shows the time and distance for the trip. During which part of the trip was the trucker driving 55 km/h?

8. The trucker stopped at a truck stop for a one-hour lunch break. During which part of the trip did he take his lunch break?

9. What was the trucker's speed as he drove from the truck stop where he had lunch to his final destination?

10. A jogger runs along a road for a distance of 2700 m. If it takes her 900 seconds to run that distance, what is her speed?

11. A car travels 40 miles in the first hour and 50 miles in the second hour. What is the car's average speed over the entire trip?

12. A bicyclist travels 10 km in half an hour, then rests for half an hour, then travels 50 km in three hours. What was the bicyclist's average speed over the entire trip?

Distance-Time Record for Trip A

