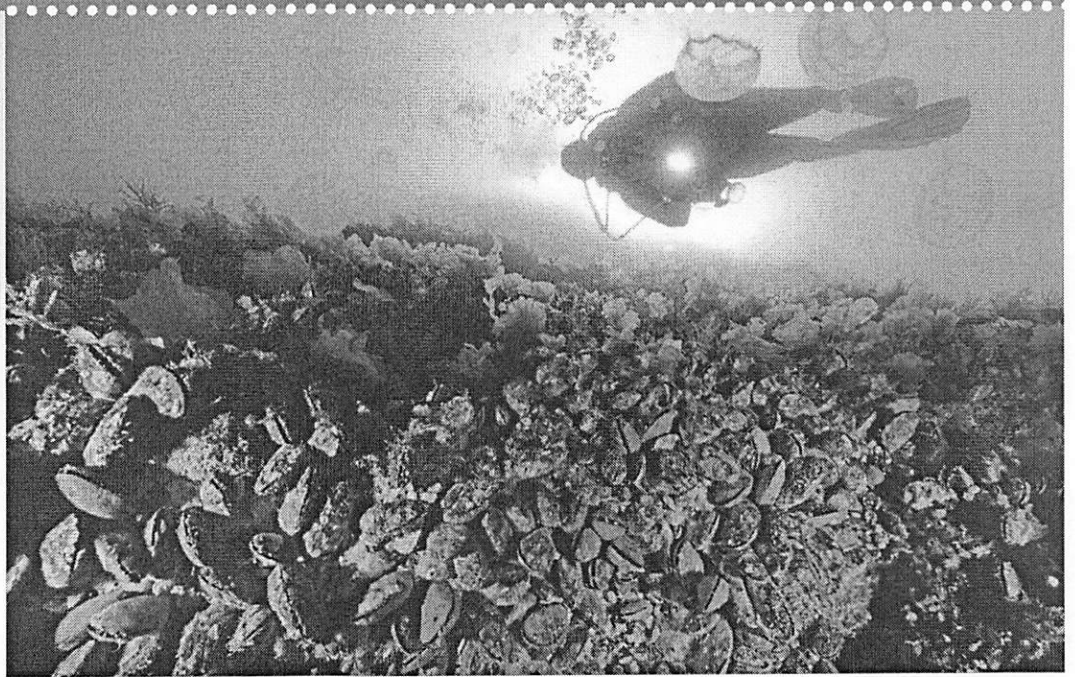


# 5.3 Interpreting and Sketching Graphs

## LESSON FOCUS

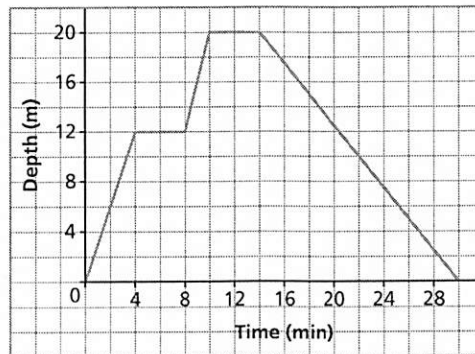
Describe a possible situation for a given graph and sketch a possible graph for a given situation.



## Make Connections

In math, a graph provides much information. This graph shows the depth of a scuba diver as a function of time.

A Scuba Diver's Dive



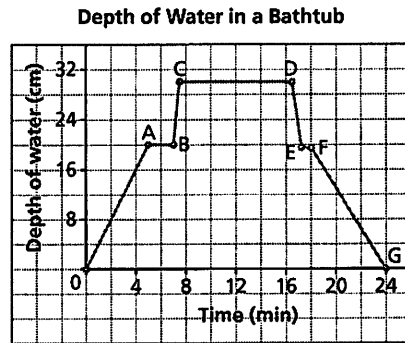
- How many minutes did the dive last?
- At what times did the diver stop her descent?
- What was the greatest depth the diver reached? For how many minutes was the diver at that depth?

# Construct Understanding

## TRY THIS

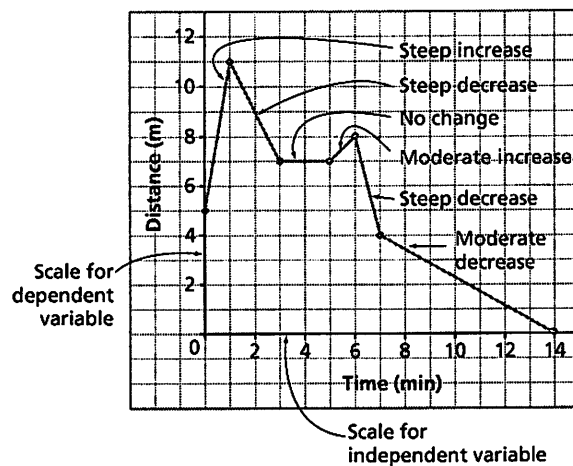
Work with a partner.  
You will need grid paper.

This graph shows the depth of water in a bathtub as a function of time.



- A. What does each segment of the graph represent? Compare your description with that of your partner. Are both your stories the same? Should they be? Explain.
- B. Sketch a graph to represent this situation:  
 You put the plug in the bath and turn on the taps.  
 You leave the bathroom and return to discover that the bath has overflowed.  
 You turn off the taps and pull out the plug to let out some water. You put the plug back in.
- C. Compare your graph with that of your partner. How are the graphs the same? How are they different?

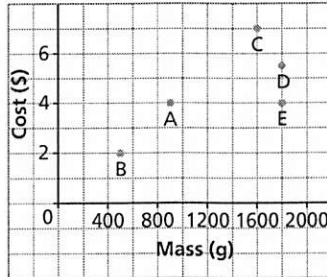
The properties of a graph can provide information about a given situation.



## Example 1 Interpreting a Graph

Each point on this graph represents a bag of popping corn. Explain the answer to each question below.

- a) Which bag is the most expensive? What does it cost?  
 b) Which bag has the least mass? What is this mass?  
 c) Which bags have the same mass? What is this mass?  
 d) Which bags cost the same? What is this cost?  
 e) Which of bags C or D has the better value for money?

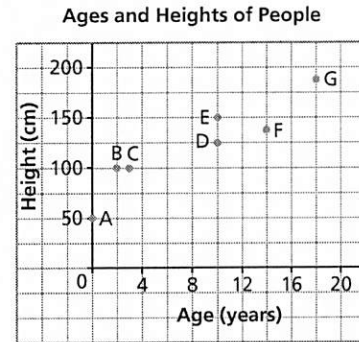


### SOLUTION

- a) Bag C is most expensive because it is represented by the highest point on the graph and the vertical axis represents cost. It costs \$7.00.
- b) Bag B has the least mass because it is represented by the point on the graph farthest to the left and the horizontal axis represents mass. The mass appears to be 500 g.
- c) Bags D and E have the same mass because the points that represent them lie on the same vertical line and it passes through 1800 on the *Mass* axis. The mass is 1800 g.
- d) Bags A and E cost the same because the points that represent them lie on the same horizontal line and it passes through 4 on the *Cost* axis. The cost is \$4.00.
- e) Bag D has the better value for money because it has a greater mass than bag C and costs less than bag C.

### CHECK YOUR UNDERSTANDING

1. Each point on this graph represents a person. Explain your answer to each question below.



- a) Which person is the oldest? What is her or his age?  
 b) Which person is the youngest? What is her or his age?  
 c) Which two people have the same height? What is this height?  
 d) Which two people have the same age? What is this age?  
 e) Which of person B or C is taller for her or his age?

[Answers: a) G, 18 years  
 b) A, newborn  
 c) B and C, 100 cm  
 d) D and E, 10 years  
 e) B]

Does this graph represent a function? Explain.

Why do you think bag D is more expensive than bag E?

The graph shows how the volume of water in a watering can changes over time.

The starting volume is 1 L, which is the volume at point A.

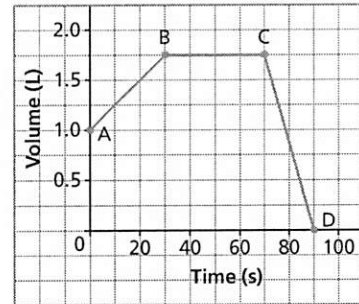
Segment AB goes up to the right, so the volume of water is increasing from 0 s to 30 s.

Segment BC is horizontal, so the volume is constant from 30 s to 70 s.

Segment CD goes down to the right, so the volume is decreasing from 70 s to 90 s.

At point D, the volume is 0 L after 90 s.

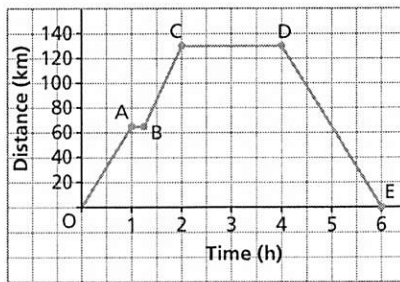
Volume of Water in a Watering Can



## Example 2 Describing a Possible Situation for a Graph

Describe the journey for each segment of the graph.

Day Trip from Winnipeg to Winkler, Manitoba



The distance between Winnipeg and Winkler is 130 km.

### SOLUTION

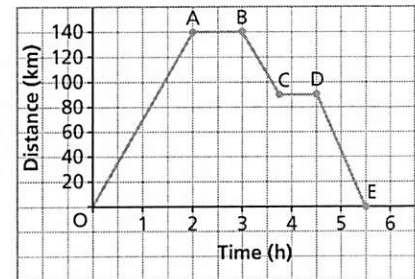
Segment	Graph	Journey
OA	The graph goes up to the right, so as time increases, the distance from Winnipeg increases.	In the first hour, the car leaves Winnipeg and travels approximately 65 km toward Winkler.
AB	The graph is horizontal, so as time increases, the distance stays the same.	The car stops for approximately 15 min.
BC	The graph goes up to the right, so as time increases, the distance increases.	The car travels approximately 65 km toward Winkler.
CD	The graph is horizontal, so as time increases, the distance stays the same.	At C, the car has travelled 130 km so it has reached Winkler, where it stops for 2 h.
DE	The graph goes down to the right, so as time increases, the distance decreases.	The car returns to Winnipeg and takes 2 h to travel 130 km.

### CHECK YOUR UNDERSTANDING

- This graph represents a day trip from Athabasca to Kikino in Alberta, a distance of approximately 140 km.

Describe the journey for each segment of the graph.

Day Trip from Athabasca to Kikino



[Answer: The car takes 2 h to travel 140 km to Kikino; the car stops for 1 h; the car takes approximately 45 min to travel 50 km toward Athabasca; the car stops for approximately 45 min; the car takes 1 h to travel approximately 90 km to Athabasca]

What was the total driving time? Explain.

What are the dependent and the independent variables?

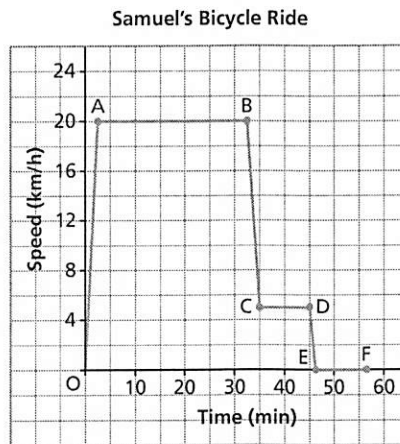
### Example 3 Sketching a Graph for a Given Situation

Samuel went on a bicycle ride. He accelerated until he reached a speed of 20 km/h, then he cycled for 30 min at approximately 20 km/h. Samuel arrived at the bottom of a hill, and his speed decreased to approximately 5 km/h for 10 min as he cycled up the hill. He stopped at the top of the hill for 10 min.

Sketch a graph of speed as a function of time. Label each section of the graph, and explain what it represents.

#### SOLUTION

Draw and label axes on a grid. The horizontal axis represents time in minutes. The vertical axis represents speed in kilometres per hour.

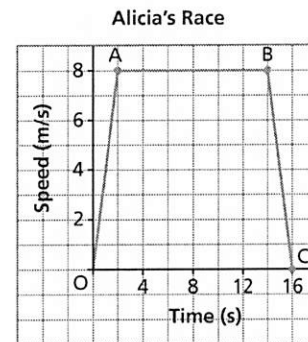


Segment	Journey
OA	Samuel's speed increases from 0 to 20 km/h, so the segment goes up to the right.
AB	Samuel cycles at approximately 20 km/h for 30 min. His speed does not change, so the segment is horizontal.
BC	Samuel's speed decreases to 5 km/h, so the segment goes down to the right.
CD	Samuel cycles uphill at approximately 5 km/h for 10 min. His speed does not change, so the segment is horizontal.
DE	Samuel slows down to 0 km/h, so his speed decreases and the segment goes down to the right.
EF	Samuel remains stopped at 0 km/h for 10 min, so the segment is horizontal.

#### CHECK YOUR UNDERSTANDING

3. At the beginning of a race, Alicia took 2 s to reach a speed of 8 m/s. She ran at approximately 8 m/s for 12 s, then slowed down to a stop in 2 s. Sketch a graph of speed as a function of time. Label each section of your graph, and explain what it represents.

Answer:



Why does the graph not end at point E?

## Discuss the Ideas

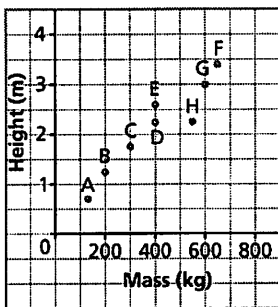
- For a graph of distance as a function of time, what does each segment represent?
  - a) a horizontal line segment
  - b) a segment that goes up to the right
  - c) a segment that goes down to the right
- For a graph of speed as a function of time, what does each segment represent?
  - a) a horizontal line segment
  - b) a segment that goes up to the right
  - c) a segment that goes down to the right

## Exercises

**A**

3. Each point on the graph represents a polar bear. Explain the answer to each question below.

Heights and Masses of 8 Polar Bears

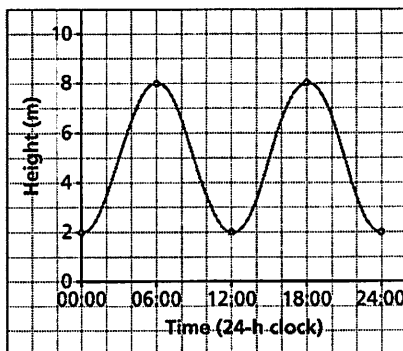


- Which bear has the greatest mass? What is this mass?
- Which bear is the shortest? What is its height?
- Which two bears have the same mass? What is this mass?
- Which two bears have the same height? What is this height?

**B**

4. This graph shows the height of the tide in a harbour as a function of time in one day. Explain the answer to each question below.

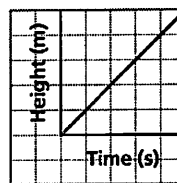
Height of the Tide in a Harbour



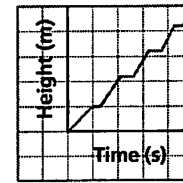
- What is the greatest height? At what times does it occur?
- What is the least height? At what times does it occur?
- How high is the tide at 04:00?
- When is the tide 4 m high?

5. To raise a flag, Sepideh pulls the rope steadily with both hands for a short time, then moves both hands up the rope and pulls again. She does this until the flag has been raised. Which graph best represents the height of the flag? Give reasons for your choice.

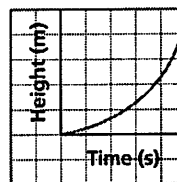
Graph A



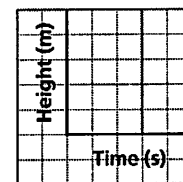
Graph B



Graph C

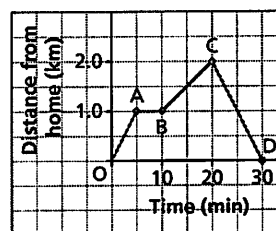


Graph D

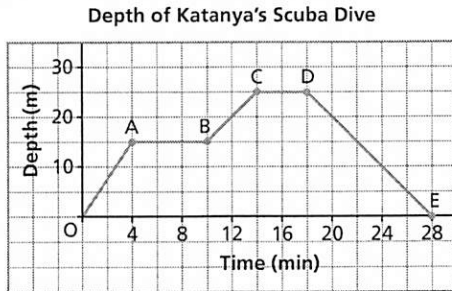


6. Gill runs for exercise. This graph shows her distance from home during one of her runs. Describe Gill's run for each segment of the graph.

Gill's Run



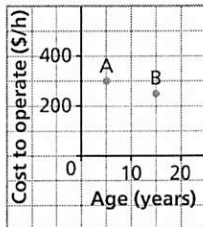
7. Katanya went scuba diving in Egypt. This graph shows her depth below sea level as a function of time on one of her dives.



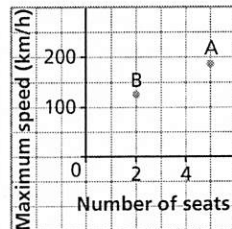
Write all that you know about the dive from the graph.

8. Point A and Point B represent the same helicopters in each of these graphs.

**Graph of Cost against Age**



**Graph of Maximum Speed against Number of Seats**

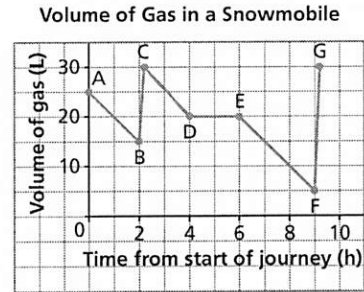


Which statements are true? Justify your answers.

- The older helicopter is cheaper to operate.
- The helicopter with more seats has the lower maximum speed.
- The helicopter with the lower maximum speed is cheaper to operate.
- The helicopter with the greater maximum speed is older.
- The helicopter with fewer seats is newer.

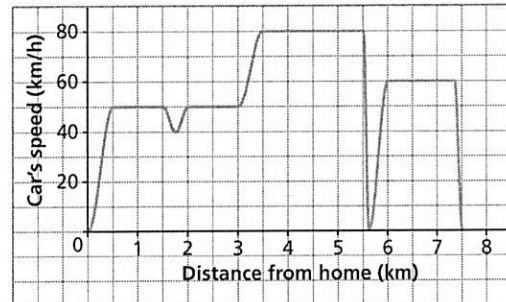


9. a) Describe what is happening for each line segment in this graph.



- b) How much gas was in the tank at the start of the journey? Was the tank full at this time? Explain.
10. An oven is turned on at a room temperature of  $20^{\circ}\text{C}$  and it takes 10 min to reach a temperature of  $190^{\circ}\text{C}$ . A tray of cookies is placed in the oven to bake for 10 min. The oven is then turned off and returns to room temperature after 15 min. Sketch a graph of temperature as a function of time. Label each section of the graph and explain what it represents.
11. Write all that you know about a person's drive to work from this graph.

**A Person's Drive to Work**



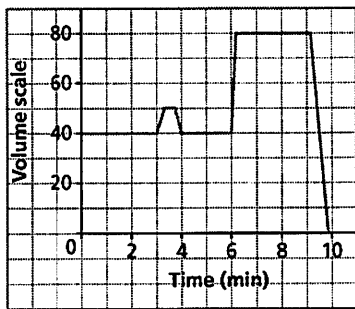
12. A school vending machine sells cartons of milk and juice. On a typical day:
- No cartons are sold between 7 A.M. and 8 A.M., or from 5 P.M. onward.
  - The machine has a capacity of 100 cartons. At 7 A.M., it is three-quarters full.
  - From 8 A.M. to 10 A.M., 10:15 A.M. to noon, and from 1 P.M. to 3 P.M. the students are in class.
  - The machine is filled at 11 A.M. and at 4 P.M.
- Sketch a graph of the number of cartons in the vending machine as a function of time. Explain what each section of the graph represents.

13. A student drew a graph to represent this situation.

“Jonah is watching television. After 3 min his mom enters the room to ask him a question. He turns the volume down a bit, answers his mom, then turns the volume back up. Two minutes later, Jonah’s dad turns on the dishwasher so Jonah gradually turns up the volume. After a further 3 min, a commercial comes on so Jonah presses the mute button.”

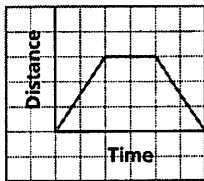
Describe any errors in the student’s graph.

Volume of a Television

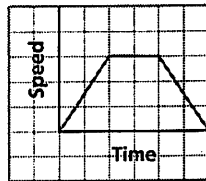


14. The two graphs below have the same shape, but different vertical axes. Copy each graph and include numbers and units on both axes. Write and justify a possible situation that it represents.

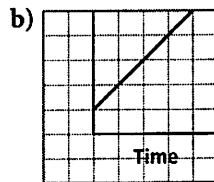
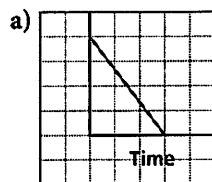
a) Graph A



b) Graph B

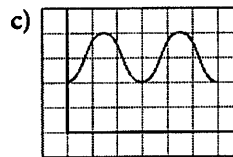
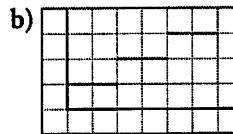
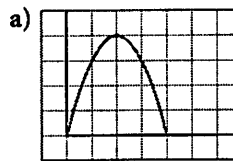


15. Each graph shows a quantity as a function of time. Choose a dependent variable for each graph, and suggest a possible situation that it represents. Copy the graph and include numbers on the axes.



16. Chad goes bungee jumping.
- Sketch each graph of his jump.
    - the distance above the ground as a function of time
    - the speed as a function of time
  - Explain the similarities and differences between the two graphs.

17. For each graph, choose a dependent variable and an independent variable, and suggest a possible situation that it represents. Describe the significance of any key points or changes in the graph.



18. The diagrams below show cross-sections of swimming pools that will be filled with water at the same constant rate. Sketch two graphs on the same grid to represent the depth of water in each pool as a function of time. Label the axes. Justify the shape of each graph.



### Reflect

When you describe a possible situation for a given graph, what features of the graph do you have to use in your description and how do you use them? Include a sketch of a graph in your explanation.