Connect and Reflect

Key Ideas

- You can represent a relation in several ways:
  - in words
  - graphically
  - numerically
  - algebraically
- The ways you represent a relation have connected meanings.
- You can represent the graph of a linear relation with an equation of the form \( y = ax + b \):
  - \( b \) represents the constant term and is the \( y \)-intercept on a graph.
  - \( ax \) is the variable term, where \( a \) represents the rate of change of \( y \) with respect to \( x \).
  - To find \( a \), use any two points on the graph and compare the change in \( y \) to the change in \( x \) between the points.

Practise

For help with #1 to #3, refer to Example 1 on page 191.

1. Describe the process you would use to determine the equation of a line from a given graph using each method. Which method do you prefer? Why?
   a) using a table of values
   b) using points on the graph

2. The graph illustrates the cost for a graphic designer to design a logo.

   a) What is the fixed cost to hire this designer? How do you know?
   b) Describe the pattern shown in the graph.
   c) Determine an equation relating cost to time.

3. The graph illustrates the typical energy burned while exercising on an elliptical machine.

   a) Make a table of values for this relation so you can see a pattern.
   b) Why does the graph start at zero?
   c) What is the rate of change?
   d) Determine an equation relating energy burned to time.
   e) How much energy would be burned after 30 minutes?
For help with #4 to #6, refer to Example 2 on pages 192–193.

4. Describe how a graph of a relation would look if there is no fixed term in the equation.

5. Choose the letter representing the graph that matches each linear equation.
   a) \( y = 5x \)
   b) \( y = -2x + 3 \)
   c) \( y = -\frac{x}{4} + 6 \)

6. a) Create a table of values for each relation, for \( x \) between -2 and 2. Include columns to show the pattern in the change in \( y \)-values.

   b) What is similar? What is different?
   c) How do these similarities and differences relate to the equations?

7. The distance–time graph illustrates two runners competing in a race.

   a) Who got a head start? How can you tell?
   b) Who is the faster runner? How can you tell?
   c) The equations representing the runners’ races are \( d = 100 - 7t \) and \( d = 98 - 7.5t \). Which equation corresponds to Dania’s race?
8. The graph shows the amount of fuel used by Sarah's car, on average, for city driving.

![City Driving Graph](image)

- a) The fuel efficiency of cars is stated in L/100 km. What is the fuel efficiency of Sarah's car in the city?
- b) State an equation that calculates the amount of fuel used in \( n \) km of city driving.
- c) Describe how the fuel efficiency rating relates to your equation.
- d) On the highway, Sarah's car uses 25% less fuel. Draw a new graph and state an equation that calculates the amount of fuel used in \( n \) km of highway driving.

9. What linear equation does each graph represent?

![Graphs A to F](image)

- a)
- b)

Apply

10. **Competency Check** The graph illustrates the air pressure remaining in a scuba tank after a given time.

- a) What is the initial air pressure in the tank?
- b) What is the rate of air consumption in PSI/min?
- c) Write an equation relating the remaining air pressure to time.
- d) After how many minutes will the tank be empty?
11. State the equation of the line passing through each set of points. Explain your reasoning. Verify that your equation is true for \( x = 2 \).

![Graphs a) and b) showing lines with points labeled](image)

12. **Competency Check** The table shows the effect of temperature on the volume of a specific gas.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Volume (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>847</td>
</tr>
<tr>
<td>20</td>
<td>862</td>
</tr>
<tr>
<td>30</td>
<td>877</td>
</tr>
<tr>
<td>40</td>
<td>892</td>
</tr>
</tbody>
</table>

a) Graph the relation.

b) State an equation representing the relationship between volume and temperature.

c) What would the volume of gas be at a temperature of 50 °C?

d) At what temperature would the volume of gas be 757 mL?

13. In a 100 m sprint, it takes runners a very short period of time to accelerate to a constant speed. The distance-time graph represents Usain Bolt's Olympic-medal-winning race, assuming that he ran at a constant speed for the entire race. Could Bolt exceed the speed limit while sprinting through any of the following zones? Explain. Hint: \( 1 \text{ m/s} = 3.6 \text{ km/h} \).

![Distance-time graph](image)

a) ![Speed limit sign](image) 50 km/h

b) ![Speed limit sign](image) 40 km/h

c) ![Speed limit sign](image) 30 km/h

d) State an equation relating distance and time.
14. Represent each side of rectangle ABCD with an equation.

15. The graph shows the average amount of food energy used by a 50-kg person while taking part in various activities.
   a) How much food energy is used per minute for each activity?
   b) State an equation representing the energy used with each activity.

16. Weights of different masses are hung from a spring and the length of the spring is measured. The graph illustrates the relationship between the length of the spring and the mass of the weights.
   a) State an equation relating the length of the spring to the mass of the weight.
   b) How do the values of the constant term and variable term relate to the experiment? Explain.
   c) Determine the length of the spring when a weight of mass 300 g is attached.
   d) How much weight needs to be attached for it to extend the spring to 30 cm?
17. The sum of two numbers, \(x\) and \(y\), is 8.
   a) Graph this relation.
   b) Is this relation linear? Explain.
   c) Determine the equation for this relation.

18. a) Plot the points \(A(-1, 4)\) and \(B(0, 1)\) on a grid.
   b) Plot a third point that would lie on a straight line passing through \(A\) and \(B\).
   c) Determine an equation of the line passing through \(A\) and \(B\).
   d) Verify that your third point satisfies this equation.

19. Graph each of the following and determine its equation.
   a) A line parallel to the line in the graph, with \(y\)-intercept = 6
   b) A line with the same \(y\)-intercept, where the rate of change with respect to \(x\) is 4.

20. Gavin drove from Kelowna to a friend's home near Coquitlam. He used a table to record the data.

<table>
<thead>
<tr>
<th>Time, (t) (h)</th>
<th>Distance (d) (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>45.0</td>
</tr>
<tr>
<td>0.9</td>
<td>81.0</td>
</tr>
<tr>
<td>1.2</td>
<td>108.0</td>
</tr>
<tr>
<td>2.0</td>
<td>180.0</td>
</tr>
<tr>
<td>2.9</td>
<td>261.0</td>
</tr>
<tr>
<td>4.1</td>
<td>369.0</td>
</tr>
</tbody>
</table>

   a) Graph the points and show the relationship of Gavin's distance over time for the entire 4.1 hours.
   b) What assumptions did you make?
   c) How far did Gavin drive in the first 1.2 h?
   d) How long did it take Gavin to drive 200 km?
   e) Write the equation that relates distance to time.
   f) What was Gavin's average driving speed for the 4.1 hours?