4.5 Using Graphs to Estimate Values

**FOCUS** Use interpolation and extrapolation to estimate values on a graph.

When we estimate values between 2 given data points on a graph of a linear relation, we use **interpolation**.

**Example 1** Using Interpolation to Solve Problems

This graph shows the distance travelled by Bobbie's family on a trip from Calgary to Moose Jaw. How long did it take his family to travel 320 km?

**Solution**

To find how long it took to travel 320 km:
- Locate the point on the vertical axis that represents 320 km.
- Draw a horizontal line to the graph.
- Then draw a vertical line from the graph to the horizontal axis.

Read the value where the vertical line meets the horizontal axis.

It took about 4 h to travel 320 km.

We could follow the same process to find that, after 3 h, the family has travelled about 240 km.

**Check**

1. Use the graph to find the following values.

   a) The cost of 15 L of fuel.
      About $______.

   b) The quantity of fuel that can be purchased for $10.
      About _______ L.
When we extend a graph of a linear relation to estimate values that lie beyond the graph, we use **extrapolation**.

**Example 2** Using Extrapolation to Solve Problems

On his family trip from Calgary to Moose Jaw, Bobbie wants to predict how long it will take to travel 640 km.

**Solution**

Since the relation appears to be linear, we can extend the graph.

- Locate the point on the vertical axis that represents 640 km.
- Draw a horizontal line to the graph.
- Then draw a vertical line from the graph to the horizontal axis.

Read the value where the vertical line meets the horizontal axis. It will take about 8 h to travel 640 km.

**Check**

1. Use the graph to find the cost of 30 L of fuel.
1. Use this graph of a linear relation.
   a) What is the value of \( x \) when \( y = 3? \)
      \[ x = _______ \]
   b) What is the value of \( y \) when \( x = 1? \)
      \[ y = _______ \]

2. This graph shows a linear relation.
   a) What is the value of \( x \) when \( y = 4? \)
      \[ x = _______ \]
   b) What is the value of \( y \) when \( x = -4? \)
      \[ y = _______ \]

3. This graph shows a linear relation for different drilling depths.
   a) Estimate the depth drilled in 1 day.
      About _______ m
   b) Estimate the time taken to drill to a depth of 750 m.
      About _______ days
   c) Estimate the depth that will be drilled in 3 days.
      About _______ m
   d) Estimate the time it will take to drill 2000 m.
      About _______ days
Lesson 4.5: Using Graphs to Estimate Values

1. This graph represents a linear relation.
   a) Determine the value of \( x \) for each value of \( y \).
      i) \( y = 1 \)  ii) \( y = 3 \)
      iii) \( y = 0 \)
   b) Determine the value of \( y \) for each value of \( x \).
      i) \( x = 2 \)  ii) \( x = 8 \)
      iii) \( x = -6 \)

2. This graph represents a linear relation.
   a) Determine the value of \( x \) for each value of \( y \).
      i) \( y = 3 \)  ii) \( y = -2 \)
      iii) \( y = 7 \)
   b) Determine the value of \( y \) for each value of \( x \).
      i) \( x = 0 \)  ii) \( x = -2 \)
      iii) \( x = -4 \)

3. This graph represents a linear relation.
   a) Determine the value of \( x \) for each value of \( y \).
      i) \( y = 2 \)  ii) \( y = 0 \)
      iii) \( y = 5 \)
   b) Determine the value of \( y \) for each value of \( x \).
      i) \( x = 0 \)  ii) \( x = 3 \)
      iii) \( x = -5 \)

4. The graph shows how the cost of a long distance call changes with the time for the call.
   a) Estimate the cost of a 7-min call. Is this interpolation or extrapolation? Explain.
   b) The cost of a call was $1.00. Estimate the time for the call.
   c) The cost of a call was $1.50. Estimate the time for the call.