**Interpreting Graphs of Functions**

Shake, Rattle, and Roll
Lesson 6-1 Key Features of Graphs

**Learning Targets:**
- Relate the domain and range of a function to its graph.
- Identify and interpret key features of graphs.

**SUGGESTED LEARNING STRATEGIES:** Marking the Text, Visualization, Interactive Word Wall, Discussion Groups

Roller coasters can be scary but fun to ride. Below is the graph of the heights reached by the cars of the Thunderball Roller Coaster over its first 1250 feet of track. The graph displays a function because each input value has one and only one output value. You can see this visually using the **vertical line test**. Study this graph to determine the domain and range.

![Graph of Thunderball Roller Coaster Height](image)

The domain gives all values of the **Independent variable**: in this case, the distance along the track in feet. The domain values are graphed along the horizontal or x-axis. The domain of the function above can be written in set notation as:

\[ \{\text{all real values of } x : 0 \leq x \leq 1250\} \]

Read this notation as: the set of all real values of \( x \), between 0 and 1250, inclusive.

The range gives the values of the **Dependent variable**: in this case, the height of the roller coaster above the ground in feet. The range values are graphed on the vertical or y-axis. The range of the function above can be written in set notation as:

\[ \{\text{all real values of } y : 10 \leq y \leq 110\} \]

Read this notation as: the set of all real values of \( y \), between 10 and 110, inclusive.

**MATH TERMS**

The **vertical line test** is a visual check to see if a graph represents a function. For a function, every vertical line drawn in the coordinate plane will intersect the graph in at most one point. This is equivalent to having each domain element associated with one and only one range element.

**MATH TERMS**

An **independent variable** is the variable for which input values are substituted in a function. A **dependent variable** is the variable whose value is determined by the input or value of the independent variable.

**Activity Standards Focus**

In Activity 6 students determine the domain and range of various relations and identify relative maxima and minima. Students extend their thinking to real-world situations by interpreting key features of graphs with context and by determining a reasonable domain and range for the problem situation.

**Lesson 6-1**

**PLAN**

Pacing: 1 class period

**Chunking the Lesson**

#1-5  #6-10
Check Your Understanding #15-21
Check Your Understanding Lesson Practice

**TEACH**

**Bell-Ringer Activity**

Have each student sketch a graph of his or her distance from school, from just leaving home to arriving at school. Students can compare graphs and consider the meaning of the attributes of the graphs.

**Developing Math Language**

This lesson contains multiple vocabulary terms that are used to describe graphs of functions. When possible, call on students’ prior knowledge to help them understand the new vocabulary. For example, have students share their understanding of the terms vertical, independent, dependent, intercept, maximum, minimum and continuous. Help them connect those understandings with the terms vertical line test, independent variable, dependent variable, y-intercept, relative maximum, relative minimum and continuous. Note that some math terms such as discrete are more difficult to connect to an everyday meaning of the word.

**Common Core State Standards for Activity 6**

- HSF-IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- HSF-IF.B.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- HSF-IF.C.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- HSF-IF.C.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.
ACTIVITY 6 Continued

1–5 Shared Reading, Marking the Text, Interactive Word Wall Discuss the important ideas in each paragraph. Encourage students to refer to the marked text and the Word Wall as they answer the questions involving the math terms in this lesson. Make sure students are using the vocabulary correctly.

CONNECT TO AP

The absolute maximum and absolute minimum of a function are important points on the graph of the function. In higher levels of algebra and in calculus, they provide useful information about functions.

MATH TIP

An open interval is an interval whose endpoints are not included. For example, $0 < x < 5$ is an open interval, but $0 \leq x \leq 5$ is not.

Lesson 5-1

Key Features of Graphs

The graph above shows data that are continuous. The points in the graph are connected, indicating that domain and range are sets of real numbers with no breaks in between. A graph of discrete data consists of individual points that are not connected by a line or curve.

Many other useful pieces of information about a function can be determined by looking at its graph.

- The y-intercept of a function is the point at which the graph of the function intersects the y-axis. The y-intercept is the point at which $x = 0$.
- A relative maximum of a function $f(x)$ is the greatest value of $f(x)$ for values in a limited open domain interval.
- A relative minimum of a function $f(x)$ is the least value of $f(x)$ for values in a limited open domain interval.

Because they must occur within open intervals of the domain, relative maximums and relative minimums cannot correspond to the endpoints of graphs.

Use the Thunderball Roller Coaster Graph on the previous page for Items 1–5.

1. **Reason abstractly.** What is the y-intercept of the function shown in the graph, and what does it represent?

   $(0, 10)$ represents the height of the roller coaster when the ride begins (at time $= 0$).

2. Identify a relative maximum of the function represented by the graph.

   $110$ or $10$

3. Identify the absolute maximum of the function represented by the graph. Interpret its meaning in the context of the situation.

   $110$: the greatest height reached by the roller coaster

4. Identify a relative minimum of the function represented by the graph.

   $10$ or $10$

5. Identify the absolute minimum of the function represented by the graph. Interpret its meaning in the context of the situation.

   $10$: the least height reached by the roller coaster

*Mini-Quiz on 5.1–5.3 First*
Suppose you got on a roller coaster called Cougar Mountain that immediately started climbing the track in a linear fashion, as shown in the graph.

6. Identify the domain and range of the function.
   Domain: (all real values of \( x: 0 \leq x \leq 200 \)), range: (all real values of \( y: 0 \leq y \leq 175 \))

7. Identify the \( y \)-intercept of the function.
   \( (0, 0) \)

8. Identify the absolute maximum and minimum of the function.
   Maximum: 175; minimum: 0

9. Does the function have any relative maximum or minimum values?
   Explain.
   No; there is no open domain interval that has maximum or minimum values. The absolute maximum and minimum occur at the endpoints, so they cannot be the relative maximum and minimum.

10. How are the extremas different on this linear graph versus the nonlinear graph for the Thunderball Roller Coaster?
    On the linear graph, the extremas occur at the endpoints of the interval.
    On the nonlinear graph, they occur in the interior as well as the endpoints of the interval.
ACTIVITY 6 Continued

Check Your Understanding

Debrief students’ answers to these items to ensure that they understand the mathematical terminology used to describe the graphs of functions. This lesson prepares students to study functions and their graphs with proper mathematical vocabulary.

**Answers**

11. No, the points are not connected. Therefore, it is a discrete function.

12. 28

13. Sometimes; it is possible that a relative minimum is not the absolute minimum.

14. Sometimes; this is not true if the absolute minimum corresponds to an endpoint, for example.

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15–21 Interactive Word Wall, Group Discussion, Think Aloud, Debriefing Before answering the questions, go over the words on the Word Wall from this activity. Have students relate each word to the graph shown. As students discuss the answers to the questions, have them address both the mathematical features as well as its meaning of each in the context of the problem.

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**Lesson 6-1**

**Key Features of Graphs**

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**Check Your Understanding**

11. The graph below shows five points that make up the function $h$. Is the function $h$ continuous? Explain.

![Graph of $h$]

12. A function has three relative maximums: –2, 103, and 28. One of the relative maximums is also the absolute maximum. What is the absolute maximum?

Tell whether each statement is sometimes, always, or never true. Explain your answers.

13. A relative minimum is also an absolute minimum.

14. An absolute minimum is also a relative minimum.

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Tom hiked along a circular trail known as the Juniper Loop. The graph shows his distance $d$ from the starting point after $t$ minutes.

![Graph showing distance $d$ vs. time $t$]

15. Identify the domain and range of the function shown in the graph.

Domain: $0 \leq t \leq 185$; Range: $0 \leq d \leq 9$

16. Identify the absolute minimum of the function. What does it represent?

$0$: Tom’s least distance from the starting point.

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Lesson 6-1
Key Features of Graphs

17. In this function, the absolute minimum corresponds to two points on the graph. What are the two points? What do they represent in this context?
(0, 0) and (185, 0); Tom’s least distance from the starting point (0 km) occurred both at the beginning and at the end of his hike.

18. Identify the absolute maximum of the function. What does it represent?
7; Tom’s greatest distance from the starting point (7 km)

19. What points on the graph correspond to the absolute maximum? What does this mean in the context of Tom’s hike?
All of the points along the graph from t = 80 to t = 120; Tom was 7 km from the starting point between these times (probably he stopped to rest).

20. Identify any relative minimums for the function shown in the graph.
5

21. Identify any relative maximums for the function shown in the graph.
5 or 7

Check Your Understanding

22. What are the independent and dependent variables for the function representing Tom’s hike? (Label)

23. Explain how to determine the maximum and minimum values of a function by examining its graph.

24. Is it possible for a function to have more than one absolute maximum or absolute minimum value? Explain.
ACTIVITY 6 Continued

ASSESS

Students’ answers to Lesson Practice problems will provide you with a formative assessment of their understanding of the lesson concepts and their ability to apply their learning. See the Activity Practice for additional problems for this lesson. You may assign the problems here or use them as a culmination for the activity.

LESSON 6-1 PRACTICE

25. The independent variable is \( t \), the number of minutes since the bath began, and the dependent variable is \( d \), the depth of the bathwater; since the depth of the water depends on how many minutes the water has been running.

26. Domain: [all real values of \( t \); \( 0 \leq t \leq 12 \)]; Range: [all real values of \( d \); \( 0 \leq d \leq 8 \)]

27. Continuous; The function includes all real values of \( t \) between 0 and 12, inclusive, and all real values of \( d \) between 0 and 8, inclusive.

28. (0, 0); the depth of the bathwater at time 0

29. Relative maximum: 8; no relative minimum

30. Absolute maximum: 8; greatest depth; absolute minimum: 0; least depth

ADAPT

Check students’ answers to the Lesson Practice to ensure that they understand the terminology used to describe features of the graph. Help students internalize the vocabulary by modeling the proper use of the terms throughout the unit.

LENS 6-1 PRACTICE

Model with mathematics. Use the graph below for Items 25–30.

25. What are the independent and dependent variables? Explain.

26. Use set notation to write the domain and range of the function.

27. Is the function discrete or continuous? Explain.

28. What is the y-intercept? Interpret the meaning of the y-intercept in this context.

29. Identify any relative maximums or minimums of the function.

30. Identify the absolute maximum and absolute minimum values. Interpret their meanings in this context.
Lesson 6-2
More Complex Graphs

Learning Targets:
- Relate the domain and range of a function to its graph and to its function rule.
- Identify and interpret key features of graphs.

SUGGESTED LEARNING STRATEGIES: Marking the Text, Levels of Questions, Think Aloud, Create Representations, Summarizing

Examine the graph of the function \( f(x) = \frac{1}{(x-2)^2} \), graphed below.

1. Describe how this graph is different from the graphs in Lesson 6-1.
   Answers will vary. Important characteristics for students to notice are that the graph consists of two distinct branches and that it continues beyond the portion shown, as indicated by the arrowheads on the curves.

Example A
Give the domain and range of the function \( f(x) = \frac{1}{(x-2)^2} \).

Then find the \( y \)-intercept, the absolute maximum, and the absolute minimum.

To find the domain and range:

Step 1: Study the graph.
   The sketch of this graph is a portion of the function represented by the equation \( f(x) = \frac{1}{(x-2)^2} \).

Step 2: Look for values for which the domain causes the function to be undefined. Look how the graph behaves near \( x = 2 \).

Solution: The domain and range of \( f(x) = \frac{1}{(x-2)^2} \) can be written:
   Domain: \( \{ \text{all real values of } x : x \neq 2 \} \)
   Range: \( \{ \text{all real values of } y : y > 0 \} \)

ACTIVITY 6 Continued

Lesson 6-2

PLAN
Pacing: 1 class period
Chunking the Lesson
#1, Example A  #2-3
#4
Check Your Understanding
Lesson Practice

TEACH

Bell-Ringer Activity
Ask students to draw the graph of a nonlinear relation that is a function and one that is not a function. Have them explain why each does or does not show a function.

1. Example A Think Aloud, Marking the Text, Questioning the Text Have students study the graph and describe its appearance. Ask them to speculate about what happens as each curve continues to infinity. Read through Example A. Have students talk through each step, asking questions on parts they do not understand. Call on other students to help explain the material to their classmates using their own words.

MATH TIP
Notice the result when \( x = 2 \) is substituted into \( f(x) \).
\[ f(2) = \frac{1}{(2-2)^2} = \frac{1}{0} \]
Division by zero is undefined in mathematics.
**ACTIVITY 6 Continued**

**Try These A Think-Pair-Share** In this set of questions, students are asked to identify the key features of the graph of an important type of function (without identifying it as such): a quadratic function. Before students answer the questions, ask students to discuss with their partners the similarities and differences between the graph of this function and the graph of the function in Example A. Identifying how this function differs from the previous function should help students identify this function's key features.

As students identify these features, some students may make use of the graph to identify key features of this function, while others may use the function rule. Encourage students to share their strategies, noting that they get the same results.

**Differentiating Instruction**

Support students who have difficulty remembering new terminology through regular references to the words in the text as well as words you and students place on the classroom Word Wall.

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To determine the y-intercept and identify any maximums or minimums:

Study the graph. We can see that the function intersects the y-axis at (0, 0.25). The value of \( f(x) \) keeps getting larger as \( x \) approaches 2 from both sides. The value of \( f(x) \) approaches, but never reaches, 0 as \( x \) gets further from 2 on both sides.

**Solution:** The y-intercept is (0, 0.25). The function does not have an absolute maximum or minimum.

**Try These A**

The function \( f(x) = 8 + 2x - x^2 \) is graphed below.

![Graph of the function](graph.png)

**a.** Identify the domain and range of the function.

**Domain:** All real numbers

**Range:** All real values of \( y : y \leq 9 \)

**b.** Identify the y-intercept.

(0, 0)

**c.** Identify any relative or absolute minimums of the function.

No minimums exist.

**d.** Identify any relative or absolute maximums of the function.

y-value only: 9
Lesson 6-2
More Complex Graphs

2. The equation \( y = 2x - 1 \) is graphed below.

\[ \text{Graph of } y = 2x - 1 \]

a. Identify the domain and range.
   Domain: \((\text{all real numbers})\)
   Range: \((\text{all real numbers})\)

b. What is the \( y \)-intercept of \( y = 2x - 1 \)?
   \((0, -1)\)

c. Identify any relative or absolute minimums of \( y = 2x - 1 \).
   No minimums exist.

d. Identify any relative or absolute maximums of \( y = 2x - 1 \).
   No maximums exist.

e. **Construct viable arguments.** Explain whether this equation represents a function and how you determined this.
   Answers may vary. Because the graph of this equation passes the vertical line test, this equation and its graph represent a function.

3. The function \( y = 2^x \) is graphed below.

\[ \text{Graph of } y = 2^x \]

a. Identify the domain and range.
   Domain: \((\text{all real numbers})\)
   Range: \((y > 0)\)

b. What is the \( y \)-intercept of the function \( y = 2^x \)?
   \((0, 1)\)

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**ACTIVITY 6 Continued**

**TEACHER TO TEACHER**

The purpose of Item 4 is for students to identify domain and range, not to graph functions. If your students do not have graphing calculators, display the graphs on an overhead or on the board and have students identify the domain and range.

**MATH TIP**

The domain is restricted to avoid situations where division by zero or taking the square root of a negative number would occur.

4. Create Representations, Discussion Groups All of the equations can be viewed in the standard window where \(-10 < x < 10\) and \(-10 < y < 10\). Depending on how much practice students have had using the graphing calculator, you may need to assist students in setting the window and in entering the equations into the calculators. Functions 7, 8, and 9 may need to be written out by keystrokes if students are not familiar with the calculator nomenclature.

After students have had the opportunity to complete the chart and to compare answers with another group, debrief the activity by asking students to share what they noticed about the results and the behavior of the graphs.

**Differentiating Instruction**

Extend this activity by having students graph other linear, quadratic and absolute value functions. Discuss how restrictions on the domain and range of the new graphs compare with the restrictions on the previous set of functions.

**ACTIVITY 6 continued**

Lessons 6.2
More Complex Graphs

c. Identify any relative or absolute minimums of \(y = 2^x\). No minimums exist.

d. Identify any relative or absolute maximums of \(y = 2^x\). No maximums exist.

4. If you have access to a graphing calculator, work with a partner to graph the equations listed in the table below. Each equation is a function.

<table>
<thead>
<tr>
<th>Function</th>
<th>Domain</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y = -3x + 4)</td>
<td>1</td>
<td>a</td>
</tr>
<tr>
<td>(y = x^2 - 6x + 5)</td>
<td>1</td>
<td>c</td>
</tr>
<tr>
<td>(y = 5x - x^2)</td>
<td>1</td>
<td>b</td>
</tr>
<tr>
<td>(y =</td>
<td>x + 1</td>
<td>)</td>
</tr>
<tr>
<td>(y = 3 + \sqrt{x})</td>
<td>5</td>
<td>f</td>
</tr>
<tr>
<td>(y = \frac{4}{x})</td>
<td>3</td>
<td>b</td>
</tr>
</tbody>
</table>

**Possible Domains**

1) all real numbers
2) all real \(x\), such that \(x = -2\)
3) all real \(x\), such that \(x = 0\)
4) all real \(x\), such that \(x = 2\)
5) all real \(x\), such that \(x \geq 0\)
6) all real \(x\), such that \(x \leq 0\)

**Possible Ranges**

a) all real numbers
b) all real \(y\), such that \(y = 0\)
c) all real \(y\), such that \(y \geq -4\)
d) all real \(y\), such that \(y \geq 0\)
e) all real \(y\), such that \(y \leq 20,25\)
f) all real \(y\), such that \(y \geq 3\)
Lesson 6-2
More Complex Graphs

Check Your Understanding

5. How can you determine from a function's graph whether the function
   has any maximum or minimum values?
6. How can you determine the domain of a function by examining its
   graph? By examining its function rule?
7. Give an example of a function that has a restricted domain. Justify
   your answer.

LESSON 6-2 PRACTICE

The function \( f(x) = 2x^2 - 3 \) is graphed below.

8. Give the domain, range, and \( y \)-intercept.
9. Identify any relative or absolute minimums.
10. Identify any relative or absolute maximums.
11. Attend to precision. Examine the graphs below. Explain why one
    function has an absolute minimum and an absolute maximum and the
    other function does not. Identify the absolute minimum and maximum
    values of the function for which they exist.

ACTIVITY 6 Continued

Check Your Understanding

Debrief students' answers to these items to see if they understand the key features
of functions and their graphs. Later on, students will use these features to solve
problems.

Answers

5. Determine whether the graph will ever reach a high or low point.
6. Graph: look at the values the graph includes over the \( x \)-axis. Function
   rule: look at which values of \( x \) are permissible to substitute.
7. \( f(x) = \frac{1}{x} \); The domain cannot
   include 0 because division by 0 is undefined.

ASSESS

Students' answers to Lesson Practice
problems will provide you with a
formative assessment of their
understanding of the lesson concepts
and their ability to apply their learning.
See the Activity Practice for additional
problems for this lesson. You may assign
the problems here or use them as a
culmination for the activity.

LESSON 6-2 PRACTICE

8. Domain: all real numbers; range:
   \( y \geq -3; y \)-intercept: \((0, -3)\)
9. \(-3\)
10. No maxima exist.
11. The graph on the left has absolute
    minimum value \(-8\) and absolute
    maximum value \(2\) because the
    graph does not extend beyond
    those points. The graph on the
    right does not have absolute
    maximum or absolute minimum
    values because the arrowheads
    indicate that the graph extends in
    both directions. It never reaches a
    highest or lowest point.

ADAPT

Check students' answers to the Lesson
Practice to ensure that they understand
the features of the graphs of functions
and are ready to solve problems using
functions. Continue to model the proper
pronunciation and use of the terms used
in this unit.
**ACTIVITY 6**

**Lesson 6-3**

**Graphs of Real-World Situations**

**Learning Targets:**
- Identify and interpret key features of graphs.
- Determine the reasonable domain and range for a real-world situation.

**SUGGESTED LEARNING STRATEGIES:** Visualization, Discussion Groups, Look for a Pattern

The function \( f(x) = 3 + 2x \) is graphed below.

1. What are the domain and range of the function?
   - **Domain:** \( \{ \text{all real numbers} \} \)
   - **Range:** \( \{ \text{all real numbers} \} \)

In many real-world situations, not all values make sense for the domain and/or range. For example, distance cannot be negative; number of people cannot be a decimal or a fraction. In such situations, the values that make sense for the domain and range are called the reasonable domain and range.

**Example A**

A taxi ride costs an initial rate of $3.00, which is charged as soon as you get in the cab, plus $2 for each mile traveled. The cost of traveling \( x \) miles is given by the function \( f(x) = 3 + 2x \). What are the reasonable domain and range?

**Step 1:** Sketch a graph of the function.

**MATH TIP**

Graph a function by substituting several values for \( x \) and generating ordered pairs. You can organize the ordered pairs in a table. There are infinitely many other solutions because the graph has infinitely many points.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = 3 + 2x )</th>
<th>((x, y))</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3</td>
<td>(0, 3)</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>(1, 5)</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>(2, 7)</td>
</tr>
</tbody>
</table>

**TEACH**

**Bell-Ringer Activity**

Have students work in small groups to brainstorm real-world situations in which only positive numbers can be used, situations in which both positive and negative numbers can be used, situations in which only whole numbers can be used, and situations in which fractions and decimals can be used.

1. Example A, 2. Shared Reading, Think Aloud, Visualization. Students should explain why both the domain and range in Item 1 are made up of all real numbers. Students should suggest real-world situations in which the set of all real numbers would be unreasonable for the domain and/or range. As you read through the example, help students picture the situation so that they understand why it would not be reasonable for \( x \) to be negative.
Lesson 6-3
Graphs of Real-World Situations

Step 2: Determine the reasonable domain. Think about what the variable $x$ represents. What values make sense?

The variable $x$ represents the number of miles, so it does not make sense for $x$ to be negative.

The reasonable domain is $\{x : x \geq 0\}$.

Step 3: Use the reasonable domain and the graph to determine the reasonable range.

From the graph, all $y$-values corresponding to the reasonable domain values are greater than or equal to 3. The reasonable range is $\{y : y \geq 3\}$.

Solution: The reasonable domain is $\{x : x \geq 0\}$. The reasonable range is $\{y : y \geq 3\}$.

Try These A

a. A banquet hall charges $15 per person plus a $100 setup fee. The cost for $x$ people is given by the function $f(x) = 100 + 15x$. What are the reasonable domain and range?

Domain: all whole numbers; range: all whole numbers $y : y \geq 100$

b. Eight Ball Billiards charges $5 to rent a table plus $10 per hour of game play, rounded to the nearest whole hour. The cost of playing billiards for $x$ hours is given by the function $f(x) = 5 + 10x$. What are the reasonable domain and range?

Domain: all whole numbers; range: $(5, 15, 25, 35, \ldots)$

2. Reason quantitatively. Are the domain and range of $f(x) = 3 + 2x$ that you found in Item 1 the same as the reasonable domain and range of $f(x) = 3 + 2x$ found in Example A? Explain.

No, when the function does not model a real-world situation, its domain and range are all real numbers. However, not all real numbers make sense for the domain and range for the real-world situation modeled in Example A. The reasonable domain and range are restricted to only those values that make sense.

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ACTIVITY 6 Continued

3 Look for a Pattern, Discussion Groups, Debriefing. Make sure that groups consider not only the individual value of each point but also the pattern made by the points (a straight line).

Have groups consider the type of function represented by this pattern (a linear function). This will help students come up with scenarios that could be represented by this graph.

Check Your Understanding

Debrief students’ answers to these questions to make sure they understand how the features of a function relate to the situation it represents. Students should use correct mathematical language when describing the features. Students will use functions to model and solve real-world problems throughout their study of mathematics and must be able to describe and interpret functions clearly and accurately.

Answers

4. Positive real numbers; The height cannot be zero or a negative number.
5. Whole numbers; The number of people cannot be a fraction, or a negative number.

ASSESS

Students’ answers to Lesson Practice problems will provide you with a formative assessment of their understanding of the lesson concepts and their ability to apply their learning. See the Activity Practice for additional problems for this lesson. You may assign the problems here or use them as a culmination for the activity.

LESSON 6-3 PRACTICE

6. Independent: number of minutes; dependent: total cost. The total cost depends on the number of minutes.
7. Domain: \(x \geq 0\) because number of minutes cannot be negative; Range: \(y \geq 0\) because the least possible \(y\)-value is the cost for 0 minutes, and that cost is $20.

ADAPT

Check students’ answers to the Lesson Practice to ensure they can interpret the features of a function that represents a real-world situation.

Lesson 6-3

Graphs of Real-World Situations

3. The graph below represents a real-world situation.

![Graph](attachment:image)

a. Identify the domain and range.

Domain: \(\{0, 1, 2, 3, 4\}\); Range: \(\{1, 3, 5, 7, 9\}\)

b. Describe a real-world situation that matches the graph. Your answers to Part (a) should be the reasonable domain and range for your situation.

Answers will vary. A bowling alley charges $1 to rent a pair of shoes and $2 per game for up to 4 games.

c. Identify the independent and dependent variables in your real-world situation.

Answers will vary. Independent: number of games played; Dependent: total amount charged

Check Your Understanding

4. For a function that models a real-world situation, the dependent variable \(y\) represents a person’s height. What is a reasonable range? Explain.

5. A tour company charges $25 to hire a tour director plus $75 per tour member. The total cost for a group of \(x\) people is given by \(f(x) = 25 + 75x\). What is the reasonable domain? Explain.

LESSON 6-3 PRACTICE

Talk the Talk Cellular charges a base rate of $20 per month for unlimited texts plus $0.15/minute of talk time. The monthly cost for \(x\) minutes is given by \(f(x) = 20 + 0.15x\).

6. Make sense of problems. What is the independent variable and what is the dependent variable? Explain how you know.

7. What are the reasonable domain and range? Explain.
**ACTIVITY 6 PRACTICE**

Write your answers on notebook paper.
Show your work.

**Lesson 6-1**

Use the graph below for Items 1–5.

1. Which point corresponds to the absolute maximum of the function?
   A. B
   B. D
   C. G
   D. H

2. Which represents the range of the function shown in the graph?
   A. \([0 \leq x \leq 10]\)
   B. \([1 \leq x \leq 10]\)
   C. \([0 \leq y \leq 10]\)
   D. \([1 \leq y \leq 10]\)

3. Which point does not correspond to a relative minimum?
   A. B
   B. C
   C. E
   D. I

4. Is the function represented by the graph discrete or continuous? Explain.

5. What is the \(y\)-intercept of the function shown in the graph?

6. a. Give the domain and range for the function graphed below. Explain why this graph represents a function.

   \[
   \begin{array}{c|c}
   x & y \\
   \hline
   0 & 2 \\
   1 & 3 \\
   2 & 5 \\
   3 & 4 \\
   4 & 3 \\
   5 & 2 \\
   \end{array}
   \]

   b. What is the \(y\)-intercept of the function shown in the graph?

   c. Identify any extrema of the function shown in the graph.

Jeff walks at an average rate of 125 yards per minute. Mark's house is located 2000 yards from Jeff's house. The graph below shows how far Jeff still needs to walk to reach Mark's house. Use the graph for Items 7–10.

7. Identify the independent and dependent variables.

8. Identify the absolute minimum and absolute maximum values. What do these values represent?

9. Identify any relative maximums or minimums.

10. What is the \(y\)-intercept? What does it represent?
ACTIVITY 6

11. \(\{x, x = 0\}\)
12. \(\{y, y = 0\}\)
13. There is no \(y\)-intercept.
14. (0, 1)
15. 1
16. \(-9\) and \(-3.8\)
17. the money raised
18. the amount that will be donated
19. \((x \geq 0)\); An amount of money raised cannot be negative.
20. \((y \geq 250)\); The least amount the organization will donate is $250 (if they raise no money from the event).
21. Answers may vary. An after-school job pays $5 per hour minus a one-time $3 fee for a storage locker.
22. The absolute maximum and absolute minimum values are the same, because the \(y\)-value of every point on the line is the same.

ADDITIONAL PRACTICE
If students need more practice on the concepts in this activity, see the eBook Teacher Resources for additional practice problems.

Lesson 6-2
Use the graph for Items 11–13.

11. What is the domain of the function shown in the graph?
12. What is the range of the function shown in the graph?
13. What is the \(y\)-intercept of the function shown in the graph?

Use the graph below for Items 14–16.

14. What is the \(y\)-intercept of the function shown in the graph?
15. Identify any relative maximums.
16. Identify any relative minimums.

Lesson 6-3
A fundraising organization will donate $250 plus half of the money it raises from a charity event. Use this information for Items 17–20.

17. What is the independent variable?
18. What is the dependent variable?
19. What is the reasonable domain? Explain.
20. What is the reasonable range? Explain.
21. Describe a real-world situation that matches the graph shown.

MATHEMATICAL PRACTICES
Look For and Make Use of Structure
22. The graph of a function is a horizontal line. What is true about the absolute maximum and absolute minimum values of this function? Explain.

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