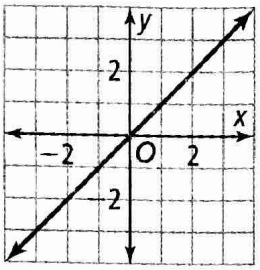
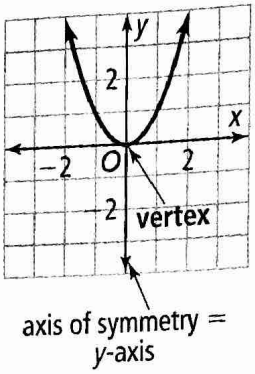
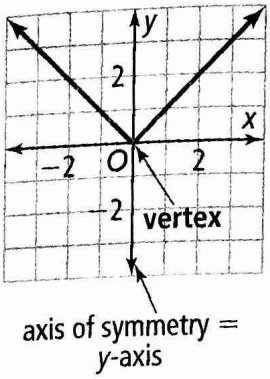
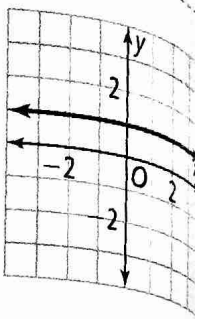
CONCEPT SUMMARY Some Functions With Key Features

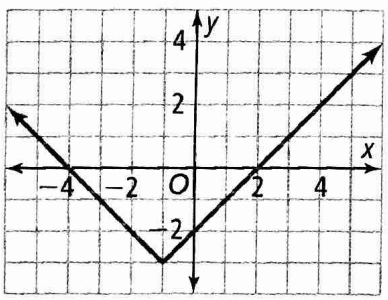
FUNCTION	Linear $y = x$	Quadratic $y = x^2$	Absolute Value $y = \lvert x \rvert$	Constant $y = 1$
GRAPH		 axis of symmetry = y-axis	 axis of symmetry = y-axis	
KEY FEATURES	Domain: $(-\infty, \infty)$ Range: $(-\infty, \infty)$ Increasing: $(-\infty, \infty)$	Domain: $(-\infty, \infty)$ Range: $[0, \infty)$ Increasing: $(0, \infty)$ Decreasing: $(-\infty, 0)$	Domain: $(-\infty, \infty)$ Range: $[0, \infty)$ Increasing: $(0, \infty)$ Decreasing: $(-\infty, 0)$	Domain: $(-\infty, \infty)$ Range: $\{y \mid y = 1\}$
INTERCEPTS	The x-intercept is 0. The y-intercept is 0.	The x-intercept is 0. The y-intercept is 0.	The x-intercept is 0. The y-intercept is 0.	There is no x-intercept. The y-intercept is 1.

Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** How do graphs and equations reveal information about a relationship between two quantities?

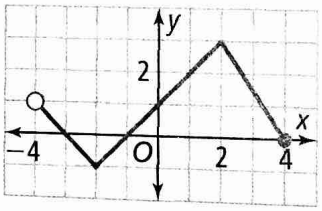
2. **Vocabulary** Define the term *zero of a function* in your own words.

3. **Error Analysis** Lonzell said the function shown in the graph is positive on the interval $(-1, 5)$ and negative on the interval $(-5, -1)$. Identify and correct Lonzell's error. **MP.3**



Do You KNOW HOW?

Find each key feature.



4. domain
5. range
6. x-intercept(s)
7. y-intercept(s)
8. interval(s) where the graph is positive
9. interval(s) where the graph is decreasing
10. interval(s) where the graph is increasing
11. rate of change on $[-1, 4]$

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PRACTICE & PROBLEM SOLVING

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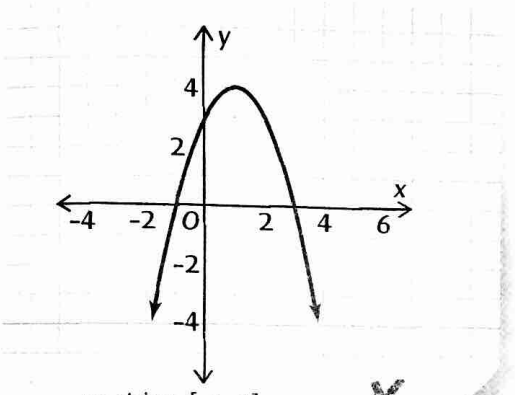
UNDERSTAND

12. **Reason** The graph of $y = -\frac{1}{2}x + 2$ is positive over the interval $(4, \infty)$ and negative over the interval $(-\infty, 4)$. What happens on the graph when $x = 4$? Explain. **MP.2**

13. **Error Analysis** Describe and correct the error a student made in finding the interval(s) over which the function is positive and negative. **MP.3**



positive: [-1, 3]
negative: $(-\infty, -1)$ and $(3, \infty)$

14. **Use Structure** Sketch a graph given the following key features. **MP.7**

domain: (−4, 4)	range: (−4, 6)
increasing: (−4, 1)	decreasing: (1, 4)
x-intercepts: (−2, 0), (3, 0)	y-intercept: (0, 4)
negative: (−4, −2) and (3, 4)	positive: (−2, 3)

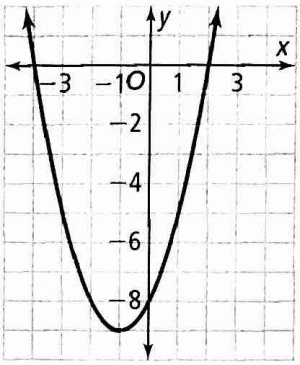
15. **Construct Arguments** A student says that all linear functions are either increasing or decreasing. Do you agree? Explain. **MP.3**

16. **Higher Order Thinking** A relative maximum of a function occurs at the highest point on a graph over a certain interval. A relative minimum of a function occurs at the lowest point on a graph over a certain interval. Explain how to identify a relative maximum and a relative minimum of a function using key features.

17. **Model With Mathematics** For a graph of speed in miles per hour as a function of time in hours, what does it mean when the function is increasing? Decreasing? **MP.4**

PRACTICE

Use the graph of the function for Exercises 18–22.



18. Identify the domain and range of the function. SEE EXAMPLE 1

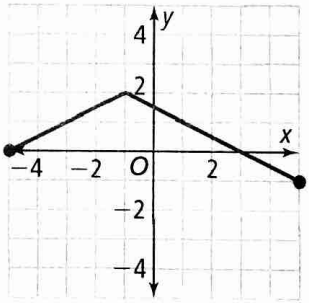
19. Identify the x- and y-intercepts of the function. SEE EXAMPLE 2

20. Determine over what interval the function is positive or negative. SEE EXAMPLE 3

21. Determine over what interval the function is increasing or decreasing. SEE EXAMPLE 4

22. What is the average rate of change over the interval (−3, 2)? SEE EXAMPLE 5

Use the graph of the function for Exercises 23–27.



23. Identify the domain and range of the function. SEE EXAMPLE 1

24. Identify the x- and y-intercepts of the function. SEE EXAMPLE 2

25. Determine over what interval the function is positive or negative. SEE EXAMPLE 3

26. Determine over what interval the function is increasing or decreasing. SEE EXAMPLE 4

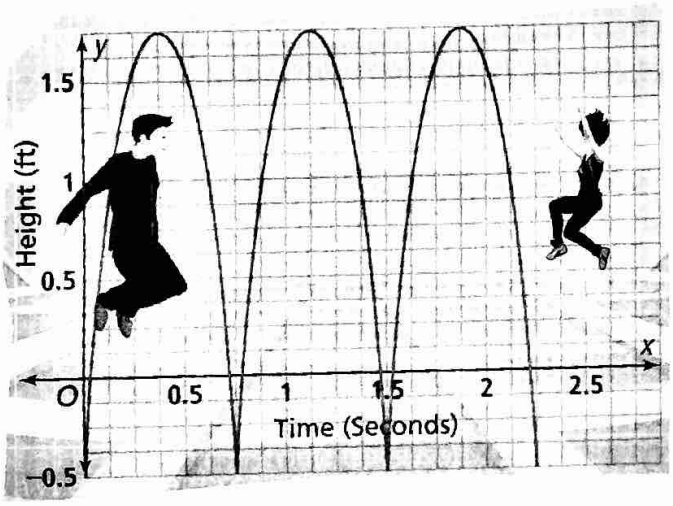
27. What is the average rate of change over the interval (−1, 5)? SEE EXAMPLE 5

PRACTICE & PROBLEM SOLVING

APPLY

28. Communicate Precisely Kathryn is filling an empty 100 ft^3 container with sand at a rate of 1.25 ft^3/min. Describe the key features of the graph of the amount of sand inside the container. MP.6

29. Make Sense and Persevere The graph shows a jumper's height, y, in feet x seconds after getting onto a trampoline. MP.1



a. What are the x- and y-intercepts? Explain what the x- and y-intercepts represent.

b. Over what intervals is the graph positive? Explain what the positive intervals represent.

c. Over what intervals is the graph negative? Explain what the negative intervals represent.

d. What is the average rate of change over the interval [0.75, 1.125]? Explain the meaning of the average rate of change.

30. Model With Mathematics Bailey starts playing a game on her cell phone with the battery fully charged, and plays until the phone battery dies. While playing the game, the charge in Bailey's battery decreases by half a percent per minute. MP.4

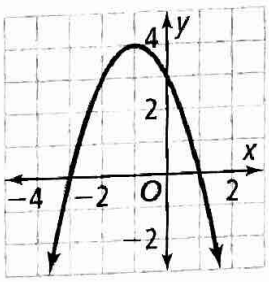
a. Write a function for the percent charge in the battery while Bailey is playing the game.

b. What is the domain and range of the function?

c. How long can Bailey play the game?

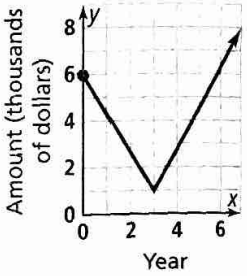
ASSESSMENT PRACTICE

31. Given the graph, select yes or no for each statement.



	Yes	No
a. The domain is $(-\infty, 4]$.	○	○
b. The range is $(-\infty, 4]$.	○	○
c. The graph is positive on the interval $(0, \infty)$.	○	○
d. The graph is decreasing on the interval $(-1, \infty)$.	○	○

32. SAT/ACT The graph shows the amount of money in an investment account. Which statement is true?



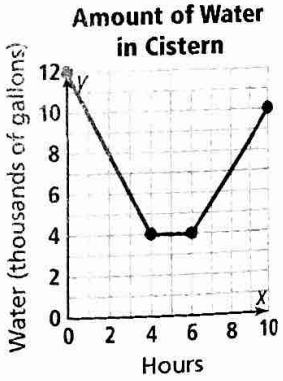
Ⓐ $6,000 was initially invested in the account.

Ⓑ $1,000 was initially invested in the account.

Ⓒ At Year 3, there was $0 in the account.

Ⓓ At Year 7, there was $0 in the account.

33. Performance Task The graph shows the amount of water in a water tank over several hours.



Part A What is the average rate of change on the interval [0, 4] and on the interval [6, 10]? What is a possible explanation for what each rate of change indicates?

Part B What is a possible explanation for what occurred between 4 and 6 h?

Part C What is the average rate of change on the interval [0, 10]? What does the rate of change mean? Does this rate of change give a good indication as to what is happening with the water in the cistern from 0 h to 10 h? Explain.