1. a. When an equation is in factored form, explain how you know whether it represents a quadratic relationship.

b. When an equation is in expanded form, explain how you know whether it represents a quadratic relationship.

c. Explain how you can tell whether a graph represents a quadratic relationship.

2. Without using your calculator to graph the equations, circle the two equations below that you are sure are quadratic and have a minimum point. Explain what you looked for in the equations.

$y = x^2 + 6x + 8$

$y = x(10 + 20)$

$y = (x + 2)(x + 4)$

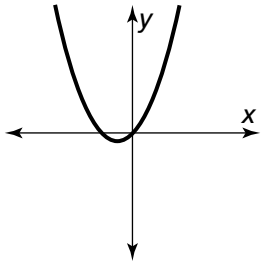
$y = -4 - x^2$

$y = x(10 - x)$

3. An equation, graph, and table are shown for three relationships.

Relationship 1

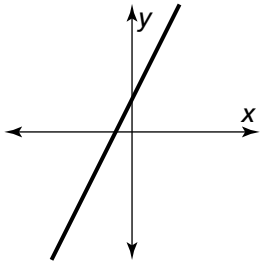
$y = x(x + 1)$



x	y
−2	2
−1	0
0	0
1	2
2	6
3	12

Relationship 2

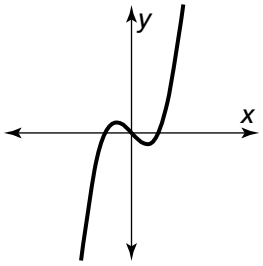
$y = 2x + 1$



x	y
−2	−3
−1	−1
0	1
1	3
2	5
3	7

Relationship 3

$y = x(x - 1)(x + 1)$



x	y
−2	−6
−1	0
0	0
1	0
2	6
3	24

a. Which relationship is linear?

i. Explain how you made this choice by examining the graph.

ii. Explain how you made this choice by examining the table.

iii. Explain how you made this choice by examining the equation.

b. Which relationship is quadratic?

i. Explain how you made this choice by examining the graph.

ii. Explain how you made this choice by examining the table.

iii. Explain how you made this choice by examining the equation.

c. Which relationship is neither linear nor quadratic?

i. Explain how you made this choice by examining the graph.

ii. Explain how you made this choice by examining the table.

iii. Explain how you made this choice by examining the equation.

4. Each expression below represents the area of a rectangle made by changing the dimensions of a square with sides of length x. Match the expression with the correct instructions.

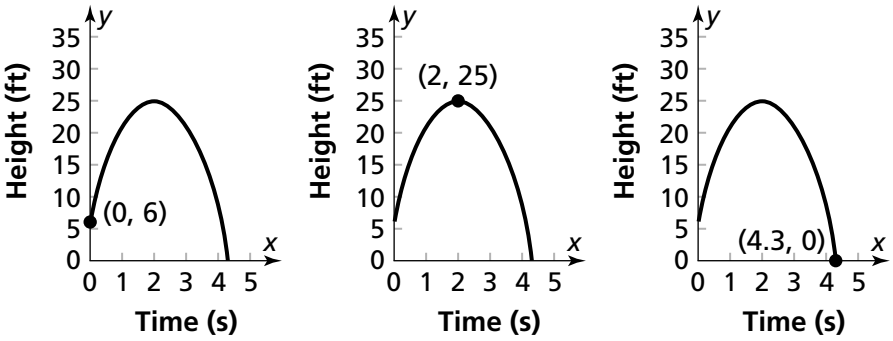
Area	**Instructions for changing a square into a rectangle.**
a. $(x - 3)(x + 3)$	**v.** Increase one dimension by 3, and increase the other by 5.
b. $x(x + 5)$	**w.** Increase one dimension by 3, and decrease the other by 3.
c. $(x + 3)(x + 5)$	**x.** Decrease one dimension by 5, and increase the other by 3.
d. $(x - 3)(x + 5)$	**y.** Increase one dimension by 5, and do not change the other.
e. $(x + 3)(x - 5)$	**z.** Increase one dimension by 5, and decrease the other by 3.

f. In parts (a)–(e), which of the instructions will *always* produce a rectangle with an area greater than that of the original square, x^2? Explain your answer.

g. In parts (a)–(e), which of the instructions will *sometimes* produce a rectangle with an area greater than that of the original square, x^2? Explain your answer.

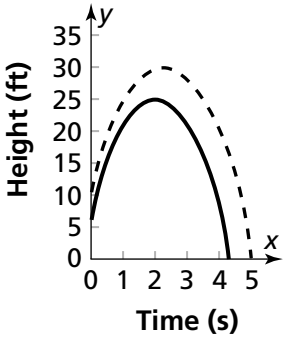
5. a. An emergency flare is fired from a boat. The graphs below represent how the flare's height changes over time. A point is marked on each graph. Explain what each point reveals about the position of the flare.

Height of a Flare



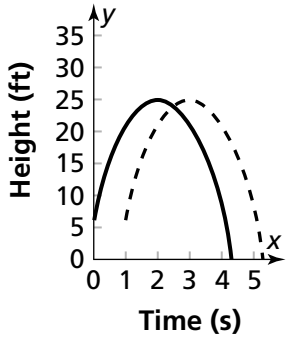
b. In the graph below, the solid line represents the flare from part (a). The dashed line represents a second flare. Explain the differences you see between the second flare's graph (the dashed line) and the original flare's graph (the solid line).

Heights of Two Flares



c. In the graph below, the solid line represents the flare from part (a). The dashed line represents a third flare. Explain the differences you see between the third flare's graph (the dashed line) and the original flare's graph (the solid line).

Heights of Two Flares



For Exercises 6–10, use the tables to answer parts (a) and (b).

a. Describe the pattern in the table, and use the pattern to predict the missing y values.

b. Tell whether the relationship between x and y is linear, exponential, quadratic or none of these. Explain how you know.

6.

x	−1	0	1	2	3	4	5
y	3	5	7	9	11		

7.

x	0	1	2	3	4	5	6
y	1	3	9	27	81		

8.

x	−1	0	1	2	3	4	5
y	−10	0	8	14	18		

9.

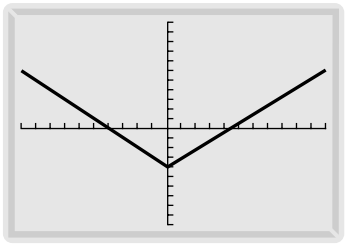
x	2	3	4	5	6	7	8
y	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{6}$		

10.

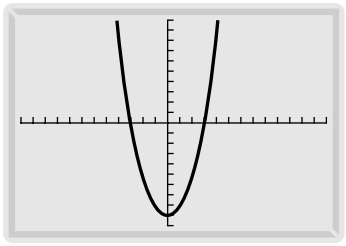
x	−1	0	1	2	3	4	5
y	−5	0	3	4	3		

11. a. Which of the following (i, ii, iii, iv) could be graphs of quadratic relations? The scale on each axis is 1. Explain the reasoning used to reach a conclusion in each case.

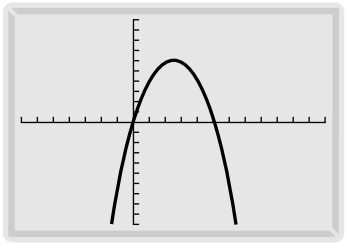
i.



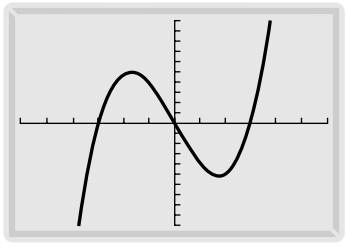
ii.



iii.



iv.

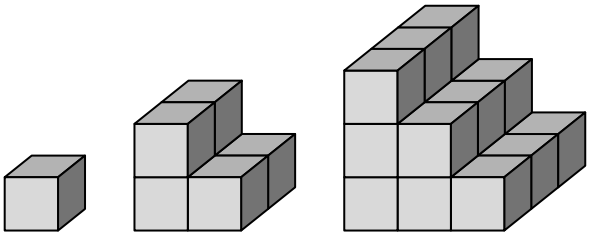


b. Suppose the graphs that you identified in part (a) actually represent quadratic relations (so they continue in either direction in a quadratic pattern). Explain what you could tell about the expanded form equation for that relation—the values of a, b, and c in $y = ax^2 + bx + c$.

12. If a large cube is built from identical small cubes, with n cubes on each edge, and then painted on all faces:

- **a.** How many small cubes will be used?
- **b.** What is the value of n if a total of 125 small cubes are used?
- **c.** What is the value of n if there are 343 small cubes with no paint on them?
- **d.** What is the value of n if there are 120 small cubes with 2 faces painted?
- **e.** What is the value of n if there are 486 small cubes with 1 face painted?

13. Unit cubes are stacked in the pattern shown at the right.



- **a.** If the pattern continues, how many cubes will be in the 4th building? In the 5th building?
- **b.** Find an equation that describes the relationship between the number of the building and the number of cubes needed to build the building.
- **c.** Is this a quadratic relation? Explain how you got your answer.

14. A square has sides of length x centimeters. A new rectangle is made by increasing one dimension by 5 centimeters and decreasing the other dimension by 4 centimeters.

- **a.** Write an expression for the area of the original square and an expression for the area of the new rectangle.
- **b.** For what x-values is the area of the new rectangle greater than the area of the square? For what x-values is the area of the new rectangle less than the area of the square? For what x-values are the areas equal? Explain how you found your answers.

15. A square has sides of length x centimeters. A new rectangle is made by increasing one dimension by 2 centimeters and decreasing the other dimension by 3 centimeters.

- **a.** Write two expressions, one in factored form and one in expanded form, for the area of the new rectangle.
- **b.** Write an equation for the area A of the rectangle. Graph the equation, and describe the graph.

16. A square has sides of length x centimeters. A new rectangle is made by increasing one dimension by 2 centimeters and doubling the other dimension and then adding 2 centimeters.

a. Make a sketch to show how the original square is transformed into the new rectangle.

b. Write two expressions, one in factored form and one in expanded form, for the area of the new rectangle.

c. Write an equation for the area A of the rectangle. Graph the equation, and describe the graph.

The equation represents the area of a rectangle made by changing the dimensions of a square with sides of length x centimeters. Answer parts (a) and (b).

a. Write an expression for the area in factored form.

b. Sketch a graph of the equation, and describe the shape of the graph.

17. $A = x^2 + 8x + 16$

18. $A = x^2 + 10x + 16$

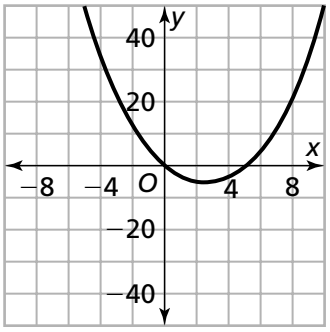
19. $A = x^2 - 6x$

20. $A = x^2 - 9$

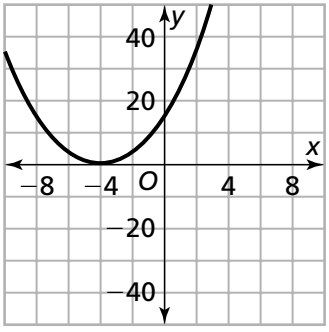
21. a. Match each equation (A, B, C) below with the correct graph (i, ii, iii).

A. $y = x^2 - 2x - 8$ **B.** $y = x^2 - 5x$ **C.** $y = x^2 + 8x + 16$

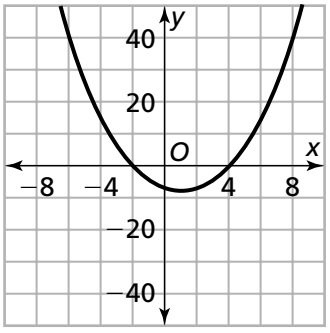
i.



ii.



iii.



b. Write each equation in factored form. Describe how you found the factored form.