

Quadratic Transformations

Learning Goals/Objectives: Students will explore and understand the effects of the parameters a , h , k on the quadratic function algebraically and graphically. Students will understand and articulate the domain and the range of quadratic functions.

Standard: F.BF.3

Materials:

- Graphing Calculators
- Colored pencils
- Student Exploration Activity Sheets (attached)

Procedure: This activity is best done by students working in small teams of 2-3 people each.

Develop

1. Group work: Graphing exploration activity.
2. Class discussion:
 - a. Vocabulary:
 - i. parabola
 - ii. vertex
 - iii. translation
 - iv. reflections
 - v. stretch/compressions
 - vi. parent function
 - b. Points to develop:
 - i. Students' hypotheses
 - ii. Examples
 - iii. Domain and Range

Solidify

1. Group work: Practice sheets A and B; Use more examples or fewer depending on class need.
2. Class discussion:
 - a. Discuss graphs and equations; Particularly 2A
3. Group work: Application problems.
4. Class discussion: have groups present solutions.

Practice

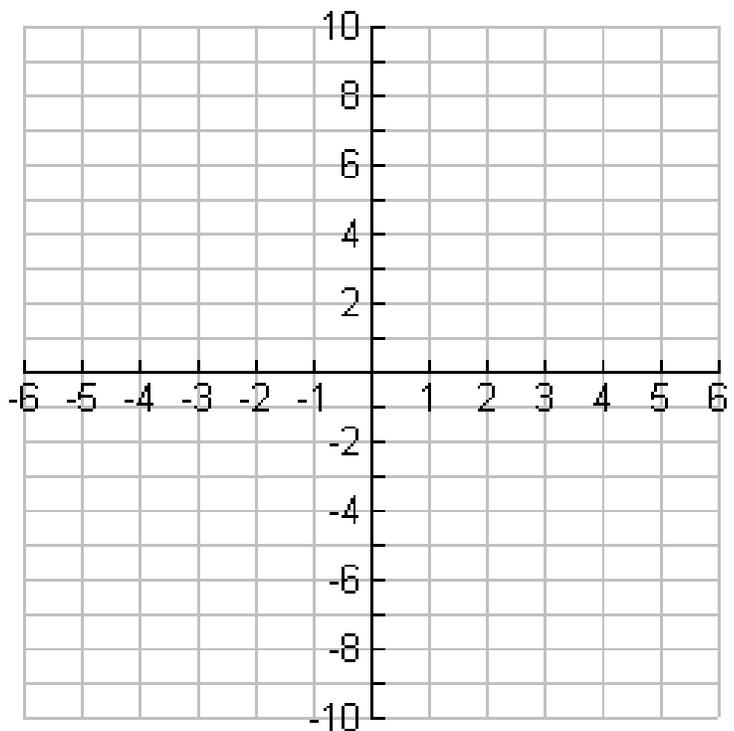
- 1.

Graphing Quadratic Functions Exploration

- Using a graphing calculator, graph the function $f(x) = x^2$; sketch the graph on the grid using 5 exact points.
 - What is the domain?
 - What is the range?
- Graph (in a different color) $f(x) = x^2 + 2$ on the same graph using 5 exact points. Describe the difference between this graph and the graph of $f(x) = x^2$.
 - What is the domain?
 - What is the range?
- Graph (in a different color) $f(x) = x^2 - 3$ on the same graph using 5 exact points. Describe the difference between this graph and the graph of $f(x) = x^2$.
 - What is the domain?
 - What is the range?

- Describe the effect of k on the equation $f(x) = x^2 + k$

- Create and graph your own function and determine if your hypothesis (answer from #4) is correct.



6. Graph (in a different color) $f(x)=(x+2)^2$ on the provided graph using 5 exact points. Describe the difference between this graph and the graph of $f(x)=x^2$.

a. What is the domain?

b. What is the range?

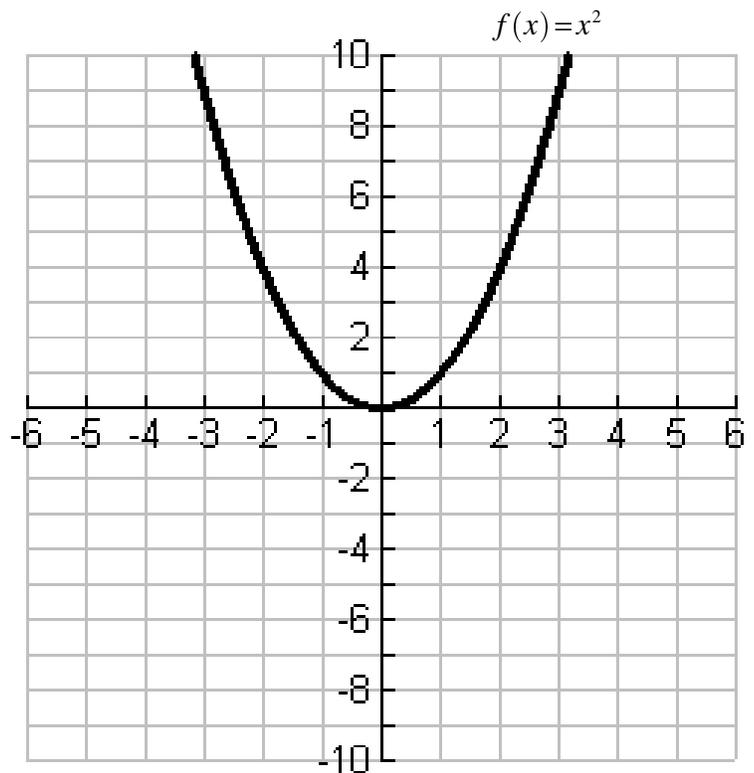
7. Graph (in a different color) $f(x)=(x-3)^2$ on the same graph using 5 exact points. Describe the difference between this graph and the graph of $f(x)=x^2$.

a. What is the domain?

b. What is the range?

8. Describe the effect of h on the equation $f(x)=(x-h)^2$

9. Create and graph your own function and determine if your hypothesis (answer from #8) is correct.



10. Graph (in a different color) $f(x) = 2x^2$ on the provided graph using 5 exact points. Describe the difference between this graph and the graph of $f(x) = x^2$.

- a. What is the domain?
- b. What is the range?

11. Graph (in a different color) $f(x) = \frac{1}{2}x^2$ on the same graph using 5 exact points. Describe the difference between this graph and the graph of $f(x) = x^2$.

- a. What is the domain?
- b. What is the range?

12. Graph (in a different color) $f(x) = -x^2$ on the provided graph using 5 exact points. Describe the difference between this graph and the graph of $f(x) = x^2$.

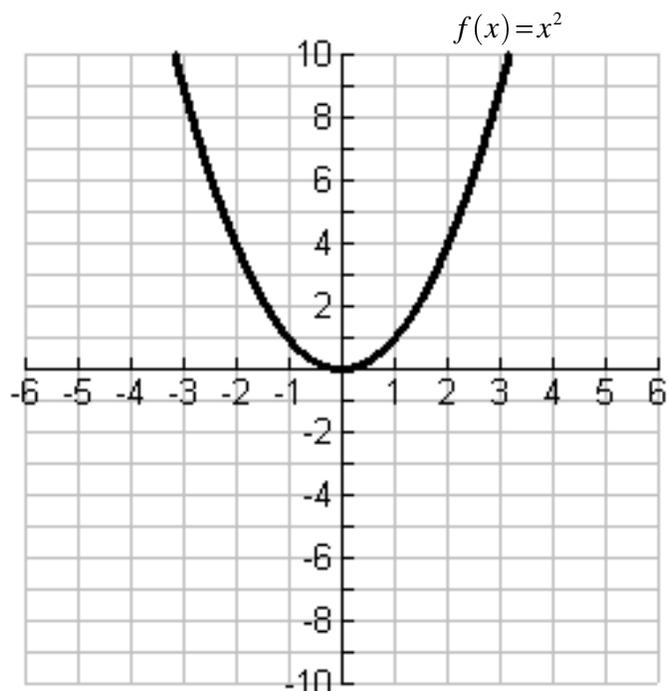
- a. What is the domain?
- b. What is the range?

13. Graph (in a different color) $f(x) = -3x^2$ on the same graph using 5 exact points. Describe the difference between this graph and the graph of $f(x) = x^2$.

- a. What is the domain?
- b. What is the range?

14. Describe the effect of a on the equation $f(x) = ax^2$

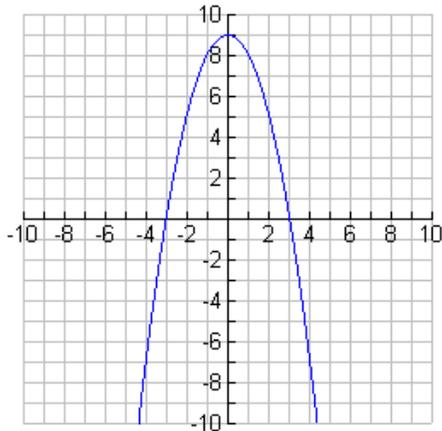
15. Create and graph your own function and determine if your hypothesis (answer from #14) is correct.



Practice A – Graphing Quadratic Functions

Write the equation of the parabolas graphed below. Use your calculator to check your answer. Verify at least 3 points.

1.



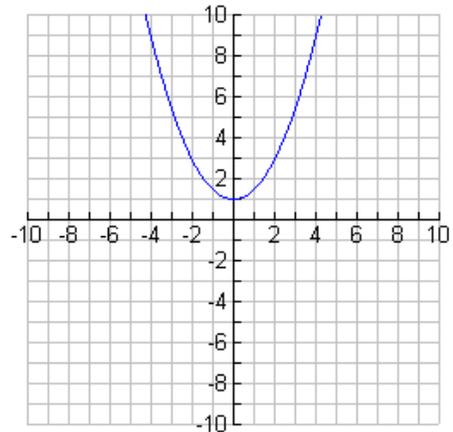
Equation: _____

Vertex: _____

Domain: _____

Range: _____

2.



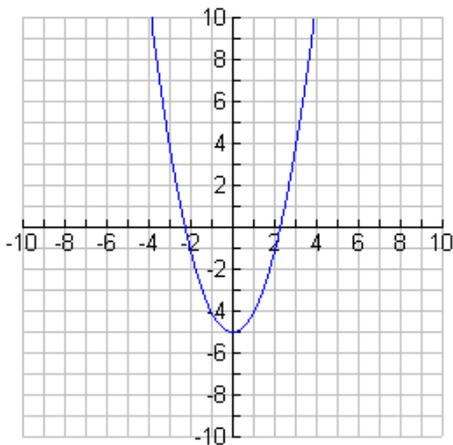
Equation: _____

Vertex: _____

Domain: _____

Range: _____

3.



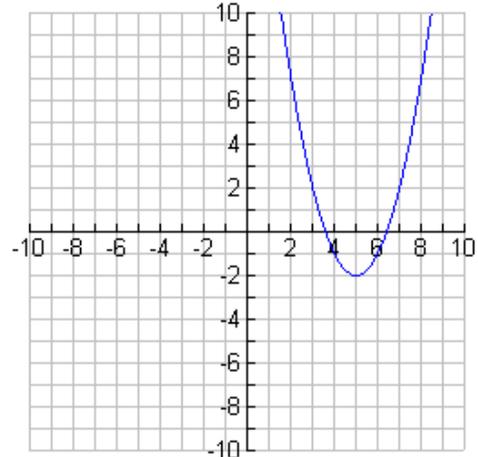
Equation: _____

Vertex: _____

Domain: _____

Range: _____

4.



Equation: _____

Vertex: _____

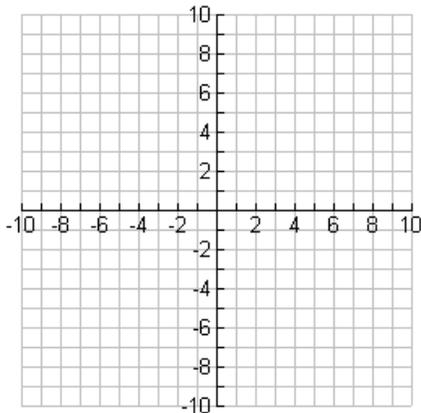
Domain: _____

Range: _____

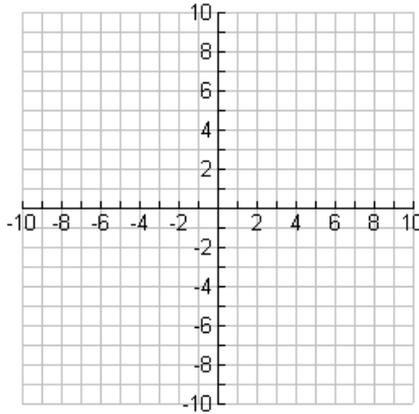
Practice B – Graphing Quadratic Functions

In the following functions, the transformations have been combined on the quadratic function that you just discovered. Graph the following functions with at least 3 precise points.

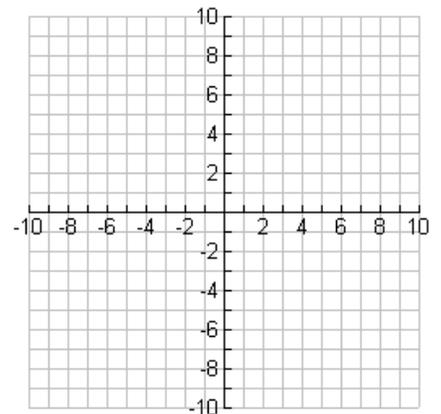
1. $f(x) = (x + 2)^2 - 3$



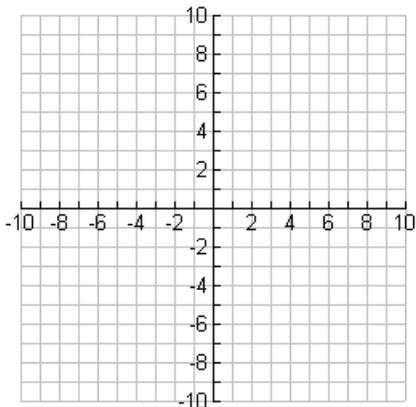
2. $f(x) = -(x - 1)^2 + 4$



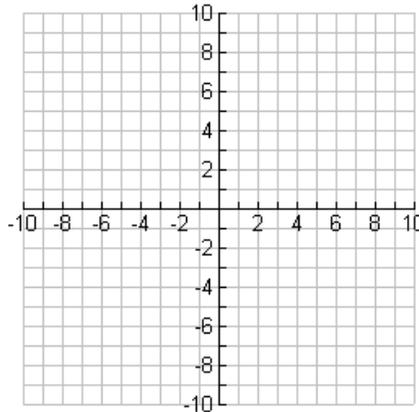
3. $f(x) = 2(x - 2)^2 - 1$



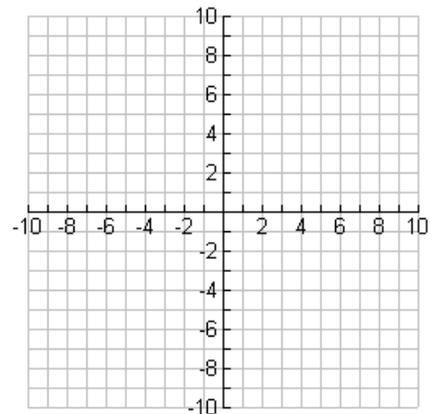
4. $f(x) = -\frac{1}{2}(x + 2)^2$



5. $f(x) = 3x^2 - 5$

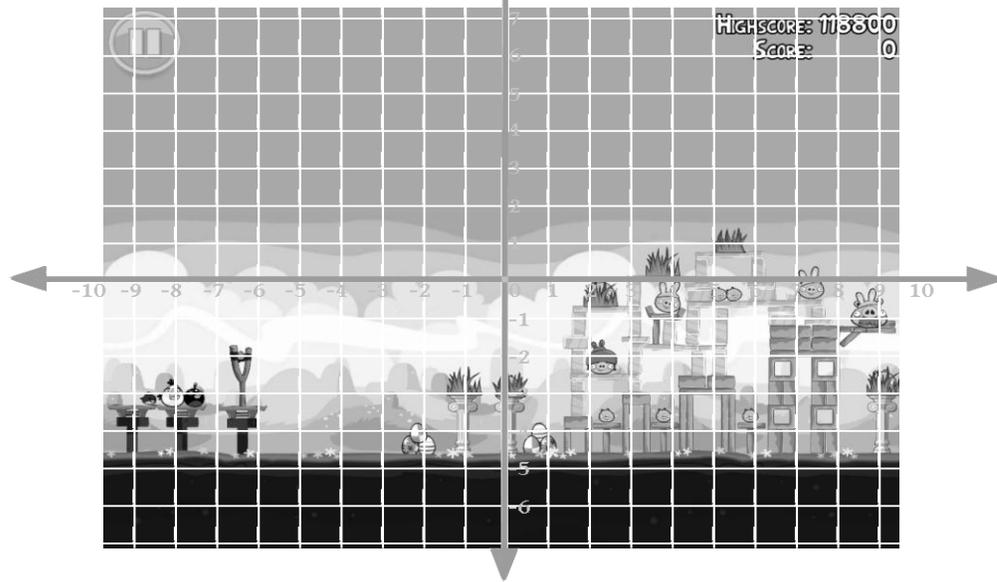


6. $f(x) = -(x + 3)^2 + 4$



Graphing Quadratic Functions – Applications

1.



A. Draw a path for the bird that would hit the target (Pigs). Write an equation for the path.

B. Describe a reasonable domain and range for your function.

C. Compare the domain and range for this function to the domain and range of $f(x) = x^2$.

2. Although the playing surface of a football or soccer field appears to be flat, its surface is actually shaped like a parabola so that rain runs off to either side. The cross section of a field with synthetic turf can be modeled by $f(x) = -0.000234(x - 80)^2 + 1.5$ where x and y are measured in feet.

A. Find the width of the field.

B. What is the maximum height of the field?

C. Explain how the width and height relate to domain and range.

3. The average gas mileage m in miles per gallon for a compact car is modeled by $m(s) = -0.015(s - 47)^2 + 33$, where s is the car's speed in miles per hour. The average gas mileage for an SUV is modeled by $m_s(s) = -0.015(s - 47)^2 + 15$. What kind of transformation describes this change and what does this transformation mean?