Activity

8-2 Quadratic Functions in Vertex Form

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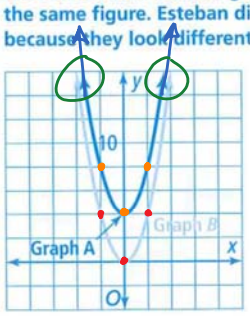
CRITIQUE & EXPLAIN

Allie states that the two graphs shown may look different, but they are actually the same figure. Esteban disagrees, stating that they are different figures because they look different.



A. Give one mathematical argument to support Esteban's thinking.

- shrinking vertically

B. Give one mathematical argument to support Allie's thinking.

- $(-2,4), (0,0), (2,4)$
  $(-2,8), (0,4), (2,8)$
  $+4$ shifts up

C. **Reason** Who do you agree with? What argument can you give to justify your reasoning? MP.2

→ Allie

- shifts up 4

HABITS OF MIND

Look for Reltionships Think about graph A and graph B and the graphs of quadratic functions. Use what you know about graphs and think of a single change that would make the graphs different. MP.7

② quadratics

$a(x-h)^2+k$ ← shift up/down; ② quadratics

vert stretch/shrink/refl: $a>1$, $0<a<1$, $a<0$

shift left/right

Notes

Assess

EXAMPLE 1 **Try It! Understand the Graph of $g(x) = x^2 + k$**

1. How does the graph of each function compare to the graph of $f(x) = x^2$?

a. $h(x) = x^2 + 3$ — k: 3, shift up; V(0, 3)

b. $j(x) = x^2 - 2$ — k: −2, shift down; V(0, −2)

EXAMPLE 2 **Try It! Understand the Graph of $g(x) = (x - h)^2$**

2. How does the graph of each function compare to the graph of $f(x) = x^2$?

a. $h(x) = (x + 1)^2$ — $(x - (-1))^2$; h: −1, shift left; V(−1, 0)

b. $j(x) = (x - 5)^2$ — h: 5, shift right

HABITS OF MIND

Make Sense and Persevere What are the values of h and k for a quadratic function with vertex (1, 2)? MP.8

EXAMPLE 3 **Try It! Understand the Graph of $f(x) = a(x - h)^2 + k$**

3. How does the graph of $f(x) = -3(x - 5)^2 + 2$ compare to the graph of the parent function?

vert refl & stretch; h: 5 right; k: 2 up

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$f(x) = a(x-h)^2+k$

Notes

V: (h, k)

aos: x = h

Assess

EXAMPLE 4 **Try It! Graph Using Vertex Form**

4. Find the vertex and axis of symmetry, and sketch the graph of the function.

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

h: 2 right

k: 1 up

a: -3 vert stretch & refl.

V(2, 1)

aos: x = 2

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

a: 1

h: -1 left

k: -4 down

V(-1, -4)

aos: x = -1

HABITS OF MIND

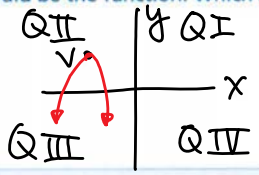
Construct Arguments The vertex of a parabola is in the second quadrant, and the parabola intersects the x-axis. A student says that $f(x) = -3(x+1)^2-5$ could be a function for the parabola. Another student says that $f(x) = 3(x+1)^2+5$ could be the function. Which student is correct? Explain. MP.3

QIII

V: (-1, -5)

V: (-1, 5)

QII



2nd Student

EXAMPLE 5 **Try It! Use Vertex Form to Solve Problems**

5. If Deshawn does not block Chris's shot, will it be a goal? Explain.

Parabolic

HABITS OF MIND

Reasoning Can you always write a function in vertex form for a parabola given the coordinates of the vertex and the coordinates of another point on the parabola? Explain. MP.2

Do You UNDERSTAND?

1. ESSENTIAL QUESTION How can the vertex form of a quadratic function help you sketch the graph of the function?

2. **Reason** A table of values for the quadratic function is shown. Do the graphs of the functions g and $f(x) = 3(x - 1)^2 + 2$ have the same axis of symmetry? Explain. MP.2

x	$g(x)$
−4	8
−2	3
0	0
6	3

3. **Use Structure** How are the form and the graph of $f(x) = (x - h)^2 + k$ similar to the form and graph of $f(x) = |x - h| + k$? How are they different? MP.7

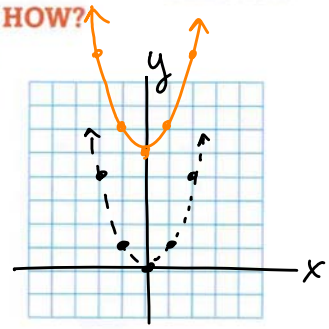
4. **Error Analysis** Sarah said the vertex of the function $f(x) = (x + 2)^2 + 6$ is (2, 6). Is she correct? Explain your answer. MP.3

Do You KNOW HOW?

Graph each function.

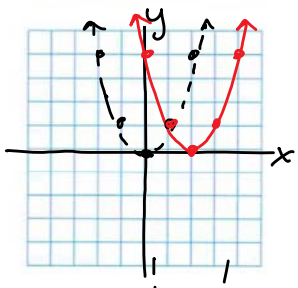
5. $g(x) = x^2 + 5$

k: 5 up



6. $f(x) = (x - 2)^2$

h: 2 right

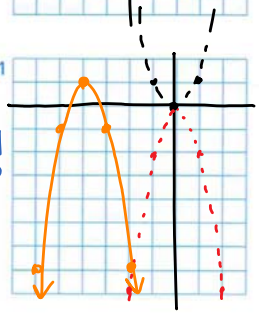


7. $h(x) = -2(x + 4)^2 + 1$

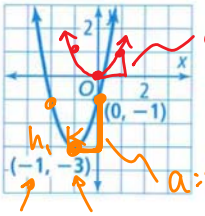
a: -2 vert refl { stretch

h: −4 left

k: 1 up



8. Write a function in vertex form for the parabola shown below.



h, k

a: 1

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

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

a: 2

9. The height of a ball thrown into the air is a quadratic function of time. The ball is thrown from a height of 6 ft above the ground. After 1 second, the ball reaches its maximum height of 22 ft above the ground. Write the equation of the function in vertex form.