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

Essential Question:

How can you describe the graph of $f(x) = a(x - h)^2$?

What You Will Learn:

- Identify even and odd functions.
- Graph quadratic functions of the form $f(x) = a(x - h)^2$.
- Graph quadratic functions of the form $f(x) = a(x - h)^2 + k$.
- Model real-life problems using $f(x) = a(x - h)^2 + k$.

Core Vocabulary:

even function
odd function
vertex form (of a quadratic function
reflection

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8.4 WS A KEY to correct

(h,k) x=h

6–8: Find the vertex and the axis of symmetry of the graph of the function.

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

$a=4$
$h=-2$
$\boxed{(-2,0) \quad x=-2}$

7. $f(x) = \frac{1}{3}(x-3)^2$

$a=\frac{1}{3}$
$h=3$
$\boxed{(3,0) \quad x=3}$

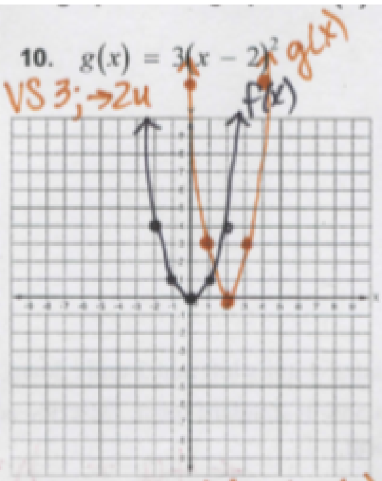
8. $y = -5(x+7)^2$

$a=-5$
$h=-7$
$\boxed{(-7,0) \quad x=-7}$

8.4 Graph y a(x-h)2 + k DAY TWO with work

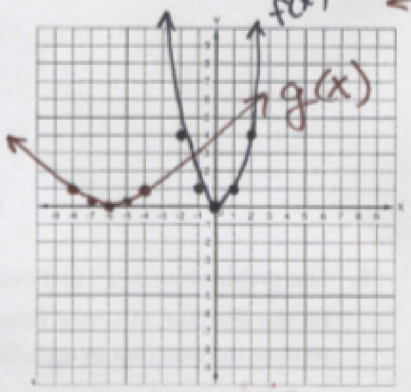
10. $g(x) = 3(x-2)^2$

VS 3; →2u



11. $g(x) = \frac{1}{4}(x+6)^2$

VC $\frac{1}{4}$
←6u



	x	$3(x-2)^2$	g(x)
	0	$3(0-2)^2$	12
	1	$3(1-2)^2$	3
h	2	$3(2-2)^2$	0
	3		3
	4		12

	x	$\frac{1}{4}(x+6)^2$	g(x)
	−4	$\frac{1}{4}(-4+6)^2$	1
	−5	$\frac{1}{4}(-5+6)^2$	$\frac{1}{4}$
h	−6	$\frac{1}{4}(-6+6)^2$	0
	−7		$\frac{1}{4}$
	−8		1

12. $y = -5(x+3)^2 - 2$

a = −5
h = −3
k = −2

$\boxed{\begin{array}{c}(-3,-2)\\ x=-3\end{array}}$

13. $f(x) = 2(x-2)^2 + 5$

a = 2
h = 2
k = 5

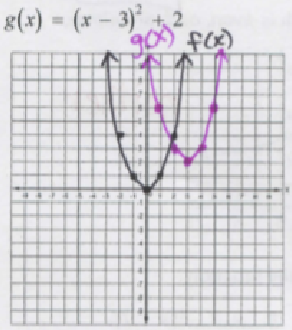
$\boxed{\begin{array}{c}(2,5)\\ x=2\end{array}}$

15 – 16: Graph the function. Compare the graph to the graph of $f(x) = x^2$.

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

a = 1
h = 3
k = 2

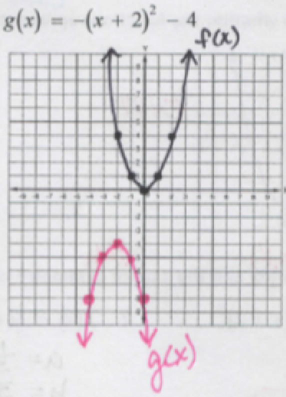
(3, 2)
x = 3
→3u
↑2u



16. $g(x) = -(x+2)^2 - 4$

a = −1
h = −2
k = −4

(−2, −4)
x = −2
←2u
↓4u



19. The graph of $y = x^2$ is translated 4 units left and 3 units down. Write an equation for the function in vertex form and in standard form. Describe advantages of writing the function in each form.

$y = (x-(-4))^2 - 3$

$\leftarrow 4u = h = -4$

$\downarrow 3u = k = -3$

$\boxed{y = (x+4)^2 - 3}$

It is easy to find the vertex & AofS in vertex form.
The y-int. is easy to find in standard form.

$y = x^2 + 8x + 13$

Core Concept

Even and Odd Functions

A function $y = f(x)$ is **even** when $f(-x) = f(x)$ for each x in the domain of f. The graph of an even function is symmetric about the y-axis.

A function $y = f(x)$ is **odd** when $f(-x) = -f(x)$ for each x in the domain of f. The graph of an odd function is symmetric about the origin. A graph is *symmetric about the origin* when it looks the same after reflections in the x-axis and then in the y-axis.

$f(x) \Rightarrow f(-x) \Rightarrow f(x) = \text{even}$

$f(x) \Rightarrow f(-x) \Rightarrow -f(x) = \text{odd}$

Core Concept

Even and Odd Functions

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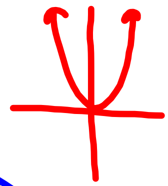
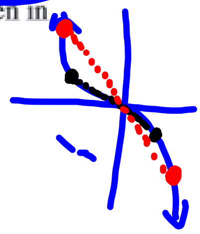
A function $y = f(x)$ is **odd** when $f(-x) = -f(x)$ for each x in the domain of f. The graph of an odd function is symmetric about the origin. A graph *is symmetric about the origin* when it looks the same after reflections in the x-axis and then in the y-axis. (180° rotation)





even → $f(-x) = f(x)$

odd → $f(-x) =$ opp. of $f(x)$

$f(2)$

$f(17)$

$f(-x)$

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Example: Identifying Even & Odd Functions

STUDY TIP

Most functions are neither even nor odd.

Determine whether each function is even, odd, or neither.

a) $f(x) = 2x$

$f(-x) = 2(-x)$

$= -2x$

ODD

opp.

b) $g(x) = x^2 - 2$

$g(-x) = (-x)^2 - 2$

$= x^2 - 2$

even

same

c) $h(x) = 2x^2 + x - 2$

$h(-x) = 2(-x)^2 + (-x) - 2$

$= 2x^2 - x - 2$

neither

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SOLUTION

a. $f(x) = 2x$ — Write the original function.

$f(-x) = 2(-x)$ — Substitute $-x$ for x.

$= -2x$ — Simplify.

$= -f(x)$ — Substitute $f(x)$ for $2x$.

▶ Because $f(-x) = -f(x)$, the function is odd.

b. $g(x) = x^2 - 2$ — Write the original function.

$g(-x) = (-x)^2 - 2$ — Substitute $-x$ for x.

$= x^2 - 2$ — Simplify.

$= g(x)$ — Substitute $g(x)$ for $x^2 - 2$.

▶ Because $g(-x) = g(x)$, the function is even.

c. $h(x) = 2x^2 + x - 2$ — Write the original function.

$h(-x) = 2(-x)^2 + (-x) - 2$ — Substitute $-x$ for x.

$= 2x^2 - x - 2$ — Simplify.

▶ Because $h(x) = 2x^2 + x - 2$ and $-h(x) = -2x^2 - x + 2$, you can conclude that $h(-x) \neq h(x)$ and $h(-x) \neq -h(x)$. So, the function is neither even nor odd.

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YOUR TURN:

Describe whether the function is odd, even or neither.

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

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8.4 Graph y a(x-h)2 + k DAY TWO with work

Describe whether the function is odd, even or neither.

1. $f(x) = \boxed{3x}$

$f(-x) = 3(-x)$

$= -3x$

$f(-x)$ opp. of $f(x)$

odd

2. $g(x) = \boxed{2x^2 - 6}$

$g(-x) = 2(-x)^2 - 6$

$= 2x^2 - 6$

$g(-x) = g(x)$

same

even

$(-x)(-x)$

3. $\boxed{3x^2 - 2x + 4}$

$3(-x)^2 - 2(-x) + 4$

$3x^2 + 2x + 4$

neither

$(-x)^2 \to (-x)(-x)$

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

Assign:

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A: 4, 12, 14, 18, 22, 26, 30, 34, 38, 42, 48, 54, 56, 62, 64, 72, 76, 80, 82

B: 4, 10 - 14(e), 18 - 22(e), 26 - 38(e), 42 - 58(e), 62, 64, 80, 82

C: 1, 3, 8, 14, 16, 22, 24, 30, 32, 38, 42, 46, 48, 52, 54, 56, 58

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