

TOPIC: QUADRATIC EQUATIONS AND FUNCTIONS

Intro to Graphing Quadratic Equations

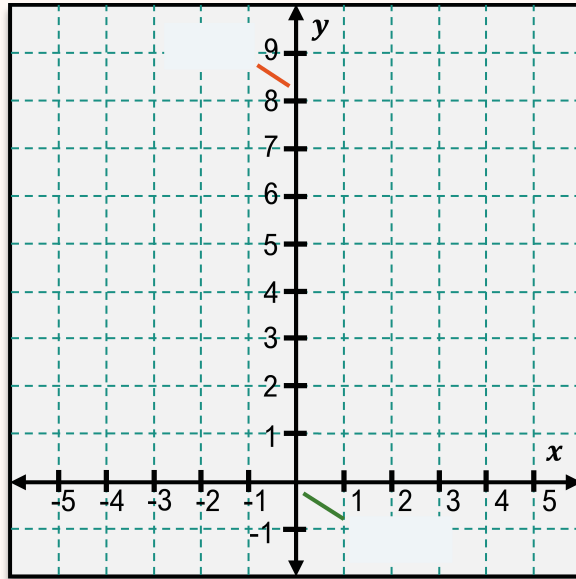
◆ A Quadratic Equation in two variables is written as $y = ax^2 + bx + c$ where $a \neq 0$.

New

New

Graphing Quadratics

$y = ax^2$	
x	$y = x^2$
-3	
-2	
-1	
0	
1	
2	
3	

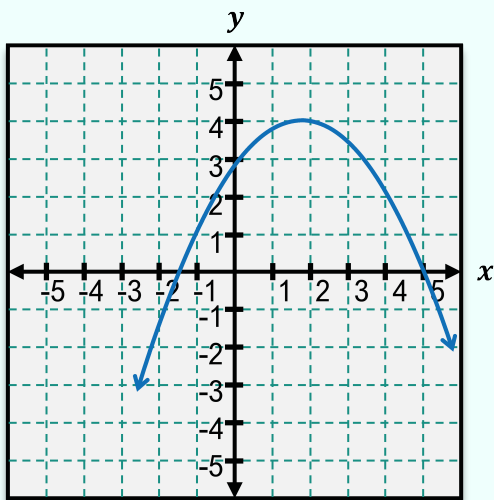


- Graph **shape** is a _____.
- When a is [**POSITIVE** | **NEGATIVE**] the graph opens [**UP** | **DOWN**].
- **High/low point** is the _____.
- The **axis of symmetry** always passes through the _____.

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EXAMPLE

Find the approximate axis of symmetry, vertex, and x -intercepts for the following graph.



PRACTICE

Determine if the parabola opens up or down.

(A) $y = -2x^2 - 6x - 7$

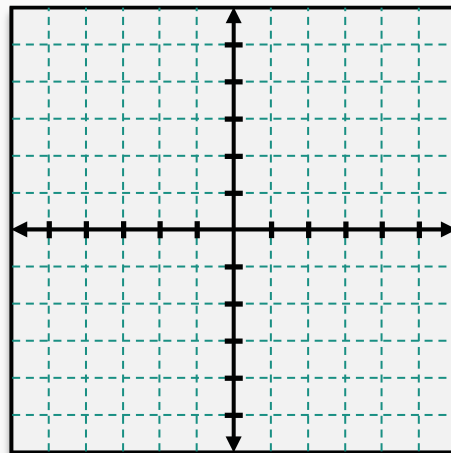
(B) $y = \frac{1}{2}x^2 - 5x$

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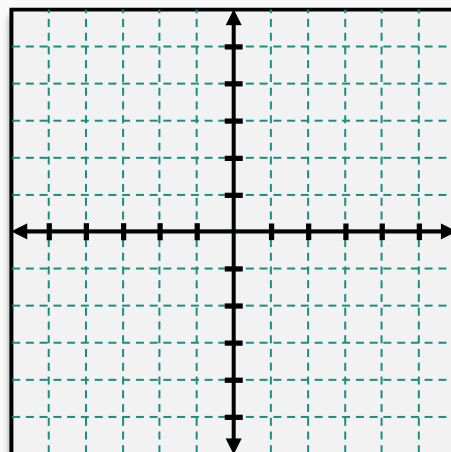
PRACTICE

Graph each quadratic equation by finding and plotting ordered pair solutions.

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



(B) $y = 2x^2 + 5$



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Horizontal and Vertical Shifts of Quadratics

◆ Recall: We can also graph Quadratic Equations by manipulating $y = x^2$ to create **horizontal & vertical shifts**.

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Horizontal and Vertical Shifts

Compare the graphs of $f(x) = x^2$, $g(x) = (x - 2)^2$ and $j(x) = (x - 2)^2 - 4$.

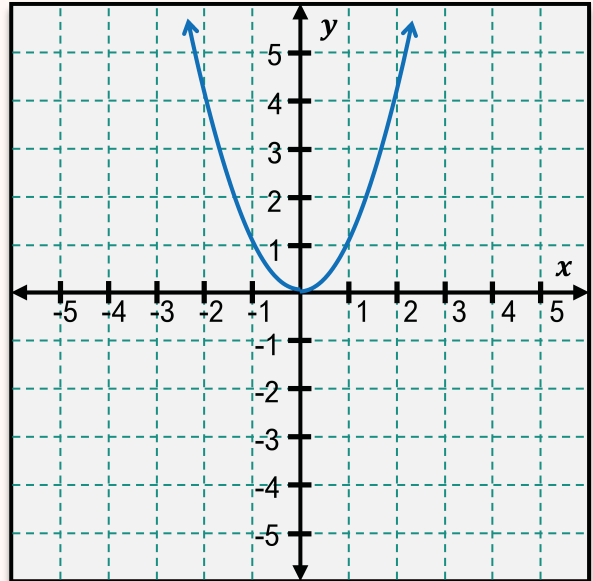
x	$f(x)$	x	$g(x)$	$j(x)$
-2	4	0		
-1	1	1		
0	0	2		
1	1	3		
2	4	4		

Each x -value
increases by 2 to get
the same y -value

Each y -value
decreases by 4

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

- If h is $[+ | -]$, the graph shifts [**RIGHT** | **LEFT**].
- If k is $[+ | -]$, the graph shifts [**UP** | **DOWN**].

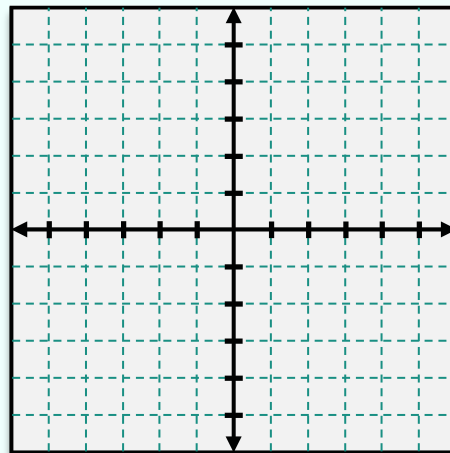


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EXAMPLE

Graph the following quadratic.

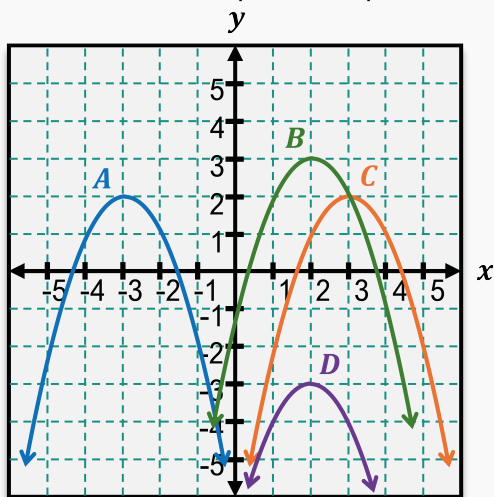
$$H(x) = -(x + 5)^2 + 3$$



PRACTICE

Which graph from choices A – D matches the quadratic equation below?

$$h(x) = -(x - 3)^2 + 2$$



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EXAMPLE

State the vertex, axis of symmetry, and domain & range for each quadratic.

$$G(x) = (x - 7)^2$$

PRACTICE

State the vertex, axis of symmetry, and domain & range for each quadratic.

(A) $y = -x^2 - 21$

(B) $f(x) = \left(x + \frac{1}{4}\right)^2 + 3$

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Stretches and Compressions of Quadratics

◆ Recall: The **sign value** of a in a quadratic equation determines if the parabola opens *upward* or *downward*.

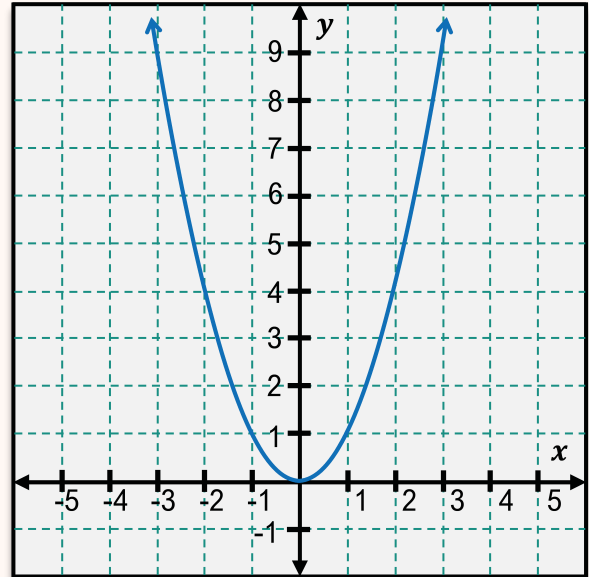
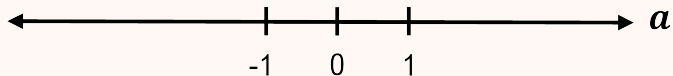
New

Stretches and Compressions

Graph the quadratic equations $g(x) = 3x^2$ and $h(x) = \frac{1}{2}x^2$, then compare them to $f(x) = x^2$.

$y = ax^2$			
x	$f(x)$	$g(x)$	$h(x)$
-2	4		
-1	1		
0	0		
1	1		
2	4		

The value of a makes the graph...



PRACTICE

State whether the graph of $f(x)$ will be narrower or wider than $g(x) = x^2$ & if it opens up or down.

(A)

$$f(x) = \frac{3}{2}x^2$$

[NARROWER | WIDER]

[UP | DOWN]

(B)

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

[NARROWER | WIDER]

[UP | DOWN]

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Vertex Form of Quadratics

◆ Recall: In a quadratic, ***a*** gives the **width & direction**, ***h*** shifts the graph **horizontally**, ***k*** shifts the graph **vertically**.

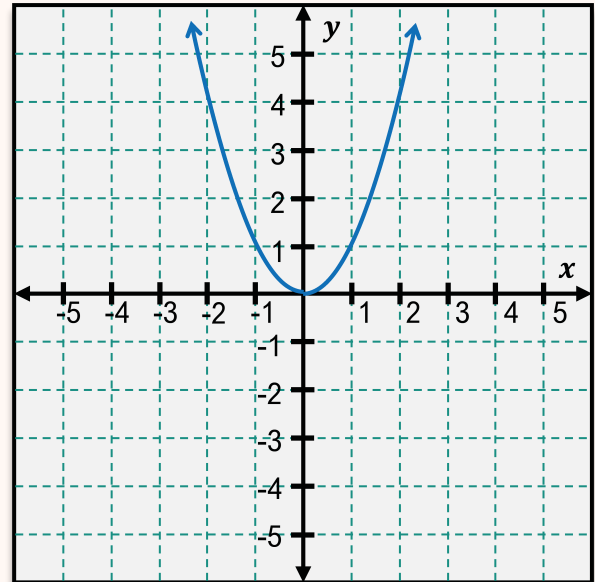
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Vertex Form

Graph the quadratic $j(x) = -\frac{1}{2}(x + 3)^2 + 2$ by finding the vertex, axis of symmetry, and intercepts.

$f(x) = a(x - h)^2 + k$			
x	$g(x) = x^2$	$j(x)$	$f(x)$
Vertex	$(0, 0)$		
Axis of Sym	$x = 0$		
x -Intercept(s)	$(0, 0)$		
y -Intercept	$(0, 0)$		

To find x -int. solve _____. To find y -int. evaluate _____.

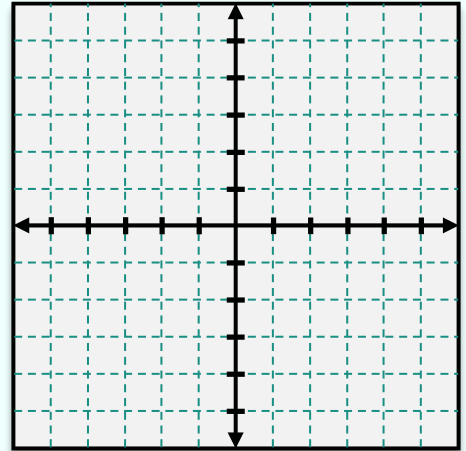


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EXAMPLE

Graph the following quadratic.

$$H(x) = -2(x - 5)^2 + 3$$



PRACTICE

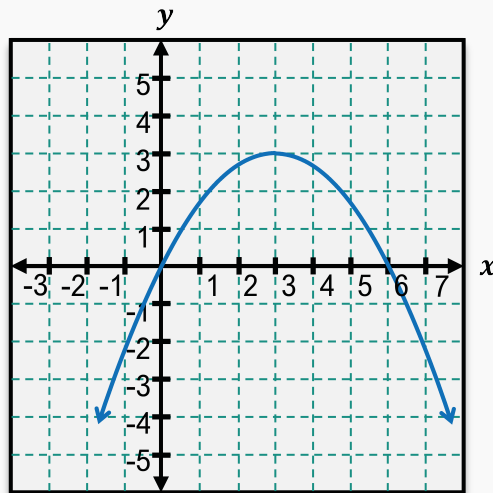
Which graph from choices A – D matches the quadratic graph below?

(A) $h(x) = -3(x + 3)^2 + 3$

(B) $h(x) = -\frac{1}{3}(x - 3)^2 + 3$

(C) $h(x) = -3(x - 3)^2 + 3$

(D) $h(x) = -\frac{1}{3}(x + 3)^2 + 3$



PRACTICE

State the vertex, intercepts, and domain & range for each quadratic.

(A) $G(x) = 3(x - 6)^2$

(B) $y = -2x^2 + 11$

(C) $f(x) = -4\left(x + \frac{2}{3}\right)^2 - 3$

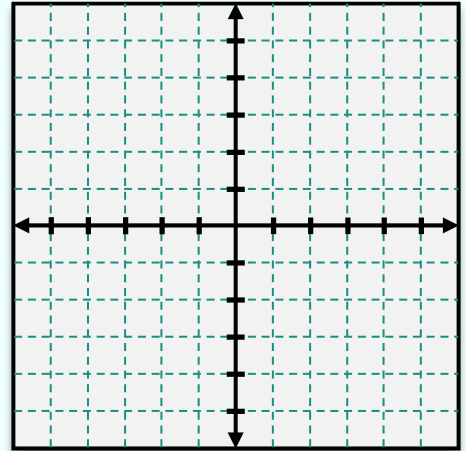
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Example: Graphing from Standard Form to Vertex Form

EXAMPLE

Rewrite the quadratic in vertex form by completing the square, then graph.

$$f(x) = x^2 - 8x + 5$$



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Graphing Using the Quadratic Formula

◆ Recall: The Quadratic Formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ gives the solution(s) to the quadratic $0 = ax^2 + bx + c$.

New

Graphing Using the Quadratic Formula

Find the vertex, intercepts, and axis of symmetry for the quadratic $y = 2x^2 + 12x + 10$

Discriminant	
+	2 x-int
0	1 x-int
-	0 x-int

$$x = \frac{-b}{2a} \pm \frac{\sqrt{b^2 - 4ac}}{2a}$$

x-intercept(s): _____

$$x = \frac{-12}{2(2)} \pm \frac{\sqrt{12^2 - 4(2)(10)}}{2(2)}$$

$$x = \frac{-12}{4} \pm \frac{\sqrt{144 - 80}}{4} \quad 64$$

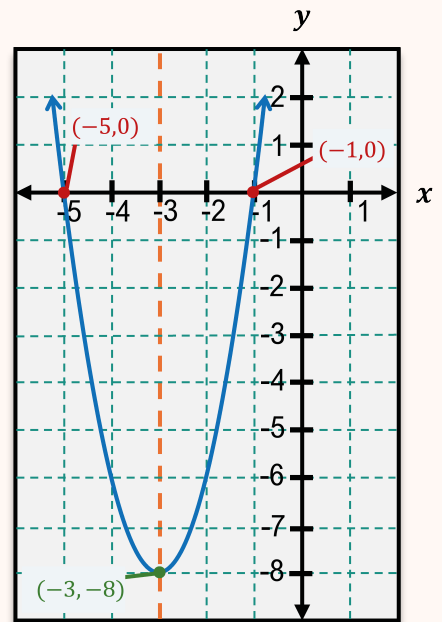
Axis of Sym: _____

$$x = -3 \pm 2$$

$$x = -1 \quad x = -5$$

Vertex: _____

y-intercept(s): _____

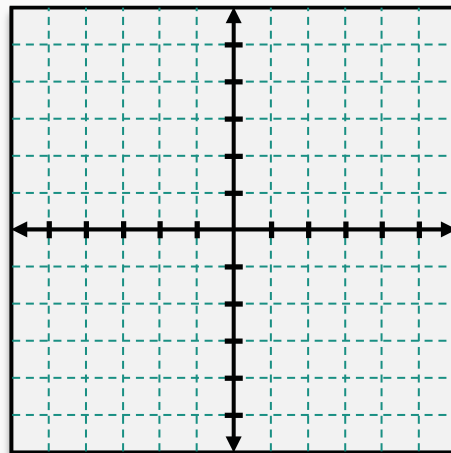


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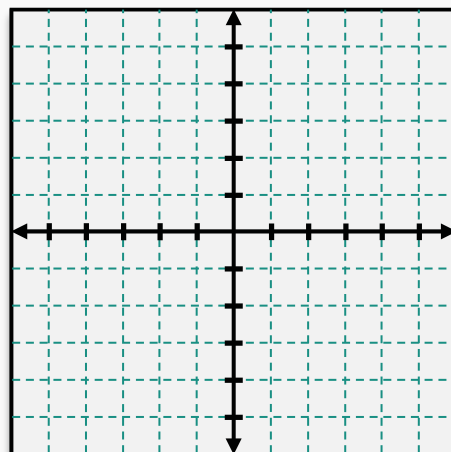
PRACTICE

Graph the following quadratics and state its vertex and intercepts.

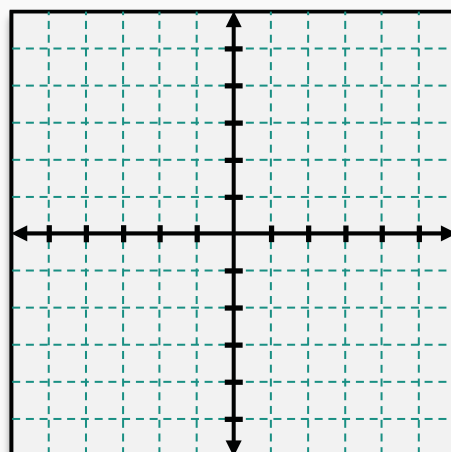
(A) $y = x^2 - 2x - 3$



(B) $y = -3x^2 + 10x - 3$



(C) $y = 4x^2 - 8x + 5$



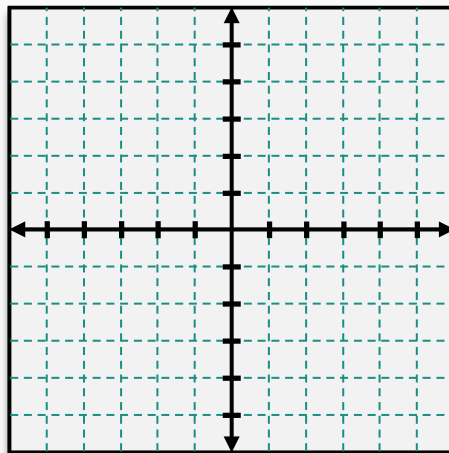
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PRACTICE

Graph the following quadratics and state its vertex, intercepts, and domain & range.

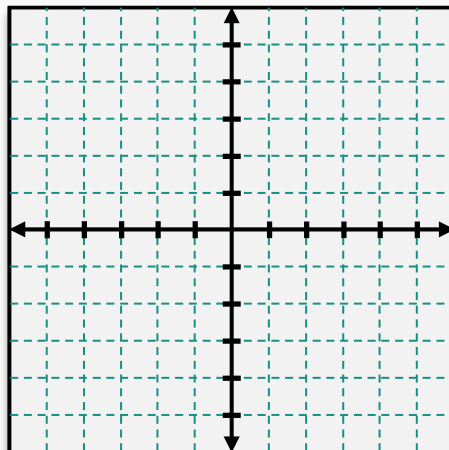
(A)

$$h(x) = \frac{1}{2}x^2 + 10x - 5$$



(B)

$$f(x) = -\frac{3}{2}x^2 - 6x + 6$$



EXAMPLE

Use the discriminant to determine how many x -intercepts the graph will have.

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