

GRADE

7

GRAPH FUNCTIONS OF THE FORM $Y = NX^2$

By DataWORKS Educational Research

Learning Objective

We will graph functions of the form $y = nx^2$.

CFU

What are we going to do?

Activate Prior Knowledge

Evaluate $4x^2$ for the values below.

1. $x = -2$

$$4(-2)^2$$

$$4(4)$$

$$16$$

2. $x = 2$

$$4(2)^2$$

$$4(4)$$

$$16$$

Make Connection

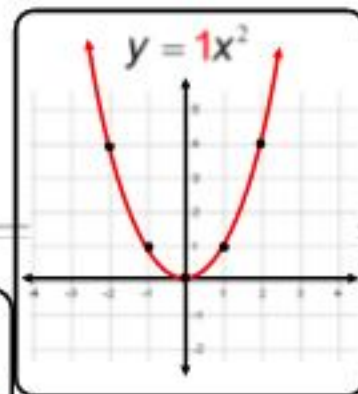
Students, you already know how to evaluate expressions with exponents. Now, we will use coefficients to graph functions of the form $y = nx^2$.

Concept Development

A **quadratic function** graphs as a parabola¹.

- A quadratic function contains a variable to the second power.
- To graph a parabola, at least 5 points must be evaluated.

Examples: $y = x^2$ $y = 4x^2 + 1$ $y = x^2 + 2x - 35$



The coefficient of x^2 determines the **direction** of the parabola.

$$y = nx^2$$

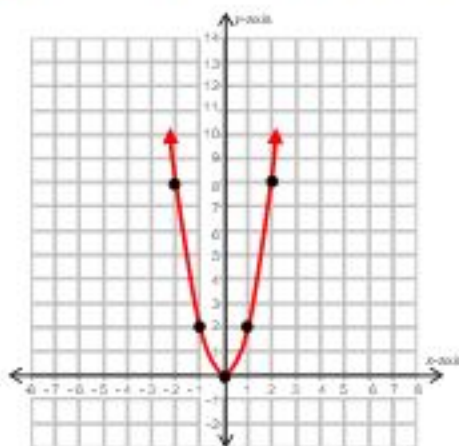
Examples:

If n is **positive**, then the parabola opens upward. If n is **negative**, then the parabola opens downward.



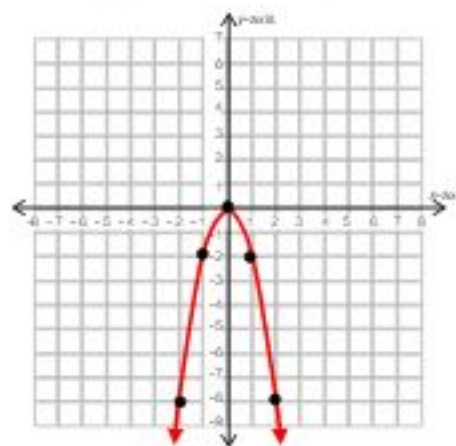
$$y = 2x^2$$

x	y
-2	8
-1	1
0	0
1	1
2	8



$$y = -2x^2$$

x	y
-2	-8
-1	-1
0	0
1	-1
2	-8



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On your whiteboard, draw a parabola. Which phrase best describes the direction of the parabola for the quadratic function $y = -4x^2$? How do you know?
A opens upward
B opens downward
In your own words, what is a quadratic function?
"A quadratic function is _____."

Vocabulary

¹ basic "U" shape graph

Skill Development/Guided Practice

A **quadratic function** graphs as a parabola.

- A quadratic function contains a variable to the second power.

What n tells about the graph:

If n is **positive**, then the parabola **opens upward**.

If n is **negative**, then the parabola **opens downward**.

Graph functions of the form $y = nx^2$.

- Identify and label the coefficient, n , of the quadratic function.
- Using n , describe whether the parabola opens upward or downward.
- Complete the table with x - and y -values by evaluating each function for the x -values in the table.
- Use the table to create ordered pairs and plot them on the coordinate grid. Sketch the parabola.

$$y = nx^2$$

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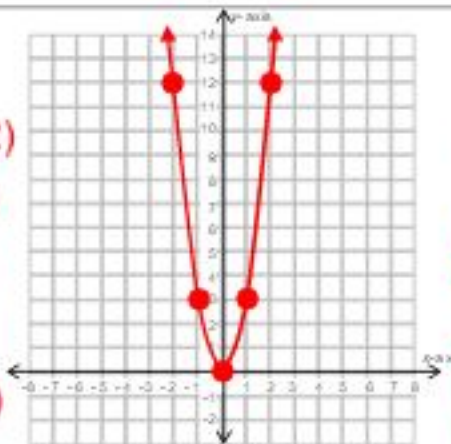
- How did I/you use the coefficient to describe how the parabola opens?
- How did I/you evaluate the function using x -values?
- How did I/you create ordered pairs and plot them on the coordinate grid?

1. $y = 3x^2$

Opens: upward

Evaluate for $x = -2$	Evaluate for $x = -1$
$y = 3x^2$	$y = 3x^2$
$y = 3(-2)^2$	$y = 3(-1)^2$
$y = 3 \cdot 4$	$y = 3 \cdot 1$
$y = 12$	$y = 3$

x	y	
-2	12	(-2, 12)
-1	3	(-1, 3)
0	0	(0, 0)
1	3	(1, 3)
2	12	(2, 12)



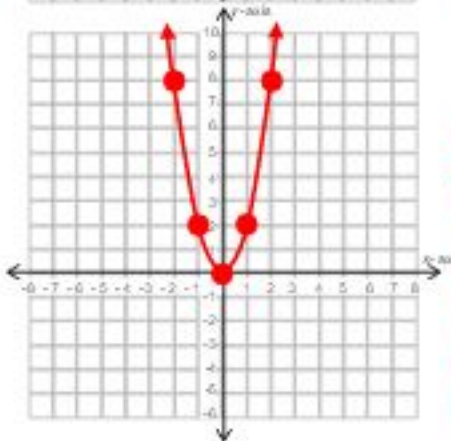
Evaluate for $x = 0$	Evaluate for $x = 1$	Evaluate for $x = 2$
$y = 3x^2$	$y = 3x^2$	$y = 3x^2$
$y = 3(0)^2$	$y = 3(1)^2$	$y = 3(2)^2$
$y = 3 \cdot 0$	$y = 3 \cdot 1$	$y = 3 \cdot 4$
$y = 0$	$y = 3$	$y = 12$

2. $y = 2x^2$

Opens: upward

Evaluate for $x = -2$	Evaluate for $x = -1$
$y = 2x^2$	$y = 2x^2$
$y = 2(-2)^2$	$y = 2(-1)^2$
$y = 2 \cdot 4$	$y = 2 \cdot 1$
$y = 8$	$y = 2$

x	y	
-2	8	(-2, 8)
-1	2	(-1, 2)
0	0	(0, 0)
1	2	(1, 2)
2	8	(2, 8)



Evaluate for $x = 0$	Evaluate for $x = 1$	Evaluate for $x = 2$
$y = 2x^2$	$y = 2x^2$	$y = 2x^2$
$y = 2(0)^2$	$y = 2(1)^2$	$y = 2(2)^2$
$y = 2 \cdot 0$	$y = 2 \cdot 1$	$y = 2 \cdot 4$
$y = 0$	$y = 2$	$y = 8$

Skill Development/Guided Practice (continued)

A quadratic function graphs as a parabola.

- A quadratic function contains a variable to the second power.

What n tells about the graph:

If n is **positive**, then the parabola opens upward.

If n is **negative**, then the parabola opens downward.

Graph functions of the form $y = nx^2$.

- Identify and label the coefficient, n , of the quadratic function.
- Using n , describe whether the parabola opens upward or downward.
- Complete the table with x - and y -values by evaluating each function for the x -values in the table.
- Use the table to create ordered pairs and plot them on the coordinate grid. Sketch the parabola.

$$y = nx^2$$

CFU

- How did I/you use the coefficient to describe how the parabola opens?
- How did I/you evaluate the function using x -values?
- How did I/you create ordered pairs and plot them on the coordinate grid?

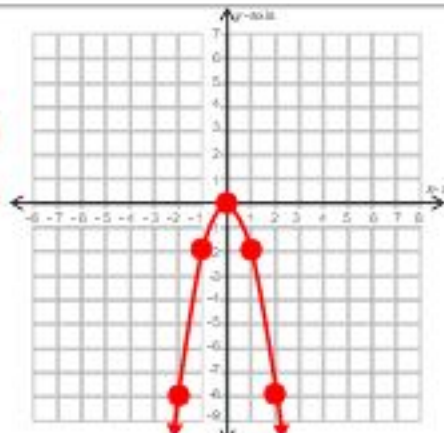
3. $y = -2x^2$

Opens: downward

Evaluate for $x = -2$	Evaluate for $x = -1$
$y = -2x^2$	$y = -2x^2$
$y = -2(-2)^2$	$y = -2(-1)^2$
$y = -2 \cdot 4$	$y = -2 \cdot 1$
$y = -8$	$y = -2$

Evaluate for $x = 0$	Evaluate for $x = 1$	Evaluate for $x = 2$
$y = -2x^2$	$y = -2x^2$	$y = -2x^2$
$y = -2(0)^2$	$y = -2(1)^2$	$y = -2(2)^2$
$y = -2 \cdot 0$	$y = -2 \cdot 1$	$y = -2 \cdot 4$
$y = 0$	$y = -2$	$y = -8$

x	y	
-2	-8	(-2, -8)
-1	-2	(-1, -2)
0	0	(0, 0)
1	-2	(1, -2)
2	-8	(2, -8)



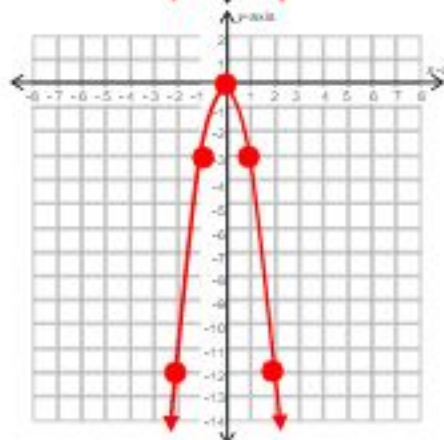
4. $y = -3x^2$

Opens: downward

Evaluate for $x = -2$	Evaluate for $x = -1$
$y = -3x^2$	$y = -3x^2$
$y = -3(-2)^2$	$y = -3(-1)^2$
$y = -3 \cdot 4$	$y = -3 \cdot 1$
$y = -12$	$y = -3$

Evaluate for $x = 0$	Evaluate for $x = 1$	Evaluate for $x = 2$
$y = -3x^2$	$y = -3x^2$	$y = -3x^2$
$y = -3(0)^2$	$y = -3(1)^2$	$y = -3(2)^2$
$y = -3 \cdot 0$	$y = -3 \cdot 1$	$y = -3 \cdot 4$
$y = 0$	$y = -3$	$y = -12$

x	y	
-2	-12	(-2, -12)
-1	-3	(-1, -3)
0	0	(0, 0)
1	-3	(1, -3)
2	-12	(2, -12)



A **quadratic function** graphs as a parabola.

- A quadratic function contains a variable to the second power.

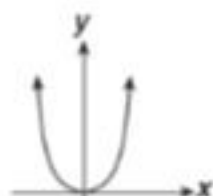
Does anyone else have another reason why it is relevant to graph functions of the form $y = nx^2$? (Pair-Share) Why is it relevant to graph functions of the form $y = nx^2$? You may give one of my reasons or one of your own. Which reason is more relevant to you? Why?

- 1 Graphing functions of the form $y = nx^2$ will help you recognize design features in art and architecture.

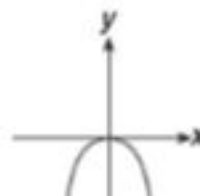


- 2 Graphing functions of the form $y = nx^2$ will help you do well on tests.

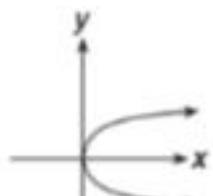
50 Which graph shows $y = -x^2$?



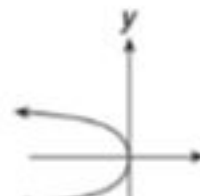
A



C



B



D

Closure

A **quadratic function** graphs as a parabola.

- A quadratic function contains a variable to the second power.

What n tells about the graph:

If n is **positive**, then the parabola opens upward.

If n is **negative**, then the parabola opens downward.

Skill Closure

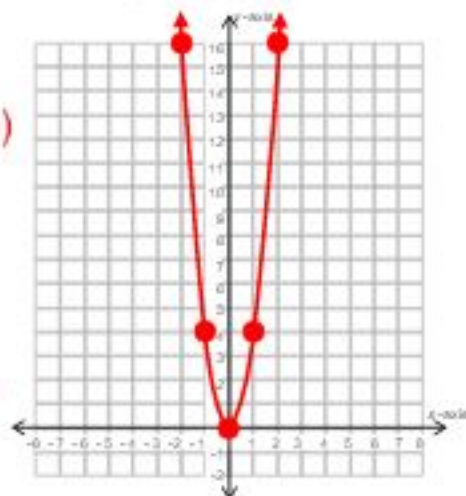
Graph functions of the form $y = nx^2$.

- 1 Identify and label the coefficient, n , of the quadratic function.
- 2 Using n , describe whether the parabola opens upward or downward.
- 3 Complete the table with x - and y -values by evaluating each function for the x -values in the table.
- 4 Use the table to create ordered pairs and plot them on the coordinate grid. Sketch the parabola.

$$y = nx^2$$

1. $y = 4x^2$ Opens: upward

x	y	
-2	16	$(-2, 16)$
-1	4	$(-1, 4)$
0	0	$(0, 0)$
1	4	$(1, 4)$
2	16	$(2, 16)$



Evaluate
for $x = -2$

$$\begin{aligned}y &= 4x^2 \\y &= 4(-2)^2 \\y &= 4 \cdot 4 \\y &= 16\end{aligned}$$

Evaluate
for $x = -1$

$$\begin{aligned}y &= 4x^2 \\y &= 4(-1)^2 \\y &= 4 \cdot 1 \\y &= 4\end{aligned}$$

Evaluate
for $x = 0$

$$\begin{aligned}y &= 4x^2 \\y &= 4(0)^2 \\y &= 4 \cdot 0 \\y &= 0\end{aligned}$$

Evaluate
for $x = 1$

$$\begin{aligned}y &= 4x^2 \\y &= 4(1)^2 \\y &= 4 \cdot 1 \\y &= 4\end{aligned}$$

Evaluate
for $x = 2$

$$\begin{aligned}y &= 4x^2 \\y &= 4(2)^2 \\y &= 4 \cdot 4 \\y &= 16\end{aligned}$$

Closure (continued)

A **quadratic function** graphs as a parabola.

- A *quadratic function* contains a variable to the second power.

What n tells about the graph:

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Constructed Response Closure

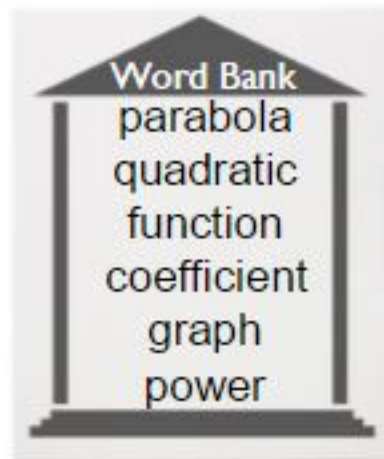
Elwood is going to graph the quadratic function $y = -3x^2$. Elwood thinks that the parabola will open upward. Do you agree with Elwood? Why or why not?

I disagree with Elwood. Since the coefficient is -3, the parabola opens downward.

Summary Closure

What did you learn today about graphing functions of the form $y = nx^2$? (Pair-Share)

Use words from the word bank.



Independent Practice

A **quadratic function** graphs as a parabola.

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$$y = nx^2$$

1. $y = 1x^2$

Opens: upward

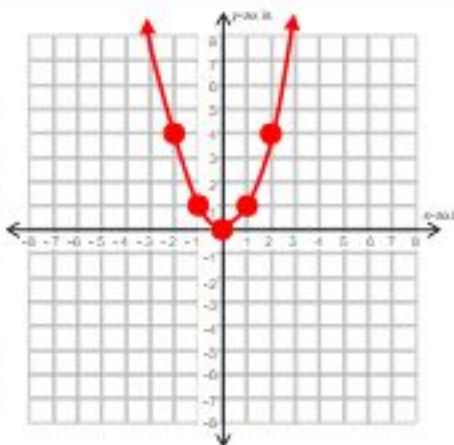
Evaluate
for $x = -2$

$$\begin{aligned} y &= 1x^2 \\ y &= 1(-2)^2 \\ y &= 1 \cdot 4 \\ y &= 4 \end{aligned}$$

Evaluate
for $x = -1$

$$\begin{aligned} y &= 1x^2 \\ y &= 1(-1)^2 \\ y &= 1 \cdot 1 \\ y &= 1 \end{aligned}$$

x	y	
-2	4	(-2, 4)
-1	1	(-1, 1)
0	0	(0, 0)
1	1	(1, 1)
2	4	(2, 4)



Evaluate
for $x = 0$

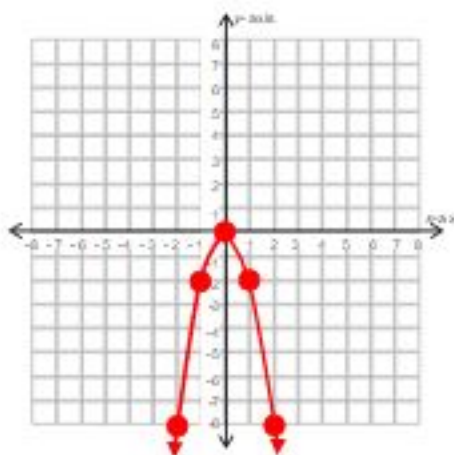
$$\begin{aligned} y &= 1x^2 \\ y &= 1(0)^2 \\ y &= 1 \cdot 0 \\ y &= 0 \end{aligned}$$

Evaluate
for $x = 1$

$$\begin{aligned} y &= 1x^2 \\ y &= 1(1)^2 \\ y &= 1 \cdot 1 \\ y &= 1 \end{aligned}$$

Evaluate
for $x = 2$

$$\begin{aligned} y &= 1x^2 \\ y &= 1(2)^2 \\ y &= 1 \cdot 4 \\ y &= 4 \end{aligned}$$



2. $y = -2x^2$

Opens: downward

Evaluate
for $x = -2$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(-2)^2 \\ y &= -2 \cdot 4 \\ y &= -8 \end{aligned}$$

Evaluate
for $x = -1$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(-1)^2 \\ y &= -2 \cdot 1 \\ y &= -2 \end{aligned}$$

x	y	
-2	-8	(-2, -8)
-1	-2	(-1, -2)
0	0	(0, 0)
1	-2	(1, -2)
2	-8	(2, -8)

Evaluate
for $x = 0$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(0)^2 \\ y &= -2 \cdot 0 \\ y &= 0 \end{aligned}$$

Evaluate
for $x = 1$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(1)^2 \\ y &= -2 \cdot 1 \\ y &= -2 \end{aligned}$$

Evaluate
for $x = 2$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(2)^2 \\ y &= -2 \cdot 4 \\ y &= -8 \end{aligned}$$

Periodic Review 1

A **quadratic function** graphs as a parabola.

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$$y = nx^2$$

1. $y = 2x^2$

Opens: upward

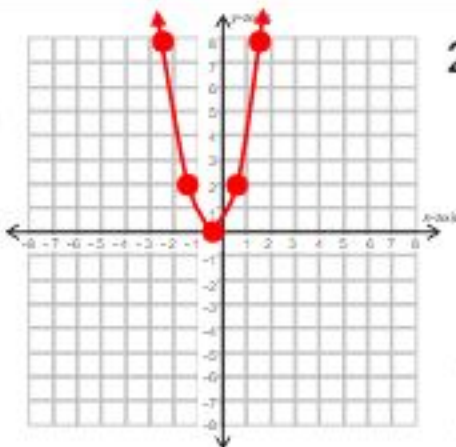
Evaluate
for $x = -2$

$$\begin{aligned} y &= 2x^2 \\ y &= 2(-2)^2 \\ y &= 2 \cdot 4 \\ y &= 8 \end{aligned}$$

Evaluate
for $x = -1$

$$\begin{aligned} y &= 2x^2 \\ y &= 2(-1)^2 \\ y &= 2 \cdot 1 \\ y &= 2 \end{aligned}$$

x	y	
-2	8	$(-2, 8)$
-1	2	$(-1, 2)$
0	0	$(0, 0)$
1	2	$(1, 2)$
2	8	$(2, 8)$



2. $y = -2x^2$

Opens: downward

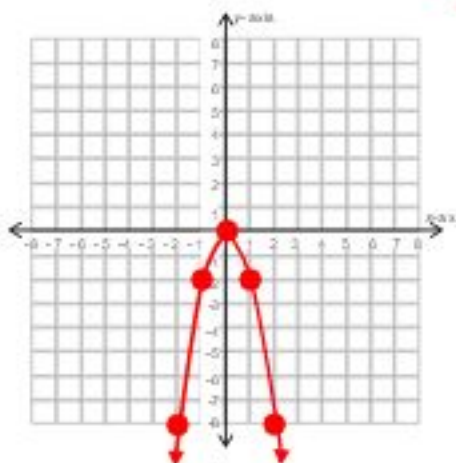
Evaluate
for $x = -2$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(-2)^2 \\ y &= -2 \cdot 4 \\ y &= -8 \end{aligned}$$

Evaluate
for $x = -1$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(-1)^2 \\ y &= -2 \cdot 1 \\ y &= -2 \end{aligned}$$

x	y	
-2	-8	$(-2, -8)$
-1	-2	$(-1, -2)$
0	0	$(0, 0)$
1	-2	$(1, -2)$
2	-8	$(2, -8)$



Evaluate
for $x = 0$

$$\begin{aligned} y &= 2x^2 \\ y &= 2(0)^2 \\ y &= 2 \cdot 0 \\ y &= 0 \end{aligned}$$

Evaluate
for $x = 1$

$$\begin{aligned} y &= 2x^2 \\ y &= 2(1)^2 \\ y &= 2 \cdot 1 \\ y &= 2 \end{aligned}$$

Evaluate
for $x = 2$

$$\begin{aligned} y &= 2x^2 \\ y &= 2(2)^2 \\ y &= 2 \cdot 4 \\ y &= 8 \end{aligned}$$

Evaluate
for $x = 0$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(0)^2 \\ y &= -2 \cdot 0 \\ y &= 0 \end{aligned}$$

Evaluate
for $x = 1$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(1)^2 \\ y &= -2 \cdot 1 \\ y &= -2 \end{aligned}$$

Evaluate
for $x = 2$

$$\begin{aligned} y &= -2x^2 \\ y &= -2(2)^2 \\ y &= -2 \cdot 4 \\ y &= -8 \end{aligned}$$

Periodic Review 2

A **quadratic function** graphs as a parabola.

- A quadratic function contains a variable to the second power.

What n tells about the graph:

If n is **positive**, then the parabola opens upward.

If n is **negative**, then the parabola opens downward.

Graph functions of the form $y = nx^2$.

- Identify and label the coefficient, n , of the quadratic function.
- Using n , describe whether the parabola opens upward or downward.
- Complete the table with x- and y-values by evaluating each function for the x-values in the table.
- Use the table to create ordered pairs and plot them on the coordinate grid. Sketch the parabola.

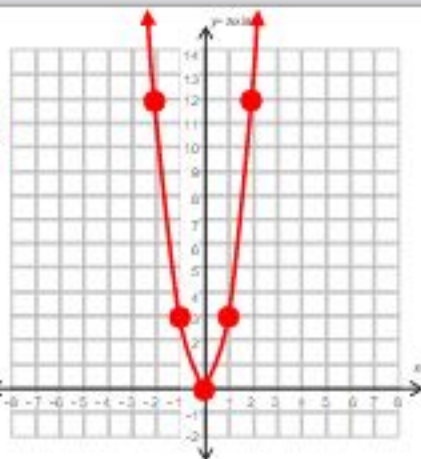
$$y = nx^2$$

1. $y = 3x^2$

Opens: upward

Evaluate for $x = -2$	Evaluate for $x = -1$
$y = 3x^2$	$y = 3x^2$
$y = 3(-2)^2$	$y = 3(-1)^2$
$y = 3 \cdot 4$	$y = 3 \cdot 1$
$y = 12$	$y = 3$

x	y
-2	12
-1	3
0	0
1	3
2	12

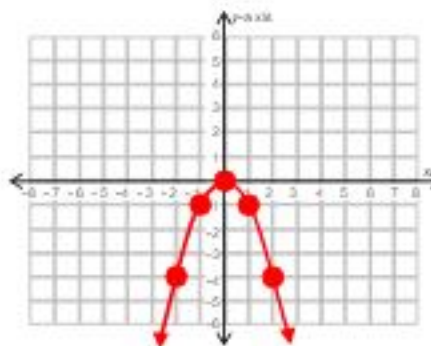


2. $y = -1x^2$

Opens: downward

Evaluate for $x = -2$	Evaluate for $x = -1$
$y = -1x^2$	$y = -1x^2$
$y = -1(-2)^2$	$y = -1(-1)^2$
$y = -1 \cdot 4$	$y = -1 \cdot 1$
$y = -4$	$y = -1$

x	y
-2	-4
-1	-1
0	0
1	-1
2	-4



Evaluate for $x = 0$	Evaluate for $x = 1$	Evaluate for $x = 2$
$y = 3x^2$	$y = 3x^2$	$y = 3x^2$
$y = 3(0)^2$	$y = 3(1)^2$	$y = 3(2)^2$
$y = 3 \cdot 0$	$y = 3 \cdot 1$	$y = 3 \cdot 4$
$y = 0$	$y = 3$	$y = 12$

Evaluate for $x = 0$	Evaluate for $x = 1$	Evaluate for $x = 2$
$y = -1x^2$	$y = -1x^2$	$y = -1x^2$
$y = -1(0)^2$	$y = -1(1)^2$	$y = -1(2)^2$
$y = -1 \cdot 0$	$y = -1 \cdot 1$	$y = -1 \cdot 4$
$y = 0$	$y = -1$	$y = -4$

A quadratic function graphs as a parabola.

- A quadratic function contains a variable to the second power.

What n tells about the graph:

If n is **positive**, then the parabola opens upward.

If n is **negative**, then the parabola opens downward.

Graph functions of the form $y = nx^2$.

- 1 Identify and label the coefficient, n , of the quadratic function.
- 2 Using n , describe whether the parabola opens upward or downward.
- 3 Complete the table with x - and y -values by evaluating each function for the x -values in the table.
- 4 Use the table to create ordered pairs and plot them on the coordinate grid. Sketch the parabola.

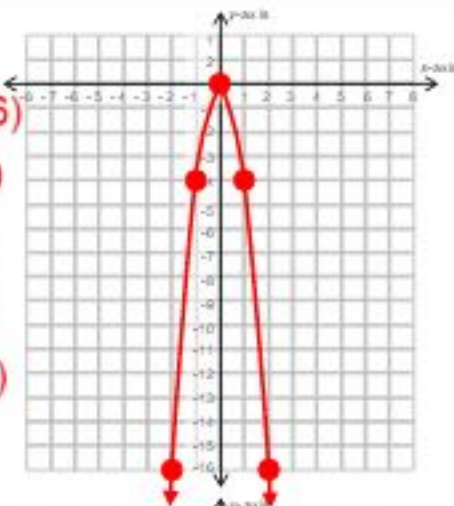
$$y = nx^2$$

1. $y = -4x^2$

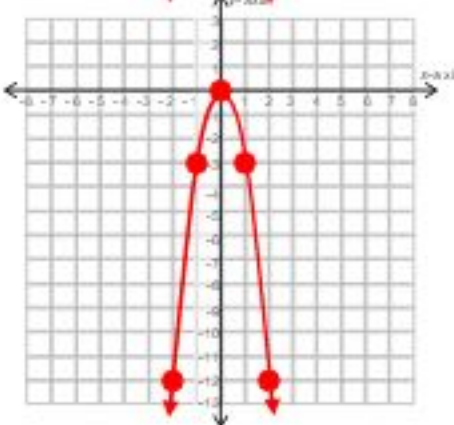
Opens: downward

Evaluate for $x = -2$	Evaluate for $x = -1$
$y = -4x^2$	$y = -4x^2$
$y = -4(-2)^2$	$y = -4(-1)^2$
$y = -4 \cdot 4$	$y = -4 \cdot 1$
$y = -16$	$y = -4$

x	y	
-2	-16	(-2, -16)
-1	-4	(-1, -4)
0	0	(0, 0)
1	-4	(1, -4)
2	-16	(2, -16)



Evaluate for $x = 0$	Evaluate for $x = 1$	Evaluate for $x = 2$
$y = -4x^2$	$y = -4x^2$	$y = -4x^2$
$y = -4(0)^2$	$y = -4(1)^2$	$y = -4(2)^2$
$y = -4 \cdot 0$	$y = -4 \cdot 1$	$y = -4 \cdot 4$
$y = 0$	$y = -4$	$y = -16$



2. $y = -3x^2$

Opens: downward

Evaluate for $x = -2$	Evaluate for $x = -1$
$y = -3x^2$	$y = -3x^2$
$y = -3(-2)^2$	$y = -3(-1)^2$
$y = -3 \cdot 4$	$y = -3 \cdot 1$
$y = -12$	$y = -3$

x	y	
-2	-12	(-2, -12)
-1	-3	(-1, -3)
0	0	(0, 0)
1	-3	(1, -3)
2	-12	(2, -12)

Evaluate for $x = 0$	Evaluate for $x = 1$	Evaluate for $x = 2$
$y = -3x^2$	$y = -3x^2$	$y = -3x^2$
$y = -3(0)^2$	$y = -3(1)^2$	$y = -3(2)^2$
$y = -3 \cdot 0$	$y = -3 \cdot 1$	$y = -3 \cdot 4$
$y = 0$	$y = -3$	$y = -12$