

Mathematics

Quarter 1 - Module 20

The Effects of Changing the Values of a, h, and k in $y = ax^2 + bx + c$

Week 8

Learning Code - M9AL-Ii-14



Learning Module for Junior High School Mathematics

Quarter 1 – Module 20 – New Normal Math for G9

First Edition 2020

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**MODULE
20**

THE EFFECTS OF CHANGING THE VALUES OF a , h , and k in $y = ax^2 + bx + c$

In the previous module, you learned how to graph quadratic functions and determine the characteristics of parabola. In this module, you will work on the effect of changing the values of a , h , and k in the graph of quadratic function of the form $y = a(x - h)^2 + k$.

WHAT I NEED TO KNOW

LEARNING COMPETENCY

The learners will be able to:

- analyze the effects of changing the values of a , h , and k of a quadratic function and its graph. **M9AL-Ii-14**

WHAT I KNOW

Find out how much you already know about the effect of changing the values of a , h , and k . Write the letter that you think is the correct answer to each question on your answer sheet. Answer all items. After taking and checking this short test, take note of the items that you were not able to answer correctly and look for the right answer as you go through this module.

1. The quadratic function $f(x) = x^2 + 2x - 1$ is expressed in vertex form as:

A. $f(x) = (x + 1)^2 + 1$	C. $f(x) = (x + 1)^2 + 2$
B. $f(x) = (x + 1)^2 - 2$	D. $f(x) = (x + 1)^2 - 1$
2. What is $f(x) = -3(x + 2)^2 + 2$ when written in the form $f(x) = ax^2 + bx + c$?

A. $f(x) = -3x^2 + 12x - 10$	C. $f(x) = -3x^2 + 12x + 10$
B. $f(x) = 3x^2 - 12x + 10$	D. $f(x) = -3x^2 - 12x - 10$
3. The graph of $y = x^2 - 3$ is obtained by sliding the graph of $y = x^2$:

A. 3 units downward	C. 3 units to the right
B. 3 units upward	D. 3 units to the left
4. In the quadratic function $y = x^2 - 2x - 3$, what are the coordinates of the vertex?

A. $(-1, -2)$	C. $(1, -4)$
B. $(-2, 4)$	D. $(3, -2)$
5. What is the axis of symmetry of the function $y = -x^2 + 4x + 5$?

A. $x = 1$	C. $x = -3$
B. $x = -5$	D. $x = 2$

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For numbers 6- 8: In the equation $y = x^2 + 3x + 1$, determine the opening of the graph, the coordinates of the vertex, and the equation of the axis of symmetry.

6. Opening of the graph

- A. to the left
- B. to the right

- C. downward
- D. upward

7. The coordinates of the vertex

- A. $V(-\frac{3}{2}, -\frac{5}{4})$
- B. $V(\frac{1}{2}, -\frac{4}{5})$

- C. $V(-\frac{2}{3}, -\frac{3}{4})$
- D. $V(\frac{3}{4}, \frac{1}{4})$

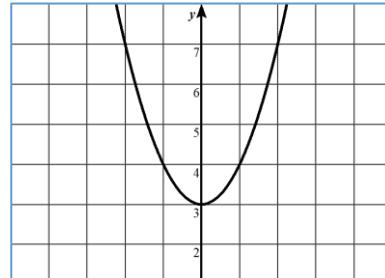
8. The equation of the axis of symmetry

- A. $x = \frac{2}{3}$
- B. $x = -\frac{3}{2}$

- C. $x = \frac{3}{2}$
- D. $x = -\frac{2}{3}$

9. What is the equation of the quadratic function with a graph at the right?

- A. $y = 3x^2$
- B. $y = -x^2 + 3$
- C. $y = x^2 + 3$
- D. $y = 3x^2 - 3$



10. Determine the vertex of the parabola in the quadratic function $y = 4 - x^2$.

- A. $V(0, 4)$
- B. $V(-1, -2)$

- C. $V(2, -4)$
- D. $V(-4, 0)$

WHAT'S IN

Communication, and Critical Thinking



Before going through this module, recall first how to graph quadratic functions.

A. Complete the table of values for the family of $y = ax^2$ and graph each table on one Cartesian plane. Label each graph using its corresponding equation.

1. $y = x^2$

x	-2	-1	0	1	2
y					

2. $y = 2x^2$

x	-2	-1	0	1	2
y					

3. $y = 3x^2$

x	-2	-1	0	1	2
y					

4. $y = \frac{1}{2}x^2$

x	-4	-2	0	2	4
y					

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5. $y = \frac{1}{3}x^2$

x	-6	-3	0	3	6
y					

6. $y = -x^2$

x	-2	-1	0	1	2
y					

7. $y = -2x^2$

x	-2	-1	0	1	2
y					

8. $y = -3x^2$

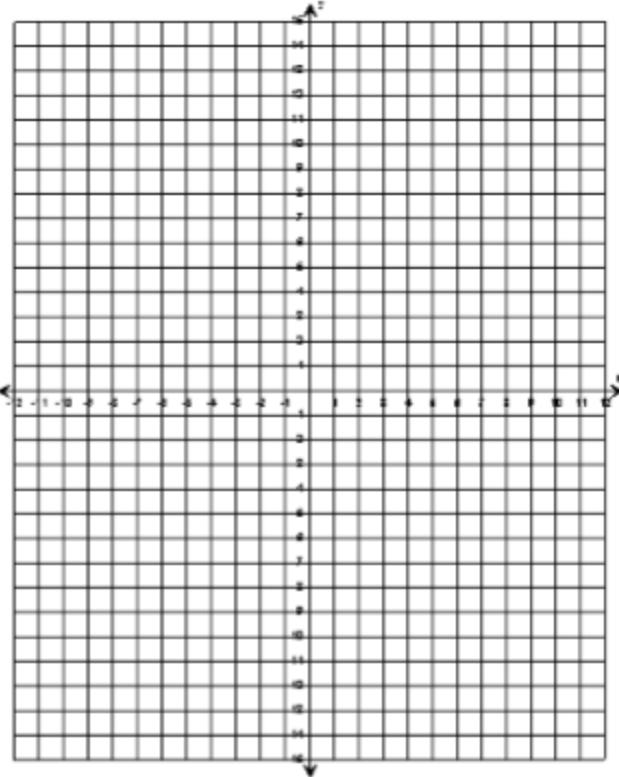
x	-2	-1	0	1	2
y					

9. $y = -\frac{1}{2}x^2$

x	-4	-2	0	2	4
y					

10. $y = -\frac{1}{3}x^2$

x	-6	-3	0	3	6
y					



B. Complete the table of values for the family of $y = (x - h)^2$ and graph each table on one Cartesian plane. Label each graph using its corresponding equation.

1. $y = x^2$

x	-2	-1	0	1	2
y					

2. $y = (x + 2)^2$

x	-4	-3	-2	-1	0
y					

2. $y = (x - 2)^2$

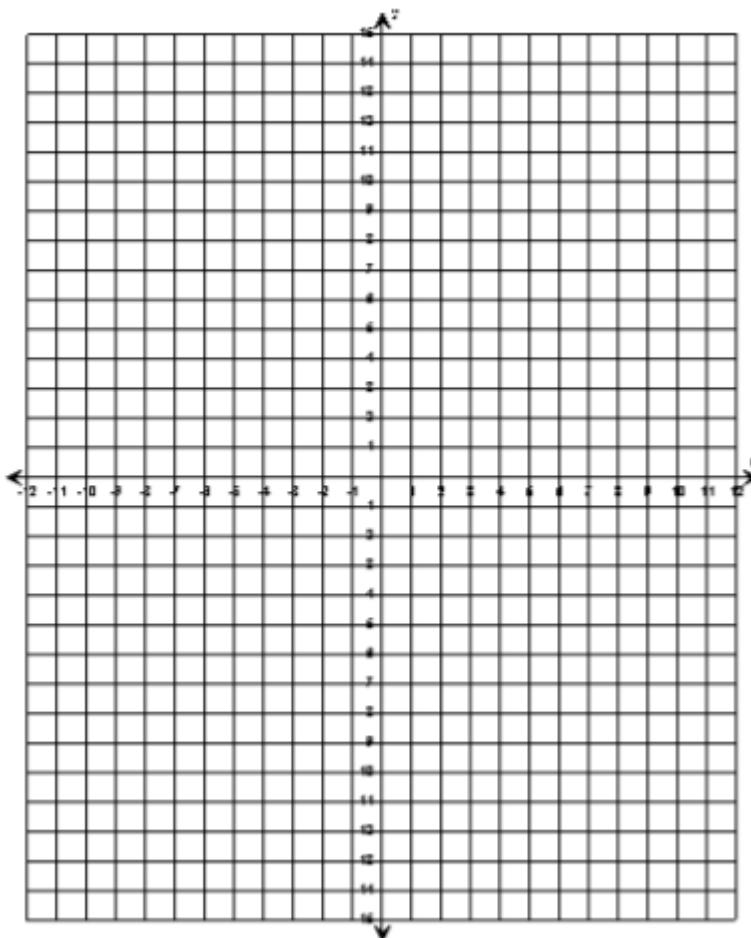
x	0	1	2	3	4
y					

4. $y = (x + 3)^2$

x	-5	-4	-3	-2	-1
y					

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

x	1	2	3	4	5
y					



C. Complete the table of values for the family of $y = x^2 + k$ and graph each table on one Cartesian plane. Label each graph using its corresponding equation.

1. $y = x^2$

x	-2	-1	0	1	2
y					

4. $y = x^2 - 2$

x	-2	-1	0	1	2
y					

2. $y = x^2 + 2$

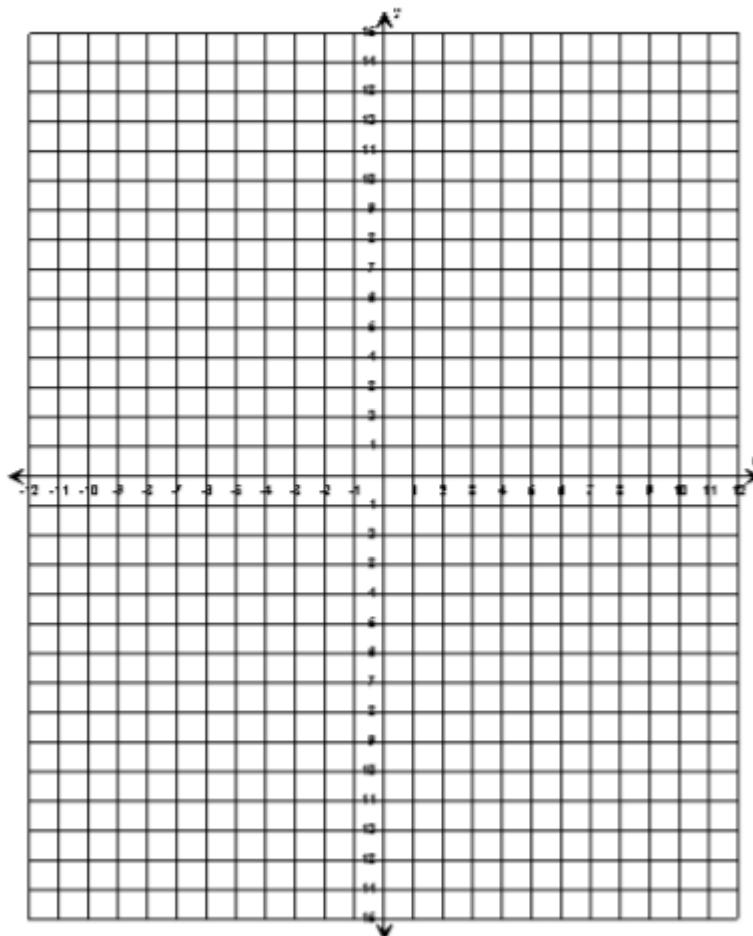
x	-2	-1	0	1	2
y					

5. $y = x^2 - 3$

x	-2	-1	0	1	2
y					

3. $y = x^2 + 3$

x	-2	-1	0	1	2
y					

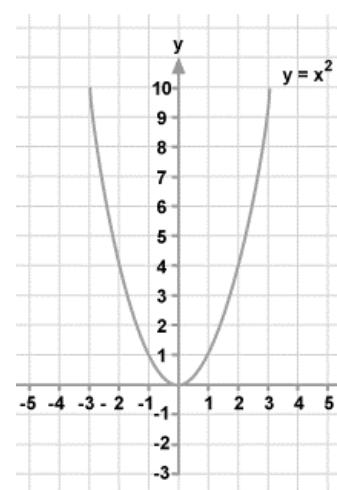

WHAT'S NEW
Communication

Parent Function

Parent functions are the function out of a group of functions that all of the other functions are derived from. They are the most basic form of function in that group.

In the group of quadratics $f(x)=x^2$ is the parent function. In this case, $a = 1$, $h = 0$ and $k = 0$. The graph is a parabola opening upward with vertex at $(0, 0)$, as shown on the left.

What will happen to the graph of quadratic function defined by $y = a(x-h)^2 + k$ as we change the values of a , h and k ?



WHAT IS IT

Communication, Critical Thinking, and Collaboration



The parent function of quadratic function plays a vital role in the effects of changing the values of a, h, and k given the equation $y = a(x-h)^2 + k$.

Let's investigate the graphs you did on the first activity.

Analyze the set of graphs for $y = ax^2$,

1. What do you notice about the opening of the graphs of the quadratic functions of the form $y = ax^2$?
2. What do you notice about the size of the opening of the graphs when $a > 1$?
3. What do you notice about the size of the opening of the graphs when $a < -1$?
4. What do you notice about the size of the opening of the graph when $0 < a < 1$?

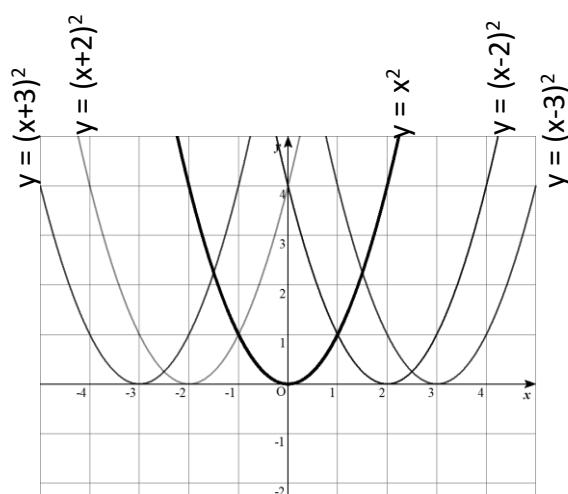
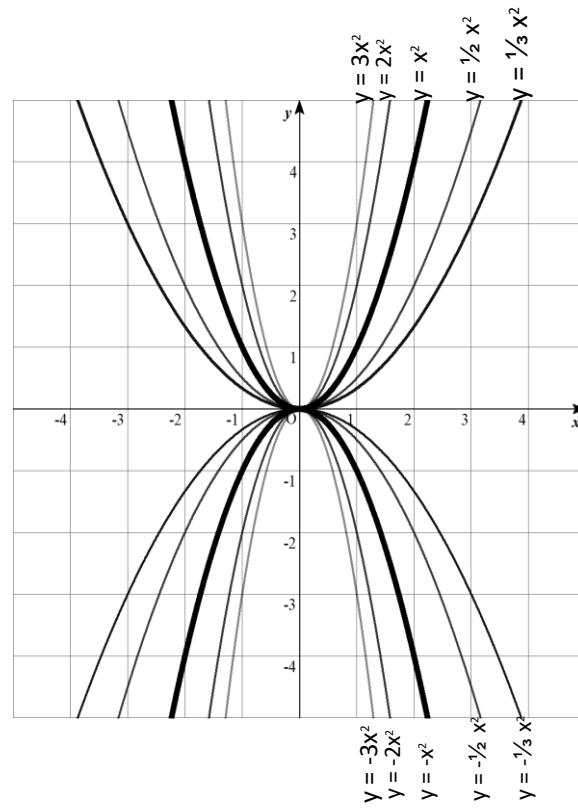
Notice that the graphs open upward when $a > 0$ and opens downward when $a < 0$.

Compared to the graph of $y = x^2$, the graphs are narrower (vertically compressed) if $a > 1$ or $a < -1$, and wider (vertically stretched) if $0 < a < 1$.

Now, analyze the set of graphs for $y = (x-h)^2$,

1. How will you compare the graphs of quadratic functions of the form $y = (x-h)^2$ with the graph of $y = x^2$?
2. What is the effect on the graph while changing the value of h?

For the set of graphs of the form $y = (x-h)^2$, changing the value of h leads to horizontal movement of the graph. The graph of $y = x^2$ moves h units to the right



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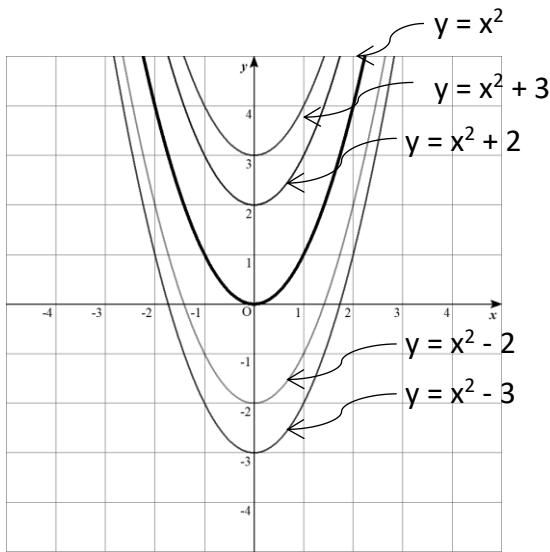
when h is positive and moves h units to the left when h is negative. The graph has its vertex at $(h, 0)$ and the axis of symmetry is as $x = h$.

Lastly, observe the graphs of quadratic functions of the form $y = x^2 + k$.

1. How will you compare the graphs of quadratic functions of the form $y = x^2 + k$ with the graph of $y = x^2$?

2. What is the effect on the graph while changing the value of k ?

For the set of graphs of the form $y = x^2 + k$, changing the value of k leads to vertical movement of the graph. The graph of $y = x^2$ moves k units upward when k is positive and moves k units downward when k is negative.



What do you think is the effect of the values of a , h and k to the graph of quadratic function of the form $y=a(x-h)^2+k$? Study the examples below.

Example 1. Sketch the graph of each quadratic function. Identify the opening of the parabola, the coordinates of the vertex, and the equation for the axis of symmetry.

- $y = (x - 2)^2 + 3$
- $y = -(x + 3)^2 + 4$
- $y = x^2 - 6x + 5$
- $y = 2x^2 - 4x - 3$

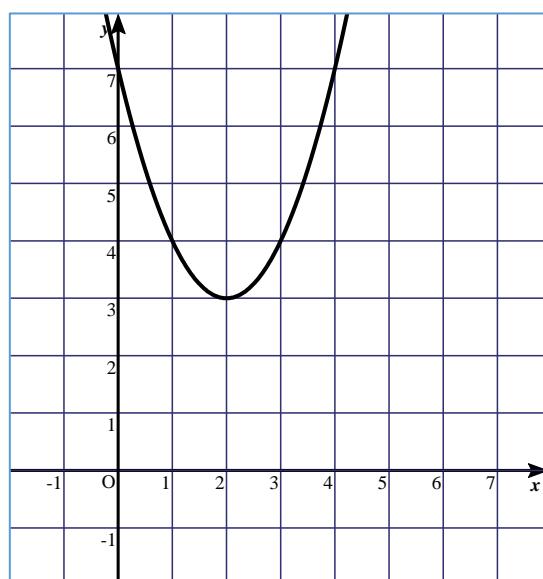
Solution:

- a. For the equation $y = (x - 2)^2 + 3$,
 $a = 1$, $h = 2$ and $k = 3$.

Since $a > 0$, the graph opens upward. The value of h tells the horizontal movement of the graph. Since $h = 2$, the graph moves 2 units to the right. The value of k tells the vertical movement of the graph. Since $k = 3$, the graph moves 3 units upward.

Thus, the graph of $y = (x - 2)^2 + 3$ is the graph of $y = x^2$ moved 2 units to the right and 3 units upward.

Opening: Upward
 Vertex: $(2, 0)$



Axis of symmetry: $x = 2$

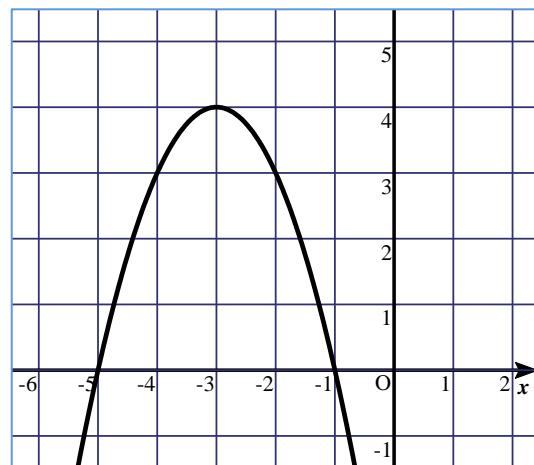
- b. For the equation $y = -(x + 3)^2 + 4$,
 $a = -1$, $h = -3$ and $k = 4$.

Since $a < 0$, the graph opens downward.

Opening: downward

Vertex: $(-3, 4)$

Axis of symmetry: $x = -3$



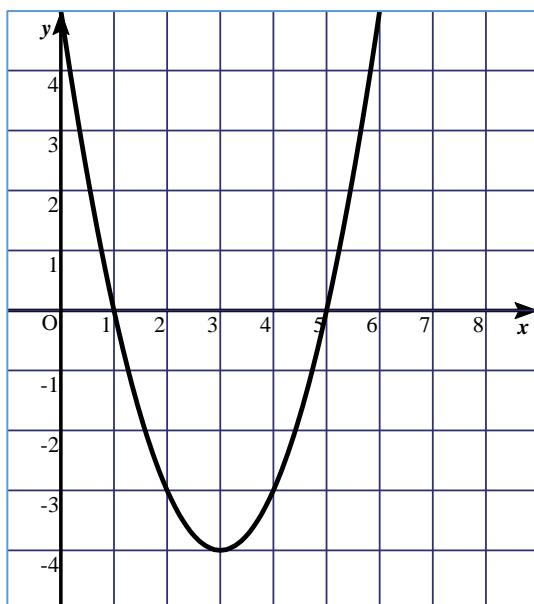
- c. Since $y = x^2 - 6x + 5$ in standard form, transform it to vertex form by completing the squares.

$$\begin{aligned}y &= x^2 - 6x + 5 \\y &= (x^2 - 6x + 9) + 5 - 9 \\y &= (x - 3)^2 - 4\end{aligned}$$

*The original equation
Complete the square
Simplify*

Therefore, $a = 1$, $h = 3$ and $k = -4$.
The graph opens upward, moves 3 units to the right and 4 units down.

Opening: upward
Vertex: $(3, -4)$
Axis of Symmetry: $x = 3$



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d. Since $y = 2x^2 - 4x - 3$ is also in standard form, transform it to vertex form by completing the squares.

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

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

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

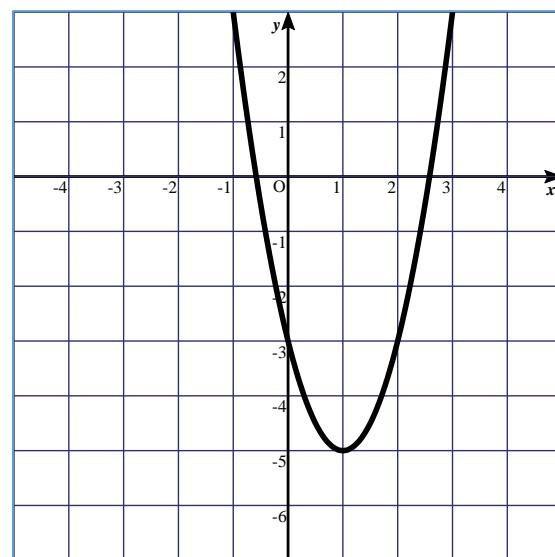
$$y = 2(x - 1)^2 - 5$$

Here we have $a = 2$, the graph is narrower than $y = x^2$ and opens upward. Since $h = 1$, the graph moves 1 unit to the right and since $k = -5$, the graph moves 5 units down.

Opening: Upward

Vertex: $(1, -5)$

Axis of Symmetry: $x = 1$



Are you ready to work on your own? Do your best in the next activity.

WHAT'S MORE

Critical Thinking, Communication and Collaboration



A. Sketch the graph of each quadratic function. Identify the opening of the parabola, the coordinates of the vertex, and the equation for the axis of symmetry.

- | | |
|-------------------------|-------------------------------------|
| 1. $y = x^2 - 7$ | 6. $y = 2x^2 + 3$ |
| 2. $y = (x + 5)^2$ | 7. $y = 2(x - 7)^2$ |
| 3. $y = (x + 3)^2 - 5$ | 8. $y = -2(x + 1)^2 + 5$ |
| 4. $y = -(x - 4)^2 + 3$ | 9. $y = \frac{1}{2}(x - 3)^2 - 2$ |
| 5. $y = -(x - 6)^2 - 4$ | 10. $y = -\frac{1}{2}(x + 2)^2 - 4$ |

B. Transform each equation in vertex form, then sketch the graph.

1. $y = -x^2 - 4x - 7$
2. $y = x^2 - 4x - 1$
3. $y = -3x^2 + 12x - 7$
4. $y = x^2 + 2x - 2$
5. $y = 2x^2 - 4x + 5$

How did you find the activity? Were you able to find out the effects of a , h , and k on the graphs of $y = a(x - h)^2 + k$? If not, in which part did you find challenging? How did you cope up with it?

WHAT I HAVE LEARNED

In the quadratic function $y = a(x - h)^2 + k$, if:

1. $a > 0$, the parabola opens upward and if $a < 0$, the parabola opens downward.
2. $a > 1$ or $a < -1$, the parabola is narrower as compared to $y = x^2$ and wider if $0 < a < 1$.
3. $h > 0$, the parabola translate h units to the right and if $h < 0$, the parabola translate h units to the left.
4. $k > 0$, the parabola translate k units upward and if $k < 0$, the parabola translate k units downward

Now that you are equipped with knowledge on the movements of the graphs of quadratic function particularly in the effect of a , h , and k , it's about time to determine what you can do.

WHAT I CAN DO

Critical Thinking



A. Sketch the graph of each quadratic function. Identify the opening of the parabola, the coordinates of the vertex, and the equation for the axis of symmetry.

- | | |
|-------------------------|------------------------------------|
| 1. $y = (x + 4)^2$ | 6. $y + 1 = 3(x + 2)^2$ |
| 2. $y = -(x - 3)^2$ | 7. $y = (x - 5)^2 + 5$ |
| 3. $y = x^2 - 3$ | 8. $(x + 3)^2 = -y - 6$ |
| 4. $y = -(x + 2)^2 + 5$ | 9. $y - 5 = -4(x - 2)^2$ |
| 5. $y = (x - 4)^2 - 3$ | 10. $y + 3 = \frac{1}{2}(x + 2)^2$ |

B. Transform each equation in vertex form, then sketch the graph.

1. $y = x^2 + 8x - 1$
2. $-x^2 + 6x = y - 5$
3. $-x^2 = -3x - 1 + y$
4. $y + 12x = 4x^2 - 7$
5. $y - 5x^2 = -10x + 9$

ASSESSMENT

Read each item carefully. Identify the choice that best completes the statement or answers the question.

1. What is the vertex form of the equation $y = x^2 - 4x + 7$?

A. $y = (x - 2)^2 - 3$	C. $y = (x + 2)^2 - 3$
B. $y = (x - 2)^2 + 3$	D. $y = (x + 2)^2 + 3$

For numbers 2-4: In the function $y = -2x^2 - 8x$, identify the opening of the graph, coordinates of the vertex and the equation of the axis of symmetry.

2. Opening of the graph

- A. upward
- B. to the right

- C. downward
- D. to the left

3. The coordinates of the vertex

- A. $V(4, -6)$
- B. $V(-2, 8)$

- C. $V(-3, -4)$
- D. $V(4, -8)$

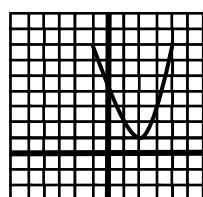
4. The equation of the axis of symmetry

- A. $x = -2$
- B. $x = -3$

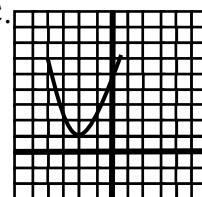
- C. $x = 4$
- D. $x = 8$

5. Sketch the graph of the quadratic function $y = x^2 + 4x + 5$.

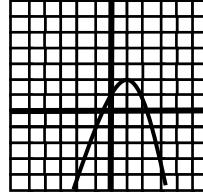
A.



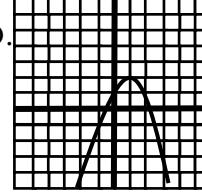
C.



B.



D.



6. The equation of the axis of symmetry of the function $y = -2x^2 + 5x$ is ____.

- A. $x = 5$
- B. $x = -2$

- C. $x = -\frac{4}{3}$
- D. $x = \frac{5}{4}$

7. Which of the following equations of parabola has a wider opening?

A. $y = \frac{1}{4}x^2$

C. $y = 3x^2$

B. $y = \frac{1}{2}x^2$

D. $y = 5x^2$

8. Determine the equation of the resulting graph when the parabola with the equation $y = x^2 + 3$, is shifted 4 units downward.

A. $y = x^2 - 4$

C. $y = x^2 + 1$

B. $y = x^2 - 1$

D. $y = x^2 + 7$

For items 9-10, refer to the graph at the right.

9. Which of the following could be the equation of the parabola?

A. $y = -x^2 + 5$

C. $y = \frac{x^2}{2} + 5$

B. $y = -\frac{x^2}{2} + 5$

D. $y = x^2 + 5$

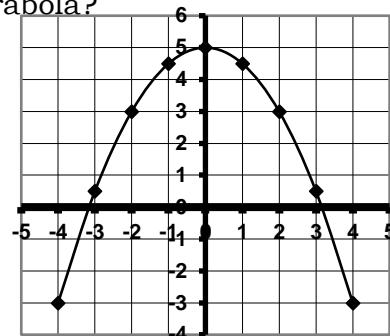
10. What is the vertex of the parabola?

A. $V(-5, 0)$

C. $V(0, 5)$

B. $V(0, -5)$

D. $V(5, 0)$



ADDITIONAL ACTIVITIES

Communication, Critical Thinking,
Creativity and Character Building



Activity 1: Parent Function to a New Function

Can you give the equation of a quadratic function when a parent function is given, directions of its translations, and the multiplying factor for its vertical stretch or vertical compress?

Give the equation of quadratic function in vertex form described by each of the following.

1. The parent function $y = x^2$ is translated 5 units to the right and 4 units down.
2. The parent function $y = x^2$ is reflected across the x-axis, translated 3 units to the left and 11 units up.
3. The parent function $y = x^2$ is vertically compressed by a factor of 3, translated 2 units to the left and 7 units down.
4. The parent function $y = x^2$ is reflected across the x-axis, vertically stretched by a factor of $\frac{1}{4}$, and is translated 8 units to the right and 3 units up.

Activity 2: Reflection

The challenges you are facing during graphing of functions, not only quadratic, can be eased out by using technology. A lot of graphing tools can be used to graph functions in seconds.

What is your stand in using graphing tools during lessons on graphing? Do you think it is necessary to learn first the graphing manually before jumping into technology? On what instances is technology the best option in graphing functions?

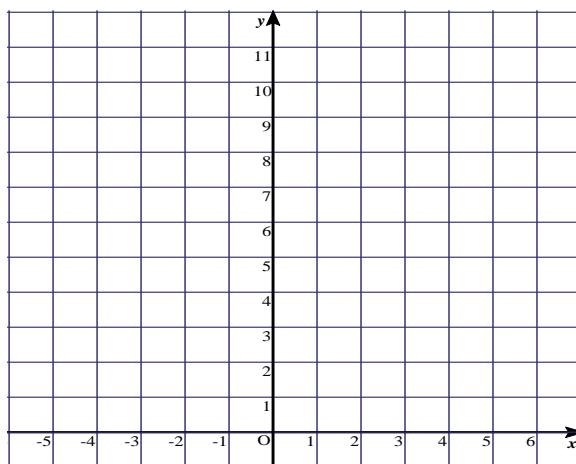
PROBLEM – BASED WORKSHEET

Students of Grade 10 – Edison were asked to write a quadratic function and then graph it. Ana graphs her quadratic function, and the vertex of the graph is $(2, 3)$. While Karen chose the function $y = -x^2 + 7$.

When Karen learned the vertex of Ana's function, she states that her function has a greater maximum value than Ana's. Is Karen correct? Justify your response.

Let's Analyze!

1. In one Cartesian plane, plot Ana's vertex and graph Karen's function.



2. Is Karen correct with her statement? Why or why not?

E-Search

You may also check the following link for your reference and further learnings on the effect of changing the values of a , h , and k on the quadratic function $y = a(x - h)^2 + k$

- <https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-forms-features/v/finding-features-of-quadratic-functions>
- <https://www.slideshare.net/Iyha14/lesson-effects-of-changing-a-h-and-k-in-the-graph-of-quadratic-function>
- <https://courses.lumenlearning.com/waymakercollegealgebra/chapter/transformations-of-quadratic-functions/>
- https://amsi.org.au/ESA_Senior_Years/SeniorTopic2/2a/2a_2content_2.html

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<https://1cdn.edl.io/N7i5exk1yrLmSgNmsIkJDCLpd8QPvCrYYOePL3wLoBHms805.pdf>

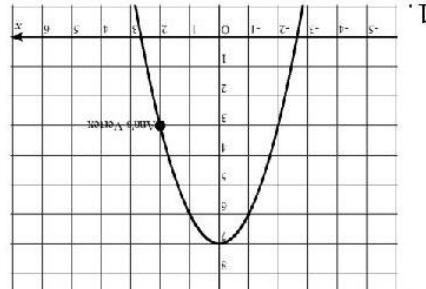
<http://ijms.psd202.org/documents/cklein/1502907329.pdf>

https://www.freepik.com/free-vector/woman-with-long-hair-teaching-online_7707557.htm

https://www.freepik.com/free-vector/kids-having-online-lessons_7560046.htm

https://www.freepik.com/free-vector/illustration-with-kids-taking-lessons-online-design_7574030.htm

2. Karen is correct. She has a maximum value at $y = 7$ while Ana's maximum value is 3.



PROBLEM - BASED WORKSHEET

4. $y = -\frac{1}{4}(x - 8)^2 + 3$

3. $y = 3(x + 2)^2 - 7$

2. $y = -(x + 3)^2 + 11$

1. $y = (x - 5)^2 - 4$

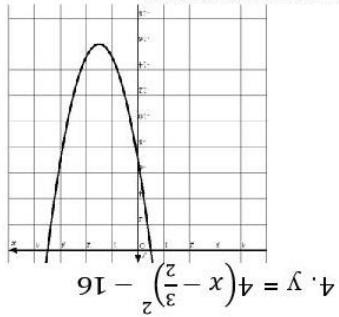
ADDITIONAL ACTIVITIES

1. B
9. B

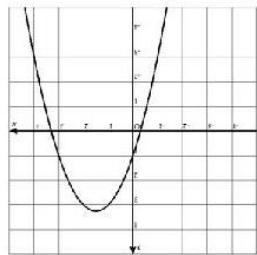
2. C
3. B
5. C
7. A

4. A
6. D
8. B
10. C

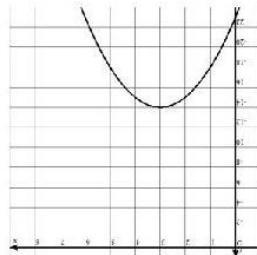
ASSESSMENT



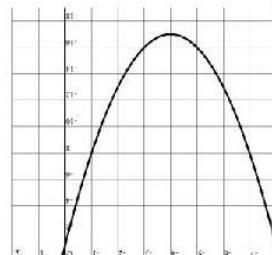
4. $y = 4(x - \frac{3}{2})^2 - 16$



B. 1. $y = (x + 4)^2 - 17$
 $3. y = -(x - 3)^2 + \frac{13}{4}$

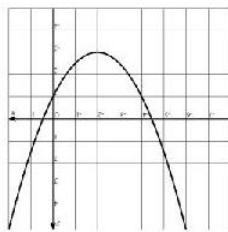


2. $y = -(x - 3)^2 - 14$



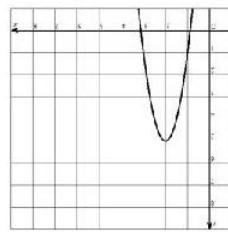
B. 1. $y = (x + 4)^2 - 17$

$x = -2$
Axes of Symmetry:



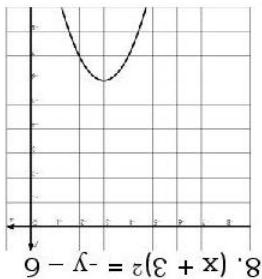
Opening: Upward
Vertex: $(-2, -3)$

$x = 2$
Axes of Symmetry:
Vertex: $(2, 5)$



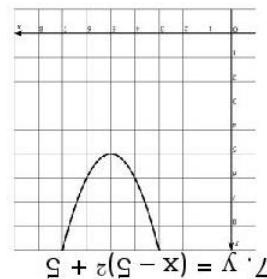
$$9. y - 5 = -4(x - 2)^2$$

$x = -3$
Axes of Symmetry:
Vertex: $(-3, -6)$



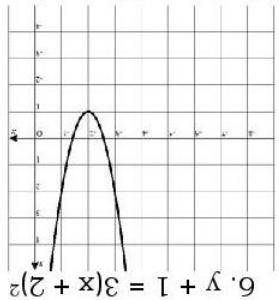
Opening: Downward
Vertex: $(-3, -6)$

$x = 5$
Axes of Symmetry:
Vertex: $(5, 5)$



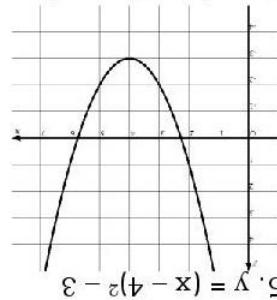
$$7. y = (x - 5)^2 + 5$$

Axes of Symmetry: $x = -2$
Vertex: $(-2, -1)$



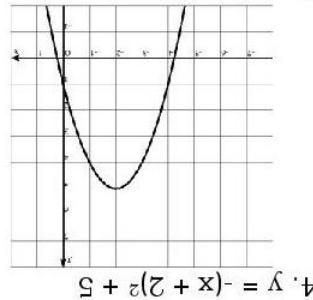
Opening: Upward
Vertex: $(-2, -1)$

Axes of Symmetry: $x = 4$
Vertex: $(4, -3)$



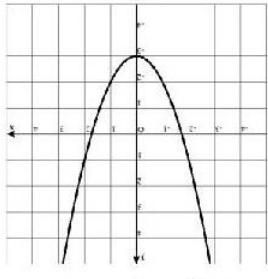
Opening: Upward
Vertex: $(4, -3)$

Axes of Symmetry: $x = -2$
Vertex: $(-2, 5)$



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

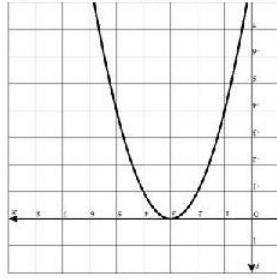
Axes of Symmetry: $x = 0$
Vertex: $(0, -3)$



$$3. y = x^2 - 3$$

Opening: Upward
Vertex: $(0, -3)$

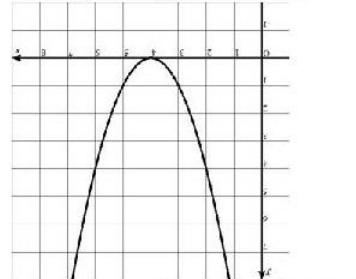
Axes of Symmetry: $x = 3$
Vertex: $(3, 0)$



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

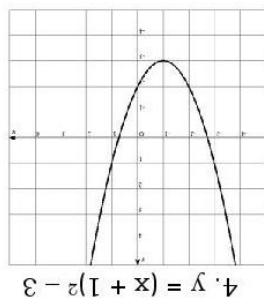
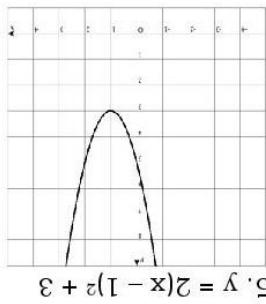
Opening: Downward
Vertex: $(3, 0)$

Axes of Symmetry: $x = 4$
Vertex: $(4, 0)$



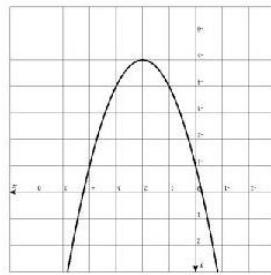
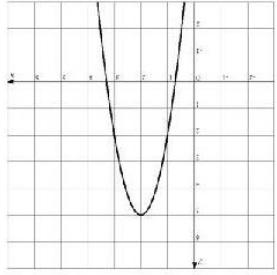
$$A. 1. y = (x - 4)^2$$

WHAT I CAN DO



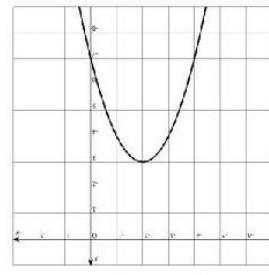
5. $y = 2(x - 1)^2 + 3$

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



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

2. $y = (x - 2)^2 - 5$



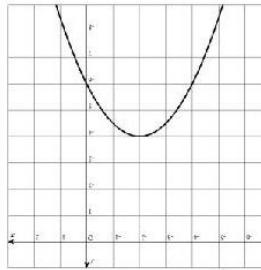
1. $y = -(x + 2)^2 - 3$

B.

Opening: Downward

Vertex: (-2, -4)

Axis of Symmetry: x = -2

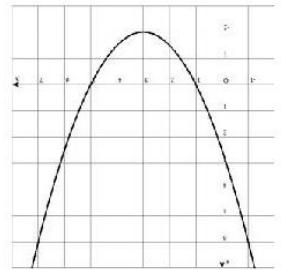


10. $y = \frac{1}{2}(x + 2)^2 - 4$

Opening: Upward

Vertex: (3, -2)

Axis of Symmetry: x = 3

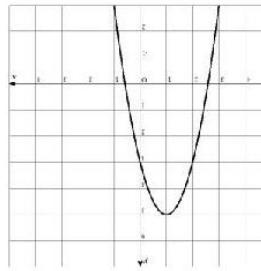


9. $y = \frac{1}{2}(x - 3)^2 - 2$

Opening: Downward

Vertex: (-1, 5)

Axis of Symmetry: x = -1

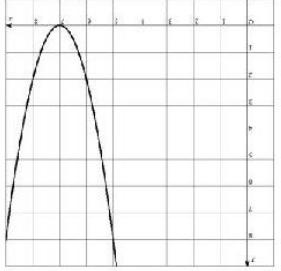


8. $y = -2(x + 1)^2 + 5$

Opening: Upward

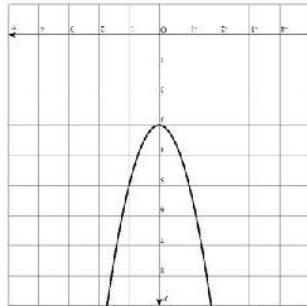
Vertex: (7, 0)

Axis of Symmetry: x = 7



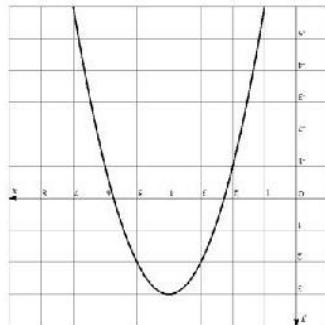
7. $y = 2(x - 7)^2$

Axes of Symmetry: $x = 0$
 Vertex: $(0, 3)$
 Opening: Upward



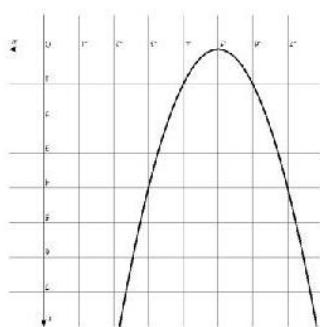
$$6. \quad y = 2x^2 + 3$$

Axes of Symmetry: $x = 4$
 Vertex: $(4, 3)$
 Opening: Downward



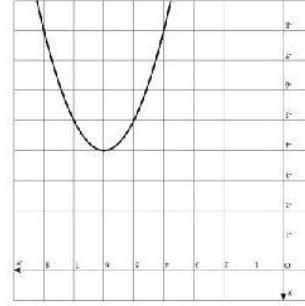
$$4. \quad y = -(x - 4)^2 + 3$$

Axes of Symmetry: $x = -5$
 Vertex: $(-5, 0)$
 Opening: Upward



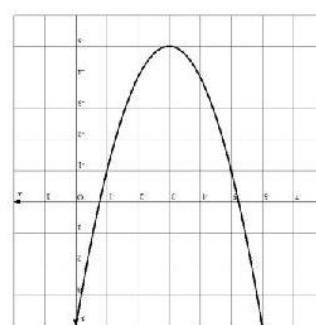
$$2. \quad y = (x + 5)^2$$

Axes of Symmetry: $x = 6$
 Vertex: $(6, -4)$
 Opening: Downward



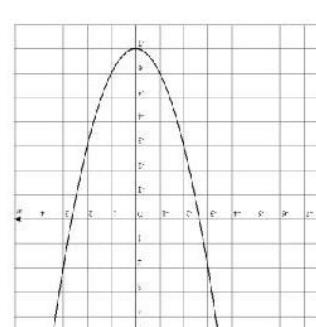
$$5. \quad y = -(x - 6)^2 - 4$$

Axes of Symmetry: $x = -3$
 Vertex: $(-3, -5)$
 Opening: Upward



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

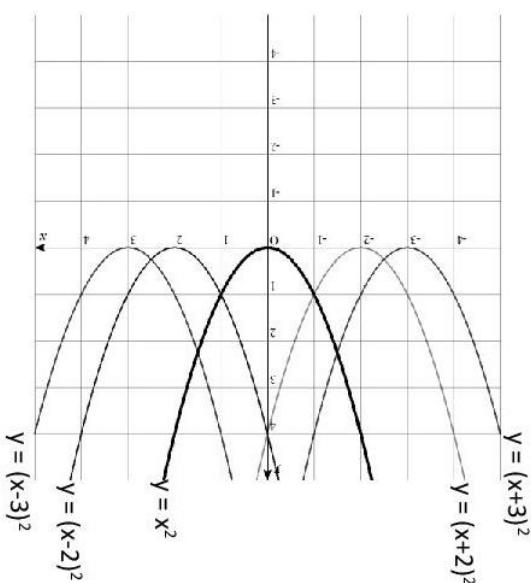
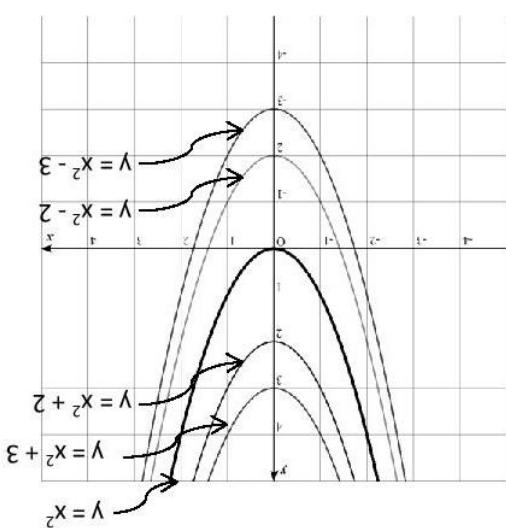
Axes of Symmetry: $x = 0$
 Vertex: $(0, -7)$
 Opening: Upward



$$A. 1. \quad y = x^2 - 7$$

WHAT'S MORE

$$5. Y = x^2 - 3$$



$$4. Y = x^2 - 2$$

$$3. Y = x^2 + 3$$

$$2. Y = x^2 + 2$$

$$1. Y = x^2$$

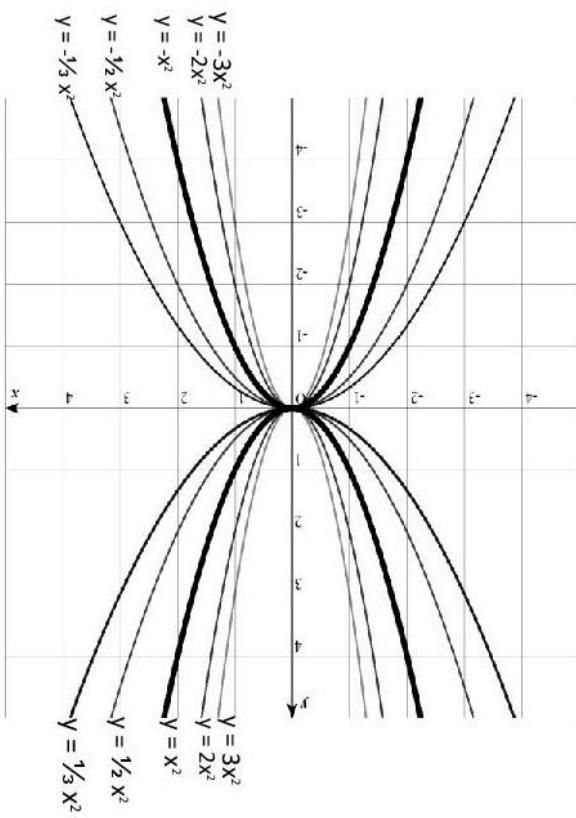
$$5. Y = (x+3)^2$$

$$4. Y = (x+2)^2$$

$$3. Y = (x-3)^2$$

$$2. Y = (x-2)^2$$

$$1. Y = x^2$$



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

8. $y = -3x^2$

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

7. $y = -2x^2$

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

6. $y = -x^2$

y	12	3	0	3	12
x	-6	-3	0	3	6

5. $y = \frac{1}{6}x^2$

y	8	2	0	2	8
x	-4	-2	0	2	4

4. $y = \frac{1}{2}x^2$

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

3. $y = 3x^2$

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

2. $y = 2x^2$

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

1. $y = x^2$

WHAT'S IN

1. B 2. D 3. A 4. C
5. D 6. D 7. A 8. B
9. C 10. A

WHAT I KNOW

ANSWER KEY