9

Mathematics

Quarter 1 – Module 7
Vertex Form of the Quadratic Function

DepED
DEPARTMENT OF EDUCATION

Reminders to Learners

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *What I Know* before moving on to the other activities included in this module.
3. Read the instructions carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your teacher/facilitator once you are through with it.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone.

We hope that through this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. You can do it!

About the Module

This module was designed and written with you in mind. It is here to help you master about **Vertex Form of the Quadratic Function**. The scope of this module permits it to be used in many different learning situations. The language used here recognizes your diverse vocabulary level. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

The module is divided into three lessons:

- Lesson 1 – Vertex Form of the Quadratic Function Using the Completing the Square Method when $a = 1$
- Lesson 2 – Vertex Form of the Quadratic Function Using the Completing the Square Method when $a > 1$
- Lesson 3 – Vertex Form of the Quadratic Function Using the HK Method

After working on this module, you are expected to:

- transform the quadratic function defined by its standard form $y = ax^2 + bx + c$ into its vertex form $y = a(x - h)^2 + k$ using:
  a. completing the square method, and
  b. h and k method

What I Know (Pre-Test)

Instructions: Read each item carefully. Choose the letter of the correct answer and write it on a separate sheet of paper.

1. Which of the following represents the standard form of the quadratic function?
   a. $ax^2 + bx + c = 0$ c. $y = ax^2 + bx + c$
   b. $y = a(x - h)^2$ d. $y = a(x - h)^2 + k$

2. What is the value of the 3rd term of the quadratic function $y = x^2 - 7x$ to make it a perfect square trinomial?
   a. $\frac{7}{2}$ b. $\frac{49}{4}$ c. 14 d. 49

3. How shall we write the vertex form of the quadratic function $y = x^2 - 8x + 6$?
   a. $y = (x - 4)^2 + 10$ c. $y = (x + 10)^2 + 4$
   b. $y = (x - 4)^2 - 10$ d. $y = (x - 10)^2 - 4$

4. What is the value of $\boldsymbol{h}$ when writing the quadratic function $y = x^2 + 10x + 21$ in vertex form?
   a. – 5 c. – 20
   b. – 10 d. – 25

5. Which of the following does NOT represent vertex form of the quadratic function?
   I. $y = 3(x + 4)^2 - 8$ a. I and III c. II and IV
   II. $y = x^2 - 7x - 15$ b. II only d. IV only
   III. $y + 2 = (x - 6)^2$
   IV. $y = x^2 - 169$

6. What should be the 3rd term of this quadratic function $y = 2x^2 + 8x$ to make it a perfect square trinomial?
   a. 2 c. 8
   b. 4 d. 16

7. What are the binomial factors of this perfect square trinomial $y = x^2 - 12x + 36$?
   a. $(x + 6)(x - 6)$ c. $(x - 3)(x - 12)$
   b. $(x + 3)(x + 12)$ d. $(x - 6)(x - 6)$

8. Which of the following functions represents the vertex form of $y = x^2 + 16x + 31$?
   a. $y = (x + 8)^2 - 33$ c. $y = (x - 8)^2 - 33$
   b. $y = (x + 8)^2 + 95$ d. $y = (x - 8)^2 - 95$

9. What is the value of k when writing the quadratic function $y = x^2 + 10x + 21$ in vertex form?
   a. 2 c. 4
   b. – 2 d. – 4

10. How shall we write the vertex form of the quadratic function $y = 2x^2 - 12x + 5$?
    a. $y = 2(x - 3)^2 + 13$ c. $y = 2(x + 13)^2 + 3$
    b. $y = 2(x - 3)^2 - 13$ d. $y = 2(x - 13)^2 - 3$

Lesson 1	Vertex Form of the Quadratic Function Using Completing the Square Method when $a = 1$

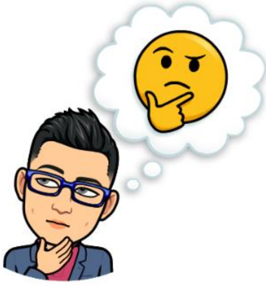
What I Need to Know

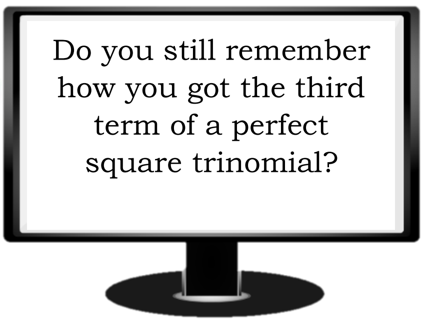
At the end of this lesson, you are expected to:

- transform the quadratic function from standard form to its vertex form using completing the square method when $a = 1$

What's In

❖ ***Flashback***





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Short Quiz: Supply the missing 3rd term of each expression to complete the perfect square trinomial. Solution for number 1 is given as guide.

1. $x^2 - 8x + \mathbf{16}$
2. $x^2 + 14 +$ ___
3. $b^2 - 16b +$ ___
4. $n^2 + 7n +$ ___
5. $p^2 - 9p +$ ___

What's New

As you would recall in Module 1 of this quarter, 3rd term of a perfect square trinomial can be derived by squaring the half of the coefficient of the middle term, bx, written in symbols as, $\boldsymbol{ax^2 + bx + \left(\frac{b}{2}\right)^2}$ can be used to answer the activity in ***What's In***.

This process of supplying the 3rd term of a perfect square trinomial is helpful in solving for the roots of this quadratic equation $\boldsymbol{x^2 + 8x + 12 = 0}$ using completing the square method as shown on the next page.

Here's how to solve it using completing the square method.

$\boldsymbol{x^2 + 8x + 12 = 0}$

$x^2 + 8x + \_\_ = -12 + \_\_$

$x^2 + 8x + \mathbf{16} = -12 + \mathbf{16}$ **step 1**

$(x+4)(x+4) = 4$ **step 2**

$\sqrt{(x+4)^2} = \sqrt{4}$ **step 3**

$x + 4 = \pm 2$

$x = -4 \pm 2$ **step 4**

$\boldsymbol{x_1 = -4 + 2 = -2}$ **step 5**

$\boldsymbol{x_2 = -4 - 2 = -6}$

Completing the Square Method when $a = 1$

If $ax^2 + bx + c = 0$ is not factorable whose $a = 1$, we do the following:

1. transfer the 3rd term to the other side of the equation and add 3rd term of the perfect square trinomial on both sides of the equation;
2. factor the perfect square trinomial on the left and add the values on the right side;
3. extract the root of both sides of the equation;
4. find the value of x by transferring the constant of the binomial $x + 4$ to the right side of the equation; and
5. determine the roots or values of x by combining the numbers in the equation.

What Is It?

❖ ***Let's Brighten Up***

Do you still remember the process of solving the roots of a quadratic equation by completing the square method above?

In solving quadratic equation using completing the square, we notice that the third term of the original equation is being transferred to the right side before adding the 3rd term of the perfect square trinomial on both sides to maintain the equality of both sides of the equation. And as the process continues, roots have been derived represented by x_1 *and* x_2, respectively.

On the other hand, the process of transforming quadratic functions from standard form denoted by $y = ax^2 + bx + c$ into its vertex form denoted by $y = a(x-h)^2 + k$ can be done using completing the square. How can this be possible? Can you illustrate?

Here's how.....

Transforming Quadratic Functions from Standard Form to Vertex Form when $a = 1$ using Completing the Square (CTS) Method

In order to transform quadratic function from standard form $y = ax^2 + bx + c$ to its vertex form $y = a(x-h)^2 + k$, do the following steps:

1. Like CTS method in solving quadratic equation, we isolate the 3rd term of the given equation into another sub-group or parenthesis in order to supply the missing 3rd term of the perfect square trinomial of the given equation considering the following conditions, as follows:
   - If $y = ax^2 + bx + c$ contains **3rd term that is positive**, then the additional 3rd term on same side shall contain **(+, -)** signs on the sub-group polynomials

- If $y = ax^2 + bx + c$ contains **3rd term that is negative**, then the additional 3rd term on same side shall contain **(+, +)** signs on the sub-group polynomials

2. Factor out the first sub-group of polynomials into two equal binomials since it is a perfect square trinomial and combine also the numbers on the second sub-group of polynomial right after;
3. Rewrite the two equal binomials into a square of a binomial and copy the number on the second sub-group following the sign of the greater number.

And, that's it! We now have transformed the quadratic function into its vertex form $\boldsymbol{y = a(x-h)^2 + k}$

To clearly visualize the said concept above, look at these examples below.

Examples for transforming quadratic function into vertex form using CTS (Completing the Square) method when $a = 1$

1. $\boldsymbol{y = x^2 - 12x + 30}$ $y = (x^2 - 12x + 36) + (30 - 36)$ **step 1** $y = (x - 6)(x - 6) + (-6)$ **step 2** $\boldsymbol{y = (x - 6)^2 - 6}$ **step 3**	Step 1. Separate 30 on the 2nd sub-group in order to get the 3rd term of the perfect square trinomial by squaring the half of 12, which is 36. Step2. When factoring a perfect square trinomial, it would give you two identical binomials $(x-6)(x-6)$ and add the result of the 2nd sub-group which is – 6 before rewriting the whole solution in vertex form.
2. $\boldsymbol{y = x^2 + 4x - 9}$ $y = (x^2 + 4x + 4) - (9 + 4)$ **step 1** $y = (x + 2)(x + 2) - (13)$ **step 2** $\boldsymbol{y = (x + 2)^2 - 13}$ **step 3**	Step 1. Separate 9 on the 2nd sub-group in order to get the 3rd term of the perfect square trinomial by squaring the half of 4, which is 4. Step2. When factoring a perfect square trinomial, it would give you two identical binomials $(x+2)(x+2)$ and add the result of the 2nd sub-group which is 13 before rewriting the whole solution in vertex form.
3. $\boldsymbol{y = x^2 + 9x + 15}$ $y = \left(x^2 + 9x + \frac{81}{4}\right) + (15 - \frac{81}{4})$ **step 1** $y = \left(x + \frac{9}{2}\right)\left(x + \frac{9}{2}\right) + (\frac{60 - 81}{4})$ **step 2** $\boldsymbol{y = (x + \frac{9}{2})^2 - \frac{21}{4}}$ **step 3**	Step 1. Separate 15 on the 2nd sub-group in order to get the 3rd term of the perfect square trinomial by squaring the half of 9, which is $\frac{81}{4}$. Step2. When factoring a perfect square trinomial, it would give you two identical binomials $\left(x+\frac{9}{2}\right)\left(x+\frac{9}{2}\right)$ and add the result of the 2nd sub-group using LCD which will give you $-\frac{21}{4}$ before rewriting the whole solution in vertex form.
4. $\boldsymbol{y = x^2 - 5x - 7}$ $y = \left(x^2 - 5x + \frac{25}{4}\right) - (7 + \frac{25}{4})$ **step 1** $y = \left(x - \frac{5}{2}\right)\left(x - \frac{5}{2}\right) - (\frac{28+25}{4})$ **step 2** $\boldsymbol{y = (x - \frac{5}{2})^2 - \frac{53}{4}}$ **step 3**	Step 1. Separate 7 on the 2nd sub-group in order to get the 3rd term of the perfect square trinomial by squaring the half of 5, which is $\frac{25}{4}$. Step2. When factoring a perfect square trinomial, it would give you two identical binomials $\left(x-\frac{5}{2}\right)\left(x-\frac{5}{2}\right)$ and add the result of the 2nd sub-group using LCD which will give you $\frac{53}{4}$ before rewriting the whole solution in vertex form.

What's More

Activity 7.1: NOW IT'S YOUR TURN!
Instruction: Write the function in vertex form using completing the square method.

1. $y = x^2 - 4x + 6$	2. $y = x^2 + 2x + 5$	3. $y = x^2 - 10x + 17$
4. $y = x^2 - 3x - 9$	5. $y = x^2 + 5x - 12$	6. $y = x^2 - 9x - 16$

What I Need To Remember

When using Completing the Square method in rewriting quadratic functions in vertex form, you need to remember the following:

- If $y = ax^2 + bx + c$ contains **3rd term that is positive**, then the additional 3rd term on both sides shall contain **(+, -)** signs on the sub-group polynomials
- If $y = ax^2 + bx + c$ contains **3rd term that is negative**, then the additional 3rd term on both sides shall contain **(+, +)** signs on the sub-group polynomials

Lesson 2

Vertex Form of the Quadratic Function Using Completing the Square Method when $a > 1$

What I Need to Know

At the end of this lesson, you are expected to:

- transform the quadratic function from standard form to its vertex form using completing the square method when a > 1.

What's In

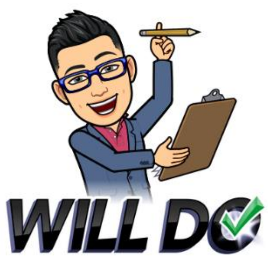
Looking back at the examples we had in Lesson 1, items 1 and 4 of page 8 were transformed into vertex form using completing the square method where the middle term represented by ***bx*** are even and odd numbers aside from its given ***third term*** that were algebraically transformed due to the fact that we need to come up with a perfect square trinomial within the process of solving.

1. $y = x^2 - 12x + 30$	
$y = (x^2 - 12x + 36) + (30 - 36)$	**step 1**
$y = (x - 6)(x - 6) + (-6)$	**step 2**
$\boldsymbol{y = (x - 6)^2 - 6}$	**step 3**

4. $y = x^2 - 5x - 7$	
$y = \left(x^2 - 5x + \frac{25}{4}\right) - (7 + \frac{25}{4})$	**step 1**
$y = \left(x - \frac{5}{2}\right)\left(x - \frac{5}{2}\right) - (\frac{28+25}{4})$	**step 2**
$\boldsymbol{y = (x - \frac{5}{2})^2 - \frac{53}{4}}$	**step 3**

Could you still remember these three-step process of transforming quadratic functions from standard to vertex form?

What's New



Short Quiz: Identify the leading coefficient or the value of a in the given quadratic functions in standard form?

1. $y = x^2 - 8x + 11$ __________
2. $y = x^2 + 12x - 16$ __________
3. $y = 2x^2 - 15x + 4$ __________
4. $y = 3x^2 + 6x - 10$ __________
5. $y = 5x^2 - 10x + 20$ __________

Follow up Questions:

1. What have you observed with the values of a in numbers 1 to 5 above?
2. What do you think would be the approach in transforming quadratic functions when $a > 1$?
3. What steps in Lesson 1 that are still applicable to Lesson 2?

What Is It?

❖ ***How should I do it?***

Since the coefficient of the first term is greater than 1, you will solve it in a different way like the process presented in the table on page 11. Study the samples for you to familiarize the process of rewriting quadratic functions in standard form into its vertex form using **completing the square (CTS) method**.

Transforming Quadratic Functions from Standard Form to Vertex Form when $a > 1$ using CTS (Completing the Square) Method In order to transform quadratic function from standard form $y = ax^2 + bx + c$ to its vertex form $y = a(x - h)^2 + k$, we shall do the following steps:	
1. Transfer the 3rd term of the given equation to the left side joining variable y and signs of these terms has been changed due to APE or Addition Property of Equality;	$y = 2x^2 - 4x + 5$ $y - 5 = 2x^2 - 4x$
2. You need a leading coefficient of 1 for completing the square, so you factor out the current leading coefficient of the binomial on the right side;	$y - 5 = 2\ (x^2 - 2x)$
3. As you supply the missing 3rd term of the perfect square trinomial on the right side which will be multiplied to the factored number outside the trinomial, the same will be added to the left side of the equation.	$y - 5 + 2(1) = 2(x^2 - 2x + 1)$
4. Simplify and find the binomial factors of the trinomial on the right side.	$y - 3 = 2(x - 1)(x - 1)$
5. Convert the right side into a squared expression and transfer the number found on the left going right side of the equation by changing its sign because of APE or addition property of equality.	$y = 2(x - 1)^2 + 3$

More examples in transforming quadratic functions into vertex form using CTS method when $a > 1$

1. $\boldsymbol{y = 2x^2 - 12x + 19}$

$y - 19 = 2x^2 - 12x$	**step 1**
$y - 19 = 2(x^2 - 6x + \_)$	**step 2**
$y - 19 + 2(9) = 2(x^2 - 6x + 9)$	**step 3**
$y - 19 + 18 = 2(x - 3)(x - 3)$	**step 4**
$y - 1 = 2(x - 3)^2$	
$\boldsymbol{y = 2(x - 3)^2 + 1}$	**step 5**

2. $\boldsymbol{y = 2x^2 + 16x + 31}$

$y - 31 = 2x^2 + 16x$	**step 1**
$y - 31 = 2(x^2 + 8x + \_)$	**step 2**
$y - 31 + 2(16) = 2(x^2 + 8x + 16)$	**step 3**
$y - 31 + 32 = 2(x + 4)(x + 4)$	**step 4**
$y + 1 = 2(x + 4)^2$	
$\boldsymbol{y = 2(x + 4)^2 - 1}$	**step 5**

Guide Questions:

1. What will you do first with the given function? What happens to the sign of the number being transferred to the other side of the function?
2. How are you going to form a perfect square trinomial given the remaining expression $ax^2 + bx$ on the right side of the function?
3. How will you get the 3rd term of the perfect square trinomial on the right side of the function? And what will you do with the 3rd term since it is added to your function on the right side? Why should it be added also on the left side of the function?
4. Why do you need to get the binomial factors of the perfect square trinomial on the right side? What does it have to do with the vertex form of the quadratic function? And what are the resulting binomials when factoring a perfect square trinomial?
5. How do you rewrite two same binomial factors in one expression? What are you going to do with the number that is found at the left side of the function? What does it represent in the vertex form of quadratic function?

$\mathbf{3.\ y = 3x^2 + 9x - 12}$

$y + 12 = 3x^2 + 9x$ **step1**

$y + 12 = 3(x^2 + 3x + \_\_)$ **step2**

$y + 12 + 3\left(\frac{9}{4}\right) = 3(x^2 + 3x + \frac{9}{4})$ **step3**

$y + 12 + \frac{27}{4} = 3(x + \frac{3}{2})(x + \frac{3}{2})$ **step4**

$$y + \frac{48 + 27}{4} = 3(x + \frac{3}{2})^2$$

$$y + \frac{75}{4} = 3(x + \frac{3}{2})^2$$

$\mathbf{y = 3(x + \frac{3}{2})^2 - \frac{75}{4}}$ **step5**

$\mathbf{4.\ y = 3x^2 - 11x - 8}$

$y + 8 = 3x^2 - 11x$ **step1**

$y + 8 = 3(x^2 - \frac{11}{3}x + \_\_)$ **step2**

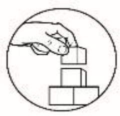
$y + 8 + 3\left(\frac{121}{36}\right) = 3(x^2 - \frac{11}{3}x + \frac{121}{36})$ **step3**

$y + 8 + \frac{121}{12} = 3(x - \frac{11}{6})(x - \frac{11}{6})$ **step4**

$$y + \frac{96 + 121}{12} = 3(x - \frac{11}{6})^2$$

$$y + \frac{217}{12} = 3(x - \frac{11}{6})^2$$

$\mathbf{y = 3(x - \frac{11}{6})^2 - \frac{217}{12}}$ **step5**



What's More

Activity 7.2: NOW IT'S YOUR TURN!

Instruction: Write the function in vertex form using completing the square method.

1. $y = 2x^2 - 16x + 10$	2. $y = 2x^2 + 7x - 6$
3. $y = 3x^2 - 5x + 1$	4. $y = 6x^2 - 12x + 5$

What I Need to Remember

When using **Completing the Square (CTS) Method** in rewriting quadratic functions whose $a > 1$ in vertex form, we should be able to:

- supply the 3rd term of the perfect square trinomial
- identify the factor outside the trinomial that is paired with the missing 3rd term of the perfect square trinomial
- find the binomial factors of the perfect square trinomial
- simplify and convert the binomials into a squared expression
- transfer the number from the left to the right side of the equation to achieve the vertex form $y = a(x - h)^2 + k$

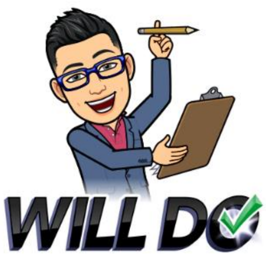
Lesson 3	**Vertex Form of the Quadratic Function Using (h, k) Method**

What I Need to Know

At the end of this lesson, you are expected to:

- transform the quadratic function from standard form to its vertex form using HK method

What's In



Short Quiz: Identify which of the given quadratic functions can be written in vertex form. Write YES if it can be written in vertex form otherwise, NO if not.

1. $y - 25 = 5x^2 + x$ _________
2. $y = (x - 3)^2 + 12$ _________
3. $y + 2 = 7x + 2x^2$ _________
4. $y + 4 = 2(x + 7)^2$ _________
5. $y - 8 = (x - 1)^2 + 7$ _________

Follow up Questions:

1. What items from the given short quiz above can be written in vertex form? What made you say so?
2. What about those items that cannot be written or are not written in vertex form? How can we transform or rewrite them into vertex form?

What's New

Based on the activity ***Short Quiz***, item number 2 is already written in vertex form while item number 4 can be rewritten in vertex form by transferring positive 4 to the right side of the function making it negative 4 based on SPE or subtraction property of equality. Also, item number 5 can be rewritten in vertex form by combining negative 8 to positive 7 on the right side of the function making it 15 by APE or addition property of equality.

On the other hand, item numbers 1 and 3 can only be written in its standard form as follows: 1.) $\boldsymbol{y = 5x^2 + x + 25}$ and 3.) $\boldsymbol{y = 2x^2 + 7x - 2}$.

So, with these answers, are there other ways that you can transform these two quadratic functions from its standard form into its vertex form aside from using the process of completing the square?

What Is It?

❖ ***How should I do it?***

When working with the vertex form of a quadratic function, you simply identify and plug-in the values of a and b of the given equation in standard form $y = ax^2 + bx + c$ to the formula, $\boldsymbol{h = \frac{-b}{2a}}$ **and** $\boldsymbol{k = f(h)}$ where $f(h)$ means to plug your answer for $\boldsymbol{h}$ into the original equation for $\boldsymbol{x}$.

Transforming Quadratic Functions from Standard Form to Vertex Form Using HK Method

In order to transform quadratic function from standard form $y = ax^2 + bx + c$ into its vertex form $y = a(x-h)^2 + k$, we shall do the following steps:

1. Identify the values of a and b of the given equation	$\boldsymbol{y = 2x^2 - 4x + 5}$ $a = 2 \text{ and } b = -4$
2. Plug-in the values of a and b to the formula $\boldsymbol{h = \frac{-b}{2a}}$	$\boldsymbol{h} = \frac{-(-4)}{2(2)} = \frac{4}{4} = \boldsymbol{1}$
3. Plug-in your answer for h to the formula $k = f(h) = f(x)$	$k = f(x) = 2(1)^2 - 4(1) + 5$ $k = 2(1) - 4 + 5$ $\boldsymbol{k = 3}$
4. Write the vertex form $\boldsymbol{y = a(x-h)^2 + k}$ given the values of $a, h \text{ and } k$	$\boldsymbol{y = 2(x-1)^2 + 3}$

To clearly visualize the said concept above, let us look at these additional examples below.

$\boldsymbol{1. y = x^2 + 10x + 21}$
$a = 1, b = 10, c = 21$ **step1**
$\boldsymbol{h = -\frac{10}{2(1)} = -5}$ **step2**
substitute the value of h to the function
$k = f(x) = f(h)$
$k = (-5)^2 + 10(-5) + 21$ **step3**
$k = 25 - 50 + 21$
$\boldsymbol{k = -4}$
so, the vertex form of equation will be
$\boldsymbol{y = (x+5)^2 - 4}$ **step4**

$\boldsymbol{2. y = x^2 - 4x + 6}$
$a = 1, b = -4, c = 6$ **step1**
$\boldsymbol{h = -\frac{(-4)}{2(1)} = 2}$ **step2**
substitute the value of h to the function
$k = f(x) = f(h)$
$k = (2)^2 - 4(2) + 6$ **step3**
$k = 4 - 8 + 6$
$\boldsymbol{k = 2}$
so, the vertex form of equation will be
$\boldsymbol{y = (x-2)^2 + 2}$ **step4**

$\mathbf{3.\, y = x^2 + 12x - 7}$

$a = 1, b = 12, c = -7$ **step1**

$\boldsymbol{h = -\frac{12}{2(1)} = -6}$ **step2**

substitute the value of h to the function

$k = f(x) = f(h)$

$k = (-6)^2 + 12(-6) - 7$ **step3**

$k = 36 - 72 - 7$

$\boldsymbol{k = -43}$

so, the vertex form of equation will be

$\boldsymbol{y = (x + 6)^2 - 43}$ **step4**

$\mathbf{4.\, y = x^2 - 8x - 2}$

$a = 1, b = -8, c = -2$ **step1**

$\boldsymbol{h = -\frac{(-8)}{2(1)} = 4}$ **step2**

substitute the value of h to the function

$k = f(x) = f(h)$

$k = (4)^2 - 8(4) - 2$ **step3**

$k = 16 - 32 - 2$

$\boldsymbol{k = -18}$

so, the vertex form of equation will be

$\boldsymbol{y = (x - 4)^2 - 18}$ **step4**

What's More

Activity 7.3: NOW IT'S YOUR TURN!

Instruction: Solve for the values of h and k before rewriting the function in vertex form using HK method.

1. $y = x^2 - 12x + 36$	2. $y = x^2 + 8x + 15$	3. $y = x^2 - 4x + 9$
4. $y = 4x^2 + 24x + 32$	5. $y = 3x^2 + 6x - 15$	6. $y = 2x^2 - 4x - 8$

What I Need to Remember

Remember this!

Notice that the $\boldsymbol{h}$ *value is* subtracted in the vertex form $\boldsymbol{y = a(x - h)^2 + k}$ and that the $\boldsymbol{k}$ value is added. This means that;

- when $\boldsymbol{h}$ is positive, the expression will be $(x - h)^2$
- when $\boldsymbol{h}$ is negative, the expression will be $(x + h)^2$

regardless if the sign of $\boldsymbol{k}$ is positive or negative.

Assessment (Post Test)

Instructions: Choose the letter of the correct answer. Write your chosen answer on a separate sheet of paper.

1. Which of the following represents the vertex form of the quadratic function?
   a. $y = (x - h)^2 + (x - h)^2$
   b. $y = a(x - h)^2$
   c. $y = ax^2 + bx + c$
   d. $y = a(x - h)^2 + k$

2. What is the value of the 3rd term of the quadratic function $y = x^2 - 11x$ to make it a perfect square trinomial?
   a. $\frac{11}{2}$
   b. $\frac{22}{4}$
   c. $\frac{121}{4}$
   d. $\frac{141}{4}$

3. How shall we write the vertex form of the quadratic function $y = x^2 - 6x - 4$?
   a. $y = (x - 3)^2 + 13$
   b. $y = (x - 3)^2 - 13$
   c. $y = (x + 13)^2 + 3$
   d. $y = (x - 13)^2 - 3$

4. What is the value of $\boldsymbol{h}$ when writing the quadratic function $y = x^2 + 4x - 9$in vertex form?
   a. – 12
   b. – 8
   c. – 6
   d. – 2

5. Which of the following does represent vertex form of the quadratic function?
   I. $y = 3(x + 4)^2 - 8$
   II. $y = x^2 - 7x - 15$
   III. $y + 2 = (x - 6)^2$
   IV. $y = x^2 - 169$
   a. I and III
   b. II only
   c. II and IV
   d. IV only

6. What should be the 3rd term of this quadratic function $y = 3x^2 + 18x$ to make a perfect square trinomial?
   a. 3
   b. 6
   c. 9
   d. 12

7. What are the binomial factors of this perfect square trinomial $y = x^2 + 18x + 81$?
   a. $(x + 9)(x + 9)$
   b. $(x + 27)(x + 3)$
   c. $(x - 27)(x - 3)$
   d. $(x - 9)(x - 9)$

8. Which of the following functions represents the vertex form of $y = x^2 - 12x - 18$?
   a. $y = (x - 6)^2 - 54$
   b. $y = (x - 6)^2 + 18$
   c. $y = (x + 6)^2 - 54$
   d. $y = (x + 6)^2 + 18$

9. What is the value of k when writing the quadratic function $y = x^2 + 10x - 17$in vertex form?
   a. 22
   b. – 22
   c. 42
   d. – 42

10. How shall we write the vertex form of the quadratic function $y = 2x^2 - 12x + 19$?
    a. $y = 2(x - 3)^2 + 1$
    b. $y = 2(x - 3)^2 - 1$
    c. $y = 2(x - 3)^2 + 37$
    d. $y = 2(x - 3)^2 - 37$

Answer Key

Remember: This portion of the module contains all the answers. Your **HONESTY** is required.

Activity 8.1

1. $y = (x-2)^2 + 2$
2. $y = (x+1)^2 + 4$
3. $y = (x-5)^2 - 8$
4. $y = \left(x - \frac{3}{2}\right)^2 - \frac{45}{4}$
5. $y = \left(x + \frac{5}{2}\right)^2 - \frac{73}{4}$
6. $y = \left(x - \frac{9}{2}\right)^2 - \frac{145}{4}$

Activity 8.2

1. $y = 2(x-4)^2 - 22$
2. $y = 2\left(x + \frac{7}{4}\right)^2 - \frac{97}{8}$
3. $y = 3\left(x - \frac{5}{6}\right)^2 - \frac{13}{12}$
4. $y = 6(x-1)^2 - 1$

Activity 8.3

1. $h = 6$ and $k = 0$
   $y = (x-6)^2$
2. $h = -4$ and $k = -1$
   $y = (x+4)^2 - 1$
3. $h = 2$ and $k = 5$
   $y = (x-2)^2 + 5$
4. $h = -3$ and $k = -4$
   $y = 4(x+3)^2 - 4$
5. $h = -1$ and $k = -18$
   $y = 3(x+1)^2 - 18$
6. $h = 1$ and $k = -10$
   $y = 2(x-1)^2 - 10$

References

Textbook

Gueta, Maria Fe Rebecca D. "Quadratic Functions of the Form: $f(x) = a(x-h)^2 + k$", Math Digest: Advanced Algebra. Caneo Enterprises, 7344 A. Bonifacio Ext., San Dionisio, Parañaque City, Philippines. Copyright 2007.

Websites

"Vertex Form of a Quadratic Function," CK-12 Foundation, accessed Aug. 12, 2020, https://www.ck12.org/book/ck-12-algebra-i-concepts-honors/

Cliparts

Clipart 1: retrieved July 9, 2020, shorturl.at/hnrAH
All clip arts are taken from cellphone app named Bitmoji

Congratulations!

You are now ready for the next module. Always remember the following:

1. Make sure every answer sheet has your
   - *Name*
   - *Grade and Section*
   - *Title of the Activity or Activity No.*
2. Follow the date of submission of answer sheets as agreed with your teacher.
3. Keep the modules with you AND return them at the end of the school year or whenever face-to-face interaction is permitted.