9

Mathematics
Quarter 1-Module 16
Representing Quadratic Function using Equation
Week 6
Learning Code - **M9AL-Ig-11.2**

Learning Module for Junior High School Mathematics

Quarter 1 – Module 16 – **New Normal Math for G9**
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MODULE 16	REPRESENTING QUADRATIC FUNCTION USING EQUATION

Given the function $f(x) = ax^2 + bx + c$ or $y = ax^2 + bx + c$, where a, b, c are real numbers and $a \neq 0$, if we set this function to be equal to zero we have $ax^2 + bx + c = 0$. If you still remember, this resulted into quadratic equation form. Therefore, in this module, you will learn to represent quadratic function using equation.

WHAT I NEED TO KNOW

LEARNING COMPETENCY

The learners will be able to:
- represent a quadratic function using: (c) equation. **M9AL-Ig-11.2**

WHAT I KNOW

Find out how much you already know about representing quadratic function using equation. Write the letter that you think is the best 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. What is the degree of the expression $5x^2 + 7x^3 - x^4$?
   A. 2   C. 4
   B. 3   D. 7

2. What must be the value of n so that the term x^{1-n} is of degree 2 ?
   A. -2 C. 0
   B. -1 D. 1

3. Which of the following is a second-degree equation?

   A. $2x^3 - 5 = 0$ C. $2^x = 16$
   B. $2 - x^2 = 0$ D. $x^4 - 2 = 0$

4. Which of the following is a function?
   A. $x - y^4 = 0$ C. $x - y^2 = 0$
   B. $x^2 - 2y = 0$ D. $x^2 - 4 = 0$

5. What kind of function is the equation $x(1 - x)^2 = (y - 3) + x^3$, if simplified?
   A. Exponential function   C. Quadratic function
   B. Linear function   D. Logarithmic function

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6. Which of the following is a quadratic function?
   A. $y = x + 2$
   B. $y = x^3 - 5$
   C. $y = 2x - x^2$
   D. $y = 2^x - 1$

7. In the quadratic function of the form $y = ax^2 + bx + c$, which of the following must not be equal to 0?
   A. a
   B. b
   C. c
   D. x-term

8. Using the function form $f(x) = ax^2 + bx + c$, which of the following are the values of a, b, and c of the function $y = 3 - 5x^2 + 4x$?
   A. $a = 3, b = -5, c = 4$
   B. $a = -5, b = 3, c = 4$
   C. $a = -5, b = 4, c = 3$
   D. $a = 4, b = 3, c = -5$

9. Express $f(x) = -3(x + 1)^2 + 4$, in the form $f(x) = ax^2 + bx + c$?
   A. $f(x) = -3x^2 - 3x - 1$
   B. $f(x) = -3x^2 - 6x - 1$
   C. $f(x) = -3x^2 - 3x + 1$
   D. $f(x) = -3x^2 - 6x + 1$

10. If $f(x) = (x + 2)^2 - 5$ is written in the form $f(x) = ax^2 + bx + c$, find a + b − c ?
    A) 14
    B) 9
    C) 4
    D) 0

WHAT'S IN

In this module, we need the concept of quadratic equation. That is why, let's have a recall below:

QUADRATIC EQUATION

A quadratic equation in one variable is a **second-degree** equation that can be written in the form:

Try to arrange the equation like this form →
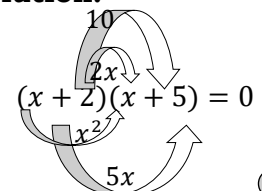
$$ax^2 + bx + c = 0,$$

Check if the highest degree is 2. If so, then it is a quadratic equation

where a, b, and c are real numbers and a ≠0.

See the next examples.

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Example 1: $12 + 3x^2 = 9x - 4$
Solution:

$12 + 3x^2 = 9x - 4$ — -Arrange $3x^2$ & 12

$3x^2 + 12 = 9x - 4$

$3x^2 + 12 = 9x - 4$ — -Subtract 9x for both sides
$\underline{-9x \qquad\quad -9x}$

$3x^2 - 9x + 12 = -4$

$3x^2 - 9x + 12 = -4$ — -Add 4 for both sides
$\underline{+4 \qquad\quad +4}$

$\boxed{3x^2 - 9x + 16 = 0}$ — -Since the highest degree is 2 then it is a quadratic eq.

→**QUADRATIC EQ.**
a = 3,   b = -9,   c = 16

Example 2: $x(x + 2) = x^2 + 4$
Solution:

$x(x + 2) = x^2 + 4$ — -Distribute x by multiplying it to x & 2

$x^2 + 2x = x^2 + 4$

$x^2 + 2x = x^2 + 4$ — -Subtract x^2 for both sides
$\underline{-x^2 \qquad\quad -x^2}$

$2x = 4$

$2x = 4$ — -Subtract 4 for both sides
$\underline{-4 \quad -4}$

$\boxed{2x - 4 = 0}$ — - Since for 2x the highest degree is 1, then it not a quadratic equation.

→**NOT QUADRATIC EQ.**

Example 3: $(x + 2)(x + 5) = 0$
Solution:

$(x + 2)(x + 5) = 0$

"FOIL"
First Terms
Outer Terms
Inner Terms
Last Terms

$x^2 + 5x + 2x + 10 = 0$ — -Add similar terms; 5x and 2x

$\boxed{x^2 + 7x + 10 = 0}$ — -Since the highest degree is 2 then it is a quadratic eq.

→**QUADRATIC EQ.**
a = 1,   b = 7,   c = 10

Example 4: $(x - 3)^2 + 10 = 0$
Solution:

$(x - 3)^2 + 10 = 0$ — -Expand $(x - 3)^2$
$(x - 3)(x - 3) + 10 = 0$

$(x - 3)(x - 3) + 10 = 0$ — -FOIL

$x^2 - 3x - 3x + 9 + 10 = 0$ — -Add similar terms

$\boxed{x^2 - 6x + 19 = 0}$ — -Since the highest degree is 2 then it is a quadratic eq.

→**QUADRATIC EQ.**
a = 1,   b = -6,   c = 19

You try!

A. Which of the following equations are quadratic? Put a ☺ if quadratic, if not put ☹ on the blank.

_____1. $3m + 8 = 15$

_____2. $x^2 - 5x + 10 = 0$

_____3. $12 - 4s = 0$

_____4. $2t^2 - 7t = 12$

_____5. $6 - 2x + 3x^2 = 0$

_____**6.** $x^2 = 15 + x^2$

_____**7.** $x^2 - 16 = 0$

_____**8.** $5(x - 5) = 2$

_____**9.** $x(x + 2) = 4$

_____**10.** $(x + 3)^2 - 1 = 0$

B. Write each quadratic equation in standard form, $ax^2 + bx + c = 0$ then identify the values of **a, b,** and **c**.

Equation	In the form of $ax^2 + bx + c = 0$	Values of		
		a	b	c
1.) $2x^2 - 3x = 7$				
2.) $5 + 2x^2 = 6x$				
3.) $2x(x - 3) = 15$				
4.) $(x + 3)(x + 4) = 0$				
5.) $(x - 4)^2 + 8 = 0$				

WHAT'S IN

Communication, Critical Thinking and Collaboration

LINEAR OR QUADRATIC?

Activity #1. You can share each other's ideas

Determine whether each function is linear or quadratic.

$$y = (x - 2)(x + 4)$$

$$f(x) = 7(x - 2) + 5(3x)$$

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

$$y = 3x^2 - 12$$

$$y = 3x - 5$$

$$y = 3x(x - 1) - (3x + 7)$$

1. How were you able to determine if the given is linear or quadratic?
2. What are the differences between linear and quadratic equations?

Classify the functons above and write your answers in the table below.

Linear Function	Quadratic Fucntion

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WHAT IS IT

A **Quadratic Function** is any function of the form:
$$y = ax^2 + bx + c \quad or \quad f(x) = ax^2 + bx + c$$
where a, b and c are real numbers and a is not equal to 0.

The function $y = x^2$ can be written as $y = 1x^2,$ where $a = 1$, $b = 0$ and $c = 0$.

Linear functions are typically in the form **y = mx + b** and are graphed as **straight lines.** To draw a linear graph, start with the y-intercept or b value, then use the slope to find a second point.
Quadratic functions are typically in the form
$y = ax^2 + bx + c \quad or \quad f(x) = ax^2 + bx + c$ and are graphed as **parabolas**.

Here are the answers and explanations for activity #1:

Example #1.

Classify the function here:

Linear Function	Quadratic Fucntion
y = 3x – 5	**y = 3x² – 12**
• This is in the form of y = mx + b	• This is in the form of $y = ax^2 + bx + c,$ where b = 0
y = 5x(x – 5) –5x² Solution: $$y = 5x^2 - 25x - 5x^2$$ $$y = -25x$$ • This is in the form of y = mx + b, where b = 0.	**y = (x – 2)(x + 4)** Solution: $y = (x - 2)(x + 4)$ "FOIL" **F**irst Terms **O**uter Terms **I**nner Terms **L**ast Terms $y = x^2 + 4x - 2x - 8$ $y = x^2 + 2x - 8$ • This is in the form of $y = ax^2 + bx + c$

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$f(x) = 7(x - 2) + 5(3x)$	$y = 3x(x - 1) - (3x + 7)$
Solution: $$f(x) = \underbrace{7x - 14 + 15x}$$ $$f(x) = 22x - 14$$ • This is in the form of y = mx + b.	**Solution:** $$y = 3x^2 - 3x - 3x - 7$$ $$y = 3x^2 - 6x - 7$$ • This is in the form of $$y = ax^2 + bx + c$$

Example #2.

From the quadratic functions above, rewrite the equation in the form of $y = ax^2 + bx + c$, and identify the values of a, b, and c.

Functions	In the form of $y = ax^2 + bx + c$	Values of		
		a	b	c
1.) $y = 3x^2 - 12$	$y = 3x^2 - 12$	3	0	-12
2.) $y = (x - 2)(x + 4)$	$y = x^2 + 2x - 8$	1	2	-8
3.) $y = 3x(x - 1) - (3x + 7)$	$y = 3x^2 - 6x - 7$	3	-6	-7

WHAT'S MORE

Which of the following are quadratic functions? Justify your answer. (Use separate sheet for justification)

1. $y = 5x^2 - 8$
2. $f(x) = (x + 3)^2$
3. $f(x) = x(x - 2)(x + 5)$
4. $y = -x^2$
5. $f(x) = \frac{x^2 + 5}{x}$

WHAT I HAVE LEARNED

A **Quadratic Function** is any function of the form:
$$y = ax^2 + bx + c \quad or \quad f(x) = ax^2 + bx + c$$
where a, b and c are real numbers and a is not equal to 0.

WHAT I CAN DO

A. Which of the following are quadratic functions? Write the letters of your answers inside the box.

a. $y = 3x^2 - 2$
b. $x = y$
c. $y = 3x^2 - 5x - 2$
d. $3x - 1 = y$
e. $y = (x + 3)(x - 4)$
f. $y = x^2$
g. $4^2 + x = y$
h. $y = 4^x + 2x + 3$
i. $x + x^2 = 3y$
j. $x(x + 3) - y = 0$

Quadratic Functions

B. From the quadratic functions above, rewrite the equation in the form of

$y = ax^2 + bx + c,$ and identify the values of a, b, and c.

Functions	In the form of $y = ax^2 + bx + c$	Values of		
		a	b	c

ASSESSMENT

Write the letter of the correct answer on your answer sheet. If your answer is not found among the choices, write E together with your final answer.

1. What is the degree of the expression $2y^5 + 5x^2y^4$?

   A) 2   B) 4   C) 5   D) 6

2. What must be the value of n so that the term x^{3-2n} is of degree 2?

   A) -1 B) $-\frac{1}{2}$ C) $\frac{1}{2}$ D) 1

3. Which of the following is a second degree equation?

    A) $7x^3 - 5x = 4$ C) $2^{x-3} = 16$

    B) $5x - 2x^2 = 0$ D) $x^4 - 1 = 2x$

4. Which of the following is a function?

    A) $2x - y^4 = 7$ C) $2x - y^2 = 5$

    B) $3x^2 - y = 4$ D) $x^2 - 4x + 3 = 0$

5. What kind of function is the equation $-x\,(1 - x)^2 = (y - 3) - x^3$, if simplified?

    A)   Exponential function   C)   Quadratic function

    B)   Linear function   D)   Logarithmic function

6. Which of the following is a quadratic function?

    A) $y = 5x - 4$ C) $y = x - 3x^2$

    B) $y = 2x^3 - 5x^2$ D) $y = 2^{1-x} - 8$

7. In the quadratic function of the form $y = ax^2 + bx + c$, which must not be equal to 0 ?

    A)   a   B)   b   C)   c   D)   x-term

8. What are the value of a, b, and c in the equation $y + 5 = 2x - 3x^2$, if written in the form $y = ax^2 + bx + c$?

    A)   a = 5 , b = – 3 , c = 2   C)   a = – 3 , b = 2 , c = – 5

    B)   a = – 3 , b = – 5 , c = 2   D)   a = – 3 , b = 2 , c = 5

9. Express $f(x) = 3(x - 7)^2 + 5$, in the form $f(x) = ax^2 + bx + c$?

    A) $f(x) = 3x^2 - 21x + 152$ C) $f(x) = 3x^2 - 21x + 54$

    B) $f(x) = 3x^2 - 42x + 152$ D) $f(x) = 3x^2 - 42x + 54$

10. If $f(x) = (2 - 3x)^2 + 1$ is written in the form $f(x) = ax^2 + bx + c$, find $a + b + c$?

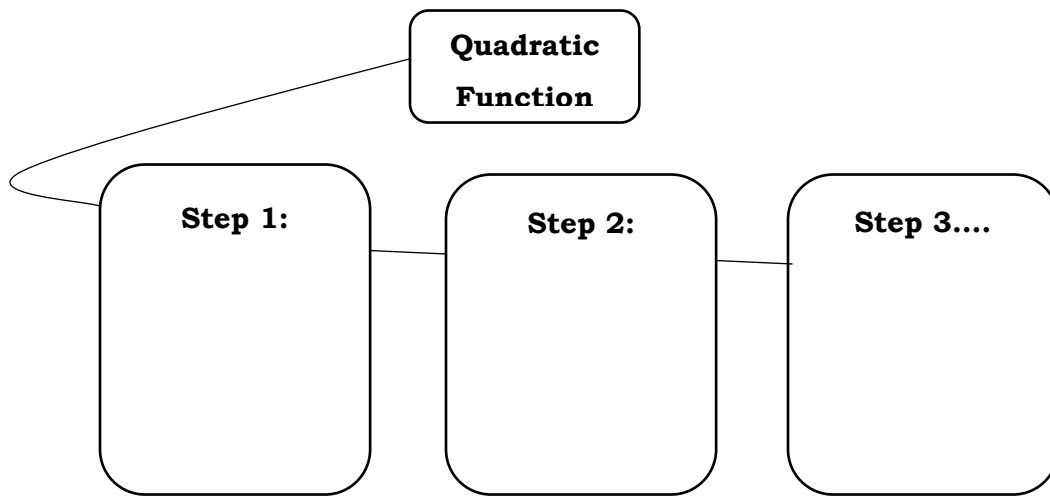   A)   2   B)   8   C)   15   D)   26

ADDITIONAL ACTIVITIES

Character Building, Critical
Thinking and Creativity

A. *How to determine the values of a, b and c?*

Copy and complete the graphic organizer. Create a step-by-step process in identifying value of a, b and c in quadratic function form of $y = ax^2 + bx + c.$

Quadratic Function

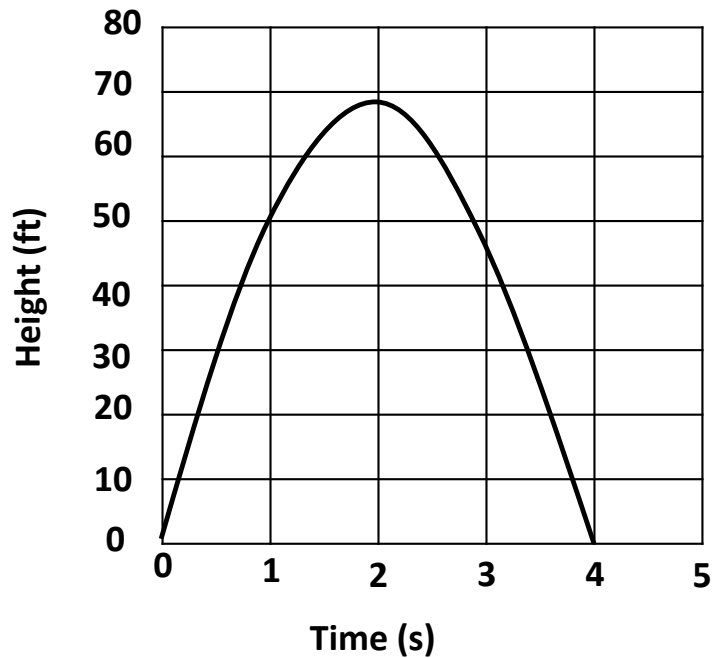| **Step 1:** | **Step 2:** | **Step 3….** |

B. **Reflect!**

1. How is the concept of identifying functions related to everyday life situations?

2. In solving real-life applications of quadratic function, why is it important in the form $y = ax^2 + bx + c.$

PROBLEM – BASED WORKSHEET

Baseball

A baseball batter pops a ball straight up. The height of the ball is shown as a function of time in a graph.

Height of a ball

Let's Analyze!

1. Which type of function best models the data?

   _____

2. How high is the ball after 1 second?

   _____

E-Search

You may also check the following link for your reference and further learnings on representing quadratic functions through equations:

- https://www.youtube.com/watch?v=k83QqpTmSDw
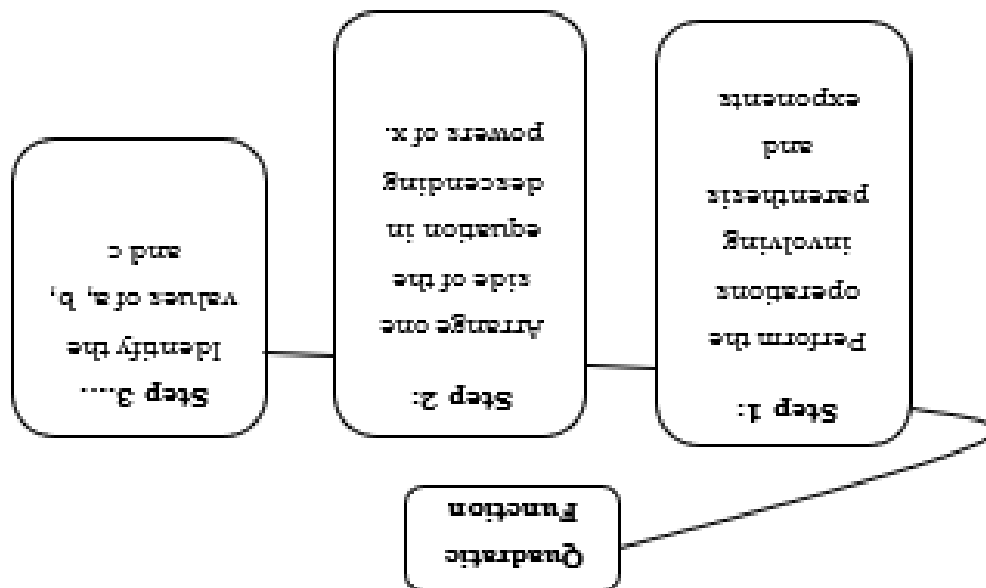- https://www.youtube.com/watch?v=wy-dvjLRBhI

REFERENCES

https://www.scasd.org/cms/lib/PA01000006/Centricity/Domain/1229/2.2%20A2% 202017%20Unit%202-2%20WS%20Packet%20LG.pdf
https://study.com/academy/lesson/comparing-graphs-of-quadratic-linear- functions.html
https://charat.me/en/face/create/
https://www.stcs.org/view/11836.pdf
https://study.com/academy/lesson/comparing-graphs-of-quadratic-linear- functions.html

PROBLEM – BASED WORKSHEET

1. Quadratic functions
2. 50 ft

Quadratic Function

Step 1: Perform the operations involving parenthesis and exponents

Step 2: Arrange one side of the equation in descending powers of x.

Step 3: Identify the values of a, b, and c

ADDITIONAL ACTIVITIES

A. Here is an example of a possible answer. You may add boxes for additional steps.

ASSESSMENT

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

B.

Functions	In the form of $y = ax^2 + bx + c$	Values of		
		a	b	c
$y = 3x^2 - 2$	$y = 3x^2 - 2$	3	0	-2
$y = 3x^2 - 5x - 2$	$y = 3x^2 - 5x - 2$	3	-5	-2
$y = (x + 3)(x - 4)$	$y = x^2 - x - 12$	1	-1	-12
$y = x^2$	$y = x^2$	1	0	0
$x + x^2 = 3y$	$y = \frac{1}{3}x^2 + \frac{1}{3}x$	1/3	1/3	0
$x(x + 3) - y = 0$	$y = x^2 + 3x$	1	3	0

ANSWER KEY

WHAT I KNOW

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

WHAT'S IN

You try!

A.

1. ☹ — $3m + 8 = 15$
2. ☺ — $x^2 - 5x + 10 = 0$
3. ☹ — $12 - 4s = 0$
4. ☺ — $2s^2 - 7t = 12$
5. ☺ — $6 - 2x + 3x^2 = 0$
6. ☹ — $x^2 = 15 + x^2$
7. ☺ — $x^2 - 16 = 0$
8. ☹ — $5(x - 5) = 2$
9. ☺ — $x(x + 2) = 4$
10. ☺ — $(x + 3)^2 - 1 = 0$

B.

Equation	In the form of $ax^2 + bx + c = 0$	Values of		
		a	b	c
1.) $2x^2 - 3x = 7$	$2x^2 - 3x - 7 = 0$	2	-3	-7
2.) $5 + 2x^2 = 6x$	$2x^2 - 6x + 5 = 0$	2	-6	5
3.) $2x(x - 3) = 15$	$2x^2 - 6x - 15 = 0$	2	-6	-15
4.) $(x + 3)(x + 4) = 0$	$x^2 + 7x + 12 = 0$	1	7	12
5.) $(x - 4)^2 + 8 = 0$	$x^2 - 8x + 24 = 0$	1	-8	24

WHAT'S MORE

The quadratic functions are 1, 2, 4.

WHAT I CAN DO

A.

Quadratic Function

a, c, e,
f, i, j

15