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Mathematics

Quarter 1-Module 1

Illustrating Quadratic Equation

Week 1

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MODULE 1

ILLUSTRATING QUADRATIC EQUATION

In the previous year level, you have learned about linear equations and how to find their solutions. You were also given some applications to solve some real-life problems using this concept. Now, since you are in a new grade level, you will acquire knowledge and skills about quadratic equations. In this module, you will learn different ways to illustrate quadratic equation and it will be helpful to understand the succeeding topics.

WHAT I NEED TO KNOW

LEARNING COMPETENCY
The learners will be able to:

- illustrate quadratic equation.**M9AL-Ia-1**

WHAT I KNOW

Find out how much you already know about quadratic equation as presented in this module. 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 do you call a second-degree polynomial equation that can be written in the form $ax^2 + bx + c = 0$, where a, b and c are real numbers and $a \neq 0$?
   A. Linear Equation
   B. Linear Inequality
   C. Quadratic Equation
   D. Quadratic Inequality

2. Which of the following is not quadratic equation?
   A. $8k - 3 = 12$
   B. $9r^2 - 25 = 0$
   C. $x^2 - 5x + 3 = 0$
   D. $(2x + 5)(x - 1) = -6$

3. Find the linear term in the quadratic equation $3x(x - 2) = -7x + 1$.
   A. 13x B. -13x C. x D. –7x

4. What is the constant term of $(x - 5)(2x + 3) = 7$?
   A. 7 B. -8 C. -15 D. -22

5. Which of the following quadratic equations is equivalent to $x^2 + 9x = -8$?
   A. (x + 1) (x + 8) = 0
   B. (x – 1) (x + 8) = 0
   C. (x -1) (x – 8) = 0
   D. (x+ 1) (x - 8) = 0

6. Which situations illustrates quadratic equation?
   A. The length of a rectangular board is 3m longer than its width and its perimeter is 25m.
   B. Joey paid at least ₱2,000 for the shirt and pants. The cost of pants is ₱700 more than the shirt.
   C. A garden's length is 7m longer that its width and the area is 18 square meters.
   D. A lot cost ₱4,000 per square meter and the area is 120 square meters.

7. If $(x + 2)^2 = 3(x + 2)$ is written in standard form, the value of b is _____.
   A. 7 B. 5 C. 3 D. 1

8. When the quadratic equation $(2x + 5)(x - 1) = -6$ is written in standard form, what are the values of a, b, and c?
   A. $a = -2, b = 3, c = 1$ C. $a = 2, b = -3, c = 1$
   B. $a = 2,\ b = 3,\ c = 1$ D. $a = -2, b = -3, c = 1$

9. The dimensions of a rectangle with an area of 56 meters^2 are (3x - 1) meters by (x + 4) meters. Which of the following quadratic equation in standard form represents the situation?
   A. $3x^2 + 11x - 60 = 0$ C. $3x^2 + 11x - 52 = 0$
   B. $3x^2 + 11x + 60 = 0$ D. $3x^2 + 11x + 52 = 0$

10. When $7 - 5x = 3x^2$ was written in standard form, Ana and Elsa got the following answers: Ana: $3x^2 + 5x - 7 = 0$ Elsa: $-3x^2 - 5x + 7 = 0$. Who do you think got the correct answer?
    A. Ana B. Elsa C. Both D. None

WHAT'S IN

Let us recall how to multiply polynomials.

Remember that to multiply two polynomials, multiply each term of one polynomial by each term of the other polynomial then simplify by combining similar terms if needed.

Study the examples below:

a. $x(x + 5) = x^2 + 5x$

b. $(x + 3)(x - 2) = x^2 + x - 6$

Try this!

Multiply and simplify, if needed.

1. $x(2x - 7)$
2. $(x + 5)(x + 9)$
3. $(2x - 1)(x + 3)$
4. $(x + 6)^2$
5. $(5x + 4)(5x - 4)$
6. $(3x - 8)(x + 2)$

Let us analyze!

a. How will you describe the products obtained?

b. What is the degree of each product?

WHAT'S NEW

Communication, character building and collaboration

There are situations that represent other function that is equally important as linear function. Perform the activity below to find out.

Vegetable Garden

In the middle of a crisis where establishments are closed and prime commodities are hard to find, we think of having our own vegetable garden. This way, we can get our supplies of vegetable right in our own backyard.

Aling Tuding is a resourceful person that is why she is planning to convert her rectangular vacant lot at the back of her house into a vegetable garden. She remembered that the area of her vacant lot is $15m^2$. She also recalled that the length is 3 meters longer than the width. Without even starting to cultivate the soil, Aling Tuding is already excited to harvest her favorite vegetables soon.

- What equation would represent the attributes of the rectangular garden? Do you think you can use this equation to find the dimensions of the rectangular garden? Why or why not?

Despite of the crisis, we should be like Aling Tuding. We must make this crisis an opportunity to develop and strengthen ourselves.

WHAT IS IT

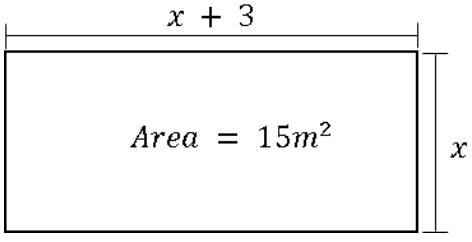
Communication, Critical Thinking, and Collaboration

Let's investigate the measurement of Aling Tuding's vegetable garden.

First, let us identify and represent the unknowns in the problem. If we let x be the width of the rectangular garden, then the length will be x + 3 since it is 3 more than the width. That is,

x = width of the garden
x + 3 = length of the garden
15 (square meters) = area of the rectangular garden

Then we can represent the dimensions as shown in the figure:



The area (A) of any rectangle can be solve by the formula:
$A = lw$, where l is the length and the w is the width. Hence, in the given figure:

$A = lw$
$15 = x(x + 3)$ *Substituting to the area formula*
$15 = x^2 + 3x$ *by Distributive Property*
$x^2 + 3x - 15 = 0$ *by Addition Property of Equality*

What is the degree of the equation obtained?

What do you call this kind of equation?

The equation in one variable obtained from the situation, $x^2 + 3x - 15 = 0$, has a degree of 2. It means the highest exponent of the variable is 2. This kind of second-degree equation is also called ***quadratic equation.***

A quadratic equation in one variable is of the form $ax^2 + bx + c = 0$ where a, b, and c are real numbers and $a \neq 0$. This form of quadratic equation is written in standard form. In this equation, ax^2 is the quadratic term, bx is the linear term, and c is the arithmetic or constant term. In addition,

a in the quadratic term is the coefficient of x^2 which may be positive or negative but not equal to zero.

b in the linear term is the coefficient of x which may be positive, negative or zero.

c is the constant term which may be positive, negative or zero.

Going back to our equation $x^2 + 3x - 15 = 0$, since it is written in standard form, we can easily identify the values of a, b and c. Look at the table below to understand it better.

Quadratic Equation in Standard Form $ax^2 + bx + c = 0$	Quadratic Term ax^2	Linear Term bx	Constant Term c
$x^2 + 3x - 15 = 0$	x^2	3x	-15
Therefore,	$a = 1$ since 1 is the coefficient of x^2	$b = 3$ since 3 is the coefficient of x	$c = -15$ since -15 is the constant term

Example 1:
Determine if the given equation is quadratic. If yes, identify the values of a, b and c.

a. $3x^2 + 2x = 9$
b. $(x - 5)(2x + 3) = 7$
c. $2x^2 - 15 = 2(x^2 + 7x)$

Solutions:

a. The equation $3x^2 + 2x = 9$ is quadratic but not in standard form. The standard form is $3x^2 + 2x - 9 = 0$ with $a = 3, b = 2$ and $c = -9$

b. To check if the equation is quadratic, multiply the left side of the equation and simplify by combining similar terms.

$$(x - 5)(2x + 3) = 7$$
$$2x^2 - 7x - 15 = 7$$
$$2x^2 - 7x - 8 = 0$$

Since the degree of the equation is 2, it is a quadratic equation. The value of $a = 2$, $b = -7$, and $c = -8$.

c. To check if the equation is quadratic, simplify the left side of the equation then combine similar terms.

$$2x^2 - 15 = 2(x^2 + 7x)$$
$$2x^2 - 15 = 2x^2 + 14x$$
$$2x^2 - 2x^2 - 14x - 15 = 0$$
$$-14x - 15 = 0$$

Since the resulting equation has a degree of 1, then it is not quadratic. Thus, $-14x - 15 = 0$ is a linear equation.

Check your understanding by completing the table below.

Quadratic Equations	Standard Form $ax^2 + bx + c = 0$	a	b	c
Example: $x(2x - 7) = 0$	$2x^2 - 7x = 0$	2	-7	0
1. $(x + 5)(x + 9) = 20$				
2. $(2x - 1)(x + 3) = -2x$				
3. $(x + 6)^2 = 12x$				
4. $(5x + 4)(5x - 4) = 0$				
5. $(3x - 8)(x + 2) = 2x^2$				

Example 2: Represent each situation using quadratic equation.

a. A rectangular prism has a height of 3 m. Its length is three times its width. The volume of the prism is 18 m^3.

Solution:

Given:

Rectangular Prism
Height = 3 m
Volume = 18 m^3

Representation of unknown:

Let w – be the width
Let 3w – be the length (since, the length is 3 times the width)

Solution:

Volume of the Rectangular Prism = Length x Width x Height

or $V = lwh$

$18 = (3w)(w)(3)$

$18 = 9w^2$

$19w^2 - 18 = 0$

Thus, the quadratic equation that described the situation is $9w^2 - 18 = 0$.

b. Jody is constructing a model house. He wants each window to have an area of 315 cm^2, and he wants the length of each window to be 6 cm more than the width.

Solution:

Given :

Area of the rectangular window = 315 cm^2

Representation of unknown:

Let x – be the width
Let x + 6 – be the length

Solution:

A = length x width or A = L x W

$315 = x(x+6)$

$x^2 + 6x = 315$

$x^2 + 6x - 315 = 0$

Thus, the quadratic equation that described the situation is $x^2 + 6x - 315 = 0$.

c. The product of two numbers is 48 and their sum is 16.

Solution:

Given:

Product of two numbers is 48
Sum of two numbers is 16

Representation of unknown:

Let x be the 1st unknown number

Let $16 - x$ be the 2nd unknown number

Solution:

$$1st\ number \cdot 2nd\ number = 48$$
$$x(16 - x) = 48$$
$$16x - x^2 = 48$$
$$-x^2 + 16x - 48 = 0$$

Therefore, the quadratic equation for the described numbers is $-x^2 + 16x - 48 = 0$

d. The product of two consecutive even integers is 288.

Solution:

Given:

Numbers are two consecutive even integers

Product of two numbers is 288

Representation of unknown:

Let x be the 1st even number

Let $x + 2$ be the 2nd even number

Solution:

$$1st\ number \cdot 2nd\ number = 288$$
$$x(x + 2) = 288$$
$$x^2 + 2x = 288$$
$$x^2 + 2x - 288 = 0$$

Therefore, the quadratic equation for the described numbers is $x^2 + 2x - 288 = 0$

WHAT'S MORE

Critical Thinking

TEST YOURSELF!

A. Which of these equations describe a quadratic equation?

1. $A = \pi r^2$
2. $x + 4x^2 = 0$
3. $(x - 2)^2 - 5 = 0$
4. $(x + 3) + 8 = 0$
5. $x^2 = 0$

B. Represent the following situations using quadratic equation in standard form.

1. If the square of a number is added to 8 times the number, the result is 100.
2. Mr. Apoloan wants to lay out a rectangular playground with an area of 30 square feet. The desired length will be 7 times the width.

WHAT I HAVE LEARNED

A quadratic equation in one variable is a second-degree equation that can be written in the form $ax^2 + bx + c = 0$, where a, b, and c are real numbers and $a \neq 0$.

WHAT I CAN DO

Critical Thinking

Which of the following is a quadratic equation? For those that are, identify the value of a, b and c.

1. $x^2 - 6x + 2 = 0$
2. $3x + 5 = 0$
3. $2x^2 + 7x = 15$
4. $(x + 1)^2 = 2(x - 3)$
5. $x^2 + 2x + 1 = 5x + 6$
6. $(x - 1)(x + 2) = x(x + 5)$
7. $(x + 2)(x - 3) = 5$
8. $x(x^2 + 3x - 10) = 0$
9. $(x - 1)^2 + 3 = 2x + 1$
10. $(x + 2)^3 = x(x^2 - 10x + 25)$

ASSESSMENT

Write the letter of the correct answer on your answer sheet.

1. Given a, b, and c are real numbers and $a \neq 0$, which of the following is the standard form of quadratic equation?
   A. $ax^2 + bx + c = 0$ C. $a = bx + c$
   B. $ax + b + c = 0$ D. $ax + b^2 + c = 0$
2. Which of the following is a quadratic equation?
   A. $3x + 5 = 0$ C. $(x + 2)(x - 3) = 5$
   B. $(x + 1)(x - 2) = x^2$ D. $2x^3 + x^2 - 5 = 0$
3. Given $(x - 1)^2 + 3 = 2x + 1$, find the value of the constant term.
   A. 1 B. 3 C. -1 D. -3
4. Which of the following is equivalent to $x^2 + 4x - 7 = 0$?
   A. $(x + 1)(x - 7) = 0$ C. $(x + 5)(x - 3) = 6$
   B. $(x + 4)(x - 3) = 5$ D. $(x + 1)(x + 3) = 10$
5. When the quadratic equation $(x + 5)(2x - 3) = 2(x + 1)$ is written in standard form, what are the values of a, b, and c.
   A. $a = 4, b = 19, c = -17$ C. $a = 1, b = -5, c = 17$
   B. $a = 2, b = 5, c = -17$ D. $a = 2, b = 10, c = 17$
6. Which of the following situations illustrates quadratic equation?
   A. A garden's length is 7m longer that its width and the area is 18 square meter.
   B. A lot cost P4,000 per square meter and the area is 120 square meters.
   C. Joey paid at least P2,000 for the shirt and pants. The cost of pants is P700 more than the shirt.
   D. The length of a rectangular board is 3m longer than the width and the perimeter is 25m.

7. Express the statement in quadratic equation: "A rectangular field with an area of 120m^2 has its length 12m. longer than the width."
   A. $x^2 - 12x - 120 = 0$ C. $x^2 + 12x - 120 = 0$
   B. $x^2 + 12x + 120 = 0$ D. $x^2 - 12x + 120 = 0$
8. Ryan is constructing a play house. He wants each window to have an area of 315 cm^2. Which of the statements below forms a quadratic equation?
   A. The length of each window is 4 less than the square of the width.
   B. The length of each window is 6 cm more than the width.
   C. The area of the window is twice its width.
   D. The sum of the length and width is twice its area.
9. The area of a square with side s is 144 cm^2. Which quadratic equation represents the area of the square?
   A. $4s = 144$ B. $s^2 = 144$ C. $s(s + 1) = 144$ D.$(s+1)^2 = 144$
10. A rectangular lot has an area of $132m^2$ and a perimeter of $46m$. Which of the following quadratic equations illustrates the given situation?
   A. $x^2 - 23x + 132 = 0$ C. $x^2 + 46x - 132 = 0$
   B. $x^2 + 23x + 132 = 0$ D. $x^2 - 46x + 132 = 0$

ADDITIONAL ACTIVITIES

Communication, Critical Thinking, Creativity and Character Building

After dealing with examples of quadratic equations and possible situation that can represent quadratic equation, think and reflect. How will quadratic equations help you in solving real-life problems and making decisions?

Write a real-life word problem that will lead you to forming quadratic equation. Provide an illustration of the problem and guide questions such that it will be expressed as quadratic equation in standard form.

E-Search

You may also check the following link for your reference and further learnings on illustrating quadratic equations.

- https://examples.yourdictionary.com/examples-of-quadratic-equation.html
- https://www.mathsisfun.com/algebra/quadratic-equation.html
- https://mathbitsnotebook.com/Algebra1/Quadratics/QDquadequations.html
- https://www.math-only-math.com/introduction-to-quadratic-equation.html
  https://www.mathsisfun.com/algebra/quadratic-equation.html
- https://bit.ly/2W94SG7

REFERENCES

Dilao, S. J., & Bernabe, J. G. (2009). *Intermediate Algebra.pp* 52-54. Quezon CIty: SD Publicaton.

MacKeague, Charles, Intermediate Algebra, Concepts and Graphs. Saunders College Publishing, USA

Mathematics 9 Learner's Material, Department of Education

Orines, Fernando B., et. al. Next Century Mathematics (Intermediate Algebra. Quezon City, Philippines: Phoenix Publishing House

Oronce, Orlando A. & Mendoza, Marilyn O. Exploring Mathematics II (Intermediate Algebra). Manila, Philippines: Rex Book Store Inc.

Ogena, Ester, et. al. Our Math Grade 9. Mc Graw Hill, Vibal Group. Inc.

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

PROBLEM – BASED WORKSHEET

The Vegetable Garden

Mang Toti joined an organization that encourages people to go into backyard farming. He owns a rectangular piece of vacant lot adjacent to his house. He is planning to convert his lot into vegetable garden for additional income.

LET'S ANALYZE

1) If the area of the vacant lot is $12m^2$ and the length is 4m longer than the width, how will you represent the length if the width is represented by w? _____

2) What expression represents the area of the of the vacant lot? _____

3) What quadratic equation in general form represents the situation? _____

4) Supposing Mang Toti bought 16m of fencing materials and plan to place it all around his rectangular land, what equation describes the situation? _____

PROBLEM – BASED WORKSHEET

Solutions:

1. Illustrate the problem:

   Let w = width (W)

   $w + 4$ = length (L)

2. $w(w + 4)$

3. Since area of rectangle is LW, then

   $w(w + 4) = 12$

   $w^2 + 4w = 12$

   $w^2 + 4w - 12 = 0$

   Therefore the quadratic equation that describes the situation is $w^2 + 4w – 12 = 0$.

4. If there will 16m of fencing material to be placed around the lot, then the perimeter is 16m. Thus,

$2L + 2W = 16$,	finding the semi-perimeter, we have
$L + W = 8$,	solve the equation in terms of l,
$L = 8 – W$	

The equation that describes the area will be,

$LW = 12$	substitute $l = 8 – w$, we have
$(8 – W) W = 12$	simplify,
$-w^2 + 8w = 12$	by addition property of equality
$-w^2 + 8w - 12 = 0$	
$w^2 - 8w + 12 = 0$	

ANSWER KEY

WHAT'S IN

1. $2x^2 - 7x$
2. $x^2 + 14x + 45$
3. $2x^2 + 5x - 3$
4. $x^2 + 12x + 36$
5. $25x^2 - 16$
6. $3x^2 - 2x - 16$

a. The products are all polynomials.
b. The degree of the product is 2.

WHAT I CAN DO

1. Quadratic; a = 1, b = -6, c = 2
2. Not Quadratic
3. Quadratic; a = 2, b = 7, c = -15
4. Quadratic; a = 1, b = 0, c = 7
5. Quadratic; a = 1, b = -3, c = -5
6. Not Quadratic
7. Quadratic; a = 1, b = -1, c = -11
8. Not Quadratic
9. Quadratic; a = 1 , b = -4, c = 3
10. Quadratic; a = 16, b = -13, c = 8

WHAT'S MORE

I. 1,2,3,5 are quadratic equations

II.
1. $x^2 + 8x = 100$
2. $7x^2 - 30 = 0$

WHAT I KNOW

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

ASSESSMENT

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