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DEPARTMENT OF EDUCATION

Mathematics

Quarter 1 - Module 21

Equation of Quadratic Function Given Table of Values

Week 9

Learning Code - M9AL-Ij-15.1

ALTERNATIVE DELIVERY MODE
ADM

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MODULE 21

EQUATION OF QUADRATIC FUNCTION GIVEN TABLE OF VALUES

In the previous module, you learned how to create table of values given the equation of quadratic function. But can you give the equation of quadratic function given the table of values? In this module, you will learn how to determine the equation of a quadratic function from several points given on its table of values.

WHAT I NEED TO KNOW

LEARNING COMPETENCY

The learners will be able to:

- determine the equation of a quadratic function given a table of values **M9AL-Ij-15.**

WHAT I KNOW

Find out how much you already know about the equation of quadratic function given table of values. 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. Which of the following is the general form of the quadratic equation?

A) $y - c = ax^2 + bx$
B) $y - bx = ax^2 + c$
C) $y = ax^2 + bx + c$
D) $y = ax^2 - bx - c$

2. What must be done in the system of equation $\begin{cases} 2a + b = 9 \\ 3a - b = 6 \end{cases}$, to eliminate variable b ?

A) Add
B) Divide
C) Multiply
D) Subtract

3. What is the value of variable a in item #2 ?

A) $-\frac{3}{2}$
B) -3
C) 3
D) 5

4. What is the value of b in item # 2 ?

A) $-\frac{3}{2}$
B) -3
C) 3
D) 5

5. Which of the following table of values represents a quadratic function?

A)

x	-2	-1	0	1	2
y	3	5	7	9	11

B)

x	-2	-1	0	1	2
y	6	3	2	3	6

C)

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

D)

x	-2	-1	0	1	2
y	18	3	2	3	18

6. What is the second difference of y-values of

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

?

A) – 2
B) – 1
C) 1
D) 2

7. Which is the quadratic function of the table of values in item # 6 ?

A) $y = -x^2 - 1$
B) $y = -x^2 + 1$
C) $y = x^2 + 1$
D) $y = -x^2 + 2x + 4$

8. Which quadratic function contain the point (1, 5) ?

A) $y = -x^2 - 2x - 4$
B) $y = -x^2 + 2x - 4$
C) $y = -x^2 - 2x + 4$
D) $y = -x^2 + 2x + 4$

9. To determine the equation defining quadratic function given its table of values, at least how many point(s) must be taken to solve for constants a, b and c ?

A) 1
B) 2
C) 3
D) 4

10. What quadratic function contain the points (0, 0), (2, 6) and (5, 30) ?

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

WHAT'S IN

Communication, and Critical Thinking

Before going through this module, it is a must that you know how to determine if a table of values represents quadratic function.

How will you know if a table of values is quadratic function? The test called second-difference is used to determine whether a table of values is quadratic or not. If there is a common second difference, then the table is quadratic. Study the example below:

x	-3	-2	-1	0	1
y	13	7	5	7	13

-6 -2 2 6 First difference

4 4 4 Second difference

Try this. Which of the following table of values represent quadratic function.

1.

x	0	1	2	3	4
y	-3	-8	-11	-12	-11

2.

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

3.

x	0	1	2	3	4
y	1	2	3	4	5

4.

x	-1	0	1	2	3
y	-5	1	3	1	-5

5.

x	-2	-1	0	1	2
y	-10	-2	0	2	9

6.

x	-3	-2	-1	0	1
y	0	-6	-8	-6	0

7.

x	0	1	2	3	4
y	-4	-10	-12	-10	-4

8.

x	-1	0	1	2	3
y	0	1	2	9	28

9.

x	-1	0	1	2	3
y	4	-5	-8	-5	4

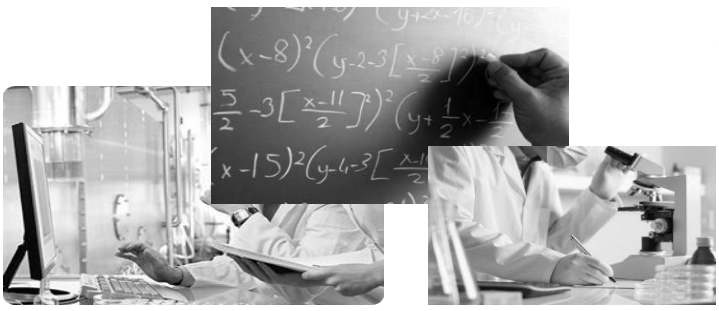
10.

x	-1	0	1	2	3
y	-6	3	6	3	-6

WHAT'S NEW

Communication

Given a quadratic equation, a table of values can easily be formed by assigning values of x and solving for the value of y for each given value of x. However, you can also reverse the process if you want to know the equation that represents the table of values. This procedure is more complicated but very essential to



some careers like scientists, mathematicians, engineers, and those that need to formulate the equation that describes results of experiments or researches.

Do you know other careers that create formula from values they collected?

WHAT IS IT

Communication, Critical Thinking, and Collaboration

If you are given table of values of quadratic function, you can find the equation that represents the function by creating a system of linear equation in three unknowns using the following steps:

1. Select three ordered pairs from the table.
2. Substitute each ordered pair into the general form of quadratic function; $y = ax^2+bx+c$.
3. Solve for the values of a, b , and c of the system of linear equations.
4. Substitute the values of a, b and c to the general form of quadratic function.

Example 1: Find the equation that represent the quadratic function in the given table.

x	-1	0	1	2	3
y	0	-1	-4	-9	-16

Solution:

a. Select three ordered pairs from the table. Let (-1, 0), (0, -1), and (1, -4) be the points on the graph of the quadratic function.

b. Substitute each ordered pair into the general form of quadratic function; $y = ax^2+bx+c$

For (-1, 0) $0 = a(-1)^2 + b(-1) + c$ equation 1
For (0, -1) $-1 = a(0)^2 + b(0) + c$ equation 2
For (1, -4) $-4 = a(1)^2 + b(1) + c$ equation 3

c. Solve for the values of a, b, and c of the system of linear equations.

From equation 2, c = -1. Substitute the value of c to equation 1,

$0 = a- b -1$ $b = a-1$

Substitute the value of b and c to equation 3, then solve for a

$-4 = a + (a-1) – 1$
$-4 = 2a – 2$
$a = -1$

Substituting the value of a,

$b=a-1$
$b=-1-1$
$b= -2$

Thus, a= -1, b=-2, and c= -1

d. Substitute the values of a, b and c to the general form of quadratic function

$y = ax^2+bx+c$

$y = -x^2-2x-1$

Therefore, the equation that represents the table of value is $y = -x^2-2x - 1$.

Example 2. Find the equation that represent the quadratic function in the given table.

x	-3	-1	1	3	5
y	21	7	9	27	61

Solution:

1. Select three ordered pairs from the table. Let (-1, 7), (1,9), and (3, 27) be the points on the graph of the quadratic function.
2. Substitute each ordered pair into the general form of quadratic function;
   $y = ax^2+bx+c$
   (-1, 7) $7 = a(-1)^2 + b(-1) + c$ equation 1
   (1, 9) $9 = a(1)^2 + b(1) + c$ equation 2
   (3, 27) $27= a(3)^2 + b(3) + c$ equation 3
3. Solve for the values of a, b, and c of the system of linear equations.

$7 = a – b + c$

$9 = a + b + c$

$27 = 9a + 3b + c$

Subtract equation 1 from equation 2,

$9 = a + b + c$

$\underline{7 = a – b + c}$

$2 = 2b$

$1 = b$

Substitute the value of b to equation 2 and 3, then solve simultaneously,

$9 = a + 1 + c \rightarrow 8 = a + c$

$27 = 9a + 3(1) + c \rightarrow \underline{24 = 9a + c}$

$-16 = -8a$

$2 = a$

Solving for c, substitute a and b to any of the equations above,

$8 = a + c$

$8 = 2 + c$

$6 = c$

Thus, a = 2, b = 1 and c = 6

d. Substitute the values of a, b and c to the general form of quadratic function

$y = ax^2+bx+c$

$y = 2x^2 + x + 6$

Therefore, the equation that represent the given table is $y = 2x^2 + x + 6$.

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

WHAT'S MORE

Critical Thinking, Communication and Collaboration

Go back to the table of values in **What's In**. Which tables represent quadratic functions? Determine the equation for the quadratic function represented by these table of values.

How did you find the activity? Did you spot the table of values representing quadratic functions? Were you able to find the equation that represents the table? If not, in which part did you find challenging? How did you cope up with it?

WHAT I HAVE LEARNED

To find the equation that represents quadratic function given a table of values,

1. Select three ordered pairs from the table.
2. Substitute each ordered pair into the general form of quadratic function; $y = ax^2+bx+c$
3. Solve for the values of a, b , and c of the system of linear equations.
4. Substitute the values of a, b and c to the general form of quadratic function.

Now that you are equipped with knowledge on determining the equation of quadratic function that represents the table of values, it's about time to find out what you can do.

Critical Thinking

WHAT I CAN DO

Find the equation that represent the quadratic function in the given table of values.

1.

x	-2	-1	0	1	2
y	6	3	2	3	6

2.

x	1	2	3	4	5
y	4	9	16	25	36

3.

x	1	2	3	4	5
y	0	-3	-4	-3	0

4.

x	-4	-3	-2	-1	0
y	7	8	7	4	-1

5.

x	0	1	2	3	4
y	1	0	3	10	21

6.

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

7.

x	-8	-7	-6	-5	-4
y	0	-3	-4	-3	0

8.

x	-1	0	1	2	3
y	7	-2	-5	-2	7

9.

x	0	1	2	3	4
y	-7	-1	1	-1	-7

10.

x	-4	-3	-2	-1	0
y	25	10	1	-2	1

Congratulations for reaching this far! You are now ready to take the assessment test. Good luck!

ASSESSMENT

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

1. Which of the following is the general form of the quadratic equation?
   A) $y - c = ax^2 + bx$
   B) $y - bx = ax^2 + c$
   C) $y = ax^2 + bx + c$
   D) $y = ax^2 - bx - c$
2. What must be done in the system of equation $\begin{cases} 2a + b = 9 \\ 2a - 3b = 5 \end{cases}$, to eliminate variable a ?
   A) Add
   B) Divide
   C) Multiply
   D) Subtract
3. What is the value of variable a in item #2 ?
   A) – 5
   B) – 4
   C) 4
   D) 5
4. Which of the following is the solution to the system of equation in item # 2 ?
   A) (1, 4)
   B) (1, 5)
   C) (5,1)
   D) (4, 1)

5. Which of the following table of values represents a quadratic function?

A)

x	-2	-1	0	1	2
y	3	5	7	9	11

B)

x	-2	-1	0	1	2
y	6	3	2	3	6

C)

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

D)

x	-2	-1	0	1	2
y	18	3	2	3	18

6. What is the second difference of y-values of

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

?

A) – 2
B) – 1
C) 1
D) 2

7. Which is the quadratic function of the table of values in item # 6 ?
   A) $y = -x^2 - 1$
   B) $y = -x^2 + 1$
   C) $y = x^2 + 1$
   D) $y = -x^2 + 2x + 4$
8. Which quadratic function contain the point (– 1, 5) ?
   A) $y = -x^2 - 2x - 4$
   B) $y = -x^2 + 2x - 4$
   C) $y = -x^2 - 2x + 4$
   D) $y = -x^2 + 2x + 4$
9. To determine the equation defining quadratic function given its table of values, at least how many point(s) must be taken to solve for constants a, b and c ?
   A) 1
   B) 2
   C) 3
   D) 4
10. What quadratic function contain the points (0, 5), (1, 6) and (2, 11) ?
    A) $y = 2x^2 - x - 5$
    B) $y = 2x^2 - x + 5$
    C) $y = 2x^2 + x - 5$
    D) $y = 2x^2 + x + 5$

ADDITIONAL ACTIVITIES

Communication, Critical Thinking, Creativity and Character Building

Activity 1: The Parent Table of Values

The parent table of values is a table generated from a general form of equation and computed for its value at given values of x.

A. Given the equation for quadratic function, $y = ax^2 + bx + c$, complete the table of values below, the value of y for x = 0 was done for you:

$y = a(0)^2 + b(0) + c$
$y = 0$

x	-3	-2	--1	0	1	2	3
y				c			

1. Determine the first differences and second differences in y.
2. What expression resulted to second difference in y?
3. How will you describe the expressions for the first differences in y?
4. How will these expressions help you find the equation of a quadratic function given a table of values?

B. Use the expressions resulted from the differences in x and y above to find the equation that represents each of the table of values below

1.

x	-1	0	1	2	3
y	16	2	-2	4	20

2.

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

3.

x	0	1	2	3	4
y	1	0	3	10	21

PROBLEM – BASED WORKSHEET

Rocket!

A rocket is shot vertically from the ground. Its height at different times after the shot is recorded in the table below.

time (s)	1	2	3	4	5	6	7
height (h)	144	256	336	384	400	384	336

Let's Analyze!

1. What kind of function is represented by the table?
2. Determine a function h(t) for the given table of values.

3. What is the maximum height the rocket could reach?

4. After how many seconds does the rocket come back to the ground?

E-Search

You may also check the following link for your reference and further learnings on determining quadratic function given table of values.

- https://www.youtube.com/watch?v=jLzkaJk0iZ0
- https://www.youtube.com/watch?v=vAPPYoBV2Ow
- https://www.youtube.com/watch?v=OXViZtD2BTE
- https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-forms-features/e/rewriting-expressions-to-reveal-information

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3.

x	0	1	2	3	4
y	1	0	3	10	21

	-1	3	7	11
	2	2	2	

The second difference, 2, is equal to 2a in the table for $y = ax^2+bx+c$,

$2a = 2$

$a = 1$

The first difference in y between x = 0 and x = 1 is -1 and that correspond to a+b in the table for $y = ax^2+bx+c$,

$a + b = -1$ Substitute a = 1

$1 + b = -1$

$b = -2$

The value of c is equal to the y-intercept, that is the value of y when x = 0. Thus, c = 1.

Therefore, the equation that represents the table of values is

$y = x^2 - 2x + 1$.

PROBLEM – BASED WORKSHEET

1. Quadratic function
2. $h(t) = -16(t - 5)^2 + 400$ or $h(t) = -16t^2 + 160t$
3. 400 ft
4. After 10 seconds

The second difference, 10, is equal to 2a in the table for $y = ax^2+bx+c$,

$2a = 10$

$a = 5$

The first difference in y between x = 0 and x = 1 is -4 and that correspond to a+b in the table for $y = ax^2+bx+c$,

$a + b = -4$ Substitute a = 5

$5 + b = -4$

$b = -9$

Take note that you can you use any expression in the first differences as long as it corresponds to the table of values you are solving.

The value of c is equal to the y-intercept, that is the value of y when x = 0. Thus, c = 2.

Therefore, the equation that represents the table of values is

$y = 5x^2 - 9x + 2$

2.

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

-4 -2 0 2

2 2 2

The second difference, 2, is equal to 2a in the table for $y = ax^2+bx+c$,

$2a = 2$

$a = 1$

The first difference in y between x = 0 and x = 1 is -0 and that correspond to a+b in the table for $y = ax^2+bx+c$,

$a + b = 0$ Substitute a = 1

$1 + b = 0$

$b = -1$

The value of c is equal to the y-intercept, that is the value of y when x = 0. Thus, c = -2.

Therefore, the equation that represents the table of values is $y = x^2 - x - 2$.

ANSWER KEY

WHAT I KNOW

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

WHAT'S IN

1. Quadratic Function
2. Quadratic Function
3. Not Quadratic Function
4. Quadratic Function
5. Not Quadratic Function
6. Quadratic Function
7. Quadratic Function
8. Not Quadratic Function
9. Quadratic Function
10. Quadratic Function

WHAT'S MORE

1. $y = x^2 - 6x - 3$
2. $y = x^2 + 2x - 1$
3. Not Quadratic Function
4. $y = -2x^2 + 4x + 1$
5. Not Quadratic Function
6. $y = 2x^2 + 4x - 6$
7. $y = 2x^2 - 8x - 4$
8. Not Quadratic Function
9. $y = 3x^2 - 6x - 5$
10. $y = -3x^2 + 6x + 3$

WHAT I CAN DO

1. $y = x^2 + 2$
2. $y = x^2 + 2x + 1$
3. $y = x^2 - 6x + 5$
4. $y = -x^2 - 6x - 1$
5. $y = 2x^2 - 3x + 1$
6. $y = x^2 - x - 2$
7. $y = x^2 + 12x + 32$
8. $y = 3x^2 - 6x - 2$
9. $y = -2(x - 2)^2 + 1$
10. $y = 3(x + 1)^2 - 2$

ASSESSMENT

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

ADDITIONAL ACTIVITIES

A.

x	-3	-2	--1	0	1	2	3
y	9a-3b+c	4a-2b+c	a-b+c	c	a+b+c	4a+2b+c	9a+3b+c

-5a+b -3a+b -a+b a+b 3a+b 5a+b

2a 2a 2a 2a 2a

B. 1.

x	-1	0	1	2	3
y	16	2	-2	4	20

-14 -4 6 16

10 10 10