

9

Mathematics

Quarter 1-Module 11

Illustrating Quadratic Inequality

Week 5

Learning Code - M9AL-Ie-7



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MODULE
11
ILLUSTRATING QUADRATIC INEQUALITY

When you were in grade 7, you have learned about linear inequalities and were able to find and apply its solution to some real-life problem situations. To have a broader range of application to real life problems, another type of inequality can also be studied. In this module, you will learn another type of inequality which is “quadratic inequality”.

WHAT I NEED TO KNOW
LEARNING COMPETENCY

The learners will be able to:

- illustrate quadratic inequality. **M9AL-Ie-7**

WHAT I KNOW

Find out how much you already know about the module. Write the letter that you think is the best answer to each question on a sheet of paper. 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.

- It is an inequality that can be written in any of the following forms: $ax^2 + bx + c > 0$, $ax^2 + bx + c < 0$, $ax^2 + bx + c \geq 0$ or $ax^2 + bx + c \leq 0$.
 A. Quadratic Equation
 B. Quadratic Inequality
 C. Linear Inequality
 D. Linear Equation
- Which of the following mathematical statements is a quadratic inequality?
 A. $2r^2 - 3r - 5 = 0$
 B. $7h + 12 < 0$
 C. $3t^2 + 7t + 2 \geq 0$
 D. $s^2 + 8s + 15 = 0$
- Which of the following is NOT true about quadratic inequality?
 A. It always contains a linear expression
 B. It contains a 2nd degree polynomial.
 C. Two sides of the inequality separated by $<$, $>$, \geq or \leq .
 D. None of the above
- Which of the following shows a relation of “greater than or equal to”?
 A. $(x + 4)^2 < 2x$
 B. $(x + 4)^2 > 2x$
 C. $x^2 + 4 \geq 2x$
 D. $x^2 + 4 \leq 2x$

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5. Which of the following is a quadratic inequality?

A. $b > 9$	C. $v(v + 7) < v^2 + 8$
B. $c^2 - 4x \geq c^2 + 8$	D. $x^2 + 8 < -4x$

6. The monthly profit P of Karen's business is represented by the equation $P(x) = x^2 + 100$. Which of the following quadratic inequalities is a representation of positive profit for Karen's business?

A. $x^2 + 100 \geq 0$	C. $-x^2 + 100 > 0$
B. $x^2 + 100 \leq 0$	D. $-x^2 + 100 < 0$

7. Referring to item #6, which of the following is a representation of negative or normal profit for Karen's business?

A. $x^2 + 100 \geq 0$	C. $x^2 + 100 > 0$
B. $x^2 + 100 \leq 0$	D. $x^2 + 100 < 0$

8. The floor of a conference hall can be covered completely with tiles. Its length is 36 ft longer than its width. The area of the floor is less than 2,040 square feet. What mathematical sentence would represent the given situation?

A. $x^2 - 36 < 2040$	C. $x^2 - 36x > 2040$
B. $x^2 + 36 < 2040$	D. $x^2 + 36x < 2040$

9. Which of the following is NOT a quadratic inequality?

A. $3(2w^2 - 5) < w$	C. $4x^2 - 9 \geq 0$
B. $6(v^2 - 2) - 4v < 0$	D. $\frac{2x-5}{x+2} \leq 0$

10. An open box is to be formed out a rectangular piece of cardboard whose length is 12 cm longer than its width. To form the box, a square of side 5 cm will be removed from each corner of the cardboard. Then the edges of the remaining cardboard will be turned up. If the box is to hold at most 1900cm^3 , what mathematical statement would represent the given situation?

A. $x^2 - 12x \leq 360$	C. $x^2 - 8x \leq 400$
B. $x^2 - 12x \leq 380$	D. $x^2 - 17x \leq 310$

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WHAT'S IN

Communication, character building and collaboration



“Racism”, “discrimination”, “being biased”, “favoritism”. These are some words synonymous to the word “INEQUALITY”. We cannot deny that this really happens in real life but despite of that, you have to remember that in every action you do or goal you reach, do your best and do not let someone discourage you. Do not forget that the “Creator” will be the one who will give you the prize.

Mathematically, there are other relevant use of Quadratic INEQUALITY.

Engineers of roller coasters (or caterpillars) must know the minimum speed required for the cars to stay on the track. It is important that the engineer is sure that the speed of the car is in the solution region.

A bicycle manufacturer must know the maximum distance the rear suspension will travel when going over rough terrain. Note that the movement of the rear wheel of bicycles is described by a quadratic equation. If the manufacturer will be made aware of this maximum distance, then it can set a specific month/date for the warranty so that it can reduce warranty claims.

WHAT'S NEW

Communication, Critical Thinking and Collaboration



Which Are Not Quadratic Equations?

Use the mathematical sentences below to answer the questions that follow. You may discuss your ideas with your classmate.

$$x^2 + 9x + 20 = 0$$

$$2t^2 < 21 - 9t$$

$$r^2 + 10r \leq -16$$

$$3w^2 + 12w \geq 0$$

$$15 - 6h^2 = 10$$

Questions:

1. Which of the given mathematical sentences are quadratic equations?
2. How do you describe quadratic equations?
3. Which of the given mathematical sentences are not quadratic equations? Why?
4. What is the similarity between the mathematical sentences that are quadratic equations and the quadratic inequality? How are they different from each other?

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WHAT IS IT

Communication, Critical Thinking,
and Collaboration



A *quadratic inequality* is an inequality that contains a polynomial of degree 2 and can be written in any of the following forms.

$$ax^2 + bx + c > 0$$

$$ax^2 + bx + c < 0$$

$$ax^2 + bx + c \geq 0$$

$$ax^2 + bx + c \leq 0$$

where a, b, and c are real numbers and $a \neq 0$.

In the activity done in “What’s new” part, to determine which mathematical sentences are quadratic equations and which are not quadratic, we simply make use of equality and inequality symbols.

- Which of the given mathematical sentences are quadratic equations?

$$x^2 + 9x + 20 = 0$$

$$15 - 6h^2 = 10$$

- How do you describe quadratic equations?

➤ A quadratic equation is a polynomial equation of degree 2.

- Which of the given mathematical sentences are not quadratic equations? Why?

$$2t^2 < 21 - 9t$$

$$r^2 + 10r \leq -16$$

$$3w^2 + 12w \geq 0$$

➤ The mathematical sentences contain inequality symbols.

- What is the similarity between the mathematical sentences that are quadratic equations and the quadratic inequality? How are they different from each other?

- The highest exponent of the variable in each mathematical sentence is 2.
- The quadratic inequality makes use of inequality symbols while the quadratic equations make use of equality symbol

Example 1: Which of the following is quadratic inequality? For those that are, read it loudly.

- $x^2 + 2x \leq 9$
- $(x - 5)(5x + 7) > 7$
- $7x^2 - 15 > 7(x^2 + 5x)$

Solutions:

- The inequality $x^2 + 2x \leq 9$ is quadratic but not in the form $ax^2 + bx + c \leq 0$. If we move all the terms to the left side, we have:

$$x^2 + 2x - 9 \leq 0$$

and can be read as “*x squared plus 2x minus nine is less than or equal to zero*”

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- b. To check if the inequality is quadratic, we have

$$\begin{aligned}(x - 5)(5x + 7) &> 7 \\ 5x^2 + 7x - 25x - 35 &> 7 \\ 5x^2 + 7x - 25x - 35 - 7 &> 0 \\ 5x^2 - 8x - 7 &> 0\end{aligned}$$

Since the degree of the expression on the left of the inequality is 2, it is quadratic inequality. It is read as *“Five x squared, minus eight x, minus seven is greater than zero”*.

- c. To check if the inequality is quadratic, expand the product and make one side of the inequality be zero.

$$\begin{aligned}7x^2 - 15 &> 7(x^2 + 5x) \\ 7x^2 - 15 &> 7x^2 + 35x \\ 0 &> 7x^2 - 7x^2 + 35x + 15 \\ 0 &> 35x + 15 \\ 35x + 15 &< 0\end{aligned}$$

Since the resulting expression on the left side has a degree of 1, then it is not quadratic. The inequality is linear. It is read as *“Thirty-five x plus fifteen is less than zero”*.

Example 2: Represent each situation using quadratic inequality.

- Despite of implementing general community quarantine, public transports are still prohibited. Because of this, there was a high demand on bicycles. The monthly profit that Demz makes on selling bicycles is represented by a mathematical model, $P(x) = x^2 + 5x - 50$. Using quadratic inequality, represent the current profit of Demz.
- An object is launched directly upward from the ground at the rate of 72 feet per second. The equation for the height of the object is:

$$h = -10x^2 + 72x$$

Give a quadratic inequality representation of the scenario if the object is below a height of 144 feet.

Solutions:

- Since it was stated that there was a high demand in bicycles, we assume that the profit is positive. Therefore, it can be represented by: $x^2 + 5x - 50 > 0$.
- The keyword is “below”. So, the inequality symbol must be “<”. Therefore, the scenario can be represented by:

$$-10x^2 + 72x < 144$$

WHAT'S MORE

Critical Thinking



TEST YOURSELF!

- I. Tell whether the following is a quadratic inequality or not. If it is, write QI. Otherwise, write NQI.
 - a. $-2x^2 \leq 8$
 - b. $5(5x + 7) > 7$
 - c. $7x^2 - 15 > 7(2x^2 + 5x)$
 - d. $0.1x^2 + 2.3x < -4$
 - e. $-3x - 5 \leq 2x^2$
- II. Represent the following scenario below using quadratic inequality.
 - a. The revenue of Aling Tura's bakery in selling bread is determined by the formula, $R(x) = 40x - x^2$ where x is the number of breads sold. The cost for producing those breads is given by a formula $C(x) = x + 50$. Using quadratic inequality, represent the positive or normal profit of Aling Tura.
(Note: Profit= Revenue- Cost)

WHAT I HAVE LEARNED

Quadratic inequality is an equality that contains a polynomial of degree 2 and can be written in any of the following forms.

$$ax^2 + bx + c > 0$$

$$ax^2 + bx + c < 0$$

$$ax^2 + bx + c \geq 0$$

$$ax^2 + bx + c \leq 0$$

where a , b and c are real numbers and a is not equal to zero.

Quadratic inequalities make use of inequality symbols such as $<$, $>$, \leq , \geq .

WHAT I CAN DO

Activity: "Quadratic Inequalities or Not?"

Directions: Determine whether the mathematical sentence is quadratic inequality or not.

1. $x^2 + 9x + 14 > 0$

2. $3s^2 - 5s = 1$

3. $4t^2 - 7t + 2 \leq 0$

4. $x^2 < 10x - 3$

5. $12 - 5x + x^2 = 0$

6. $3m + 20 \geq 0$

7. $(2r - 5)(r + 4) > 0$

8. $x^2 - 1 < x + 1$

9. $(4h^2 - 9)(2h + 3) \geq 0$

10. $15 - 2x = 3x^2$

ADDITIONAL ACTIVITIES

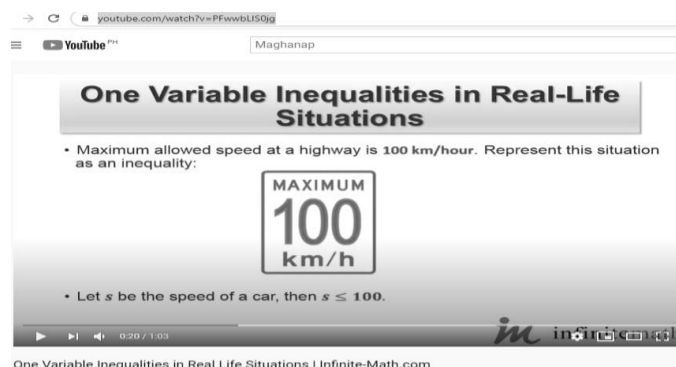
Collaboration, Creativity and
Critical Thinking



A. “Make it Real!”

- ✓ This short video clip shows how quadratic inequalities are used in solving real-life problems and in making decisions.

Watch in youtube: <https://www.youtube.com/watch?v=PFwwbLIS0jg>



B. Create your Own!

Make 3 real life scenarios that can be illustrated by quadratic inequality. Trade your constructed scenarios to your classmate and let them represent it using quadratic inequality.

E-Search

You may also check the link for your reference and further learnings on illustrating quadratic inequality:

- <https://www.khanacademy.org>

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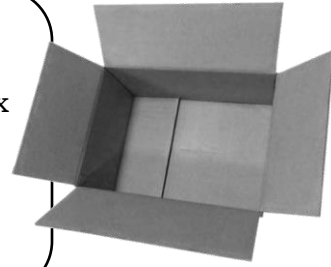
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PROBLEM – BASED WORKSHEET**Packaging Thing**

A company decided to increase the size of the box for the packaging of their canned sardines. The length of the original packaging box was 20 inches longer than its width, the height was 12 inches, and the volume was at most $3,600 \text{ in}^3$.



1. If w represents the width of the box, what mathematical sentence would represent the volume of the original packaging box?
2. What could be the range of the length of the width of the original packaging box?

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We only consider the **positive value of w** since the situation involves measures of length. Thus, the range for the width of the box is **10 inches or less**. And if the dimensions of the box is in whole inches, the greatest possible dimensions of the box are; **width = 10 inches, length = 30 inches, and height = 12 inches**.

$$w^2 + 20w - 300 = 0 \rightarrow (w + 30)(w - 10) = 0 \rightarrow w = -30 \text{ or } w = 10$$

value of w .

3. To solve the resulting mathematical sentence, apply the rule on solving quadratic inequality, that is, replacing the inequality symbol by an equal sign to solve for the

$$(w)(w + 20)(12) \leq 3600 \text{ or } w^2 + 20w - 300 \leq 0$$

Then, the mathematical sentence that will help us solve the problem is,

$$\text{Volume(box)} = (\text{width})(\text{length})(\text{height})$$

1. Let w = the width of the box, length = $w + 20$, height = 12 inches.

PROBLEM - BASED WORKSHEET

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

WHAT I CAN DO

$$\text{II. } -x^2 + 39x - 50 \geq 0 \text{ or } x^2 - 39x + 50 \leq 0$$

1. QI
2. NOI
3. QI
4. QI
5. QI

I.

WHAT'S MORE

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

WHAT I KNOW

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

ASSESSMENT

ANSWER KEY