

GED® Preparation Lesson Plan

Module: Mathematical Reasoning

Lesson Title: Graphing Linear Inequalities

Standards: GED® Preparation (Adult General Education)

Prerequisite Skills ABE Florida Curriculum Framework 2017-2018	Mathematical Reasoning 2014 GED® Assessment Targets Quantitative Problem Solving Standards High Impact Indicator
<p>Write, read, and evaluate expressions in which letters stand for numbers. (CCR.MA.ABE.6.3.1b)</p> <p>Solve an equation or inequality as a process of answering a question – which values, if any, make the inequality true. (CCR.MA.ABE.6.3.2a)</p> <p>Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition – recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions on number line diagrams. (CCR.MA.ABE. 6.3.2d)</p>	<p>Write, manipulate, solve, and graph linear inequalities. (A.3)</p> <p>Identify or graph the solution to a one variable linear inequality on a number line. (A.3. b)</p>

Objectives of the Lesson

Students will:

- Review vocabulary related to the lesson and discuss real-world applications of inequalities
- Write each symbol ($<$, $>$, \leq , \geq) with words and math examples
- Identify one-variable inequality graphed on a number line
- Graph a one-variable inequality on the number line
- Write a one-variable inequality

Materials

- You Tube video: Writing and Graphing Inequalities (10.01 minutes)
<https://www.youtube.com/watch?v=oElmCg5fcWU>
- Handout A: Properties of Inequality <https://www.Math-Aids.com>
- Handout B: Identifying Graphs <https://www.mathworksheets4kids.com>
- Handout C: Number Lines

- Handout D: Graphing Inequalities <https://www.kutasoftware.com>
- Handout E: Writing Inequalities <https://www.mathworksheets4kids.com>
- Handout F: Solving and Graphing Inequalities – Extension Activity 1 <https://www.Math-Aids.com>
- Handout G: Solving and Graphing Inequalities – Extension Activity 2 <https://www.Math-Aids.com>
- Computer, internet access, projector

Instructional Plan

Overview

Solving problems involving inequalities and graphing can be difficult for students, especially when they involve variables and processes to solve equations, as well as positive and negative number rules. By building on the understanding of these relationships and demystifying the greater than and less than concepts, this lesson demonstrates how inequalities can be used mathematically and connected to real-world situations. The GED Testing Service® has identified this assessment target as a high impact indicator that describes some of the critical thinking skills students need to be successful in college, career training, and the workforce.

Process

Introduce the lesson by asking the following questions and discussing the answers as a class:

- What are inequalities?
- When would you use inequalities in the real world?

Write the following words/terms on the board:

- Inequality
- Greater than Less than
- Greater than or equal to Less than or equal to
- Variable
- Coefficient
- Rational number

Review vocabulary definitions on the first page of **Handout A: Properties of Inequality** and briefly discuss the following:

- Difference between an equation (=sign) and an inequality
- Language/vocabulary used (less than, greater than, less than or equal to)
- Review the number line (graphing a point on the number line, using a filled in dot or open dot to show less than or less than or equal to) using **Handout C: Number Lines**

*Brainstorming Activity: “When do we use inequalities in the real world?” I am splitting a pizza with 4 friends and there are 10 slices. We want to eat and be fair. How many slices can I eat and be fair to all? I can eat no more than 2 slices or $x \leq 2$.

*Small group work: write 2 or more real world examples and share out with the group.

After prep activities with vocabulary show the YouTube video “Writing and Graphing an Inequality”
<https://www.youtube.com/watch?v=oElmCg5fcWU>

Pass out **Handout B: Identifying Graphs**.

Discuss open and closed dots on the graph and how they relate to the symbol used. Do number 1 together: $x \geq -2$. “I see the symbol is \geq so I am looking for a closed circle graph, I can eliminate answer choices a and c. Now to decide which graph makes a true statement, I am going to substitute a number for x. I chose 10. Is 10 greater than or equal to -2. Yes, greater than, so I know the arrow must go towards the 10”. This is answer choice b. Repeat the process for problem 2, then have students complete worksheet on their own.

You may wish provide students with a copy of a number line (**Handout C: Number Lines**) so that they can practice graphing each inequality, rather than merely identifying which completed graph best describes each inequality.

Once students have an understanding of the identifying graphs process, introduce **Handout D: Graphing Inequalities** and review the process for creating their own graph of an inequality.

Do number 1 together: $n \leq -5$. Example: “I see the symbol is \leq so I need to make this a closed circle graph. I will start at -5 and draw my arrow going left in a negative (less than) direction.” Repeat the process for problem 2, and then have the students complete worksheet on their own through problem 12. Check and discuss the answers as a group.

Once students have conquered identifying correctly graphed inequalities and graphing inequalities, add the extra step of writing inequalities from a graphed model. Provide students with copies of **Handout E: Writing Inequalities**. Model this process by completing problems 1 and 2 together, then have students complete the rest of the sheet on their own or in pairs. Go over answers and then have students brainstorm additional examples and share with group.

Sample Debriefing Questions

- How are inequalities and equations different?
- Give a real world example using an inequality.
- Explain the difference between an open circle and a closed circle on a graphed inequality?
- Using a number line graph an inequality with a negative number ex: $x > -6$ or $x \leq -5$
- Write a one-variable inequality

Modifications for Different Levels

To modify instruction, provide students with number lines, highlighters, pencils. Have the students brainstorm a real-world situation using an inequality or use one from the lesson. Using the number lines, show the graph of each symbol and have them create it on their number line. Provide students with a copy of **Handout C: Number Lines**.

For higher levels use **Handouts F and G: Solving and Graphing Inequalities – Extension Activity 1 and 2**. You may need to review the rules for signed numbers, the processes for solving inequalities involving negative numbers, and the vocabulary from **Handout A: Properties of Inequality**.

Assessments/ Extensions

Throughout the lesson, be sure to monitor and check for student understanding for each new concept. Allowing students to work in pairs helps to build confidence and share knowledge. There are several resources available on the internet, as well in the GED[®] preparation materials, which will give students more practice with GED[®] type questions that deal with inequalities. Below are two extension activities that can be used for higher level students to practice their solving and graphing inequalities skills.

Properties of Inequality

Inequality Symbols:

- $>$ Greater Than
- \geq Greater Than or Equal To
(The line underneath the Greater Than sign indicates also Equal To.)
- $<$ Less Than
- \leq Less Than or Equal To
(The line underneath the Less Than sign indicates also Equal To.)

Graphing Inequality Symbols:

-  Greater Than
(The open circle indicates that this is NOT EQUAL TO the number that is graphed.)
-  Greater Than or Equal To
(The closed circle indicates that this is EQUAL TO the number that is graphed.)
-  Less Than
(The open circle indicates that this is NOT EQUAL TO the number that is graphed.)
-  Less Than or Equal To
(The closed circle indicates that this is EQUAL TO the number that is graphed.)

**Whenever you multiply by a negative number,
you must reverse the inequality sign.**

If $x < y$, and $z < 0$, then $x * z > y * z$

Example:

Suppose $2 < 4$, and $z = -2$

then $2 * -2 > 4 * -2$ or $-4 > -8$

If $x > y$, and $z < 0$, then $x * z < y * z$

Example

Suppose $6 > 3$, and $z = -8$

Then $6 * -8 < 3 * -8$ or $-48 < -24$

**Whenever you divide by a negative number,
you must reverse the inequality sign.**

If $x < y$, and $z < 0$, then $x \div z > y \div z$

Example:

Suppose $12 < 24$, and $z = -2$

then $12 \div -2 > 24 \div -2$ or $-6 > -12$

If $x > y$, and $z < 0$, then $x \div z < y \div z$

Example

Suppose $16 > 12$, and $z = -4$

then $16 \div -4 < 12 \div -4$ or $-4 < -3$

Adapted from Math-Aids.com

Name : _____

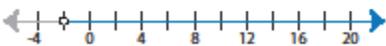
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Identifying Graphs

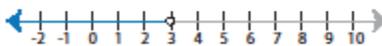
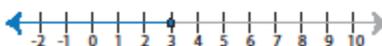
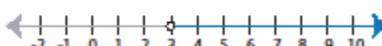
Sheet 1

Choose the correct graph that best describes each inequality.

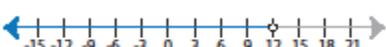
1) $x \geq -2$

- a) 
- b) 
- c) 
- d) 

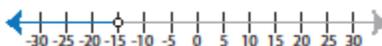
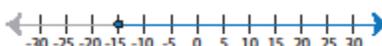
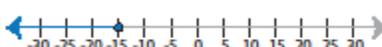
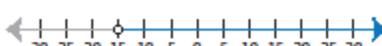
2) $x < 3$

- a) 
- b) 
- c) 
- d) 

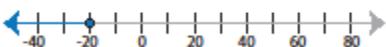
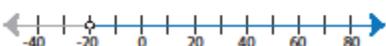
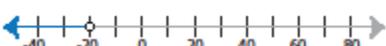
3) $x > 12$

- a) 
- b) 
- c) 
- d) 

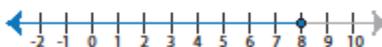
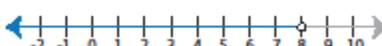
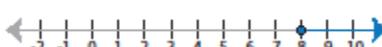
4) $x \leq -15$

- a) 
- b) 
- c) 
- d) 

5) $x < -20$

- a) 
- b) 
- c) 
- d) 

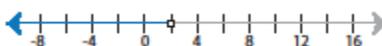
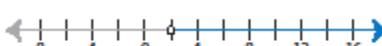
6) $x \leq 8$

- a) 
- b) 
- c) 
- d) 

7) $x \geq 24$

- a) 
- b) 
- c) 
- d) 

8) $x > 2$

- a) 
- b) 
- c) 
- d) 

Answer Key: Identifying Graphs

Worksheet Created at mathworksheets4kids.com - <https://www.mathworksheets4kids.com>

Name : _____

Answer key

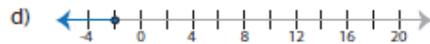
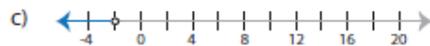
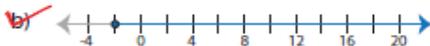
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Identifying Graphs

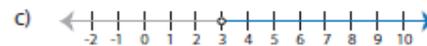
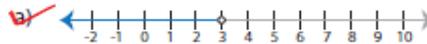
Sheet 1

Choose the correct graph that best describes each inequality.

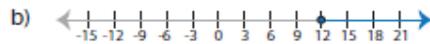
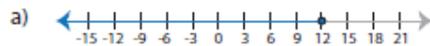
1) $x \geq -2$



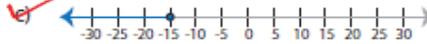
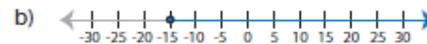
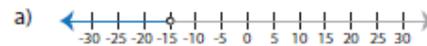
2) $x < 3$



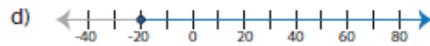
3) $x > 12$



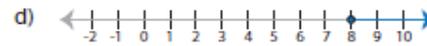
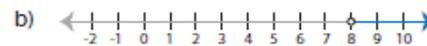
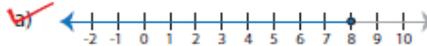
4) $x \leq -15$



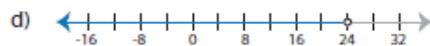
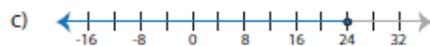
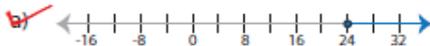
5) $x < -20$



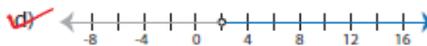
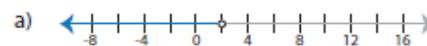
6) $x \leq 8$



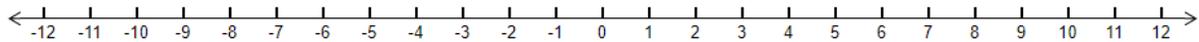
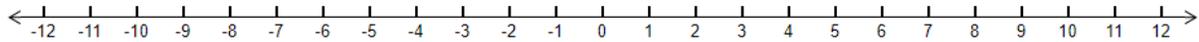
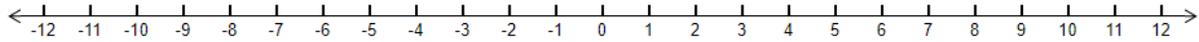
7) $x \geq 24$



8) $x > 2$



Number Lines



Graphing Inequalities

Kuta Software - Infinite Algebra 1

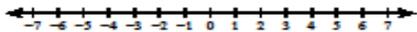
Name _____

Graphing Inequalities

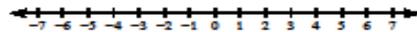
Date _____ Period _____

Draw a graph for each inequality.

1) $n \leq -5$



2) $n \leq 5$



3) $x < 1$



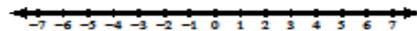
4) $r > 2$



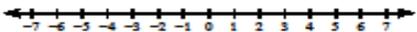
5) $n > 5$



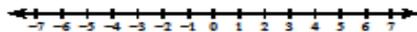
6) $r \leq -2$



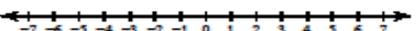
7) $k \leq -2$



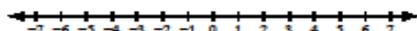
8) $m < -5$



9) $x \geq 2$



10) $-5 \geq v$



11) $-2 \geq v$



12) $x < 5$



Answer Key: Graphing Inequalities

Worksheet Created at Kutasoftware.com - <https://www.kutasoftware.com>

Kuta Software - Infinite Algebra 1

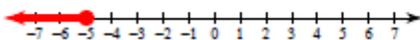
Name _____

Graphing Inequalities

Date _____ Period _____

Draw a graph for each inequality.

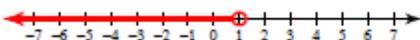
1) $n \leq -5$



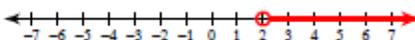
2) $n \leq 5$



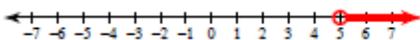
3) $x < 1$



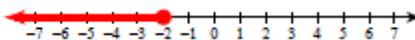
4) $r > 2$



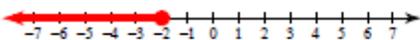
5) $n > 5$



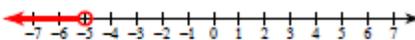
6) $r \leq -2$



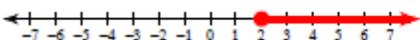
7) $k \leq -2$



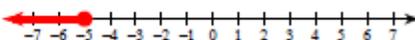
8) $m < -5$



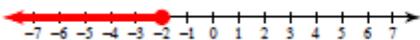
9) $x \geq 2$



10) $-5 \geq v$



11) $-2 \geq v$



12) $x < 5$



Name : _____

Score : _____

Writing Inequalities

ES1

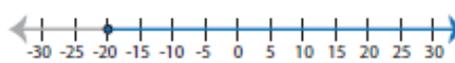
Write the inequality that best describes each graph :

1)



Inequality : _____

2)



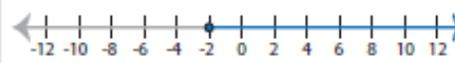
Inequality : _____

3)



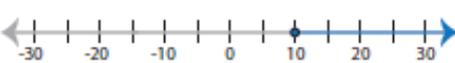
Inequality : _____

4)



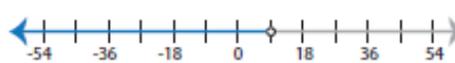
Inequality : _____

5)



Inequality : _____

6)



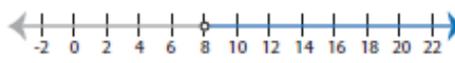
Inequality : _____

7)



Inequality : _____

8)



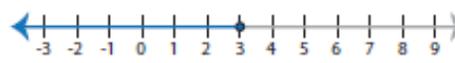
Inequality : _____

9)



Inequality : _____

10)



Inequality : _____

Answer Key: Writing Inequalities

Worksheet Created at mathworksheets4kids.com - <https://www.mathworksheets4kids.com>

Name : _____

Answer key

Score : _____

Writing Inequalities

ES1

Write the inequality that best describes each graph :

1)



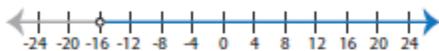
Inequality : $x \leq 4$

2)



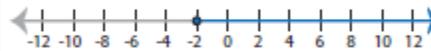
Inequality : $x \geq -20$

3)



Inequality : $x > -16$

4)



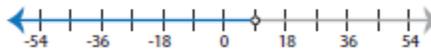
Inequality : $x \geq -2$

5)



Inequality : $x \geq 10$

6)



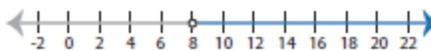
Inequality : $x < 9$

7)



Inequality : $x < 15$

8)



Inequality : $x > 8$

9)



Inequality : $x > -24$

10)



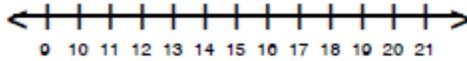
Inequality : $x \leq 3$

Name : _____ Score : _____

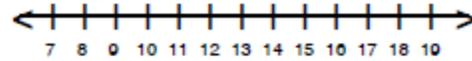
Teacher : _____ Date : _____

Solve and Graph the Inequalities

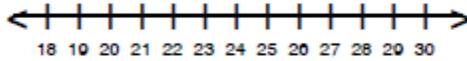
1) $-6z \geq -72$



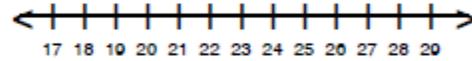
6) $\frac{z}{2} < 8$



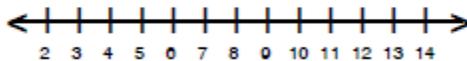
2) $\frac{g}{4} \leq 6$



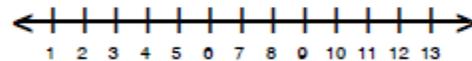
7) $\frac{v}{3} \geq 7$



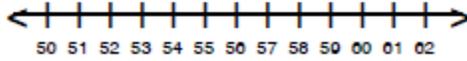
3) $-22 < -2h$



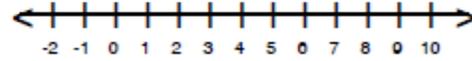
8) $36 < 4x$



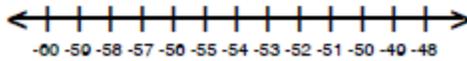
4) $9 > \frac{c}{6}$



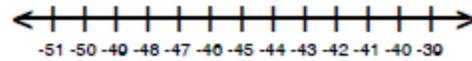
9) $-5g > -30$



5) $-10 \geq \frac{p}{5}$



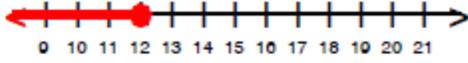
10) $-7 \leq \frac{b}{6}$



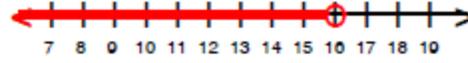
Answer Key: Solve and Graph Inequalities – Extension Activity 1

Worksheet Created at - Math-Aids.com - [https:// www.math-aids.com](https://www.math-aids.com)

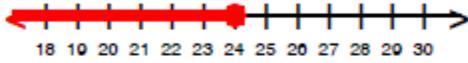
1) $z \leq 12$



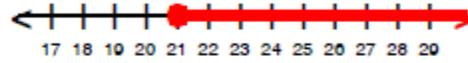
6) $s < 16$



2) $q \leq 24$



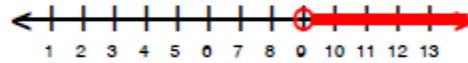
7) $v \geq 21$



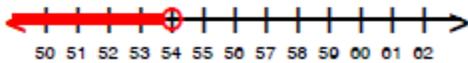
3) $h < 11$



8) $x > 9$



4) $c < 54$



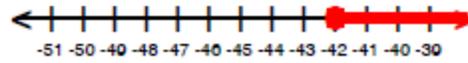
9) $g < 6$



5) $p \leq -50$



10) $b \geq -42$

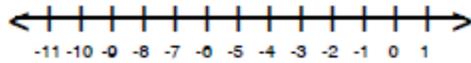


Name : _____ Score : _____

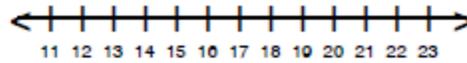
Teacher : _____ Date : _____

Solve and Graph the Inequalities

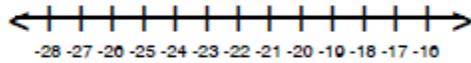
1) $-7 > -1 + a$



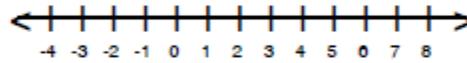
6) $-4 + c \geq 12$



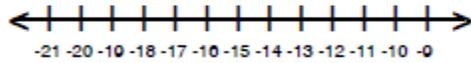
2) $-17 \geq j + 8$



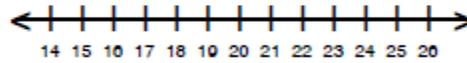
7) $6 > k + 1$



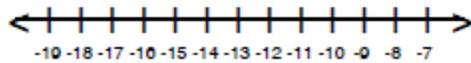
3) $n - 1 \leq -15$



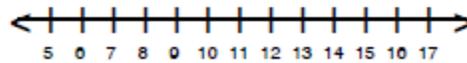
8) $-7 + v < 17$



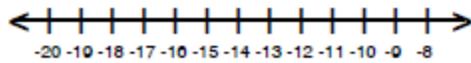
4) $-5 \leq 6 + p$



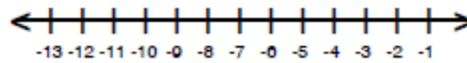
9) $w - 7 \leq 6$



5) $q - 1 > -12$



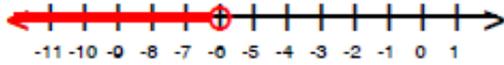
10) $9 + g \geq 5$



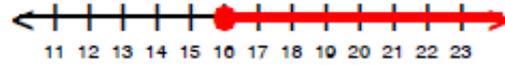
Answer Key: Solve and Graph Inequalities – Extension Activity 2

Worksheet Created at – Math-Aids.com - [https:// www.math-aids.com](https://www.math-aids.com)

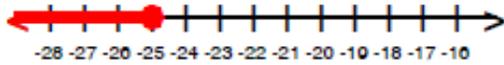
1) $a < -6$



6) $c \geq 16$



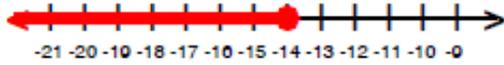
2) $j \leq -25$



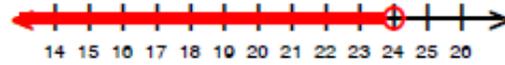
7) $k < 5$



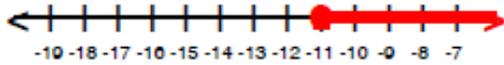
3) $n \leq -14$



8) $v < 24$



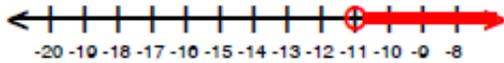
4) $p \geq -11$



9) $w \leq 13$



5) $q > -11$



10) $g \geq -4$

