

Important Concepts . . .

Preview Review



Mathematics Grade 9 TEACHER KEY
W2 - Lesson 8: Linear Inequalities

Important Concepts of Grade 9 Mathematics

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Materials Required

Paper
Pencil
Graph Paper
Calculator

No Textbook Required

This is a stand-alone course.

Mathematics Grade 9

Version 6

Preview/Review W2 - Lesson 8

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Preview/Review Concepts for Grade Nine Mathematics

Teacher Key



W2 – Lesson 8:

Linear Inequalities

OBJECTIVES

By the end of this lesson, you will be able to:

- Determine if a rational number is a possible solution for a given inequality.
- Solve linear inequalities and problems involving linear inequalities.
- Graph the solution of a linear inequality on a number line.
- Verify the solution of an inequality.

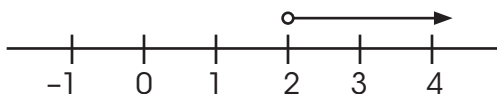
GLOSSARY

Inequality: A way of representing an expression where one value is greater than, less than or equal to another value. Examples of an inequality:
 $x \geq 5$, $-7 \leq y$, $n > 0.6$, $R < -3.5$.

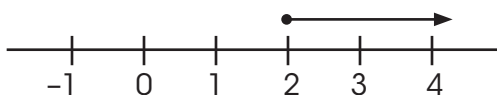
Solution of an Inequality: A value or a set of values that satisfy an inequality.

Boundary Point: Separates the values greater than the unknown from the values less than the unknown.

An open circle shows that the boundary point is not included in the solution.



A closed circle shows that the boundary point is included in the solution.



W2 – Lesson 8: Linear Inequalities

Materials required:

- Paper, Pencil, Graph Paper, and Calculator

Part 1: Representing Inequalities

An inequality is an expression where one value is greater than, less than or equal to another value.

The symbols used for inequality are:

- $>$ means 'greater than'
- $<$ means 'less than'
- \geq means 'greater than or equal to'
- \leq means 'less than or equal to'

To read an inequality:

- $x > y$ x is greater than y
- $x < y$ x is less than y
- $x \geq y$ x is greater than or equal to y
- $x \leq y$ x is less than or equal to y
- $x \neq y$ x is not equal to y

For example, $x < -5$ is read as: x is less than -5 .

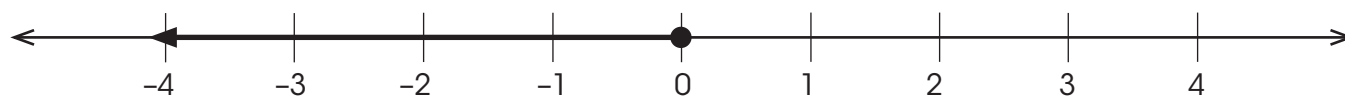
It means that the unknown value, x , is less than -5 . Possibilities include $-6, -7, -8, -9 \dots$

Example 1

An inequality can be represented graphically.



In the above the line segment, the beginning at -2 is an open circle. This represents $>$ and means -2 is **not** a possible solution for this equation. Only values greater than -2 satisfy the equation.



In the above line segment, the beginning at 0 is coloured in, depicting a closed circle. This represents \leq and means 0 **is** a possible solution for this equation. Zero and values less than 0 satisfy the equation.

Practice Questions

1. Insert the correct equation or inequality beside its corresponding graph.

$m \geq 4$

$m > 4$

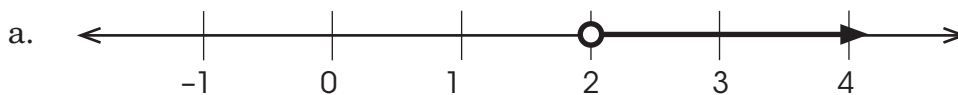
$x = 4$

$4 \geq y$

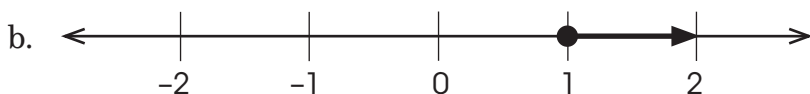
$4 > y$

$m > 4$	
$4 \geq y$	
$4 > y$	
$x = 4$	
$m \geq 4$	

2. Write the inequality that represents the following number lines.



$x > 2$



$x \geq 1$

3. Write the inequality to represent each situation.

- a. All values are greater than or equal to 8.

$x \geq 8$

- b. All values are less than -3.

$x < -3$

Part 2: Solving Inequalities

Solving an inequality is very similar to solving an equation. The purpose is to isolate the variable to solve for a solution.

Example 1

$$6y \geq 54$$

$$\frac{6y}{6} \geq \frac{54}{6}$$

$$y \geq 9$$



Example 2

$$x + 4 < 9$$

$$x + 4 - 4 < 9 - 4$$

$$x < 5$$



Part 3: Solving Inequalities by Multiplying or Dividing by a Negative Number

Example 1

When each side of the inequality is multiplied or divided by a negative number, the inequality sign must be reversed in order for it to be true.

$$\begin{array}{l} -3x > -12 \\ \frac{-3x}{-3} < \frac{-12}{-3} \\ x < 4 \end{array}$$

Note: Because the inequality is divided by a negative number, the inequality symbol is reversed.



Example 2

$$\begin{array}{l} -n \geq -15 \\ -n \times -1 \geq -15 \times -1 \\ n \leq 15 \end{array}$$

Note: Because the inequality is multiplied by a negative number, the inequality symbol is reversed.



The solution of an inequality can contain many values. The solution will be the value or the set of values that satisfy the inequality.

In the first example, where $x < 4$, possible solutions include:

$$3, 2, 1, 0, -1 \dots$$

$$2.05, 3.99, 0.007, \frac{1}{2}, -\frac{3}{4}, -\frac{5}{12}$$

In the second example, where $n > 15$, possible solutions include:

$$15, 16, 17, 18, 19, 20 \dots$$

$$742, 1000, 15.7, 16.359$$

Part 4: Solving Multi-Step Inequalities

To solve inequalities involving addition, subtraction, multiplication and division, work to isolate the variable, remembering to reverse the inequality sign when multiplying or dividing by a negative number.

Example 1

$$4m - 18 < 36$$

$$4m - 18 + 18 < 36 + 18$$

$$4m < 44$$

$$\frac{4m}{4} < \frac{44}{4}$$

$$m < 11$$

Example 2

$$-7p + 2 > -3p + 22$$

$$-7p + 2 - 2 > -3p + 22 - 2$$

$$-7p > -3p + 20$$

$$-7p + 3p > -3p + 3p + 20$$

$$-4p > 20$$

$$\frac{-4p}{-4} < \frac{20}{-4}$$

$$p < -5$$

Remember to reverse the inequality symbol when multiplying or dividing by a negative number.

Practice Questions

1. Solve the following inequalities. Graph the inequality for b and c.

a. $6x < 2x + 30$

$$6x - 2x < 2x - 2x + 30$$

$$4x < 30$$

$$\frac{4x}{4} < \frac{30}{4}$$

$$x < 7.5$$

b. $-12x + 15 > 19 - 4x$

$$-12x + 15 - 15 > 19 - 15 - 4x$$

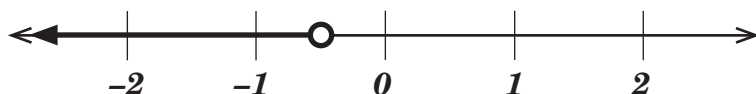
$$-12x > 4 - 4x$$

$$-12x + 4x > -4x + 4x + 4$$

$$-8x > 4$$

$$\frac{8x}{-8} < \frac{4}{-8}$$

$$x < -0.5$$



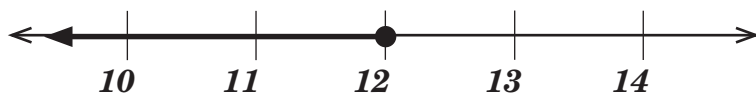
c. $3x - 6 \leq 30$

$$3x - 6 + 6 \leq 30 + 6$$

$$3x \leq 36$$

$$\frac{3x}{3} \leq \frac{36}{3}$$

$$x \leq 12$$



d. $6x + 5 \geq 2x - 15$

$$6x + 5 - 5 \geq 2x - 15 - 5$$

$$6x \geq 2x - 10$$

$$6x - 2x \geq 2x - 10 - 2x$$

$$4x \geq -10$$

$$x \geq -\frac{10}{4} = -2\frac{1}{2} \text{ or } -2.5$$

2. Give 3 possible solutions that satisfy the following inequalities.

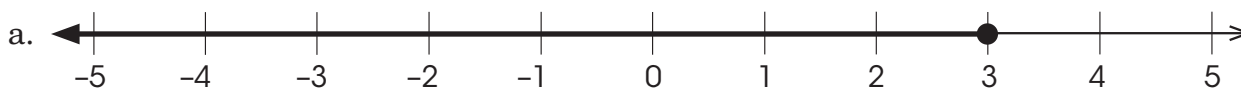
a. $p \geq 6$ **6, 7, 8, 9, 6.02, 1000, etc**

b. $2 \leq b$ **2, 1, 0, -1, -10, -1000, 1.5 etc**

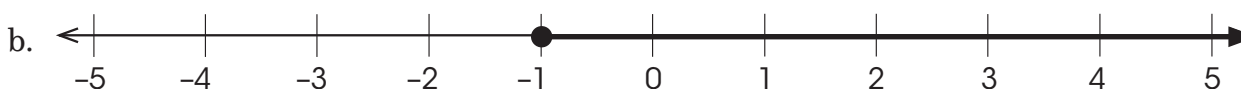
c. $r > 3.05$ **3.06, 3.07, 4, 5, 10, 100, 1000, etc**

Lesson 8 Assignment

1. Write the inequality for each of the following graphs.



$$x \leq 3$$



$$x \geq -1$$

2. Represent the following inequalities in words form. Give an example of what the value could be.

a. $x < 6$

x is less than 6

Examples: 4, -1, 0, $-\frac{4}{5}$

b. $9 \leq y$

y is greater than or equal to 9.

Examples: 9, 14.5, 200

3. Solve the following inequalities.

a. $4d > -20$

$$\begin{aligned} -\frac{4d}{4} &> -\frac{20}{4} \\ d &> -5 \end{aligned}$$

c. $6 + x \geq 12$

$$\begin{aligned} 6 - 6 + x &\geq 12 - 6 \\ x &\geq 6 \end{aligned}$$

b. $\frac{h}{12} < -3$

$$\begin{aligned} \frac{h}{12} \times 12 &< -3 \times 12 \\ h &< -36 \end{aligned}$$

d. $5 \leq 3 - r$

$$\begin{aligned} 5 - 3 &\leq 3 - 3 - r \\ 2 &\leq -r \\ 2(-1) &> -r(-1) \\ -2 &> r \end{aligned}$$

4. Solve and graph the following inequalities.

a. $-7x + 2 > -3x + 22$

$$-7x + 2 - 2 > -3x + 22 - 2$$

$$-7x + 3x > -3x + 3x + 20$$

$$-4x > 20$$

$$x < -5$$



b. $4x + 7 \leq 7x - 8$

$$4x + 7 + 8 \leq 7x - 8 + 8$$

$$4x - 4x + 15 \leq 7x - 4x$$

$$15 \leq 3x$$

$$5 \leq x$$



c. $3x - 4 \geq 6x + 11$

$$3x - 4 + 4 \geq 6x + 11 + 4$$

$$3x - 6x \geq 6x - 6x + 15$$

$$-3x \geq 15$$

$$x \leq -5$$



d. $-6x + 5 \geq 29$

$$-6x + 5 - 5 \geq 29 - 5$$

$$-6x \geq 24$$

$$x \leq -4$$



