**INEQUALITIES**

**Solving Linear Inequalities**

<table>
<thead>
<tr>
<th>Common Core Standard</th>
<th>Next Generation Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-REI.B.3</td>
<td>AI-A.REI.3</td>
</tr>
<tr>
<td>Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</td>
<td>Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. Note: Algebra I tasks do not involve solving compound inequalities.</td>
</tr>
</tbody>
</table>

NOTE: This lesson is closely related to, and builds upon, Expressions and Equations, Lesson 3, Solving Linear Equations.

**LEARNING OBJECTIVES**

Students will be able to:

1) Solve one step and multiple step inequalities.
2) Explain each step involved in solving one step and multiple step inequalities.
3) Do a check to see if the solution is correct.

**Overview of Lesson**

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<th>Teacher Centered Introduction</th>
<th>Student Centered Activities</th>
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<tr>
<td>Overview of Lesson</td>
<td>guided practice</td>
</tr>
<tr>
<td>- activate students’ prior knowledge</td>
<td>Teacher: anticipates, monitors, selects, sequences, and connects student work</td>
</tr>
<tr>
<td>- vocabulary</td>
<td>- developing essential skills</td>
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<tr>
<td>- learning objective(s)</td>
<td>- Regents exam questions</td>
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<tr>
<td>- big ideas: direct instruction</td>
<td>- formative assessment assignment (exit slip, explain the math, or journal entry)</td>
</tr>
<tr>
<td>- modeling</td>
<td></td>
</tr>
</tbody>
</table>

**VOCABULARY**

- big rule of inequalities
- equality
- four column strategy
- four general rules
- greater than
- greater than or equal to
- inequality
- inequality sign
- less than
- less than or equal to
- not equal to
- solution set

**BIG IDEAS**

The Big Rule for Solving Inequalities:

All the rules for solving equations apply to inequalities – plus one:

When an inequality is multiplied or divided by any negative number, the direction of the inequality sign changes.
Inequality Symbols:

- less than
- greater than
- less than or equal to
- greater than or equal to
- not equal to

The solution of an inequality includes any values that make the inequality true. Solutions to inequalities can be graphed on a number line using open and closed dots.

Checking Solutions to Inequalities

To check the solution to an inequality, replace the variable in the inequality with a value in the solution set. If the value selected is a correct solution, the simplified inequality will produce a true statement.

NOTE: The value selected must be in the solution set.

DEVELOPING ESSENTIAL SKILLS

Solve for x: \( 4 + \frac{2}{5}x > 3 + x \)

<table>
<thead>
<tr>
<th>Notes</th>
<th>Left Hand Expression</th>
<th>Sign</th>
<th>Right Hand Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given</td>
<td>( 4 + \frac{2}{5}x )</td>
<td>&gt;</td>
<td>( 3 + x )</td>
</tr>
<tr>
<td>Multiply by 5</td>
<td>( 20 + 2x )</td>
<td>&gt;</td>
<td>( 15 + 5x )</td>
</tr>
<tr>
<td>Subtract 2x</td>
<td>( 20 )</td>
<td>&gt;</td>
<td>( 15 + 3x )</td>
</tr>
<tr>
<td>Subtract 15</td>
<td>( 5 )</td>
<td>&gt;</td>
<td>( 3x )</td>
</tr>
<tr>
<td>Divide by 3</td>
<td>( \frac{5}{3} )</td>
<td>&gt;</td>
<td>( x )</td>
</tr>
</tbody>
</table>

Check: Select \( \frac{4}{3} \), which is less than \( \frac{5}{3} \), to test the solution.

\[
4 + \frac{2}{5} \cdot \frac{4}{3} > 3 + \frac{4}{3}
\]

\[
4 + \frac{8}{15} > 3 + \frac{20}{15}
\]

\[
60 + 8 > 45 + 20
\]

\[
\frac{68}{15} > \frac{65}{15} \quad \text{true}
\]

REGENTS EXAM QUESTIONS (through June 2018)

A.REI.B.3: Solving Linear Inequalities
138) The inequality $7 - \frac{2}{3}x < x - 8$ is equivalent to

1) $x > 9$
2) $x > \frac{3}{5}$
3) $x < 9$
4) $x < \frac{3}{5}$

139) Given that $a > b$, solve for $x$ in terms of $a$ and $b$:

$b(x - 3) \geq ax + 7b$

140) When $3x + 2 \leq 5(x - 4)$ is solved for $x$, the solution is

1) $x \leq 3$
2) $x \geq 3$
3) $x \leq -11$
4) $x \geq 11$

141) What is the solution to $2k + 8 > 3k - 6$?

1) $k < 14$
2) $k < \frac{14}{5}$
3) $k > 14$
4) $k > \frac{14}{5}$

142) Solve the inequality below:

$1.8 - 0.4y \geq 2.2 - 2y$

143) What is the solution to the inequality $2 + \frac{4}{9}x \geq 4 + x$?

1) $x \leq -\frac{18}{5}$
2) $x \geq -\frac{18}{5}$
3) $x \leq \frac{54}{5}$
4) $x \geq \frac{54}{5}$

144) The solution to $4p + 2 < 2(p + 5)$ is

1) $p > -6$
2) $p < -6$
3) $p > 4$
4) $p < 4$

SOLUTIONS

138) ANS: 1

Strategy: Use the four column method for solving and documenting an equation or inequality.

<table>
<thead>
<tr>
<th>Notes</th>
<th>Left Expression</th>
<th>Sign</th>
<th>Right Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given:</td>
<td>$7 - \frac{2}{3}x$</td>
<td>$&lt;$</td>
<td>$x - 8$</td>
</tr>
<tr>
<td>Add +8 to both expressions (Addition property of equality)</td>
<td>$15 - \frac{2}{3}x$</td>
<td>$&lt;$</td>
<td>$x$</td>
</tr>
<tr>
<td>Add $\frac{2}{3}x$ to both expressions (Addition property of equality)</td>
<td>$15$</td>
<td>$&lt;$</td>
<td>$x + \frac{2}{3}x$</td>
</tr>
<tr>
<td>Simplify</td>
<td>$15$</td>
<td>$&lt;$</td>
<td>$\frac{5}{3}x$</td>
</tr>
</tbody>
</table>
Divide both expressions by $\frac{5}{3}$
(Division property of equality)

| Simplify | $9$ | $<$ | $\frac{5}{3}x$ |
| Rewriting | $x$ | $>$ | $9$ |

PTS: 2 NAT: A.REI.B.3 TOP: Solving Linear Inequalities

139) ANS:

$x \leq \frac{10b}{b-a}$

Strategy: Use the four column method. Remember that $a > b$.

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<th>Notes</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Given</td>
<td>$b(x - 3)$</td>
<td>$\geq$</td>
<td>$ax + 7b$</td>
</tr>
<tr>
<td>Distributive Property</td>
<td>$bx - 3b$</td>
<td>$\geq$</td>
<td>$ax + 7b$</td>
</tr>
<tr>
<td>Transpose</td>
<td>$bx - ax$</td>
<td>$\geq$</td>
<td>$10b$</td>
</tr>
<tr>
<td>Factor</td>
<td>$x(b - a)$</td>
<td>$\geq$</td>
<td>$10b$</td>
</tr>
<tr>
<td>Divide by $(b - a)$</td>
<td>$x$</td>
<td>$\leq$</td>
<td>$\frac{10b}{b-a}$</td>
</tr>
</tbody>
</table>

NOTE: Since $a > b$, the expression $(b - a)$ must be a negative number. When dividing an inequality by a negative number, the direction of the inequality sign must be reversed.

PTS: 2 NAT: A.REI.B.3 TOP: Solving Linear Inequalities

140) ANS: 4

$3x + 2 \leq 5(x - 4)$
$3x + 2 \leq 5x - 20$
$2 + 20 \leq 5x - 3x$
$22 \leq 2x$
$11 \leq x$
$x \geq 11$

PTS: 2 NAT: A.REI.B.3 TOP: Solving Linear Inequalities

141) ANS: 1

$2h + 8 > 3h - 6$
$2h + 14 > 3h$
$14 > h$

PTS: 2 NAT: A.REI.B.3

142) ANS:

$y \geq \frac{1}{4}$

| Given | $1.8 - 0.4y$ | $\geq$ | $2.2 - 2y$ |
### 143) ANS: 1

\[ 1.8 - 0.4y \geq 2.2 - 2y \]
\[ 1.6y \geq 0.4 \]
\[ y \geq 0.25 \]

Remember to change the direction of the inequality sign when multiplying or dividing by a negative number.

### 144) ANS: 4

**Strategy:** Use order of operations.

<table>
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<tr>
<th>Notes</th>
<th>Left Expression</th>
<th>Sign</th>
<th>Right Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given</td>
<td>( 4p + 2 )</td>
<td>&lt;</td>
<td>( 2(p + 5) )</td>
</tr>
<tr>
<td>Divide by 2</td>
<td>( 2p + 1 )</td>
<td>&lt;</td>
<td>( p + 5 )</td>
</tr>
<tr>
<td>Subtract p</td>
<td>( p + 1 )</td>
<td>&lt;</td>
<td>5</td>
</tr>
<tr>
<td>Subtract 1</td>
<td>( p )</td>
<td>&lt;</td>
<td>4</td>
</tr>
</tbody>
</table>

Remember to change the direction of the inequality sign when multiplying or dividing by a negative number.