1.7 Inequalities: Linear and Absolute Value

GOALS:
1. Recognize the verbs used in inequalities.
2. Recognize solutions to inequalities as those values of a variable that make the inequality true.
3. Solve inequalities using properties comparable to those used to solve equations:
* Addition Property of Inequality
* Multiplication Property of Inequality.

Study 1.7 CVC # 1-13;
1,5,9,13; 27, 31, 35, ...91

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1.7 Inequalities: Linear and Absolute Value

Algebraic Sentences

I. Equations contain verb:
=   "is equal to"

II. Inequalities contain verb:
>   " is greater than"
or   <   " is less than"

III. Combination:
$\geq$ " is greater than or equal to"

$\leq$ " is less than or equal to"

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.7 Inequalities: Linear and Absolute Value

Examples

1.   >   " is greater than"
      4 > 2   x > 0   2x - 1 > 11

2.   <   " is less than"
      2 < 4   x < 0   2x - 1 < 11

3.   ≥   " is greater than or equal to"
      4 ≥ 2   x ≥ 0   2x - 1 ≥ 11

4.   ≤   " is less than or equal to"

      2 ≤ 4   x ≤ 0   2x - 1 ≤ 11

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.7 Inequalities: Linear and Absolute Value

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Examples

1.   >   " is greater than"
      4 > 2   x > 0   2x - 1 > 11

2.   <   " is less than"
      2 < 4   x < 0   2x - 1 < 11

3.   ≥   " is greater than or equal to"
      4 ≥ 2   x ≥ 0   2x - 1 ≥ 11

4.   ≤   " is less than or equal to"

      2 ≤ 4   x ≤ 0   2x - 1 ≤ 11

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1.7 **Inequalities:** Linear and Absolute Value

Solve for x:
What values of x make the sentence true?

1.   4 > 2   _____

2.   x < 0   _____

3.   x - 1 $\leq$ 11   _____

4. 2x - 1 $\geq$ 11   _____

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1.7 **Inequalities:** Linear and Absolute Value

Solve for x:
What values of x make the sentence true?

1.   4 > 2   all x

2.   x < 0   all negative x

3.   x - 1 $\leq$ 11   all x less than or equal to 12

4. 2x - 1 $\geq$ 11   all x greater than or equal to 6

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1.7 Inequalities: Linear and Absolute Value

How Can You Solve for x?
Need properties similar to those use for equations.

1.   Addition Property of Inequality:

$$\text{If} \quad a \;<\; b,$$
$$\text{then} \quad a \pm c \;<\; b \pm c$$

Examples:

If $a < b$, then:	$5 < 9$
if $c > 0$, $a+c \;<\; b+c$	$5 + 2 \;?\; 9 + 2$; $7 < 11$
if **c < 0**, $a+c \;<\; b+c$	$5+(-2) \;?\; 9+(-2)$; $3 < 7$

Works the same way as the Addition Property of Equality.

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1.7 Inequalities: Linear and Absolute Value

How Can You Solve for x?
Need properties similar to those use for equations.

2.   Multiplication Property of Inequality:

$$\text{If} \quad a \;<\; b, \quad \text{then:}$$
$$\text{if } c > 0, \quad ac \;<\; bc \quad \text{and}$$
$$\text{if } c \;<\; 0, \quad ac \;>\; bc$$

When you multiply or divide an inequality by a negative, you change the verb from < to >, or from > to <

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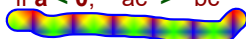## 1.7 Inequalities: Linear and Absolute Value

How Can You Solve for x?
Need properties similar to those use for equations.

1. Addition Property of Inequality:
    If $a < b$,
    then $a \pm c < b \pm c$

2. Multiplication Property of Inequality:
    If $a < b$,   then:
    if $a > 0$, $ac < bc$ and
    if **$a < 0$**, $ac > bc$

Properties for inequalities are the same as for equalities, except:

When multiply or divide by a negative, you change the verb

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1.7 Inequalities: Linear and Absolute Value

Start with $5 > 2$

Multiply by -3: $- 15$? -6

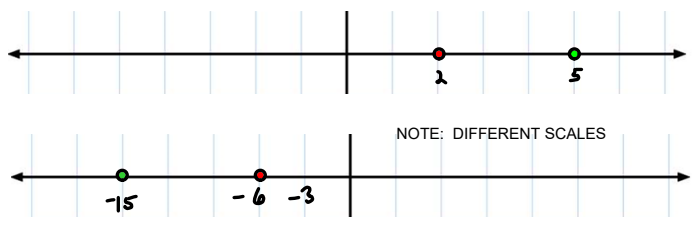Class Notes: Prof. G. Battaly, Westchester Community College, NY

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1.7 **Inequalities:** Linear and Absolute Value

Start with   5 > 2

Multiply by -3:   - 15 ? -6

                            - 15 < -6

NOTE: DIFFERENT SCALES

2   5

-15   - 6 -3

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1.7 Inequalities: Linear and Absolute Value

Solve for x: -2x > 4

Divide by -2:   x ? -2

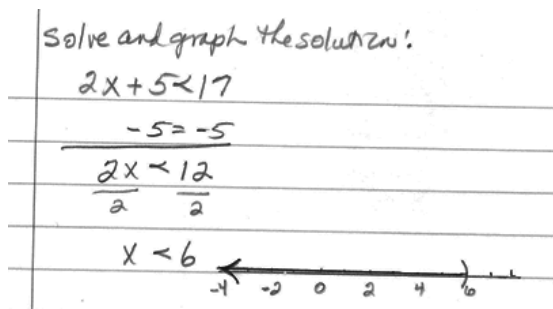Class Notes: Prof. G. Battaly, Westchester Community College, NY

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1.7 Inequalities: Linear and Absolute Value

Solve for x: -2x > 4

Divide by -2:   x < -2

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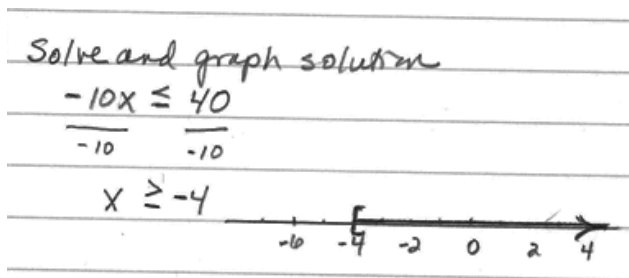
1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

2x + 5 < 17

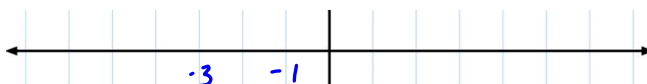Class Notes: Prof. G. Battaly, Westchester Community College, NY

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1.7 Inequalities: Linear and Absolute Value

Solve and graph the solution:

$2x + 5 < 17$

$\underline{\quad -5 = -5 \quad}$

$\dfrac{2x}{2} < \dfrac{12}{2}$

$x < 6$

(number line with points -4, -2, 0, 2, 4, 6)

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$-10\,x \le -40$

(number line with points 2, 4)

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$-10 x \le -40$$

Solve and graph solution

$$-10x \le 40$$
$$\overline{-10} \qquad \overline{-10}$$

$$x \ge -4$$

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$-4 (x + 2) > 5 x + 19$$

-3   -1

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$-4(x+2) > 5x + 19$$

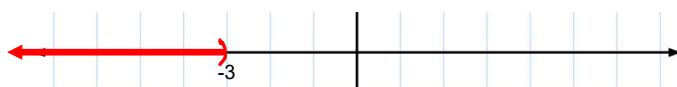$$-4(x+2) > 5x + 19$$
$$-4x - 8 > 5x + 19$$
$$+4x - 19 = 4x - 19$$
$$-27 > 9x$$
$$or \; 9x < -27$$
$$x < -3$$

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$\frac{3x}{10} + 1 \geq \frac{1}{5} - \frac{x}{10}$$

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$\frac{3x}{10} + 1 \geq \frac{1}{5} - \frac{x}{10}$$

$$\frac{3x}{10} + 1 \geq \frac{1}{5} - \frac{x}{10} \qquad LCD = 10$$
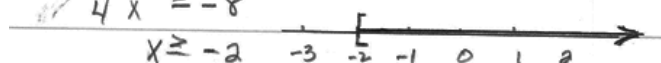
$$10 \cdot \frac{3x}{10} + 10(1) \geq 10 \cdot \frac{1}{5} - 10 \cdot \frac{x}{10}$$

$$3x + 10 \geq 2 - x$$

$$x - 10 = -10 + x$$

$$4x \geq -8$$

$$x \geq -2 \qquad$$

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$1 \leq 3x - 2 < 10$$

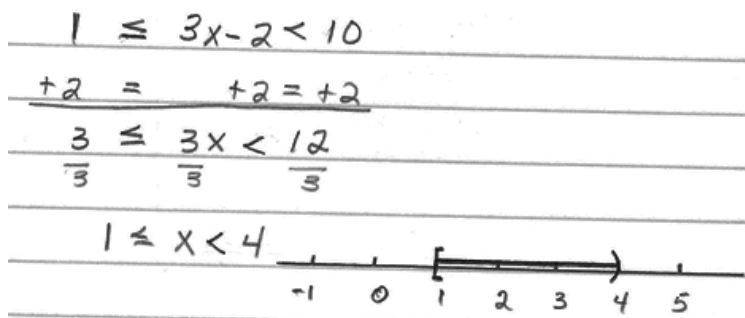Class Notes: Prof. G. Battaly, Westchester Community College, NY

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$1 \le 3x - 2 < 10$$

$$1 \le 3x - 2 < 10$$
$$+2 \quad = \quad +2 = +2$$
$$3 \le 3x < 12$$
$$\frac{}{3} \quad \frac{}{3} \quad \frac{}{3}$$
$$1 \le x < 4$$

-1   0   1   2   3   4   5

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$-3 < \frac{-1}{2}x \le 3$$

-6   -4   -2   2   4   6

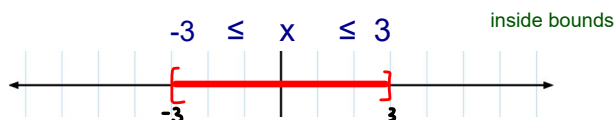Class Notes: Prof. G. Battaly, Westchester Community College, NY

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$-3 < \frac{-1}{2}x \le 3$$

$$-3 < -\tfrac{1}{2}X \le 3 \qquad \text{when multiply}$$

$$-2(-3) \quad -2(-\tfrac{1}{2})x \quad -2(3) \qquad \text{by a negative,}$$

$$6 > x \ge -6 \qquad \text{change verb.}$$

$$\text{or; } -6 \le x < 6$$

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$|x| \le 3$$

$$-3 \le x \le 3 \qquad \text{inside bounds}$$

In general, to solve for *u* :

$$|u| < c \qquad \text{where c > 0}$$

$$-c < u < c$$

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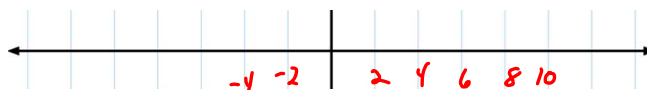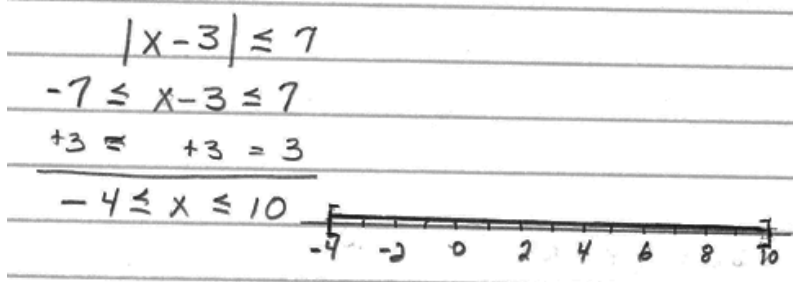College Algebra & Trig Home Page   Homework

1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$| x - 3 | \le 7$$

-4 -2 | 2 4 6 8 10

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$| x - 3 | \le 7$$

$$|x - 3| \le 7$$
$$-7 \le x - 3 \le 7$$
$$+3 \le \qquad +3 = 3$$
$$-4 \le x \le 10$$

-4 -2 0 2 4 6 8 10

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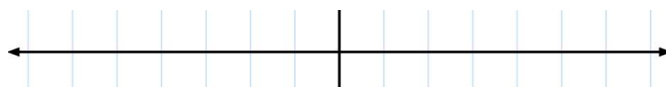
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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$\left| \frac{3(x-1)}{4} \right| < 6$$

-10 -8 -6 -4 -2   2 4 6 8 10

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1.7 Inequalities: Linear and Absolute Value
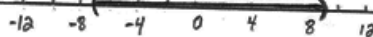
Solve for x and graph the solution:

$$\left| \frac{3(x-1)}{4} \right| < 6$$

$$\left| \frac{3(x-1)}{4} \right| < 6$$

$$-6 < \frac{3(x-1)}{4} < 6$$

$$-24 < 3(x-1) < 24$$

$$-8 < x-1 < 8$$

$$-7 < x < 9$$

-12 -8 -4 0 4 8 12

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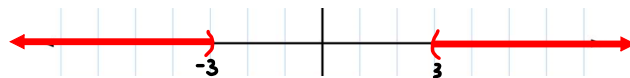
1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:
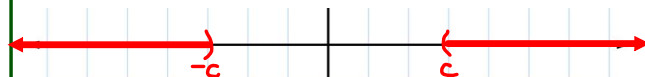
$$| x | \; > \; 3$$

outside bounds

x < -3　and　x > 3

In general, to solve for *u* :

$$| \, u \, | \; > \; c \quad \text{where c > 0}$$

u < -c　and　*u* > c

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$| \, x + 3 \, | \; > \; 6$$

-10　-8　-6　-4　-2　　2　4　6

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$|x + 3| > 6$$

$|x+3| > 6$

$x+3 < -6$ or $x+3 > 6$

$x < -9$ $x > 3$

(number line: -12, -9, -6, -3, 0, 3, 6, 9)

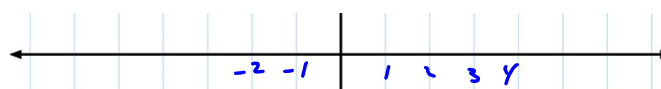Class Notes: Prof. G. Battaly, Westchester Community College, NY

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$6|x - 1| - 3 \geq 15$$

(number line: -2, -1, 1, 2, 3, 4)
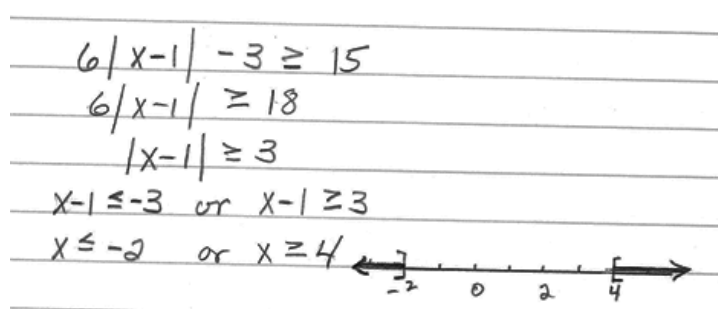
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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$6 \, | \, x - 1 \, | \, - 3 \geq 15$$

$$6|x-1| - 3 \geq 15$$
$$6|x-1| \geq 18$$
$$|x-1| \geq 3$$
$$x-1 \leq -3 \quad \text{or} \quad x-1 \geq 3$$
$$x \leq -2 \quad \text{or} \quad x \geq 4$$

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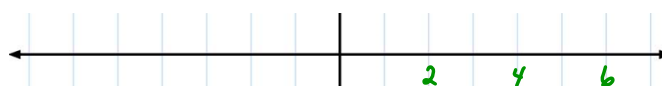
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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$-2 \, | \, 4 - x \, | \, < \, -4$$

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1.7 Inequalities: Linear and Absolute Value

Solve for x and graph the solution:

$$-2\,|\,4 - x\,|\ <\ -4$$

$$\frac{-2\,|\,4-x\,|\ <\ -4}{-2 \qquad -2}$$

$$|\,4-x\,|\ >\ 2$$

$$4-x < -2 \quad \text{or} \quad 4-x > 2$$

$$-x < -6 \qquad\qquad -x > -2$$

$$x > 6 \qquad\qquad x < 2$$

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