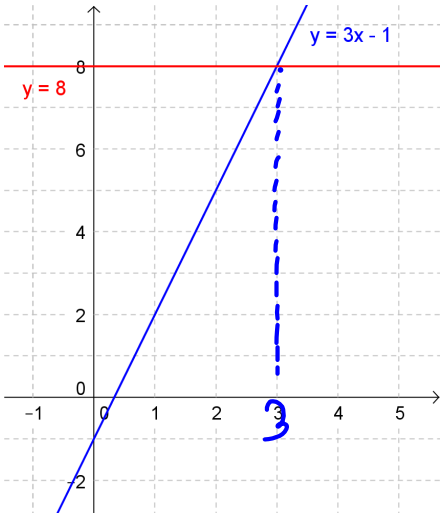
Solving Linear Inequalities

Oct 11/2018

To solve an inequality, find all values that satisfy the inequality.

Consider: $3x - 1 < 8$

The simplest way to visualize the solution is to graph and compare the LS and RS:



Where is the line y = 3x - 1 less than the line y = 8?

$x < 3$

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We have also solved such inequalities by:
(1) solving the corresponding equation, then
(2) testing values around the solution(s).

(1) Solve $3x - 1 = 8$

$3x = 9$
$x = 3$

(2) Test x < 3 and x > 3

$3x - 1 < 8$

try 2:
LS = 3(2) - 1
= 5
LS < RS ✓

try 4:
LS = 3(4) - 1
= 11
LS > RS X

Solution is $x < 3$

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$3x - 1 < 8$

(1) Solve $3x - 1 = 8$

$3x = 9$

$x = 3$

(2) Test $x < 3$: $3(2) - 1 = 5$, pass

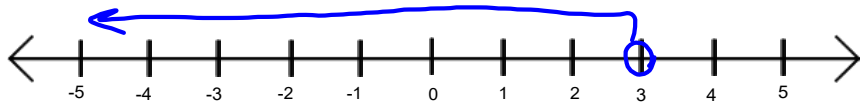
Test $x > 3$: $3(4) - 1 = 11$, fail

The solution can be represented as:

(a) set notation: $\{x \in \mathbb{R} | x < 3\}$ $x \leq 3$

(b) interval notation: $x \in (-\infty, 3)$ $(-\infty, 3]$

(c) a number line:



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Algebraic Operations on Inequalities

What are the effects of adding, subtracting, multiplying, and dividing on a very simple inequality?

Start with $4 < 8$, which is obviously true.

add positive: $+1$

$5 < 9$ ✓

add negative: $+(-1)$

$3 < 7$ ✓

subtract positive: $-(1)$

$3 < 7$ ✓

subtract negative: $-(-1)$

$5 < 9$ ✓

multply by positive: $\times(2)$

$8 < 16$ ✓

multiply by negative: $\times(-2)$

$-8 > -16$ X

divide by positive: $\div(2)$

$2 < 4$ ✓

divide by negative: $\div(-2)$

$-2 > -4$ X

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Solving Inequalities Algebraically:

We can use the same basic operations (add, subtract, multiply, divide) that we would with a regular equation.

Note: When multiplying or dividing by a negative value, the direction of the inequality must be switched.

Ex. Solve

(a) $2x - 3 > 5$

$+3 \quad +3$

$\frac{2x}{2} > \frac{8}{2}$

$x > 4$

(b) $\frac{-1}{3}(x+4) \leq -7$

$\times(-3)$ flip $\times(-3)$

$x + 4 \geq 21$

$-4 \quad -4$

$x \geq 17$

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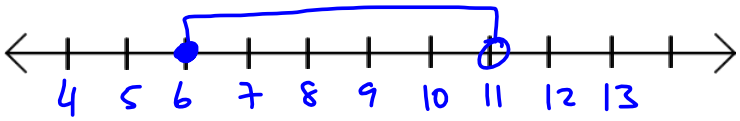
For a double-inequality, perform each operation on all parts simultaneously. (or separately)

Ex. Solve $10 \leq 3(2x-5) - (3x-7) < 25$.

Express your solution using:
(a) set notation,
(b) interval notation,
(c) a number line.



$10 \leq 6x - 15 - 3x + 7 < 25$

$10 \leq 3x - 8 \quad < 25$

$+8 \quad +8 \quad +8$

$\frac{18}{3} \leq \frac{3x}{3} < \frac{33}{3}$

$6 \leq x < 11$

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Assigned Work:

p.213 # 5bdf, 6be, 7bdf, 8, 9, 11, 15, 19

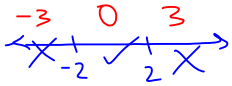
9. (a) $x^2 < 4$

$(x-2)(x+2) < 0$

① solve equation: $x^2 = 4$

$x = \pm 2$

try −3, 0, 3



$LS = (-3)^2$ $LS = 0^2$

$= 9$ $= 0$

$RS = 4$ $LS < RS$ ✓

$LS > RS$ ✗

Solution

$-2 < x < 2$

$(x+2)(x-2) < 0$

	−3	0	3
		-2	+2
$x+2$	−	+	+
$x-2$	−	−	+
Result	+	−	+

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