Linear Inequalities

Andrew Gloag
Eve Rawley
Anne Gloag

CK-12 flexbook
next generation textbooks

To access a customizable version of this book, as well as other interactive content, visit www.ck12.org

CK-12 Foundation is a non-profit organization with a mission to reduce the cost of textbook materials for the K-12 market both in the U.S. and worldwide. Using an open-content, web-based collaborative model termed the **FlexBook®**, CK-12 intends to pioneer the generation and distribution of high-quality educational content that will serve both as core text as well as provide an adaptive environment for learning, powered through the **FlexBook Platform®**.

Printed: December 13, 2014

flexbook
next generation textbooks

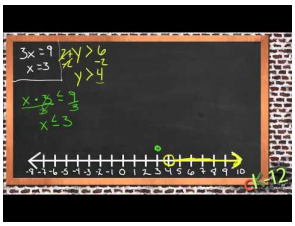
AUTHORS
Andrew Gloag
Eve Rawley
Anne Gloag

CHAPTER 1 Linear Inequalities

Here you'll learn how to solve inequalities by isolating the variable on one side of the inequality sign. You'll also learn how to graph their solution set.

What if you had an inequality with an unknown variable like $x - 12 > -5$? How could you isolate the variable to find its value? After completing this Concept, you'll be able to solve one-step inequalities like this one.

Watch This



MEDIA

Click image to the left or use the URL below.

URL: http://www.ck12.org/flx/render/embeddedobject/133223

CK-12 Foundation: 0602S Solving One-Step Inequalities (H264)

Guidance

To solve an inequality we must isolate the variable on one side of the inequality sign. To isolate the variable, we use the same basic techniques used in solving equations.

We can solve some inequalities by adding or subtracting a constant from one side of the inequality.

Example A

Solve the inequality and graph the solution set.

$x - 3 < 10$

Solution

Starting inequality: $x - 3 < 10$

Add **3** to both sides of the inequality: $x - 3 + 3 < 10 + 3$

Simplify: $x < 13$

Example B

Solve the inequality and graph the solution set.

$x - 20 \leq 14$

Solution:

Starting inequality: $x - 20 \leq 14$

Add **20** to both sides of the inequality: $x - 20 + 20 \leq 14 + 20$

Simplify: $x \leq 34$

Solving Inequalities Using Multiplication and Division

We can also solve inequalities by multiplying or dividing both sides by a constant. For example, to solve the inequality $5x < 3$, we would divide both sides by 5 to get $x < \frac{3}{5}$.

However, something different happens when we multiply or divide by a negative number. We know, for example, that 5 is greater than 3. But if we multiply both sides of the inequality $5 > 3$ by -2, we get $-10 > -6$. And we know that's not true; -10 is less than -6.

This happens whenever we multiply or divide an inequality by a negative number, and so we have to flip the sign around to make the inequality true. For example, to multiply $2 < 4$ by -3, first we multiply the 2 and the 4 each by -3, and then we change the <sign to a >sign, so we end up with $-6 > -12$.

The same principle applies when the inequality contains variables.

Example C

Solve the inequality.

$4x < 24$

Solution:

Original problem: $4x < 24$

Divide both sides by 4: $\frac{4x}{4} < \frac{24}{4}$

Simplify: $x < 6$

Example D

Solve the inequality.

$-5x \leq 21$

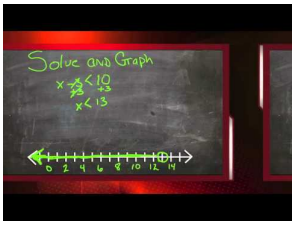
Solution:

Original problem: $-5x \leq 21$

Divide both sides by -5 : $\frac{-5x}{-5} \geq \frac{21}{-5}$ ***Flip the inequality sign.***

Simplify: $x \geq -\frac{21}{5}$

Watch this video for help with the Examples above.



MEDIA

Click image to the left or use the URL below.

URL: http://www.ck12.org/flx/render/embeddedobject/133224

CK-12 Foundation: Solving One-Step Inequalities

Vocabulary

- The answer to an **inequality** is usually an **interval of values**.
- Solving inequalities works just like solving an equation. To solve, we isolate the variable on one side of the equation.
- When multiplying or dividing both sides of an inequality by a negative number, you need to ***reverse the inequality***.

Guided Practice

Solve each inequality.

a) $x+8 \leq -7$

b) $x+4 > 13$

c) $\frac{x}{25} < \frac{3}{2}$

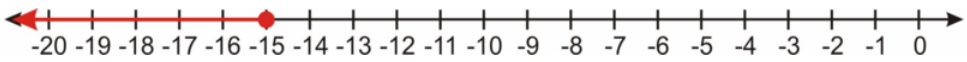
d) $\frac{x}{-7} \geq 9$

Solutions:

a) Starting inequality: $x+8 \leq -7$

Subtract **8** from both sides of the inequality: $x+8-8 \leq -7-8$

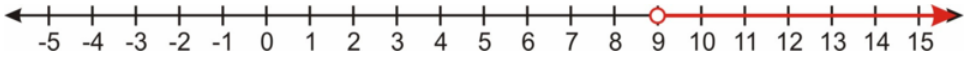
Simplify: $x \leq -15$



b) Starting inequality: $x+4 > 13$

Subtract **4** from both sides of the inequality: $x+4-4 > 13-4$

Simplify: $x > 9$



c) Original problem: $\frac{x}{25} < \frac{3}{2}$

Multiply both sides by 25: $25 \cdot \frac{x}{25} < \frac{3}{2} \cdot 25$

Simplify: $x < \frac{75}{2}$ or $x < 37.5$

d) Original problem: $\frac{x}{-7} \geq 9$

Multiply both sides by -7: $-7 \cdot \frac{x}{-7} \leq 9 \cdot (-7)$ ***Flip the inequality sign.***

Simplify: $x \leq -63$

Explore More

For 1-8, solve each inequality and graph the solution on the number line.

1. $x-5 < 35$
2. $x+15 \geq -60$
3. $x-2 \leq 1$

4. $x-8>-20$
5. $x+11>13$
6. $x+65<100$
7. $x-32\leq 0$
8. $x+68\geq 75$

For 9-12, solve each inequality. Write the solution as an inequality and graph it.

9. $3x\leq 6$
10. $\frac{x}{5}>-\frac{3}{10}$
11. $-10x>250$
12. $\frac{x}{-7}\geq -5$