

Solving and Graphing Two-Step Inequalities

Grade 7 math · Lesson · Standards: 7.EE.B.4b

Quick answer: A two-step inequality, such as $4x - 5 > 11$, is solved like an equation: undo addition or subtraction, then undo multiplication or division. Reverse the inequality sign whenever you multiply or divide both sides by a negative number. Graph the solution set with an open circle and a shaded ray, then interpret it in context.

Standards: 7.EE.B.4b · **Level:** Grade 7

What is the solution set of an inequality?

An inequality such as $4x - 5 > 11$ has many solutions, not just one. Its solution set contains every number that makes the statement true, and a graph on a number line shows the whole set at once.

Graphing rules

Use an **open circle** at the endpoint for $>$ or $<$, because the endpoint itself is not a solution. Shade toward the numbers that make the inequality true.



The graph of $x > 3$: an open circle at 3 and a ray to the right.

How do you solve $px + q > r$?

Use the same inverse-operation steps as for equations: undo the addition or subtraction first, then undo the multiplication or division.

Worked example

Solve $4x - 5 > 11$.

$$4x > 16 \quad \text{so} \quad x > 4$$

Test 5: $4(5) - 5 = 15$, which is greater than 11. The test passes.

Why does the inequality sign reverse for a negative number?

Multiplying by a negative moves numbers to the opposite side of zero, which reverses their order. Start with the true statement $2 < 5$.

Operation on $2 < 5$	Result	True statement
Multiply by 3	6 and 15	$6 < 15$
Multiply by -3	-6 and -15	$-6 > -15$

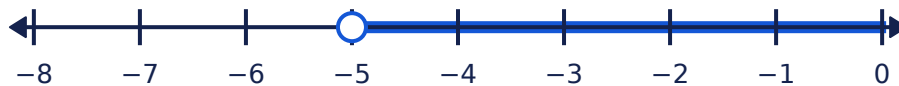
Reversal rule

When you multiply or divide both sides by a **negative** number, reverse the inequality sign. Adding or subtracting never changes it.

Method for solving and graphing

1. Undo the addition or subtraction.
2. Undo the multiplication or division, reversing the sign if the number is negative.
3. Graph with an open circle and shade the correct side.
4. Test one number from the shaded part in the original inequality.

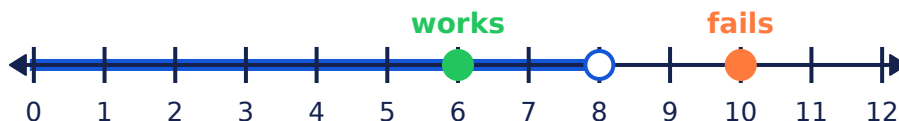
For example, $-3x + 4 < 19$ gives $-3x < 15$, and dividing by -3 gives $x > -5$.



The solution of $-3x + 4 < 19$ is $x > -5$.

How do you interpret a solution in context?

A streaming plan costs \$20 plus \$1.50 per movie rental, and the budget is under \$32. The inequality $20 + 1.5t < 32$ gives $t < 8$, so any number of rentals below 8 stays within budget.



Testing one point on each side confirms the direction of the ray.

Do not flip for the wrong reason

Subtracting a negative number or having a negative constant does not reverse the sign. Only multiplying or dividing by a negative does.

Mathbot's tip

Always test one point from your shaded ray. If it fails the original inequality, the sign or the direction is wrong.

Key points to remember

- An inequality usually has infinitely many solutions, shown as a ray on a number line.
- Use an open circle for the symbols $>$ and $<$, since the endpoint is not included.
- Multiplying or dividing both sides by a negative number reverses the inequality sign.
- Testing one number from the shaded ray in the original inequality catches most mistakes.

Solving and Graphing Two-Step Inequalities: frequently asked questions

When do I reverse the inequality sign?

Reverse it only when you multiply or divide both sides by a negative number. Adding or subtracting any number, including a negative one, leaves the sign unchanged.

What does an open circle mean on the graph?

It marks an endpoint that is not part of the solution set. For $x > 3$, the number 3 itself does not make the inequality true, so the circle stays open.

How can I check a solution of an inequality?

Pick a number from the shaded region, substitute it into the original inequality, and confirm the statement is true. Also try the endpoint, which should fail.

Why can a real-life answer differ from the graph?

Contexts such as tickets or shirts require whole numbers. The graph includes decimals, so an answer like $n > 22.5$ becomes "at least 23" in a story.

Is $x < 5$ the same as $5 > x$?

Yes. Both statements say that x is less than 5. Reading the inequality with the variable first makes the graph easier to draw.