

Graphing Inequalities and Systems with Shaded Regions

Grade 9 – Algebra 1 math · Lesson · Standards: A-REI.D.12, A-CED.A.3

Quick answer: The graph of a linear inequality is a half-plane bounded by a line: solid for $\leq$ or $\geq$ and dashed for $<$ or $>$. Shade the side that contains true test points. A system of inequalities is graphed by shading each half-plane, and its solutions are the points in the overlapping region.

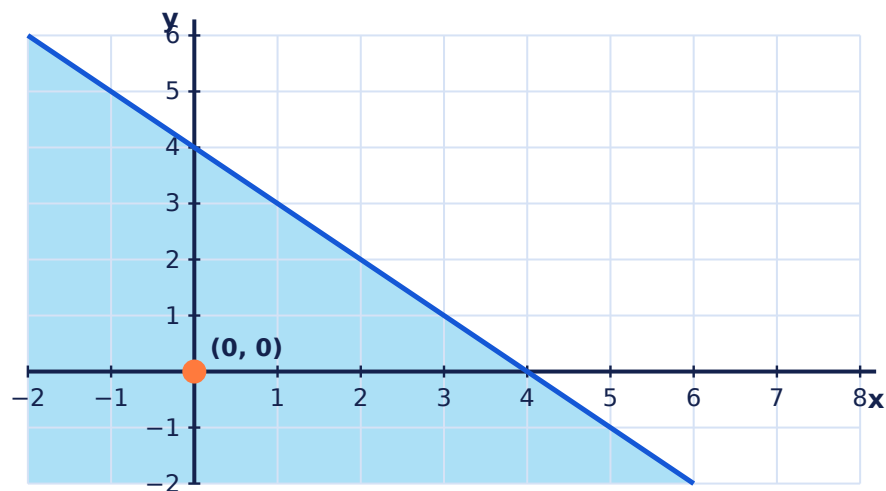
Standards: A-REI.D.12, A-CED.A.3 · **Level:** Grade 9 Algebra 1

How do you graph a linear inequality?

The graph of a linear inequality is a **half-plane**: every point on one side of a boundary line. Three steps produce it.

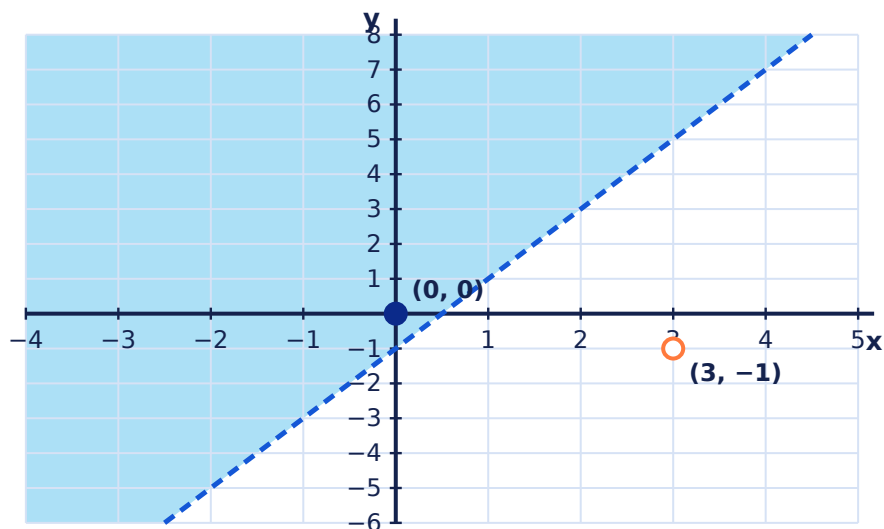
Method: graph $y \leq -x + 4$

1. Graph the boundary $y = -x + 4$. Use a **dashed** line for $<$ or $>$ and a **solid** line for $\leq$ or $\geq$.
2. Test a point that is not on the line. For $(0, 0)$: $0 \leq 0 + 4$ is true.
3. Shade the side containing the true test point, here the region below the line.



$y \leq -x + 4$: solid line, shade below.

A strict inequality leaves the boundary out. For $y > 2x - 1$ the line is dashed. The test point $(0, 0)$ gives $0 > -1$, which is true, so the origin is on the shaded side, above the line.



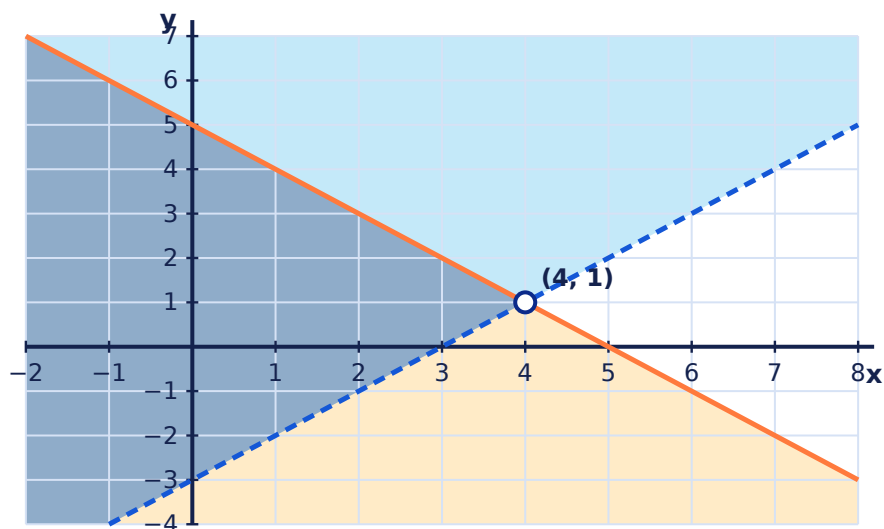
$y > 2x - 1$: dashed line, shade above.

Solid versus dashed

- $\leq$ or $\geq$: solid line, boundary points are solutions.
- $<$ or $>$: dashed line, boundary points are not solutions.

What is a system of inequalities?

A **system of inequalities** is two or more inequalities that must all be true. Graph each half-plane, and the **solution region** is where the shadings overlap.



The darkest overlap is the solution of the system.

Step	What to do	In the graph above
1	graph each boundary	dashed $y = x - 3$, solid $y = -x + 5$
2	shade each half-plane	above the first line, below the second
3	mark the overlap and test a point	$(4, 1)$ is on the dashed line, so it is not a solution

How do constraints become inequalities?

Words translate into symbols: "at most" is $\leq$, "at least" is $\geq$, and "between" needs two inequalities. In real problems the variables often cannot be negative, adding $x \geq 0$ and $y \geq 0$. A point of the overlap is a **feasible** choice, and its corners come from solving pairs of boundary equations.

Common mistake

Using a solid line for a strict inequality, or forgetting to reverse the sign when dividing by a negative number while solving for y .

Mathbot's tip

Always test a point from the shaded region in every original inequality before you finish.

Key points to remember

- A boundary line is solid for $\leq$ and $\geq$, dashed for $<$ and $>$.
- Test a point not on the line to decide which side to shade.
- Dividing by a negative number reverses the inequality sign.
- The solution of a system is the overlap of all the shaded half-planes.
- In real problems, add $x \geq 0$ and $y \geq 0$ when quantities cannot be negative.

Graphing Inequalities and Systems with Shaded Regions: frequently asked questions

When is the boundary line dashed?

The line is dashed when the inequality is strict ($<$ or $>$), because points on the line do not make the inequality true. It is solid for $\leq$ and $\geq$.

How do you choose which side to shade?

Pick a test point not on the line, often $(0, 0)$, and substitute it. If the statement is true, shade the side with that point; if false, shade the other side.

Why does dividing by a negative number reverse the sign?

Multiplying or dividing by a negative number reverses the order of values. In $4x - 2y \leq 10$, dividing by -2 gives $y \geq 2x - 5$, so the shading is above the line.

What is a feasible region?

It is the set of points that satisfy every constraint in a real problem. Its corner points come from the intersections of the boundary lines and often help find a best choice.

Can a system of inequalities have no solution?

Yes. If the half-planes do not overlap, as with $y \geq 2x + 1$ and $y \leq 2x - 3$, no point satisfies both and the system has no solution.