

Solving Absolute Value Linear Equations**TEACHER KEY** | Algebra II Honors | Unit 2 | Day 5 | TEK A2.6.E

Objective: I can isolate an absolute value, split it into two cases, solve each case, and confirm my answers by hand and in Desmos - including equations with a variable on both sides.

Vocabulary

Isolate: get the absolute value expression **alone** on one side before splitting.

Split into two cases: $|A| = B$ becomes $A = B$ **OR** $A = -B$.

Desmos check: graph each side of the equation as its own function - the solutions are exactly where the two graphs **cross**.

KEY IDEA

Step 1 - Isolate: get the absolute value alone on one side.

Step 2 - Split: $|A| = B$ becomes $A = B$ OR $A = -B$. Put parentheses around the whole -B.

Step 3 - Solve: solve each case separately.

Step 4 - Check: plug BOTH answers into the ORIGINAL equation.

Step 5 - Desmos check: type the left side as y1 and the right side as y2 - your answers should be the x-values where they cross.

Let's Work Through It

Example 1 — Solve $2|x + 1| - 3 = 7$.

Step 1 - Isolate: $2|x + 1| = 10 \rightarrow |x + 1| = 5$

Step 2 - Split: $x + 1 = 5$ OR $x + 1 = -5$

Step 3 - Solve: $x = 4$ or $x = -6$

Step 4 - Check: $2|4 + 1| - 3 = 7 \checkmark$ $2|-6 + 1| - 3 = 7 \checkmark$

Example 2 — Solve $|3x - 4| = 2x - 1$. The variable is on both sides now.

Step 2 - Split: $3x - 4 = 2x - 1$ OR $3x - 4 = -(2x - 1)$

Step 3 - Solve: $x = 3$ or $5x = 5 \rightarrow x = 1$

Step 5 - Desmos: $y1 = |3x - 4|$, $y2 = 2x - 1$. They cross at $x = 1$ and $x = 3$.

Example 3 — Solve $|2x - 3| = x + 3$.

Step 2 - Split: $2x - 3 = x + 3$ OR $2x - 3 = -(x + 3)$

Step 3 - Solve: $x = 6$ or $3x = 0 \rightarrow x = 0$

Step 4 - Check: $x = 6$: $|9| = 9, 6 + 3 = 9$ ✓ $x = 0$: $|-3| = 3, 0 + 3 = 3$ ✓

Step 5 - Desmos: $y1 = |2x - 3|$, $y2 = x + 3$. They cross at $x = 0$ and $x = 6$.

Example 4 — Solve $|3x + 1| = 2x + 9$.

Step 2 - Split: $3x + 1 = 2x + 9$ OR $3x + 1 = -(2x + 9)$

Step 3 - Solve: $x = 8$ or $5x = -10 \rightarrow x = -2$

Step 4 - Check: $x = 8$: $|25| = 25, 2(8) + 9 = 25$ ✓ $x = -2$: $|-5| = 5, 2(-2) + 9 = 5$ ✓

Step 5 - Desmos: $y1 = |3x + 1|$, $y2 = 2x + 9$. They cross at $x = -2$ and $x = 8$.

Your Turn

You Try 1 — Solve $3|x + 2| - 4 = 11$, then confirm it in Desmos.

Isolate: $|x + 2| = 5$ Split: $x + 2 = 5$ OR $x + 2 = -5$

Solve: $x = 3$ or $x = -7$ Desmos: $y1 = 3|x + 2| - 4$, $y2 = 11$ cross at $x = -7$ and $x = 3$

You Try 2 — Solve $|2x - 6| = x$, showing all five steps.

Split: $2x - 6 = x$ OR $2x - 6 = -x$

Solve: $x = 6$ or $x = 2$ Check: **both work** Desmos: **y1 and y2 cross twice**