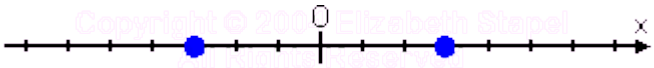
Absolute Values

The concept of absolute value has many uses, but for now you should view the absolute value of a number as its distance from zero.

Let's look at the number line:



The absolute value of *x*, denoted "| *x* |" (and which is read as "the absolute value of *x*"), is the distance of *x* from zero. This is why absolute value is never negative; absolute value only asks "how far?", not "in which direction?" This means not only that | 3 | = 3, because 3 is three units to the right of zero, but also that | –3 | = 3, because –3 is three units to the left of zero.

It is important to note that the absolute value bars do NOT work in the same way as do parentheses. Whereas –(–3) = +3, this is NOT how it works for absolute value.

Simplify –| –3 |

Given –| –3 |, first handle the absolute value part, taking the positive and converting the absolute value bars to parentheses: –| –3 | = –(+3)

Now take the negative through the parentheses: –| –3 | = –(3) = **–3**

If you take the negative of an absolute value, you will get a negative number for your answer.

The absolute value does get a little more complicated when dealing with variables, since we don't know the sign of the variable. For example, if we have $|x| = 3$ we don't know if *x* is 3 or –3 .So we'd have to say that the solution to the equation is 3 and –3.

Here are examples of solving absolute value equations:

|3*x* −6| = 21

Positive side

3*x* −6 = 21
3*x* −6 + 6 = 21 + 6
3*x* = 27
3*x* ÷ 3 = 27 ÷ 3
x = 9

Negative side

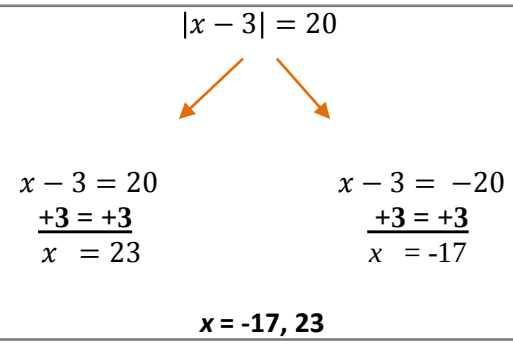
(3*x* −6) = -21
-3*x* + 6 −6 = - 21 + 6
3*x* = -15
$\frac{3x}{3} = \frac{-15}{3}$
x = -5

|3(9) −6 | = 21
|21 | = 21

|3(-5) −6 | = 21
|-21| = 21

Check your answers by inserting solution into original equation.

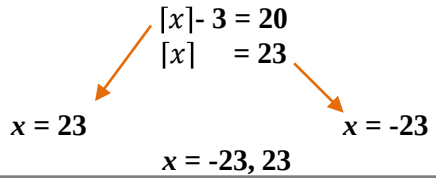
Algebraic Equations with Absolute Values



Note that we have to separate the absolute value problem into two separate equations.

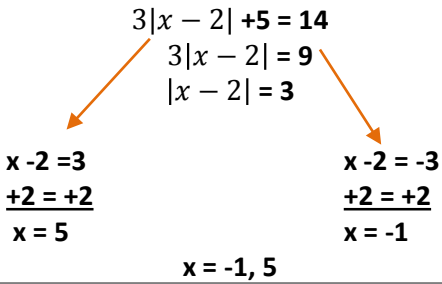
We don't know what the value of x is, therefore we don't know if x-3 is positive or negative.

So x has two answers: -17 and 23. Try it out, they both work!



This one is a little different from the example above, as we need to simplify (get the absolute value by itself) before we divide up the equations.

Note that we'll get a different answer than above. Try the answers in the original equation to make sure they work!



Here's one a little bit more complicated. Note that we still have to simplify first to separate the absolute value from the rest of the numbers.

Check your number!

Problems: Simplify the following

| 2 + 3(–4) |

| 2 + 3(–4) | = | 2 – 12 | = | –10 | = **10**

–| –4 |

–| –4| = –(4) = **–4**

–| (–2)² |

–| (–2)² | = –| 4 | = **–4**

–| –2 |²

–| –2 |² = –(2)² = –(4) = **–4**

(–| –2 |)²

(–| –2 |)² = (–(2))² = (–2)² = **4**

Try these equations:

|*X* + 5 | = 3 — Answer = {-5, 9}

| 5X +20| = 80 — Answer = {12, -20}

|3*X* −6 | = 21 — Answer = {-5, 9}

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