Multiplication one-step equations in one variable

When we have a situation where a number times the variable equals an answer, we can solve for the variable.

$2x=6$

$x=$

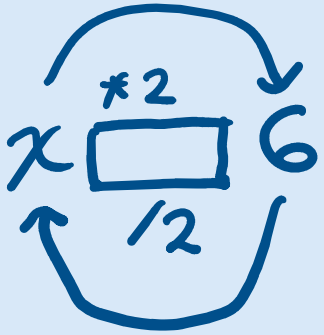
The goal is to get the variable on one side and all the other numbers on the other side.

$n* x = a$

$x=$

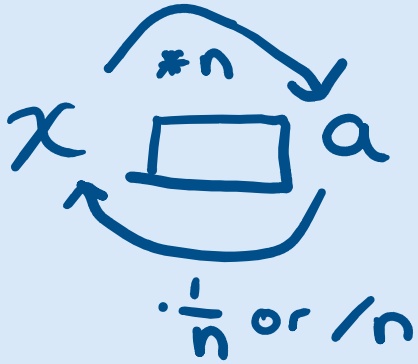
If we multiply x by 2 to get 6, we would divide the 6 by 2 to get back to where we started with x.

$2x = 6$



This works for any number the we multiply by x to get an answer. To get back to x by itself, we would divide the answer by the number that we multiplied.

$nx = a$



Another way of thinking about this is doing the same thing to both sides to make the multiplier turn into one, which is the identity for multiplication.

$$2x = 6$$

Here I would divide both sides by 2 so that I have:

$$\frac{2}{2}x = \frac{6}{2}$$

Remember that whatever you do to one side, you have to do to the other side to maintain the equality.

$$nx = a$$

$$\frac{nx}{n} = \frac{a}{n}$$

$$x = \frac{a}{n}$$

Moving the pieces

I think of moving the pieces of a puzzle to unwrap the variable by doing the inverse to the other side. If the number is multiplied on one side and on top of the bar, it moves to the bottom, which is division on the other side.

$nx = a$ $\quad nx = a \rightarrow \frac{nx}{n} = \frac{a}{n}$

Here are some practice problems. Do you see the pattern? How do you think about it?

$2x = 4$ $3x = 5$ $6x = 3$

To check the problems, you plug the result back into the original problem.

We can do literal equations:

$nx = a$

$x = \frac{a}{n}$

$nx = y$

$x = \frac{y}{n}$

To check the problems, you plug the result back into the original problem.

$n \cdot \frac{a}{n} = a$ ✓

$n \cdot \frac{y}{n} = y$ ✓

Any time we want to undo multiplying by a number on one side, we divide by that number on the other side.

$$nx = a$$

$$x = \frac{a}{n}$$

Here the n is representing a number that isn't zero.

Warning! This doesn't work for dividing by the variable. Since the variable could be zero, you can't divide by the variable unless you are dealing with a rational equation, where the variable is on the bottom.

$3x = 2x$

$3x = 2x$

$-2x \quad -2x$

$1x = 0$

$x = 0$

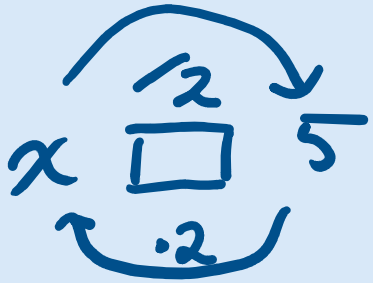
$\frac{3x}{x} = \frac{2x}{x}$ $\quad 3 \neq 2$

Need to undo division with multiplication.

If you are dividing by a number, then you would multiply the answer by that number to get back to the x.

$\frac{x}{2} = 5$

$x = 5 \cdot 2$



$\frac{x}{n} = a$

$x = a \cdot n$

Division with moving pieces

If the number is on the bottom on one side (division) then it goes to the top of the other side (multiplication).

$\frac{x}{2} = 5 \cdot 2$

$\frac{x}{n} = a$

$\frac{x}{n} = a \cdot n$

$x = a \cdot n$

You can also think of doing the same thing to both sides to undo the division and make it one.

If you are dividing the variable on one side, then you multiply both sides by the same coefficient.

$$\frac{x}{2} = 5$$

$$2 \cdot \frac{x}{2} = 5 \cdot 2$$

$$x = 10$$

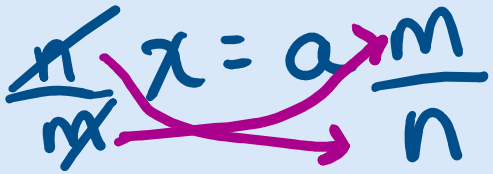
$$\frac{x}{n} = a$$

$$n \cdot \frac{x}{n} = a \cdot n$$

$$x = an$$

What if you are multiplying by a fraction? That is the same as multiplying by the top and dividing by the bottom.

$$\frac{n}{m}x = a$$



$$x = a\frac{m}{n} \quad \text{or} \quad \frac{am}{n}$$

$$\frac{3}{5}x = \frac{2}{7}$$

$$\frac{3}{5}x = \frac{2}{7} \cdot \frac{5}{3} = \frac{2 \cdot 5}{3 \cdot 7}$$

$$\frac{3}{5}x = \frac{2}{7}$$

$$\frac{3}{5}\left(\frac{2 \cdot 5}{3 \cdot 7}\right) = \frac{2}{7} \checkmark$$

Literal one step equations: $n \neq 0$

$nx = a$

$x = \frac{a}{n}$

$\frac{x}{n} = a$

$x = a \cdot n$

$\frac{nx}{m} = a$

$x = \frac{am}{n}$

b, d ≠ 0

$$\frac{a}{b}x = \frac{c}{d}$$

$$x = \frac{cb}{da} \text{ or } \frac{bc}{ad}$$

Practice and then write some of your own to practice undoing multiplication

$2x=6$

$3x=9$

$5x=10$

$rx=s$

$\frac{x}{2} = 5$

$\frac{x}{3} = 2$

$\frac{x}{5} = 2$

$\frac{x}{7} = 3$

$\frac{x}{10} = 4$

$\frac{x}{r} = s$

$\frac{x}{n} = m$

$\frac{x}{a} = b$

$\frac{x}{\pi} = e$