Addition and Subtraction Equations

You can denote the operation that is done	Way 1:	Way 2:
to both sides of an equation in two ways.	x + 9 = 4	x + 9 = 4 -9
One way is that you write the operation under both sides of the equation. The other is to write it in the margin, like we did in the last lesson.	$\frac{-9}{x} = -5$	x + 9 - 9 = 4 - 9 (This step is optional.) x = -5
Lastly, check your solution: does it fulfill the original equation?	Check: $-5 + 9 \stackrel{?}{=}$	4. Yes, it checks.

1. Solve these one-step equations. You or your teacher can choose which way you will write the solution steps (under the equation or in the margin).

a.	x + 5 = 9	b. $x + 5 = -9$
с.	x-2 = 3	d. $w - 2 = -3$
е.	z + 5 = 0	f. $y - 8 = -7$

2. In these equations, your first step is to simplify what is on the right side.

a.	x - 7 =	2 + 8	b.	<i>x</i> – 10	=	-9 + 5
	x - 7 =	10				
c.	<i>s</i> + 5 =	3 + (-9)	d.	<i>t</i> + 6	=	-3 - 5
с.	<i>s</i> + 5 =	3 + (-9)	d.	<i>t</i> + 6	=	-3 - 5
с.	<i>s</i> + 5 =	3 + (-9)	d.	<i>t</i> + 6	=	-3 - 5

Sample worksheet from www.mathmammoth.com

If the unknown is initially on the right side , you have two options:	1. Flip the sides first:	2. Solve as it is:
 First, flip the two sides. Then solve as usual. Or, solve as usual, isolating the unknown —this time on the right side of the equation. The solution will initially read as -7 = x. Flip the sides now and write the solution as x = -7. 	$-9 = x - 2$ $x - 2 = -9$ $\underbrace{+2}{x} = -7$	-9 = x - 2 $+2 + 2$ $-7 = x$ $x = -7$

^{3.} Solve. Check your solutions.

a.	-8 = s+6	b. $-2 = x - 7$
c.	4 = s + (-5)	d. $2-8 = y+6$
e.	5 + x = -9	f. $-6-5 = 1+z$
g.	y - (-7) = 1 - (-5)	h. $6 + (-2) = x - 2$
i.	3 - (-9) = x + 5	j. $2-8 = 2+w$

Sample worksheet from www.mathmammoth.com

Example. Solve $-2 + 8 = -x$.	1. Flip the sides first:	2. Solve as it is:
Our first step is to simplify the sum $-2 + 8$.	-2 + 8 = -r	-2 + 8 = -r
After that, the equation is $-x = 6$ (or $6 = -x$). Think about it. It means that the <u>opposite of x</u> is 6. So x must equal $-6!$	-x = -2 + 8	2 + 8 = -x $6 = -x$
Lastly we check the solution $x = -6$:	-x = 6	-6 = x
$-2+8 \stackrel{?}{=} -(-6)$, which simplifies to $6 \stackrel{?}{=} 6$, so it checks.	x = -6	

4. Solve for *x*. Check your solutions.

a.	-x = 6	b. $-x = 5-9$
c.	4 + 3 = -y	d. $-2-6 = -z$

5. a. Which equation matches the situation?

The side lengths of a square-shaped playground were reduced by 1/2 m, and now its perimeter is 12 m.

- **b.** How long were the sides before they were made shorter? Solve the problem using mental math.
- **c.** *Challenge*: Solve the problem also using the equation, comparing the solution steps in the two ways of solving it. Are the steps similar?

4s - 1/2 = 12	4(s-1/2) = 12	4s - 50 = 12
$s - 1/2 = 4 \cdot 12$	s - 1/2 = 12	4(s-0.5) = 12

6. Here is a growing pattern again. Draw the next steps and answer the questions.



Example. Solve 8 - x = -2.

As usual, think what needs done to the side with x so that x will be isolated. There is an 8 on the side with x, so we need to subtract 8 from both sides.

However, note that x is being *subtracted*, or in other words, there is a negative sign in front of x.

This negative sign <u>does not disappear</u> when you subtract 8 from both sides.

1: Write the operation under both sides.	2: Write the operation in the margin
8-x = -2	8 - x = -2 -8
<u>-8</u> <u>-8</u>	8 - x - 8 = -2 - 8
-x = -10	-x = -10
x = 10	x = 10

If this is confusing, think of it this way. We can write the equation 8 - x = -2 also as 8 + (-x) = -2. When we subtract 8 from both sides, the *left* side becomes 8 + (-x) = 8. The 8 and negative 8 will cancel each other and -x remains.

After that, we end up with the equation -x = -10. This means that the opposite of x is negative 10, so x itself must be 10. Can you see that?

Lastly, check your solution by substituting x = 10 into the original equation: $8 - \underline{10} \stackrel{?}{=} -2$

7. Solve. Check your solutions.

a.	2-x = 6	b. $8-x = 7$
c.	-5 - x = 5	d. $2-x = -6$
e.	1 = -5 - x	f. $2 + (-9) = 8 - z$
g.	-8+r = -5+(-7)	h. $2 - (-5) = 2 + 5 + t$

Sample worksheet from www.mathmammoth.com