

Lesson 9: Representing Subtraction

Let's subtract signed numbers.

9.1: Equivalent Equations

Consider the equation $2 + 3 = 5$. Here are some more equations, using the same numbers, that express the same relationship in a different way:

$$3 + 2 = 5$$

$$5 - 3 = 2$$

$$5 - 2 = 3$$

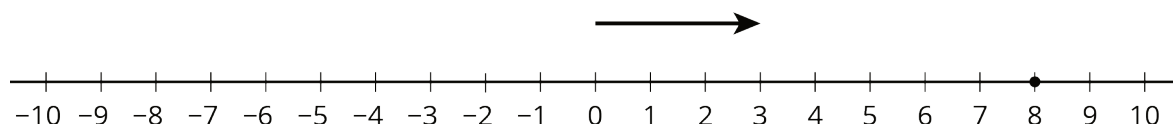
For each equation, write two more equations, using the same numbers, that express the same relationship in a different way.

1. $9 + (-1) = 8$

2. $-11 + x = 7$

9.2: Subtraction with Number Lines

1. Here is an unfinished number line diagram that represents a sum of 8.

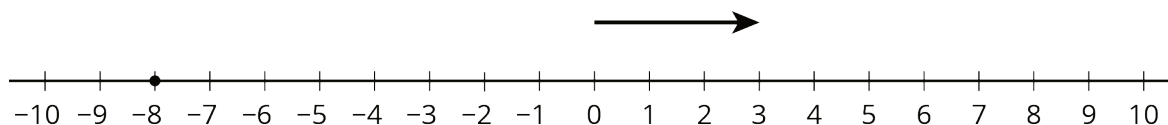
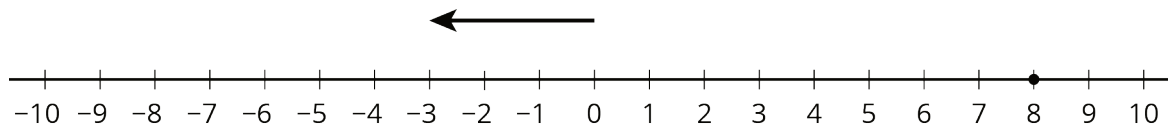


a. How long should the other arrow be?

b. For an equation that goes with this diagram, Mai writes $3 + ? = 8$.
Tyler writes $8 - 3 = ?$. Do you agree with either of them?

c. What is the unknown number? How do you know?

2. Here are two more unfinished diagrams that represent sums.



For each diagram:

- What equation would Mai write if she used the same reasoning as before?
- What equation would Tyler write if he used the same reasoning as before?
- How long should the other arrow be?
- What number would complete each equation? Be prepared to explain your reasoning.

3. Draw a number line diagram for $(-8) - (-3) = ?$ What is the unknown number? How do you know?

9.3: We Can Add Instead

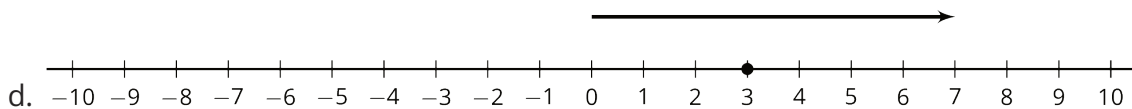
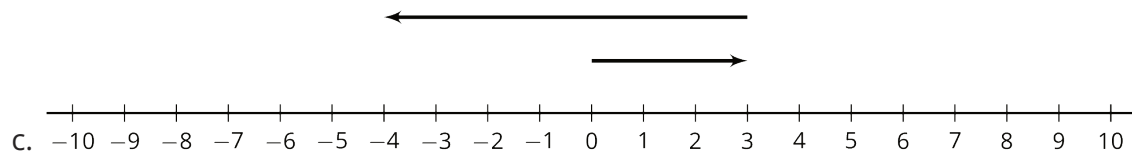
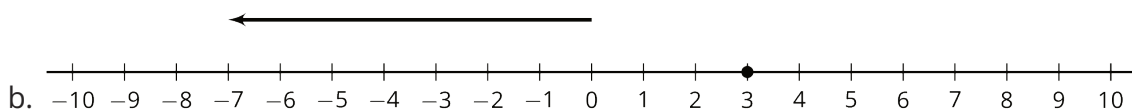
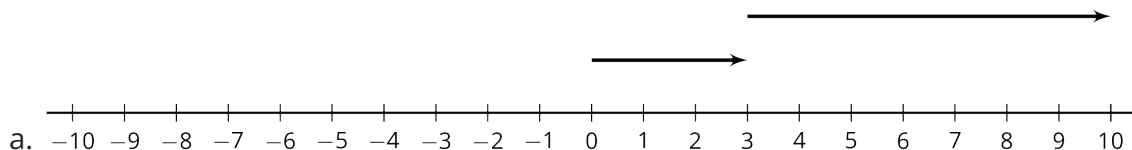
1. Match each diagram to one of these expressions:

$3 + 7$

$3 - 7$

$3 + (-7)$

$3 - (-7)$



2. Which expressions in the first question have the same value? What do you notice?

3. Complete each of these tables. What do you notice?

expression	value
$8 + (-8)$	
$8 - 8$	
$8 + (-5)$	
$8 - 5$	
$8 + (-12)$	
$8 - 12$	

expression	value
$-5 + 5$	
$-5 - (-5)$	
$-5 + 9$	
$-5 - (-9)$	
$-5 + 2$	
$-5 - (-2)$	

Are you ready for more?

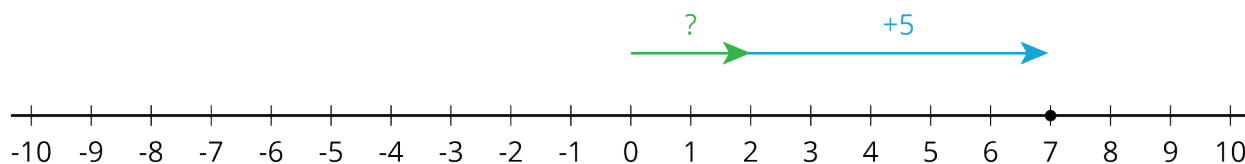
It is possible to make a new number system using *only* the numbers 0, 1, 2, and 3. We will write the symbols for adding and subtracting in this system like this: $2 \oplus 1 = 3$ and $2 \ominus 1 = 1$. The table shows some of the sums.

\oplus	0	1	2	3
0	0	1	2	3
1	1	2	3	0
2	2	3	0	1
3				

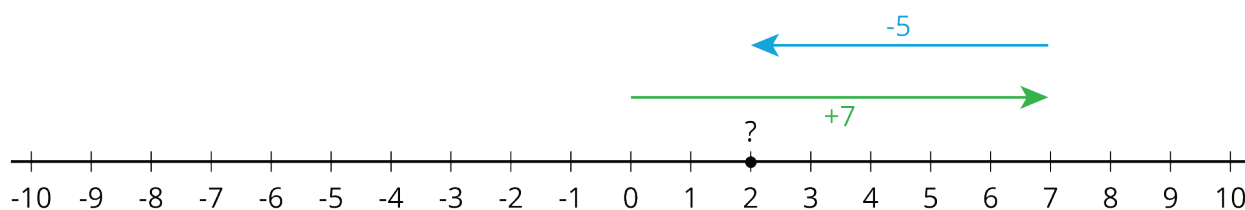
1. In this system, $1 \oplus 2 = 3$ and $2 \oplus 3 = 1$. How can you see that in the table?
2. What do you think $3 \oplus 1$ should be?
3. What about $3 \oplus 3$?
4. What do you think $3 \ominus 1$ should be?
5. What about $2 \ominus 3$?
6. Can you think of any uses for this number system?

Lesson 9 Summary

The equation $7 - 5 = ?$ is equivalent to $? + 5 = 7$. The diagram illustrates the second equation.

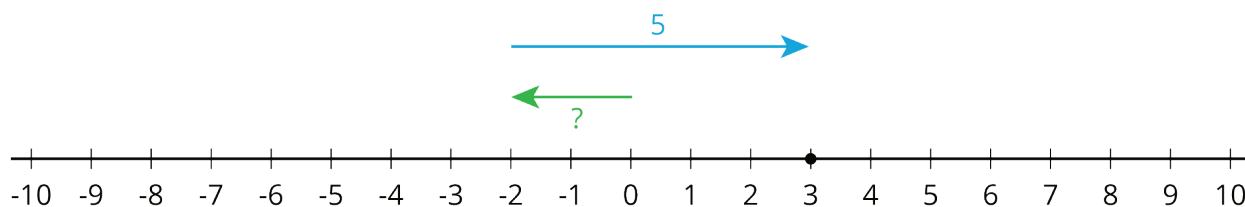


Notice that the value of $7 + (-5)$ is 2.

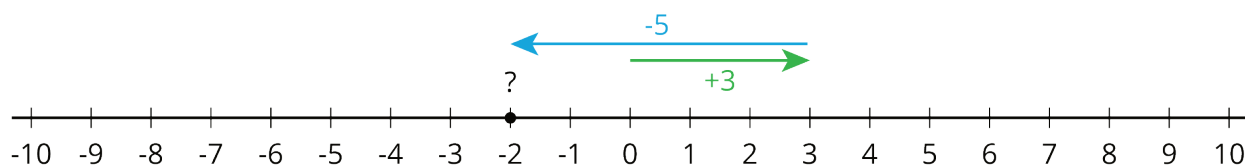


We can solve the equation $? + 5 = 7$ by adding -5 to both sides. This shows that $7 - 5 = 7 + (-5)$

Likewise, $3 - 5 = ?$ is equivalent to $? + 5 = 3$.



Notice that the value of $3 + (-5)$ is -2 .



We can solve the equation $? + 5 = 3$ by adding -5 to both sides. This shows that $3 - 5 = 3 + (-5)$

In general:

$$a - b = a + (-b)$$

If $a - b = x$, then $x + b = a$. We can add $-b$ to both sides of this second equation to get that $x = a + (-b)$