



Solving Equations with Rational Numbers

Let's solve equations that include negative values.

20.1 Math Talk: Opposites and Reciprocals

Solve each equation mentally.

• $7 \cdot b = 1$

• $c \cdot d = 1$

• $11 + f = 0$

• $g + h = 0$

20.2 Match Solutions

Match each equation to its solution.

A. $\frac{1}{2}x = -5$

B. $-2x = -9$

C. $-\frac{1}{2}x = \frac{1}{4}$

D. $-2x = 7$

E. $x + -2 = -6.5$

F. $-2 + x = \frac{1}{2}$

1. $x = -4.5$

2. $x = -\frac{1}{2}$

3. $x = -10$

4. $x = 4.5$

5. $x = 2\frac{1}{2}$

6. $x = -3.5$

Be prepared to explain your reasoning.



20.3 Trip to the Mountains

The Hiking Club is on a trip to hike up a mountain.

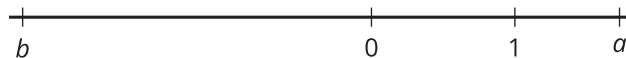
1. The members increased their elevation 290 feet during their hike this morning. Now they are at an elevation of 450 feet.
 - a. Explain how to find their elevation before the hike.
 - b. Han says the equation $e + 290 = 450$ describes the situation. What does the variable e represent?
 - c. Han says that he can rewrite his equation as $e = 450 + -290$ to solve for e . Compare Han's strategy to your strategy for finding the beginning elevation.
2. The temperature fell 4 degrees in the last hour. Now it is 21 degrees. Write and solve an equation to find the temperature it was 1 hour ago.



3. There are 3 times as many students participating in the hiking trip this year than last year. There are 42 students on the trip this year.
- Explain how to find the number of students that came on the hiking trip last year.
 - Mai says the equation $3s = 42$ describes the situation. What does the variable s represent?
 - Mai says that she can rewrite her equation as $s = \frac{1}{3} \cdot 42$ to solve for s . Compare Mai's strategy to your strategy for finding the number of students on last year's trip.
4. The cost of the hiking trip this year is $\frac{2}{3}$ of the cost of last year's trip. This year's trip cost \$32. Write and solve an equation to find the cost of last year's trip.

Are you ready for more?

A number line is shown below. The numbers 0 and 1 are marked on the line, as are two other rational numbers a and b .



Decide which of the following numbers are positive and which are negative.

$a - 1$ $a - 2$ $-b$ $a + b$ $a - b$ $ab + 1$



20.4

Card Sort: Matching Inverses

Your teacher will give you a set of cards. Take turns with your partner to match a number with its additive inverse.

1. For each match that you find, explain to your partner how you know it's a match.
2. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking, and work to reach an agreement.
Pause here for a class discussion.
3. Use the same cards and take turns with your partner to match a number with its multiplicative inverse.



Lesson 20 Summary

To solve the equation $x + 8 = -5$, we can add the opposite of 8, or -8, to each side:

Because adding the opposite of a number is the same as subtracting that number, we can also think of it as subtracting 8 from each side.

We can use the same approach for this equation:

$$\begin{aligned}x + 8 &= -5 \\(x + 8) + -8 &= (-5) + -8 \\x &= -13\end{aligned}$$

$$\begin{aligned}-12 &= t + -\frac{2}{9} \\(-12) + \frac{2}{9} &= \left(t + -\frac{2}{9}\right) + \frac{2}{9} \\-11\frac{7}{9} &= t\end{aligned}$$

To solve the equation $8x = -5$, we can multiply each side by the reciprocal of 8, or $\frac{1}{8}$:

Because multiplying by the reciprocal of a number is the same as dividing by that number, we can also think of it as dividing by 8.

We can use the same approach for this equation:

$$\begin{aligned}8x &= -5 \\\frac{1}{8}(8x) &= \frac{1}{8}(-5) \\x &= -\frac{5}{8}\end{aligned}$$

$$\begin{aligned}-12 &= -\frac{2}{9}t \\-\frac{9}{2}(-12) &= -\frac{9}{2}\left(-\frac{2}{9}t\right) \\54 &= t\end{aligned}$$