Lesson 15: Solving Equations with Rational Numbers

Let's solve equations that include negative values.

15.1: Number Talk: Opposites and Reciprocals

The **variables** a through h all represent *different* numbers. Mentally find numbers that make each equation true.

$\frac{3}{5} \cdot \frac{5}{3} = a$

$7 \cdot b = 1$

$c \cdot d = 1$

$\text{-}6 + 6 = e$

$11 + f = 0$

$g + h = 0$

15.2: Match Solutions

1. Match each equation to its solution.

   a. $\frac{1}{2}x = \text{-}5$ 1. $x = \text{-}4.5$

   b. $\text{-}2x = \text{-}9$ 2. $x = \text{-}\frac{1}{2}$

   c. $\text{-}\frac{1}{2}x = \frac{1}{4}$ 3. $x = \text{-}10$

   d. $\text{-}2x = 7$ 4. $x = 4.5$

   e. $x + \text{-}2 = \text{-}6.5$ 5. $x = 2\frac{1}{2}$

   f. $\text{-}2 + x = \frac{1}{2}$ 6. $x = \text{-}3.5$

Be prepared to explain your reasoning.

15.3: 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 $e = 450 + \text{-}290$ 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.

    a. Explain how to find the number of students that came on the hiking trip last year.

b. Mai says the equation $3s = 42$ describes the situation. What does the variable s represent?

c. 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.

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

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15.4: Card Sort: Matching Inverses

Your teacher will give you a set of cards with numbers on them.

1. Match numbers with their additive inverses.

2. Next, match numbers with their multiplicative inverses.

3. What do you notice about the numbers and their inverses?

Lesson 15 Summary

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

$$x + 8 = -5$$
$$(x + 8) + -8 = (-5) + -8$$
$$x = -13$$

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:

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

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

$$8x = -5$$
$$\frac{1}{8}(8x) = \frac{1}{8}(-5)$$
$$x = -\frac{5}{8}$$

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:

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