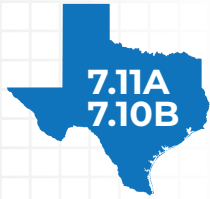


SOLVING TWO-STEP EQUATIONS



The student is expected to model and solve one-variable, two-step equations and inequalities.

The student is expected to represent solutions for one-variable, two-step equations and inequalities on number lines.



TELL ME MORE...

An **equation** is a relationship between two equivalent expressions. An equal sign ($=$) is used to indicate that the expression on the left has the same value as the expression on the right. If the expressions contain one variable, you can use the properties of algebra to solve the equation for the value of the variable.

You can solve an equation using one of many different strategies. One strategy is to use models to represent the equation. Then, you can use the properties of algebra to manipulate the model until you determine the value of the object that represents the variable. For example, you can use models to represent the equation $2x - 5 = 7$. In this model, a triangle represents the variable, x , and a circle represents the unit constant, 1. Shaded triangles or circles indicate a negative value.

Useful Properties of Algebra

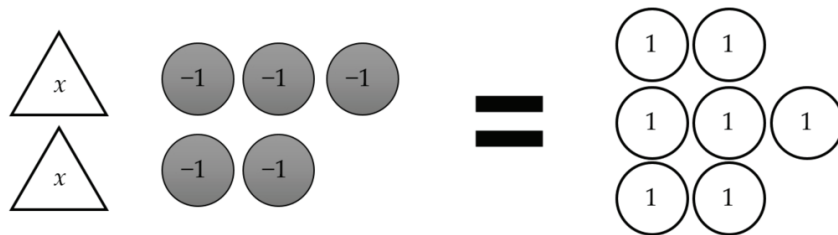
Additive Inverse: $a + (-a) = 0$

Multiplicative Inverse: $a \div a = 1$
 $a \times \frac{1}{a} = 1$

Combine Like Terms: $ax + bx = (a + b)x$

Distributive Property: $a(b + c) = ab + ac$

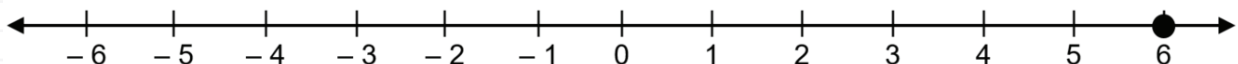
Note: a , b , c , and x represent real numbers.



If the equation is presented or can be written symbolically, then you can use the properties of algebra to manipulate the constants and variable so that you can solve for the value of the variable. The solution to this equation is $x = 6$.

A number line is a line representing the set of all real numbers. The numbers are marked off in intervals.

The solution to the equation $2x - 5 = 7$ is represented on the number line below.





EXAMPLES

EXAMPLE 1: What value of x makes the equation $-3x + 4 = 13$ true?

STEP 1 Isolate x on one side of the equal sign and a real number on the other.

- Use inverse operations to manipulate both sides of the equation.
 - Apply the additive inverse to subtract 4 from both sides of the equation.
- $-3x = 9$**

$$-3x + 4 = 13$$

$$-3x + 4 - 4 = 13 - 4$$

$$-3x = 9$$

STEP 2 Apply the multiplicative inverse.

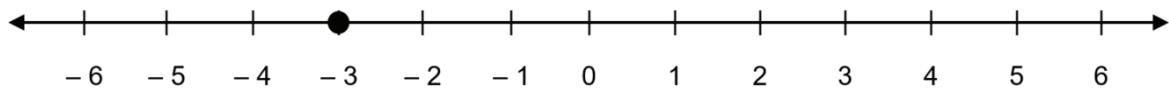
- The variable, x , is being multiplied by -3 .
 - The inverse of multiplication is division, so divide both sides of the equation by -3 .
- $x = -3$**

$$-3x = 9$$

$$\frac{-3x}{-3} = \frac{9}{-3}$$

$$x = -3$$

STEP 3 Represent the solution on a number line.



EXAMPLE 2: The measures of the three interior angles of a triangle are $(4x + 3)^\circ$, $(6x - 5)^\circ$, and 62° . What is the value of x ?

STEP 1 Write an equation relating the angle measures.

- The measures of the three interior angles of a triangle have a sum of 180° .
- Write an equation showing that the sum of the measures of the interior angles equals 180.

$$(4x + 3) + (6x - 5) + (62) = 180$$

STEP 2 Apply the associative property to combine like terms to simplify the equation.

- $4x + 3 + 6x - 5 + 62 = 180$
- $(4x + 6x) + (3 - 5 + 62) = 180$
- $10x + 60 = 180$

$$10x + 60 = 180$$

STEP 3 Apply the additive inverse to subtract 60 from both sides of the equation.

$$10x + 60 = 180$$

$$\underline{-60} \quad \underline{-60}$$

$$10x = 120$$

$$10x = 120$$

YOU TRY IT!

Fill in the missing blanks to solve for x .

$$\frac{x}{5} + 4 = -3$$

$$\frac{x}{5} + 4 - \underline{\hspace{1cm}} = -3 - \underline{\hspace{1cm}}$$

$$\frac{x}{5} = -7$$

$$\frac{x}{5} \cdot \underline{\hspace{1cm}} = -7 \cdot \underline{\hspace{1cm}}$$

$$x = \underline{\hspace{1cm}}$$

STEP 4 Apply the multiplicative inverse to divide both sides of the equation by 10.

$$\frac{10x}{10} = \frac{120}{10}$$
$$10x = 12$$

$$x = 12$$

STEP 5 Check the solution by substituting **12** for x in the original equation (Step 1) and simplify.

$$4x + 3 + 6x - 5 + 62 = 180$$

$$4(12) + 3 + 6(12) - 5 + 62 = 180$$

$$48 + 3 + 72 - 5 + 62 = 180$$

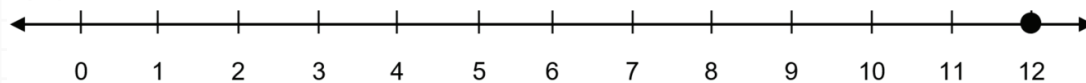
$$51 + 72 - 5 + 62 = 180$$

$$123 - 5 + 62 = 180$$

$$118 + 62 = 180$$

$$180 = 180$$

STEP 6 The solution is represented on the number line below.



EXAMPLE 3: Lisa has \$125.00 on a gift card from *Coffee Hut*. Each morning she stops at *Coffee Hut* and purchases a medium cup of coffee. The medium cup of coffee costs \$2.75 with tax. After many mornings, her card shows a balance of \$111.25. How many medium cups of coffee has Lisa purchased?



STEP 1 Write an equation to represent the situation. Let x represents number of medium cups of coffee.

$$125 - 2.75x = 111.25$$

STEP 2 Apply the additive inverse to subtract 125 from both sides of the equation.

$$125 - 2.75x = 111.25$$
$$\begin{array}{r} -125 \qquad -125 \\ \hline -2.75x = -13.75 \end{array}$$

$$-2.75x = -13.75$$

STEP 3 Apply the multiplicative inverse to divide both sides of the equation by -2.75 .

$$-2.75x = -13.75$$
$$\frac{-2.75x}{-2.75} = \frac{-13.75}{-2.75}$$
$$x = 5$$

$$x = 5$$



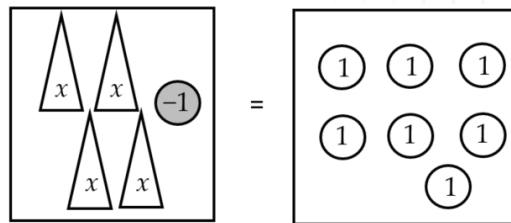
PRACTICE

For questions 1–3, determine the value of x that makes the equation true.

1. $5x - 7 = 23$

2. $\frac{x}{7} - 3 = -12$

3.



4. The equation $3x + 2 = -7$ is modeled below.



What value of x makes the equation true?

6. Lola wants to purchase several light bulbs and a lamp at a hardware store. The lamp cost \$35, light bulbs cost \$1.50 each, and she wants to spend exactly \$50 before tax. How many light bulbs, x , can Lola purchase?

5. One angle in a triangle measures $(2x - 10)^\circ$. A second angle measures $(100 - 3x)^\circ$. If the third angle measures 115° , what is the value of x ?

7. For any triangle, the sum of the measure of the three angles equals 180° . If two of the angles have the same measure, a , and the third angle measures 45° , what is the measure of a ?

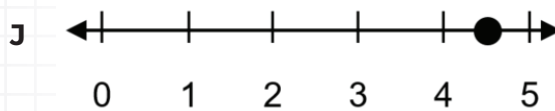
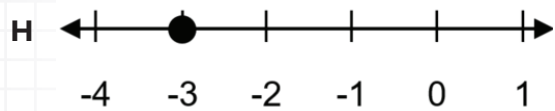
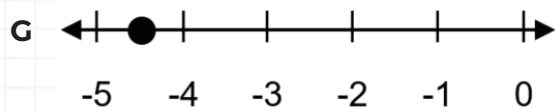
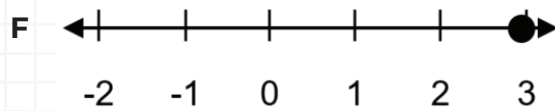
8. What value of x makes this equation true?

$$-2.5x + 8 = 1.25$$

- A -2.7
- B 2.7
- C 3.7
- D -3.7

9. Which number line shows the solution to the equation below?

$$\frac{2}{3}x - \frac{1}{2} = -\frac{5}{2}$$



10. The model represents the equation.

$$4x - 3 = 5$$



What value of x makes the equation true?

- A 2
- B $\frac{1}{2}$
- C -2
- D $-\frac{1}{2}$