2.3. Solving 1-Step Equations

Solving 1-Step Equations with Adding and Subtracting

Example 1: Solve $x + 5 = 9$ using the opposite operation.

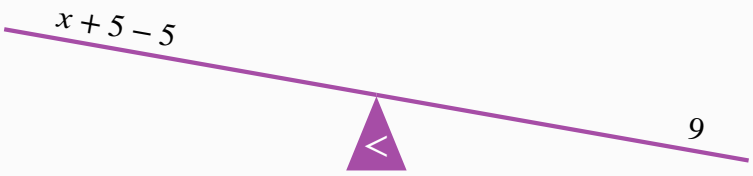
Solution:

Solve for x



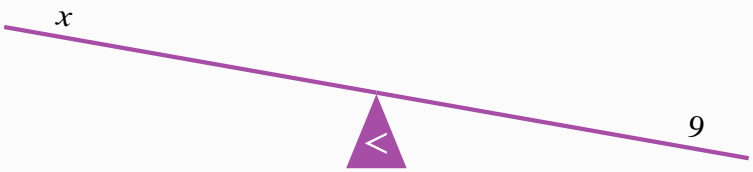
$LS = RS$

Subtract 5 from x



$LS < RS$

Now, the left side is less then the right side:



Subtract 5 from the right side:



$LS = RS$

x = 4



Numerical solution:

$$x + 5 = 9 \quad \text{|subtract 5 from each side}$$
$$x + 5 - 5 = 9 - 5$$
$$x = 4$$

Check:

$$x + 5 = 9 \quad \text{|replace the } x \text{ with } 4$$
$$4 + 5 = 9$$
$$9 = 9$$
$$\textit{Left Side} = \textit{Right Side} \quad \textit{Ok!}$$

Example 2: Solve for x:

$$x + 2 = 5$$

Solution:

$$\begin{aligned} x + 2 &= 5 && \text{|}\textit{subtract 2 from each side} \\ x + 2 - 2 &= 5 - 2 \\ x &= 3 \end{aligned}$$

Check:

$$\begin{aligned} x + 2 &= 5 && \text{|}\textit{substitute the } x \textit{ with 3} \\ (3) + 2 &= 5 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

Practice 1: Solve the equations. Check your solutions.

a) $x + 8 = 6$

Subtract 8 from each side:

$$x + 8 - 8 = 6 - 8$$

$$x = -2$$

Check:

$$\begin{aligned} (-2) + 8 &= 6 \\ 6 &= 6 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

b) $a + 4 = 4$

Subtract 4 from each side:

$$a + 4 - 4 = 4 - 4$$

$$a = 0$$

Check:

$$\begin{aligned} (0) + 4 &= 4 \\ 4 &= 4 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

c) $6 + x = 8$

Subtract 6 from each side:

$$6 - 6 + x = 8 - 6$$

$$x = 2$$

Check:

$$\begin{aligned} 6 + (2) &= 8 \\ 8 &= 8 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

d) $3 + x = 20$

Subtract 3 from each side:

$$3 - 3 + x = 20 - 3$$

$$x = 17$$

Check:

$$\begin{aligned} 3 + (17) &= 20 \\ 20 &= 20 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

Example 3: Solve for x:

$$x - 4 = 10$$

Solution:

$$\begin{aligned} x - 4 &= 10 && \text{|add 4 to each side} \\ x - 4 + 4 &= 10 + 4 \\ x &= 14 \end{aligned}$$

Check:

$$\begin{aligned} x - 4 &= 10 && \text{|substitute the } x \text{ with } 14 \\ (14) - 4 &= 10 \\ 10 &= 10 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

Practice 2: Solve the equations. Check your solutions.

a) $x - 5 = 4$

Add 5 to each side:

$$x - 5 + 5 = 4 + 5$$

$$x = 9$$

Check:

$$\begin{aligned} (9) - 5 &= 4 \\ 4 &= 4 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

b) $x - 3 = -10$

Add 3 to each side:

$$x - 3 + 3 = -10 + 3$$

$$x = -7$$

Check:

$$\begin{aligned} (-7) - 3 &= -10 \\ -10 &= -10 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

c) $-4 + x = -2$

Add 4 to each side:

$$-4 + 4 + x = -2 + 4$$

$$x = 2$$

Check:

$$\begin{aligned} -4 + (2) &= -2 \\ -2 &= -2 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

d) $-12 + x = 24$

Add 12 to each side:

$$-12 + 12 + x = 24 + 12$$

$$x = 36$$

Check:

$$\begin{aligned} -12 + (36) &= 24 \\ 24 &= 24 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

Solving 1-Step Equations with Multiplying and Dividing

Example 4: Solve $3x = 9$ using the opposite operation. Check to show that the left side (LS) equals the right side (RS).

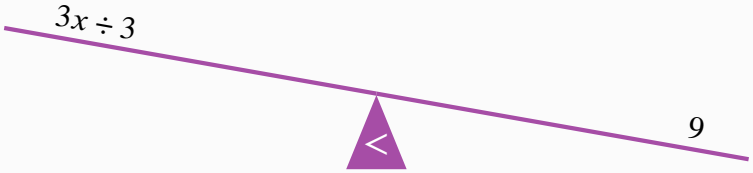
Solution:

Solve for x



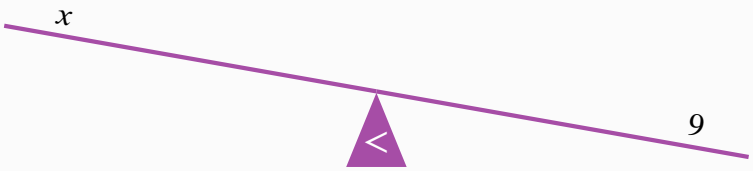
$LS = RS$

Divide $3x$ by 3



$LS < RS$

Now, the left side is less then the right side:



Divide the other side by 3:



$LS = RS$

x = 3



Numerical solution:

$$3x = 9 \quad |\textit{divide each side by 3}$$
$$3x \div 3 = 9 \div 3$$
$$x = 3$$

Check:

$$3x = 3(3) = 9 \quad \textit{Ok!}$$

Example 5: Solve for x:

$$2x = 6$$

Solution:

$$\begin{aligned} 2x &= 6 && \text{|divide each side by 2} \\ \frac{2x}{2} &= \frac{6}{2} \\ x &= 3 \end{aligned}$$

Check:

$$\begin{aligned} 2x &= 6 && \text{|substitute the } x \text{ with 3} \\ 2(3) &= 6 \\ 6 &= 6 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

Practice 3: Solve the equations. Check solutions.

a) $4x = 12$

Divide each side by 4:

$$\frac{4x}{4} = \frac{12}{4}$$

$$x = 3$$

Check:

$$\begin{aligned} 4(3) &= 12 \\ 12 &= 12 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

b) $-2z = 12$

Divide each side by -2:

$$\frac{-2z}{-2} = \frac{12}{-2}$$

$$z = -6$$

Check:

$$\begin{aligned} -2(-6) &= 12 \\ 12 &= 12 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

c) $-3x = -18$

Divide each side by -3:

$$\frac{-3x}{-3} = \frac{-18}{-3}$$

$$x = 6$$

Check:

$$\begin{aligned} -3(6) &= -18 \\ -18 &= -18 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

d) $15x = 45$

Divide each side by 15:

$$\frac{15x}{15} = \frac{45}{15}$$

$$x = 3$$

Check:

$$\begin{aligned} 15(3) &= 45 \\ 45 &= 45 \\ \textit{Left Side} &= \textit{Right Side} \end{aligned}$$

Example 6: Solve for x: $\frac{x}{2} = 4$

Solution:

$$\frac{x}{2} = 4 \quad | \textit{multiply each side by 2}$$
$$\frac{x}{2} \cdot 2 = 4 \cdot 2$$
$$x = 8$$
$$\textit{Check:} \quad \frac{x}{2} = 4 \quad | \textit{substitute the } x \textit{ with 8}$$
$$\frac{(8)}{2} = 4$$
$$4 = 4$$
$$\textit{Left Side} = \textit{Right Side}$$

Practice 4: Solve the equations. Check solutions.

a) $\frac{x}{2} = -5$

Multiply each side by 2:

$$\frac{2x}{2} = -5 \times 2$$
$$x = -10$$

Check:

$$\frac{(-10)}{2} = -5$$
$$-5 = -5$$
$$\textit{Left Side} = \textit{Right Side}$$

b) $\frac{x}{3} = 4$

Multiply each side by 3:

$$\frac{x}{3} \times 3 = 4 \times 3$$
$$x = 12$$

Check:

$$\frac{(12)}{3} = 4$$
$$4 = 4$$
$$\textit{Left Side} = \textit{Right Side}$$

c) $\frac{a}{5} = -3$

Multiply each side by 5:

$$\frac{5a}{5} = -3 \times 5$$
$$a = -15$$

Check:

$$\frac{(-15)}{5} = -3$$
$$-3 = -3$$
$$\textit{Left Side} = \textit{Right Side}$$

d) $\frac{a}{3} = 9$

Multiply each side by 3:

$$\frac{3a}{3} = 9 \cdot 3$$
$$a = 27$$

Check:

$$\frac{(27)}{3} = 9$$
$$9 = 9$$
$$\textit{Left Side} = \textit{Right Side}$$

Solving 1-Step Equations with Exponents and Roots

Example 7: Solve for x: $x^2 = 4$

Solution:

$$x^2 = 4 \qquad \text{|take the square root of each side}$$
$$\sqrt{x^2} = \sqrt{4}$$

We get 2 solutions:

$$x = 2 \quad \textit{and} \quad x = -2$$

Check:

$x^2 = 4$ *|substitute the x with 2*
$2^2 = 4$
$4 = 4$
Left Side = Right Side

$x^2 = 4$ *|substitute the x with −2*
$(-2)^2 = 4$
$4 = 4$
Left Side = Right Side

Practice 5: Solve the equations. Check solutions.

a) $x^2 = 100$

Take a square of each side:

$$\sqrt{x^2} = \sqrt{100}$$
$$x = 10 \quad \textit{and} \quad x = -10$$

Check:

$$x^2 = 100$$
$$10^2 = 100$$
$$100 = 100$$
$$\textit{Left Side} = \textit{Right Side}$$
$$x^2 = 100$$
$$(-10)^2 = 100$$
$$100 = 100$$
$$\textit{Left Side} = \textit{Right Side}$$

b) $x^2 = \frac{16}{25}$

Multiply each side by 3:

$$\sqrt{x^2} = \sqrt{\frac{16}{25}}$$
$$x = \frac{4}{5} \quad \textit{and} \quad x = -\frac{4}{5}$$

Check:

$$x^2 = \frac{16}{25}$$
$$\left(\frac{4}{5}\right)^2 = \frac{16}{25}$$
$$\textit{Left Side} = \textit{Right Side}$$
$$x^2 = \frac{16}{25}$$
$$\left(-\frac{4}{5}\right)^2 = \frac{16}{25}$$
$$\textit{Left Side} = \textit{Right Side}$$