# 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 $x$

$$x + 5 \qquad 9 \qquad LS = RS$$

Subtract 5 from $x$

$$x + 5 - 5 \qquad 9 \qquad LS < RS$$

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

$$x \qquad 9 \qquad$$

Subtract 5 from the right side:

$$x \qquad 9 - 5 \qquad LS = RS$$

x = 4

$$x \qquad 4$$

***Numerical solution:***

$$x + 5 = 9 \qquad \textcolor{blue}{|subtract\ 5\ from\ each\ side}$$
$$x + 5 - 5 = 9 - 5$$
$$x = 4$$

*Check:*

$$x + 5 = 9 \qquad \textcolor{blue}{|replace\ the\ x\ with\ 4}$$
$$4 + 5 = 9$$
$$9 = 9$$
$$Left\ Side = Right\ Side \qquad Ok!$$

**Example 2:** Solve for $x$:
$$x + 2 = 5$$

***Solution:***

$$x + 2 = 5 \qquad |\textit{subtract 2 from each side}$$
$$x + 2 - 2 = 5 - 2$$
$$x = 3$$

*Check:*

$$x + 2 = 5 \qquad |\textit{substitute the x with 3}$$
$$(3) + 2 = 5$$
$$\textit{Left Side} = \textit{Right Side}$$

**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:

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

b) $a + 4 = 4$

Subtract 4 from each side:

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

$$a = 0$$

Check:

$$(0) + 4 = 4$$
$$4 = 4$$
$$\textit{Left Side} = \textit{Right Side}$$

c) $6 + x = 8$

Subtract 6 from each side:

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

$$x = 2$$

Check:

$$6 + (2) = 8$$
$$8 = 8$$
$$\textit{Left Side} = \textit{Right Side}$$

d) $3 + x = 20$

Subtract 3 from each side:

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

$$x = 17$$

Check:

$$3 + (17) = 20$$
$$20 = 20$$
$$\textit{Left Side} = \textit{Right Side}$$

**Example 3:** Solve for $x$:

$$x - 4 = 10$$

***Solution:***

$$x - 4 = 10 \qquad |add\ 4\ to\ each\ side$$
$$x - 4 + 4 = 10 + 4$$
$$x = 14$$

*Check:*

$$x - 4 = 10 \qquad |substitute\ the\ x\ with\ 14$$
$$(14) - 4 = 10$$
$$10 = 10$$
$$Left\ Side = Right\ Side$$

**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:

$$(9) - 5 = 4$$
$$4 = 4$$
$$Left\ Side = Right\ Side$$

b) $x - 3 = -10$

Add 3 to each side:

$$x - 3 + 3 = -10 + 3$$
$$x = -7$$

Check:

$$(-7) - 3 = -10$$
$$-10 = -10$$
$$Left\ Side = Right\ Side$$

c) $-4 + x = -2$

Add 4 to each side:

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

Check:

$$-4 + (2) = -2$$
$$-2 = -2$$
$$Left\ Side = Right\ Side$$

d) $-12 + x = 24$

Add 12 to each side:

$$-12 + 12 + x = 24 + 12$$
$$x = 36$$

Check:

$$-12 + (36) = 24$$
$$24 = 24$$
$$Left\ Side = Right\ Side$$

**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 $x$

$3x$         $9$     **LS = RS**

$=$

Divide $3x$ by 3

$3x \div 3$       $9$     **LS < RS**

$<$

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

$x$      $9$

$<$

Divide the other side by 3:

$x$        $9 \div 3$     **LS = RS**

$=$

x = 3

$x$        $3$

$=$

***Numerical solution:***

$$3x = 9 \qquad |divide\ each\ side\ by\ 3$$
$$3x \div 3 = 9 \div 3$$
$$x = 3$$

*Check:*

$$3x = 3(3) = 9 \qquad Ok!$$

**Example 5:** Solve for $x$:

$$2x = 6$$

**Solution:**

$$2x = 6 \qquad |\textit{divide each side by 2}$$
$$\frac{2x}{2} = \frac{6}{2}$$
$$x = 3$$

*Check:*

$$2x = 6 \qquad |\textit{substitute the x with 3}$$
$$2(3) = 6$$
$$6 = 6$$
$$\textit{Left Side} = \textit{Right Side}$$

**Practice 3:** Solve the equations. Check solutions.

a) $4x = 12$

Divide each side by 4:

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

$$x = 3$$

Check:

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

b) $-2z = 12$

Divide each side by $-2$:

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

$$z = -6$$

Check:

$$-2(-6) = 12$$
$$12 = 12$$
$$\textit{Left Side} = \textit{Right Side}$$

c) $-3x = -18$

Divide each side by $-3$:

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

$$x = 6$$

Check:

$$-3(6) = -18$$
$$-18 = -18$$
$$\textit{Left Side} = \textit{Right Side}$$

d) $15x = 45$

Divide each side by 15:

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

$$x = 3$$

Check:

$$15(3) = 45$$
$$45 = 45$$
$$\textit{Left Side} = \textit{Right Side}$$

**Example 6:** Solve for $x$: $\qquad\qquad \dfrac{x}{2} = 4$

***Solution:***

$$\dfrac{x}{2} = 4 \qquad\qquad |\textit{multiply each side by 2}$$

$$\dfrac{x}{2} \cdot 2 = 4 \cdot 2$$

$$x = 8$$

$$\textit{Check:} \quad \dfrac{x}{2} = 4 \qquad\qquad |\textit{substitute the } x \textit{ with 8}$$

$$\dfrac{(8)}{2} = 4$$

$$4 = 4$$

$$\textit{Left Side = Right Side}$$

**Practice 4:** Solve the equations. Check solutions.

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

Multiply each side by 2:

$$\dfrac{2x}{2} = -5 \times 2$$

$$x = -10$$

Check:

$$\dfrac{(-10)}{2} = -5$$

$$-5 = -5$$

$$\textit{Left Side = Right Side}$$

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

Multiply each side by 3:

$$\dfrac{x}{3} \times 3 = 4 \times 3$$

$$x = 12$$

Check:

$$\dfrac{(12)}{3} = 4$$

$$4 = 4$$

$$\textit{Left Side = Right Side}$$

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

Multiply each side by 5:

$$\dfrac{5a}{5} = -3 \times 5$$

$$a = -15$$

Check:

$$\dfrac{(-15)}{5} = -3$$

$$-3 = -3$$

$$\textit{Left Side = Right Side}$$

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

Multiply each side by 3:

$$\dfrac{3a}{3} = 9 \cdot 3$$

$$a = 27$$

Check:

$$\dfrac{(27)}{3} = 9$$

$$9 = 9$$

$$\textit{Left Side = Right Side}$$

## Solving 1-Step Equations with Exponents and Roots

**Example 7:** Solve for $x$: $\qquad x^2 = 4$

***Solution:***

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

$$\sqrt{x^2} = \sqrt{4}$$

*We get 2 solutions:*

$$x = 2 \quad and \quad x = -2$$

*Check:*

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

**Practice 5:** Solve the equations. Check solutions.

a)  $x^2 = 100$

Take a square of each side:

$$\sqrt{x^2} = \sqrt{100}$$

$$x = 10 \quad and \quad x = -10$$

Check:

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

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

Multiply each side by 3:

$$\sqrt{x^2} = \sqrt{\dfrac{16}{25}}$$

$$x = \dfrac{4}{5} \quad and \quad x = -\dfrac{4}{5}$$

Check:

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