

## 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  $x$

$$\begin{array}{ccc} x + 5 & & 9 \\ \hline & \triangleq & \\ & = & \end{array} \quad LS = RS$$

Subtract 5 from  $x$

$$\begin{array}{ccc} x + 5 - 5 & & 9 \\ \hline & \triangle < & \\ & < & \end{array} \quad LS < RS$$

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

$$\begin{array}{ccc} x & & 9 \\ \hline & \triangle < & \\ & < & \end{array}$$

Subtract 5 from the right side:

$$\begin{array}{ccc} x & & 9 - 5 \\ \hline & \triangleq & \\ & = & \end{array} \quad LS = RS$$

$x = 4$

$$\begin{array}{ccc} x & & 4 \\ \hline & \triangleq & \\ & = & \end{array}$$

**Numerical solution:**

$$\begin{array}{ll} x + 5 = 9 & | \text{subtract 5 from each side} \\ x + 5 - 5 = 9 - 5 & \\ x = 4 & \end{array}$$

**Check:**

$$\begin{array}{ll} x + 5 = 9 & | \text{replace the } x \text{ with } 4 \\ 4 + 5 = 9 & \\ 9 = 9 & \\ \text{Left Side} = \text{Right Side} & \text{Ok!} \end{array}$$

**Example 2:** Solve for  $x$ :

$$x + 2 = 5$$

**Solution:**

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

**Check:**

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

**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:

$$(-2) + 8 = 6$$

$$6 = 6$$

*Left Side = Right Side*

b)  $a + 4 = 4$

Subtract 4 from each side:

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

$$a = 0$$

Check:

$$(0) + 4 = 4$$

$$4 = 4$$

*Left Side = Right Side*

c)  $6 + x = 8$

Subtract 6 from each side:

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

$$x = 2$$

Check:

$$6 + (2) = 8$$

$$8 = 8$$

*Left Side = Right Side*

d)  $3 + x = 20$

Subtract 3 from each side:

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

$$x = 17$$

Check:

$$3 + (17) = 20$$

$$20 = 20$$

*Left Side = Right Side*

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

$$x - 4 = 10$$

**Solution:**

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

**Check:**

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

**Practice 2:** Solve the equations. Check your solutions.

a)  $x - 5 = 4$

Add 5 to each side:

$$\begin{aligned}x - 5 + 5 &= 4 + 5 \\x &= 9\end{aligned}$$

Check:

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

b)  $x - 3 = -10$

Add 3 to each side:

$$\begin{aligned}x - 3 + 3 &= -10 + 3 \\x &= -7\end{aligned}$$

Check:

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

c)  $-4 + x = -2$

Add 4 to each side:

$$\begin{aligned}-4 + 4 + x &= -2 + 4 \\x &= 2\end{aligned}$$

Check:

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

d)  $-12 + x = 24$

Add 12 to each side:

$$\begin{aligned}-12 + 12 + x &= 24 + 12 \\x &= 36\end{aligned}$$

Check:

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

## 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  $x$

$$\begin{array}{ccc} 3x & & 9 \\ \hline & \triangleq & \\ & = & \end{array} \quad LS = RS$$

Divide  $3x$  by 3

$$\begin{array}{ccc} 3x \div 3 & & 9 \\ \hline & \triangle < & \\ & < & \end{array} \quad LS < RS$$

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

$$\begin{array}{ccc} x & & 9 \\ \hline & \triangle < & \\ & < & \end{array}$$

Divide the other side by 3:

$$\begin{array}{ccc} x & & 9 \div 3 \\ \hline & \triangleq & \\ & = & \end{array} \quad LS = RS$$

$x = 3$

$$\begin{array}{ccc} x & & 3 \\ \hline & \triangleq & \\ & = & \end{array}$$

**Numerical solution:**

$$3x = 9$$

*| divide each side by 3*

$$3x \div 3 = 9 \div 3$$

$$x = 3$$

**Check:**

$$3x = 3(3) = 9$$

*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:**

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

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

a)  $4x = 12$

Divide each side by 4:

$$\begin{aligned} \frac{4x}{4} &= \frac{12}{4} \\ x &= 3 \end{aligned}$$

Check:

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

c)  $-3x = -18$

Divide each side by  $-3$ :

$$\begin{aligned} \frac{-3x}{-3} &= \frac{-18}{-3} \\ x &= 6 \end{aligned}$$

Check:

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

b)  $-2z = 12$

Divide each side by  $-2$ :

$$\begin{aligned} \frac{-2z}{-2} &= \frac{12}{-2} \\ z &= -6 \end{aligned}$$

Check:

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

d)  $15x = 45$

Divide each side by 15:

$$\begin{aligned} \frac{15x}{15} &= \frac{45}{15} \\ x &= 3 \end{aligned}$$

Check:

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

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

**Solution:**

$$\frac{x}{2} = 4 \quad | \text{multiply each side by 2}$$

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

$$x = 8$$

Check:  $\frac{x}{2} = 4 \quad | \text{substitute the } x \text{ with } 8$

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

$$4 = 4$$

*Left Side = 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:

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

$$-5 = -5$$

*Left Side = Right Side*

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

Multiply each side by 3:

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

$$x = 12$$

Check:

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

$$4 = 4$$

*Left Side = Right Side*

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

Multiply each side by 5:

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

$$a = -15$$

Check:

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

$$-3 = -3$$

*Left Side = Right Side*

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

Multiply each side by 3:

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

$$a = 27$$

Check:

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

$$9 = 9$$

*Left Side = Right Side*

## Solving 1-Step Equations with Exponents and Roots

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

**Solution:**

$$\begin{aligned}x^2 &= 4 && \text{|take the square root of each side} \\ \sqrt{x^2} &= \sqrt{4}\end{aligned}$$

We get 2 solutions:

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

Check:

$$x^2 = 4 \quad \text{|substitute the } x \text{ with } 2$$

$$2^2 = 4$$

$$4 = 4$$

Left Side = Right Side

$$x^2 = 4 \quad \text{|substitute the } x \text{ with } -2$$

$$(-2)^2 = 4$$

$$4 = 4$$

Left Side = Right Side

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

a)  $x^2 = 100$

Take a square of each side:

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

$$x = 10 \quad \text{and} \quad x = -10$$

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

Multiply each side by 3:

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

$$x = \frac{4}{5} \quad \text{and} \quad x = -\frac{4}{5}$$

Check:

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

$$\left(\frac{4}{5}\right)^2 = \frac{16}{25}$$

Left Side = Right Side

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

$$\left(-\frac{4}{5}\right)^2 = \frac{16}{25}$$

Left Side = Right Side