

# Solving Linear Equations - One Step Equations

**Objective:** Solve one step linear equations by balancing using inverse Operations

Solving linear equations is an important and fundamental skill in algebra. In algebra, we are often presented with a problem where the answer is known, but part of the problem is missing. The missing part of the problem is what we seek to find. An example of such a problem is shown below.

**Example 44.**

$$\begin{array}{ll}
 x + 7 = -5 & \text{The 7 is added to the } x \\
 \underline{-7 \quad -7} & \text{Subtract 7 from both sides to get rid of it} \\
 x = -12 & \text{Our solution!}
 \end{array}$$

**Check your answer:** Substitute  $x = -12$   $-12 + 7 \stackrel{?}{=} -5$   
 $-5 = -5$  ✓

Then we get our solution,  $x = -12$ . The same process is used in each of the following examples.

**Example 45.**

$$\begin{array}{l}
 4 + x = 8 \\
 \underline{-4 \quad -4} \\
 x = 4
 \end{array}$$

$$\begin{array}{l}
 7 = x + 9 \\
 \underline{-9 \quad -9} \\
 -2 = x
 \end{array}$$

$$\begin{array}{l}
 5 = 8 + x \\
 \underline{-8 \quad -8} \\
 -3 = x
 \end{array}$$

**Example 48.**

$$\begin{array}{ll}
 4x = 20 & \text{Variable is multiplied by 4} \\
 \underline{\frac{4}{4} \quad \frac{4}{4}} & \text{Divide both sides by 4} \\
 x = 5 & \text{Our solution!}
 \end{array}$$

**Example 50.**

$$\begin{array}{l}
 8x = -24 \\
 \underline{\frac{8}{8} \quad \frac{8}{8}} \\
 x = -3
 \end{array}$$

$$\begin{array}{l}
 -4x = -20 \\
 \underline{\frac{-4}{-4} \quad \frac{-4}{-4}} \\
 x = 5
 \end{array}$$

$$\begin{array}{l}
 42 = 7x \\
 \underline{\frac{42}{7} \quad \frac{7}{7}} \\
 6 = x
 \end{array}$$

**Example 51.**

$$\begin{array}{ll}
 \frac{x}{5} = -3 & \text{Variable is divided by 5} \\
 (5)\frac{x}{5} = -3(5) & \text{Multiply both sides by 5} \\
 x = -15 & \text{Our Solution!}
 \end{array}$$

**Example 52.**

$$\begin{array}{l}
 \frac{x}{-7} = -2 \\
 (-7)\frac{x}{-7} = -2(-7) \\
 x = 14
 \end{array}$$

$$\begin{array}{l}
 \frac{x}{8} = 5 \\
 (8)\frac{x}{8} = 5(8) \\
 x = 40
 \end{array}$$

$$\begin{array}{l}
 \frac{x}{-4} = 9 \\
 (-4)\frac{x}{-4} = 9(-4) \\
 x = -36
 \end{array}$$

# 1.1 Practice - One Step Equations

Show **ALL** your work in notebook (paper). Answers must be correct to get make-up credits!

Solve each equation.

1)  $v + 9 = 16$

2)  $14 = b + 3$

3)  $x - 11 = -16$

4)  $-14 = x - 18$

5)  $30 = a + 20$

6)  $-1 + k = 5$

7)  $x - 7 = -26$

8)  $-13 + p = -19$

9)  $13 = n - 5$

10)  $22 = 16 + m$

11)  $340 = -17x$

12)  $4r = -28$

13)  $-9 = \frac{n}{12}$

14)  $\frac{5}{9} = \frac{b}{9}$

15)  $20v = -160$

16)  $-20x = -80$

17)  $340 = 20n$

18)  $\frac{1}{2} = \frac{a}{8}$

19)  $16x = 320$

20)  $\frac{k}{13} = -16$

21)  $-16 + n = -13$

22)  $21 = x + 5$

23)  $p - 8 = -21$

24)  $m - 4 = -13$

25)  $180 = 12x$

26)  $3n = 24$

27)  $20b = -200$

28)  $-17 = \frac{x}{12}$

29)  $\frac{r}{14} = \frac{5}{14}$

30)  $n + 8 = 10$

# Linear Equations - Two-Step Equations

**Objective:** Solve two-step equations by balancing and using inverse operations.

Example 53.

$$\begin{array}{r} 4x - 20 = -8 \\ + 20 \quad + 20 \\ \hline 4x \quad = 12 \\ \hline \frac{4x}{4} \quad = \frac{12}{4} \\ x = 3 \end{array}$$

Start by focusing on the subtract 20  
Add 20 to both sides  
Now we focus on the 4 multiplied by  $x$   
Divide both sides by 4  
Our Solution!

Notice in our next example when we replace the  $x$  with 3 we get a true statement.

Checking your answer:

$$\begin{array}{r} 4(3) - 20 = -8 \\ 12 - 20 = -8 \\ -8 = -8 \end{array}$$

Multiply 4(3)  
Subtract 12 - 20  
True!

Example 56.

$$\begin{array}{r} 8 - x = 2 \\ - 8 \quad - 8 \\ \hline -x = -6 \\ - 1x = -6 \\ \hline \frac{-1x}{-1} = \frac{-6}{-1} \\ x = 6 \end{array}$$

Start by focusing on the positive 8  
Subtract 8 from both sides  
Negative (subtraction) stays on the  $x$   
Remember, no number in front of variable means 1  
Divide both sides by  $-1$   
Our Solution!

Example 57.

$$\begin{array}{r} -3x + 7 = -8 \\ - 7 \quad - 7 \\ \hline -3x = -15 \\ \hline \frac{-3x}{-3} = \frac{-15}{-3} \\ x = 5 \end{array}$$

$$\begin{array}{r} -2 + 9x = 7 \\ + 2 \quad + 2 \\ \hline 9x = 9 \\ \hline \frac{9x}{9} = \frac{9}{9} \\ x = 1 \end{array}$$

$$\begin{array}{r} 8 = 2x + 10 \\ - 10 \quad - 10 \\ \hline -2 = 2x \\ \hline \frac{-2}{2} = \frac{2x}{2} \\ -1 = x \end{array}$$

$$\begin{array}{r} 7 - 5x = 17 \\ - 7 \quad - 7 \\ \hline -5x = 10 \\ \hline \frac{-5x}{-5} = \frac{10}{-5} \\ x = -2 \end{array}$$

$$\begin{array}{r} -5 - 3x = -5 \\ + 5 \quad + 5 \\ \hline -3x = 0 \\ \hline \frac{-3x}{-3} = \frac{0}{-3} \\ x = 0 \end{array}$$

$$\begin{array}{r} -3 = \frac{x}{5} - 4 \\ + 4 \quad + 4 \\ \hline (5)(1) = \frac{x}{5}(5) \\ 5 = x \end{array}$$

## 1.2 Practice - Two-Step Problems

When completed with this page, **SUBMIT** answers on a [Google Form](#) then **turn-in** your work.

Solve each equation.

1)  $5 + \frac{n}{4} = 4$

3)  $102 = -7r + 4$

5)  $-8n + 3 = -77$

7)  $0 = -6v$

9)  $-8 = \frac{x}{5} - 6$

11)  $0 = -7 + \frac{k}{2}$

13)  $-12 + 3x = 0$

15)  $24 = 2n - 8$

17)  $2 = -12 + 2r$

19)  $\frac{b}{3} + 7 = 10$

21)  $152 = 8n + 64$

23)  $-16 = 8a + 64$

25)  $56 + 8k = 64$

27)  $-2x + 4 = 22$

29)  $-20 = 4p + 4$

31)  $-5 = 3 + \frac{n}{2}$

33)  $\frac{r}{8} - 6 = -5$

35)  $-40 = 4n - 32$

37)  $87 = 3 - 7v$

39)  $-x + 1 = -11$

2)  $-2 = -2m + 12$

4)  $27 = 21 - 3x$

6)  $-4 - b = 8$

8)  $-2 + \frac{x}{2} = 4$

10)  $-5 = \frac{a}{4} - 1$

12)  $-6 = 15 + 3p$

14)  $-5m + 2 = 27$

16)  $-37 = 8 + 3x$

18)  $-8 + \frac{n}{12} = -7$

20)  $\frac{x}{1} - 8 = -8$

22)  $-11 = -8 + \frac{v}{2}$

24)  $-2x - 3 = -29$

26)  $-4 - 3n = -16$

28)  $67 = 5m - 8$

30)  $9 = 8 + \frac{x}{6}$

32)  $\frac{m}{4} - 1 = -2$

34)  $-80 = 4x - 28$

36)  $33 = 3b + 3$

38)  $3x - 3 = -3$

40)  $4 + \frac{a}{3} = 1$



## Solving Linear Equations - General Equations

**Objective:** Solve general linear equations with variables on both sides.

This section will focus on manipulating an equation we are asked to solve in such a way that we can use our pattern for solving two-step equations to ultimately arrive at the solution. One such issue is parenthesis. As you might expect we can get rid of the unwanted parenthesis by using the distributive property.

**Example 59.**

$$\begin{array}{ll} 4(2x - 6) = 16 & \text{Distribute 4 through parenthesis} \\ 8x - 24 = 16 & \text{Focus on the subtraction first} \\ \underline{+ 24 + 24} & \text{Add 24 to both sides} \\ 8x = 40 & \text{Now focus on the multiply by 8} \\ \underline{\quad 8 \quad 8} & \text{Divide both sides by 8} \\ x = 5 & \text{Our Solution!} \end{array}$$

Notice here the  $x$  is on both the left and right sides of the equation. This can make it difficult to decide which side to work with. We fix this by combining Like Terms “**LT**” It doesn’t matter which term gets moved,  $4x$  or  $2x$ , however, it would be easier to move the smaller term (to avoid negative coefficients).

**Example 62.**

$$\begin{array}{ll} 4x - 6 = 2x + 10 & \text{Notice the variable on both sides} \\ \underline{- 2x \quad - 2x} & \text{Subtract } 2x \text{ from both sides} \\ 2x - 6 = 10 & \text{Focus on the subtraction first} \\ \underline{+ 6 + 6} & \text{Add 6 to both sides} \\ 2x = 16 & \text{Focus on the multiplication by 2} \\ \underline{\quad 2 \quad 2} & \text{Divide both sides by 2} \\ x = 8 & \text{Our Solution!} \end{array}$$

**Check your answer:**

$$\begin{array}{ll} 4(\mathbf{8}) - 6 = 2(\mathbf{8}) + 10 & \text{Multiply } 4(8) \text{ and } 2(8) \text{ first} \\ 32 - 6 = 16 + 10 & \text{Add and Subtract} \\ 26 = 26 & \text{True!} \end{array}$$

**Example 65.**

$$\begin{array}{ll} 3(4x - 5) - 4(2x + 1) = 5 & \text{Distribute 3 and } -4 \text{ through parenthesis} \\ 12x - 15 - 8x - 4 = 5 & \text{Combine like terms } 12x - 8x \text{ and } -15 - 4 \\ 4x - 19 = 5 & \text{Focus on subtraction of 19} \\ \underline{+ 19 + 19} & \text{Add 19 to both sides} \\ 4x = 24 & \text{Focus on multiplication by 4} \\ \underline{\quad 4 \quad 4} & \text{Divide both sides by 4} \\ x = 6 & \text{Our Solution} \end{array}$$

## 1.3 Practice - General Linear Equations

When completed with this page, **SUBMIT** answers on a [Google Form](#) then **turn-in** your work.

Solve each equation.

1)  $2 - (-3a - 8) = 1$

3)  $-5(-4 + 2v) = -50$

5)  $66 = 6(6 + 5x)$

7)  $0 = -8(p - 5)$

9)  $-2 + 2(8x - 7) = -16$

11)  $-21x + 12 = -6 - 3x$

13)  $-1 - 7m = -8m + 7$

15)  $1 - 12r = 29 - 8r$

17)  $20 - 7b = -12b + 30$

19)  $-32 - 24v = 34 - 2v$

21)  $-2 - 5(2 - 4m) = 33 + 5m$

23)  $-4n + 11 = 2(1 - 8n) + 3n$

25)  $-6v - 29 = -4v - 5(v + 1)$

27)  $2(4x - 4) = -20 - 4x$

29)  $-a - 5(8a - 1) = 39 - 7a$

31)  $-57 = -(-p + 1) + 2(6 + 8p)$

33)  $-2(m - 2) + 7(m - 8) = -67$

35)  $50 = 8(7 + 7r) - (4r + 6)$

37)  $-8(n - 7) + 3(3n - 3) = 41$

39)  $-61 = -5(5r - 4) + 4(3r - 4)$

2)  $2(-3n + 8) = -20$

4)  $2 - 8(-4 + 3x) = 34$

6)  $32 = 2 - 5(-4n + 6)$

8)  $-55 = 8 + 7(k - 5)$

10)  $-(3 - 5n) = 12$

12)  $-3n - 27 = -27 - 3n$

14)  $56p - 48 = 6p + 2$

16)  $4 + 3x = -12x + 4$

18)  $-16n + 12 = 39 - 7n$

20)  $17 - 2x = 35 - 8x$

22)  $-25 - 7x = 6(2x - 1)$

24)  $-7(1 + b) = -5 - 5b$

26)  $-8(8r - 2) = 3r + 16$

28)  $-8n - 19 = -2(8n - 3) + 3n$

30)  $-4 + 4k = 4(8k - 8)$

32)  $16 = -5(1 - 6x) + 3(6x + 7)$

34)  $7 = 4(n - 7) + 5(7n + 7)$

36)  $-8(6 + 6x) + 4(-3 + 6x) = -12$

38)  $-76 = 5(1 + 3b) + 3(3b - 3)$

40)  $-6(x - 8) - 4(x - 2) = -4$

Show **ALL** your work in notebook (paper). Answers must be correct to make-up credits!