Chapter 4
Solving One-Step Equations and Inequalities

ONE-STEP ALGEBRA PROBLEMS WITH ADDITION AND SUBTRACTION

You have been solving algebra problems since second grade by filling in blanks. For example, $5 + \_\_\_\_ = 8$. The answer is 3. You can solve the same kind of problems using algebra. The problems only look a little different because the blank has been replaced with a letter. The letter is called a **variable**.

EXAMPLE: **Arithmetic** $5 + \_\_\_\_ = 14$
Algebra $5 + x = 14$

The goal in any algebra problem is to move all the numbers to one side of the equal sign and have the letter (called a **variable**) on the other side. In this problem, the 5 and the "x" are on the same side. The 5 is added to x. To move it, do the **opposite** of **add**. The **opposite** of **add** is **subtract**, so subtract 5 from both sides of the equation. Now the problem looks like this:

$5 + x = 14$
$-5 \quad -5$
$x = 9$

To check your answer, put 9 in the place of x in the original problem. Does $5 + 9 = 14$? Yes, it does.

EXAMPLE: $y - 16 = 27$
$+16 \quad +16$

Again, the 16 has to move. To move it to the other side of the equation, we do the **opposite** of **subtract**. We **add** 16 to both sides.

$y = 43$

Check by putting 43 in place of the y in the original problem. Does $43 - 16 = 27$? Yes.

Solve the problems below.

1. $n + 9 = 27$	6. $15 + x = 24$	11. $k - 5 = 29$	16. $t - 16 = 28$	21. $r - 12 = 37$
2. $12 + y = 55$	7. $w - 14 = 89$	12. $a + 17 = 45$	17. $m + 14 = 37$	22. $h - 17 = 22$
3. $51 + v = 67$	8. $t - 26 = 20$	13. $d + 26 = 56$	18. $y - 21 = 29$	23. $x - 37 = 46$
4. $f + 16 = 31$	9. $m - 12 = 17$	14. $15 + x = 56$	19. $f + 7 = 31$	24. $r - 11 = 28$
5. $5 + x = 23$	10. $c - 7 = 21$	15. $y + 19 = 32$	20. $h - 12 = 18$	25. $t - 5 = 52$

MORE ONE-STEP ALGEBRA PROBLEMS

Sometimes the answer to the algebra problem is a negative number. The problems work the same. Study the **examples** below.

EXAMPLES:

$$\begin{array}{r} n + 8 = 6 \\ -8 \quad -8 \\ \hline n = (-2) \end{array} \qquad \begin{array}{r} x - 10 = -14 \\ +10 \quad +10 \\ \hline x = (-4) \end{array} \qquad \begin{array}{r} y - (-6) = (-2) \\ +(-6) \quad +(-6) \\ \hline y = (-8) \end{array}$$

Solve the problems below.

1. $w + 4 = (-6)$
2. $q - 8 = (-9)$
3. $j + 7 = 1$
4. $y + 14 = 6$
5. $k - 5 = (-8)$
6. $h - 7 = (-2)$
7. $7 + d = (-3)$
8. $(-7) + k = (-4)$
9. $(-4) + h = 8$
10. $(-5) + g = -2$
11. $y - (-8) = (-5)$
12. $x + 21 = (-2)$
13. $w - (-3) = 8$
14. $q - (-6) = 12$
15. $z + 8 = 3$
16. $(-4) + m = 4$
17. $(-10) + r = (-2)$
18. $(-6) + b = 9$
19. $p - (-7) = (-2)$
20. $q - 5 = (-11)$
21. $x + 17 = (-4)$
22. $(-9) + x = 14$
23. $(-17) + r = -12$
24. $(-3) + y = 19$
25. $t - (-2) = (-8)$
26. $d - 9 = (-16)$
27. $x + 16 = -3$
28. $w + 14 = (-9)$
29. $q + 12 = (-5)$
30. $j + (-7) = (-1)$
31. $y - (-9) = 8$
32. $x + 12 = 6$

ONE-STEP ALGEBRA PROBLEMS WITH MULTIPLICATION AND DIVISION

Solving one-step algebra problems with multiplication and division is just as easy as solving addition and subtraction problems. Again, you perform the **opposite** operation. If the problem is a **multiplication** problem, you **divide** to find the answer. If it is a **division** problem, you **multiply** to find the answer. Carefully read the examples below, and you will see how easy they are.

EXAMPLE 1: $4x = 20$ (**$4x$** means **4 times x. 4** is the **coefficient** of x.)

The goal is to get the numbers on one side of the equal sign and the variable x on the other side. In this problem, the **4** and x are on the same side of the equal sign. The **4** has to be moved over. **$4x$** means **4** times x. The opposite of **multiply** is **divide.** If we divide both sides of the equation by **4,** we will find the answer.

$4x = 20$ **We need to divide both sides by 4.**

This means divide by 4. $\frac{\cancel{4}x}{\cancel{4}} = \frac{20}{\cancel{4}}$ **We see that** $1x = 5$ **so** $x = 5$

When you put 5 in place of x in the original problem, it is correct. $4 \times 5 = 20$

EXAMPLE 2: $\frac{y}{4} = 2$ This problem means y divided by **4** is equal to 2. In this case, the opposite of **divide** is **multiply**. We need to multiply both sides of the equation by **4.**

$\cancel{4} \times \frac{y}{\cancel{4}} = 2 \times 4$ so $y = 8$

When you put 8 in place of y in the original problem, it is correct. $\frac{8}{4} = 2$

Solve the problems below.

1. $2x = 14$
2. $\frac{w}{5} = 11$
3. $3h = 45$
4. $10y = 30$
5. $5a = 60$
6. $\frac{x}{3} = 9$
7. $6d = 66$
8. $\frac{w}{9} = 3$
9. $7r = 98$
10. $\frac{y}{3} = 2$
11. $\frac{x}{4} = 36$
12. $\frac{r}{4} = 7$
13. $8t = 96$
14. $\frac{z}{2} = 15$
15. $\frac{n}{9} = 5$
16. $4z = 24$
17. $6d = 84$
18. $\frac{t}{3} = 3$
19. $\frac{m}{6} = 9$
20. $9p = 72$

Sometimes the answer to the algebra problem is a **fraction**. Read the example below, and you will see how easy it is.

EXAMPLE

$4x = 5$ Problems like this are solved just like the problems on the previous page. The only difference is that the answer is a **fraction**.

In this problem, the 4 is **multiplied** by x. To solve, we need to divide both sides of the equation by 4.

$4x = 5$ Now **divide** by 4. $\frac{4x}{4} = \frac{5}{4}$ Now cancel. $\frac{\cancel{4}x}{\cancel{4}} = \frac{5}{4}$ so $x = \frac{5}{4}$

When you put $\frac{5}{4}$ in place of x in the original problem, it is correct.

$4 \times \frac{5}{4} = 5$ Now cancel. ⟶ $\cancel{4} \times \frac{5}{\cancel{4}} = 5$ so $5 = 5$

Solve the problems below. Some of the answers will be fractions. Some answers will be integers.

1. $2x = 3$
2. $4y = 5$
3. $5t = 2$
4. $12b = 144$
5. $9a = 72$
6. $8y = 16$
7. $7x = 21$
8. $4z = 64$
9. $7x = 126$
10. $6p = 10$
11. $2n = 9$
12. $5x = 11$
13. $15m = 180$
14. $5h = 21$
15. $3y = 8$
16. $2t = 10$
17. $3b = 2$
18. $5c = 14$
19. $4d = 3$
20. $5z = 75$
21. $9y = 4$
22. $7d = 12$
23. $2w = 13$
24. $9g = 81$
25. $6a = 18$
26. $2p = 16$
27. $15w = 3$
28. $5x = 13$

MULTIPLYING AND DIVIDING WITH NEGATIVE NUMBERS

EXAMPLE 1: $-3x = 15$ In the problem, –3 is **multiplied** by x. To find the solution, we must do the opposite. The opposite of **multiply** is **divide**. We must **divide** both sides of the equation by –3.

$\frac{-3x}{-3} = \frac{15}{-3}$ Then cancel. $\frac{\cancel{-3}x}{\cancel{-3}} = \frac{\overset{5}{\cancel{15}}}{\cancel{-3}_{1}}$ $x = -5$

EXAMPLE 2: $\frac{y}{-4} = -20$ In this problem, y is **divided** by –4. To find the answer, do the opposite. **Multiply** both sides by –4.

$\cancel{-4} \times \frac{y}{\cancel{-4}} = (-20) \times (-4)$ so $y = 80$

EXAMPLE 3: $-6a = 2$ The answer to an algebra problem can also be a negative fraction.

$\frac{\cancel{-6}a}{\cancel{-6}} = \frac{2}{-6}$ ← reduce to get $a = \frac{1}{-3}$ or $-\frac{1}{3}$

Note: A negative fraction can be written several different ways.

$$\frac{1}{-3} = \frac{-1}{3} = -\frac{1}{3} = -\left(\frac{1}{3}\right)$$

All mean the same thing.

Solve the problems below. Reduce any fractions to lowest terms.

1. $2z = -6$
2. $\frac{y}{-5} = 20$
3. $-6k = 54$
4. $4x = -24$
5. $\frac{t}{7} = -4$
6. $\frac{r}{-2} = -10$
7. $9x = -72$
8. $\frac{x}{-6} = 3$
9. $\frac{w}{-11} = 5$
10. $5y = -35$
11. $\frac{x}{-4} = -9$
12. $7t = -49$
13. $-14x = -28$
14. $\frac{m}{3} = -12$
15. $-8z = 32$
16. $-15w = -60$
17. $\frac{y}{-9} = -4$
18. $\frac{d}{8} = -7$
19. $-12v = 36$
20. $\frac{c}{-6} = -6$

21. $-4x = -3$

22. $-12y = 7$

23. $\frac{a}{-2} = 22$

24. $-18b = 6$

25. $13a = -36$

26. $\frac{b}{-2} = -14$

27. $-24x = -6$

28. $-6p = 42$

29. $\frac{x}{-23} = -1$

30. $7x = -7$

31. $-9y = -1$

32. $\frac{d}{5} = -10$

33. $\frac{z}{-13} = -2$

34. $-5c = 45$

35. $2d = -3$

36. $-8d = -12$

37. $-24w = 9$

38. $\frac{y}{-9} = -6$

39. $-9a = -18$

40. $\frac{p}{-2} = 15$

VARIABLES WITH A COEFFICIENT OF NEGATIVE ONE

The answer to an algebra problem should not have a negative sign in front of the variable. For example, the problem $-x = 5$ is not completely simplified. Study the examples below to learn how to finish simplifying this problem.

EXAMPLE 1: $-x = 5$ $-x$ means the same thing as $-1x$ or -1 times x. To simplify this problem, **multiply** by -1 on both sides of the equation.

$(-1)(-1x) = (-1)(5)$ so $x = -5$

EXAMPLE 2: $-y = -3$ Solve the same way.

$(-1)(-y) = (-1)(-3)$ so $y = 3$

Simplify the following equations.

1. $-w = 14$

2. $-a = 20$

3. $-x = -15$

4. $-x = -25$

5. $-y = -16$

6. $-t = 62$

7. $-p = -34$

8. $-m = 81$

9. $-w = 17$

10. $-v = -9$

11. $-k = 13$

12. $-q = 7$