

Evaluating Numerical Expressions

A numerical expression is a group of numbers and math operations such as $3 + 4$ or $(3 + 8) \cdot 5$ (the sum of 3 plus 8 multiplied by 5). When an expression has more than one operation, you must do the operations in a specific order to evaluate, or find the answer of, the expression. The rules below show the order in which math operations must be done.

Order of Operations

1. Do operations within parentheses.
2. Do operations with powers and roots.
3. Do all multiplication and division operations from left to right.
4. Do all addition and subtraction operations from left to right.

Evaluate $(3 + 4) \cdot 7$

$$\begin{array}{l} (3 + 4) \cdot 7 \\ 7 \cdot 7 = 49 \end{array}$$

Evaluate $12 \div (10 - 4)$

$$\begin{array}{l} 12 \div (10 - 4) \\ 12 \div 6 = 2 \end{array}$$

Evaluate using the correct order of operations.

- | | | | |
|-------------------------------------|---------------------|-------------------|---------------------|
| 1. $5 \cdot 5 + 9$
$25 + 9 = 34$ | $(6 - 2) \div 4$ | $2 \cdot 7 + 6$ | $14 - 4 \div 2$ |
| 2. $18 + 2 \cdot 3$ | $(21 - 7) \cdot 7$ | $(4 + 3) \cdot 9$ | $30 \div 3 \cdot 2$ |
| 3. $16 - 9 + 4$ | $42 - 12 \div 6$ | $3 \cdot 5 - 10$ | $12 \cdot (2 - 1)$ |
| 4. $50 \div (8 + 2)$ | $5 + 6 \cdot 3$ | $12 \div 4 + 8$ | $2 + 3 \cdot 3$ |
| 5. $10 - 3 \div 3$ | $(15 - 10) \div 5$ | $5 \cdot 3 + 2$ | $20 - 7 \cdot 2$ |
| 6. $16 \div 4 - 4$ | $10 \cdot 10 - 100$ | $9 \div (2 + 1)$ | $9 + 10 \div 5$ |
| 7. $(10 - 1) \cdot 9$ | $13 - 7 + 4$ | $18 + 4 \cdot 2$ | $2 \cdot 4 \div 2$ |
| 8. $(2 + 7) \cdot 8$ | $1 + (9 - 3)$ | $8 \cdot 6 + 9$ | $12 \div 4 - 1$ |

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Evaluating Numerical Expressions

Some expressions contain powers and roots as well as parentheses and math operations. Refer to the rules on page 5 for the correct order of operations.

Evaluate $3^2 \div (7 - 4) + 2$

$$\begin{array}{r} 3^2 \div (7 - 4) + 2 \\ 3^2 \div 3 + 2 \\ 9 \div 3 + 2 \\ 3 + 2 = 5 \end{array}$$

Evaluate $(4 + 5) \div (2^2 - 1)$

$$\begin{array}{r} (4 + 5) \div (2^2 - 1) \\ 9 \div (4 - 1) \\ 9 \div 3 = 3 \end{array}$$

Evaluate.

1. $5^2 \cdot (2 + 3) - 2^2$
 $25 \cdot 5 - 4$
 $125 - 4 = 121$

$(9 - 6) \cdot (8 + 2)$

$35 \div (7 - 2) \div \sqrt{49}$

2. $3 + 4 \cdot 4 - 15 \div 5$

$8^2 + 6 \cdot (8 - 3)$

$(9 + 9) \div (10 - 4)$

3. $10^2 - 20 \div (4 + 6)$

$(11 - 3) \cdot \sqrt{16} + 9$

$6^2 - (3 + 7) + 2^3$

4. $(12 + 8) \div (5 - 3)$

$1 + 7^2 \cdot 4 + \sqrt{9}$

$3^3 - 5 \cdot (7 - 5)$

5. $12^2 \div 3 \cdot 4 - \sqrt{144}$

$(12 - 6) \cdot (8 + 2)$

$(20 + 7) \div 3^2$

6. $9^2 + 7 \cdot (4 + 3)$

$\sqrt{81} + 6^2 \div (7 - 1)$

$15 \div 3 + 2 - 6$

7. $(30 + 5) \div (9 - 2)$

$4^3 \div 2 - 2^2 \cdot 5$

$6^3 \div (10 + 2) + 2$

8. $(29 - 5) \div \sqrt{36} + 3^2$

$(2 + 3) \cdot (9 - 5)$

$9^2 - (15 - 4) - 32$

9. $17 + 3 \div 3 \cdot \sqrt{25}$

$42 \div 6 \cdot (18 - 9)$

$(16 + 18) \div (19 - 2)$

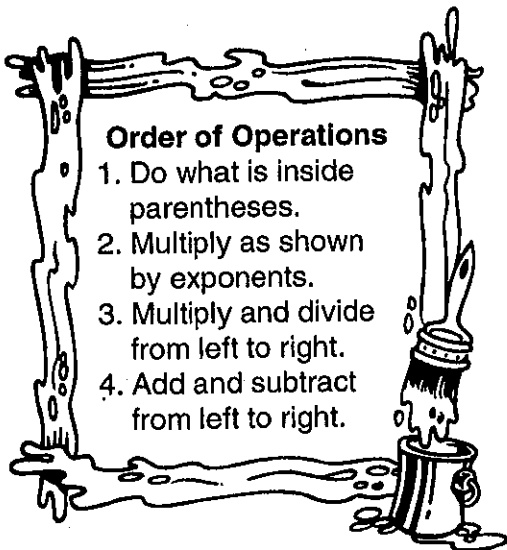
10. $(33 - 6) \div 3^3$

$4^2 + 2^3 \cdot 5$

$(99 + 1) \div \sqrt{100}$

Solve It in Order

Find the value of each expression. Follow the order of operations shown on the banner.



A. $16 - 7 \cdot 2$

$12 + 9 \cdot 3 - 28$

B. $54 + 24 \div 3 - 30$

$9 \cdot 4 \div 2$

C. $8 \cdot 2 + 45 \div 9$

$16 + 30 \div 3 \cdot 2$

D. $5 \cdot 6 \div 3$

$3 \cdot 2^2 \div (6 - 3)$

$2 \cdot 3 + 10 \div 2$

E. $29 + 21 - 25$

$36 \div 9 - 2$

$48 \div (6 \cdot 2)$

F. $4 \cdot 3 + 2 - 7$

$45 \div 15 + 2 \cdot 3$

$3 + 7 \cdot 5 - 1$

G. $3 \cdot (8 - 5)$

$(20 + 12) \div (4 + 4)$

$(15 - 3) \div 12 + 1$

H. $4^2 - 5 \cdot 3$

$42 \div 7 + 2^2$

$5 \cdot (8 - 2) \cdot 3$

I. $3^3 \div (2^3 + 1)$

$4 \cdot 5 - 3 \cdot 5 + 4$

$54 + 36 \div 3 - 30$

Facts to Know

Remember from Unit 4 that to evaluate an algebraic expression, sometimes you need to perform more than one operation. Perform the operations, one at a time, in this order:

- Simplify expressions by performing the operations needed inside the parentheses.
- Multiply or divide. (Work from left to right.)
- Add or subtract. (Work from left to right.)

As you also learned in Unit 3, terms that have all of the same variables (xy , $3xy$, $-5xy$, etc.) or variables with the same exponents ($4a^2 + a^2$), are called *like* or *similar terms*. Like terms can be combined by combining the numerical coefficients. A *numerical coefficient* is any number in front of a variable.

Likewise, you combine terms to solve equations just like you do in evaluating algebraic expressions.

Solving Two- and Three-Step Equations

If more than one step must be performed to solve an equation, do addition and subtraction *before* multiplication and division.

Example: Solve $4y - 4 = -16$

Step 1: Add 4 to both sides (remember about inverse operations: what you do to one side of an equation, you must do to the other).

$$\begin{array}{r} 4y - 4 = -16 \\ + 4 = + 4 \\ \hline 4y = -12 \end{array}$$

Step 2: Divide by 4 on both sides.

$$\begin{array}{r} 1y = -3 \\ \frac{4y}{4} = \frac{-12}{4} \\ \hline y = -3 \end{array}$$

Example: Solve $5z + 15 = 60$

Step 1: Subtract 15 on both sides. (Remember with inverse operations, what you do to one side of an equation, you must do to the other.)

$$\begin{array}{r} 5z + 15 = 60 \\ - 15 = - 15 \\ \hline 5z = 45 \end{array}$$

Step 2: Divide by 5 on both sides.

$$\begin{array}{r} 1z = 9 \\ \frac{5z}{5} = \frac{45}{5} \\ \hline z = 9 \end{array}$$

Facts to Know (cont.)

Solving Two- and Three-Step Equations (cont.)

Example: Solve $\frac{-2}{3}s + 3 = 18$

Step 1: Subtract 3 from both sides of the equation.

$$\frac{-2}{3}s + 3 = 18$$

$$\begin{array}{r} -3 \quad -3 \\ \hline \end{array}$$

Step 2: Multiply by the reciprocal of $\frac{-2}{3}$ to eliminate it and leave the s by itself.

$$\frac{-2}{3}s = 15$$

$$\left(\frac{-3}{2}\right) \frac{-2}{3}s = 15 \left(\frac{-3}{2}\right) = -\frac{45}{2} \text{ or } -22\frac{1}{2}$$

Combining Variables to Solve Equations

To solve equations, combine variables when you can. Then use inverse operations.

Example: Solve $2r + 4r + 12 = 120$

Step 1: Combine the variables.

$$2r + 4r + 12 = 120$$

$$\begin{array}{r} \boxed{} \\ \hline 6r \end{array}$$

Step 2: Subtract 12 from both sides to get $6r$ by itself.

$$6r + \cancel{12} = 120$$

$$\begin{array}{r} -\cancel{12} = -12 \\ \hline 6r = 108 \end{array}$$

Step 3: Divide both sides by 6.

$$\frac{\cancel{6}r}{\cancel{6}} = \frac{108}{\cancel{6}} \text{ so } r = 18$$

Example: Solve $2(y - 4) = 12$

Step 1: Multiply 2 and $(y - 4)$.

$$2(y - 4) = 12 \rightarrow 2y - 8 = 12$$

Step 2: Add 8 to both sides to get $2y$ by itself.

$$2y - 8 = 12$$

$$\begin{array}{r} +8 \quad +8 \\ \hline 2y = 20 \end{array}$$

Step 3: Divide both sides by 2 to get y by itself.

$$2y = 20$$

$$\frac{\cancel{2}y}{\cancel{2}} = \frac{20}{\cancel{2}} \text{ so } y = 10$$

Facts to Know (cont.)**Solving Equations with Variables on Both Sides**

If there are variables and numbers on both sides of the equal sign, you will have to get all variables on one side of the equation and all numbers on the other side.

Example: $5y - 3 = 2y + 15$

Step 1: Place all variables on one side of the equation.
Since $2y$ is smaller than $5y$, subtract it from both sides.

$$\begin{array}{r} 5y - 3 = 2y + 15 \\ - 2y \quad - 2y \\ \hline 3y - 3 = 15 \end{array}$$

Step 2: Add 3 to both sides to get $3y$ by itself.

$$\begin{array}{r} 3y - \cancel{3} = 15 \\ + \cancel{3} \quad + 3 \\ \hline 3y = 18 \end{array}$$

Step 3: Divide by 3 on both sides to get y by itself.

$$\frac{1y}{\cancel{3}} = \frac{6}{\cancel{3}} \text{ so } y = 6$$

Example: Solve $3x + 23 = 10x + 2$

Step 1: Place all variables on one side of the equation.
Since $3x$ is smaller than $10x$, subtract it from both sides.

$$\begin{array}{r} 3x + 23 = 10x + 2 \\ - 3x \quad - 3x \\ \hline 23 = 7x + 2 \end{array}$$

Step 2: Subtract 2 from both sides to get $7x$ by itself.

$$\begin{array}{r} 23 = 7x + 2 \\ - 2 \quad - 2 \\ \hline 21 = 7x \end{array}$$

Step 3: Divide both sides by 7 to get x by itself.

$$\frac{21}{\cancel{7}} = \frac{7x}{\cancel{7}} \text{ so } x = 3$$

Directions: Solve these two- and three-step equations.

1. $8a - 4 = 60$

4. $\frac{w}{12} + 8 = 30$

2. $9z - 12 = 69$

5. $\frac{3}{4}c - 3 = 9$

3. $\frac{b}{3} + 4 = 16$

6. $39 = 14d - 3$

Directions: Combine the variables to solve the equations.

7. $7(2 + x) = 28$

11. $2(3 + x) = 7$

8. $8x + 2 + 2x = 32$

12. $14x - 10 - 4x = 0$

9. $3x - 2x - 10 = -9$

13. $x + 2x + 3x = 12$

10. $6(x - 3) = 18$

14. $y + 3y + 2(y + 3) = 15$

Directions: Solve these equations with variables on both sides.

15. $4x = 8 + 2x$

19. $3a + 10 = 8a$

23. $48 - 4y = 8y - 12$

16. $5(x - 4) = 3(x + 8)$

20. $2(r - 3) = 4(r - 10)$

24. $28 - 2x = 5x$

17. $3n - 9 = 7n + 5$

21. $5r + 32 = 8r + 17$

25. $9w + 17 = 6w + 32$

18. $7a + 15 = 4a + 37$

22. $6y - 2 - 9y = 4$

26. $19b - 14 - 21b = -2$

Solving Two-Step Equations

To solve some equations, you may need to use more than one operation. Be sure to add or subtract first. Then multiply or divide.

Solve $6x - 3 = -9$

Add 3 to both sides.

$$\begin{aligned}6x - 3 + 3 &= -9 + 3 \\6x &= -6\end{aligned}$$

Divide both sides by 6.

$$\begin{aligned}\frac{6x}{6} &= \frac{-6}{6} \\x &= -1\end{aligned}$$

Check by substituting -1 for x .

$$\begin{aligned}6(-1) - 3 &= -9 \\-6 - 3 &= -9 \\-9 &= -9\end{aligned}$$

Solve. Check.

1. $4x + 2 = 10$

$$\begin{aligned}4x + 2 - 2 &= 10 - 2 \\4x &= 8 \\ \frac{4x}{4} &= \frac{8}{4} \\x &= 2\end{aligned}$$

$$\frac{x}{6} - 3 = 1$$

$$8 - 2x = -16$$

2. $\frac{5}{7}x - 3 = 2$

$$-6y + 2 = 8$$

$$\frac{y}{5} - 1 = 0$$

3. $\frac{3}{4}y - 3 = 3$

$$9 - 3x = 36$$

$$\frac{y}{3} - 5 = 10$$

4. $4 + 8x = -4$

$$\frac{1}{2}y + 2 = -2$$

$$\frac{y}{7} - 8 = -9$$

5. $18y - 6 = 12$

$$-5 + 10x = 15$$

$$\frac{2}{3}y + 1 = 3$$

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Solving Two-Step Fraction Equations

The variable in a fraction equation may be in either the numerator or the denominator.

$$\frac{3x}{5} = 6 \qquad \frac{12}{x} = 4$$

To solve these equations, use two steps. Multiply each side of the equation by the denominator. Then divide.

Solve $\frac{5x}{9} = 5$

Solve $\frac{2}{x} = 2$

Multiply by 9.
Then divide.

Check by substituting
9 for x.

$$(9) \frac{5x}{9} = 5(9)$$

$$5x = 45$$

$$x = \frac{45}{5}$$

$$x = 9$$

$$\frac{5 \cdot 9}{9} = 5$$

$$\frac{45}{9} = 5$$

$$5 = 5$$

Multiply by x.
Then divide.

Check by substituting
1 for x.

$$(x) \frac{2}{x} = 2(x)$$

$$2 = 2x$$

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

$$1 = x$$

$$\frac{2}{1} = 2$$

$$2 = 2$$

Solve. Check.

1. $\frac{3x}{4} = -9$

$$(4) \frac{3x}{4} = -9(4)$$

$$3x = -36$$

$$x = -12$$

$$\frac{9}{x} = 3$$

$$-\frac{2x}{3} = 4$$

2. $\frac{4x}{7} = 16$

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

$$\frac{26}{x} = 13$$

3. $\frac{6x}{10} = -12$

$$-\frac{4}{x} = 1$$

$$\frac{7x}{8} = 7$$

4. $-\frac{5x}{6} = 10$

$$\frac{14}{x} = -2$$

$$-\frac{18x}{3} = 12$$

5. $\frac{8x}{12} = -4$

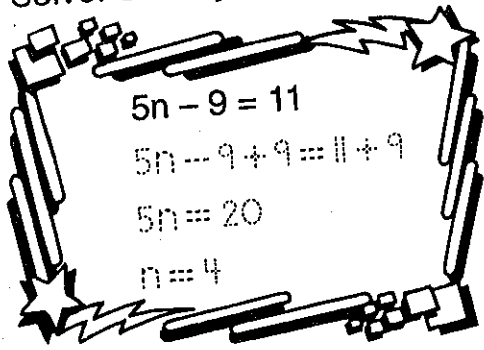
$$\frac{15}{x} = 3$$

$$-\frac{54}{x} = 3$$

Name _____

Use Two Steps

Solve. Show your work.



A. $5y + 3 = 18$

$3y - 4 = 14$

B. $2x - 1 = 11$

$3y - 8 = 16$

$4n + 9 = -3$

C. $5c + 7 = -28$

$\frac{x}{2} - 5 = 3$

$\frac{2}{3}b + 4 = 5$

D. $\frac{a}{4} - 2 = 3$

$2x + 5 = 19$

$\frac{x}{2} + 3 = 9$

E. $8y + 11 = 83$

$5n + 2 = -33$

$\frac{1}{5}z - 1 = 3$

Checking Up

Solve each equation. Check.

1. $\frac{1}{9}x = 3$

$$-\frac{2}{3}y = 6$$

$$\frac{3}{7}x = -9$$

2. $\frac{4}{5}x = -8$

$$\frac{1}{10}y = 2$$

$$-\frac{3}{4}y = 6$$

3. $-\frac{3}{4}y + 1 = -14$

$$7x - 10 = -3$$

$$14 - 5x = -1$$

4. $5x - 6 = 9$

$$3 - 9y = -6$$

$$\frac{y}{8} - 2 = 3$$

5. $\frac{3}{5}x + 4 = 10$

$$5 - 2y = 1$$

$$\frac{x}{9} + 10 = 20$$

6. $\frac{5x}{6} = -10$

$$-\frac{2x}{3} = 4$$

$$\frac{7}{9}y = 21$$

7. $\frac{12}{x} = 3$

$$\frac{15}{y} = -5$$

$$\frac{8}{x} = 1$$

8. $\frac{1y}{2} = -15$

$$-\frac{22}{x} = 2$$

$$\frac{5y}{12} = 5$$

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Facts to Know

Whether equations have numbers and letters or just letters, the key is to get the unknown variable alone on one side of the equal sign.

Removing Parentheses Before Solving Equations

In algebra, parentheses are used to show multiplication $(4)(2) = 8$ and to simplify an expression such as $2(a + 6)$, you multiply both items inside the parentheses by 2.

$$2(a + 6) \longrightarrow 2a + 2(6) \longrightarrow 2a + 12$$

This process of removing the parentheses is an important step toward solving the equation.

Example: $2(x + 5) - x = -7$

Step 1: Multiply 2 times x and 2 times 5.

$$2(x + 5) - x = -7 \longrightarrow 2x + 2(5) - x = -7 \longrightarrow 2x + 10 - x = -7$$

Step 2: Combine like terms.

$$2x + 10 - x = -7 \longrightarrow x + 10 = -7$$

Step 3: Subtract from both sides to get x by itself.

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

Example: $38 = 2 - 3(y - 5)$

Step 1: Multiply -3 times y and -3 times -5.

$$38 = 2 - 3(y - 5) \longrightarrow 38 = 2 - 3y - 3(-5) \longrightarrow 38 = 2 - 3y + 15$$

Step 2: Combine like terms.

$$38 = 2 - 3y + 15 \longrightarrow 38 = 17 - 3y$$

Step 3: Subtract 17 from both sides.

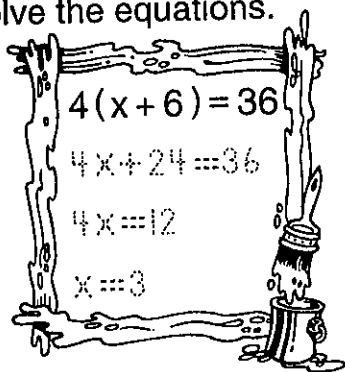
$$\begin{array}{r} 38 = 17 - 3y \\ -17 \quad -17 \\ \hline 21 = -3y \end{array}$$

Step 4: Divide both sides by -3.

$$\begin{array}{r} -7 \quad 1y \\ \cancel{21} = \cancel{-3y} \text{ so } y = -7 \\ -3 \quad -3 \end{array}$$

Distribute and Solve

Solve the equations.



A. $3(x + 2) = 12$

$4(x - 3) = 8$

B. $2(x + 7) = 20$

$5(x - 5) = 5$

$6(x - 7) = 12$

C. $5(x - 3) = 5$

$7(x - 2) = 28$

$5(x + 2) = 40$

D. $2(x + 8) = 20$

$6(x + 2) = 54$

$3(x - 3) = 30$

E. $4(x + 6) = 60$

$8(x - 4) = 64$

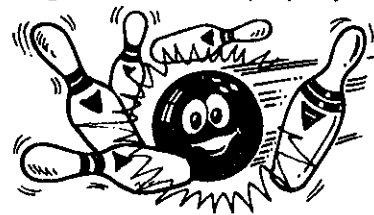
$7(x + 3) = 91$

F. $9(x - 2) = 0$

$5(x + 9) = 100$

$8(x - 8) = 8$

Distribute and Solve



Solve the equations. Remember to multiply both numbers inside the parentheses by the number in front of the parentheses.

A. $3(x - 2) = -3$

$2(x + 5) = -2$

$-4(x - 5) = 24$

B. $-6(x + 7) = 12$

$-4(m + 12) = 36$

$2(x - 4) = 22$

C. $20 = 4(x + 3)$

$3(y - 7) = 27$

$3(a - 5) = -21$

D. $4(y + 8) = 22$

$35 = 5(n + 2)$

$6(z + 4) = -10$

E. $-5(a + 7) = 5$

$3(b - 4) = -6$

$-18 = 3(x - 4)$

F. $-6(x - 1) = 12$

$-9(x + 1) = 18$

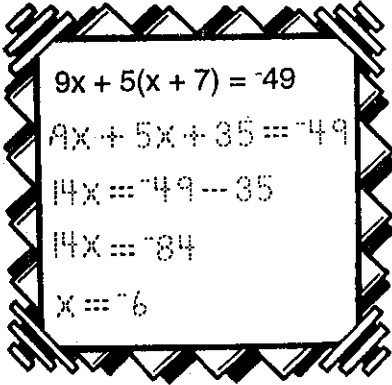
$4(x - 5) = -42$

Directions: Solve the following equations by removing parentheses.

1. $5(x + 2) = 25$	7. $2x = 7 + 3(2 - x)$
2. $5(x + 3) = 6(x - 4)$	8. $-5(1 + x) = 8 - 4x$
3. $7(b + 2) = 28$	9. $2(4x + 11) = -3 + 3x$
4. $2(x + 3) - 4 = 8 + 6x$	10. $-7 - (-3 - 2x) = 10$
5. $4x + 3(x + 7) = 14$	11. $\frac{1}{2}(11x - 60) - 2x = x$
6. $3(2 + x) = -10 + 2x$	12. $4(x - 2) = 72$

Combine the Variables

Multiply the number and variable inside each parentheses by the number in front of the parentheses. Then combine the like variables and solve the equation.



$9x + 5(x + 7) = -49$
 $9x + 5x + 35 = -49$
 $14x = -49 - 35$
 $14x = -84$
 $x = -6$

A. $2b + 3(b - 7) = 44$

$2v + 3(8 - v) = -16$

B. $4(2y + 9) + 7y = -24$

$5(3n) + 14 + 6n = 21$

$5(n + 3) + 5 = -25$

C. $-8a + 6(a + 7) = 1$

$10z + 5(z - 12) = 0$

$7y + 7(y + 3) = -21$

D. $-3x + 6(x + 4) = 9$

$4z + 9 + 3(2z) = 129$

$6(3a - 2) + 5a = 57$

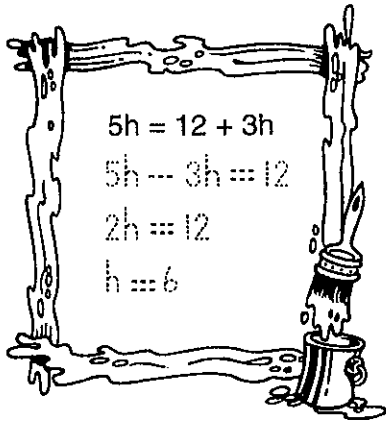
E. $5x + 3(x + 4) = 76$

$-3(x + 4) - 21x = 72$

$-4(3 + f) + 6f = -24$

On Both Sides Now

Arrange the variables so that they are on the same side of the equation. Then solve the equation.



A. $2x + 72 = 4x$

$24 + y = 9y$

B. $9b = 26 - 4b$

$7n = 15 - 8n$

$12h = 48 - 4h$

C. $42 + 9c = 16c$

$7f = 3f - 52$

$9r + 7 = 4r - 8$

D. $-5w - 9 = 3w + 7$

$72 + 7d = 15d$

$7r = -5r + 144$

E. $-3g + 9 = 15g - 9$

$5e = 14 - 2e$

$3s + 10 = 5s + 4$

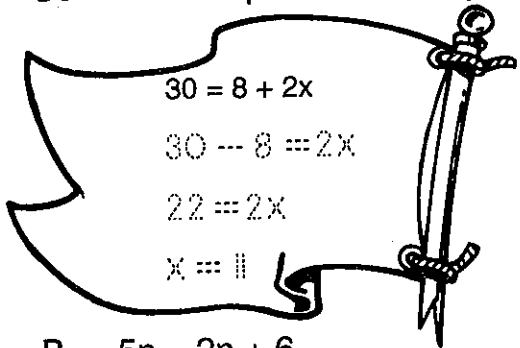
F. $6(s + 1) = 4s + 8$

$7b + 6 = 2b - 19$

$8x - 1 = 23 - 4x$

Be an Equation Buster!

Solve each equation. Show your work.



A. $5a + 7 = -23$

$x + 38 = 86 - 3x$

B. $5n = 2n + 6$

$y = 24 - 3y$

$-12n = 35 - 5n$

C. $\frac{x}{3} = 7$

$4n + 5 = 6n + 7$

$2(x - 6) = 3x$

D. $3p - 8 = 13 - 4p$

$8(5 - n) = 2n$

$5(2 + n) = 3n + 18$

E. $4u - 8 = -5(1 - u)$

$2(x - 6) = 3x$

$\frac{x}{2} + 5 = 6$

F. $98 - 4b = -11b$

$\frac{1}{2}(x + 8) = 10$

$3(m + 5) = 2m + 10$

More Equation Busting

Solve each equation. Show your work.

$$\begin{aligned} \frac{3}{4}x &= 12 + \frac{1}{4}x \\ \frac{3}{4}x - \frac{1}{4}x &= 12 \\ \frac{2}{4}x &= 12 \\ x &= 12 \div \frac{2}{4} \\ x &= 24 \end{aligned}$$

A. $8a = 2a + 30$

$2b = 80 - 8b$

B. $\frac{2}{3}x = 6 - \frac{1}{3}x$

$51 = 9 - 3x$

$39c = 33c - 78$

C. $5p - 9 = 2p + 12$

$89 + x = 2 - 2x$

$4(y - 6) = 7y$

D. $7(10 - m) = 3m$

$\frac{2}{3}x - 7 = x$

$3(30 + s) = 4(s + 19)$

E. $-7a = -12a + 65$

$4(x + 2) = 6x + 10$

$\frac{x}{2} + 5 = x$

F. $3(2 + v) = 5v + 16$

$4(3y - 1) = 5y - 11$

$5x + 2(1 - x) = 2(2x - 1)$

Facts to Know (cont.)

Solving Literal Equations

Some equations have no numbers, but only variables. These equations are called *literal equations*. Solve them the same way you solve equations with numbers. You need to find the desired unknown on one side of the equal sign to discover its value.

Formulas, for example, are sometimes easier to use if the unknown value is by itself. But sometimes the way a formula is written doesn't fit the problem!

Example: How long does it take to go 160 miles at 55 miles per hour?

Problems like this usually use the formula $d = rt$ or *distance = rate \times time*. But to find the time, you need to get t (time) by itself.

Step 1: Divide both sides of the formula by r to get t by itself (perform an inverse operation).

$$\frac{d}{r} = \frac{rt}{r}$$

Now instead of $d = rt$, you now have $\frac{d}{r} = t$.

Step 2: Replace letters with values from the problem.

$$\frac{160}{55} = t \text{ so } t = 2.91$$

It takes 2.91 hours to go 160 miles at 55 miles per hour.

Here's an example in which you have no numbers at all.

Example: Solve $ax - b = c$ for x .

Remember to do addition and subtraction before multiplication and division.

Step 1: Add b to both sides as a step toward getting x by itself.

$$\begin{array}{r} ax - b = c \\ + b \quad + b \\ \hline ax = c + b \end{array}$$

Step 2: Perform another inverse operation. Divide both sides by a to get x by itself.

$$\begin{array}{r} \frac{ax}{a} = \frac{c + b}{a} \\ \hline x = \frac{c + b}{a} \end{array}$$

Directions: Solve the following literal equations for the indicated variable.

1. $c + d + y = b$ Solve for y . _____
2. $tx = a + b$ Solve for x . _____
3. $sm + w = p$ Solve for m . _____
4. $x - t = r$ Solve for x . _____
5. $\frac{x}{b} = a$ Solve for x . _____
6. $x + y = w$ Solve for x . _____
7. $dx = b$ Solve for x . _____
8. $x + b = p$ Solve for x . _____
9. $h = wx$ Solve for x . _____
10. $cy = d - a$ Solve for y . _____
11. $A = lw$ Solve for l . _____
12. $d = rt$ Solve for t . _____
13. $bx + y = z$ Solve for x . _____
14. $cr + s = t$ Solve for r . _____
15. $\frac{ab}{c} = d$ Solve for b . _____
16. $\frac{rs}{t} = v$ Solve for s . _____
17. $w = x + yz$ Solve for z . _____
18. $c^2 = a^2 + b^2$ Solve for b . _____

19. The formula for finding the circumference of a circle with radius r is $C = 2\pi r$. Find the value of r ($\pi = 3.14$).

20. The formula for finding the perimeter of a rectangle with length l and width w is $P = 2l + 2w$. Find the value of w .

Problem Solving

The sum of three times a number and 45 is 66. Find the number.

$$3x + 45 = 66$$

$$3x + 45 - 45 = 66 - 45$$

$$3x = 21$$

$$x = 7 \quad \text{The number is 7.}$$

Write an equation for each word problem and solve it.

1. The sum of 4 times a number and 5 is -7 . Find the number.

Equation _____

Solution _____

2. The difference of 5 times a number and 6 is 14. Find the number.

Equation _____

Solution _____

3. The product of a number and 5 is 80. Find the number.

Equation _____

Solution _____

4. Twice a number added to 7 is 13. Find the number.

Equation _____

Solution _____

5. The sum of a number and -6 is 4. Find the number.

Equation _____

Solution _____

6. The difference of a number and -3 is 8. Find the number.

Equation _____

Solution _____

7. 12 subtracted from 3 times a number is 15. Find the number.

Equation _____

Solution _____

8. The quotient of a number and 4 is -8 . Find the number.

Equation _____

Solution _____

Problem Solving

The sum of three times a number and 45 is 67. Find the number.

$$3x + 45 = 67$$
$$3x + 45 - 45 = 67 - 45$$

$$3x = 22$$

$$x = 7 \quad \text{The number is 7.}$$

Write an equation for each word problem and solve it.

1. The sum of 5 times a number and -11 is -16 . Find the number.

Equation _____

Solution _____

2. The sum of four times a number and 3 is -13 . Find the number.

Equation _____

Solution _____

3. 5 times the sum of a number and 2 is 35. Find the number.

Equation _____

Solution _____

4. 3 times the sum of a number and negative 2 is -15 . Find the number.

Equation _____

Solution _____

5. Six times the difference of a number and 9 is 42. Find the number.

Equation _____

Solution _____

6. The sum of eight times a number and 3 is 59. Find the number.

Equation _____

Solution _____

7. Twelve times the sum of a number and -8 is 36. Find the number.

Equation _____

Solution _____

8. The sum of seven times a number and 11 is 81. Find the number.

Equation _____

Solution _____