

# Solving Linear Equations and Rearranging Formulas

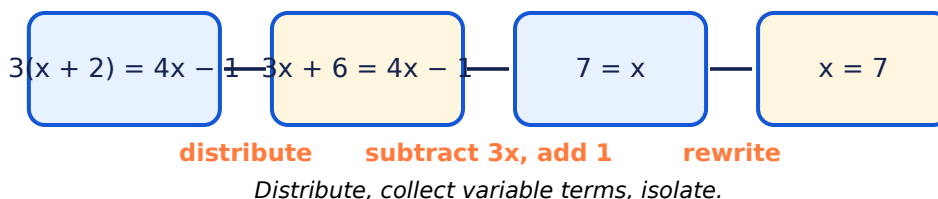
Grade 9 – Algebra 1 math · Lesson · Standards: A-REI.A.1, A-REI.B.3, A-CED.A.1, A-CED.A.4

**Quick answer:** To solve a linear equation, apply the same operation to both sides until the variable stands alone, justifying each step with a property such as the distributive property or the subtraction property of equality. Clear fractions by multiplying by the common denominator, and rearrange formulas by undoing operations in reverse order.

**Standards:** A-REI.A.1, A-REI.B.3, A-CED.A.1, A-CED.A.4 · **Level:** Grade 9 Algebra 1

## How do you solve a multi-step linear equation?

Solving means finding the value that makes both sides equal. Each step must do the same thing to both sides, so the equation stays balanced and you can **justify** every line with a property.



**Method: solve  $3(x + 2) = 4x - 1$**

1. Distribute:  $3x + 6 = 4x - 1$  (distributive property).
2. Move variable terms to one side: subtract  $3x$  to get  $6 = x - 1$  (subtraction property of equality).
3. Isolate: add 1 to both sides to get  $7 = x$ .
4. Check:  $3(7 + 2) = 27$  and  $4(7) - 1 = 27$ , so  $x = 7$ .

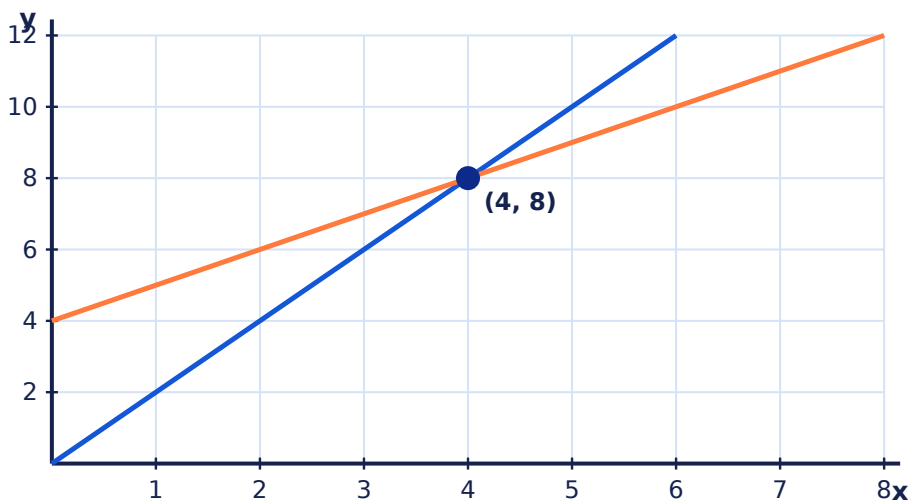
## How do you handle fractions and decimals?

Clear them first. Multiply every term by the least common denominator, or by a power of 10 for decimals.

| Equation                 | Multiply by | Result                                |
|--------------------------|-------------|---------------------------------------|
| $\frac{2x}{3} - 5 = 7$   | 3           | $2x - 15 = 21$ , so $x = 18$          |
| $0.4x + 1.5 = 0.15x + 4$ | 100         | $40x + 150 = 15x + 400$ , so $x = 10$ |

## What if there is no solution or every number works?

If the variable terms cancel and the leftover statement is false (like  $8 = 5$ ), there is **no solution**. If it is always true (like  $6 = 6$ ), the equation has **infinitely many solutions**.



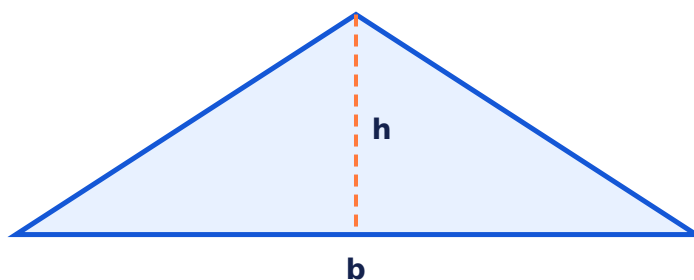
$2x = x + 4$  is true where the graphs meet:  $x = 4$ .

## How do you rearrange a formula?

A literal equation has several letters. To solve for one letter, treat the others as numbers and undo operations in reverse order.

**Example: solve  $A = \frac{1}{2}bh$  for  $h$**

1. Multiply both sides by 2:  $2A = bh$ .
2. Divide both sides by  $b$ :  $h = \frac{2A}{b}$ .



The formula  $A = \frac{1}{2}bh$  solved for  $h$ :  $h = 2A \div b$ .

### Common mistake

Distributing to only the first term:  $5(x - 2)$  is  $5x - 10$ , not  $5x - 2$ .

### Mathbot's tip

After solving, always substitute your answer into the original equation. A quick check catches

almost every slip.

### Key points to remember

- Every step keeps both sides equal and can be justified by a property.
- Multiply by the least common denominator to clear fractions.
- A false leftover statement means no solution; a true one means infinitely many.
- To solve a formula for one letter, treat the other letters as numbers.
- Always substitute the answer into the original equation to check it.

## Solving Linear Equations and Rearranging Formulas: frequently asked questions

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### What does it mean to justify a step?

It means naming the property that allows it, such as the addition property of equality or the distributive property. This shows that the new equation has exactly the same solution as the old one.

### Why multiply by the common denominator?

Multiplying every term by the least common denominator turns fractions into whole numbers without changing the solution. For  $x/3 - 1/2 = 5/6$ , multiplying by 6 gives  $2x - 3 = 5$ .

### How can an equation have no solution?

When the variable terms cancel and the numbers disagree, such as  $4x + 8 = 4x + 5$ , no value of  $x$  works. Graphically, the two sides are parallel lines that never meet.

### What is a literal equation?

A literal equation is a formula or equation with more than one letter, like  $A = \frac{1}{2}bh$ . You solve it for one letter by undoing operations, exactly as you would with numbers.

### How do you check a solution?

Substitute it into the original equation, not a later line, and simplify both sides separately. If both sides give the same number, the solution is correct.