

Simple Algebra

The Big Mystery:

$$\mathbf{x} + 5 = 12$$

*What does **x** stand for?*

In this guide, you'll become a math detective and crack the code!

1. What IS Algebra?

Imagine your friend says: "I'm thinking of a number. If you add 3 to my number, you get 10. What is my number?"

You'd probably think: "Hmm, what plus 3 equals 10?" And then: "7!"

Congratulations — you just did ALGEBRA!

The Big Idea

Algebra is just math with MYSTERY NUMBERS.

You know some of the numbers in a problem, and one of them is missing. Your job is to be a detective and figure out the missing one.

You've been doing baby algebra for years! Every time you saw a problem like:

$$3 + ? = 10$$

...you were finding a mystery number. That ? is the mystery. In real algebra, we usually use a letter instead of a question mark — but it means the same thing!

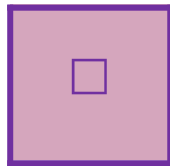
2. Meet the Mystery Number (Variables)

In algebra, the "mystery number" has a fancy name: a VARIABLE. (It's called a variable because it can VARY — meaning it can change from problem to problem.)

People write variables in lots of different ways. They all mean the same thing — a number we don't know yet:



a question mark



an empty box



the letter x



the letter n

All The Same Thing!

These all mean: "There's a number here. I don't know what it is yet."

$x + 5 = 12$ means the same as $? + 5 = 12$

Why do mathematicians use letters? Because sometimes problems have TWO or THREE mystery numbers, and you need different names for them!

Example: $x + y = 10$ (two mystery numbers — x and y can be different)

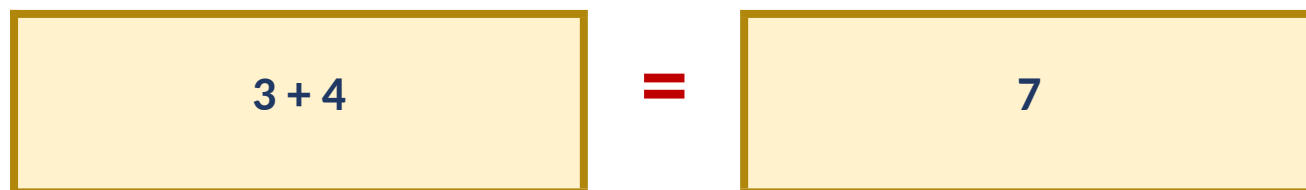
3. Equations Are a Balance Game

An EQUATION is a math sentence with an equals sign (=) in it. Like this:

$$3 + 4 = 7$$

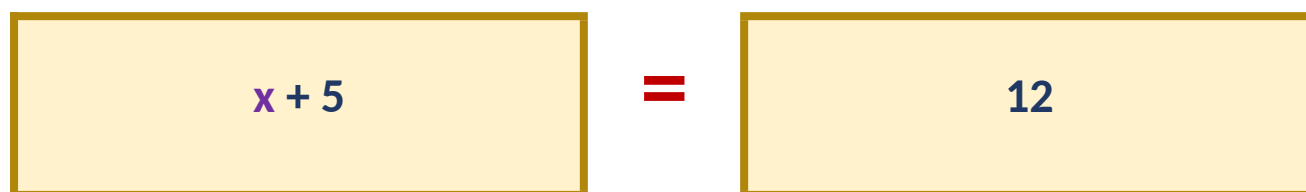
Here's the secret: the equals sign doesn't mean "the answer is." It really means "these two things are EQUAL — they balance."

Picture an equation like a balance scale:



Both sides weigh the same! $3 + 4$ is the same amount as 7 . The scale is balanced.

Now look at an algebra problem:



Your Mission

Find the number x has to be so the scale stays balanced.

If $x + 5 = 12$, then x must be... 7! (Because $7 + 5 = 12$.)

4. Your First Algebra Problem

Let's solve our first problem together. Here it is:

$$x + 5 = 12$$

There are THREE ways to solve this. Try them all!

Way 1 — Guess and Check

Just try numbers. Plug them in and see what works.

- If $x = 3$: $3 + 5 = 8$. *Nope, too small.*
- If $x = 10$: $10 + 5 = 15$. *Nope, too big.*
- If $x = 7$: $7 + 5 = 12$. **YES! ✓**

Way 2 — Think Backwards

Ask yourself: "What number, plus 5, makes 12?"

Think: "I need to get to 12. I'm adding 5. So I started at 12 minus 5, which is 7."

Way 3 — Do the Opposite (the BIG one!)

This is the official algebra trick. To get x by itself, do the OPPOSITE of whatever is being done to it.

The Steps

$$x + 5 = 12$$

The 5 is being ADDED to x . The opposite of adding is SUBTRACTING.

Subtract 5 from BOTH sides (to keep the scale balanced!):

$$x + 5 - 5 = 12 - 5$$

$$x = 7 \quad \checkmark$$

5. The Four Magic Moves (Inverse Operations)

Every operation has an OPPOSITE that undoes it. These opposites are the magic that solves algebra problems.

If the problem has...	...do the opposite	Example	Solution
+	−	$x + 4 = 10$	$x = 10 - 4 = 6$
−	+	$x - 3 = 8$	$x = 8 + 3 = 11$
×	÷	$4x = 20$	$x = 20 \div 4 = 5$
÷	×	$x \div 3 = 6$	$x = 6 \times 3 = 18$

Quick Tip

4x means "4 TIMES x" — when a number is right next to a letter, that means multiplication.

So $4x = 20$ means "4 times x equals 20."

6. The Golden Rule of Algebra

Here's the most important rule in all of algebra. If you remember nothing else, remember THIS:



THE GOLDEN RULE

Whatever you do to ONE side of the equation, you MUST do to the OTHER side.

If you don't, the scale tips over and the equation is no longer true!

Picture the balance scale. If you put a 5-pound rock on one side, you have to put a 5-pound rock on the other side too — otherwise the scale tips!

Solving $x - 4 = 9$. Add 4 to both sides:

$\begin{array}{r} x - 4 \\ + 4 \end{array}$	$=$	$\begin{array}{r} 9 \\ + 4 \end{array}$
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$$\begin{array}{c} x - 4 = 9 \\ \downarrow \\ x - 4 + 4 = 9 + 4 \\ \downarrow \\ x = 13 \checkmark \end{array}$$

See? Both sides got the same thing added (+4), so the scale stayed balanced. And now x is alone on one side, and we know it equals 13.

7. Translating Words Into Equations

Sometimes algebra problems come as STORIES instead of equations. Your first job is to translate the words into math.

When you see...	It means...
a number, some number, what number	use a letter like x or n
plus, more than, added to, increased by, sum	+
minus, less than, subtracted from, decreased by	-
times, multiplied by, of, twice ($\times 2$), triple ($\times 3$)	$\times$
divided by, split into, shared between	$\div$
is, equals, makes, totals, gives	=

Worked Example

Story: "I'm thinking of a number. If I add 8 to it, I get 20. What's my number?"

Translate:

- "I'm thinking of a number" $\rightarrow x$ (use a letter for the mystery)
- "add 8 to it" $\rightarrow + 8$
- "I get 20" $\rightarrow = 20$

Equation: $x + 8 = 20$

Solve: $x = 20 - 8 = 12$ ✓

8. Patterns and Rules

Algebra is also about finding the RULE that makes a pattern. Look at these numbers:

2, 4, 6, 8, __ ?

What comes next? Easy — 10! The rule is "add 2 each time." In algebra, we might write that rule as $2n$, meaning "2 times n ," where n is which number in the list you want.

The Rule $2n$

1st number: $2 \times 1 = 2$

2nd number: $2 \times 2 = 4$

3rd number: $2 \times 3 = 6$

4th number: $2 \times 4 = 8$

10th number: $2 \times 10 = 20$

Look at this pattern:

1, 4, 9, 16, __ ?

What's the rule here? Try multiplying each position by itself: $1 \times 1 = 1$, $2 \times 2 = 4$, $3 \times 3 = 9$, $4 \times 4 = 16$. So the next is $5 \times 5 = 25$! The rule is $n \times n$ (or n^2).

These rules — $2n$, $n \times n$, $n + 3$, and so on — are called **expressions**. They're like little machines that turn an input number into an output number.

9. Algebra in Real Life

You actually use algebra ALL THE TIME without realizing it. Here are some examples:



Sharing pizza

You and 4 friends order a pizza with 12 slices. How many slices each? You're solving $5x = 12$ (well, $x = 2$ with 2 left over to fight over!).



Saving money

You have \$15 and want to save up for a \$40 video game. How much more do you need? That's solving: $15 + x = 40$. Answer: $x = \$25$.



Travel time

If a car goes 60 mph and you want to travel 180 miles, how long does it take? That's $60t = 180$, so $t = 3$ hours.



Sports stats

Your team needs 50 points to win. You've scored 32. How many more do you need? $32 + p = 50$, so $p = 18$ points.



Doubling a recipe

A recipe needs $1\frac{1}{2}$ cups of flour for 4 people. How much for 8 people? Multiply by 2. That's algebra (scaling up)!



Phone plans

A phone plan costs \$20 a month plus \$0.10 per minute. $\text{Cost} = 20 + 0.10m$. If you used 50 minutes, $\text{cost} = \$25$.

10. Try It Yourself!

Try this!

Question 1: Solve: $x + 7 = 15$

$x =$ _____

Try this!

Question 2: Solve: $n - 6 = 4$

$n =$ _____

Try this!

Question 3: Solve: $3y = 21$

$y =$ _____ (remember: $3y$ means "3 times y ")

Try this!

Question 4: Translate this story into an equation, then solve:

"I'm thinking of a number. If I subtract 5 from it, I get 12. What's my number?"

Equation: _____ Answer: _____

Try this!

Question 5: Find the pattern! What number comes next?

3, 6, 9, 12, _____

What's the rule? _____

Answers

1) $x = 8$ 2) $n = 10$ 3) $y = 7$ 4) $x - 5 = 12$, so $x = 17$ 5) 15. Rule: $3n$ (add 3 each time)

Now you're an algebra detective!

You can crack the code on mystery numbers wherever you find them.