Simple Algebra

Part 2 · Going Further

In Part 1, you solved this:

$$x + 5 = 12$$

Now we'll tackle this:

$$2x + 3 = 11$$

1. Welcome Back!

If you read Part 1, you already know the basics. Quick reminder:

> 📌 **Quick Review**
>
> **Variables** (x, n, ?) are mystery numbers.
>
> **Equations** have an = sign — both sides balance.
>
> Use **inverse operations** to undo: + ↔ − and × ↔ ÷.
>
> **The Golden Rule:** do the same thing to BOTH sides.

Got it? Great! Now we'll do harder problems — but they all use the same tricks. You just use them MORE TIMES.

2. Two-Step Equations

Sometimes an equation has TWO things being done to the variable. So you need TWO steps to undo them.

$$2x + 3 = 11$$

Look closely. The x is being:

- **multiplied by 2** (because of the 2 next to it)
- **then added to 3** (because of the + 3)

> 📌 **Unwrap It Like a Present**
>
> x is wrapped up in TWO layers. To get x by itself, unwrap one layer at a time — in REVERSE order!
>
> **Step 1:** Undo the addition/subtraction first → subtract 3 from both sides.
>
> **Step 2:** Then undo the multiplication → divide both sides by 2.

$$2x + 3 = 11$$

$$\downarrow$$

$$2x + 3 - 3 = 11 - 3 \quad \text{(subtract 3 from both sides)}$$

$$\downarrow$$

$$2x = 8$$

$$\downarrow$$

$$2x \div 2 = 8 \div 2 \quad \text{(divide both sides by 2)}$$

$$\downarrow$$

$$x = 4 \ \checkmark$$

Always check: plug 4 back into the original. $2 \times 4 + 3 = 8 + 3 = 11$. ✓

3. Combining Like Terms

What if you see this:

$$x + x + x = 12$$

Three x's added together is the same as 3 × x, which we write as 3x. So we can simplify:

$$x + x + x = 12$$
$$\downarrow$$
$$3x = 12$$
$$\downarrow$$
$$x = 4 \ \checkmark$$

📌 **Like Terms**

"Like terms" are pieces that match each other — same letter, or just plain numbers.

You can combine like terms by adding (or subtracting) the numbers in front:

- **4x + 5x = 9x**
- **7n − 2n = 5n**
- **6 + 4 = 10**

But you CANNOT combine UNLIKE terms!

- 3x + 5 stays 3x + 5 (the x's and the plain numbers don't combine)

Here's a bigger example. Simplify first, then solve:

$$2x + 5 + 3x = 20$$
$$\downarrow$$
$$5x + 5 = 20 \quad \text{(combine 2x and 3x)}$$
$$\downarrow$$
$$5x = 15 \quad \text{(subtract 5 from both sides)}$$
$$\downarrow$$
$$x = 3 \ \checkmark \quad \text{(divide both sides by 5)}$$

4. Variables on BOTH Sides

What if x shows up on both the left AND the right?

$$3x + 2 = x + 10$$

Your goal is the same: get x alone on ONE side. So first, move all the x's together.

> 📌 **The Strategy**
>
> **Step 1:** Pick a side for x to live on. Move all x's there. (Use the Golden Rule!)
>
> **Step 2:** Move all plain numbers to the OTHER side.
>
> **Step 3:** Solve like before.

$$3x + 2 = x + 10$$

$$\downarrow$$

$$3x + 2 - x = x + 10 - x \qquad \text{(subtract x from both sides)}$$

$$\downarrow$$

$$2x + 2 = 10$$

$$\downarrow$$

$$2x = 8 \qquad \text{(subtract 2 from both sides)}$$

$$\downarrow$$

$$x = 4 \ \checkmark \qquad \text{(divide both sides by 2)}$$

Check: 3(4) + 2 = 12 + 2 = 14, and 4 + 10 = 14. Both sides match! ✓

5. Expressions vs Equations

People sometimes mix these up. They're different!

Expression	Equation
3x + 5 *(no equals sign)* **You SIMPLIFY it.**	**3x + 5 = 11** *(has an equals sign)* **You SOLVE it.**

📌 **Think of it Like Sentences**

Expression = *a phrase. "the tall boy with brown hair." Just a description.*

Equation = *a complete sentence. "The tall boy with brown hair is my friend." Has a verb (= is the verb!).*

6. Always Check by Substituting

After you solve an equation, you should ALWAYS check your answer. The easiest way? Substitution.

> 📌 **What is Substitution?**
>
> **Substitution = putting a number in place of a variable.**
>
> Take your answer for x, plug it back into the ORIGINAL equation, and see if both sides match.

Example: You solved 4x − 5 = 19 and got x = 6. Check it!

Original: 4x − 5 = 19

↓

Substitute x = 6: 4(6) − 5 = 19?

↓

24 − 5 = 19?

↓

19 = 19 ✓ YES!

If both sides match, you're right! If they don't, go back and find your mistake.

7. The Distributive Property

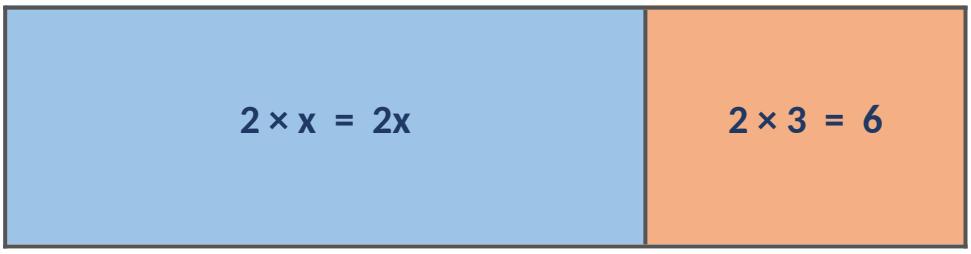
Sometimes you'll see parentheses in an equation:

$$2(x + 3) = 14$$

What does the 2 outside the parentheses do? It MULTIPLIES everything inside!

> 📌 **The Distributive Property**
>
> $2(x + 3) = 2 \times x + 2 \times 3 = 2x + 6$
>
> The 2 "distributes" — it visits each thing inside the parentheses and multiplies.

Picture a rectangle. The total area is $2 \times (x + 3)$, but you can also see it as two smaller rectangles: $2 \times x$ and 2×3.



So now let's solve $2(x + 3) = 14$:

$$2(x + 3) = 14$$

$$\downarrow$$

$$2x + 6 = 14 \quad \text{(distribute the 2)}$$

$$\downarrow$$

$$2x = 8 \quad \text{(subtract 6 from both sides)}$$

$$\downarrow$$

$$x = 4 \ \checkmark \quad \text{(divide both sides by 2)}$$

8. Negative Numbers in Algebra

Sometimes the answer to an algebra problem is NEGATIVE. That's totally OK!

$$x + 7 = 3$$

Hmm — what number plus 7 equals 3? It must be SMALLER than 3 (because we're adding 7 to get up to it). It has to be negative.

$$x + 7 = 3$$

$$\downarrow$$

$$x = 3 - 7 \quad \text{(subtract 7 from both sides)}$$

$$\downarrow$$

$$x = -4 \quad \checkmark$$

Check: −4 + 7 = 3. ✓ Yes!

📌 **The Number Line Goes Both Ways!**

Numbers don't stop at 0. They keep going into the NEGATIVES: −1, −2, −3, …

Adding a negative number is the same as subtracting: 5 + (−3) = 5 − 3 = 2.

Subtracting a negative is the same as adding: 5 − (−3) = 5 + 3 = 8.

9. Trickier Word Problems

Word problems get harder when there are multiple steps. The trick: read carefully, then translate piece by piece.

📌 **Worked Example**

"Sara has $20. She buys 3 books that all cost the same amount. After buying them, she has $5 left. How much did each book cost?"

Translate piece by piece:

- "each book cost" → let b = cost of one book
- "3 books that all cost the same" → 3b total cost
- "$20 minus the cost" → 20 − 3b
- "has $5 left" → = 5

Equation: 20 − 3b = 5

$$20 - 3b = 5$$

$$\downarrow$$

$$-3b = -15 \quad \text{(subtract 20 from both sides)}$$

$$\downarrow$$

$$b = 5 \ \checkmark \quad \text{(divide both sides by } -3\text{)}$$

Each book cost $5. Let's check: 3 books × $5 = $15. Sara starts with $20, spends $15, has $5 left. ✓

10. Try It Yourself!

Try this!

Question 1: Solve this two-step equation: **3x + 4 = 19**

x = _____

Try this!

Question 2: Combine like terms, then solve: **2x + 3 + 5x = 24**

x = _____

Try this!

Question 3: Variables on both sides: **4x + 1 = 2x + 9**

x = _____

Try this!

Question 4: Distribute, then solve: **3(x − 2) = 12**

x = _____

Try this!

Question 5: Word problem: "Tom has 24 marbles. He gives the same number to each of his 4 friends. Now he has 8 left. How many did each friend get?"

Equation: _____ Each friend got: _____

Answers

1) x = 5 2) 7x + 3 = 24, x = 3 3) x = 4 4) 3x − 6 = 12, x = 6 5) 24 − 4m = 8, m = 4 marbles each

You're ready for Part 3!

Coming next: graphs, function machines, and inequalities.