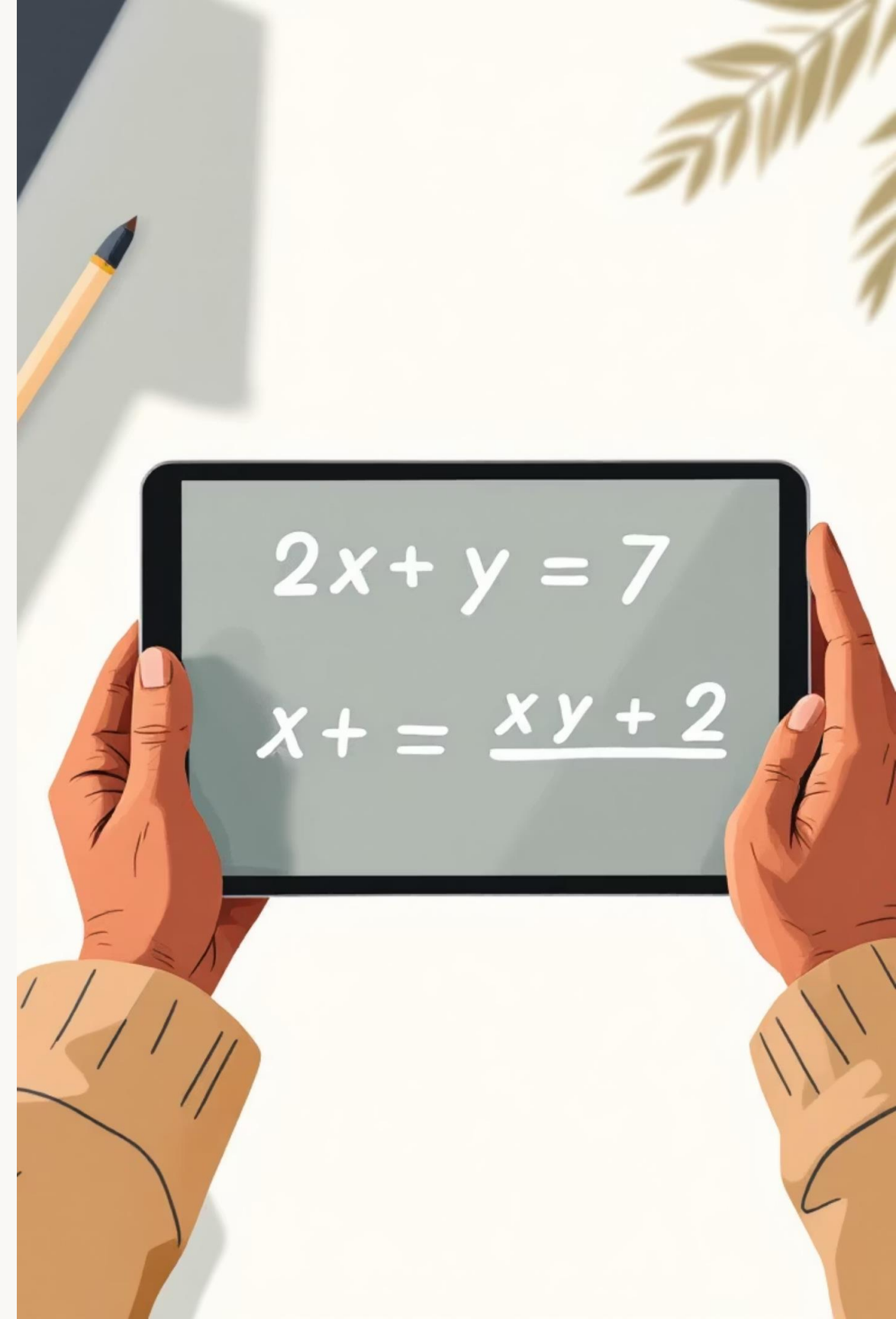


Solving Simultaneous Equations by Substitution

An interactive lesson that makes algebra easier to understand using real-world examples and step-by-step guidance.



What Are Simultaneous Equations?

Definition

Two equations with two unknowns (like x and y) that must be true at the same time. Think of it as solving a puzzle where both pieces must fit perfectly.

Real-world example: You buy 2 apples and 3 bananas for \$11, and your friend buys 1 apple and 2 bananas for \$7. What's the price of each fruit?



This becomes:

- $2x + 3y = 11$
- $x + 2y = 7$



Step 1: Choose One Equation and Solve for One Variable

01

Pick the Easier Equation

Look for the equation where one variable has a coefficient of 1. In our example, choose: $x + 2y = 7$

02

Isolate One Variable

Solve for x by subtracting $2y$ from both sides:

$$x = 7 - 2y$$

📌 **Pro tip:** Choose the variable that's easiest to isolate - usually the one with no coefficient or the smallest coefficient!

Step 2: Substitute the Expression

Now we replace x in the first equation with our expression from Step 1.

1

Original Equation

$$2x + 3y = 11$$

2

After Substitution

$$2(7 - 2y) + 3y = 11$$

Notice how we've eliminated x completely! Now we have just one equation with one unknown (y).





Step 3: Solve the New Equation

Time to simplify and solve for y step by step:

1 — Distribute

$$2(7 - 2y) + 3y = 11$$

$$14 - 4y + 3y = 11$$

2 — Combine Like Terms

$$14 - y = 11$$

3 — Isolate y

$$-y = 11 - 14$$

$$-y = -3$$

$$y = 3$$

Step 4: Find the Other Variable

Now substitute $y = 3$ back into our expression for x :

Substitution

$$x = 7 - 2y$$

$$x = 7 - 2(3)$$

$$x = 7 - 6$$

$$x = 1$$

Solution: Apples cost \$1 each, bananas cost \$3 each!



Always Check Your Solution!

Verify by substituting $x = 1$ and $y = 3$ into both original equations:

First Equation Check

$$2x + 3y = 11$$

$$2(1) + 3(3) = 2 + 9 = 11\checkmark$$

Second Equation Check

$$x + 2y = 7$$

$$1 + 2(3) = 1 + 6 = 7\checkmark$$

Both equations work! Our solution is correct.



Real-Life Example: Movie Night Budget

Sarah and Mike go to the movies. Sarah buys 3 tickets and 2 drinks for \$45. Mike buys 2 tickets and 1 drink for \$30. Find the cost of each item.

Set Up Equations

- $3t + 2d = 45$ (Sarah)
- $2t + d = 30$ (Mike)

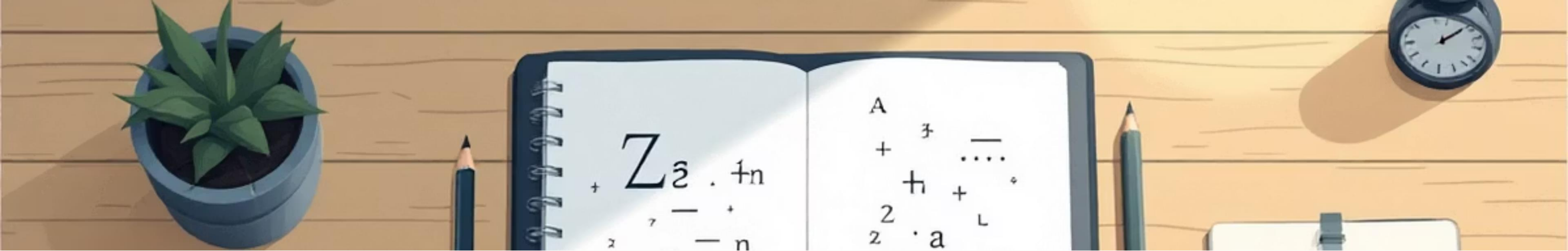
Solve by Substitution

From equation 2: $d = 30 - 2t$

Substitute into equation 1

Result: Tickets = \$12, Drinks = \$6





Practice Activity: Your Turn!

Try solving this system using substitution:

1

Given Equations

$$y = 2x + 1$$

$$3x + y = 11$$


2

Your Work Space

Step 1: The first equation is already solved for y !

Step 2: Substitute $y = 2x + 1$ into the second equation

Step 3: Solve for x , then find y

 **Hint:** The answer is $x = 2$ and $y = 5$. Try working through it yourself first!

Summary & Next Steps

Isolate
Choose one equation and solve for one variable

Verify
Check your solution in both original equations



Substitute
Replace the variable in the other equation

Solve
Find the value of the remaining variable

Coming up next: Learn the elimination method - another powerful technique for solving simultaneous equations!