

Work Backwards

A GUIDE

Solve mystery-number puzzles by rewinding the math — undo each step, last one first.

The Mystery Machine

Imagine a machine that changes numbers. You drop a number in the top, the machine does its steps, and a new number pops out the bottom. If you know the starting number, finding the ending number is easy — you just follow the steps.

But some puzzles flip that around. You can see the number that came OUT, and you have to figure out what went IN. That is exactly what working backwards is for: you rewind the machine, step by step, until you reach the start.



Every Step Has an Undo

Here is the big secret: every math step has an opposite that cancels it out. Adding is undone by subtracting. Multiplying is undone by dividing. It works the other way too — subtracting is undone by adding, and dividing is undone by multiplying.

Think of it like a video game. If you walk 3 steps north, you get back by walking 3 steps south. If a machine did $+6$, you rewind it with -6 . Same number, opposite move.

Worked example A machine adds 6 to any number. A mystery number went in, and 14 came out. What went in?

1. The machine did one step: $+6$.
2. To rewind it, do the opposite: subtract 6.
3. $14 - 6 = 8$, so the mystery number is 8.
4. Check it forwards: $8 + 6 = 14$. It works!

Answer: 8

Rewind in Reverse Order

When there is more than one step, the order matters. You put on socks, then shoes — but to undo it, the shoes come off FIRST. Working backwards is the same: undo the LAST step first, then work your way back to the beginning.

Look at the chain below. Going forwards, 8 gets multiplied by 2, then 3 is added, and 19 comes out. To rewind, you start at 19 and undo the $+3$ first (because it happened last), and only then undo the $\times 2$.



Worked example A number is multiplied by 2, then 3 is added. The result is 19. What was the number?

1. The last step was $+3$, so undo it first: $19 - 3 = 16$.
2. The step before that was $\times 2$, so undo it next: $16 \div 2 = 8$.
3. Check forwards: $8 \times 2 = 16$, then $16 + 3 = 19$. Correct!

Answer: 8

I Thought of a Number...

Now you are ready for the classic puzzle. Someone says: "I thought of a number, did some steps to it, and here is my result." It sounds like mind reading, but it is really just a chain waiting to be rewound.

Your plan is always the same three moves. First, list the steps in order. Then start from the result and undo each step, last one first, swapping $+$ with $-$, and $\times$ with $\div$. Finally, run your answer forwards through the original steps to check it.



Worked example "I thought of a number, multiplied it by 3, then added 7. I got 25." What was the number?

1. List the steps in order: $\times 3$, then $+ 7$.
2. Undo the last step first: $25 - 7 = 18$.
3. Undo the first step next: $18 \div 3 = 6$.
4. Check forwards: $6 \times 3 = 18$, and $18 + 7 = 25$. Solved!

Answer: 6

Remember

- ★ Undo the last step first — working backwards means rewinding the whole chain in reverse order.
- ★ Every step has an opposite: $+$ swaps with $-$, and $\times$ swaps with $\div$.
- ★ Always check by running your answer forwards through the original steps — if you land on the given result, you nailed it.
- ★ If a puzzle tells you the ending but hides the beginning, that is your signal to work backwards.

Now you try

- 1) A machine adds 9 to any number. A mystery number went in, and 15 came out. What went in?
Answer: _____
- 2) You subtract 8 from a number and get 12. What number did you start with?
Answer: _____
- 3) A number is multiplied by 5 and the result is 45. What is the number?
Answer: _____
- 4) A number is doubled, then 4 is added. The result is 18. What is the number?
Answer: _____
- 5) "I thought of a number, multiplied it by 3, then subtracted 6. I got 21." What was the number?
Answer: _____
- 6) A number is divided by 4, then 5 is added. The result is 12. What is the number?
Answer: _____
- 7) Maya had some stickers. She gave away 7, and then her collection doubled in a trade. Now she has 24. How many did she start with?
Answer: _____
- 8) "I thought of a number, multiplied it by 2, added 10, then divided by 6. I got 4." What was the number?
Answer: _____

Answers — check yourself

1. 6
2. 20
3. 9
4. 7
5. 9
6. 28
7. 19
8. 7