

• Ready for Real Algebra •

How to Stop Being a Math Liar and Solve Equations Like a Pro

Name: _____

Date: _____

Part 1: One Pattern, Not Twenty Rules

The Hidden Connection: Fraction division and negative number arithmetic look like different topics — but they're the SAME pattern!

Rewrite each problem using the inverse. The first ones are done for you.

Original	Rewrite Using Inverse
$8 \div 2$	$8 \times (1/2) = 4$
$8 - 2$	$8 + (-2) = 6$

- $12 \div 4 = 12 \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$
- $12 - 4 = 12 + \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$
- $15 \div 3 = 15 \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$
- $15 - 3 = 15 + \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$
- $6 \div 1/2 = 6 \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$
- $6 - (-2) = 6 + \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$

Discovery Question

7. What's the pattern? Complete: Division becomes _____ by the _____ . Subtraction becomes _____ by the _____ .

Part 2: Don't Be a Math Liar!

The equals sign means THE LEFT SIDE AND RIGHT SIDE HAVE THE SAME VALUE.

It does NOT mean "and then..." or "the answer is..."

8. A student wrote: $3 + 4 = 7 + 2 = 9$

Is $3 + 4$ equal to $7 + 2$? _____ This statement is: TRUE / FALSE (circle one)

9. A student wrote: $5 \times 2 = 10 \div 2 = 5$

Is 5×2 equal to $10 \div 2$? _____ This statement is: TRUE / FALSE (circle one)

10. Fix the math lying! Rewrite correctly:

Wrong: $8 + 4 = 12 - 3 = 9$

Correct: _____

Why does this matter? When we solve equations, we do the same thing to both sides. This works BECAUSE equals means equals — if two things are the same, and you do the same thing to both, they're still the same!

11. Start with: $10 = 10$ (obviously true!)

Add 5 to both sides: $10 + 5 = 10 + 5 \rightarrow$ _____ $=$ _____ Still true? YES / NO

Multiply both sides by 2: $10 \times 2 = 10 \times 2 \rightarrow$ _____ $=$ _____ Still true? YES / NO

Subtract 3 from both sides: $10 - 3 = 10 - 3 \rightarrow$ _____ $=$ _____ Still true? YES / NO

Part 3: The Invisible 1

When you see $-x$, it really means $-1 \times x$
 When you see $-(\text{stuff})$, it really means $-1 \times (\text{stuff})$
 The negative sign is secretly multiplication by -1 !

12. Write with the invisible 1 showing:

$$-x = \underline{\hspace{2cm}}$$

$$-(3 + 5) = \underline{\hspace{2cm}}$$

$$-(x + 2) = \underline{\hspace{2cm}}$$

Common Mistake vs. Correct Method

✗ WRONG:

$$-(4 + 3) = -4 + 3 = -1$$

Only the first term got the negative!

✓ CORRECT:

$$-(4 + 3) = -1(4 + 3)$$

$$= (-1 \times 4) + (-1 \times 3)$$

$$= -4 + (-3) = -7$$

13. Simplify using the invisible 1: $-(5 + 2)$

$$= -1 \times (5 + 2) = (-1 \times \underline{\hspace{1cm}}) + (-1 \times \underline{\hspace{1cm}}) = \underline{\hspace{1cm}} + \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

14. Simplify: $-(8 - 3)$ — First rewrite $8 - 3$ as $8 + (-3)$!

$$= -1 \times (8 + (-3)) = (-1 \times 8) + (-1 \times (-3)) = \underline{\hspace{1cm}} + \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

15. Simplify: $-(x + 4)$

$$= \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

16. Simplify: $-(2x - 5)$ — Don't forget to rewrite the subtraction first!

$$= \underline{\hspace{2cm}}$$

Part 4: Solving Equations — Level Up!

The Method:

1. REWRITE: Change subtraction \rightarrow addition, division \rightarrow multiplication
2. SOLVE: Use inverses (do the same thing to both sides)
3. CHECK: Substitute your answer back in!

Level 1: One-Step Equations

17. $x + 7 = 15$

Solve: Add _____ to both sides: $x =$ _____

Check: _____ $+ 7 = 15$ \checkmark ?

18. $4x = 20$

Solve: Multiply both sides by _____ : $x =$ _____

Check: $4 \times$ _____ $= 20$ \checkmark ?

Level 2: Rewrite First!

19. $x - 5 = 12$

Rewrite: $x + (-5) = 12$

Solve: Add _____ to both sides: $x =$ _____

Check: _____ $- 5 = 12$ \checkmark ?

20. $x \div 4 = 3$

Rewrite: $x \times (1/4) = 3$

Solve: Multiply both sides by _____ : $x =$ _____

Check: _____ $\div 4 = 3$ \checkmark ?

Part 4 Continued: Two-Step and Beyond

Level 3: Two-Step Equations

21. $3x + 4 = 19$

Solve:

Check:

$x = \underline{\hspace{2cm}}$

22. $2x - 7 = 11$ (Remember to rewrite first!)

Rewrite: $2x + (-7) = 11$

Solve:

Check:

$x = \underline{\hspace{2cm}}$

Level 4: Equations with Negatives

23. $-3x = 18$

The invisible 1: This is $(-3) \times x = 18$

Solve: Multiply both sides by $-1/3$: $x = \underline{\hspace{2cm}}$

Check: $-3 \times \underline{\hspace{2cm}} = 18 \checkmark?$

24. $5 - x = 12$

Rewrite: $5 + (-1)x = 12$

Solve:

$x = \underline{\hspace{2cm}}$

Level 5: With Parentheses

25. $-(x + 3) = 10$

Make invisible 1 visible: $-1(x + 3) = 10$

Distribute:

Solve:

$x =$ _____

26. $2(x - 4) = 14$

Rewrite inside parentheses: $2(x + (-4)) = 14$

Distribute:

Solve:

$x =$ _____

★ Grand Finale: The Boss Level

This problem uses EVERYTHING you've learned: rewriting subtractions, the invisible 1, distributing, combining like terms, and solving with inverses. Take it step by step!

27. Solve: $7 - 4(3x - 2) = -21$

Step 1 — Rewrite subtractions:

$$7 + (-4)(3x + (-2)) = -21$$

Step 2 — Distribute the -4:

$$-4 \times 3x = \underline{\hspace{2cm}}$$

$$-4 \times (-2) = \underline{\hspace{2cm}}$$

$$\text{So: } 7 + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} = -21$$

Step 3 — Combine like terms:

$$7 + 8 = \underline{\hspace{2cm}}$$

$$\text{So: } \underline{\hspace{2cm}} + (-12x) = -21$$

Step 4 — Isolate the x term:

Add $\underline{\hspace{2cm}}$ to both sides:

$$-12x = \underline{\hspace{2cm}}$$

Step 5 — Solve for x:

Multiply both sides by $\underline{\hspace{2cm}}$:

$$x = \underline{\hspace{2cm}}$$

Step 6 — CHECK!

$$\text{Original: } 7 - 4(3x - 2) = -21$$

Substitute $x = \underline{\hspace{2cm}}$:

$$7 - 4(3(\underline{\hspace{2cm}}) - 2) = 7 - 4(\underline{\hspace{2cm}} - 2) = 7 - 4(\underline{\hspace{2cm}}) = 7 - \underline{\hspace{2cm}} =$$

$$\underline{\hspace{2cm}}$$

Does it equal -21? $\underline{\hspace{2cm}}$

Part 5: A Sneak Peek at Future Notation

Mathematicians use a superscript **-1** to mean "inverse."

- 5^{-1} means "the multiplicative inverse of 5" = $\frac{1}{5}$
- Later, f^{-1} means "the inverse function" — NOT $1/f$!

28. Write the multiplicative inverse:

$$3^{-1} = \underline{\hspace{2cm}} \quad 7^{-1} = \underline{\hspace{2cm}} \quad \left(\frac{1}{2}\right)^{-1} = \underline{\hspace{2cm}}$$

Why This Matters

29. Many students see f^{-1} in later math and think it means $1/f$. And f stands for a function or a rule. f^{-1} means a rule that undoes what f does. Like if f means "double it," then f^{-1} means "cut it in half." They get confused! But you won't — because you know what inverse really means. Where did you first learn about inverses?

Part 6: Reflection

30. Why do we rewrite subtraction as addition and division as multiplication before solving equations?

31. What does the equals sign actually mean?

32. What's the "invisible 1" and why does it matter?



Congratulations!

You started with colored circles on a table. You discovered properties, found inverses, connected colors to numbers, and upgraded your mental models. Now you're solving real algebra — not with tricks and memorization, but with understanding.

You see what other students don't see. You understand the structure underneath.