



Solving Equations

Solving is undoing. Step 1, every time: translate subtraction and division, and write in the invisible 1s. Then undo what is added to the letter and its coefficient, doing the same thing to both sides.

Name _____

Date _____

Words we use say the math word, then the plain English

WORD	PLAIN ENGLISH	WHAT YOU DO
Translate (Step 1)	Rewrite subtraction as adding the opposite, and division as multiplying by the reciprocal. Write in the invisible 1s.	Do it first, before any undoing.
Coefficient	The number on the variable. It means the variable is multiplied by that number: $3x$ is 3 times x .	Write it down, even when it is 1. A lonely x is $1x$. Anything you leave to do in your head is a top cause of mistakes.
Solve	Get the letter by itself.	Find the value that makes the equation true.
Additive inverse (the opposite)	$a + (-a) = 0$	Add the opposite to undo what is added. A 0 appears.
Multiplicative inverse (the reciprocal)	$a \times \frac{1}{a} = 1$	Multiply by the reciprocal to undo the coefficient. A 1 appears.
Do the same to both sides	Keep it balanced.	Whatever you do to one side, do to the other.

Part A Name the coefficient, and what is added

Do not solve yet. For each equation, write the coefficient of the letter (even when it is an invisible 1), what is added to the letter, and the undo partner (inverse) for each. Row 1 is done for you.

EQUATION	COEFFICIENT OF X	ADDED TO X	UNDO PARTNER(S)
$x + 6 = 10$	1 (invisible: x is $1x$)	+6	add -6 (the opposite of 6)
$4x = 20$			
$x - 8 = 2$			
$\frac{x}{3} = 5$			

Part B Solve the one-step equations

Show Step 1 (translate and write the invisible 1), then the undo partner (inverse) you used, the do-nothing number (identity) that appeared, and the solution. Row 1 is done for you.

EQUATION	STEP 1: TRANSLATE	UNDO PARTNER I USED	DO-NOTHING NUMBER	SOLUTION
$x + 7 = 12$	$1x + 7 = 12$	add -7 (opposite of 7)	$x + 0 = x$	$x = 5$
$9x = 54$				
$x - 5 = 11$				
$\frac{x}{2} = 8$				
$\frac{2}{5}x = 4$				

Part C Solve the two-step equations

Step 1 first. Then peel the outside layer: undo what is added before you undo the coefficient. Show your work.

1. $2x + 3 = 11$

2. $5x - 4 = 26$

3. $\frac{x}{3} + 2 = 5$

4. $-2x + 9 = 1$

5. $3(x + 4) = 27$ (distribute first, Lesson 2)

Part D Solve, then check

For each one, solve and then check by putting your answer back into the original equation.

1. Solve $4x - 7 = 13$, then check.
2. A gym charges a \$10 sign-up fee plus \$6 for each month. Maria paid \$40. Write an equation for the number of months m , then solve it.
3. Name the property or undo partner used at each line of this solution of $5(x + 1) = 20$:
Line A: $5x + 5 = 20$ Line B: $5x = 15$ Line C: $x = 3$.

Part E In your own words (exit ticket)

Short answers are fine. Use the math word and the plain English.

1. In $4x + 5 = 25$, what is the coefficient of x , what is added to x , and which do you undo first?
2. Solve $3x - 6 = 9$. Show Step 1, then solve and check your answer.
3. Why do we do the same thing to both sides? (One sentence.)
4. How is solving an equation the same idea as Lessons 1, 2, and 3? (One sentence.)



Answer Key

Accept any wording that names the coefficient, the undo partner (inverse), and the do-nothing number (identity) correctly, and any correct check. Step 1 (translate, and write the invisible 1) should appear before any undoing.

Part A Name the coefficient, and what is added

EQUATION	COEFFICIENT OF X	ADDED TO X	UNDO PARTNER(S)
$4x = 20$	4	nothing	multiply by $\frac{1}{4}$ (the reciprocal of 4)
$x - 8 = 2$	1 (invisible)	-8 (subtracting 8 is adding -8)	add +8 (the opposite of -8)
$\frac{x}{3} = 5$	$\frac{1}{3}$ (dividing by 3 is multiplying by $\frac{1}{3}$)	nothing	multiply by 3 (the reciprocal of $\frac{1}{3}$)

Part B Solve the one-step equations

EQUATION	STEP 1	UNDO PARTNER USED	DO-NOTHING NUMBER	SOLUTION
$9x = 54$	already + and $\times$	multiply by $\frac{1}{9}$ (reciprocal of 9)	$1 \cdot x = x$	$x = 6$
$x - 5 = 11$	$1x + (-5) = 11$	add +5 (opposite of -5)	$x + 0 = x$	$x = 16$
$\frac{x}{2} = 8$	$\frac{1}{2}x = 8$	multiply by 2 (reciprocal of $\frac{1}{2}$)	$1 \cdot x = x$	$x = 16$
$\frac{2}{5}x = 4$	already + and $\times$	multiply by $\frac{5}{2}$ (reciprocal of $\frac{2}{5}$)	$1 \cdot x = x$	$x = 10$

Part C Solve the two-step equations

- $2x + 3 = 11$: add -3 (makes 0), so $2x = 8$; multiply by $\frac{1}{2}$ (makes 1). $x = 4$.
- $5x - 4 = 26$: Step 1, $5x + (-4) = 26$. Add +4 (makes 0), so $5x = 30$; multiply by $\frac{1}{5}$ (makes 1). $x = 6$.
- $\frac{x}{3} + 2 = 5$: Step 1, $\frac{1}{3}x + 2 = 5$. Add -2 (makes 0), so $\frac{1}{3}x = 3$; multiply by 3 (makes 1). $x = 9$.
- $-2x + 9 = 1$: add -9 (makes 0), so $-2x = -8$; multiply by $-\frac{1}{2}$ (makes 1). $x = 4$.
- $3(x + 4) = 27$: distribute, $3x + 12 = 27$; add -12, so $3x = 15$; multiply by $\frac{1}{3}$. $x = 5$. (Or multiply both sides by $\frac{1}{3}$ first: $x + 4 = 9$, $x = 5$.)

Part D Solve, then check

1. $4x - 7 = 13$: Step 1, $4x + (-7) = 13$. Add +7, so $4x = 20$; multiply by $\frac{1}{4}$. $x = 5$. Check: $4(5) - 7 = 20 - 7 = 13$. Correct.
2. Gym: $6m + 10 = 40$. Add -10, so $6m = 30$; multiply by $\frac{1}{6}$. $m = 5$ months. Check: $6(5) + 10 = 40$.
3. $5(x + 1) = 20$: Line A, distributive property (hand the 5 to each term). Line B, additive inverse: add -5, which leaves the additive identity 0. Line C, multiplicative inverse: multiply by $\frac{1}{5}$, which leaves the multiplicative identity 1. $x = 3$.

Part E In your own words

1. The coefficient of x is 4 (x is multiplied by 4), and +5 is added to it. Undo the +5 first (add -5), then the coefficient (multiply by $\frac{1}{4}$). $x = 5$.
2. Step 1: $3x - 6 = 3x + (-6) = 9$. Add +6, so $3x = 15$; multiply by $\frac{1}{3}$. $x = 5$. Check: $3(5) - 6 = 15 - 6 = 9$.
3. Because the equation is a balance. Doing the same thing to both sides keeps the two sides equal.
4. Every step is one idea from Lessons 1 to 3: translate first (Lesson 3), then add an opposite to make 0 or multiply by a reciprocal to make 1 (Lesson 1), and each move is one of the properties (Lesson 2).

LISTEN FOR

Students who skip the invisible 1 ("the coefficient of x is nothing") or who undo the coefficient before the number that is added. Both are the same habit: doing a step in your head instead of on paper.