

INDEPENDENT VARIABLE

IDV WORKSHEETS



SOLVING MULTI-STEP EQUATIONS

COMBINING LIKE TERMS | VARIABLES ON BOTH SIDES | SPECIAL CASES

ANIMATED
POWERPOINT:
DOES THE WORK
FOR YOU!

FULL ANSWER
KEYS
INCLUDED



6 EXAMPLE
PROBLEMS
5 PRACTICE
SHEETS

ALONG • FOLLOW-ALONG SHEET, BOX 6 • CHALLENGE

Solving the Multi-Step Equation

is a two-step equation.

$$-x - 4 - 3x = -20 - 9x + 1 + x - 2x$$

COMBINE

$$-2 - 4x = -19 - 10x$$

REWRITE

$$+10x \quad +10x$$
$$-2 + 6x = -19$$

INVERSE 1

$$+2 \quad +2$$
$$6x = -17$$

REWRITE

$$\frac{6x}{6} = \frac{-17}{6}$$

INVERSE 2

$$x = -\frac{17}{6}$$

REWRITE

CHECK

Substitute $-\frac{17}{6}$ for x in the original equation. Both sides match ✓

KEY IDEA

When the x's Disappear

Sometimes Step 1 gets rid of EVERY variable term. Then read what is left.

NO SOLUTION

$$4x + 4 = 5x + 9 - x$$
$$4x + 4 = 4x + 9$$
$$-4x \quad -4x$$
$$4 = 9$$

No solution

4 = 9 is never true. No value of x works.

ALL SOLUTIONS

$$4x + 13 = 4x + 5 + 8$$
$$4x + 13 = 4x + 13$$
$$-4x \quad -4x$$
$$13 = 13$$

All solutions

13 = 13 is always true. Every value of x works.

False statement: no solution. True statement: all solutions

LEVELED
PRACTICE,
FIND THE
MISTAKE +
MAZE

MORE PRACTICE. LESS PREP. BETTER OUTCOMES.

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Inside the Animated Lesson

INDEPENDENT VARIABLE

GRADES 7-8 • PRE-ALGEBRA

SOLVING MULTI-STEP EQUATIONS

COMBINING LIKE TERMS | VARIABLES ON BOTH SIDES | NO SOLUTION & ALL SOLUTIONS

Animated PowerPoint lesson

6 animated worked problems • follow-along sheet
Practice A, B, C • Find the Mistake • maze

$$3x + 2x + 4 = -20 - 4x$$

$$4 + 5x = -20 - 4x$$

MORE PRACTICE. LESS PREP. BETTER OUTCOMES.

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LESSON OVERVIEW

Today's Goals

I CAN...

- Combine like terms to solve multi-step equations.
- Combine the things that are alike on each side first. Then it is a three-step equation I already know how to solve.
- Recognize an equation with no solution or with all numbers as solutions, and check my answer.

KEY VOCABULARY

Like terms terms that are alike: $3x$ and $2x$, or 4 and -20	Combine add like terms on the SAME side: $3x + 2x = 5x$
Variable term a number times the variable: the $5x$ in $4 + 5x$	Constant a number by itself: the 4 in $4 + 5x$
Additive inverse the opposite: $4x + (-4x) = 0$	No solution no number works: it ends as something false, like $2 = 3$

STANDARDS

CCSS 8.EE.C.7a CCSS 8.EE.C.7b

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ENTRY TASK

Can You Read My Mind?

I'm thinking of a number. If I doubled it twice and then added 2, it would be the same as quadrupling it and adding 3. What is it?

WRITE IT DOWN. IT COUNTS!

YOU MUST SHOW MATH!

THINK ABOUT IT

Try a number. If it is 5:
 $5 + 5 + 5 + 5 + 2 = 22$
 $4 \cdot 5 + 3 = 23$
 Doubled twice is the same as quadrupled, so $+2$ and $+3$ never match.

AS AN EQUATION

$$2x + 2x + 2 = 4x + 3$$

$$4x + 2 = 4x + 3$$

$$-4x \quad -4x$$

$$2 = 3$$

No solution

$2x + 2x = 4x$.
 Subtract $4x$: $2 = 3$.
 Never true: **no solution**.
 Today: combine FIRST.

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KEY IDEA

Combine Things That Are Alike

Step 0: on EACH side of the =, combine the x terms and combine the numbers.

STEP 0: COMBINE LIKE TERMS

$$1 - x - 4 - 3x = -20 - 9x + 1 + x$$

$$-3 - 4x = -19 - 8x$$

☐ variable terms ☐ numbers
 Left: $1 - 4 = -3$ and $-x - 3x = -4x$.
 Right: $-20 + 1 = -19$ and $-9x + x = -8x$.

NOW IT IS A THREE-STEP EQUATION

$$-3 - 4x = -19 - 8x$$

Step 1: get rid of the smallest variable term, $-8x$ (add $8x$).
Step 2: get rid of the number by the variable, -3 (add 3).
Step 3: isolate the variable (divide by 4): $x = -4$

Combine like terms on each side first (never across the = sign). Then it is a three-step equation.

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HOW THIS LESSON WORKS

Combine. Three Inverses. Rewrite. Check.

Combine first, then three inverses. Rewrite each time, then check.

COMBINE Step 0: combine things that are alike on each side.

REWRITE Rewrite. Now it is a three-step equation.

INVERSE 1 Get rid of the smallest variable term on BOTH sides.

REWRITE Rewrite. Now it is a two-step equation.

INVERSE 2 Get rid of the number by the variable.

REWRITE Rewrite the new, shorter equation.

INVERSE 3 Isolate the variable: divide by the coefficient.

REWRITE Rewrite as $x = \frac{\quad}{\quad}$. Reduce fractions if you can.

CHECK Put your answer into the ORIGINAL equation.

EXAMPLE

$$3x + 2x + 4 = -20 - 4x$$

$$4 + 5x = -20 - 4x$$

$$+4x \quad +4x$$

$$4 + 9x = -20$$

$$-4 \quad -4$$

$$9x = -24$$

$$\frac{9}{9} \quad \frac{9}{9}$$

$$x = -\frac{24}{9} = -\frac{8}{3}$$

CHECK

$$3 \cdot \left(-\frac{8}{3}\right) + 2 \cdot \left(-\frac{8}{3}\right) + 4 = -20 - 4 \cdot \left(-\frac{8}{3}\right)$$

$$-20 - 4 \cdot \left(-\frac{8}{3}\right) = -20 + \frac{32}{3} = -\frac{28}{3}$$

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FOLLOW-ALONG • FOLLOW-ALONG SHEET, BOX 1

Solve the Multi-Step Equation

Now it is a three-step equation.

$$x + 4 + 8x = 4x + 14$$

$$9x + 4 = 4x + 14$$

COMBINE

REWRITE Rewrite: $9x + 4 = 4x + 14$. Now it is a three-step equation.

STEP 0 GOAL: combine the things that are alike on each side. Then it is a three-step equation.

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FOLLOW-ALONG • FOLLOW-ALONG SHEET, BOX 6 • CHALLENGE

Solve the Multi-Step Equation

Now it is a two-step equation.

$$3 - 1 - x - 4 - 3x = -20 - 9x + 1 + x - 2x$$

$$-2 - 4x = -19 - 10x$$

$$+10x \quad +10x$$

$$-2 + 6x = -19$$

$$+2 \quad +2$$

$$6x = -17$$

$$\frac{6}{6} \quad \frac{6}{6}$$

$$x = -\frac{17}{6}$$

CHECK

$$3 - 1 - \left(-\frac{17}{6}\right) - 4 - 3 \cdot \left(-\frac{17}{6}\right) = \frac{28}{3}$$

$$-20 - 9 \cdot \left(-\frac{17}{6}\right) + 1 + \left(-\frac{17}{6}\right) - 2 \cdot \left(-\frac{17}{6}\right) = \frac{28}{3}$$

COMBINE

REWRITE

INVERSE 1

REWRITE

INVERSE 2

REWRITE

INVERSE 3

REWRITE

CHECK Substitute $-17/6$ for x in the original equation. Both sides match ✓

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KEY IDEA

When the x's Disappear

Sometimes Step 1 gets rid of EVERY variable term. Then read what is left.

NO SOLUTION

$$4x + 4 = 5x + 9 - x$$

$$4x + 4 = 4x + 9$$

$$-4x \quad -4x$$

$$4 = 9$$

No solution

$4 = 9$ is never true. No value of x works.

ALL SOLUTIONS

$$4x + 13 = 4x + 5 + 8$$

$$4x + 13 = 4x + 13$$

$$-4x \quad -4x$$

$$13 = 13$$

All solutions

$13 = 13$ is always true. Every value of x works.

False statement: no solution. True statement: all solutions.

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Directions: Getting started. Whole numbers, positive answers. Combine like terms first, then get rid of the smallest variable term, the number by the variable, and the coefficient. Use the example as a guide.

PRACTICE A • GETTING STARTED

Example: combining like terms (easy)

$$-4 - 6x = \boxed{2x} - 12 \boxed{+ x}$$

$$-4 - 6x = -12 \boxed{+ 3x}$$

$$+6x \qquad +6x$$

$$-4 = -12 + 9x$$

$$+12 \quad +12$$

$$\frac{8}{9} = \frac{9x}{9}$$

$$\frac{8}{9} = x$$

Step 0: combine things that are alike (box the x terms, circle the numbers)

Step 1: get rid of the smallest variable term (additive inverse)

Step 2: get rid of the number by the variable (additive inverse)

Step 3: multiplicative inverse; reduce if you can

1. $4x + 20 + x = 7x + 8$	2. $3 + 7x + 4x = 19 + 9x$	3. $7x + 6 + 6x = 9x + 14$
4. $4 + 7x + 5x = 16 + 9x$	5. $2 + 9x + 3x = 23 + 9x$	6. $3x + 1 + 7x = 8x + 25$
7. $x + 2 + 7x = 3x + 17$	8. $23 + 3x + 4x = 1 + 9x$	9. $2x + 23 + 3x = 7x + 3$
10. $9x + 12 + x = 8x + 44$	11. $6 + 5x + 3x = 24 + 6x$	12. $6 + 4x + 2x = 21 + 3x$

Directions: Each student made ONE mistake. Circle the first wrong line, explain what went wrong, then solve it correctly.

1. *Taylor solved:*

$$4x + 4 + 2x = 58$$

$$10x = 58$$

$$x = 5.8$$

What went wrong?

Solve it correctly:

2. *Quinn solved:*

$$5x - 3 - 2x = x + 9$$

$$7x - 3 = x + 9$$

$$6x - 3 = 9$$

$$6x = 12$$

$$x = 2$$

What went wrong?

Solve it correctly:

3. *Jordan solved:*

$$4x + 8 + 3x = 57$$

$$15x = 57$$

$$x = 3.8$$

What went wrong?

Solve it correctly:

4. *Avery solved:*

$$7x - 2 - 3x = x + 10$$

$$4x - 2 = x + 10$$

$$5x - 2 = 10$$

$$5x = 12$$

$$x = 12/5$$

What went wrong?

Solve it correctly:

5. *Morgan solved:*

$$6x + 5 = 2x - 7 + x$$

$$6x + 5 = 3x - 7$$

$$3x + 5 = -7$$

$$3x = -2$$

$$x = -2/3$$

What went wrong?

Solve it correctly:

6. *Riley solved:*

$$2x + 6 + x = 5x - 4$$

$$3x + 6 = 5x - 4$$

$$-2x + 6 = -4$$

$$-2x = -10$$

$$x = -5$$

What went wrong?

Solve it correctly:

Directions: Solve the problem in each box. Follow the connector labeled with your answer to the next box. Trace your path from START to STOP.

START

1. $-2 + 3x = -20 - 15x$				2. $15x - 15 = 25x - 25$				3. $-29 + 18x = 25 + 21x$				4. $7 - 20x = -23 - 5x$		
			-1				1				-18			
-11			1		-8		-10		3		-16		2	
5. $49 + -8x = 7 + 6x$				6. $-17x + 11 = -21x - 13$				7. $-44 - 3x = -50 - 6x$				8. $-32 + 13x = 48 + 18x$		
			1				-3				-11			
-6			-1		-4		-2		-8		-5		-16	
9. $16x + -42 = 24x + 46$				10. $-11x + 6 = -14x + -24$				11. $6 + -15x = -30 + -11x$				12. $45 + 11x = 35 + 9x$		
			2				-10				-1			
-24			9		-18		2		3		9		1	
13. $x + 39 = -9x + 9$				14. $36 - 4x = 12 - 7x$				15. $29 + 16x = -39 + -x$				16. $-50 + -12x = -2 + -10x$		
			-8				-4				-24			

STOP