

Solving Two-Step Equations

Strand:	Patterns, Functions, and Algebra
Topic:	Solving one and two step linear equations
Primary SOL:	7.12 The student will solve two-step linear equations in one variable, including practical problems that require the solution of a two-step linear equation in one variable.
Related SOL:	7.13

Materials

- Manipulatives to represent equations
- Sample Balance (attached)
- Review of One-Step Equations activity sheet (attached)
- Balances to Two-Step Equations activity sheet (attached)
- Two-Step Equations to Balances activity sheet (attached)
- Additional Practice with Two-Step Equations activity sheet (attached)
- Sample Practical Problems activity sheet (attached)
- Error Analysis with Property Application activity sheet (attached)
- Calculators

Vocabulary

equation, expression, inverse operations, one-step equation, order of operations, properties, variable (earlier grades)

algebraic equation, algebraic expression, numerical expression, two-step equation, variable expression, verbal expression, verbal sentence (7.12)

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Present students with the following scenario as a think-pair-share activity: Joe and his friend, Bob, together have 17 games. If Joe has 6 games, how many does Bob have? Have students represent the scenario with an equation and solve it.
2. Discuss the scenario and students' equations as a class, incorporating vocabulary when possible. Use different manipulatives to represent variables and numbers and a balance scale with pictures to model and solve the equation. Emphasize maintaining balance by applying properties. Make connections between the concrete, the pictorial, and the symbolic. Have students check the solution using substitution.
3. Continue the process above, being sure to use examples and including all operations. Solve the four one-step equation examples using the Review of One-Step Equations activity sheet.
4. Now that one-step equations have been reviewed (Grade 6 standard), begin exploring two-step equations (Grade 7 standard). Give students pictures of equations represented on balances, ask them to translate them into equations, then solve and use a calculator to confirm that the solutions are correct. Reinforce that the students will continue to

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solve equations by isolating the variable through the inverse operation. Justify the properties of equality as the problems are solved.

5. Give students equations, and ask them to represent the equations on balances, then solve and check the solutions.
6. Ask the students to complete the additional practice problems. This can be completed independently or in thoughtfully paired groups.
7. Once the students have a good foundation, turn the focus to practical problems. Ask the students to translate, solve, and check the given the Sample Practical Problems activity sheet.
8. Distribute the Error Analysis with Property Application activity sheet. Ask the students to locate the example where the mistake occurred.

Assessment

- **Questions**
 - When solving an equation, why is it important to perform identical operations on both sides of the equal sign?
 - What are the differences between solving one-step equations and solving two-step equations?
 - How can you prove that your solution is correct?
- **Journal/writing prompts**
 - Write a word problem whose solution can be found by solving the equation $2x - 8 = 10$. Solve the problem.
 - Jack had \$24 to spend on 7 markers. He had \$10 remaining after buying the markers. How much did each marker cost? Jack thinks he should solve the equation $7m - 10 = 24$ to see how much he spent. His friend, Jill, thinks he should solve the equation $7m + 10 = 24$ to see how much he spent. Identify who you think is correct, and explain why.
 - Create a word problem that can be represented by a two-step equation. Write the equation and solve it, applying the properties of equality. Check your solution.
- **Other Assessments**
 - Have students proofread equations to find and correct mistakes.
 - Have students create equation matching cards. One card has the equation, a second card has the solution, and a third card has a word problem that can be represented by the equation. Distribute cards and have students form groups by finding their matches.

Extensions and Connections

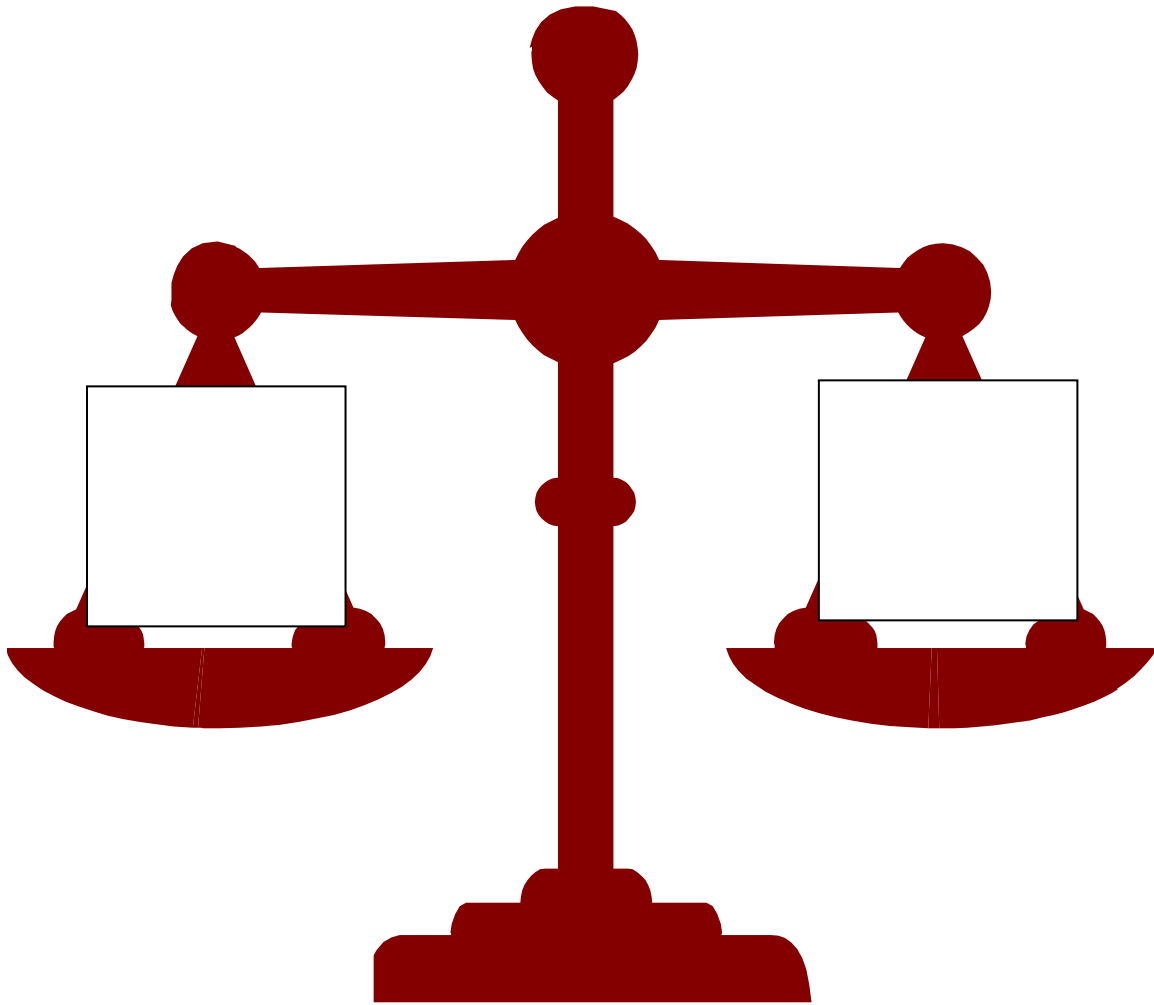
- Have the students use the internet to explore situations where equations are present in the real world.
- Provide the students with additional real-world examples. Have them set up the equations and solve.

Strategies for Differentiation

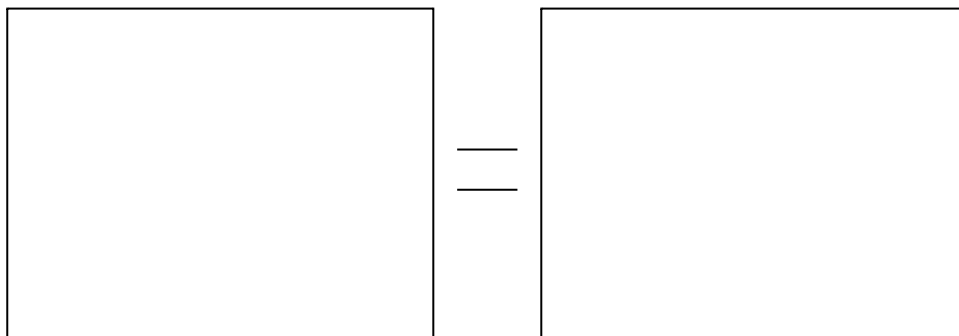
- Have students create a poster illustrating how to solve a multistep equation.
- Use graphic organizers to show the steps involved in solving an equation.
- Use different types of manipulatives and online resources to assist students with solving equations.
- Enlarge the sample balance mat to an entire page size.
- Have students model/draw each step of solving an equation on a separate balance mat.
- Write down the steps used to solve an equation. Begin with a simple example that has been solved for the student. Advance to more complex equations.
- Allow students to work with a partner for all learning activities.
- Review prior vocabulary and preteach new essential vocabulary for certain students before introducing the lesson.
- Provide 2-3 similar worked examples for some students if necessary, for each problem during independent practice activities.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

Sample Balance



Sample Balance Mat



Review of One-Step Equations

Solve the following equations using the inverse operation.

$$p + 5 = 13$$

$$7p = 21$$

$$\frac{x}{10} = 50$$

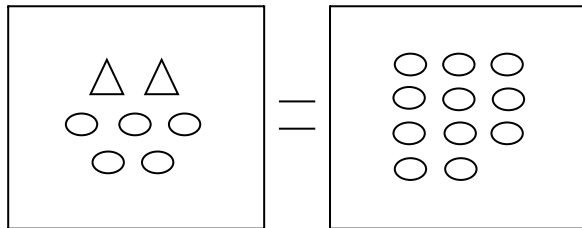
$$22 = x - 8$$

Balances to Two-Step Equations

Directions: Write the equation based on the pictorial representation. Solve each equation using the inverse operation. Check your work.

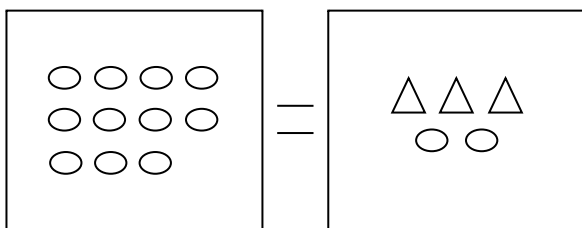
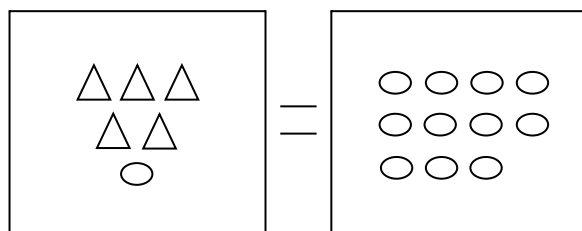
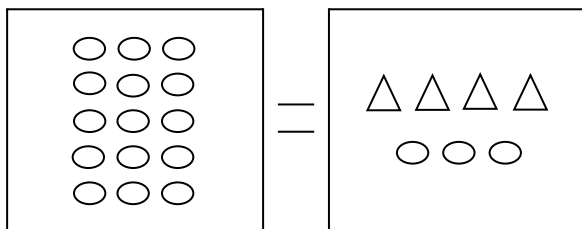
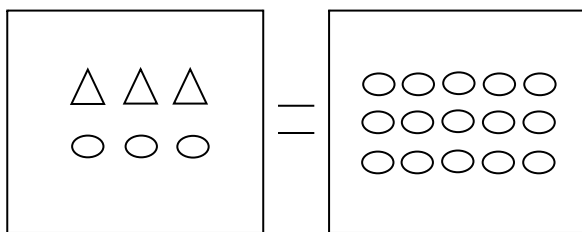
$\triangle = x$

$\circ = 1$



SOLVE

CHECK



Two-Step Equations to Balances

Directions: Draw a pictorial representation for each equation. Solve and check each equation.

$\triangle = x$ $\bigcirc = 1$

$4x + 3 = 11$

	=	
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SOLVE

CHECK

$21 = 5x + 6$

	=	
--	---	--

$17 = 3 + 2x$

	=	
--	---	--

$3x + 7 = 22$

	=	
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$4x + 2 = 14$

	=	
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Additional Practice with Two-Step Equations

Directions: Isolate the variable through the inverse operation. Show your work as you solve each equation. Check your work.

$9 + 3x = 21$	$\frac{n}{5} + 2 = 6$
$29 = 8b + 5$	$1 - 11n = 67$
$-143 = 1 - 7.2x$	$2x + \frac{1}{2} = -5$
$\frac{x-7}{-3} = 4$	$\frac{3}{4}x - 2 = 10$

Sample Practical Problems

Name _____ Date _____

1. The quotient of x and three increased by 12 is 20. What is x ?
2. Five increased by product of x and three is 23. What is x ?
3. Twice x decreased by four is 36. What is x ?
4. The local craft fair charges the vendors a flat rate of \$15 plus \$5 for each hour that they spend at the fair. If the vendor owed \$50, how many hours did he remain at the craft fair?
5. During the fall, you charge \$8 to go to a house and rake the leaves and an additional \$6 for every hour that you rake the yard. If you earned \$32, how many hours did you spend raking the leaves?
6. You spent \$1,400 on new furniture. The local furniture store allows you to make a down payment of \$500 and then pay the remaining balance in three equal monthly payments. How much are the monthly payments?
7. A cellphone company charges \$17 plus \$0.25 for each text message sent. The total bill was \$45.50. How many text messages were sent?

Error Analysis with Property Application

In which example has the student applied the properties of equality incorrectly to solve the equation?

$$\begin{aligned}2x + 5 &= 25 \\2x + 5 + (-5) &= 25 + (-5) \\ \frac{2x}{2} &= \frac{20}{2} \\ x &= 10\end{aligned}$$

$$\begin{aligned}\frac{x}{3} - 2 &= 4 \\ \frac{x}{3} - 2 + (-2) &= 4 + (-2) \\ 3 \cdot \frac{x}{3} &= 6 \cdot 3\end{aligned}$$

$$\begin{aligned}36 &= -15z + 6 \\ 36 + (-6) &= -15z + 6 + (-6) \\ \frac{30}{-15} &= \frac{-15z}{-15} \\ z &= -2\end{aligned}$$