4.1 Solve Simple Equations

Strand:
Number Sense and Algebra

Student Text Pages
186 to 195

Suggested Timing
80–160 min

Tools
- algebra tiles

Technology Tools
- *The Geometer's Sketchpad®*
- computers
- Computer Algebra System
- calculators
- TI-89 calculators

Related Resources
BLM 4.1.1 Practice: Solve Simple Equations
BLM 4.1.2 Use Algebra Tiles
BLM T7 The Computer Algebra System (CAS) on the TI-89 Calculator
BLM A9 Communication General Scoring Rubric
BLM 4.1.3 Achievement Check Rubric

Mathematical Process Expectations Emphasis

- ☑ Problem Solving
- ☐ Reasoning and Proving
- ☑ Reflecting
- ☑ Selecting Tools and Computational Strategies
- ☑ Connecting
- ☑ Representing
- ☑ Communicating

Specific Expectations

Manipulating Expressions and Solving Equations

NA2.07 solve first-degree equations, including equations with fractional coefficients, using a variety of tools (e.g., computer algebra systems, paper and pencil) and strategies (e.g., the balance analogy, algebraic strategies).

Link to Get Ready

Students will need to recall geometric relationships and how to collect like terms for this section. Assign Get Ready questions 1, 2, 5, and 6 prior to teaching this section.

Warm-Up

Use this activity as a Warm-Up or as an alternate Investigate. You may wish to use *The Geometer's Sketchpad®* to support the manipulatives. By constructing a rectangle or using a pre-drawn image, students could manipulate the image to answer these questions in an organized way.

1. The Henderson's have a rectangular garden with a perimeter of 24 m. They want to change the dimensions (length and width) so that it looks better.

a) The length of the garden now is 8 m. What is the width? Explain in words the math operations that you used to find the width.

b) If the Henderson's told you that the width of the garden was 2 m, what would be the length? Explain in words the math operations you used to find the length. List the operations that match the language you described. Are the operations the same as those described in part a)?

Warm-Up Answers

1. a) $P = 2\ell + 2w$
$24 = 2(8) + 2w$
$24 = 16 + 2w$
$8 = 2w$
$4 = w$
The width of the garden is 4 m.

b) $P = 2\ell + 2w$
$24 = 2\ell + 2(2)$
$24 = 2\ell + 4$
$20 = 2\ell$
$10 = \ell$
The length of the garden is 10 m.

Teaching Suggestions

- A major focus of this section is to introduce the algebraic method. Some students may not appreciate the need for this because the equations they have encountered so far have not been very complicated. In grade 9 and beyond, however, the equations will become more complicated, and the ability to efficiently apply the algebraic method is vital. Emphasize the need for proper form (showing all steps to solutions).
- Have students work on the Investigate with a partner or in small groups. (5 min)
- Students will have solved simple equations in elementary school, however, they may not be familiar with formal algebraic methodologies. Use the Investigate to review the concept of variables as it relates to

Common Errors

- Some students may resist, or improperly apply, the formal algebraic method.

R_x Emphasize and model good form at all times. Express the need for clear presentation of solutions so that others can comprehend the student's work.

- Some students may apply the wrong operation when solving one-step equations.

R_x Remind students that the idea is to solve for the variable. Typically, the variable is "trapped" within some operation involving a numeric quantity. Have students think of "releasing the trap" by performing the opposite operation. Students will need to recall that addition and subtraction are opposite operations, as are multiplication and division.

- Some students may apply operations in the incorrect order when solving two-step equations.

R_x Remind students that they must isolate the variable term first, before solving for it. This typically requires that operations be done in the opposite order as BEDMAS suggests for simplifying expressions.

Ongoing Assessment

- Use Achievement Check question 17 to monitor student success. See Achievement Check Answers and **BLM 4.1.3 Achievement Check Rubric**.
- Chapter Problem question 14 can also be used as an assessment tool.
- Communicate Your Understanding questions can be used as quizzes to assess students' Communication skills.

solving an equation. Students should be able to come up with the answers, but not necessarily using a formal algebraic solution. You may wish to use **BLM 4.1.1 Practice: Solve Simple Equations** for remediation or extra practice.

- For Examples 1 and 2, conduct a discussion. (10–15 min)
- Examples 1 and 2 illustrate three methods for solving simple algebraic equations. Students will be familiar with inspection, and it appeals intuitively. This is a valid method for simple equations. The balance analogy segues to the formal algebraic approach (using the opposite operation). Note that the method of opposite operations is most likely new to students, and is the method of choice for further mathematics work.
- An excellent web site that supports the balance analogy and provides an interactive model of the balance method for solving equations can be found at: http://nlvm.usu.edu/en/nav/frames_asid_324_g_3_t_2.html.
- For Example 2 b), you may wish students to use algebra tiles as an alternate method of solving equations. Use **BLM 4.1.2 Use Algebra Tiles** to support this activity.
- Assign Communicate Your Understanding questions C1 a), b), and c), and follow up with a class discussion. (2–3 min)
- Assign Practise questions 1 to 5. (5–10 min)
- Debrief Practise answers with a class discussion. (2–3 min)
- Examples 3 and 4 use contextual situations to provide an opportunity to apply methods of solving equations, and extend into solving two-step equations. "Root" terminology is also introduced here, as is the use of Computer Algebra System (CAS) as an equation-solving tool. You may wish to use **BLM T7 The Computer Algebra System (CAS) on the TI-89 Calculator** to support this activity.
- It is important that students not use CAS as a replacement for learning the algebraic method. The solution presented in the text requires students to select and apply each algebraic step, but lets the technology take care of the calculations. This approach may be of benefit for the student whose rudimentary operational skills with integers and fractions are still weak. It may also be helpful for students to use this as a means of checking their paper-and-pencil work.
- For Examples 3 and 4, have a class discussion. (15–20 min)
- Assign Communicate Your Understanding questions C1 d), 2, and 3. Follow up with a class discussion. (5 min)
- Assign the balance of the exercises as independent work. (balance of period)
- Depending on the progress of the class, you may wish to extend this lesson to 1.5 to 2 periods.

Investigate Answers (page 186)

1. a) Let x represent the cost of the other magazine.
b) $5 + x = 11$
c) $x = 6$; To find the answer, subtract 5 from both sides of the equation and simplify.

2. a) Let x represent the cost of a mechanical pencil.
b) $4 + 2x = 10$
c) $x = 3$; Step 1: Subtract 4 from both sides. Step 2: Divide both sides by 2.

3. a) With the help of mathematical operations, you can isolate the unknown quantity. The value of the unknown quantity can then be found.
b) Answers can be verified by substituting the answer you found into the original equation. Then, independently, evaluate the left side and right side. If both sides have the same value then the answer is correct.

Communicate Your Understanding Responses (page 192)

C1. a) Add 5 to both sides.
b) Divide both sides by 3.
c) Multiply both sides by 5.
d) Subtract 75 from both sides, then divide both sides by 5.

C2. B. Substitute each possible solution into the L.S. of the equation. The result should be 21.

C3. B. Each jacket costs \$50 and n represents the number of jackets. Hence, the money raised, \$1000, should be equal to $50n$.

Accommodations

Gifted and Enrichment—In addition to the Extend questions, the Math Contest question provides additional challenges for talented students. Every section has some of these questions. Questions have been selected for their interest level as well as their level of difficulty.

Visual—The use of colour, bolding, or highlighting may help some students to more easily identify like terms.

Memory—Encourage students to write out cue cards to remember the rules for multiplying positive and negative numbers. Encourage students to use visual cues when adding like terms.

ESL—Be sure to stress that there are many terms that mean the same thing in mathematics. The root and the solution mean the same thing. So to solve or to find the root or to isolate the variable all have the same meaning and process.

Practise

The early questions are a good opportunity to get students using proper form and showing their steps.

For questions 9 and 10, some students may have difficulty in setting up the equations, based on given information. Consider having students work in pairs on some of the word problems.

Connect and Apply

For question 11, you may wish to use **BLM A9 Communication General Scoring Rubric** to assist you in assessing your students.

For question 12, some students may need a quick review on reducing fractions to lowest terms.

Question 13 requires students to add and subtract fractions, which is a common source of difficulty. Some remediation may be warranted. Later in the chapter, students will learn another technique for solving such equations that simplifies the fraction work.

Questions 14 to 16 require students to build and solve equations based on given information, and then make a decision. Ensure that students have answered all questions completely by looking back at the question.

In Achievement Check question 17, geometry and algebra are connected. Students will need to recall the geometric properties of an isosceles triangle. You may wish to use **BLM 4.1.3 Achievement Check Rubric** to assist you in assessing your students.

Achievement Check Answers (page 195)

17. a) $a + 2(25°) = 180°$ $\qquad$ $a + 2(100°) = 180°$

$a = 130°$ $\qquad$ $a = -20°$

Note that the second situation is impossible.

b) $40° + 2b = 180°$ $\qquad$ $100° + 2b = 180°$

$2b = 140°$ $\qquad$ $2b = 80°$

$b = 70°$ $\qquad$ $b = 40°$

c) The maximum value of a is 178°. For a to be large, b must be as small as possible, say 1°. ($1° + 1° + 178° = 180°$). This assumes you are measuring to the nearest degree; otherwise, a is a value just less than 180°.

d) The maximum value of b is 89°. For b to be large, a must be as small as possible, say 2°. ($1° + 89° + 89° = 180°$). This assumes you are measuring to the nearest degree; otherwise, b is a value just less than 90°.

Extend

Question 19 is connected to linear systems in section 6.7 Linear Systems. Explain to students that the best choice of hall can change, depending on the particular circumstances.

Literacy Connections

Solutions

Remind students that when they are writing out a solution, they must be sure to make each line show what they are doing. Have them imagine that someone who has not studied this chapter is reading their solution. Explain that it needs to be very clear what they are doing so that someone can follow along and understand their solution. Remind students that it is important to only have one equal sign in any line.

Isolating the variable

Explain to students that *isolating the variable* in math has the same meaning as *isolating* in our English class. It means separating the variable from everything else so that it is alone.

Exercise Guide

Category	Question Number
Minimum (essential questions for all students to cover the expectations)	1–6, 8–10, 12, 14
Typical	1–6, 8–12, 13, 15, 16
Extension	18–20