3.1 Selling Greeting Cards: Solving Linear Equations

Focus Question What strategies can you use to solve equations that contain parentheses?

Launch

Use the questions in the Introduction to the Problem to review the strategies for solving linear equations. You may want to display Teaching Aid 3.1. Ask the class to provide a reason for each step.

For steps (1) and (2), the property of equality was used; it states that subtracting the same quantity from each side of the equation maintains equality. In (1), the quantity was $4x$; for (2) it was 25.

- *Could you begin with a different first step?*
- *How could you check that 25 is the correct solution?*
- *Describe another method for finding the solution to the equation.*

By the end of this discussion, students should be comfortable with using the principles of equality to solve equations. The principles state that equality is maintained by adding the same quantity to or subtracting the same quantity from each side of an equation and by multiplying or dividing each side of an equation by the same nonzero quantity.

Key Vocabulary

- properties of equality

Materials

Teaching Aid

- 3.1: Solving Linear Equations

Explore

Point to various parts of the equation and ask what information each part represents. For Question A, part (3), some students may need to be reminded of what break-even means.

- *How do you find the break-even point?*

Look at the ways students are solving the equation. Suggest to students who are solving using a table or graph to try solving without a table or graph.

This Problem is another opportunity to see how students use the units associated with the context.

- *What information does 5s represent? What units should be attached to this expression?*

Summarize

Be sure students give a reason for each step, or have someone else give a reason for each step as a student presents his/her solution.

- *In Question A, part (2), is there another way to solve the equation $200 = 5s - (100 + 2s)$?*

Summarize strategies for solving equations with parentheses. Take note of how students use the Order of Operations. Then let the class solve the equations in Question C. Pick one or two of the equations and ask stduents to show the solution on a graph or table.

ACE

Assignment Guide for Problem 3.1

Applications: 1–7 | Connections: 35–38
Extensions: 53–55

Answers to Problem 3.1

A. **1.** The $5s$ represents the income, so the school choir makes \$5 for each box of greeting cards it sells. The $100 + 2s$ represents the expenses, so the start-up cost is \$100 and it costs \$2 to produce each box of greeting cards.

2. 100 boxes; the equation that students must solve is $200 = 5s - (100 + 2s)$.

3. 34 boxes; the solution to the equation $P = 5s - (100 + 2s)$ when $P = 0$ is $s \approx 33.333$. So to break even, the school choir must sell 34 boxes.

4. $P = 3s - 100$; the 3 represents the income made per box sold and the 100 is the start-up cost. Students may find other equivalent expressions such as $P = 5s - 100 - 2s$, but these expressions do not provide as much new information.

5. Yes; $5s - 2(50 + s)$ is equivalent to $5s - (100 + 2s)$ by applying the Distributive Property to factor out a common factor of 2. Students can also check two different values for s and show that they produce the same value for P in each expression since the expressions are linear. Or students can use a graph or table to show that both expressions are equivalent.

B. One possible strategy: To solve an equation like $200 = 5s - (100 + 2s)$, first replace the right hand expression with the equivalent expression $5s - 100 - 2s$. This expression is equivalent since you can rewrite the equation as $200 = 5s + (-1)(100 + 2s)$ and then distribute the -1. Make sure students recognize that replacing an expression in an equation with an equivalent expression does not change the equality. This results in $200 = 5s - 100 - 2s$. You can replace $5s - 100 - 2s$ with the equivalent expression $3s - 100$, resulting in $200 = 3s - 100$.

Using the properties of equality on $200 = 3s - 100$ results in:

$200 + 100 = 3s - 100 + 100$ (Add 100 to each side.)

$300 = 3s$ (Combine like terms.)

$100 = s$ (Divide each side by 3.)

To solve an equation involving parentheses, distribute the number in front of the parentheses and then combine like terms. Next, continue to use the properties of equality to write simpler equations until it is easy to read the solution.

C. **1.** $0 = 5 + 2(3 + 4x)$
$0 = 5 + 6 + 8x$
$0 = 11 + 8x$
$0 - 11 = 11 + 8x - 11$
$-11 = 8x$
$-\frac{11}{8} = x$

2. $0 = 5 - 2(3 + 4x)$
$0 = 5 - 6 - 8x$
$0 = -1 - 8x$
$0 + 1 = -1 - 8x + 1$
$1 = -8x$
$-\frac{1}{8} = x$

3. $0 = 5 + 2(3 - 4x)$
$0 = 5 + 6 - 8x$
$0 = 11 - 8x$
$0 - 11 = 11 - 8x - 11$
$-11 = -8x$
$\frac{11}{8} = x$

4. $0 = 5 - 2(3 - 4x)$
$0 = 5 - 6 + 8x$
$0 = -1 + 8x$
$0 + 1 = -1 + 8x + 1$
$1 = 8x$
$\frac{1}{8} = x$