3.6 Add and Subtract Polynomials

Strand:
Number Sense and Algebra

Student Text Pages
154 to 159

Suggested Timing
80 min

Tools
- algebra tiles

Technology Tools
- *The Geometer's Sketchpad®*
- computers

Related Resources
BLM 3.6.1 Practice: Add and Subtract Polynomials
BLM A8 Application General Scoring Rubric
BLM A9 Communication General Scoring Rubric
BLM T4 *The Geometer's Sketchpad®* 3
BLM T5 *The Geometer's Sketchpad®* 4

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

NA2.04 add and subtract polynomials with up to two variables [e.g., $(2x - 5) + (3x + 1)$, $(3x^2y + 2xy^2) + (4x^2y - 6xy^2)$], using a variety of tools (e.g., algebra tiles, computer algebra systems, paper and pencil);

Link to Get Ready

Understanding of all of the concepts in the Get Ready section is required by this point. Ensure that students have completed all of the Get Ready questions prior to working on this section.

Warm-Up

Review collecting like terms.

1. a) What are like terms? **b)** Give an example of two like terms.

2. State two like terms for each term given.
a) $3x$ **b)** $-2y$ **c)** $7x^2$ **d)** $2ab^2$

3. Simplify, by collecting like terms.
a) $2x + 5x$ **b)** $7y - y$ **c)** $4x^2 - 6x^2$
d) $3m + 2 + 4m - 3$

Warm-Up Answers

1. a) Like terms have the same variable or variables.
b) $3x$ and $5x$, $4y^2$ and $7y^2$

2. a) $5x$, $-8x$ **b)** $-5y$, $11y$ **c)** $15x^2$, $4x^2$ **d)** $-9ab^2$, ab^2

3. a) $7x$ **b)** $6y$ **c)** $-2x$ **d)** $7m - 1$

Teaching Suggestions

- Use the introduction to generate a brief class discussion about how different people are paid. Let the students come up with the examples, however, here are some prompting examples, if needed:
  - professional athletes
  - car salespersons
  - recording musicians
- Most of these people are paid some sort of partial commission that depends on job performance. Example 4 returns to this context.
- Example 1 deals with addition of polynomials. Students who are still struggling with symbolic methods of collecting like terms may benefit from working further with algebra tiles at this point. The desired approach here is to remove brackets and collect like terms.

Common Errors

- Some students may only reverse the sign of the first term when subtracting polynomials, for example,
  $(5x + 4) - (3x - 2)$
  $= 5x + 4 - 3x - 2$.

R_x Use algebra tiles to illustrate that the opposite polynomial must contain the opposite of all terms. Another approach to overcoming this error is to think of distributing -1, for example,
$(5x + 4) - (3x - 2)$
$= (5x + 4) - 1(3x - 2)$

- Some students may mix up integer signs when simplifying double signs, for example,
  $(3y + 4) - (-2y + 7)$
  $= 3y + 4 - 2y - 7$.

R_x Have students rewrite the subtraction statement as an addition statement, using the opposite polynomial, before attempting to simplify integer signs.

Ongoing Assessment

Communicate Your Understanding questions can be used as quizzes to assess students' Communication skills.

Accommodations

Perceptual—Encourage students to colour code the like terms in polynomial expressions, for example, $3x + 5y + 2x + 4y = 5x + 9y$.

- In part c), point out to students to simplify integer signs. Illustrating both methods, collecting like terms and vertical alignment, may help students to better visualize the operations involved. A strong command of integer operations is clearly required by this point.
- Example 2 provides a segue into polynomial subtraction. The focus of this example is on identifying and writing opposite polynomials. Algebra tiles are useful in providing a visual illustration. Symbolically, students should realize that to form an opposite polynomial, you must reverse the sign of each term in the polynomial.
- Example 3 addresses polynomial subtraction. The method is to add the opposite polynomial. Ensure that students take special care in managing integer signs. After rewriting the expression as an addition statement, ensure that students remove the brackets and collect like terms.
- In Example 4, the royalty context is revisited. The first step of the solution is to develop an algebraic expression to model the problem, consisting of the sum of several polynomials. In part a), this expression is then simplified to provide a general solution. Part b) is solved by substituting given information.
- Use **BLM 3.6.1 Practice: Add and Subtract Polynomials** for remediation or extra practice.

Communicate Your Understanding Responses (page 157)

C1. a) Collect any like terms together and use integer rules to find their sum. For example: $5x + 9 + 3x + 4 = 5x + 3x + 9 + 4 = 8x + 13$.

b) Collect any like terms together and use integer rules to subtract them. For example: $13x - 2 - 8x - 7 = 13x - 8x - 2 - 7 = -5x - 9$.

C2. a) The constants were not subtracted correctly: $-3 - 2 = -5$

b) The error occurred when removing the brackets: $-(2y - 5) = -2y + 5$. The final answer should be $2y - 2$.

Practise

When identifying like terms in long expressions, some of the following techniques may be helpful:

- use different colours to underline each group of like terms;
- use underline, double-underline, squiggly underline, etc.;
- always extend the underline to include the sign to the left of the term.

Make sure that students do not begin to identify and collect like terms before removing brackets. This is especially important when subtracting polynomials; have students rewrite these as addition statements first.

Connect and Apply

Students sometimes struggle with setting up algebraic models. Question 6 provides additional scaffolding for this type of problem, because the terms are all given. Ensure that students combine the information to form the algebraic expression. You may wish to use **BLM A8 Application General Scoring Rubric** for question 6 to assist you in assessing your students.

Questions 9 and 10 draw connections between measurement and algebra. Remind students how to find the perimeter. You may wish to use **BLM A9 Communication General Scoring Rubric** for question 10 to assist you in assessing your students.

Extend

Students may wish to investigate question 11 using *The Geometer's Sketchpad*®. Use **BLM T4 *The Geometer's Sketchpad*® 3** or **BLM T5 *The Geometer's Sketchpad*® 4** to support this activity.

Exercise Guide

Category	Question Number
Minimum (essential questions for all students to cover the expectations)	1, 2a), c), e), 3, 4a), c), e), 5a), c), e), g), 6, 7, 8
Typical	1–10
Extension	11, 12