9.1 Add and Subtract Polynomials

Before You added and subtracted integers.
Now You will add and subtract polynomials.
Why? So you can model trends in recreation, as in Ex. 37.

Key Vocabulary
- **monomial**
- **degree**
- **polynomial**
- **leading coefficient**
- **binomial**
- **trinomial**

A **monomial** is a number, a variable, or the product of a number and one or more variables with whole number exponents. The **degree of a monomial** is the sum of the exponents of the variables in the monomial. The degree of a nonzero constant term is 0. The constant 0 does not have a degree.

Monomial	Degree
10	0
$3x$	1
$\frac{1}{2}ab^2$	$1 + 2 = 3$
$-1.8m^5$	5

Not a monomial	Reason
$5 + x$	A sum is not a monomial.
$\frac{2}{n}$	A monomial cannot have a variable in the denominator.
4^a	A monomial cannot have a variable exponent.
x^{-1}	The variable must have a whole number exponent.

A **polynomial** is a monomial or a sum of monomials, each called a *term* of the polynomial. The **degree of a polynomial** is the greatest degree of its terms.

When a polynomial is written so that the exponents of a variable decrease from left to right, the coefficient of the first term is called the **leading coefficient**.

leading coefficient, degree, constant term

$$2x^3 + x^2 - 5x + 12$$

EXAMPLE 1 Rewrite a polynomial

Write $15x - x^3 + 3$ so that the exponents decrease from left to right. Identify the degree and leading coefficient of the polynomial.

Solution

Consider the degree of each of the polynomial's terms.

Degree is 1. Degree is 3. Degree is 0.

$$15x - x^3 + 3$$

The polynomial can be written as $-x^3 + 15x + 3$. The greatest degree is 3, so the degree of the polynomial is 3, and the leading coefficient is -1.

1 PLAN AND PREPARE

Warm-Up Exercises

Transparency Available

Simplify the expression.

1. $5x + 4(2x + 7)$ **$13x + 28$**
2. $9x - 6(x + 2) + 3$ **$3x - 9$**
3. Imported square tiles used for a kitchen floor measure 18 centimeters on one side. What is the area of a floor composed of 50 tiles? Use $A = s^2$ for the area of a tile. **16,200 cm^2**

Notetaking Guide

Transparency Available

Promotes interactive learning and notetaking skills, pp. 188–190.

Pacing

Basic: 1 day
Average: 1 day
Advanced: 1 day
Block: 0.5 block with 9.2
• See *Teaching Guide/Lesson Plan*.

2 FOCUS AND MOTIVATE

Essential Question

Big Idea 1, p. 553

How do you add and subtract polynomials? **Tell students they will learn how to answer this question by using vertical and horizontal formats to find sums and differences of polynomials.**

NCTM STANDARDS

Standard 2: Represent situations using algebraic symbols

Standard 10: Use representations to communicate mathematical ideas

Resource Planning Guide

Chapter Resource Book
- Teaching Guide/Lesson Plan (pp. 3–4)
- Activity Master (p. 5)
- Practice levels A, B, C (pp. 7–9)
- Study Guide (pp. 10–11)
- Catch-up for Absent Students (p. 12)
- Problem Solving Workshop (p. 13)
- Challenge (p. 14)

Workbooks
- Notetaking Guide (pp. 188–190)
- Practice Workbook (pp. 133–134)

Teaching Options
- **Power Presentations CD-ROM** provides dynamic electronic teaching resources for the classroom.
- **Activity Generator CD-ROM** provides editable activities for all ability levels.

Interactive Technology
- Easy Planner
- Power Presentations CD-ROM
- Activity Generator CD-ROM
- Animated Algebra
- Test Generator CD-ROM
- Online Quiz
- eWorkbook
- eEdition
- @HomeTutor

Resources for English Learners
- Quick Reference for English Learners
- Spanish Study Guide
- Multi-Language Visual Glossary
- Student Resources in Spanish

See also the *Algebra 1 Toolkit* for more strategies for meeting individual needs.

BINOMIALS AND TRINOMIALS A polynomial with two terms is called a **binomial**. A polynomial with three terms is called a **trinomial**.

EXAMPLE 2 Identify and classify polynomials

Tell whether the expression is a polynomial. If it is a polynomial, find its degree and classify it by the number of its terms. Otherwise, tell why it is not a polynomial.

	Expression	Is it a polynomial?	Classify by degree and number of terms
a.	9	Yes	0 degree monomial
b.	$2x^2 + x - 5$	Yes	2nd degree trinomial
c.	$6n^4 - 8^n$	No; variable exponent	
d.	$n^{-2} - 3$	No; negative exponent	
e.	$7bc^3 + 4b^4c$	Yes	5th degree binomial

ADDING POLYNOMIALS To add polynomials, add like terms. You can use a vertical or a horizontal format.

EXAMPLE 3 Add polynomials

Find the sum.

a. $(2x^3 - 5x^2 + x) + (2x^2 + x^3 - 1)$ **b.** $(3x^2 + x - 6) + (x^2 + 4x + 10)$

Solution

ALIGN TERMS If a particular power of the variable appears in one polynomial but not the other, leave a space in that column, or write the term with a coefficient of 0.

a. Vertical format: Align like terms in vertical columns.

$$\begin{array}{r} 2x^3 - 5x^2 + x \\ +\quad x^3 + 2x^2 \quad - 1 \\ \hline 3x^3 - 3x^2 + x - 1 \end{array}$$

b. Horizontal format: Group like terms and simplify.

$$(3x^2 + x - 6) + (x^2 + 4x + 10) = (3x^2 + x^2) + (x + 4x) + (-6 + 10)$$
$$= 4x^2 + 5x + 4$$

Animated Algebra at classzone.com

GUIDED PRACTICE for Examples 1, 2, and 3

1. Write $5y - 2y^2 + 9$ so that the exponents decrease from left to right. Identify the degree and leading coefficient of the polynomial. $-2y^2 + 5y + 9$; 2, -2
2. Tell whether $y^3 - 4y + 3$ is a polynomial. If it is a polynomial, find its degree and classify it by the number of its terms. Otherwise, tell why it is not a polynomial. polynomial; 3, trinomial
3. Find the sum $(5x^3 + 4x - 2x) + (4x^2 + 3x^3 - 6)$. $8x^3 + 4x^2 + 2x - 6$

Differentiated Instruction

Below Level To help students gain confidence in recognizing polynomials, have them work with partners to write examples of 1st degree through 6th degree monomials, binomials, and trinomials. Suggest that they create a table to organize their work. Encourage students to write some polynomials with more than one variable per term. Have partners exchange their polynomials so that other partners can check that the polynomials fit the descriptions.

See also the *Algebra 1 Toolkit* for more strategies.

Motivating the Lesson

Tell students that they can add or subtract polynomials to model a real-world situation. For example, if one polynomial models ticket sales for boys' sports and another models ticket sales for girls' sports, they can add the polynomials and evaluate the sum to find total ticket sales.

3 TEACH

Extra Example 1

Write $3b^3 - 4b^4 + b^2$ so that the exponents decrease from left to right. Identify the degree and leading coefficient of the polynomial. $-4b^4 + 3b^3 + b^2$; degree: 4; leading coefficient: -4

Extra Example 2

Tell whether the expression is a polynomial. If it is a polynomial, find its degree and classify it by the number of its terms. Otherwise, tell why it is not a polynomial.

a. $5xy^2$ yes, 3rd degree monomial

b. $3a^{-5}$ no, negative exponent

c. $x^4 + 3x^3 - x$ yes, 4th degree trinomial

d. $\frac{9}{m}$ no, variable in denominator

e. $6a^2c + 5ac^5$ yes, 6th degree binomial

Extra Example 3

Find the sum.

a. $(-2x^2 + 3x - x^3) + (3x^2 + x^3 - 12)$ $x^2 + 3x - 12$

b. $(4x^3 + 2x^2 - 4) + (x^3 - 3x^2 + x)$ $5x^3 - x^2 + x - 4$

Animated Algebra classzone.com

An **Animated Algebra** activity is available on-line for **Example 3**. This activity is also available on the **Power Presentations CD-ROM**.