

# 9.2 Multiply Polynomials



## 1 PLAN AND PREPARE

### Warm-Up Exercises

#### Transparency Available

- Simplify  $-2(9a - b)$ .  $-18a + 2b$
- Simplify  $r^2s \cdot rs^3$ .  $r^3s^4$
- The number of hardback  $h$  and paperback  $p$  books (in hundreds) sold from 1999–2005 can be modeled by  $h = 0.2t^2 - 1.7t + 14$  and  $p = 0.17t^3 - 2.7t^2 + 11.7t + 27$  where  $t$  is the number of years since 1999. About how many books sold in 2003? **5200**

### Notetaking Guide

#### Transparency Available

Promotes interactive learning and notetaking skills, pp. 191–194.

### Pacing

- Basic:** 1 day  
**Average:** 1 day  
**Advanced:** 1 day  
**Block:** 0.5 block with 9.1  
 • See *Teaching Guide/Lesson Plan*.

## 2 FOCUS AND MOTIVATE

### Essential Question

#### Big Idea 1, p. 553

How do you multiply polynomials?  
**Tell students they will learn how to answer this question by using the distributive property to find the product of two polynomials.**

### NCTM STANDARDS

**Standard 8:** Use the language of math to express ideas

**Standard 10:** Use representations to communicate mathematical ideas

#### Before

You added and subtracted polynomials.

#### Now

You will multiply polynomials.

#### Why?

So you can determine areas, as in Example 7.

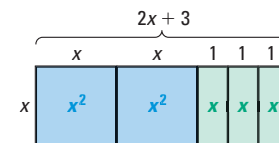
### Key Vocabulary

- polynomial**, p. 554
- binomial**, p. 555

The diagram shows that a rectangle with width  $x$  and length  $2x + 3$  has an area of  $2x^2 + 3x$ . You can also find this product by using the distributive property.

$$x(2x + 3) = x(2x) + x(3) = 2x^2 + 3x$$

In this lesson, you will learn several methods for multiplying polynomials. Each method is based on the distributive property.



### EXAMPLE 1 Multiply a monomial and a polynomial

Find the product  $2x^3(x^3 + 3x^2 - 2x + 5)$ .

$$\begin{aligned} 2x^3(x^3 + 3x^2 - 2x + 5) &= 2x^3(x^3) + 2x^3(3x^2) - 2x^3(2x) + 2x^3(5) \\ &= 2x^6 + 6x^5 - 4x^4 + 10x^3 \end{aligned}$$

Write product.

Distributive property

Product of powers property

### REVIEW PROPERTIES OF EXPONENTS

For help with using the properties of exponents, see p. 489.

### EXAMPLE 2 Multiply polynomials using a table

Find the product  $(x - 4)(3x + 2)$ .

#### Solution

**STEP 1** Write subtraction as addition in each polynomial.

$$(x - 4)(3x + 2) = [x + (-4)](3x + 2)$$

**STEP 2** Make a table of products.

	$3x$	$2$	
$x$	$3x^2$		→
$-4$			
	$3x$	$2$	
$x$	$3x^2$	$2x$	
$-4$	$-12x$	$-8$	

► The product is  $3x^2 + 2x - 12x - 8$ , or  $3x^2 - 10x - 8$ .



### GUIDED PRACTICE for Examples 1 and 2

Find the product.

1.  $x(7x^2 + 4)$   $7x^3 + 4x$

2.  $(a + 3)(2a + 1)$   
 $2a^2 + 7a + 3$

3.  $(4n - 1)(n + 5)$   
 $4n^2 + 19n - 5$

## Resource Planning Guide

### Chapter Resource Book

- Teaching Guide/Lesson Plan (pp. 15–16)
- Practice levels A, B, C (pp. 18–20)
- Study Guide (pp. 21–22)
- Catch-up for Absent Students (p. 23)
- Application (p. 24)
- Challenge (p. 25)

### Workbooks

- Notetaking Guide (pp. 191–194)
- Practice Workbook (pp. 135–136)

### 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.

### EXAMPLE 3 Multiply polynomials vertically

Find the product  $(b^2 + 6b - 7)(3b - 4)$ .

**Solution**

**STEP 1** Multiply by  $-4$ .

$$\begin{array}{r} b^2 + 6b - 7 \\ \times \quad 3b - 4 \\ \hline -4b^2 - 24b + 28 \end{array}$$

**STEP 2** Multiply by  $3b$ .

$$\begin{array}{r} b^2 + 6b - 7 \\ \times \quad 3b - 4 \\ \hline -4b^2 - 24b + 28 \\ 3b^3 + 18b^2 - 21b \end{array}$$

**STEP 3** Add products.

$$\begin{array}{r} b^2 + 6b - 7 \\ \times \quad 3b - 4 \\ \hline -4b^2 - 24b + 28 \\ 3b^3 + 18b^2 - 21b \\ \hline 3b^3 + 14b^2 - 45b + 28 \end{array}$$

#### AVOID ERRORS

Remember that the terms of  $(3b - 4)$  are  $3b$  and  $-4$ . They are *not*  $3b$  and  $4$ .

### EXAMPLE 4 Multiply polynomials horizontally

Find the product  $(2x^2 + 5x - 1)(4x - 3)$ .

$$(2x^2 + 5x - 1)(4x - 3)$$

$$= 2x^2(4x - 3) + 5x(4x - 3) - 1(4x - 3)$$

$$= 8x^3 - 6x^2 + 20x^2 - 15x - 4x + 3$$

$$= 8x^3 + 14x^2 - 19x + 3$$

Write product.

Distributive property

Distributive property

Combine like terms.

**FOIL PATTERN** The letters of the word FOIL can help you to remember how to use the distributive property to multiply binomials. The letters should remind you of the words First, Outer, Inner, and Last.

$$(2x + 3)(4x + 1) = 8x^2 + 2x + 12x + 3$$

### EXAMPLE 5 Multiply binomials using the FOIL pattern

Find the product  $(3a + 4)(a - 2)$ .

$$(3a + 4)(a - 2)$$

$$= (3a)(a) + (3a)(-2) + (4)(a) + (4)(-2)$$

Write products of terms.

$$= 3a^2 + (-6a) + 4a + (-8)$$

Multiply.

$$= 3a^2 - 2a - 8$$

Combine like terms.



**GUIDED PRACTICE** for Examples 3, 4, and 5

Find the product.

4.  $(x^2 + 2x + 1)(x + 2)$   
 $x^3 + 4x^2 + 5x + 2$

5.  $(3y^2 - y + 5)(2y - 3)$   
 $6y^3 - 11y^2 + 13y - 15$

6.  $(4b - 5)(b - 2)$   
 $4b^2 - 13b + 10$

### Motivating the Lesson

You want to know how much wall space you need for a poster surrounded by different borders. If you know the length and width of the poster, you can write an expression that models the total area of the poster and its border. You can then evaluate the expression to determine how much wall space you need.

## 3 TEACH

### Extra Example 1

Find the product

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

$$6x^5 - 3x^4 + 12x^3 - 9x^2$$

### Key Question to Ask for Example 1

- How do you multiply powers that have the same base? **Write the base, add the exponents.**

### Extra Example 2

Find the product  $(x + 4)(2x - 1)$ .

$$2x^2 + 7x - 4$$

### Extra Example 3

Find the product

$$(a^2 + 3a - 4)(2a + 3).$$

$$2a^3 + 9a^2 + a - 12$$

### Extra Example 4

Find the product

$$(2x^2 - x - 2)(3x - 1).$$

$$6x^3 - 5x^2 - 5x + 2$$

### Extra Example 5

Find the product  $(4a + 3)(a + 2)$ .

$$4a^2 + 11a + 6$$

### Differentiated Instruction

**Below Level** Some students may find the FOIL pattern confusing. To help these students, you may want to use algebra tiles to show how the filled-in rectangle corresponds to each letter of the FOIL pattern. After they have a better understanding of the pattern, encourage them to use notecards to write out each step of the pattern. Suggest that they write an example at the top of the card, such as  $(4x + 2)(3x - 1)$ , and then First, Outer, Inner, and Last, each on one line of the card. They should show the step next to each word and explain the step in words.

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