Glencoe McGraw-Hill

Florida Math Connects

Chapter 12 Resource Masters

Contents

Chapter Resource Masters are provided for every chapter in both print and digital formats.

Course 3

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2 3 4 5 6 7 8 9 10 032 18 17 16 15 14 13 12 11 10 09

CONTENTS

AL = Approaching Level BL = Beyond Level

Lesson 12-3

Lesson Resources

A **Explore: Factors of Polynomials**

B **Use the GCF to Factor Polynomials**

C **Explore: Factors of Trinomials**

D **Factor Trinomials**

E **PSI: Use a Graph**

Assessment Resources

Chapter Tests

Teacher's Guide to Using the *Chapter 12 Resource Masters*

The *Chapter 12 Resource Masters* includes the core materials needed for Chapter 12. These materials include information for families, student worksheets, extensions, and assessment options. The answers for these pages appear at the back of this booklet.

All of the materials found in this booklet are included for viewing and printing from the online Teacher Edition.

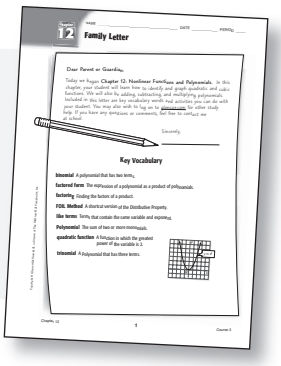
Family Resources

Family Introduction to Course 3 **(Available in Chapter 0)**

- Talks about the focus of the grade level.
- Gives Web site information.

Family Letter

- English and Spanish
- Overview of the chapter
- Key vocabulary
- Provides at-home activities


12 Family Letter

Dear Parent or Guardian,

Today we began Chapter 12, Nonlinear Functions and Polynomials. In this chapter, your student will learn how to identify and graph quadratic and cubic functions. We will also be adding, subtracting, and multiplying polynomials. Included in this letter are key vocabulary words and activities you can do with your student. You may also wish to log on to [illegible] for other study help. If you have any questions or comments, feel free to contact me.

Sincerely,

Key Vocabulary

binomial A polynomial that has two terms.

factored form The [illegible] of a polynomial as a product of polynomials.

factoring Finding the factors of a product.

FOIL Method A shortcut version of the Distributive Property.

like terms Terms that contain the same variable and exponent.

Polynomial The sum of two or more monomials.

quadratic function A function in which the greatest power of the variable is 2.

trinomial A polynomial that has three terms.

Chapter Resources

Are You Ready Worksheets

- Use after the Are You Ready section in the Student Edition.
- AL Review: Approaching-level students
- Practice: On-level students
- BL Apply: Beyond-level students

Chapter Diagnostic Test

- Use to test skills needed for success in the upcoming chapter.
- Retest approaching-level students after the Are You Ready worksheets.

Chapter Pretest

- Quick check of the upcoming chapter's concepts to determine pacing.
- Use before the chapter to gauge students' skill level.
- Use to determine class grouping.

Language Arts Resources

Student Glossary

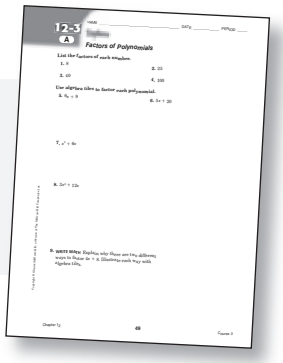
- Includes key vocabulary terms from the chapter.
- Students record definitions and/or examples for each term.
- Students can use the page as a bookmark as they study the chapter.

Practice and Reinforcement

Facts Practice

- Quick recall of concepts needed in the upcoming chapter.
- Use as a timed test to gauge student mastery of prior concepts.

Lesson Resources


12-3 A
Factors of Polynomials

Explore

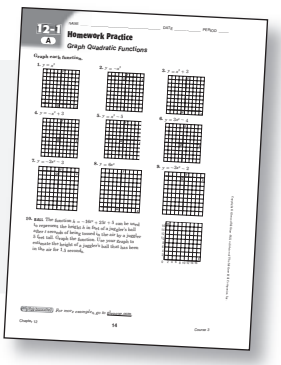
- Provides additional practice for the activities and exercises found in the Student Edition.
- Use as homework for same-day teaching.

Reteach

- Provides vocabulary, key concepts, additional worked-out examples, and exercises.
- Use for students who have been absent.

Skills Practice

- Focuses on the computational nature of the lesson.
- Use as an additional practice.
- Use as homework for second-day teaching.


12-1 A
Homework Practice
Graph Quadratic Functions

Homework Practice

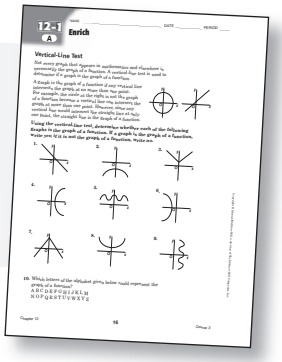
- Mimics the types of problems found in the Practice and Problem Solving of the Student Edition.
- Use as an additional practice.
- Use as homework for second-day teaching.

Problem-Solving Practice

- Includes word problems that apply the concepts of the lesson.
- Use as an additional practice.
- Use as homework for second-day teaching.

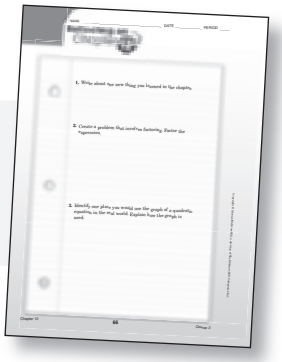
Enrich

- Provides an extension of the concepts, offers a historical or multicultural look at the concepts, or widens students' perspectives on the mathematics.
- For use with all levels of students.



Technology Activities

- Presents ways in which technology can be used with the concepts in some of the lessons.
- Use as an alternative approach to teaching the concept.
- Use as part of the lesson presentation.



Assessment Resources

Reflecting on Chapter 12

- Three open-ended questions
- Allows students to write about mathematics.

Chapter Quizzes

- Free-response questions
- One quiz for each multi-part lesson

Vocabulary Test

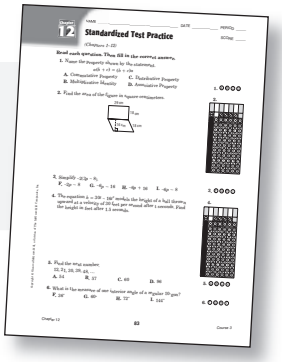
- Includes a list of vocabulary words and questions to assess students' knowledge of those words.
- Use in conjunction with one of the Chapter Tests.

Chapter Tests

- AL 1A-1B Approaching-level students
  - Contains multiple-choice questions.
- 2A-2B On-level students
  - Contains both multiple-choice and free-response questions.
- BL 3A-3B Beyond-level students
  - Contains free-response questions.
- Tests A and B are the same format with different numbers.
  - Use when students are absent or for different rows.

Standardized Test Practice

- Test is cumulative.
- Includes multiple-choice and short-response questions.

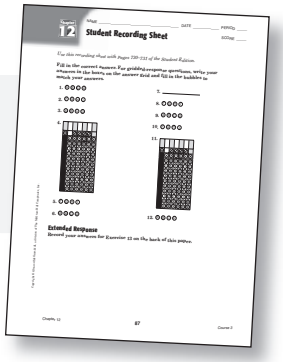


Extended-Response Test

- Contains performance-assessment tasks
- Sample answers are included.

Extended-Response Rubric

- The scoring rubric for the Extended-Response Test.


Chapter 12

Student Recording Sheet

Use this recording sheet with pages 720–721 of the Student Edition.

Fill in the correct answer. For grid-in response questions, write your answer in the boxes, on the answer grid and fill in the bubbles to match your answers.

1. ○○○○
2. ○○○○
3. ○○○○
4.
5.
6. ○○○○
7. ○○○○
8. ○○○○
9. ○○○○
10. ○○○○
11.
12. ○○○○

Extended Response

Record your answers for Exercise 12 on the back of this paper.

Chapter 12 87 Course 2

Student Recording Sheet

- Corresponds with the Test Practice at the end of the Student Edition chapter.

Chapter Project Rubric

- The scoring rubric for the Chapter Project found in the Teacher Edition.

Answers

Chapter and Lesson Resources

- Chapter Resources, Facts Practice, and Lesson Resources are provided as reduced pages with answers appearing in black.

Assessments

- Full-size answer keys are provided for the assessment masters.

Chapter 12

NAME _____ DATE _____ PERIOD _____

Family Letter

Dear Parent or Guardian:

Today we began **Chapter 12: Nonlinear Functions and Polynomials.** In this chapter, your student will learn how to identify and graph quadratic and cubic functions. We will also be adding, subtracting, and multiplying polynomials. Included in this letter are key vocabulary words and activities you can do with your student. You may also wish to log on to glencoe.com for other study help. If you have any questions or comments, feel free to contact me at school.

Sincerely,

_____

Key Vocabulary

binomial A polynomial that has two terms.

factored form The expression of a polynomial as a product of polynomials.

factoring Finding the factors of a product.

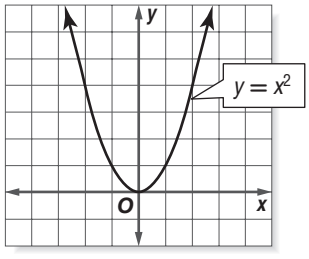
FOIL Method A shortcut version of the Distributive Property.

like terms Terms that contain the same variable and exponent.

polynomial The sum of two or more monomials.

quadratic function A function in which the greatest power of the variable is 2.

trinomial A polynomial that has three terms.



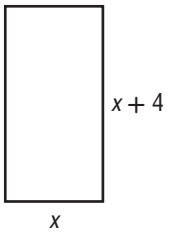
NAME _____ DATE _____ PERIOD _____

At-Home Activities

Hands-On Activity

Materials: picture frame, paper, pencil

- Find a picture frame or similar object in your home.
- Find the width of the frame. Use x to represent the width.
- Now find the length of the frame. Write the length as a function of the width; for example, $(x + 4)$.
- Write an expression to find the area of the frame using the monomials you created using the frame's dimensions. Remember, $A = b \times h$.
- Draw a sketch of the frame and label it with the monomials you used to show how you found the area.



Real-World Activity

- Think of a business you would like to start someday.
- Assume that you will make $6x^2 + 4{,}500$ dollars per year, with x being the number of products you sell or make.
- Decide how much money you would like the business to earn each year.
- Find the number of products you would have to sell or make in order to earn that much money.
- Show your work.

NOMBRE_____ FECHA _____ PERÍODO ____

Carta a la familia

Estimado padre o apoderado:

Hoy comenzamos el **Cap tulo 12: Funciones no lineales y polinomios.** En este cap tulo, su estudiante aprender a identificar y a graficar funciones c bicas y cuadr ticas. Adem s, sumaremos, restaremos y multiplicaremos polinomios. En esta carta se incluyen palabras del vocabulario clave y actividades que pueden realizar con su estudiante. Si desean obtener m s ayuda para el estudio, visiten glencoe.com. Si tienen alguna pregunta o desean hacer alg n comentario, pueden contactarme en la escuela.

Sinceramente,

_____

Vocabulario clave

binomio Polinomio con dos términos.

forma factorizada Expresión de un polinomio como el producto de polinomios.

factorizar Hallar los factores de un producto.

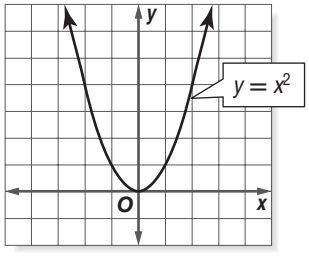
método FOIL Versión abreviada de la propiedad distributiva.

términos semejantes Términos que contienen la misma variable y el mismo exponente.

polinomio Suma de dos o más monomios.

función cuadrática Función en la cual la potencia más alta de la variable es 2.

trinomio Polinomio con tres términos.



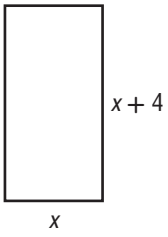
NOMBRE_____ FECHA _____ PERÍODO ____

Actividades para el hogar

Actividad manual

Materiales: portarretrato, papel, lápiz

- Encuentren un portarretratos u objeto similar en sus casas.
- Calculen el ancho del portarretratos. Sea x el ancho.
- Ahora calculen el largo del portarretratos. Escriban el largo como una función del ancho; por ejemplo, $(x + 4)$.
- Escriban una expresión para calcular el área del portarretratos usando el monomio que crearon con las dimensiones del portarretratos. Recuerden $A = b \times h$.
- Tracen un bosquejo del portarretratos y rotúlenlo con los monomios que usaron a fin de demostrar cómo calcularon el área.



Actividad concreta

- Piensen en alguna empresa que les gustaría comenzar algún día.
- Imaginen que ganarán $6x^2 + 4{,}500$ dólares por año. Aquí, x es el número de productos que venderán o fabricarán.
- Decidan cuánto dinero les gustaría que generara la empresa cada año.
- Calculen el número de productos que deberán vender o fabricar para generar esa cantidad de dinero.
- Muestren los cálculos.

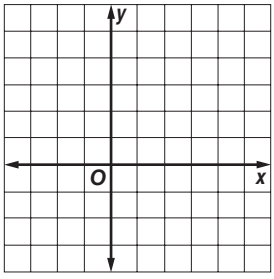
NAME _____ DATE _____ PERIOD _____

Are You Ready for Chapter 12?

Practice

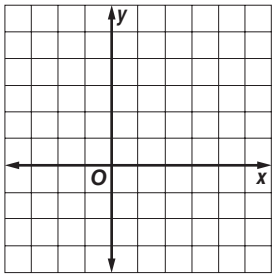
1. Graph $y = 5x - 2$.

1.



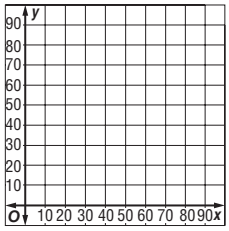
2. Graph $y = \frac{1}{2}x + 1$.

2.



3. **TREES** Mr. Johnston wants to plant trees on his farm. Pine tree seedlings cost \$0.95 each. The equation $y = 0.95x$ describes the total cost y for x seedlings. Graph the function. Then use the graph to estimate the cost for 40 seedlings.

3. _____



Write each expression in simplest form.

4. $3x - 14 + 12x + 7 - x + 10$

4. _____

5. $19 + 2z - 4z + 23 - z - 40 + 6z$

5. _____

6. $n + 11 - 5n - 16 + 9n - 2n + 1$

6. _____

7. $17d + 26 - 8d - 10 - 13d + 8$

7. _____

8. **PRACTICE** The drama club practiced x hours on Monday, $2x$ hours on Wednesday, $2x$ hours on Friday, and 4 hours on Saturday for the upcoming play. Write an expression in simplest form to represent the total number of hours they practiced for the play.

8. _____

Get Connected *For more examples, go to* glencoe.com.

NAME _____ DATE _____ PERIOD _____

Are You Ready for Chapter 12?

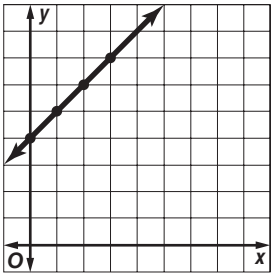
Review

You can graph equations by making a table of values and graphing the ordered pairs.

Example 1 **Graph $y = x + 4$.**

First, make a table of values. Then, graph the ordered pairs and connect the points.

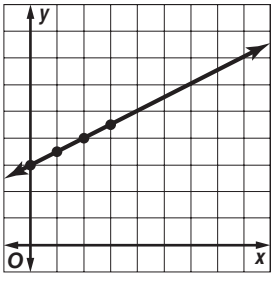
x	y	(x, y)
0	4	(0, 4)
1	5	(1, 5)
2	6	(2, 6)
3	7	(3, 7)



Example 2 **Graph $y = \frac{1}{2}x + 3$.**

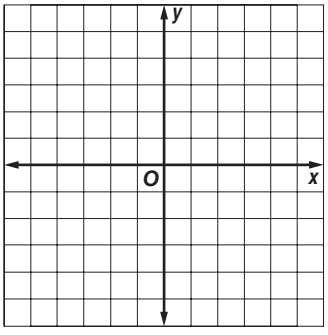
First, make a table of values. Then, graph the ordered pairs and connect the points.

x	y	(x, y)
0	3	(0, 3)
1	$3\frac{1}{2}$	$\left(1, 3\frac{1}{2}\right)$
2	4	(2, 4)
3	$4\frac{1}{2}$	$\left(3, 4\frac{1}{2}\right)$

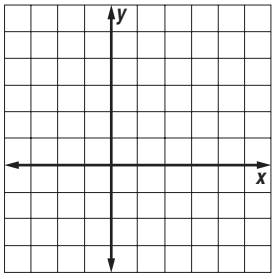


Exercises **Graph each equation.**

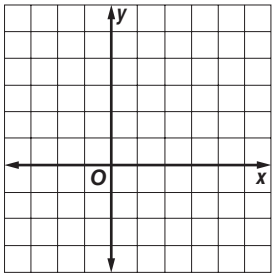
1. $y = 5x$



2. $y = \frac{1}{2}x + 2$



3. $y = x - 3$

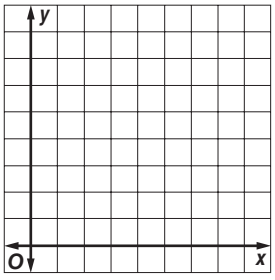


NAME _____ DATE _____ PERIOD _____

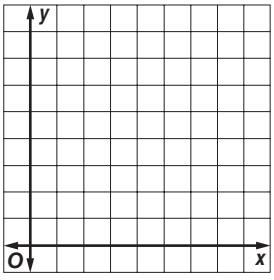
Are You Ready for Chapter 12?

Apply

1. PHONES Terese's telephone plan costs \$0.12 per minute for long distance. The equation $y = 0.12x$ describes how much it costs y to talk for x minutes. Graph the function. Then use the graph to estimate the cost of talking for 8 minutes long distance.



2. TRACK The distance around the school track, or a "lap," is 0.75 mile. The equation $y = 0.75x$ describes how many miles y a runner has run after x laps. Graph the function. Then use the graph to estimate the number of miles in 5 laps.



3. HOMEWORK Saquan spent x minutes working on homework on Monday, $3x$ minutes on Tuesday, 20 minutes on Wednesday, and x minutes on Thursday. Write an expression in simplest form to represent the total amount of time he spent working on homework.

4. FACTORY A local beverage factory produced x gallons of beverage on Monday, $2x$ gallons on Tuesday, $2x$ gallons on Wednesday, x gallons on Thursday, and 240 gallons on Friday. Write an expression in simplest form to represent the total number of gallons of beverage produced.

5. TAXI A taxi driver drove x miles in January, $3x$ miles in February, $2x$ miles in March, and 1,200 miles in April. Write an expression in simplest form to represent the total number of miles he drove.

6. SALES Brett, Renee, Jaleel, and Leona sold fruit to raise money for their school. Brett sold x boxes, Renee sold $4x$ boxes, Jaleel sold $3x$ boxes, and Leona sold 48 boxes. Write an expression in simplest form to represent the total number of boxes they sold.

Chapter 12

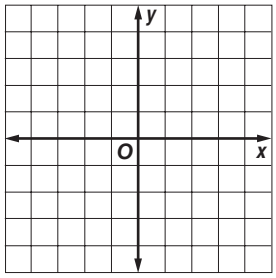
NAME _____ DATE _____ PERIOD _____

Diagnostic Test

Graph each equation.

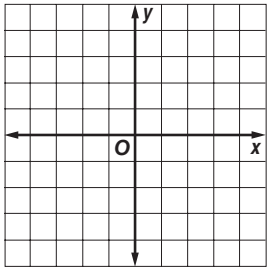
1. $y = x - 1$

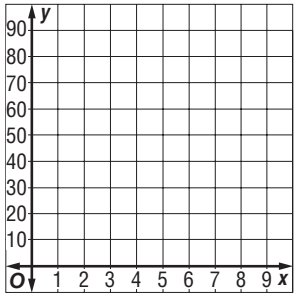
1.



2. $y = 2x + 1$

2.





3. **RESTAURANT** The Elberton family eats at a restaurant for $8.50 per person. The equation $y = 8.5x$ describes the entire cost y for x number of people. Graph the function. Then use the graph to estimate the cost for 5 people to eat.

3. _____

Write each expression in simplest form.

4. $4n - 6 - 2n + 8n + 9 - n$

4. _____

5. $7t + 12 + 3t - 5t - 11 + 4$

5. _____

6. $s - 9 - 1 + 11s + 14 - 8s + 2s - 6$

6. _____

7. $18 - 9p + 8p + 19 + 2 - 3p - 5p - 12$

7. _____

8. **MONEY** Dawson deposited x dollars into his savings in January, $2x$ dollars in February, $85 in March, and x dollars in April. Write an expression in simplest form to represent the total amount of money he deposited into his savings account.

8. _____

Chapter 12

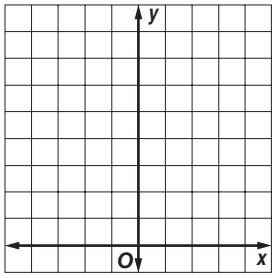
NAME _____ DATE _____ PERIOD _____

Pretest

Graph each equation.

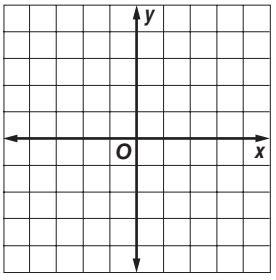
1. $y = x^2 + 2$

1.



2. $y = x^3 - 1$

2.



3. Simplify the polynomial $4x - 8 + 3x + 5x^2$. **3.** _____

Add or subtract.

4. $(3x + 2) + (x + 2)$ **4.** _____

5. $(4x + 1) - (2x + 3)$ **5.** _____

Multiply.

6. $x(x + 7)$ **6.** _____

7. $(x + 1)(x + 5)$ **7.** _____

Factor each polynomial using the GCF. If the polynomial cannot be factored, write *cannot be factored.*

8. $25x^2 + 35x$ **8.** _____

9. $x^2 + 4x + 4$ **9.** _____

10. $x^2 + 4x + 1$ **10.** _____

Chapter 12

NAME _____ DATE _____ PERIOD _____

Student Glossary

This is an alphabetical list of new vocabulary terms you will learn in Chapter 12. Fold the page vertically and use it as a bookmark. As you study the chapter, write each term's definition or description in as few words as possible.

Vocabulary Word	Definition/Description/Example
binomial	
factored form	
factoring	
FOIL method	
like terms	
polynomial	
quadratic function	
trinomial	

Fold over

NAME _____ DATE _____ PERIOD _____

Facts Practice

Write each expression in simplest form

1. $9 - 18 + 2 + 12$	**2.** $14 - 3 - 8 + 11$	**3.** $-1 + 7 - 3 - 6$	**4.** $13 - 4 + 7 + 8$
5. $-22 + 1 + 3$	**6.** $17 - 18 + 2 - 4$	**7.** $4 + 8 - 7 + 1$	**8.** $-7 - (-12)$
9. $3 - (-5) + 16$	**10.** $30 - 4 - (-18)$	**11.** $19 - 1 + 2 + 7$	**12.** $4 + 2 - 3 + 4$
13. $41 + 12 - 2 + 9$	**14.** $-13 - 7 - 15$	**15.** $8 + 4 - 8 - 3$	**16.** $-9 + 18 + 17$
17. $12 + 3 - (-17)$	**18.** $35 - 8 + 2 + 12$	**19.** $13 - 7 - 4 + 9$	**20.** $5 + 14 - 3 + 12$

NAME _____ DATE _____ PERIOD _____

12-1 A

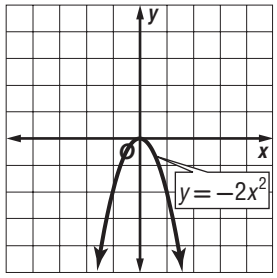
Reteach

Graph Quadratic Functions

A **quadratic function,** such as $A = s^2$, is a function in which the greatest power of the variable is 2. Its graph is U-shaped, opening upward or downward.

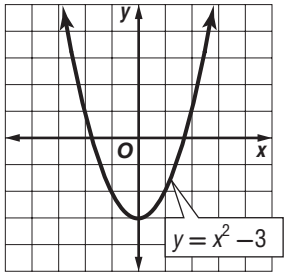
Example 1 **Graph $y = -2x^2$.**

x	$-2x^2$	y	(x, y)
-2	$-2(2)^2 = -8$	-8	$(-2, -8)$
-1	$-2(-1)^2 = -2$	-2	$(-1, -2)$
0	$-2(0)^2 = 0$	0	$(0, 0)$
1	$-2(1)^2 = -2$	-2	$(1, -2)$
2	$-2(2)^2 = -8$	-8	$(2, -8)$



Example 2 **Graph $y = x^2 - 3$.**

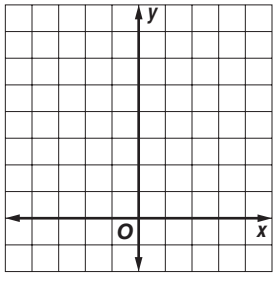
x	$x^2 - 3$	y	(x, y)
-2	$(-2)^2 - 3 = 1$	1	$(-2, 1)$
-1	$(-1)^2 - 3 = -2$	-2	$(-1, -2)$
0	$(0)^2 - 3 = -3$	-3	$(0, -3)$
1	$(1)^2 - 3 = -2$	-2	$(1, -2)$
2	$(2)^2 - 3 = 1$	1	$(2, 1)$



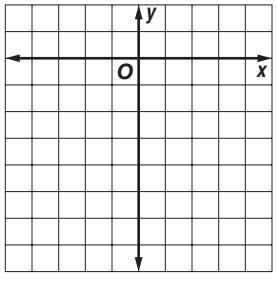
Exercises

Graph each function.

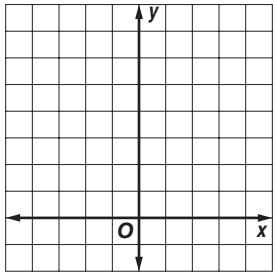
1. $y = 2x^2$



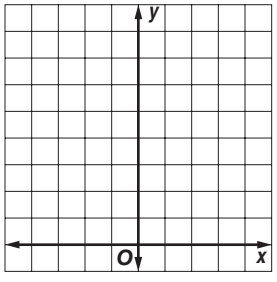
2. $y = -0.5x^2$



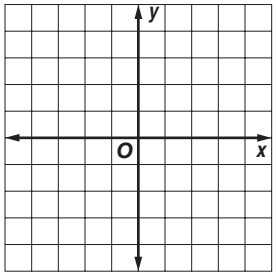
3. $y = x^2 - 1$



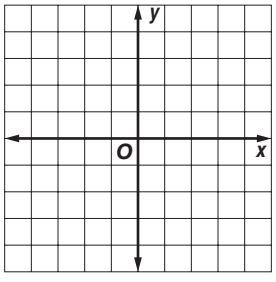
4. $y = 2x^2 + 4$



5. $y = -x^2 - 3$



6. $y = -3x^2 + 1$



NAME _____ DATE _____ PERIOD _____

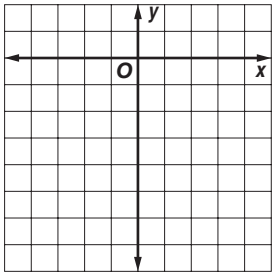
12-1
A

Skills Practice

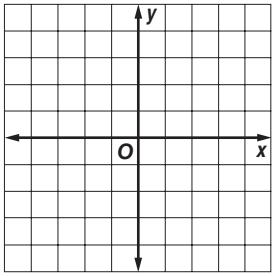
Graph Quadratic Functions

Graph each function.

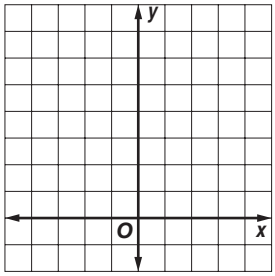
1. $y = -4x^2$



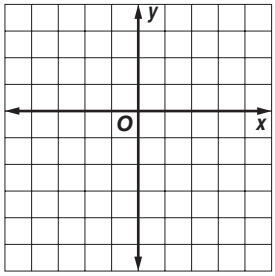
2. $y = 6x^2$



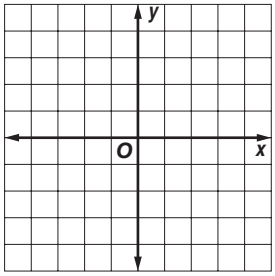
3. $y = x^2 + 4$



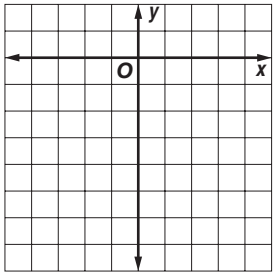
4. $y = x^2 - 5$



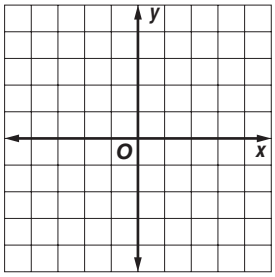
5. $y = -x^2 + 3$



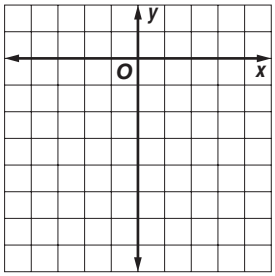
6. $y = -x^2 - 1$



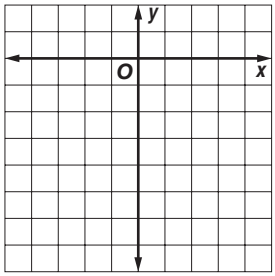
7. $y = 2x^2 - 3$



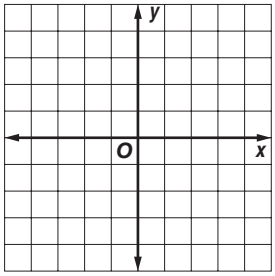
8. $y = -2x^2 + 1$



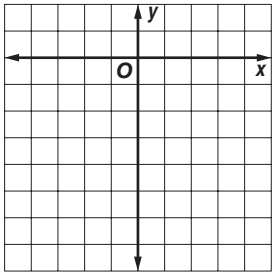
9. $y = -2x^2 - 2$



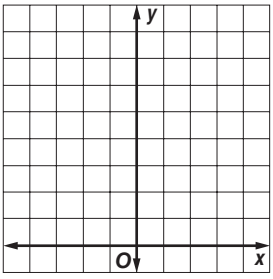
10. $y = 3x^2 + 1$



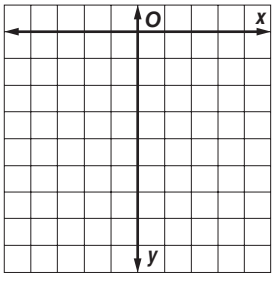
11. $y = -3x^2 + 3$



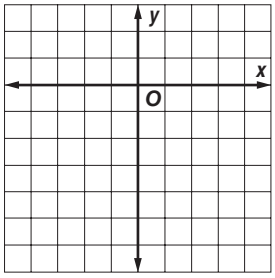
12. $y = 5x^2 + 2$



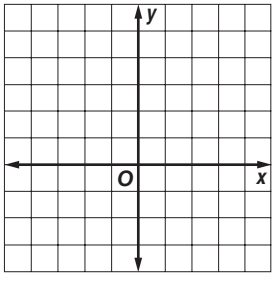
13. $y = -x^2 - 1$



14. $y = -6x^2 + 1$



15. $y = 3x^2 - 2$



NAME _____ DATE _____ PERIOD _____

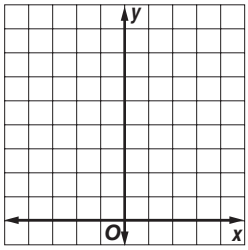
12-1 A

Homework Practice

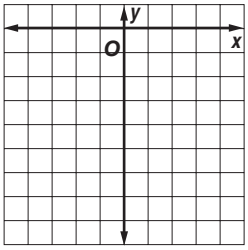
Graph Quadratic Functions

Graph each function.

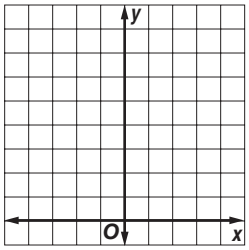
1. $y = x^2$



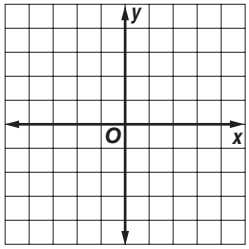
2. $y = -x^2$



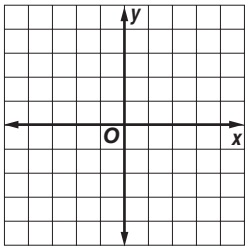
3. $y = x^2 + 3$



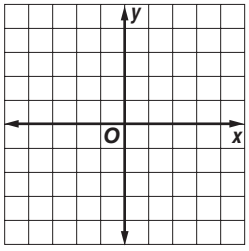
4. $y = -x^2 + 3$



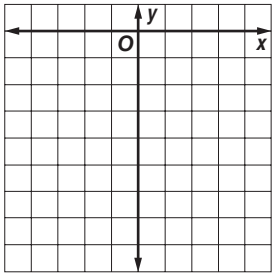
5. $y = x^2 - 5$



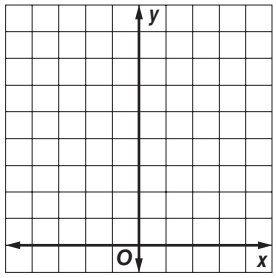
6. $y = 3x^2 - 4$



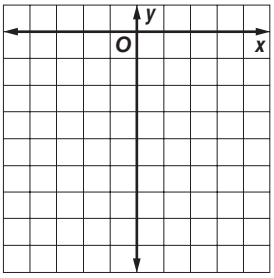
7. $y = -2x^2 - 3$



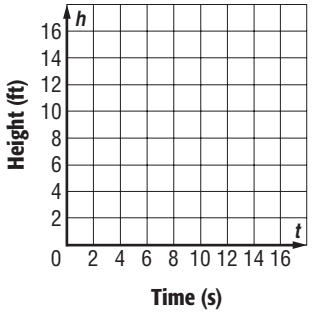
8. $y = 6x^2$



9. $y = -3x^2 - 2$



10. BALL The function $h = -16t^2 + 25t + 5$ can be used to represent the height h in feet of a juggler's ball after t seconds of being tossed in the air by a juggler 5 feet tall. Graph the function. Use your graph to estimate the height of a juggler's ball that has been in the air for 1.5 seconds.



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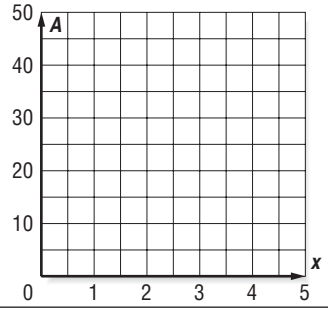
12-1 A

Problem-Solving Practice

Graph Quadratic Functions

GEOMETRY For Exercises 1–3, use the following information.
The quadratic equation $A = 6x^2$ models the area of a triangle with base $3x$ and height $4x$.

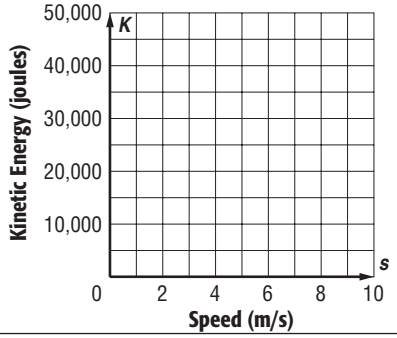
1. Graph the equation. Explain why you only need to graph the function in the upper right quadrant.



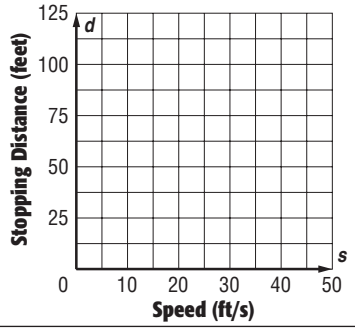
2. Explain how to find the area of the triangle when $x = 3$ inches. Then find the area.

3. Explain how to use your graph to determine the value of x when the area is 24 square inches. Then find the base and height of the triangle when its area is 24 square inches.

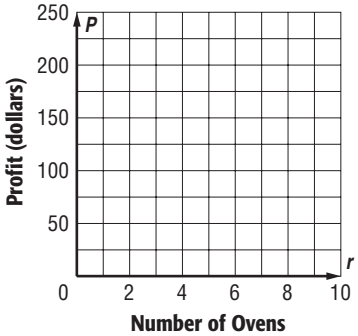
4. PHYSICS The quadratic equation $K = 500s^2$ models the kinetic energy in joules of a 1,000-kilogram car moving at a speed of s meters per second. Graph this function. Then use your graph to estimate the kinetic energy at a speed of 8 meters per second.



5. CARS The quadratic equation $d = \frac{s^2}{20}$ models the stopping distance in feet of a car moving at a speed of s feet per second. Graph this function. Then use your graph to estimate the stopping distance at a speed of 40 feet per second.



6. BUSINESS The quadratic equation $p = 50 + 2r^2$ models the gross profit made by a factory that produces r ovens. Graph this function. Then use your graph to estimate the profit for 5 ovens.



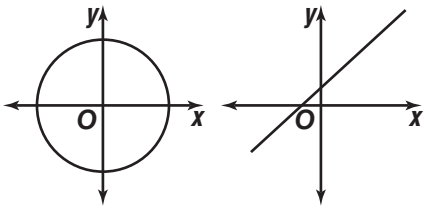
NAME _____ DATE _____ PERIOD _____

12-1 A Enrich

Vertical-Line Test

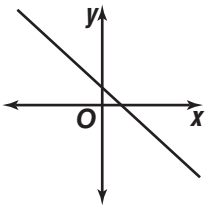
Not every graph that appears in mathematics and elsewhere is necessarily the graph of a function. A vertical-line test is used to determine if a graph is the graph of a function.

A graph is the graph of a function if any vertical line intersects the graph at no more than one point. For example, the circle at the right is not the graph of a function because a vertical line can intersect the graph at more than one point. However, since any vertical line would intersect the straight line at only one point, the straight line is the graph of a function.



Using the vertical-line test, determine whether each of the following graphs is the graph of a function. If a graph is the graph of a function, write *yes*; if it is not the graph of a function, write *no*.

1.



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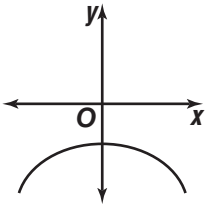

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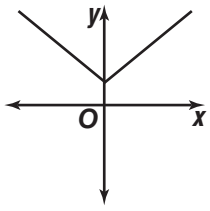

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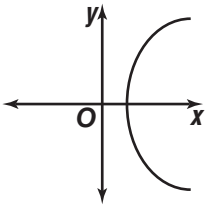

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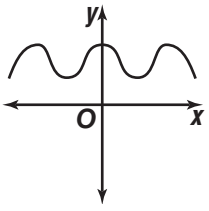

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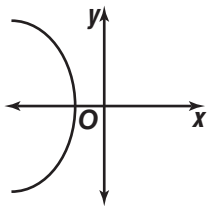

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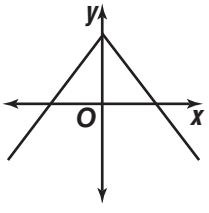
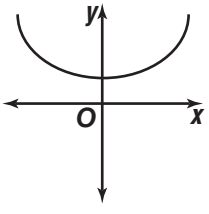


8.



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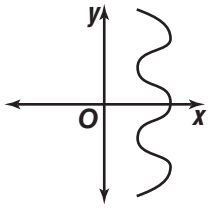

10. Which letters of the alphabet given below could represent the graph of a function?

A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z

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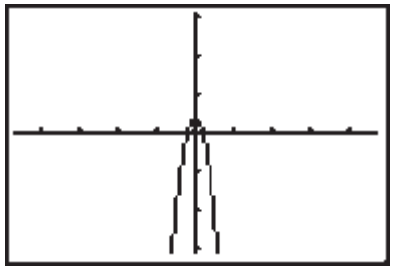
12-1 A

TI-73 Activity

Graph Quadratic Functions

Use your calculator to graph and investigate quadratic functions.

Example **Graph the function $y = -x^2 + 4$. Write the coordinates of the points where the graph crosses the x-axis and the coordinates of the highest or lowest point. Complete a function table for $x = -3, -2, 0, 1,$ and 2.**

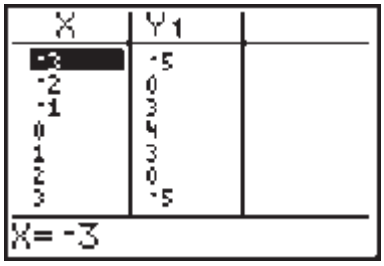


Step 1 Enter the equation of the function.

[Y=] [CLEAR] [(–)] [x] [x^2] [+] 4

Step 2 Set the window and graph the function. Choose the integer window.

[ZOOM] 6 [ZOOM] 0 [ENTER]



Step 3 Use [TRACE] and the ◀ ◀ keys to locate points on the graph. The highest point has coordinates (0, 4). The graph crosses the x-axis at two points, (−2, 0) and (2, 0).

Step 4 Use TABLE to find points on the graph of this function. Set Tbl Start to −3 and △TBL to 1.

[2nd] [TBLSET] [(–)] 3 [ENTER] 1 [2nd] [TABLE]

Exercises

Graph each function. Write the coordinates of the points where the graph crosses the x-axis (if any). Write the coordinates of the highest or lowest point. Complete the function table. Sketch the graph. Mark the function table points on the graph.

1. $y = x^2 - 9$

x	y
−3	
−2	
0	
3	
4	

2. $y = -x^2 - 1$

x	y
−2	
0	
1	
2	
4	

NAME _____ DATE _____ PERIOD _____

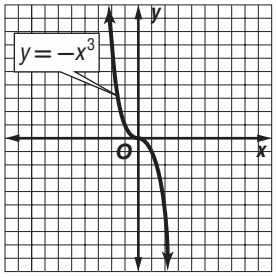
12-1 B Reteach

Graph Cubic Functions

A **cubic function,** such as $A = s^3$, is a function in which the greatest power of the variable is 3. Its graph is a curve. You can graph cubic functions by making a table of values.

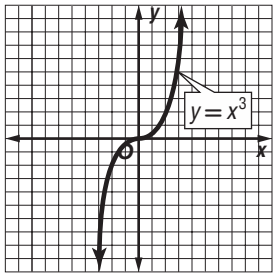
Example 1 **Graph $y = -x^3$.**

x	$y = -x^3$	(x, y)
-2	$-(-2)^3$	$(-2, 8)$
-1	$-(-1)^3$	$(-1, -1)$
0	$-(0)^3$	$(0, 0)$
1	$-(1)^3$	$(1, -1)$
2	$-(2)^3$	$(2, -8)$



Example 2 **Graph $y = x^3$.**

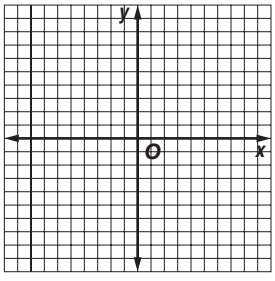
x	$y = x^3$	(x, y)
-1.5	$(-1.5)^3 \approx -3.4$	$(-1.5, -3.4)$
-1	$(-1)^3 = -1$	$(-1, -1)$
0	$(0)^3 = 0$	$(0, 0)$
1	$(1)^3 = 1$	$(1, 1)$
1.5	$(1.5)^3 \approx 3.4$	$(1.5, 3.4)$



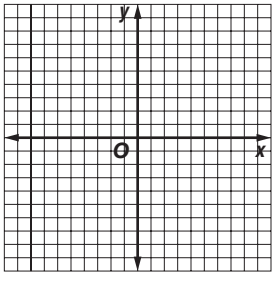
Exercises

Graph each function.

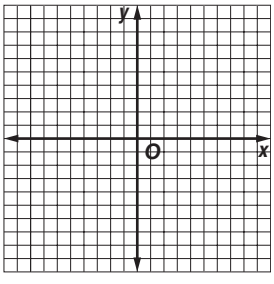
1. $y = x^3 + 1$



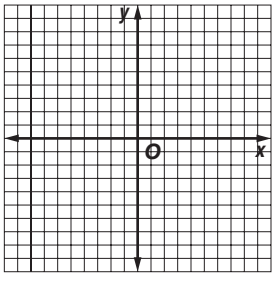
2. $y = x^3 - 2$



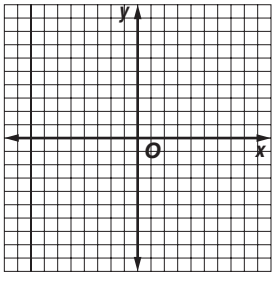
3. $y = 2x^3$



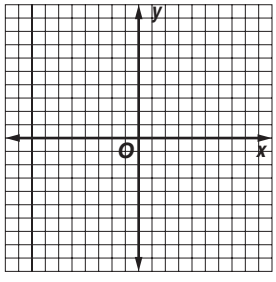
4. $y = 2x^3 - 1$



5. $y = 3x^3 + 1$



6. $y = -x^3 - 1$



NAME _____ DATE _____ PERIOD _____

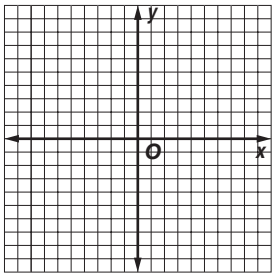
12-1 B

Skills Practice

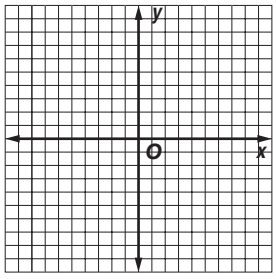
Graph Cubic Functions

Graph each function.

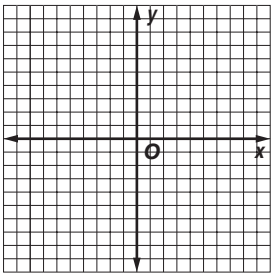
1. $y = 2x^3 + 1$



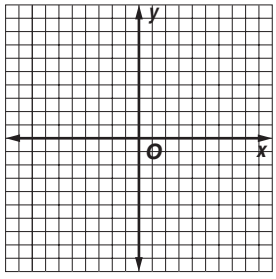
2. $y = -2x^3$



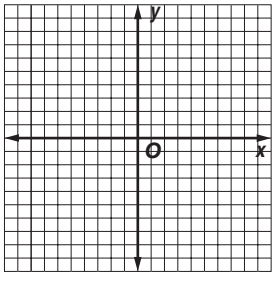
3. $y = x^3 - 3$



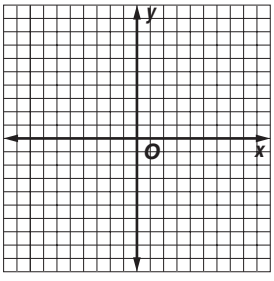
4. $y = -3x^3$



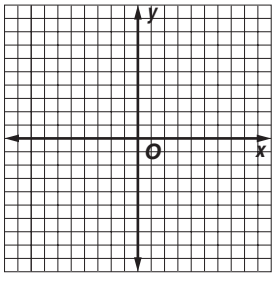
5. $y = -x^3 - 2$



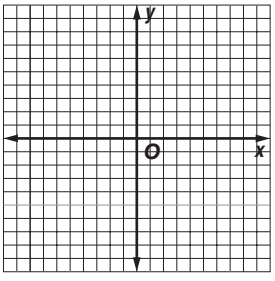
6. $y = 2x^3 - 2$



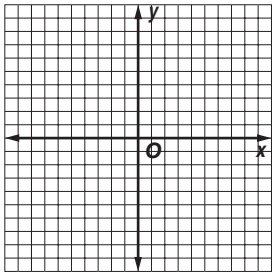
7. $y = x^3 + 3$



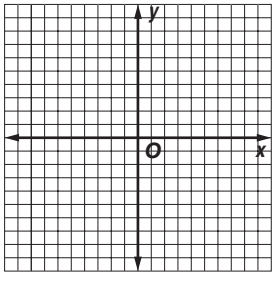
8. $y = -3x^3 - 2$



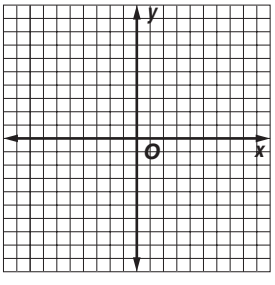
9. $y = -x^3 + 1$



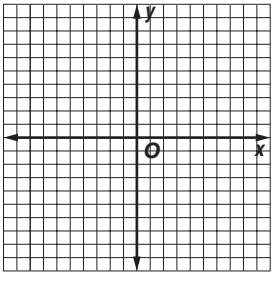
10. $y = -2x^3 + 2$



11. $y = -2x^3 - 2$



12. $y = x^3 + 4$



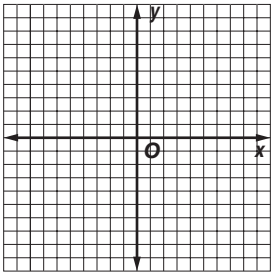
NAME _____ DATE _____ PERIOD _____

12-1 B Homework Practice

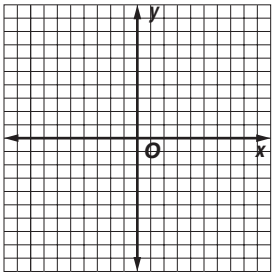
Graph Cubic Functions

Graph each function.

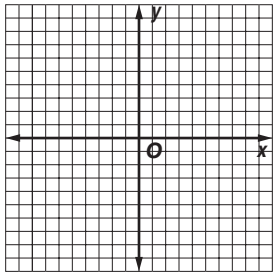
1. $y = 0.1x^3 + 1$



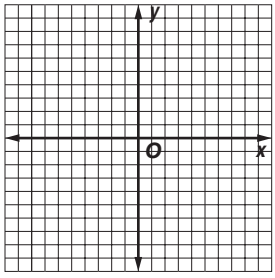
2. $y = \frac{1}{4}x^3$



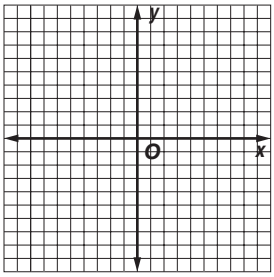
3. $y = 0.2x^3$



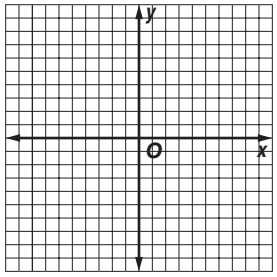
4. $y = \frac{1}{3}x^3$



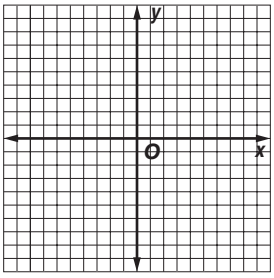
5. $y = -4x^3$



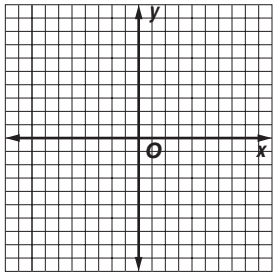
6. $y = \frac{1}{2}x^3$



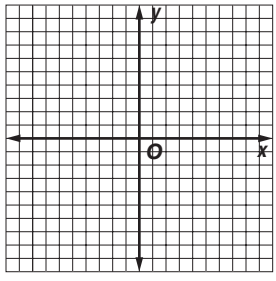
7. $y = -\frac{1}{4}x^3$



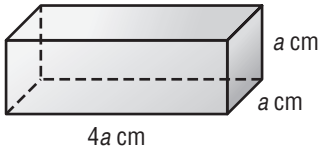
8. $y = -0.2x^3$

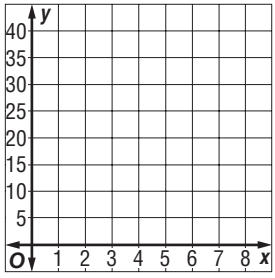


9. $y = 0.1x^3$



10. MEASUREMENT Write a function to find the volume of the prism at the right. Then graph the function in the first quadrant. Use your graph to estimate the volume of the prism if $a = 2$ centimeters.





Get Connected *For more examples, go to* glencoe.com.

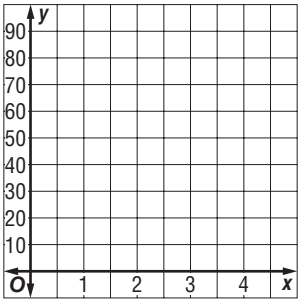
NAME _____ DATE _____ PERIOD _____

12-1 B

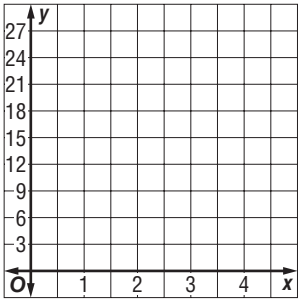
Problem-Solving Practice

Graph Cubic Functions

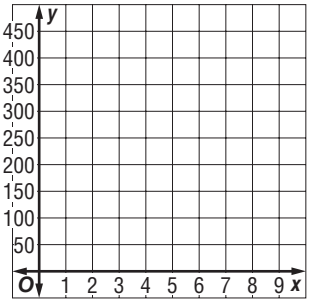
1. MEASUREMENT A rectangular prism with a square base of side length x centimeters has a height of $(x + 2)$ centimeters. Write the function for the volume V of the prism. Graph the function. Then estimate the dimensions of the box that would give a volume of approximately 96 cubic centimeters.



2. MEASUREMENT A pyramid with a square base of side length x inches has a height of $(x + 4)$ inches. Write the function for the volume V of the pyramid. Graph the function. Then estimate the length of one side of the square base of the pyramid if the volume is approximately 21 cubic inches.



3. MEASUREMENT The formula for the volume V of a basketball is given by the equation $V = \frac{4}{3}\pi r^3$ where r represents the radius of the ball. Graph this function. Then estimate the length of the radius if the volume of the basketball is approximately 463 cubic inches.



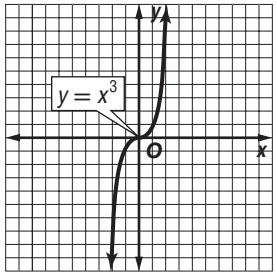
4. MEASUREMENT Explain why only quadrant I is used when creating a table or graph involving volume.

NAME _____ DATE _____ PERIOD _____

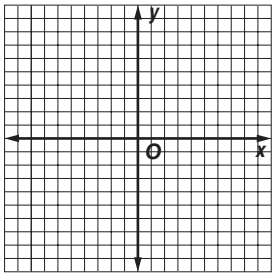
12-1 B Enrich

Graph Cubic Functions

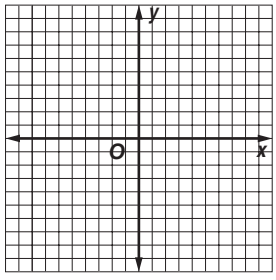
The graph of x^3 is shown below.



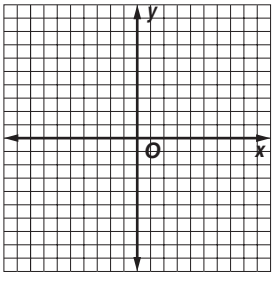
1. Graph $x^3 + 1$. What happens when you add a positive number to x^3?



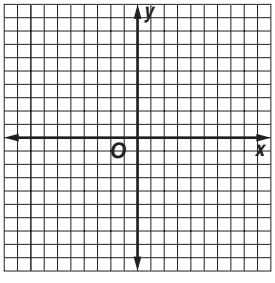
2. Graph $x^3 - 1$. What happens when you subtract a positive number from x^3?



3. Graph $2x^3$. What happens when you multiply x^3 by a positive number?



4. Graph $-3x^3$. What happens when you multiply x^3 by a negative number?



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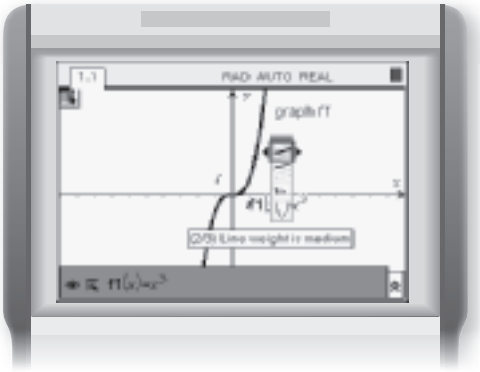
12-1
B

TI-Nspire Activity

Compare Graphs of Cubic Functions

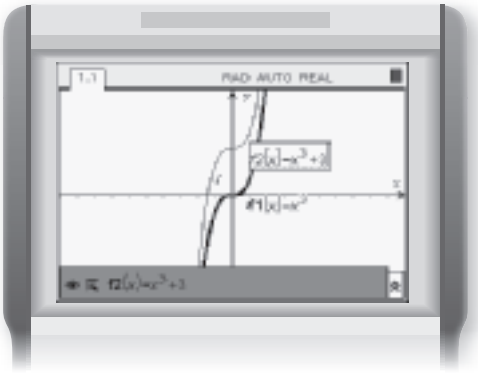
You can use the TI-Nspire to explore and compare the graphs of cubic functions.

Open a **Graphs & Geometry** page. In the function entry line, type x^3. To enter an exponent, press the key with the carat symbol (^).
Press enter.



Press menu > Actions > Attributes, move the cursor to the graph, and press enter. Press the right arrow key to change the line weight to medium. Press enter.

Press esc to exit the Actions tool and press tab to return to the function entry line. Type $x^3 + 3$ and press enter. The second graph is shown.



To continue to compare graphs of other cubic functions to the graph of $f(1) = x^3$, you can double-click on the function rule for $f(2)$ in the graph area and type the new rule.

Exercises

Enter each rule for $f(2)$. Sketch the graph of $f(2)$ on the given screen.

1. $f(2) = (x + 5)^3$

2. $f(2) = -x^3$

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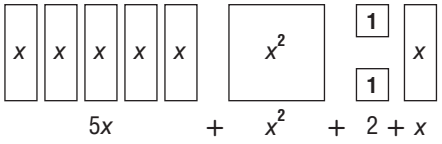
12-2 A

Reteach

Polynomials

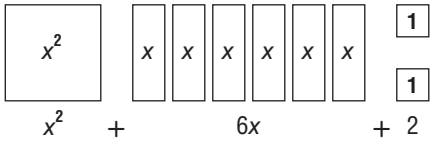
A **polynomial** is a monomial or a sum of monomials. The monomials are called terms of the polynomial. **Like terms** are terms that contain the same variable and exponent. When simplifying polynomials, combine like terms and arrange them so the powers of the variable are in descending order.

Example 1 **Simplify $5x + x^2 + 2 + x$.**



Group tiles with the same shape.

Then write the polynomial.



So, $5x + x^2 + 2 + x = x^2 + 6x + 2$.

Example 2 **Simplify $2x - 3 + 1 - 3x$.**

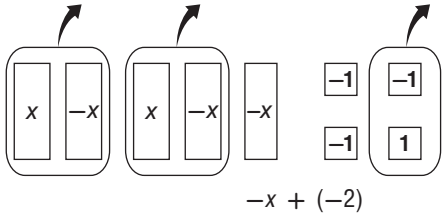
Write the polynomial as the sum of terms.

$2x - 3 + 1 - 3x = 2x + (-3) + 1 + (-3x)$

Group tiles with the same shape.

Remove the zero pairs and combine like terms.

Then write the polynomial.

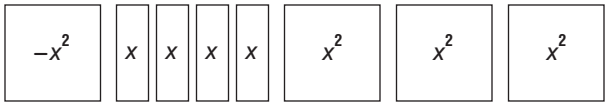


So, $2x - 3 + 1 - 3x = -x - 2$.

Exercises

Simplify each polynomial. Use models if needed.

1. $-x^2 + 4x + 3x^2$



2. $2x^2 + 5 + x^2 + 2$

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

NAME _____ DATE _____ PERIOD _____

12-2 A Skills Practice

Polynomials

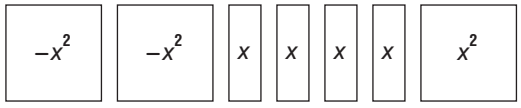
Use algebra tiles to model each polynomial.

1. $x^2 - 3x$

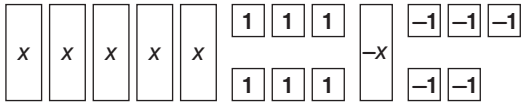
2. $2x^2 + x + 4$

Simplify each polynomial. Use models if needed.

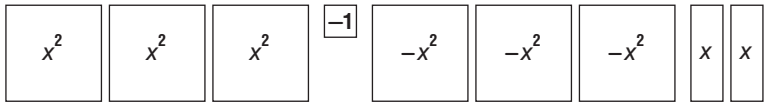
3. $-2x^2 + 4x + x^2$



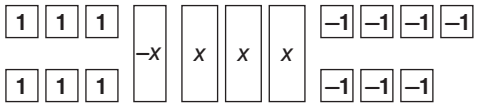
4. $5x + 6 - x - 5$



5. $3x^2 - 1 - 3x^2 + 2x$



6. $6 - x + 3x - 7$



7. $6x - 8 + 2x - x^2$

8. $x^2 + 4 - 4x^2 - 8$

9. $5x^2 + 7x - 11 + x^2 - 3x$

10. $6 - 8x^2 + 6x^2 - 9$

11. $7x^2 + 6x - 4x^2 - 5x$

12. $3x^2 + 4x^2 - 2x + 1$

NAME _____ DATE _____ PERIOD _____

12-2 A

Homework Practice

Polynomials

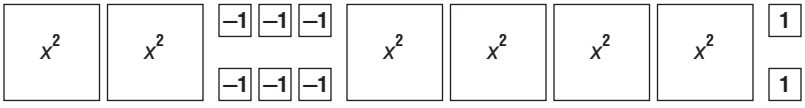
Use algebra tiles to model each polynomial.

1. $7 - 4x$

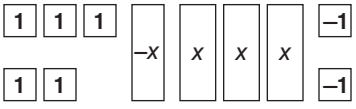
2. $3x + 2 + x^2$

Simplify each polynomial. Use models if needed.

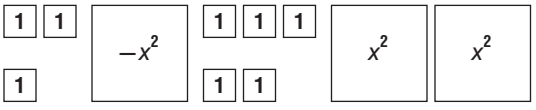
3. $2x^2 - 6 + 4x^2 + 2$



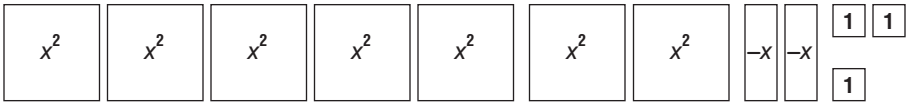
4. $5 - x + 3x - 2$



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



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



7. $x^2 - 5x + 2 + 3x^2 + 8x - 7$

8. $-7 - 5x + 9x + 10$

Simplify each polynomial.

9. $\frac{2}{3}x^2 + 4x + \frac{5}{3}x^2 - \frac{3}{5}x + 6\frac{1}{3}$

10. $4.2x^2 - 2x + 1.1x^2 - 3.6$

11. **BANANAS** Amani bought x bananas, Somnuck bought $4x$ bananas, and Eleanor bought 6 bananas. Write and simplify a polynomial expression to represent the total number of bananas these three people bought.

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12-2 A

Problem-Solving Practice

Polynomials

1. GEOMETRY Write and simplify a polynomial expression for the perimeter of the rectangle.

2. DESSERTS Terri paid $2x + 6$ dollars for pudding, Sherwin paid $3x - 5$ dollars for sherbet, and Pia paid $x + 8$ dollars for ice cream. Write and simplify a polynomial expression for the total these three students spent on dessert.

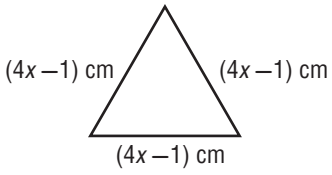
3. CABLE TELEVISION Roberta has basic cable television service. The table gives the cost of various options. Write and simplify a polynomial expression to represent the cost if Roberta paid her monthly fee and bought x movies and x football games during the month.

Option	Cost ($)
Monthly fee	29
Movie	5
Football Game	3

4. DOG WALKING Brenton walked his dog x blocks, Peyton walked his dog four times as far, and Toya walked her dog 7 blocks. Write and simplify a polynomial expression to represent the total number of blocks these three students walked their dogs.

5. TEXT MESSAGES Sarah sent $2x + 6$ text messages and received $3x - 4$ text messages. Write and simplify a polynomial expression to represent the total number of text messages Sarah sent and received.

6. MUSIC Travis played the triangle in music class. Write and simplify a polynomial expression to represent the perimeter of the triangle.



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12-2 A

Enrich

Find the Degree of a Polynomial

The **degree** of a polynomial in one variable is the highest exponent of the variable. If the degree is one, the polynomial is linear. If the degree is two, the polynomial is quadratic, and if the degree is three, the polynomial is cubic.

Examples

Find the degree of each polynomial.

1. $x^2 - 2x + 6$
The exponents of x are 2, 1, and 0, since $6 = 6x^0$. The greatest exponent is 2. So, the degree of this polynomial is 2. It is a quadratic polynomial.

2. $6x^3 - 2x^5 + 8x + 2x^4$
The exponents of x are 3, 5, 1, and 4. The greatest exponent is 5. So, the degree of this polynomial is 5.

Exercises

Find the degree of each polynomial.

1. $12x^3 - 2x + 5$

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

3. $5x^4 + 3x^2 + x^7$

4. $18x^8$

5. $9x - 10$

6. 12

7. $19x + 12x^3 - 5x^5$

8. $8x^4 + 3x^7$

9. $4 - 8x^2 - 9x + 2x^3$

10. $17x + 3x^4 - 5x^2 + 6$

Write the exercise number of all polynomials in Exercises 1–10 that fit each description.

11. linear

12. quadratic

13. cubic

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12-2 B

Reteach

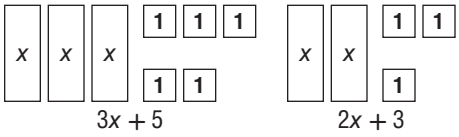
Add Polynomials

You can use models to add polynomials.

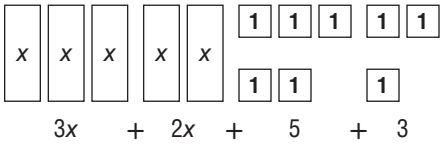
Example 1

Add $(3x + 5) + (2x + 3)$.

Step 1 Model each polynomial.



Step 2 Combine like tiles and write a polynomial for the combined tiles.

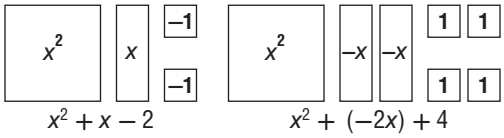


So, $(3x + 5) + (2x + 3) = 5x + 8$.

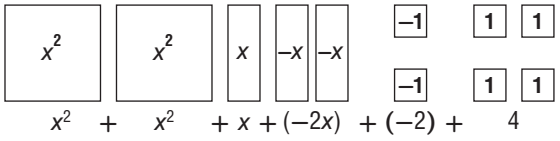
Example 2

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

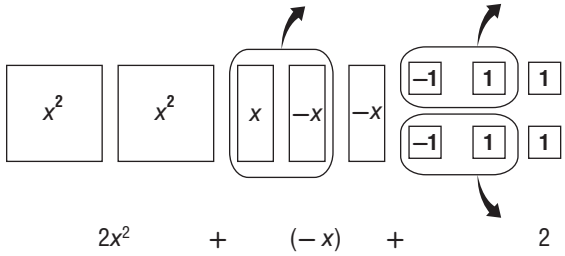
Step 1 Model each polynomial.



Step 2 Combine like tiles and write a polynomial for the combined tiles.



Step 3 Remove all zero pairs and write a polynomial for the remaining tiles.



So, $(x^2 + x - 2) + (x^2 - 2x + 4) = 2x^2 - x + 2$.

Exercises

Add. Use models if needed.

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

2. $(-8x + 1) + (-2x^2 + 6)$

3. $(x^2 - 7x + 4) + (3x^2 + x - 5)$

4. $(3x^2 - 6x + 1) + (4x^2 - 1)$

NAME _____ DATE _____ PERIOD _____

12-2 B

Skills Practice

Add Polynomials

Add. Use models if needed.

1. $(5x + 7) + (x + 2)$

2. $(2x^2 - 6x + 3) + (x^2 - 7x)$

3. $(-x^2 + 12) + (-4x + 2)$

4. $(-5x + 3) + (-7x - 1)$

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

6. $(2x^2 + 5x + 4) + (x^2 - 8x - 2)$

7. $(3x^2 - 7x + 1) + (4x^2 - 5)$

8. $(x^2 + 6x - 2) + (4x^2 - x + 5)$

9. $(-9x + 1) + (-7x + 8)$

10. $(-3x - 9) + (4x + 8)$

11. $(6x^2 - 9x - 12) + (x - 8)$

12. $(14x^2 + 7x) + (-3x + 2)$

13. $(5x^2 + 2x - 1) + (-3x^2 + 7)$

14. $(-6x^2 - 5x + 4) + (-4x^2 - 9x - 2)$

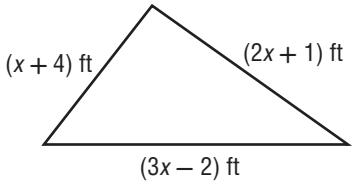
15. $(x^2 + 11x + 2) + (x^2 - 8x - 2)$

16. $(-9x - 10) + (-5x - 4)$

17. Find the sum of $(x^2 + 10x + 3)$ and $(2x^2 - 4x - 2)$.

18. Find the sum of $(-4x^2 + x + 3)$ and $(-3x^2 - x - 4)$.

19. **GEOMETRY** Write and simplify a polynomial to represent the perimeter of the triangle shown. Then find the value of x if the perimeter is 45 feet.



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12-2 B

Homework Practice

Add Polynomials

Add. Use models if needed.

1. $(9x + 7) + (x + 3)$

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

3. $(-3x^2 + 15) + (-3x + 2)$

4. $(-2x + 10) + (-8x - 1)$

5. $(x^2 - 2x + 4) + (x^2 + x - 11)$

6. $(3x^2 + 8x + 9) + (x^2 - 6x - 1)$

7. $(x^2 - 6x + 3) + (5x^2 - 4)$

8. $(x^2 + 2x - 4) + (3x^2 - x + 9)$

9. $(-8x + 2) + (-5x + 7)$

10. $(-4x - 2) + (13x + 1)$

11. $(2x^2 - 7x - 14) + (x - 6)$

12. $(12x^2 + 3x) + (-7x + 5)$

13. $(3x^2 + 4x - 1) + (-5x^2 + 17)$

14. $(-4x^2 - 9x + 2) + (-4x^2 - 8x - 2)$

15. $(x^2 + 1.3x + 2.4) + (3.6x^2 - 6.1x - 3.2)$

16. $\left(-\frac{1}{2}x - \frac{2}{3}\right) + \left(\frac{3}{4}x - \frac{1}{6}\right)$

17. **GEOMETRY** A rectangle has side lengths of $(3x^2 + 6)$ inches and $(2x^2 - 4)$ inches. Write a polynomial to represent the perimeter of the rectangle. Then find the value of x if the perimeter is 94 inches.

18. **CRUISE SHIPS** The table shows the number of cruise ships in a harbor on various days.

Day	Monday	Tuesday	Wednesday	Thursday	Friday
Number	$x - 4$	$x + 9$	$2x$	$3x - 7$	4

a. Write a polynomial expression for the total number of cruise ships in the harbor on Monday and Tuesday.

b. Write a polynomial expression for the total number of cruise ships in the harbor on all 5 days.

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12-2 B

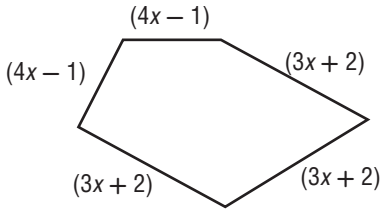
Problem-Solving Practice

Add Polynomials

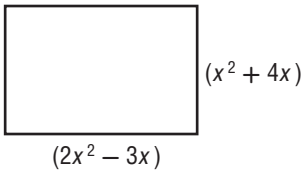
1. SWIMMING The table gives the number of laps Pragitha swam each week. Write a polynomial expression for the total number of laps she swam all four weeks.

Week	1	2	3	4
Laps	$x + 2$	$3x$	$2x + 1$	$4x - 6$

2. GEOMETRY Write a polynomial expression for the perimeter of this pentagon. If the perimeter is 157 units, find x.



3. BEDROOM Write a polynomial expression for the perimeter of the bedroom shown below.



4. HOCKEY The table shows the number of goals scored during each game. Write a polynomial expression for the total number of goals scored in these 3 games.

Game	1	2	3
Goals	$2x$	$x + 2$	$3x - 1$

5. FLIGHT An airline charges $\$(22x + 20)$ for a ticket, $\$(x + 1)$ to check a bag, $\$2x$ for food, and $\$(15x - 16)$ to upgrade to first class. Write a polynomial expression to represent the total cost of flying first class, checking a bag, and buying food on the plane.

6. FOOD Loy paid $\$(4x + 7)$ for a beef roast and $\$(2x - 5)$ for five pounds of potatoes. Write a polynomial expression for the total amount he spent on food.

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12-2 B

Enrich

Add Polynomials

Add the polynomials. Then write the letter for the correct answer on each blank below to solve the puzzle.

1. $(2x + 6) + (9x - 5)$

2. $(3x - 7) + (-2x - 8)$

3. $(x^2 + 5x + 2) + (2x^2 - 7x)$

4. $(4x^2 - 6x - 11) + (7x^2 + 6x)$

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

6. $(6x^2 - 2x - 9) + (-6x^2 + 3x + 10)$

7. $(3x^4 + 4x - 1) + (8x^4 - 8x - 10)$

8. $(x^2 + 6x + 4) + (x^2 - 18x - 6)$

A. $11x^2 - 11$

B. $2x^2 - 12x - 2$

C. $11x - 11$

D. $x - 1$

E. $3x^2 - 2x + 2$

F. $11x^4 - 12x - 11$

G. $11x + 1$

H. $x^4 - 12x - 2$

J. $x + 1$

L. $2x^2 - 12x + 2$

M. $5x^2 - 15x + 1$

N. $-5x + 1$

O. $11x^4 - 4x - 11$

P. $3x^4 - 2x^2 + 2$

R. $x - 15$

S. $11x^8 - 4x^2 - 11$

T. $5x^2 - 5x - 7$

___	___	___	___	___	___	___	___
1	2	3	4	5	6	7	8

NAME _____ DATE _____ PERIOD _____

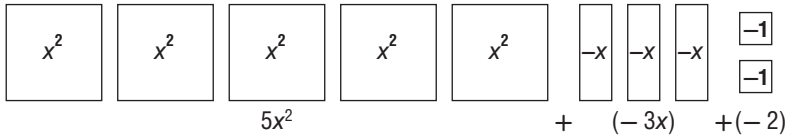
12-2 C Reteach

Subtract Polynomials

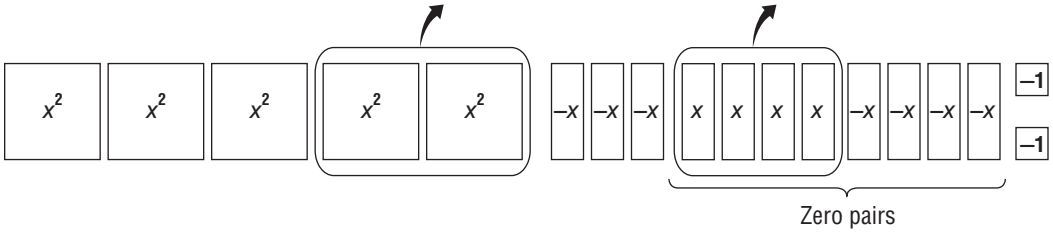
When subtracting polynomials, subtract like terms. You can use models or the additive inverse.

Example 1 **Find $(5x^2 - 3x - 2) - (2x^2 + 4x)$.**

Step 1 Model the polynomial $5x^2 - 3x - 2$.



Step 2 Since there are no positive x-tiles to remove, add four zero pairs of x-tiles. Remove two positive x^2-tiles and four positive x-tiles.



So, $(5x^2 - 3x - 2) - (2x^2 + 4x) = 3x^2 - 7x - 2$.

Example 2 **Subtract $(4x + 6) - (-7x + 1)$.**

The additive inverse of $-7x + 1$ is $7x - 1$.

$4x + 6$ Arrange like terms in columns.

$+7x - 1$ Add.

$11x + 5$

So, $(4x + 6) - (-7x + 1) = 11x + 5$.

Exercises

Subtract. Use models if needed.

1. $(9x + 10) - (2x + 4)$

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

3. $(6x^2 + 3x) - (-x^2 - 2)$

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

5. $(x^2 + 3x - 1) - (2x^2 - 6)$

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12-2 C

Skills Practice

Subtract Polynomials

Subtract. Use models if needed.

1. $(5x + 7) - (x + 2)$

2. $(2x^2 - 6x) - (x^2 - 7x)$

3. $(-x^2 + 12) - (-4x + 2)$

4. $(-5x + 3) - (-7x - 1)$

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

6. $(2x^2 + 5x + 4) - (x^2 - 8x - 2)$

7. $(3x^2 - 7x + 1) - (4x^2 - 5)$

8. $(x^2 + 6x - 2) - (4x^2 - x + 5)$

9. $(-9x + 1) - (-7x + 8)$

10. $(-3x - 9) - (4x + 8)$

11. $(-9x - 12) - (x - 8)$

12. $(14x^2 + 7x) - (-3x + 2)$

13. $(5x^2 - 1) - (-3x^2 + 7)$

14. $(-6x^2 - 5x + 4) - (-4x^2 - 9x - 2)$

15. $(x^2 + 11x + 2) - (x^2 - 8x - 2)$

16. $(-9x - 10) - (-5x - 4)$

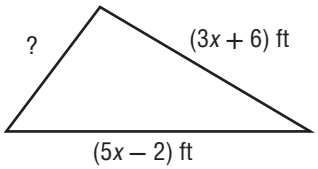
17. $(2x^2 + x - 2) - (x^2 - 6x)$

18. $(-x^2 - 6x + 1) - (-2x^2 - 3x + 1)$

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

20. $(-12x - 6) - (-4x^2 + 3x)$

21. **GEOMETRY** The perimeter of the triangle shown is $(10x + 1)$ feet. Find the length of the missing side.



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12-2 C

Homework Practice

Subtract Polynomials

Subtract. Use models if needed.

1. $(9x + 7) - (x + 3)$

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

3. $(-3x + 15) - (-3x + 2)$

4. $(-2x + 10) - (-8x - 1)$

5. $(x^2 - 2x + 4) - (x^2 + x - 11)$

6. $(3x^2 + 8x + 9) - (x^2 - 6x - 1)$

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

8. $(x^2 + 2x - 4) - (3x^2 - x + 9)$

9. $(-8x + 2) - (-5x + 7)$

10. $(-4x - 2) - (13x + 1)$

11. $(2x^2 - 7x - 14) - (x - 6)$

12. $(12x + 3) - (-7x + 5)$

13. $(3x^2 - 1) - (-5x^2 + 17)$

14. $(-4x^2 - 9x + 2) - (-4x^2 - 8x - 2)$

15. $(x^2 + 1.3x + 2.4) - (3.6x^2 - 6.1x - 3.2)$

16. $\left(-\frac{1}{2}x - \frac{2}{3}\right) - \left(-\frac{3}{4}x - \frac{1}{6}\right)$

17. FOOTBALL The Dolphins scored $x^2 + 2x - 7$ points, while the Jaguars scored $2x^2 - 5x - 3$ points. How many more points did the Dolphins score than the Jaguars?

18. LUNCH The table shows the cost of a sandwich and a drink at a local cafeteria. How much more does a sandwich cost than a drink?

Item	Sandwich	Drink
Cost ($)	$2x + 1.50$	$x + 0.49$

19. COLLEGE COSTS The table shows some college costs. How much more is tuition than the cost of fees and room and board?

Item	Tuition	Fees	Room and Board
Cost ($)	$2x^2 + 8x + 75$	$x + 50$	$x^2 + 3x$

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12-2 C

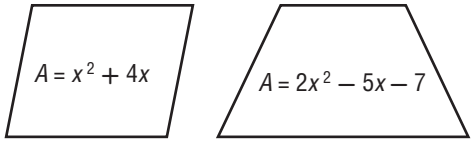
Problem-Solving Practice

Subtract Polynomials

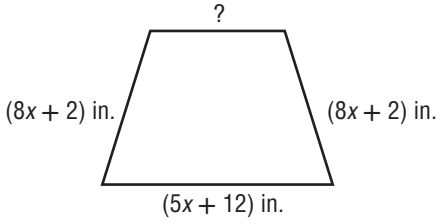
1. GASOLINE The table gives the cost of a gallon of gasoline at two stations. How much more does gasoline cost at Gas For Less than at Cut-Rate?

Cut-Rate	$x^2 - 2x + 3.5$
Gas for Less	$3x^2 + x - 1.2$

2. GEOMETRY What is the difference in the areas of the polygons shown?



3. PLACEMATS Find the missing side of the placemat shown if the perimeter is $28x + 11$ inches.



4. SHOES Uthara has $6x - 7$ pairs of shoes while China has $2x + 3$ pairs of shoes. How many more pairs of shoes does Uthara have than China?

5. INSECTS A grasshopper has a length of $5x - 2$ inches. A spider has a length of $2x - 1\frac{1}{4}$ inches. How much longer is the grasshopper?

6. PANTHERS Two Florida panthers were weighed. One weighs $6x + 21$ pounds and the two together weigh $14x + 11$ pounds. How much does the other panther weigh alone?

NAME _____ DATE _____ PERIOD _____

12-2 C

Enrich

Subtract Polynomials with More Than One Variable

Recall that when subtracting integers, you add the opposite, or the additive inverse. Also, when subtracting polynomials, you subtract like terms. Subtraction of polynomials with more than one variable can use the same process.

Example **Subtract $(3a + 4b - 6c) - (-5a - b + 2c)$.**

Step 1 Find the additive inverse of the polynomial being subtracted.

The additive inverse of $-5a - b + 2c$ is $5a + b - 2c$.

Step 2 Arrange like terms in columns and then add the like terms.

$$\begin{array}{r} 3a + 4b - 6c \\ +\ 5a + b - 2c \\ \hline 8a + 5b - 8c \end{array}$$

So, $(3a + 4b - 6c) - (-5a - b + 2c) = 8a + 5b - 8c$.

Exercises

Subtract.

1. $(2x - 3y + 12) - (4x + 6y - 3)$

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

3. $(4x - 7y) - (-3x - 5y)$

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

5. $(6x + 3y - 5z) - (-2x + y - 3z)$

6. $(4ab - 2bc) - (9ab + 7bc)$

7. $(8a^3 - 3b^2) - (2a^3 - 4b^2 - 5a)$

8. $(16c - 9d - 12e) - (2c + 5d)$

9. $(2x^3 + 3x^2y - 4xy^2 - y^3) - (2x^3 - 11x^2y - 9xy^2 - 4y^3)$

10. $(-5x^2 - 2xy - 3y^2) - (-6x^2 - 7xy - y^2)$

NAME _____ DATE _____ PERIOD _____

12-2 D

Reteach

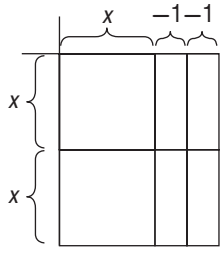
Multiply a Binomial by a Monomial

You multiply a binomial by a monomial by using algebra tiles or by using the Distributive Property, $a(b + c) = ab + ac$.

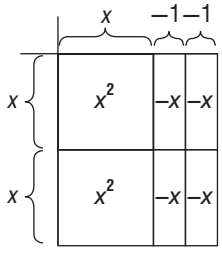
Example 1

Use algebra tiles to find $2x(x - 2)$.

Step 1 Make a rectangle with a width of $2x$ and a length of $x - 2$.



Step 2 Using the marks as a guide, fill in the rectangle with algebra tiles.

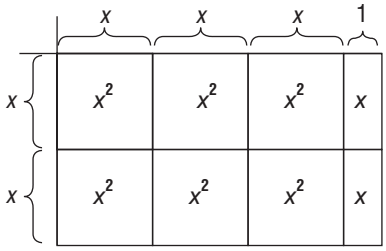


So, $2x(x - 2) = 2x^2 - 4x$.

Example 2

Find $2x(3x + 1)$.

Method 1 Use a model.



So, $2x(3x + 1) = 6x^2 + 2x$.

Method 2 Use the Distributive Property.

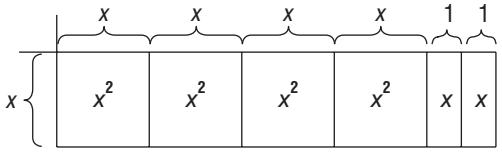
$$2x(3x + 1) = 2x(3x) + 2x(1)$$
$$= 6x^2 + 2x$$

So, $2x(3x + 1) = 6x^2 + 2x$.

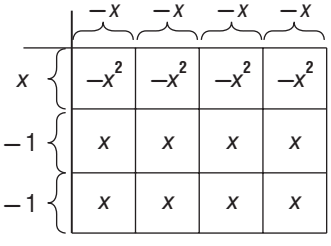
Exercises

Multiply. Use models if needed.

1. $x(4x + 2)$



2. $-4x(x - 2)$



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

4. $-2x(3x^2 + 6x)$

NAME _____ DATE _____ PERIOD _____

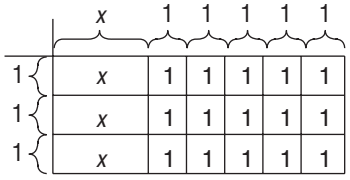
12-2 D

Skills Practice

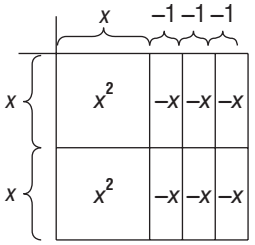
Multiply a Binomial by a Monomial

Multiply. Use models if needed.

1. $3(x + 5)$



2. $2x(x - 3)$



3. $x(5x - 2)$

4. $-3x(x + 1)$

5. $6x(x^2 - 2x)$

6. $x(7x^2 + 4x)$

7. $5x(x^2 - 3)$

8. $-2x(2x - 6)$

9. $8(3x^2 + 9)$

10. $x^2(5x - 7)$

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

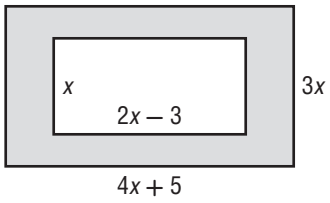
12. $4x(2x + 4)$

13. $x^2(x + 3)$

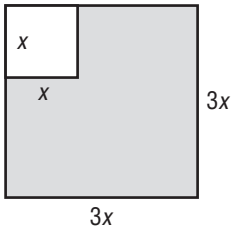
14. $x(5x^2 - 2)$

Find the area of the shaded region for each figure.

15.



16.



NAME _____ DATE _____ PERIOD _____

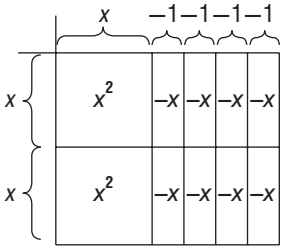
12-2 D

Homework Practice

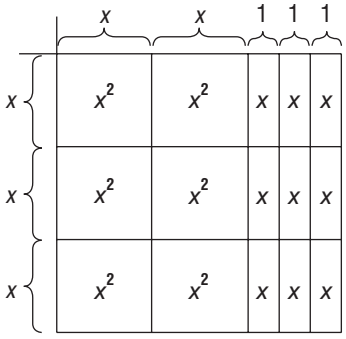
Multiply a Binomial by a Monomial

Multiply. Use models if needed.

1. $2x(x - 4)$



2. $3x(2x + 3)$



3. $8x(2x - 3)$

4. $-5x(-x + 1)$

5. $2x^2(4x - 6)$

6. $7(9x^2 + 3)$

7. $x(10x^2 + 2x)$

8. $-3x(5x + 6)$

9. PING-PONG A ping-pong table has a length of $(5x - 4)$ feet and a width of $2x$ feet. Write an expression for the area of the table.

10. EARRINGS Fiona wants to buy two pairs of earrings. One pair costs \$15. There is a 7% sales tax. If x represents the cost of the other pair of earrings, then the expression $x + 15 + 0.07(x + 15)$ represents the total cost.

a. Simplify the expression.

b. If the other pair of earrings costs \$19 and Fiona has \$36, does she have enough money to buy both pairs? Explain.

Simplify.

11. $x(x - 2) + 5x(2x + 3)$

12. $x^2(x + 1) - 4x(x - 2)$

Get Connected *For more examples, go to* glencoe.com.

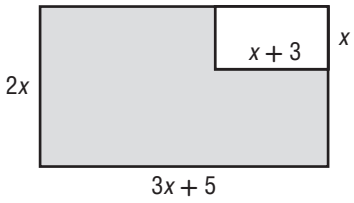
NAME _____ DATE _____ PERIOD _____

12-2 D

Problem-Solving Practice

Multiply a Binomial by a Monomial

1. GEOMETRY Find the area of the shaded region.



2. GUITARS Suri wants to buy an electric guitar and a beanbag chair. The guitar costs \$180. Sales tax is 5%. If x represents the cost of the chair, then the expression $x + 180 + 0.05(x + 180)$ represents the total cost of the two items. Simplify the expression.

3. LUNCH You took a friend to a restaurant for lunch. Your lunch cost \$8 and you left a 15% tip. If x represents the cost of your friend's lunch, then the expression $x + 8 + 0.15(x + 8)$ represents the total cost of the meal.

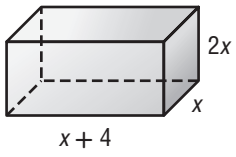
a. Simplify the expression.

b. You have \$20 and your friend's lunch cost \$9. Do you have enough money to pay the bill? Explain.

4. RESORT A resort has $3x$ hotels. Each hotel has $x + 5$ rooms. Simplify an expression for the total number of rooms at the resort.

5. VIDEO GAMES Van is playing a video game. There are $2x + 3$ levels in the game, and each level takes $5x$ minutes to complete. Write and simplify an expression for the number of minutes it will take Van to play all of the levels.

6. TISSUE BOX Write and simplify an expression for the volume of the tissue box shown.



NAME _____ DATE _____ PERIOD _____

12-2 D

Enrich

Multiply a Polynomial by a Monomial

Example 1 **Multiply $2x(x^2 + 3x + 7)$.**

Use the Distributive Property.

$2x(x^2 + 3x + 7) = 2x(x^2) + 2x(3x) + 2x(7)$ Distributive Property

$= 2x^3 + 6x^2 + 14x$ Simplify.

So, $2x(x^2 + 3x + 7) = 2x^3 + 6x^2 + 14x$.

Example 2 **Multiply $5a(2b - 4c + d)$.**

Use the Distributive Property.

$5a(2b - 4c + d) = 5a(2b) - 5a(4c) + 5a(d)$ Distributive Property

$= 10ab - 20ac + 5ad$ Simplify.

So, $5a(2b - 4c + d) = 10ab - 20ac + 5ad$.

Exercises

Multiply.

1. $4x(x^2 + 5x + 6)$

2. $8x(2x^2 + 3x + 1)$

3. $2m(5m^2 + 9m + 12)$

4. $a(a^2 + 4ab + b^2)$

5. $3a(2a + 5b + 6c)$

6. $5y(2y^3 - 8y^2 + 4y - 9)$

7. $-7x(10x^3 - 5x - 11)$

8. $-\frac{2}{3}r(-3r^2 + 4r - 9)$

9. $6n(n^2 - 2n^3 + n^4 - 1)$

10. $\frac{1}{2}b(-4b^2 - 12b + 14)$

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12-2 E

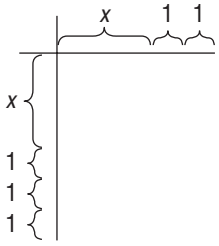
Reteach

Multiply Polynomials

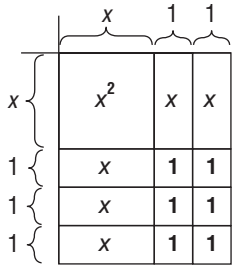
You can use algebra tiles to multiply two binomials. You can also use the box method or the Distributive Property to multiply two binomials. The **FOIL Method** is a shortcut version of the Distributive Property. FOIL stands for "First, Outer, Inner, Last" and refers to the terms in the binomials that you must multiply together.

Example 1 **Use algebra tiles to find $(x + 2)(x + 3)$.**

Step 1 Make a rectangle with a width of $x + 2$ and a length of $x + 3$.



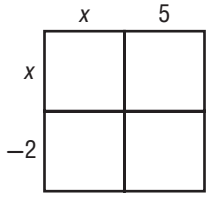
Step 2 Fill in the rectangle with algebra tiles. There is one x^2-tile, five x-tiles, and six 1-tiles.



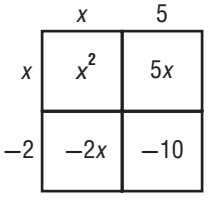
So, $(x + 2)(x + 3) = x^2 + 5x + 6$.

Example 2 **Find $(x + 5)(x - 2)$.**

Step 1 Put $x + 5$ and $x - 2$ outside the box.



Step 2 Multiply the x by x and 5 and the -2 by x and 5. Place the products in the corresponding boxes.



Step 3 Find the sum of the terms inside the boxes by combining like terms.

So, $(x + 5)(x - 2) = x^2 + 3x - 10$.

Exercises

Multiply. Use models if needed.

1. $(x + 4)(x + 6)$

2. $(x + 8)(x + 1)$

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

4. $(x - 2)(x - 5)$

NAME _____ DATE _____ PERIOD _____

12-2 E

Skills Practice

Multiply Polynomials

Multiply. Use models if needed.

1. $(x + 3)(x + 5)$

2. $(x + 1)(x + 7)$

3. $(x - 2)(x + 6)$

4. $(x + 8)(x - 4)$

5. $(x - 5)(x - 9)$

6. $(x + 12)(x + 4)$

7. $(x - 3)(x + 3)$

8. $(x - 15)(x - 2)$

9. $(x - 11)(x + 7)$

10. $(x + 5)(x + 10)$

11. $(x + 1)(x - 7)$

12. $(x + 6)(x + 13)$

13. $(x - 5)(x - 11)$

14. $(x - 10)(x + 3)$

15. $(x + 2)(x + 3)$

16. $(x + 8)(x + 7)$

17. $(x - 18)(x + 4)$

18. $(x - 20)(x - 30)$

19. $(x + 25)(x - 6)$

20. $(x + 15)(x + 10)$

21. **QUARTERS** If $(x + 3)$ children each have $(x - 7)$ quarters, write a simplified polynomial for the total number of quarters they have.

22. **BEDSPREAD** A bedspread has a length of $(x + 6)$ inches and a width of $(x + 8)$ inches. Write a simplified polynomial for the area of the bedspread.

NAME _____ DATE _____ PERIOD _____

12-2 E

Homework Practice

Multiply Polynomials

Multiply. Use models if needed.

1. $(x + 6)(x + 7)$

2. $(x + 5)(x + 5)$

3. $(x + 14)(x - 2)$

4. $(x - 9)(x + 9)$

5. $(x - 13)(x + 4)$

6. $(x - 8)(x - 8)$

7. $(x - 4)(x + 5)$

8. $(x + 11)(x + 12)$

9. $(x + 1)(x - 6)$

10. $(x - 7)(x - 9)$

11. $(x + 16)(x + 3)$

12. $(x - 11)(x - 6)$

13. $(x + 20)(x + 12)$

14. $(x - 19)(x + 2)$

15. $(4x - 3)(x + 2)$

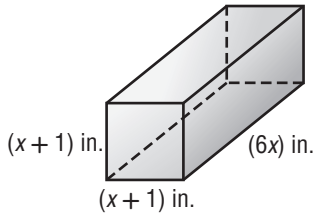
16. $(3x + 7)(x - 4)$

17. $(2x + 6)(2x + 5)$

18. $(5x - 1)(2x + 7)$

19. **SWIMMING POOL** A 20-foot-by-24-foot swimming pool has a deck width of x feet all around it. Express the area of the pool and deck together as a polynomial.

20. **GEOMETRY** Write a polynomial for the volume of the figure.



21. **GO-CARTS** A go-cart travels at $(x + 5)$ miles per hour for $(x - 4)$ hours. How many miles does it travel?

Get Connected *For more examples, go to* glencoe.com.

NAME _____ DATE _____ PERIOD _____

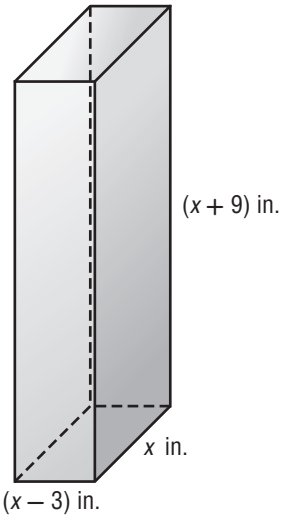
12-2 E

Problem-Solving Practice

Multiply Polynomials

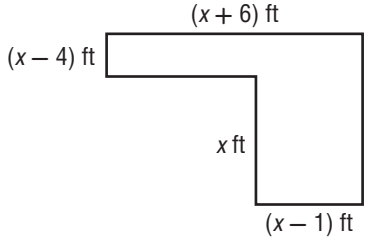
1. TENNIS BALLS Nikhil bought $(x + 7)$ tennis balls for $\$(x + 2)$ each. Write a polynomial to represent the total cost of the tennis balls.

2. CEREAL A box of cereal has dimensions as shown. Write a polynomial to represent the volume of the box.



3. PARK A rectangular park with dimensions $(x + 20)$ meters and $(x + 12)$ meters, has a bicycle path width of 2 meters all around it. Write a polynomial to represent the area of the park and path.

4. LIVING ROOM Aimee has an L-shaped living room as shown. Write a polynomial to represent the total area of the living room.



5. FIND THE ERROR Renaldo multiplied $2x + 3$ and $5x + 2$ using the FOIL method. His answer was $10x + 4x + 15x + 6$, which he simplified to $29x + 6$. What was his mistake?

6. PICTURE A 20-inch-by-16-inch photograph is going to be enclosed in a frame x-inches wide. Express the area of the photo and frame as a polynomial.

NAME _____ DATE _____ PERIOD _____

12-2 Enrich

E

Special Products of Binomials

Example 1 **Multiply $(x + 4)(x - 4)$.**

Use FOIL.

$$(x + 4)(x - 4) = x(x) + x(-4) + 4(x) + 4(-4) \quad \text{Multiply.}$$
$$= x^2 + (-4x) + 4x + (-16) \quad \text{Combine like terms.}$$
$$= x^2 - 16$$

This product is called the *difference of two squares*. The product can be found using the pattern $(a + b)(a - b) = a^2 - b^2$.

Example 2 **Find $(x + 5)^2$.**

$$(x + 5)^2 = (x + 5)(x + 5) \quad \text{Write the factor twice.}$$
$$= x(x) + x(5) + 5(x) + 5(5) \quad \text{Use FOIL.}$$
$$= x^2 + 5x + 5x + 25 \quad \text{Multiply.}$$
$$= x^2 + 10x + 25 \quad \text{Simplify.}$$

This product is called a *perfect square trinomial* because it is the square of a binomial.

The product can be found using the pattern $(a + b)^2 = a^2 + 2ab + b^2$ or the pattern $(a - b)^2 = a^2 - 2ab + b^2$.

Exercises

Multiply.

1. $(x + 5)(x - 5)$

2. $(x - 7)(x + 7)$

3. $(x + 10)(x - 10)$

4. $(2x + 1)(2x - 1)$

5. $(3x - 2)(3x + 2)$

6. $(5x - 3)(5x + 3)$

7. $(x + 2)^2$

8. $(x + 9)^2$

9. $(x - 6)^2$

10. $(2x + 1)^2$

11. $(3x - 2)^2$

12. $(5x + 3)^2$

NAME _____ DATE _____ PERIOD _____

12-3
A

Explore

Factors of Polynomials

List the factors of each number.

1. 8

2. 25

3. 40

4. 100

Use algebra tiles to factor each polynomial.

5. $6x + 9$

6. $5x + 20$

7. $x^2 + 6x$

8. $3x^2 + 12x$

9. WRITE MATH Explain why there are two different ways to factor $4x + 8$. Illustrate each way with algebra tiles.

NAME _____ DATE _____ PERIOD _____

12-3 B

Reteach

Use the GCF to Factor Polynomials

A polynomial is in **factored form** when it is expressed as the product of polynomials.

Example 1 **Factor $20x^2 + 36x$ using the GCF.**

Find the GCF of $20x^2$ and $36x$.

$20x^2 = (2) \cdot (2) \cdot 5 \cdot x \cdot (x)$ Write the prime factorization of $20x^2$ and $36x$.

$36x = (2) \cdot (2) \cdot 3 \cdot 3 \cdot (x)$ Circle the common factors.

The GCF of $20x^2$ and $36x$ is $2 \cdot 2 \cdot x$ or $4x$. Write each term as a product of the GCF and its remaining factors.

$20x^2 + 36x = 4x(5x) + 4x(9)$

$= 4x(5x + 9)$ Distributive Property

Example 2 **Factor $6x + 11$ using the GCF.**

Find the GCF of $6x$ and 11.

$6x = 2 \cdot 3 \cdot x$ Write the prime factorization of $6x$ and 11.

$11 = 1 \cdot 11$

There are no common factors, so $6x + 11$ *cannot be factored*.

Exercises

Factor each polynomial using the GCF. If the polynomial cannot be factored, write *cannot be factored*.

1. $10x + 20$

2. $x^2 + 6x$

3. $24x + 25$

4. $5x^2 + 15x$

5. $14x^3 + 7x^2$

6. $9x^2 - 2x$

7. $x^2 - x$

8. $6x^2 + x$

9. $6x - 2$

10. $5x^2 + 4$

11. $4x^2 + 12$

12. $9x - 3x^2$

NAME _____ DATE _____ PERIOD _____

12-3 B

Skills Practice

Use the GCF to Factor Polynomials

Factor each polynomial using the GCF. If the polynomial cannot be factored, write *cannot be factored*.

1. $6x + 12$

2. $x^2 + 7x$

3. $2x^2 + 4x$

4. $x^3 + 6x^2$

5. $8x^2 + 9x$

6. $2x^3 + 4x^2$

7. $15x^2 + 45x$

8. $9x + 72$

9. $13x^2 + 15$

10. $6x^3 + 36x^2$

11. $4x^2 + 20$

12. $6x - 3x^2$

13. $x^3 - 3x^2$

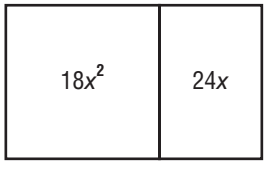
14. $12x + 7x^2$

15. $16x + 3x^2$

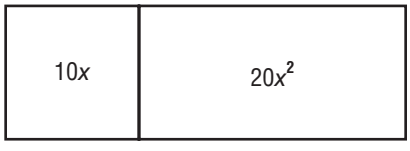
16. $20x - 3x^3$

Write a polynomial in factored form to represent the total area of each rectangle.

17.



18.



NAME _____ DATE _____ PERIOD _____

12-3 B

Homework Practice

Use the GCF to Factor Polynomials

Factor each polynomial using the GCF. If the polynomial cannot be factored, write *cannot be factored*.

1. $4x + 12$

2. $x^2 + 9x$

3. $3x^2 + 15x$

4. $15x + 4$

5. $18x^2 + 90$

6. $7x^2 + 2$

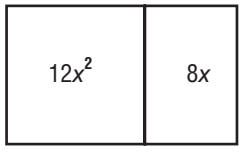
7. $36x^3 - 24x^2$

8. $54x^4 + 9x^2$

9. $28x - 35$

10. $45x^2 + 48x$

11. **GEOMETRY** Write a polynomial in factored form to represent the total area of the rectangle.



12. **PHYSICS** Theodosia dropped a shell from the top floor of a condominium building on Sanibel Island. The height h, in feet, of the shell above the ground after t seconds is given by $h = 96 - 16t^2$. Factor $96 - 16t^2$.

Get Connected *For more examples, go to* glencoe.com.

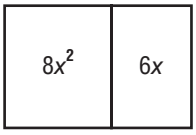
NAME _____ DATE _____ PERIOD _____

12-3 B

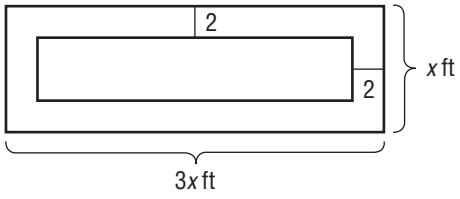
Problem-Solving Practice

Use the GCF to Factor Polynomials

1. POOLS The figure shows a swimming pool and a diving well with their areas labeled. Write an expression in factored form that represents the dimensions of the pool and diving well.



2. RUGS The figure shows an area rug on a hardwood floor. There is 2 feet of floor on all edges of the rug. Write an expression in factored form for the area of the rug.



3. PHYSICS A ball is thrown into the air at 10 feet per second. Its height h, in feet, above the ground after t seconds is given by the formula $h = 10t - 16t^2$. Factor the expression $10t - 16t^2$.

4. BOATS The Srinivasans have saved \$600 as a down payment on a motor boat. The expression $60x + 600$ represents the total cost of the boat if x is the monthly payment for 5 years. Factor $60x + 600$.

5. TRIANGLE The area of a triangle is given by the expression $6x^2 + 10x$. Factor $6x^2 + 10x$.

6. BOX The volume of a box with a height of 3 inches is $24x^2 + 12x$ cubic inches. Factor this expression to find the length and width of the box.

NAME _____ DATE _____ PERIOD _____

12-3 B Enrich

Factor Out a Binomial GCF

Example 1 **Factor $(2x - 1)3x + (2x - 1)4$.**

The GCF is $2x - 1$. Write each term as a product of the GCF and its remaining factors.

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

Example 2 **Factor $x^2(x - 4) + 2x(x - 4) + 5(x - 4)$.**

The GCF is $x - 4$. Write each term as a product of the GCF and its remaining factors.

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

Example 3 **Factor $x^2 + 6x + 9x + 54$ by grouping.**

$x^2 + 6x + 9x + 54 = (x^2 + 6x) + (9x + 54)$ Group the terms in pairs.

$= x(x + 6) + 9(x + 6)$ Factor out the GCF of each group.

$= (x + 6)(x + 9)$ Factor out the GCF, $x + 6$.

Exercises

Factor.

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

2. $x(x - 4) + 6(x - 4)$

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

4. $(x + y)3a + (x + y)7$

5. $4a(2x + 9) + 3b(2x + 9)$

6. $(x - 2)x^2 + (x - 2)11x + (x - 2)1$

7. $(a + b)5b - (a + b)6a$

8. $2y(x - y) - x(x - y)$

Factor by grouping.

9. $x^2 + 5x + 2x + 10$

10. $x^2 + 9x + 8x + 72$

11. $a^2 + ab + 2ab + 2b^2$

12. $3a^2 + 12ab + ab + 4b^2$

NAME _____ DATE _____ PERIOD _____

12-3
C

Explore

Factors of Trinomials

Use algebra tiles to factor each polynomial. Arrange the tiles into a rectangle with no gaps or leftover tiles. The area of the rectangle represents the trinomial. The dimensions of the rectangle represent the factors.

1. $x^2 + 4x + 3$

2. $x^2 + 9x + 14$

3. $x^2 - 6x + 8$

4. $x^2 - 5x + 6$

5. **WRITE MATH** When the x-term is negative and the term without a variable (constant) is positive, what does that tell you about the factors? Explain.

NAME _____ DATE _____ PERIOD _____

12-3 D

Reteach

Factor Trinomials

One method of factoring trinomials is using the box method. Another method is using the FOIL method to help you find the factors.

Example 1 **Factor $x^2 + 7x + 10$ using the box method.**

Step 1 Draw a square with four sections. Put the first and last terms in the boxes as shown.

x^2	
	10

Step 2 Factor x^2 as $x \cdot x$ and place the factors outside the box. Think of factors of 10 to place outside the box.

	x	■
x	x^2	↑
■	←	10

Step 3 The number 10 has two different factor pairs, 2 and 5, and 10 and 1. The factor pairs must have a sum of the middle term, $7x$.

	x	2
x	x^2	$2x$
5	$5x$	10

So, $x^2 + 7x + 10 = (x + 2)(x + 5)$.

Example 2 **Factor $x^2 - 3x + 2$ using the FOIL Method.**

The x^2 term is the product of the **F**irst terms. The only set of factors that are valid are $x \cdot x$.

$$x^2 - 3x + 2 = (x + \blacksquare)(x + \blacksquare)$$

The **L**ast two terms in each binomial must have a product of 2. The middle term of the trinomial is the sum of the **O**uter and **I**nner terms. In order to have a sum that is –3, the two factors of 2 must both be negative, so they are –2 and –1.

So, $x^2 - 3x + 2 = (x - 2)(x - 1)$.

Exercises

Factor each trinomial.

1. $x^2 + 9x + 14$

2. $x^2 + 10x + 9$

3. $x^2 - 8x + 12$

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

5. $x^2 - x - 12$

6. $x^2 - 4x + 4$

NAME _____ DATE _____ PERIOD _____

12-3 D

Skills Practice

Factor Trinomials

Factor each trinomial.

1. $x^2 + 16x + 28$

2. $x^2 + 2x + 1$

3. $x^2 + 9x + 18$

4. $x^2 - 6x + 9$

5. $x^2 + 12x + 32$

6. $x^2 - 12x + 36$

7. $x^2 + 10x + 21$

8. $x^2 + 9x + 8$

9. $x^2 - 8x + 15$

10. $x^2 - 5x + 6$

11. $x^2 - 13x + 22$

12. $x^2 - 10x + 21$

13. $x^2 - 22x + 96$

14. $x^2 + 15x + 26$

15. $x^2 - 6x + 5$

16. $x^2 - 12x + 20$

17. $x^2 + 7x + 6$

18. $x^2 + 17x + 30$

19. $x^2 + 7x + 12$

20. $x^2 - 10x + 25$

21. **RECTANGLE** The area of a rectangle is represented by the trinomial $x^2 + 18x + 80$. Factor the trinomial to find the dimensions of the rectangle.

22. **FIND THE ERROR** Sumali factored $x^2 + 13x + 30$ as $(x + 5)(x + 6)$. What was his mistake?

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12-3 D

Homework Practice

Factor Trinomials

Factor each trinomial.

1. $x^2 + 15x + 50$

2. $x^2 + 2x + 1$

3. $x^2 + 7x + 10$

4. $x^2 + 11x + 24$

5. $x^2 - 10x + 24$

6. $x^2 - 12x + 27$

7. $x^2 - 16x + 60$

8. $x^2 + 10x + 16$

9. $x^2 + 9x - 22$

10. $x^2 - 6x - 16$

11. **GEOMETRY** A square has an area of $x^2 + 10x + 25$ square centimeters. Find the perimeter of the square.

12. **GENETICS** Brown eyes are dominant and blue eyes are recessive. B represents brown eyes and b represents blue eyes. Find the missing genes or gene pairs in this Punnett square.

	B	
B		Bb
b	Bb	

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12-3 D

Problem-Solving Practice

Factor Trinomials

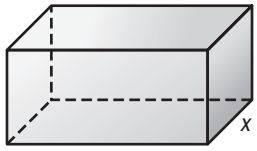
1. TABLE A table has an area of $x^2 - 8x + 7$ square feet. Factor this trinomial to find the dimensions of the table.

2. GEOMETRY The area of a rectangle is $x^2 + 18x + 45$ square centimeters. Factor the trinomial to find the length and width.

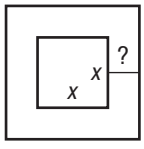
3. GENETICS Tall pea plants are dominant and short pea plants are recessive. T represents tall pea plants and t represents short pea plants. Complete this Punnett square.

	T	T
T		
t		

4. JEWELRY BOX Tetra has a jewelry box with a volume of $x^3 + 13x^2 + 36x$ as shown. Find the length and height of the box.



5. PATIO The figure shows a square patio with a rock border around it. The total area in square feet of the patio and border is $x^2 + 6x + 9$. Write this area in factored form.



6. ROCK BORDER Find the width of the rock border in Exercise 5.

NAME _____ DATE _____ PERIOD _____

12-3 D

Enrich

Factor Difference of Squares and Perfect Square Trinomials

A factoring pattern is $a^2 - b^2 = (a + b)(a - b)$. A polynomial of the form $a^2 - b^2$ is called the *difference of two squares*. To factor a difference of squares, you find the square root of each term. Then one factor uses addition and the other uses subtraction.

Example 1 **Factor $x^2 - 49$.**

$x^2 - 49 = (x)^2 - (7)^2$ Write as the difference of two squares.

$= (x + 7)(x - 7)$ Factor using the pattern.

Check by multiplying: $(x + 7)(x - 7) = x(x) - x(7) + 7(x) + 7(-7)$

$= x^2 - 7x + 7x - 49$

$= x^2 - 49$ ✓

Other factoring patterns are $(a + b)^2 = a^2 + 2ab + b^2$ and $(a - b)^2 = a^2 - 2ab + b^2$. A polynomial that can be factored into a binomial squared is called a *perfect square trinomial*. The first and last terms must be perfect squares and the middle term must be twice the product of the square roots of the first and last terms.

Example 2 **Factor $x^2 + 12x + 36$.**

$x^2 + 12x + 36 = (x)^2 + 2(x)(6) + (6)^2$

$= (x + 6)^2$

Check by multiplying: $(x + 6)^2 = (x + 6)(x + 6)$

$= x(x) + x(6) + 6(x) + 6(6)$

$= x^2 + 6x + 6x + 36$

$= x^2 + 12x + 36$ ✓

Exercises

Factor each polynomial.

1. $x^2 - 4$

2. $x^2 - 9$

3. $x^2 - 100$

4. $x^2 - 64$

5. $4x^2 - 25$

6. $9x^2 - 1$

7. $x^2 + 6x + 9$

8. $x^2 + 10x + 25$

9. $x^2 - 18x + 81$

10. $x^2 + 22x + 121$

11. $4x^2 + 12x + 9$

12. $9x^2 - 30x + 25$

NAME _____ DATE _____ PERIOD _____

12-3 D

TI-84 Plus Activity

Factor Trinomials

A graphing calculator can help you find the numbers for the factors of a trinomial.

Example **Factor $x^2 + 24x + 119$.**

You know the factors are $(x + \blacksquare)(x + \blacksquare)$. The two numbers that are missing must be factors of 119 and they must add up to 24.

Step 1 Enter $y = \frac{119}{x}$.

Y= 119 ÷ X,T,Θ,n

Step 2 Use the table to find factors of 119.

2nd [TABLE]

Scroll down the Y1 column until you find two numbers that add up to 24. They are 7 and 17. So the factors are $(x + 7)(x + 17)$.

If the x values in the table are not whole numbers, reset the table.

2nd [TBLSET] 1 ENTER 1 ENTER 2nd [QUIT]

Be sure you CLEAR the Y= menu before you enter another equation.

Exercises

Factor each trinomial. Use your calculator to help you find the factors.

1. $x^2 + 26x + 165$

2. $x^2 + 31x + 228$

3. $x^2 + 22x + 112$

4. $x^2 - 22x + 117$

5. $x^2 - 31x + 198$

6. $x^2 - 29x + 138$

NAME _____ DATE _____ PERIOD _____

12-3 E

Reteach

Problem-Solving Investigation: Use a Graph

Example **The length of your yard is 25 feet longer than its width. The area of the yard is 7,500 square feet. Use a graph to find the width of the yard.**

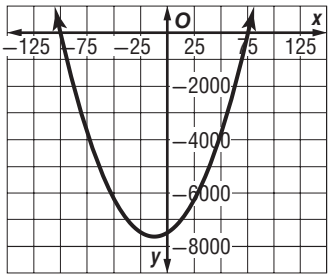
Understand You know that the yard is 25 feet longer than it is wide and it covers an area of 7,500 square feet.

Plan Write and graph a quadratic equation to find the width of the yard.

Solve Since the yard is 25 feet longer than it is wide and covers an area of 7,500 square feet, use the equation $7{,}500 = w(w + 25)$.

You can rewrite the equation in quadratic form by using the Distributive Property and subtracting 7,500 from each side, or $0 = w^2 + 25w - 7{,}500$.

Graph the equation $y = w^2 + 25w - 7500$ on a coordinate plane. You can see that the graph crosses the x-axis at –100 and 75. Since distance cannot be negative, the width of the yard is 75 feet.

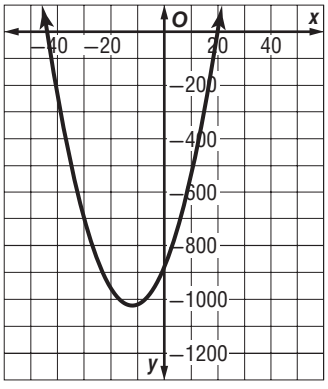


Check Substitute 75 into the equation.
$7{,}500 = w(w + 25)$
$7{,}500 = 75(75 + 25)$
$7{,}500 = 75(100)$ or $7{,}500$ ✓

Exercise

Use a graph to solve.

1. **BADMINTON COURT** The length of a badminton court is 24 feet longer than the width. If the area of the court is 880 square feet, what is the width of the court?



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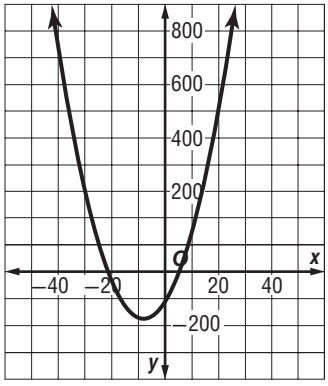
12-3 E

Skills Practice

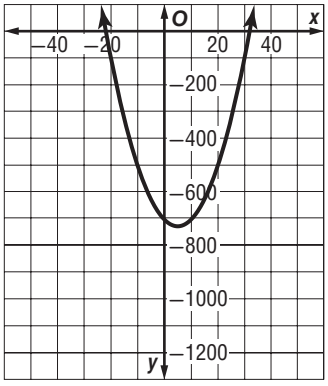
Problem-Solving Investigation: Use a Graph

Use a graph to solve each problem.

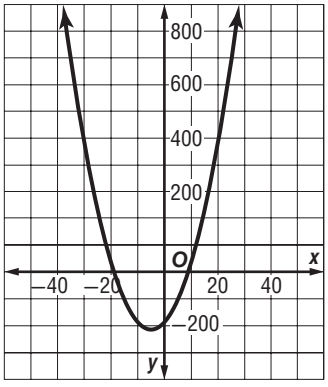
1. **PORCH** The length of a porch is 6 feet longer than it is wide. The area is 112 square feet. Find the width.



2. **CLASSROOM** Your classroom is 10 feet shorter than it is long. The area is 704 square feet. Find the length.

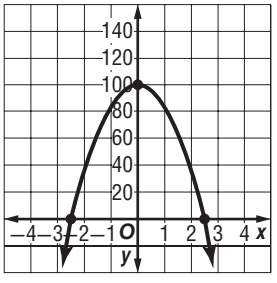


3. **GEOMETRY** The base of a parallelogram is 10 inches longer than the height. If the area of the parallelogram is 171 square inches, what are the base and height?



4. **ALGEBRA** Factor the trinomial $h^2 + 10h - 171$. What are the x-intercepts of the equation $h^2 + 10h - 171$? Explain how this exercise relates to Exercise 3.

5. **PHYSICS** The graph shows the height of a rock t seconds after it is dropped from a height of 100 feet.



   a. How high is the rock after 1 second?

   b. When will the rock hit the ground?

NAME _____ DATE _____ PERIOD _____

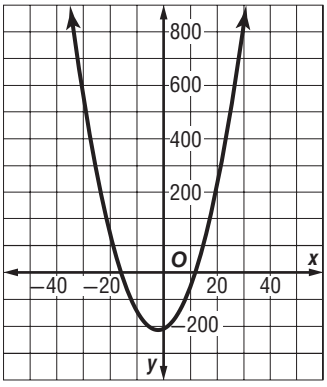
12-3 E

Homework Practice

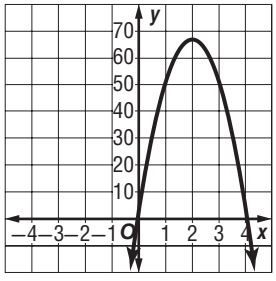
Problem-Solving Investigation: Use a Graph

Use a graph to solve Exercises 1 and 2.

1. **PLAYGROUND** The area of a rectangular playground is 192 square yards. The length is 4 yards more than the width. Find the width.



2. **PHYSICS** A ball is thrown up in the air at a velocity of 64 feet per second from a height of 3 feet. The height h of the ball after t seconds is given by the formula $h = 3 + 64t - 16t^2$. The graph is shown.



a. How high is the ball after 1 second?

b. After how many seconds will the ball reach its maximum height?

c. What is the maximum height?

Use any strategy to solve Exercises 3–5.

PROBLEM-SOLVING STRATEGIES
• Use a graph. • Look for a pattern. • Guess, check, and revise. • Choose an operation.

3. **ALGEBRA** What are the next three numbers in the pattern?

226, 268, 310, 352, _____ , _____ , _____

4. **TICKETS** Stuart sold 15 tickets to the orchestra concert. The value of these tickets was \$100. Adult tickets cost \$8 and student tickets cost \$3. How many of each type of ticket did Mack sell?

5. **JOBS** Ang is considering three different part-time jobs. She can work for 10 hours per week at a soda fountain and earn \$7 per hour. Or she can work for 4 days per week at a dry cleaner and earn \$15 per day for each 2 hours of work. Or she can work in a clarinet shop for 12 hours per week and earn \$81 per week.

a. At which job will she earn the best hourly rate?

b. At which job will she earn the most each week?

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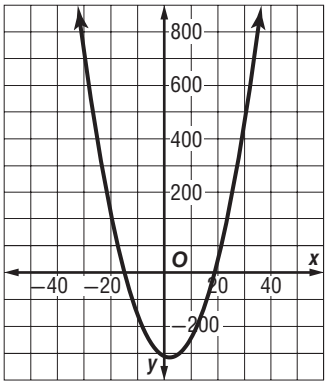
12-3 E

Problem-Solving Practice

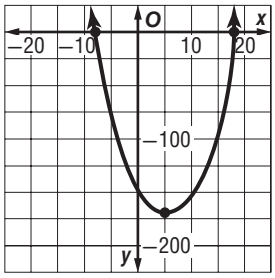
Problem-Solving Investigation: Use a Graph

Solve each problem using any strategy you have learned.

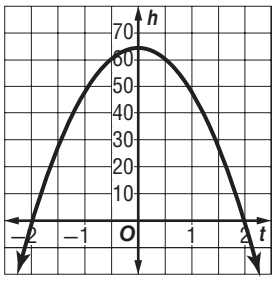
1. COURTYARD The area of a courtyard is 285 square feet. The width is 4 feet less than the length. Find the length.



2. GEOMETRY The base of a triangle is 10 centimeters longer than the height of the triangle. If the area of the triangle is 72 square centimeters, what are the measures of the base and height?



3. STONES The quadratic equation $h = 64 - 16t^2$ models the height above the water of a stone t seconds after it is dropped from a bridge. The graph is shown below. How high is the stone after 1 second?



4. TIME How long does it take for the stone in Exercise 3 to hit the water?

5. NEWSPAPERS Miko surveyed the 30 students in his math class. He found that 22 read the comics in the newspaper, 14 read the sports, and 8 of these read both the comics and the sports.

a. How many read the comics but not the sports?

b. How many read neither?

6. PATTERN Find the next number in the pattern: 7, 9, 12, 16, _____ .

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Reflecting on Chapter 12

1. Write about one new thing you learned in the chapter.

2. Create a problem that involves factoring. Factor the expression.

3. Identify one place you would use the graph of a quadratic equation in the real world. Explain how the graph is used.

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