SKILL 59

Are You Ready?

Properties of Exponents

Teaching Skill 59

Objective Simplify expressions using properties of exponents.

Review with students the vocabulary at the top of the student page and then the rule for multiplying variables with the same base.

Ask: **Do the expressions x^2 and y^2 have the same base?** (No) **What is the product of x^2 and y^2?** (x^2y^2) **Do you add the exponents?** (No) **Why not?** (The bases are not the same.)

Review with students how to multiply expressions that have numbers and variables. Ask: **In the expression $7x^5$, what is the number 7 called?** (the coefficient)

Emphasize that to find the product of two expressions, <u>multiply</u> the coefficients but <u>add</u> the exponents of those variables that have the same base.

Also point out that when a variable does not have a coefficient, it is understood to be 1. Likewise, when a variable does not have an exponent, it is understood to be 1.

Work through each of the examples and then have students complete the practice exercises.

PRACTICE ON YOUR OWN

In exercises 1–12, students use properties of exponents to simplify expressions.

CHECK

Determine that students understand properties of exponents.

Students who successfully complete the **Practice on Your Own** and **Check** are ready to move on to the next skill.

COMMON ERRORS

When multiplying variables with exponents, students may multiply the exponents rather than adding them.

Students who made more than 2 errors in the **Practice on Your Own,** or who were not successful in the **Check** section, may benefit from the **Alternative Teaching Strategy.**

Alternative Teaching Strategy

Objective Simplify expressions using properties of exponents.

Some students may benefit from seeing numbers and variables raised to exponents written in expanded form.

Write the following on the board: 3^4. Ask: **How would you write this expression without an exponent?** ($3 \cdot 3 \cdot 3 \cdot 3$).

Next, write the following on the board: $3^4 \cdot 3^2$. Ask a volunteer to come to the board and rewrite the product without using any exponents. ($3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$) Ask: **How would you write this in exponential form?** (3^6) Write $3^4 \cdot 3^2 = 3^{4+2} = 3^6$ and point out that the result is the same.

Move on to variables. Write: x^7. Ask: **How would you write this expression without an exponent?** ($x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x$) Have the students write the following problem on their paper: $x^4 \cdot x^6$. Instruct them to rewrite the problem without using exponents and to simplify their final answer. ($x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x = x^{10}$)

Finally, present an example with variables and coefficients. Write on the board: $3n^4 \cdot 7n^2$. Ask: **What are the coefficients in this problem?** (3 and 7) **What do you do with them?** (multiply them)

Instruct students to rewrite the problem without using exponents and simplify. ($3 \cdot 7 \cdot n \cdot n \cdot n \cdot n \cdot n \cdot n = 21n^6$)

Have students use this technique to simplify the expressions below. Remind students that if a variable does not have a coefficient or an exponent, they are understood to be 1.

$2x \cdot 12x^5$ ($24x^6$); $5n^3 \cdot 8n^7$ ($40n^{10}$); $6p^2 \cdot p^4$ ($6p^6$); $7h^5 \cdot 7h^5$ ($49h^{10}$)

When students are comfortable writing out and simplifying expressions, have them redo the problems using properties of exponents; $x^a \cdot x^b = x^{a+b}$. Remind students that you multiply coefficients and add exponents.

Name ______________________ Date ___________ Class ____________

SKILL **59**

Are You Ready?

Properties of Exponents

Vocabulary: x^3 $\longrightarrow$ exponent (3); base (x)

To multiply variables with the same base, <u>add</u> the exponents.

Rule: $x^a \cdot x^b = x^{a+b}$

To multiply expressions that include numbers and variables:

- Multiply the coefficients. If a variable does not have a coefficient, it is understood to be 1.
- <u>Add</u> the exponents of those variables that are the same. If a variable does not have an expressed exponent, it is understood to be 1.

Example 1: $5n \cdot 6n$	Example 2: $-4x^3 \cdot 7x$	Example 3: $h^3k \cdot 3h^5k^2$
$(5 \cdot 6)(n^{1+1}) = 30n^2$	$(-4 \cdot 7)(x^{3+1}) = -28x^4$	$(1 \cdot 3)(h^{3+5})(k^{1+2}) = 3h^8k^3$

Practice on Your Own

Simplify each expression.

1. $2x \cdot 5x$ ________

2. $-3a \cdot 7a^3$ ________

3. $-2 \cdot 8mn$ ________

4. $15p^2 \cdot 3pq$ ________

5. $5b^2c \cdot 5b^3c^3$ ________

6. $-2xy \cdot (-3xy)$ ________

7. $-16z^4 \cdot (-z)$ ________

8. $d^2e \cdot 8de$ ________

9. $6t \cdot (-3t)$ ________

10. $w^2 \cdot w \cdot w^5$ ________

11. $-2r \cdot 11r^2 \cdot (-r^4)$ ________

12. $5x \cdot 10y \cdot xy$ ________

Check

Simplify each expression.

13. $15f \cdot 2f$ ________

14. $-9 \cdot 3x^2y$ ________

15. $-20h \cdot (-3h^3)$ ________

16. $7ab \cdot 7ab$ ________

17. $p^3q \cdot 4pq$ ________

18. $-3u \cdot 7u^2v$ ________

19. $g^3 \cdot g^4 \cdot g$ ________

20. $-2y \cdot 8z \cdot yz$ ________

SKILL 57

Are You Ready?

Combine Like Terms

Teaching Skill 57

Objective Simplify expressions by combining like terms.

Discuss with students that combining like terms simply means adding or subtracting terms that are alike.

Point out that terms can be constants (numbers), variables (letters), or a combination of both. Stress that in order to be like terms, the "variable factors" must be the same. That is, the exponent of the variables must be the same. Ask: **Are 3*x* and $3x^2$ like terms?** (No) **Why not?** (Because the first term has an exponent of 1 and the second term has an exponent of 2.) Give several examples of like terms and unlike terms.

Remind students that a coefficient is the number that precedes the variable. Ask: **In the term 7*x*, what is the coefficient?** (7) Explain that if a variable does not have a coefficient, it is understood to be 1. Explain to students that combining like terms is achieved by adding (or subtracting) the coefficients of the like terms.

Review both examples and then have students complete the exercises.

PRACTICE ON YOUR OWN

In exercises 1–14, students simplify expressions by combining like terms.

CHECK

Determine that students know how to combine like terms.

Students who successfully complete the **Practice on Your Own** and **Check** are ready to move on to the next skill.

COMMON ERRORS

Students may forget that when a variable does not have a coefficient, it is understood to be 1.

Students who made more than 3 errors in the **Practice on Your Own,** or who were not successful in the **Check** section, may benefit from the **Alternative Teaching Strategy.**

Alternative Teaching Strategy

Objective Simplify expressions by combining like terms.

Some students may benefit from physically matching like terms using circles, squares, triangles, etc.

Remind students that like terms must have identical variable factors.

Write the following problem on the board:

$$12x + 1 + 7x + 19$$

Circle the constants and draw a square around the terms with *x*'s.

$$\boxed{12x} + 1 + \boxed{7x} + 19$$

Ask: **Can you add circles and squares and get a common term?** (No) **Can you add constants and variables and get a common term?** (No) **What is the sum of the terms that have squares around them?** (19*x*) **What is the sum of the terms that have circles around them?** (20) **What is the simplified form of the expression?** (19*x* + 20)

Point out that this method works well when there are multiple types of terms. Write the following problem on the board:

$$7n + 13m - 6 - 3n + 2m + 10 - n$$

Ask: **How many different types of terms are part of this problem?** (3; constants, *m*'s, and *n*'s) Circle the constants, draw squares around the *m*'s, and draw triangles around the *n*'s. Remind students to include the negatives.

$$7n + \boxed{13m}\ -6\ -3n + \boxed{2m} + 10\ -n$$

Before simplifying, ask: **What is the coefficient of the last term?** (−1)

Instruct students to simplify the expression. Emphasize that they should be careful with negatives. (3*n* + 15*m* + 4)

Have students work a number of problems using this technique.

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SKILL 57

Are You Ready?

Combine Like Terms

Definition: An algebraic term is a number, a variable, or the product of numbers and variables. *Like terms* are those terms that have exactly the same variable factor. For example, $2x$ and $7x$ are like terms because they both have the variable factor, x.

Combining like terms means adding or subtracting them. To combine like terms:

- Step 1: Reorder the terms so that like terms are together.
- Step 2: Add (or subtract) the coefficients of the like terms. If a variable does not have a coefficient, it is understood to be 1.

Example 1	$7x - 5 + 2x + 15$	Example 2	$6 + 2a - 8b + 4a - 11$
Reorder:	$7x + 2x - 5 + 15$	Reorder:	$6 - 11 + 2a + 4a - 8b$
Add:	$7x + 2x = (7 + 2)x = 9x$	Subtract:	$6 - 11 = -5$
Add:	$-5 + 15 = 10$	Add:	$2a + 4a = (2 + 4)a = 6a$
		Single term:	$-8b$
Answer:	$9x + 10$	Answer:	$-5 + 6a - 8b$

Practice on Your Own

Simplify each expression by combining like terms.

1. $2x + 10x$ ________

2. $9m + (-5m)$ ________

3. $6a^2 + a^2$ ________

4. $-10t + 3t$ ________

5. $14b + (-17b)$ ________

6. $12d^2 - 4d^2$ ________

7. $6x - 7x$ ________

8. $-5f + 5f$ ________

9. $8.2h + 2.8h$ ________

10. $4y - 9 - 13y$ ________

11. $3 + 6x + 7 + 4x$ ________

12. $2 + 4u - 7 + 3u + 10 - 12u$ ________

13. $9y - 2x + 4y + 11x - 3x$ ________

14. $16j + 8 - 9j - 4 - 7j$ ________

Check

Simplify each expression by combining like terms.

15. $9x + x$ ________

16. $-5c + 2c$ ________

17. $a^2 - 4a^2$ ________

18. $11.5z - 3.1z$ ________

19. $22m + 16 - m - 5 - 11m$ ________

20. $7q + 3r - 2r + q - 6r$ ________

SKILL 4

Are You Ready?

Greatest Common Factors

Teaching Skill 4

Objective Find the greatest common factor of two expressions.

Explain to students that the greatest common factor, or GCF, of two expressions is the largest of the common factors that the expressions share.

Direct students to Steps 1–3.

Ask: **What are variables?** (Variables are the letters in an expression.)

Ask: **What is a coefficient?** (A coefficient is the number that precedes one or more variables in an expression.)

Direct students to the example. Ask: **What are the coefficients of the two expressions?** (18 and 30)

Ask: **What is the smallest exponent of the variable *x* in the two expressions?** (1) **What is the smallest exponent of the variable *y* in the two expressions?** (2)

PRACTICE ON YOUR OWN

Review each step in the example.

In exercises 1–9, students find the greatest common factor for each pair of numbers or expressions.

CHECK

Determine that students know how to find the greatest common factor for a pair of expressions.

Students who successfully complete the **Practice on Your Own** and **Check** are ready to move on to the next skill.

COMMON ERRORS

When the expressions include variables, students choose the largest exponent of the variable, rather than the smallest exponent.

Students who made more than 2 errors in the **Practice on Your Own**, or who were not successful in the **Check** section, may benefit from the **Alternative Teaching Strategy**.

Alternative Teaching Strategy

Objective Find the greatest common factor using prime factorization.

Explain to students that monomial expressions include a coefficient (number), one or more variables (letters), or both.

Provide the following examples of monomial expressions: $24x^3y$ and $80x^2y^2$.

Ask: **What are the coefficients of these two expressions?** (24 and 80) Ask: **What are the variables in the expressions?** (x and y)

Remind students that they can use prime factorization to find the greatest common factor, or GCF, of the coefficients. Work through the process using 24 and 80.

$$\begin{array}{r|l} 2 & 24 \\ 2 & 12 \\ 2 & 6 \\ & 3 \end{array} \qquad \begin{array}{r|l} 2 & 80 \\ 2 & 40 \\ 2 & 20 \\ 2 & 10 \\ & 5 \end{array}$$

Have students write the prime factorization of the two numbers.

$24 = 2 \times 2 \times 2 \times 3$
$80 = 2 \times 2 \times 2 \times 2 \times 5$

Next have students line up matching factors according to occurrence and circle complete pairs.

$$\begin{array}{l} 24 = 2 \times 2 \times 2 \times 3 \\ 80 = 2 \times 2 \times 2 \times 2 \times 5 \end{array}$$

Explain that the GCF of the two numbers is the product of the matched pairs only.

Ask: **What is the GCF of 24 and 80?** ($2 \times 2 \times 2 = 8$)

Explain that finding the GCF of the variables is much easier–simply choose the smallest power of each variable.

Ask: **What is the GCF of the variables in the two expressions and why?** (x^2y since 2 is the smallest exponent of x and 1 is the smallest exponent of y)

The GCF of $24x^3y$ and $80x^2y^2$ is $8x^2y$.

Name ________________________________ Date __________ Class __________

SKILL 4

Are You Ready?

Greatest Common Factors

To find the greatest common factor, or GCF, in algebraic expressions:

- Step 1: Find the GCF of the coefficients of the expressions.
- Step 2: Find the GCF of each variable by choosing the one with the smallest exponent.
- Step 3: Write the GCF of the two expressions as a product of the GCFs found in Steps 1 and 2.

Example: Find the GCF of $18xy^4$ and $30x^2y^2$.

Step 1	Step 2	Step 3
coefficients: 18 and 30	variables: xy^4 and x^2y^2	GCF of coefficients: 6
factors of 18: {1, 2, 3, **6**, 9, 18}	smallest exponent of x: x	GCF of variables: xy^2
factors of 30: {1, 2, 3, 5, **6**, 10, 15, 30}	smallest exponent of y: y^2	product: 6 times xy^2
GCF = 6	GCF = xy^2	GCF = $6xy^2$

Practice on Your Own

Find the greatest common factor of each pair of numbers or expressions.

1. 8 and 20 ____________

2. 14 and 28 ____________

3. $32a$ and $60a^3$ ____________

4. x^3y and x^2y^4 ____________

5. $18a^2$ and $42a^5$ ____________

6. $4x^2y$ and $6x^2y^3$ ____________

7. $16e^2f$ and $64ef^3$ ____________

8. $28r^2st$ and $70rs^3$ ____________

9. $10xyz$ *and* $5x^3z$ ____________

Check

Find the greatest common factor of each pair of expressions.

10. 24 and 60 ____________

11. $60e^4f$ and $24e^2f$ ____________

12. $12a^5$ and $28a^3$ ____________

13. $15gh$ and $8g^2h$ ____________

14. $12a^3b^2$ and $30a^3d$ ____________

15. $50x^5$ and $40x^3$ ____________

SKILL 67

Are You Ready?

Factor Trinomials

Teaching Skill 67
Objective Factor trinomials.

Review with students the definition of a trinomial. Explain that most trinomials of the form $ax^2 + bx + c$ can be factored into two binomials.

Instruct students to read Steps 1 and 2. Point out that if the coefficient of x^2 is 1, then both factors will always be x since $x \cdot x = x^2$.

Instruct students to read Step 3. Explain that if the last term in the expression is positive, you use the same signs (either both $+$ or both $-$ depending on the sign of the middle term). If the last term is negative, use opposite signs.

Instruct students to read Step 4. Explain that the factors that go in the last position have to be two numbers such that their product equals c (the constant) and their sum equals b (the coefficient of the middle term).

Work through the example. When you get to Step 4, remind students that they are looking for the factors of -12 that add up to $+4$. Have students verify that the factors are correct using FOIL to multiply the binomials.

Have students complete the practice exercises.

PRACTICE ON YOUR OWN
In exercises 1–9, students factor trinomials.

CHECK
Determine that students know how to factor trinomials.

Students who successfully complete the **Practice on Your Own** and **Check** are ready to move on to the next skill.

COMMON ERRORS
Students may choose the wrong factors of c or may use the wrong signs in one or both of the binomial factors.

Students who made more than 2 errors in the **Practice on Your Own,** or who were not successful in the **Check** section, may benefit from the **Alternative Teaching Strategy.**

Alternative Teaching Strategy
Objective Factor trinomials.

Some students may benefit from discovering patterns on their own when learning to factor trinomials.

Present the following statements:
$(x + 5)(x + 2) = x^2 + 7x + 10$

$(x + 4)(x + 3) = x^2 + 7x + 12$

$(x + 3)(x + 9) = x^2 + 12x + 27$

$(x + 6)(x + 4) = x^2 + 10x + 24$

Ask: **On the left side of the first statement, what is the sum of the two constants?** (7) **Where is the 7 on the right side?** (the coefficient of the middle term) **What is the product of the two constants?** (10) **Where is the 10 on the right side?** (the last term)

Repeat these questions for each of the statements, then ask students to make a general statement about what the sum of the two constants should be and what the product of the two constants should be. (The sum should be equal to the coefficient of the middle term and the product should be equal to the last term.)

Repeat the exercise using the following statements:
$(x + 5)(x - 3) = x^2 + 2x - 15$

$(x - 7)(x + 2) = x^2 - 5x - 14$

$(x - 6)(x - 3) = x^2 - 9x + 18$

Guide students to realize that the general statement they made works regardless of the signs.

Present the following problem:
Factor $x^2 - 7x - 18$. Ask: **What are the factors of 18?** (1, 18 and 2, 9 and 3, 6) Explain that since the product of the factors must equal -18, one of them should be negative. Ask: **Which set of factors has a sum of -7 if one of them is negative?** (2, -9)

Write the factored form on the board and then have students work more problems.

Name ______________________________ Date __________ Class __________

SKILL 67

Are You Ready?

Factor Trinomials

Definition: A trinomial is a polynomial that has three terms. For example, $x^2 + 5x + 4$ is a trinomial. The factored form of $x^2 + 5x + 4$ is $(x + 4)(x + 1)$.

To factor a trinomial:
Step 1: Set up a product of two ( ) where each will hold two terms. It will look like ( )( ).
Step 2: Find the factors that go in the first positions of each set of ( ).
Step 3: Decide on the signs that will go in each set of ( ).
Step 4: Find that factors that go in the last positions of each set of ( ).

Example: Factor: $x^2 + 4x - 12$.		
Step 1:	$(\quad)(\quad)$	
Step 2:	$(x \quad)(x \quad)$	The only possible factors of x^2 are x and x.
Step 3:	$(x + \quad)(x - \quad)$	The last term is negative, use opposite signs.
Step 4:	$(x + 6)(x - 2)$	The factors of -12 are $\pm 1 \cdot \pm 12$ or $\pm 3 \cdot \pm 4$ or $\pm 6 \cdot \pm 2$ and the only pair of these that can have a sum of 4 (the coefficient of the middle term) is 6 and -2.

Practice on Your Own

Factor each polynomial completely.

1. $x^2 + 5x + 4$ ____________
2. $x^2 + 3x - 10$ ____________
3. $x^2 - 4x + 3$ ____________

4. $x^2 - x - 20$ ____________
5. $x^2 + 2x - 24$ ____________
6. $x^2 + 10x + 21$ ____________

7. $x^2 - 10x + 16$ ____________
8. $x^2 - 8x - 9$ ____________
9. $x^2 - 18x + 45$ ____________

Check

Factor each polynomial completely.

10. $x^2 + 7x + 10$ ____________
11. $x^2 - 11x + 28$ ____________
12. $x^2 + 7x - 30$ ____________

13. $x^2 - 3x + 2$ ____________
14. $x^2 + 49x + 48$ ____________
15. $x^2 - 7x - 60$ ____________

SKILL 81

Are You Ready?

Solve Quadratic Equations

Teaching Skill 81

Objective Solve quadratic equations by taking the square root.

Remind students that there are a number of ways to solve quadratic equations: factoring; grouping; using the quadratic formula; and taking square roots. Point out that when the equation to be solved has only an x^2 term and a constant, the quickest way to solve the equation is to find the square root.

Remind students that when you solve the equation $x^2 = 9$, you get two answers, $+3$ and -3. To illustrate this, ask: **Is 3^2 equal to 9?** (Yes) **Is $(-3)^2$ also equal to 9?** (Yes)

Review with students the steps for solving a quadratic equation by taking square roots. Emphasize that the x^2 term must be on one side of the equal sign and the constant must be on the other side. Also point out that the coefficient of the x^2 term should be 1 before finding the square root.

Work through the example with students. Remind students to use inverse operations when moving terms from one side of the equation to the other.

PRACTICE ON YOUR OWN

In exercises 1–9, students solve quadratic equations by finding the square root.

CHECK

Determine that students know how to solve quadratic equations by isolating the variable and taking square roots.

Students who successfully complete the **Practice on Your Own** and **Check** are ready to move on to the next skill.

COMMON ERRORS

Students may forget that finding the square root of a number results in both a positive answer and a negative answer.

Students who made more than 2 errors in the **Practice on Your Own,** or who were not successful in the **Check** section, may benefit from the **Alternative Teaching Strategy.**

Alternative Teaching Strategy

Objective Solve quadratic equations by factoring a difference of squares.

Some students are more comfortable solving quadratics by factoring. Explain to students that they can factor any quadratic equation that can be solved by the square root method.

Remind students that there are special quadratics called differences of squares. Write the following equation on the board: $x^2 - 36 = 0$. Then remind students that the factored form of this equation is $(x - 6)(x + 6)$. Ask: **What happens to the middle terms when this product is multiplied out?** (They are opposites, $6x$ and $-6x$, and have a sum of zero.) Have students practice factoring simple differences of squares.

Next, remind students that when solving quadratic equations, if either factor is equal to zero, then the whole product is equal to zero. This explains why you are allowed to set each factor equal to zero and solve. Write $(x + 6)(x - 6) = 0$ on the board and demonstrate how to solve the equation to get $x = 6$ and $x = -6$.

Next, write the equation $x^2 = 49$ on the board. Ask: **How can you make this look like a difference of squares?** (Subtract 49 from both sides of the equation). **Then how can you solve the equation?** (Factor and solve.) Have students practice several of these types of problems.

Next, write the problem $7x^2 = 28$ on the board, and then subtract 28 from both sides to get the equation $7x^2 - 28 = 0$. Ask: **Is this a difference of squares?** (No) **Why not?** (7 is not a perfect square, nor is 28.) Remind students that they can factor out the GCF. Demonstrate using the problem above. [$7(x^2 - 4) = 0$] Point out that there is now a difference of squares and the problem can be solved by factoring. Work several problems similar to the example.

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SKILL 81

Are You Ready?

Solve Quadratic Equations

One method of solving quadratic equations is to find the square root of both sides of the equation. This method only works when the equation is limited to an x^2 term and a constant.

To solve a quadratic equation by the square root method, follow these steps:

- Step 1: Simplify the expression by combining like terms and then isolate the x^2 term.
- Step 2: Divide both sides of the equation by the coefficient of x^2.
- Step 3: Find the square root of both sides of the equation. Remember, you will get a positive and a negative value as your answers.

Example: Solve $5x^2 = 3x^2 + 32$.	
$2x^2 = 32$	Step 1: Subtract $3x^2$ from both sides.
$x^2 = 16$	Step 2: Divide both sides by 2.
$x = 4$ or -4	Step 3: Find the square root of both sides.

Practice on Your Own

Solve each equation.

1. $7x^2 = 28$

$x =$ ____ or ____

2. $3x^2 = x^2 + 32$

$x =$ ____ or ____

3. $4x^2 - 4 = 60$

$x =$ ____ or ____

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

$x =$ ____ or ____

5. $200 = 2x^2$

$x =$ ____ or ____

6. $10x^2 - 27 = 7x^2$

$x =$ ____ or ____

7. $-220 = 5 - x^2$

$x =$ ____ or ____

8. $10x^2 = 5x^2 + 125$

$x =$ ____ or ____

9. $2x^2 - 6 = x^2 + 30$

$x =$ ____ or ____

Check

Solve each equation for the indicated variable.

10. $12x^2 = 12$

$x =$ ____ or ____

11. $6x^2 - 10 = 140$

$x =$ ____ or ____

12. $19 = x^2 - 17$

$x =$ ____ or ____

13. $8 + x^2 = 3x^2$

$x =$ ____ or ____

14. $20 - x^2 = -80$

$x =$ ____ or ____

15. $2x^2 - 150 = 650$

$x =$ ____ or ____

SKILL 56 ANSWERS:

Practice on Your Own

1. $5x + 30$
2. $5z - 35$
3. $2n - 4$
4. $12 + 4k$
5. $48 - 8y$
6. $6m + 18$
7. $10p + 10$
8. $60 - 3c$
9. $7q - 7$
10. $55 + 11t$
11. $14 + 2b$
12. $36 - 9w$

Check

13. $12c + 24$
14. $15 - 5a$
15. $25 + 25d$
16. $50 - 10j$
17. $4x + 12$
18. $30 + 15y$
19. $3g - 75$
20. $9m - 9$

SKILL 57 ANSWERS:

Practice on Your Own

1. $12x$
2. $4m$
3. $7a^2$
4. $-7t$
5. $-3b$
6. $8d^2$
7. $-x$
8. 0
9. $11h$
10. $-9y - 9$
11. $10 + 10x$
12. $5 - 5u$
13. $13y + 6x$
14. 4

Check

15. $10x$
16. $-3c$
17. $-3a^2$
18. $8.4z$
19. $10m + 11$
20. $8q - 5r$

SKILL 58 ANSWERS:

Practice on Your Own

1. $5 + n$
2. a number decreased by 15; 15 less than a number; the difference between a number and 15; etc.
3. $C = 3(9.95) + 2(14.98)$
4. $P = 7 + 10 + s$
5. $V = 12{,}000 + 500y$
6. $n = 56 - 3w$

Check

7. $n - 6$
8. $C = 6(6.99) + 2(22.98)$
9. $A = 400 + 150m$

SKILL 59 ANSWERS:

Practice on Your Own

1. $10x^2$
2. $-21a^4$
3. $-16mn$

4. $45p^3q$
5. $25b^5c^4$
6. $6x^2y^2$
7. $16z^5$
8. $8d^3e^2$
9. $-18t^2$
10. w^8
11. $22r^7$
12. $50x^2y^2$

Check

13. $30f^2$
14. $-27x^2y$
15. $60h^4$
16. $49a^2b^2$
17. $4p^4q^2$
18. $-21u^3v$
19. g^8
20. $-16y^2z^2$

SKILL 60 ANSWERS:

Practice on Your Own

1. 36
2. 28
3. -3
4. -27
5. 9
6. -2
7. -10
8. 8
9. -6

Check

10. 15
11. 2
12. 0
13. -6
14. -4
15. 2

SKILL 61 ANSWERS:

Practice on Your Own

1. $10m^4n^2$
2. $4x^2y$
3. $-20a^4b$
4. $\frac{5}{2t^3}$
5. $-\frac{f^2}{3}$
6. $-3p^3q^2r^3$
7. u^4v
8. $\frac{4c^2}{d^5}$
9. $144h^2k^2$
10. -1
11. $10xy^3z^2$
12. $-\frac{wz}{9}$

Check

13. $35s^4t$
14. $-\frac{x}{5y}$
15. $-8b^4c^4$
16. $5pq^3$
17. $-\frac{5mn}{3}$
18. $36u^3w^4$
19. $-10x^8y^2$
20. $\frac{7}{f}$

16. No
17. {1, 17}
18. {1, 3, 5, 9, 15, 45}
19. {1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 80, 160}
20. {1, 2, 4, 7, 14, 28}

SKILL 4 ANSWERS:

Practice on Your Own

1. 4
2. 14
3. $4a$
4. x^2y
5. $6a^2$
6. $2x^2y$
7. $16ef$
8. $14rs$
9. $5xz$

Check

10. 12
11. $12e^2f$
12. $4a^3$
13. gh
14. $6a^3$
15. $10x^3$

SKILL 5 ANSWERS:

Practice on Your Own

1. {1, 3, 11, 33}
2. {1, 23}
3. {1, 2, 3, 5, 6, 9, 10, 15, 18, 30, 45, 90}
4. {1, 2, 4, 5, 10, 20}
5. composite, 5×5 or 1×25
6. composite, 2×23 or 1×46
7. prime
8. composite, 2×6 or 3×4 or 1×12
9. prime
10. prime
11. composite, 11×11 or 1×121
12. prime

Check

13. composite, 3×9 or 1×27
14. prime
15. composite, 9×9 or 1×81
16. composite, 2×14 or 4×7 or 1×28
17. prime
18. composite, 2×9 or 3×6 or 1×18
19. composite, 3×7 or 1×21
20. prime

SKILL 6 ANSWERS:

1. 9
2. 64
3. 256
4. 625
5. 4
6. 12
7. 20
8. 9
9. No
10. Yes, 1
11. Yes, 15
12. No
13. Yes, 13
14. Yes, 14
15. No
16. No

SKILL 65 ANSWERS:

Practice on Your Own

1. $49x^2 + 14x + 1$
2. $w^2 - 36$
3. $9p^2 - 30p + 25$
4. $m^2 + 18m + 81$
5. $25y^2 - 1$
6. $d^2 - 4d + 4$
7. $16b^2 - 49$
8. $100 - 9h^2$
9. $a^2 - 64$
10. $4z^2 - 1$

Check

11. $36x^2 + 48x + 16$
12. $4t^2 + 4t + 1$
13. $u^2 - 9$
14. $9h^2 - 25$
15. $y^2 + 14y + 49$
16. $q^2 - 36$

SKILL 66 ANSWERS:

Practice on Your Own

1. $x(x + 6)$
2. $3(x - 4)$
3. $5x(3x + 1)$
4. $7(x^2 - 2)$
5. $x(6x + 5)$
6. $4(x^2 - 2)$
7. $3x(4x - 3)$
8. $3x(x^2 - 1)$
9. $x^2(5x + 1)$
10. $3x^2(x - 2)$
11. $x^3(x + 1)$
12. $2x(x^3 - 1)$

Check

13. $x(x - 5)$
14. $5(4x + 1)$
15. $8x(x - 2)$
16. $3(4x^2 + 3)$
17. $x^2(10x - 1)$
18. $9x(3x^2 + 2)$
19. $x^2(x + 1)$
20. $2x^2(x^2 - 3)$

SKILL 67 ANSWERS:

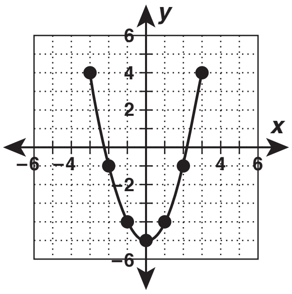
Practice on Your Own

1. $(x + 4)(x + 1)$
2. $(x + 5)(x - 2)$
3. $(x - 1)(x - 3)$
4. $(x + 4)(x - 5)$
5. $(x + 6)(x - 4)$
6. $(x + 3)(x + 7)$
7. $(x - 2)(x - 8)$
8. $(x + 1)(x - 9)$
9. $(x - 3)(x - 15)$

Check

10. $(x + 2)(x + 5)$
11. $(x - 4)(x - 7)$
12. $(x + 10)(x - 3)$
13. $(x - 1)(x - 2)$
14. $(x + 1)(x + 48)$
15. $(x + 5)(x - 12)$

4.



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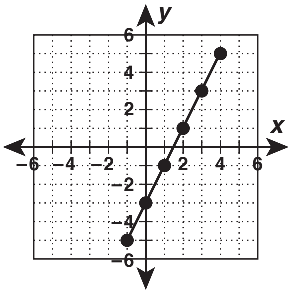

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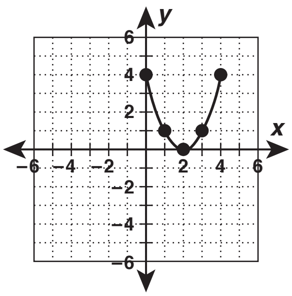

Check

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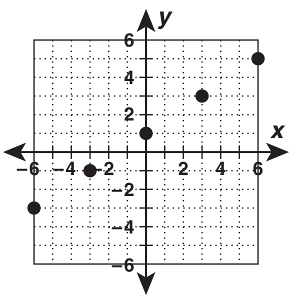

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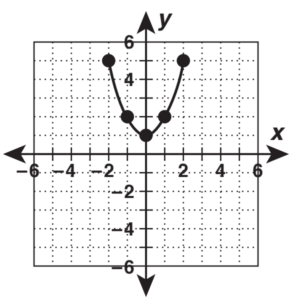

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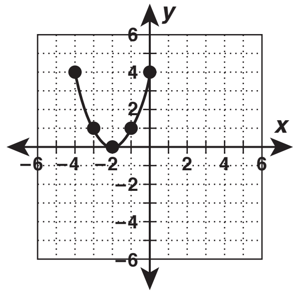


SKILL 81 ANSWERS:

Practice on Your Own

1. $x = 2$ or -2
2. $x = 4$ or -4
3. $x = 4$ or -4
4. $x = 1$ or -1
5. $x = 10$ or -10
6. $x = 3$ or -3
7. $x = 15$ or -15
8. $x = 5$ or -5
9. $x = 6$ or -6

Check

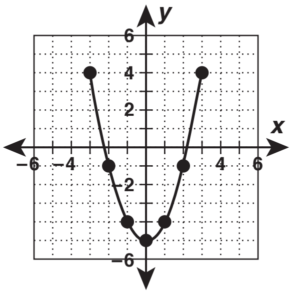
10. $x = 1$ or -1
11. $x = 5$ or -5
12. $x = 6$ or -6
13. $x = 2$ or -2
14. $x = 10$ or -10
15. $x = 20$ or -20

SKILL 82 ANSWERS:

Practice on Your Own

1. $16; (x + 4)^2$
2. $36; (x - 6)^2$
3. $\frac{1}{4}; \left(x + \frac{1}{2}\right)^2$
4. $25; (x - 5)^2$
5. $121; (x - 11)^2$
6. $\frac{9}{4}; \left(x - \frac{3}{2}\right)^2$

4.



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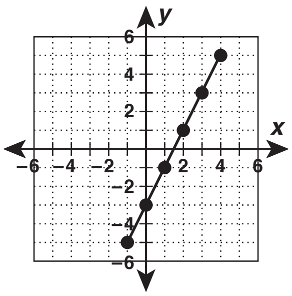

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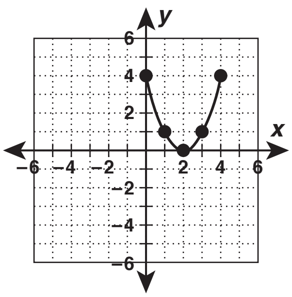
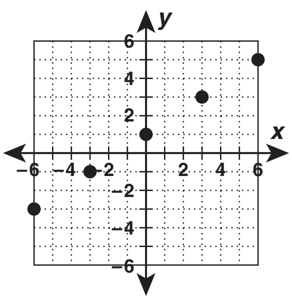


Check

7.



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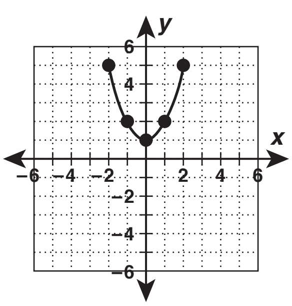
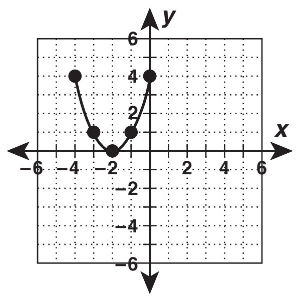


9.



SKILL 81 ANSWERS:

Practice on Your Own

1. $x = 2$ or -2
2. $x = 4$ or -4
3. $x = 4$ or -4
4. $x = 1$ or -1
5. $x = 10$ or -10
6. $x = 3$ or -3
7. $x = 15$ or -15
8. $x = 5$ or -5
9. $x = 6$ or -6

Check

10. $x = 1$ or -1
11. $x = 5$ or -5
12. $x = 6$ or -6
13. $x = 2$ or -2
14. $x = 10$ or -10
15. $x = 20$ or -20

SKILL 82 ANSWERS:

Practice on Your Own

1. 16; $(x + 4)^2$
2. 36; $(x - 6)^2$
3. $\frac{1}{4}$; $\left(x + \frac{1}{2}\right)^2$
4. 25; $(x - 5)^2$
5. 121; $(x - 11)^2$
6. $\frac{9}{4}$; $\left(x - \frac{3}{2}\right)^2$