Unit 3 – Algebraic Expressions

Topics

The Distributive Property

Simplifying Algebraic Expressions

Adding Linear Expressions

Subtracting Linear Expressions

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Multiplying and Dividing Monomials
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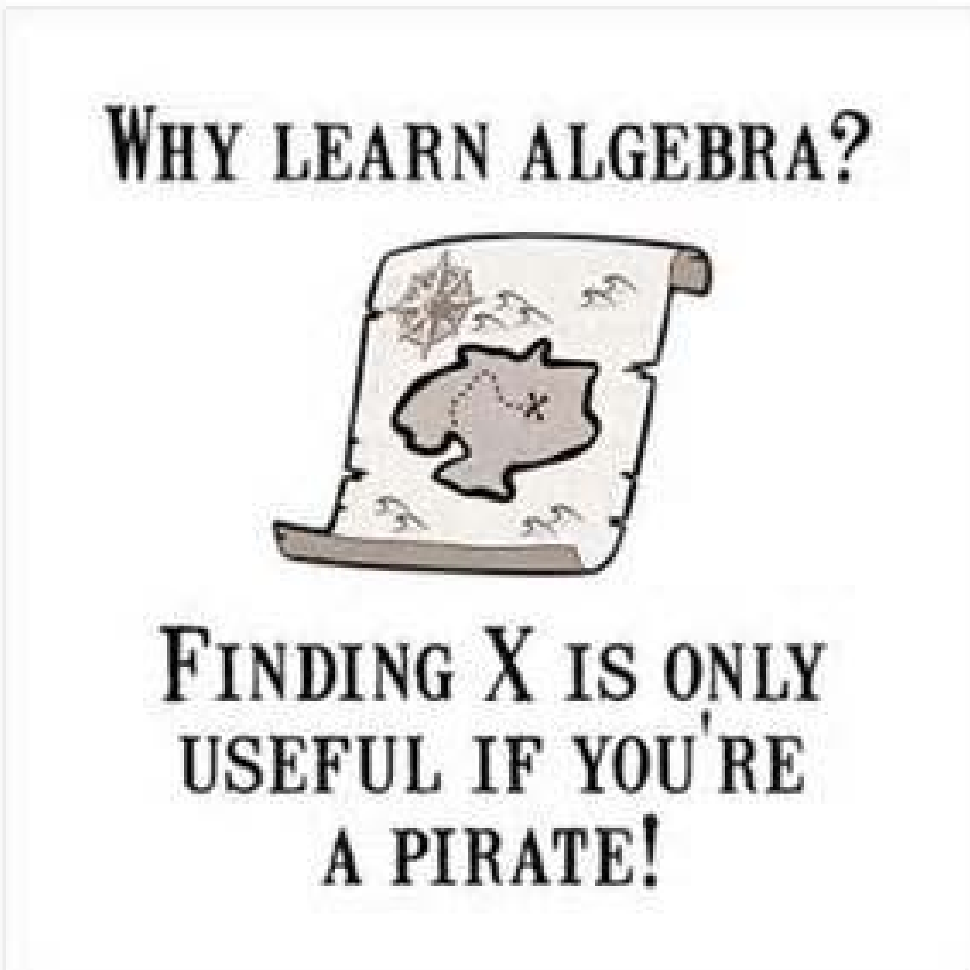
Order of Operations



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Lesson 1 Reteach

The Distributive Property

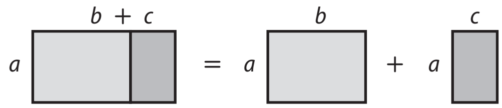
The expressions 2(1 + 5) and 2 • 1 + 2 • 5 are equivalent expressions because they have the same value, 12. The **Distributive Property** combines addition and multiplication. The Distributive Property can also be used with algebraic expressions containing variables.

Symbols

$a(b + c) = ab + ac$

$(b + c)a = ab + ac$

Model



The Distributive Property also combines subtraction and multiplication.

Symbols

$a(b - c) = ab - ac$

$(b - c)a = ab - ac$

Example 1 Use the Distributive Property to write 2(6 + 3) as an equivalent expression. Then evaluate the expression.

$2(6 + 3)$	$= 2 \cdot 6 + 2 \cdot 3$	Distributive Property
	$= 12 + 6$	Multiply.
	$= 18$	Add.

Example 2 Use the Distributive Property to write $3(n - 8)$ as an equivalent algebraic expression.

$3(n - 8)$	$= 3[n + (-8)]$	Rewrite $n - 8$ as $n + (-8)$.
	$= 3n + 3 \cdot (-8)$	Distributive Property
	$= 3n + (-24)$	Simplify.
	$= 3n - 24$	Definition of subtraction

Exercises

Use the Distributive Property to write each expression as an equivalent expression. Then evaluate the expression.

1. $3(8 + 2)$

2. $2(9 + 11)$

3. $5(19 - 6)$

4. $-6(3 + 14)$

5. $(17 - 4)3.5$

6. $(6 + 4)\frac{1}{2}$

Use the Distributive Property to write each expression as an equivalent algebraic expression.

7. $-14(j + 3)$

8. $(a - 15)20$

9. $9(h + 50)$

10. $-12(s - 2)$

11. $0.2(x + 60)$

12. $\frac{1}{4}(c - 12)$

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Lesson 2 Reteach

Simplifying Algebraic Expressions

Listed below are some definitions related to algebraic expressions.

term: a number, variable, or a product of numbers and variables; terms in an expression are seperated by addition or subtraction signs

coefficient: the numerical part of a term that also contains a variable

constant: term without a variable

like terms: terms that contain the same variables

like terms

constant

$6a - b + 2a + 7$

terms

The coefficient of a is 6.

$6a - b + 2a + 7$

The coefficient of b is -1.

The coefficient of a is 2.

When an algebraic expression has no like terms and no parentheses, it is in **simplest form.**

To make it easier to simplify an algebraic expression, rewrite subtraction as addition. Then use the Commutative Property to group like terms together.

Example

Simplify $5t - 7(s - 4t)$.

$5t - 7(s - 4t)$	$= 5t + (-7)[s + (-4t)]$	Definition of Subtraction
	$= 5t + (-7s) + (-7 \cdot -4t)$	Distributive Property
	$= 5t + (-7s) + 28t$	Simplify.
	$= 5t + 28t + (-7s)$	Commutative Property
	$= 33t + (-7s)$ or $33t - 7s$	Simplify.

Exercises

Simplify each expression.

1. $9m + 3m$

2. $5x - x$

3. $8y + 2y + 3y$

4. $4.3x - 8.1 + 0.2x - 17.5$

5. $-7.6 - 9y - 6.5 + 4.7y$

6. $-0.3g - 4.2 + 6.1g - 0.9$

7. $\frac{1}{5}(p - 10) + 13p - 7$

8. $(a + 12)\frac{5}{6} - 5a + 11$

9. $-6h - 5 + \frac{2}{3}(24h - 12)$

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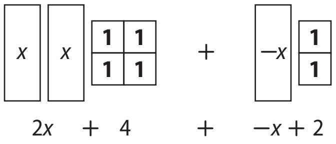
Lesson 3 Reteach

Adding Linear Expressions

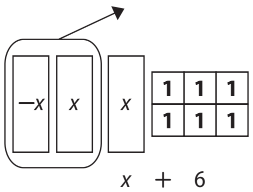
A **linear expression** is an algebraic expression in which the variable is raised to the first power. You can use models to add linear expressions.

Example **Add $(2x + 4) + (-x + 2)$.**

Step 1 Model the linear expressions.



Step 2 Group tiles with the same shape. Then remove any zero pairs.



So, $(2x + 4) + (-x + 2) = x + 6$.

Exercises

Add. Use models if needed.

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

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

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

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

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

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

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

8. $(12x - 5) + (-3x + 8)$

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Lesson 4 Reteach

Subtracting Linear Expressions

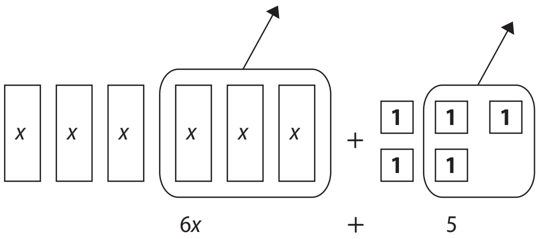
You can subtract linear expressions using models. Draw a model to represent the first linear expression. Then, remove the tiles that are represented by the second linear expression.

Example **Subtract. Use models.**

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

Step 1 Model the linear expression $6x + 5$.

Step 2 To subtract $3x + 3$, remove three x-tiles and three 1-tiles.

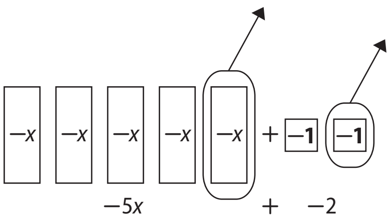


Step 3 Write the linear expression for the remaining tiles.
$(6x + 5) - (3x + 3) = 3x + 2$

b. $(-5x - 2) - (-x - 1)$

Step 1 Write the linear expression as the sum of terms. Then model the linear expression.

Step 2 To subtract $-x - 1$, remove one negative x-tiles and one negative 1-tile.



Step 3 Write the linear expression for the remaining tiles.
$(-5x - 2) - (-x - 1) = -4x - 1$

Exercises

Subtract. Use models if needed.

1. $(6x - 3) - (2x - 2)$

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

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

4. $(-3x - 7) - (-2x - 6)$

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

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

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Lesson 5 Reteach

Factoring Linear Expressions

A **linear expression** is in factored form when it is expressed as the product of its factors.

Example 1 **Factor $5x + 10$.**

Use the GCF to factor the linear expression.

$5x = 5 \cdot x$ Write the prime factorization of $5x$ and 10.
$10 = 5 \cdot 2$ Circle the common factors.

The GCF of $5x$ and 10 is 5. Write each term as a product of the GCF and its remaining factors.

$$5x + 10 = 5(x) + 5(2)$$
$$= 5(x + 2) \quad \text{Distributive Property}$$

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

Example 2 **Factor $3x + 8$.**

$3x = 3 \cdot x$ Write the prime factorization of $3x$ and 8.
$8 = 2 \cdot 2 \cdot 2$

There are no common factors, so $3x + 8$ *cannot be factored.*

Exercises

Factor each expression. If the expression cannot be factored, write *cannot be factored.* Use algebra tiles if needed.

1. $15x + 10$

2. $7x - 3$

3. $6x + 9$

4. $30x - 25$

5. $13x + 14$

6. $50x - 75$

7. $24x - 18$

8. $18x + 13$

9. $16x - 12$

10. $36x + 45$

Lesson 1 Problem-Solving Practice

The Distributive Property

1. Mr. Johannsen has a farm with 3 cows, 8 chickens, and some ducks. If the total number of farm animal legs is 40, how many ducks does Mr. Johannsen have on his farm?

2. Amy buys retired stamps from the U.S. Postal Service catalog. Last month, she bought 28 Candy Hearts stamps for $0.37 each. How much did Amy spend on stamps in all?

3. The table shows the cookie sales for Tina's troop. If each box costs $3.50, show two ways that Tina could find the troop's total cookie sales.

Kind of Cookie	Number of Boxes
Mint	60 boxes
Vanilla sandwich	42 boxes
Peanut butter	56 boxes

4. Jonah drew two squares with the same dimensions. He then added 2 inches to the length of one square to make it a rectangle. He also added 2 inches to the width of the other square to make it a rectangle. Compare the perimeters of the two rectangles.

5. Daniel wants to buy a bicycle that costs $200.00. He saves the same amount each month from the money he earns mowing lawns. He also saves $15.00 of his monthly allowance. If x represents the amount he earns mowing lawns each month, write an expression to show Daniel's total savings after 8 months.

6. Refer to the information in Exercise 5. If Daniel earns $25 each month mowing lawns, how long will it take him to save enough money to buy his bicycle?

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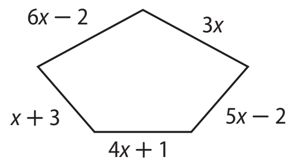
Lesson 2 Problem-Solving Practice

Simplifying Algebraic Expressions

1. There are 15 dogs, 22 cats, and 4 rabbits at a shelter. Each dog needs a collar, a bowl, and a toy. Each cat needs a collar and a bowl. In addition, one scratching post is needed for all of the cats. Each rabbit needs a bowl. Write an expression in simplest form to show the total number of collars c, bowls b, and toys t, that the animal shelter needs for its resident animals.

2. Rangley's father is making a walkway in the backyard. He will use large tiles for the walkway like the one shown below. Write an expression in simplified form for the perimeter of one tile.



3. Mr. Raphael needs to buy notebooks for his children to start the school year. His son Manny needs some notebooks. His daughter Daphne needs twice as many as does Manny. His other daughter Ophelia says she needs one fewer than 3 times as many as Manny needs. If Mr. Raphael buys x notebooks for Manny, how many notebooks will he need to buy in all? Write an expression in simplest form.

4. Three families recently ordered jeans from a catalogue. The Rodriguez family ordered twice as many jeans as the Gomez family, and the Jimenes family ordered 4 times as many jeans as the Gomez family. Write an expression in simplest form to show how many jeans the families bought all together.

5. Three families went to an amusement park together. The number of people in each family is listed in the table.

Family	Adults	Children	Seniors
McGraw	2	3	1
Churchill	1	2	2
Sanchez	2	1	1

Write an expression in simplest form to show how much it costs all adults, children, and seniors from the three families to attend the amusement park when a is the cost of an adult ticket, c is the cost of a child ticket, and s is the cost of a senior ticket.

6. Refer to the table in Exercise 5. The admission ticket cost was \$40 for adults, \$25 for children, and \$27 for seniors. Write an expression to find how much the three families spent in all for admission tickets.

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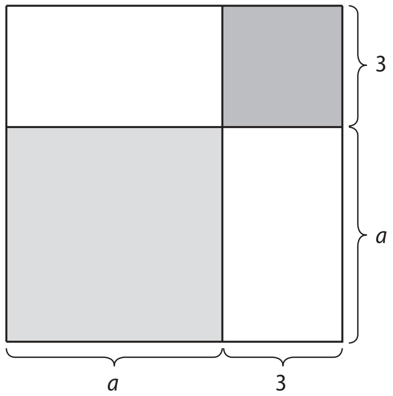
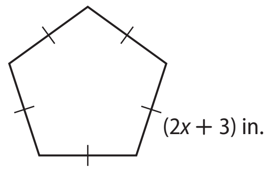
Lesson 3 Problem-Solving Practice

Adding Linear Expressions

1. Write an expression in simplest form to show the perimeter of the large square below.



2. Heather was building a scale model of the Pentagon for her history class.

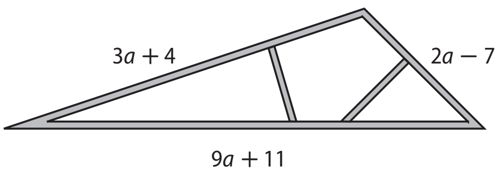


a. Write and simplify an expression to represent the perimeter of Heather's scale model.

b. Find the perimeter of the model if $x = 2$.

3. A mailing supply company produces yellow mailing envelopes. The envelopes come in a variety of sizes, but the length is always 4 centimeters more than double the width. Write and simplify an expression to give the perimeter of any of the envelopes.

4. Find the simplest expression for the perimeter of the triangular roof truss.



5. Kevin built a deck in his backyard. The length of the deck was $5x + 1$ units and the width of the deck was $4x - 1$ units. Write and simplify an expression to represent the perimeter of Kevin's deck.

6. The cost to produce x monitors is represented by the expression $350x + 1500$. The cost to produce x chairs is represented by the expression $175x - 50$. Write and simplify an expression to represent the cost of x monitors and chairs.

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Lesson 4 Problem-Solving Practice

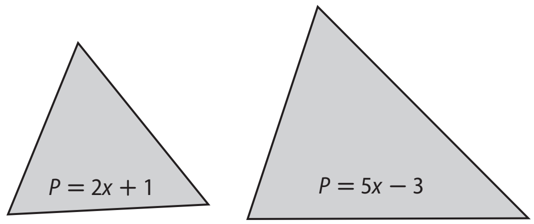
Subtracting Linear Expressions

1. The expression $5x + 10$ represents the amount of money in dollars the swim team earns by selling x school spirit shirts.

a. If the team had to pay $2x + 3$ in expenses, write and simplify an expression to represent their profit.

b. If the team sold 25 shirts, what was their profit?

2. Find the difference in the perimeters of the triangles shown.



3. The expression $6x + 4$ represents the number of miles Sarah ran in x hours. The expression $9x$ represents the number of miles Libby ran in the same number of hours.

a. Write an expression to show how many more miles Libby ran than Sarah.

b. If they each ran for 3 hours, how many more miles did Libby run?

4. Pete's Plumbing charges $25x + 50$ dollars for x hours of work. Plugged Pipes Plumbing charges $50x + 75$ dollars for the same number of hours.

a. Write an expression to represent how much more Plugged Pipes Plumbing costs than Pete's Plumbing for x hours of work.

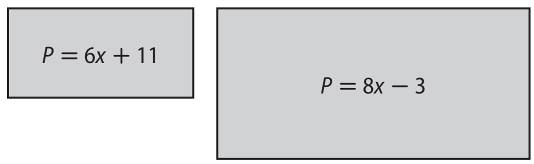
b. If they each worked for 2 hours, how much more expensive is Plugged Pipes Plumbing?

5. The cost to rent a car from Lou's Garage is $50 + 0.10m$ dollars for m miles. The cost to rent a car at Jerry's Garage is $25 + 0.05m$ dollars for the same number of miles.

a. Write an expression to represent how much more Lou's Garage is than Jerry's for m miles.

b. If Ainsley wanted to rent a car and drive 100 miles, how much more expensive would Lou's Garage be?

6. What is the difference in the perimeters of the rectangles shown?



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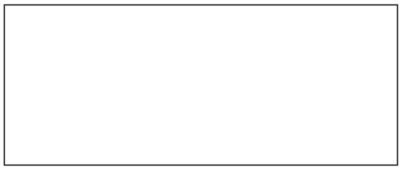
Lesson 5 Problem-Solving Practice

Factoring Linear Expressions

1. A sidewalk has an area that can be represented by the expression $(8x + 24)$ square feet. Factor the expression $8x + 24$.

2. The cost of renting a speedboat can be represented by the expression $50x + 250$, where x is the number of hours it is rented. Factor the expression $50x + 250$.

3. The rectangle shown below has an area of $(28x + 49)$ square inches. Factor the expression $28x + 49$.



4. Four friends went to a concert and paid \$12 total for parking and \$$x$ per ticket. The expression \$$4x$ + \$12 represents the total cost paid of all four friends. Factor $4x + 12$.

5. Marisa has \$40 in her savings account and plans to save x dollars each month for 5 months. The expression $5x + 40$ represents the total amount in the account in dollars after 5 months. Factor the expression $5x + 40$.

6. A square picture frame has a perimeter of $(20x + 32)$ inches. What is the length of one side of the picture frame?

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Lesson 1 Reteach

Powers and Exponents

A number that is expressed using an exponent is called a **power.** The **base** is the number that is multiplied. The **exponent** tells how many times the base is used as a factor. So, 4^3 has a base of 4 and an exponent of 3, and $4^3 = 4 \cdot 4 \cdot 4 = 64$.

$$\text{base} \longrightarrow \underbrace{4^3}_{\text{powerabo}} \longleftarrow \text{exponent}$$

Example 1 Write each expression using exponents.

a. $\mathbf{10 \cdot 10 \cdot 10 \cdot 10 \cdot 10}$

The base is 10. It is a factor 5 times, so the exponent is 5.

$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 = 10^5$

b. $\mathbf{(p + 2)(p + 2)(p + 2)}$

The base is $p + 2$. It is a factor 3 times, so the exponent is 3.

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

When evaluating expressions with exponents, follow the order of operations.

Example 2 Evaluate $x^2 - 4$ if $x = -6$.

$x^2 - 4$	$= (-6)^2 - 4$	Replace x with -6.
	$= (-6)(-6) - 4$	-6 is a factor 2 times.
	$= 36 - 4$	Multiply.
	$= 32$	Subtract.

Exercises

Write each expression using exponents.

1. $5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$

2. $(-7)(-7)(-7)$

3. $\left(\frac{1}{3}\right) \cdot \left(\frac{1}{3}\right) \cdot \left(\frac{1}{3}\right) \cdot \left(\frac{1}{3}\right)$

4. $x \cdot x \cdot y \cdot y$

5. $(z - 4)(z - 4)$

6. $3(-t)(-t)(-t)$

Evaluate each expression if $g = 3$, $h = -1$, and $m = 9$.

7. g^5

8. $5g^2$

9. $g^2 - m$

10. $4(2m - 3)^2$

11. $-2(g^3 + 1)$

12. $5(h^4 - m^2)$

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Lesson 2 Reteach

Negative Exponents

A **negative exponent** is the result of repeated division. Extending the pattern below shows that $4^{-1} = \frac{1}{4}$ or $\frac{1}{4^1}$.

$4^2 = 16$

$\div 4$

$4^1 = 4$

$\div 4$

$4^0 = 1$

$\div 4$

$4^{-1} = \frac{1}{4}$

This suggests the following definition.

$a^{-n} = \frac{1}{a^n}$ for $a \neq 0$ and any whole number n. Example: $6^{-4} = \frac{1}{6^4}$

For $a \neq 0$, $a^0 = 1$. Example: $9^0 = 1$

Example 1 Write each expression using a positive exponent.

a. 3^{-4}

$3^{-4} = \frac{1}{3^4}$ Definition of negative exponent

b. y^{-2}

$y^{-2} = \frac{1}{y^2}$ Definition of negative exponent

Example 2 Write each fraction as an expression using a negative exponent other than −1.

a. $\frac{1}{6^3}$

$\frac{1}{6^3} = 6^{-3}$ Definition of negative exponent

b. $\frac{1}{81}$

$\frac{1}{81} = \frac{1}{9^2}$ Definition of exponent

$= 9^{-2}$ Definition of negative exponent

Exercises

Write each expression using a positive exponent.

1. 6^{-4} **2.** $(-7)^{-8}$ **3.** b^{-6} **4.** n^{-1}

5. $(-2)^{-5}$ **6.** 10^{-3} **7.** j^{-9} **8.** a^{-2}

Write each fraction as an expression using a negative exponent other than −1.

9. $\frac{1}{2^2}$ **10.** $\frac{1}{13^4}$ **11.** $\frac{1}{25}$ **12.** $\frac{1}{49}$

13. $\frac{1}{3^3}$ **14.** $\frac{1}{9^2}$ **15.** $\frac{1}{121}$ **16.** $\frac{1}{27}$

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Lesson 3 Reteach

Multiplying and Dividing Monomials

When multiplying powers with the same base, add the exponents.

Symbols	$a^m \cdot a^n = a^{m+n}$
Example	$4^2 \cdot 4^5 = 4^{2+5}$ or 4^7

Example 1 Find the product $5^7 \cdot 5$.

$5^7 \cdot 5 = 5^7 \cdot 5^1$ $\quad$ $5 = 5^1$

$= 5^{7+1}$ $\quad$ Product of Powers Property; the common base is 5.

$= 5^8$ $\quad$ Add the exponents.

Example 2 Find the product $2a^2 \cdot 3a$.

$2a^{-2} \cdot 3a = 2 \cdot 3 \cdot a^{-2} \cdot a$ $\quad$ Commutative Property of Multiplication

$= 2 \cdot 3 \cdot a^{-2+1}$ $\quad$ Product of Powers Property; the common base is a.

$= 2 \cdot 3 \cdot a^{-1}$ $\quad$ Add the exponents.

$= 6a^{-1}$ $\quad$ Multiply.

When dividing powers with the same base, subtract the exponents.

Symbols	$\frac{a^m}{a^n} = a^{m-n}$, where $a \neq 0$
Example	$\frac{5^6}{5^2} = 5^{6-2}$ or 5^4

Example 3 Find the quotient $\frac{(-8)^4}{(-8)^2}$.

$\frac{(-8)^4}{(-8)^2} = (-8)^{4-2}$ $\quad$ Quotient of Powers Property; the common base is (−8).

$= (-8)^2$ $\quad$ Subtract the exponents.

Exercises

Find each product. Express using positive exponents.

1. $4^7 \cdot 4^6$

2. $v^5 \cdot v^4$

3. $(f^3)(f^9)$

4. $(-31^4)(-31^{-2})$

5. $(-cr^{-5})(-r^2)$

6. $9z^3 \cdot 2z$

7. $3^8 \cdot 3^3$

8. $-7u^6(-6u^5)$

9. $-5m^3(4m^6)$

Find each quotient. Express using positive exponents.

10. $\frac{7^5}{7^2}$

11. $\frac{1^8}{1^6}$

12. $\frac{(-12)^3}{(-12)^3}$

13. $\frac{(-p^{18})}{(-p^{12})}$

14. $\frac{2w^{-3}}{2w}$

15. $\frac{e^{10}}{e^{-3}}$

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Lesson 4 Reteach

Scientific Notation

Numbers like 5,000,000 and 0.0005 are in **standard form** because they do not contain exponents. A number is expressed in **scientific notation** when it is written as a product of a factor and a power of 10. The factor must be greater than or equal to 1 and less than 10.

By definition, a number in scientific notation is written as $a \times 10^n$, where $1 \le a < 10$ and n is an integer.

Example 1 **Express the number 7.8×10^{-6} in standard form.**

$7.8 \times 10^{-6} = 7.8 \times 0.000001$ $\quad$ $10^{-6} = 0.000001$

$= 0.0000078$ $\quad$ Move the decimal point 6 places to the left.

Example 2 **Express the number 62,000,000 in scientific notation.**

$62{,}000{,}000 = 6.2 \times 10{,}000{,}000$ $\quad$ The decimal point moves 7 places.

$= 6.2 \times 10^7$ $\quad$ The exponent is positive.

To compare numbers in scientific notation, compare the exponents.

- If the exponents are positive, the number with the greatest exponent is the greatest.
- If the exponents are negative, the number with the least exponent is the least.
- If the exponents are the same, compare the factors.

Example 3 **Compare each set of numbers using <, > or =.**

a. 2.097×10^5 ● 3.12×10^3 $\quad$ Compare the exponents: $5 > 3$.

So, $2.097 \times 10^5 > 3.12 \times 10^3$.

b. 8.706×10^{-5} ● 8.809×10^{-5} $\quad$ The exponents are the same, so compare the factors: $8.706 < 8.809$.

So, $8.706 \times 10^{-5} < 8.809 \times 10^{-5}$.

Exercises

Express each number in standard form.

1. 4.12×10^6 **2.** 5.8×10^2 **3.** 9.01×10^{-3}

4. 1.034×10^9 **5.** 3.48×10^{-4} **6.** 6.02×10^{-6}

Express each number in scientific notation.

7. 12,000,000,000 **8.** 5000 **9.** 0.00475

10. 7,989,000,000 **11.** 0.0000403 **12.** 13,000,000

Order each set of numbers from least to greatest.

13. $6.9 \times 10^3, 7.6 \times 10^{-6}, 7.1 \times 10^3, 6.8 \times 10^4$ **14.** $4.02 \times 10^{-8}, 4.15 \times 10^{-3}, 4.2 \times 10^2, \times 4.0 \times 10^{-8}$

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Lesson 5 Reteach

Compute with Scientific Notation

When you multiply and divide with numbers in scientific notation, multiply or divide the leading numbers first, then use the Product of Powers or Quotient of Powers properties to multiply or divide the powers of 10.

Example 1 **Evaluate $(4.9 \times 10^3) \times (2 \times 10^5)$. Express the result in scientific notation.**

$= (4.9 \times 2) \times (10^3 \times 10^5)$ Commutative and Associative Properties.

$= (9.8) \times (10^3 \times 10^5)$ Multiply 4.9 by 2.

$= 9.8 \times 10^{3+5}$ Product of Powers

$= 9.8 \times 10^8$ Add the exponents.

When you add and subtract with numbers in scientific notation, the exponents must be the same. Sometimes you need to rewrite one of the numbers so it has the same exponent as the other.

Example 2 **Evaluate $(4.68 \times 10^5) + (7.2 \times 10^6)$. Express the result in scientific notation.**

$= (4.68 \times 10^5) + (72 \times 10^5)$ Write 7.2×10^6 as 72×10^5.

$= (4.68 + 72) \times 10^5$ Distributive Property

$= 76.68 \times 10^5$ Add 4.68 and 72.

$= 7.668 \times 10^6$ Write 76.68×10^5 in scientific notation.

Exercises

Evaluate each expression. Express the result in scientific notation.

1. $(4.3 \times 10^5)(7.5 \times 10^3)$

2. $(1.07 \times 10^2)(9.2 \times 10^{-3})$

3. $(1.41 \times 10^{-4})(27{,}000)$

4. $(7.53 \times 10^7)(8 \times 10^{-7})$

5. $\dfrac{3.96 \times 10^3}{1.8 \times 10^2}$

6. $\dfrac{1.68 \times 10^4}{2.8 \times 10^{-2}}$

7. $(2.4 \times 10^2) + (1.77 \times 10^3)$

8. $(5.18 \times 10^{-2}) + (4.9 \times 10^{-1})$

9. $(6.21 \times 10^7) + (1.1 \times 10^8)$

10. $(8.88 \times 10^4) - (8.8 \times 10^2)$

11. $(2.7 \times 10^{-6}) - (1.7 \times 10^{-8})$

12. $(7.328 \times 10^6) - (2.37 \times 10^5)$

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Lesson 6 Reteach

Square Roots and Cube Roots

- A **square root** of a number is one of two equal factors of the number.
- A **radical sign**, $\sqrt{\ }$, is used to indicate a positive square root.
- Every positive number has a positive square root and a negative square root.
- The square root of a negative number, such as −64, is not real because the square of a number cannot be negative.

Example 1 Find each square root.

a. $-\sqrt{121}$

$-\sqrt{121} = -11$ Find the negative square root of 121; $11^2 = 121$.

b. $\pm\sqrt{49}$

$\pm\sqrt{49} = \pm 7$ Find both square roots of 49; $7^2 = 49$.

- A **cube root** of a number is one of three equal factors of the number.
- The symbol $\sqrt[3]{\ }$ is used to indicate the cube root of a number.
- The cube root of a positive number is positive.
- The cube root of a negative number is negative.

Example 2 Find each cube root.

a. $\sqrt[3]{729}$

$\sqrt[3]{729} = 9$ 93 = 9 • 9 • 9 or 729

b. $\sqrt[3]{-125}$

$\sqrt[3]{-125} = -5$ $(-5)^3 = (-5) \cdot (-5) \cdot (-5)$ or −125

Exercises

Find each square root.

1. $\sqrt{25}$ **2.** $\sqrt{-25}$ **3.** $\sqrt{169}$

4. $\sqrt{-9}$ **5.** $-\sqrt{484}$ **6.** $\sqrt{1521}$

Find each cube root.

7. $\sqrt[3]{-1000}$ **8.** $\sqrt[3]{1728}$ **9.** $\sqrt[3]{8}$

10. $\sqrt[3]{0}$ **11.** $\sqrt[3]{-2197}$ **12.** $\sqrt[3]{-8000}$

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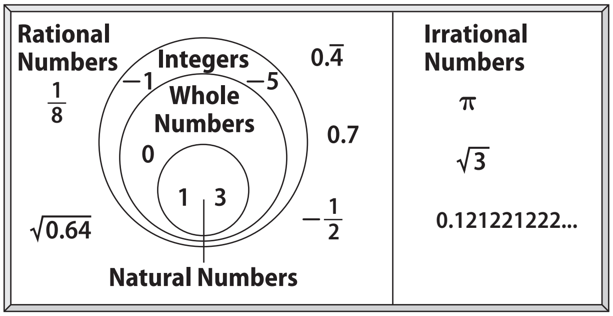
Lesson 7 Reteach

The Real Number System

The set of **real numbers** consists of all natural numbers, whole numbers, integers, rational numbers, and irrational numbers.

- **Rational numbers** can be written as fractions.
- **Irrational numbers** are numbers that



Example 1 **Name all sets of numbers to which each real number belongs. Write *natural*, *whole*, *integer*, *rational*, or *irrational*.**

a. 7

This number is a natural number, a whole number, an integer, and a rational number.

b. $0.\overline{6}$

This repeating decimal is a rational number because it is equivalent to $\frac{2}{3}$.

c. $\sqrt{71}$

It is not the square root of a perfect square so it is an irrational number.

If $x^2 = y$, then $x = \pm\sqrt{y}$.
If $x^3 = y$, then $x = \sqrt[3]{y}$.

Example 2 **Solve the equation $b^2 = 121$.**

$b^2 = 121$	Write the equation.
$b = \pm\sqrt{121}$	Definition of square root
$b = 11$ and -11	Check $11 \cdot 11 = 121$ and $(-11) \cdot (-11) = 121$

The solutions are 11 and −11.

Exercises

Name all sets of numbers to which each real number belongs. Write *natural*, *whole*, *integer*, *rational*, or *irrational*.

1. 21 **2.** $\frac{3}{7}$ **3.** $\frac{8}{12}$

4. −5 **5.** 17 **6.** 0

7. 0.257 **8.** 0.9 **9.** $\sqrt{5}$

Solve each equation. Round to the nearest tenth, if necessary.

10. $x^2 = 9$ **11.** $4h^3 = 864$ **12.** $16t^2 = 784$

13. $4s^2 = 576$ **14.** $3a^2 = 243$ **15.** $5m^3 = -6655$