

# 8.4 Lesson

## Key Ideas

### Zero Exponents

**Words** For any nonzero number  $a$ ,  $a^0 = 1$ . The power  $0^0$  is *undefined*.

**Numbers**  $4^0 = 1$

**Algebra**  $a^0 = 1$ , where  $a \neq 0$

### Negative Exponents

**Words** For any integer  $n$  and any nonzero number  $a$ ,  $a^{-n}$  is the reciprocal of  $a^n$ .

**Numbers**  $4^{-2} = \frac{1}{4^2}$

**Algebra**  $a^{-n} = \frac{1}{a^n}$ , where  $a \neq 0$

## EXAMPLE 1 Evaluating Expressions

a.  $3^{-4} = \frac{1}{3^4}$   
 $= \frac{1}{81}$

Definition of a negative exponent

Evaluate the power.

b.  $(-8.5)^{-4} \cdot (-8.5)^4 = (-8.5)^{-4+4}$   
 $= (-8.5)^0$   
 $= 1$

Product of Powers Property

Simplify.

Definition of a zero exponent

c.  $\frac{2^6}{2^8} = 2^{6-8}$   
 $= 2^{-2}$   
 $= \frac{1}{2^2}$   
 $= \frac{1}{4}$

Quotient of Powers Property

Simplify.

Definition of a negative exponent

Evaluate the power.

**Try It** Evaluate the expression.

1.  $4^{-2}$

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

3.  $6^{-8} \cdot 6^8$

4.  $\frac{(-3)^5}{(-3)^6}$

5.  $\frac{1}{5^7} \cdot \frac{1}{5^{-4}}$

6.  $\frac{4^5 \cdot 4^{-3}}{4^2}$

**EXAMPLE 2****Simplifying Expressions**

$$\begin{aligned} \text{a. } -5x^0 &= -5(1) \\ &= -5 \end{aligned}$$

Definition of a zero exponent

Multiply.

$$\begin{aligned} \text{b. } \frac{9y^{-3}}{y^5} &= 9y^{-3-5} \\ &= 9y^{-8} \\ &= \frac{9}{y^8} \end{aligned}$$

Quotient of Powers Property

Simplify.

Definition of a negative exponent

$$\begin{aligned} \text{c. } \frac{n^4 \cdot n^{-7}}{6} &= \frac{n^{4+(-7)}}{6} \\ &= \frac{n^{-3}}{6} \\ &= \frac{1}{6n^3} \end{aligned}$$

Product of Powers Property

Simplify.

Definition of a negative exponent

**Try It** Simplify. Write the expression using only positive exponents.

7.  $8x^{-2}$

8.  $b^0 \cdot b^{-10}$

9.  $\frac{z^6}{15z^9}$

**Self-Assessment for Concepts & Skills**

Solve each exercise. Then rate your understanding of the success criteria in your journal.

**EVALUATING EXPRESSIONS** Evaluate the expression.

10.  $7^{-2}$

11.  $4^{-3} \cdot 4^0$

12.  $\frac{(-9)^5}{(-9)^7}$

**SIMPLIFYING EXPRESSIONS** Simplify. Write the expression using only positive exponents.

13.  $10t^{-5}$

14.  $w^3 \cdot w^{-9}$

15.  $\frac{r^8 \cdot r^{-8}}{4}$

16. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find “both” answers.Write  $\frac{1}{3 \cdot 3 \cdot 3}$  using a negative exponent.

Write 3 to the negative third.

Write  $\frac{1}{3}$  cubed as a power with an integer base.Write  $(-3) \cdot (-3) \cdot (-3)$  as a power with an integer base.