

## LESSON

**Practice B****1-5** *Properties of Exponents*

Write each expression in expanded form.

1.  $-3x^5$

\_\_\_\_\_

2.  $(j - 3k)^3$

\_\_\_\_\_

3.  $7t^2(-4r)^4$

\_\_\_\_\_

Evaluate each expression.

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

\_\_\_\_\_

5.  $\left(\frac{5}{8}\right)^{-2}$

\_\_\_\_\_

6.  $\left(-\frac{3}{2}\right)^{-3}$

\_\_\_\_\_

Simplify each expression. Assume all variables are nonzero.

7.  $\frac{68f^5g^{-3}}{4f^{-3}g^6}$

\_\_\_\_\_

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

\_\_\_\_\_

9.  $6m^4n^9(-3m^2n^3)^{-2}$

\_\_\_\_\_

Evaluate each expression. Write the answer in scientific notation.

10.  $(7.2 \times 10^{-5})(4.5 \times 10^3)$

\_\_\_\_\_

11.  $\frac{1.7 \times 10^5}{3.4 \times 10^9}$

\_\_\_\_\_

12.  $(7.8 \times 10^8)(2.8 \times 10^{11})$

\_\_\_\_\_

**Solve.**

13. The A-1 Moving and Storage Company sells crates that measure  $x^2y$  units wide,  $x$  units long, and  $y^2$  units tall. Find the volume of the crate.

\_\_\_\_\_

14. The average lifespan for an adult living today is about 82 years. Some scientists believe that people born in the early part of this century may live up to 150 years. Calculate the number of minutes an 82-year-old and a 150-year-old could live. Round to the nearest million. Record the difference in scientific notation.

\_\_\_\_\_

15. A movie made  $\$6.7 \times 10^7$ . It took 250 hours to film it. How much money was earned for each hour of filming? Write your answer in scientific notation.

\_\_\_\_\_

**LESSON 1-5 Practice A**

**Properties of Exponents**

Fill in the blanks to expand each expression.

1.  $a^3 = \underline{a \cdot a \cdot a}$       2.  $a^5 = \underline{a \cdot a \cdot a \cdot a \cdot a}$   
 3.  $(3d)^4 = \underline{(3d)(3d)(3d)(3d)}$       4.  $\left(\frac{x}{7}\right)^3 = \underline{\left(\frac{x}{7}\right)\left(\frac{x}{7}\right)\left(\frac{x}{7}\right)}$

Fill in the blanks to evaluate each expression.

5.  $3^{-3} = \left(\frac{1}{3}\right)^3 = \underline{\frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} = \frac{1}{27}}$       6.  $\left(\frac{-5}{6}\right)^{-2} = \left(\frac{6}{-5}\right)^2 = \underline{\frac{6}{-5} \cdot \frac{6}{-5} = \frac{36}{25}}$

Simplify each expression. Use the multiplication properties of exponents.

7.  $3r^2(-3r^3)$       8.  $(4f^6g)^2(2fg^3)$

Multiply a power of a power	<u>no power of a power</u>	<u><math>(16f^{10}g^2)(2fg^3)</math></u>
Add exponents with same base	<u><math>3r^5(-3)</math></u>	<u><math>(16f^{11}g^5)(2)</math></u>
Multiply whole numbers	<u><math>-9r^5</math></u>	<u><math>32f^{11}g^5</math></u>

Simplify each expression. Use the division properties of exponents.

9.  $\frac{9k^2m^8}{3k^2m^2}$       10.  $\frac{16p^{-2}q^{-3}}{2p^{-5}q^{-4}}$

Substitute reciprocals	<u>no negative exponents</u>	<u><math>\frac{16p^5q^4}{2p^2q^3}</math></u>
Subtract exponents with same base	<u><math>\frac{9m^6}{3k^2}</math></u>	<u><math>\frac{16p^3q}{2}</math></u>
Divide whole numbers	<u><math>\frac{3m^6}{k^2}</math></u>	<u><math>8p^3q</math></u>

Evaluate each expression. Write the answer in scientific notation.

11.  $(4.2 \times 10^3)(2.0 \times 10^2)$       12.  $\frac{1.4 \times 10^6}{7.0 \times 10^2}$   
 $8.4 \times 10^5$        $2.0 \times 10^3$   
 13.  $\frac{4.5 \times 10^4}{9.0 \times 10^7}$       14.  $(3.5 \times 10^{-3})(5.8 \times 10^5)$   
 $5.0 \times 10^{-4}$        $2.03 \times 10^3$

**LESSON 1-5 Practice B**

**Properties of Exponents**

Write each expression in expanded form.

1.  $-3x^5$       2.  $(j-3k)^3$       3.  $7t^2(-4r)^4$   
 $-3 \cdot x \cdot x \cdot x \cdot x \cdot x$        $((j-3k)(j-3k)(j-3k))$        $7 \cdot t \cdot t(-4r)(-4r)(-4r)(-4r)$

Evaluate each expression.

4.  $-(-2)^{-4}$       5.  $\left(\frac{5}{8}\right)^{-2}$       6.  $\left(-\frac{3}{2}\right)^{-3}$   
 $\frac{-1}{16}$        $\frac{64}{25}$        $\frac{-8}{27}$

Simplify each expression. Assume all variables are nonzero.

7.  $\frac{68f^6g^{-3}}{4f^{-3}g^6}$       8.  $(-4a^3b^7)^{-2}$       9.  $6m^4n^9(-3m^2n^3)^{-2}$   
 $\frac{17f^9}{g^9}$        $\frac{1}{16a^6b^{14}}$        $\frac{2n^3}{3}$

Evaluate each expression. Write the answer in scientific notation.

10.  $(7.2 \times 10^{-5})(4.5 \times 10^3)$       11.  $\frac{1.7 \times 10^5}{3.4 \times 10^9}$       12.  $(7.8 \times 10^9)(2.8 \times 10^{11})$   
 $3.24 \times 10^{-1}$        $5.0 \times 10^{-5}$        $2.184 \times 10^{20}$

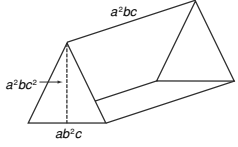
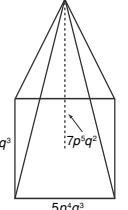
Solve.

13. The A-1 Moving and Storage Company sells crates that measure  $x^2y$  units wide,  $x$  units long, and  $y^2$  units tall. Find the volume of the crate.  
 $x^3y^3$  cubic units
14. The average lifespan for an adult living today is about 82 years. Some scientists believe that people born in the early part of this century may live up to 150 years. Calculate the number of minutes an 82-year-old and a 150-year-old could live. Round to the nearest million. Record the difference in scientific notation.  
43 million; 79 million;  $3.6 \times 10^7$
15. A movie made  $\$6.7 \times 10^7$ . It took 250 hours to film it. How much money was earned for each hour of filming? Write your answer in scientific notation.  
 $2.68 \times 10^5$

**LESSON 1-5 Practice C**

**Properties of Exponents**

Write and simplify an expression for the volume of each figure.

1.       2.   
 $V = \text{area of base} \times \text{height}$        $V = \frac{1}{3} \text{area of base} \times \text{height}$   
 $\frac{1}{2}a^5b^4c^4$  cubic units       $\frac{175p^{13}q^8}{3}$  cubic units

Simplify each expression. Assume all variables are nonzero.

3.  $(-5x^5y^{-3}z^8)^3$       4.  $7g^2h^3(-2h^5k^0)^{-3}$       5.  $\frac{(24m^7n^3)^{-2}}{4mn^{-5}}$   
 $\frac{125x^{15}z^{24}}{y^9}$        $\frac{7g^2}{8h^{12}}$        $\frac{1}{36m^{12}n^{16}}$

One cubic foot of pennies is 49,152 pennies. Use this fact for Exercises 6–8. Write your answers in scientific notation rounded to the nearest tenth.

6. The Empire State Building in New York City has an approximate volume of  $3.7 \times 10^7$  ft<sup>3</sup>. About how many pennies would fit in the Empire State Building?  
 $1.8 \times 10^{12}$
7. If the Sears Tower in Chicago were filled with pennies, it would hold about  $2.6 \times 10^{12}$  pennies. What is the approximate volume of the Sears Tower?  
 $5.3 \times 10^7$  ft<sup>3</sup>
8. Think about covering the entire earth with two layers of pennies. The total number of pennies needed could be stacked in a cube that measures  $2.73 \times 10^7$  ft on each side. How many pennies are in this cube?  
 $1.0 \times 10^{18}$

**LESSON 1-5 Review for Mastery**

**Properties of Exponents**

Write		Read
Expanded Form	Exponent Form	
$a \cdot a$	$a^2$	$a$ squared
$a \cdot a \cdot a$	$a^3$	$a$ cubed
$a \cdot a \cdot a \cdot a$	$a^4$	$a$ to the fourth power
$a \cdot a \cdot \dots \cdot a$	$a^n$	$a$ to the $n$ th power

$-4x^5 = -4(x \cdot x \cdot x \cdot x \cdot x)$   
 $(-4x)^5 = (-4x)(4x)(4x)(4x)(4x)$   
 $(-4x)^5 = (-4x)(-4x)(-4x)(-4x)(-4x)$   
 $4x^3(y+6)^2 = 4(x)(x)(x)(y+6)(y+6)$

List the factors to expand exponential expressions.

**Zero Exponent Property:**  $a^0 = 1$ ;  $a$  is not zero       $38^0 = 1$   
**Negative Exponent Property:**  $a^{-n} = \frac{1}{a^n}$  and  $\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$ ;  $a$  is not zero.

$3^{-4} = \frac{1}{3^4} = \frac{1}{3 \cdot 3 \cdot 3 \cdot 3} = \frac{1}{81}$   
 $\left(\frac{2}{5}\right)^{-3} = \left(\frac{5}{2}\right)^3 = \frac{5 \cdot 5 \cdot 5}{2 \cdot 2 \cdot 2} = \frac{125}{8}$

Write each expression in expanded form.

1.  $-8c^3$       2.  $(3xy)^4$       3.  $a^3(b-c)^2$   
 $-8(c \cdot c \cdot c)$        $(3xy)(3xy)(3xy)(3xy)$        $a \cdot a \cdot a(b-c)(b-c)$

Evaluate each expression.

4.  $6^{-1}$       5.  $10^0$       6.  $12^{-2}$   
 $\frac{1}{6}$       1       $\frac{1}{144}$

7.  $(-4)^{-3}$       8.  $\left(\frac{1}{7}\right)^{-2}$       9.  $\left(\frac{3}{4}\right)^{-3}$   
 $-\frac{1}{64}$       49       $\frac{64}{27}$

10.  $-5^0$       11.  $\left(\frac{-2}{5}\right)^2$       12.  $-\left(\frac{1}{3}\right)^{-2}$   
-1       $\frac{4}{25}$       -9