

**LESSON**

**7-4**

**Review for Mastery**

**Division Properties of Exponents**

The **Quotient of Powers Property** can be used to divide terms with exponents.

$$\frac{a^m}{a^n} = a^{m-n} \quad (a \neq 0, m \text{ and } n \text{ are integers.})$$

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

$$\begin{aligned} \frac{7^5}{7^2} &= 7^{5-2} \\ &= 7^3 \end{aligned}$$

Simplify  $\frac{x^7y}{x^3}$ .

$$\begin{aligned} \frac{x^7y}{x^3} &= x^{7-3} \cdot y \\ &= x^4y \end{aligned}$$

The **Positive Power of a Quotient Property** can be used to raise quotients to positive powers.

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n} \quad (a \neq 0, b \neq 0, n \text{ is a positive integer.})$$

Simplify  $\left(\frac{2}{5}\right)^4$ .

$$\begin{aligned} \left(\frac{2}{5}\right)^4 &= \frac{2^4}{5^4} \\ &= \frac{16}{625} \end{aligned}$$

*Use the Positive Power of a Quotient Property.*

*Simplify.*

Simplify  $\left(\frac{2x^5}{y^4}\right)^3$ .

$$\left(\frac{2x^5}{y^4}\right)^3 = \frac{(2x^5)^3}{(y^4)^3}$$

*Use the Positive Power of a Quotient Property.*

$$= \frac{2^3(x^5)^3}{(y^4)^3}$$

*Use the Power of a Product Property.*

$$= \frac{8x^{15}}{y^{12}}$$

*Simplify.*

**Simplify.**

1.  $\frac{5^6}{5^4}$

\_\_\_\_\_

2.  $\frac{x^6y^5}{y^3}$

\_\_\_\_\_

3.  $\frac{a^2b^4}{(ab)^3}$

\_\_\_\_\_

4.  $\left(\frac{2}{5}\right)^3$

\_\_\_\_\_

5.  $\left(\frac{x^3}{y^2}\right)^6$

\_\_\_\_\_

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

\_\_\_\_\_

7.  $\left(\frac{a}{b^2}\right)^3$

\_\_\_\_\_

8.  $\left(\frac{x^3}{xy}\right)^2$

\_\_\_\_\_

9.  $\left(\frac{30}{20}\right)^2$

\_\_\_\_\_

**LESSON**

**7-4**

**Review for Mastery**

**Division Properties of Exponents** *continued*

You can divide quotients raised to a negative power by using the **Negative Power of a Quotient Property**.

$$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n = \frac{b^n}{a^n} \quad (a \neq 0, b \neq 0, n \text{ is a positive integer})$$

**Simplify**  $\left(\frac{3}{4}\right)^{-2}$ .

$$\left(\frac{3}{4}\right)^{-2} = \left(\frac{4}{3}\right)^2$$

$$= \frac{4^2}{3^2}$$

$$= \frac{16}{9}$$

*Rewrite with a positive exponent.*

*Use the Positive Power of a Quotient Property.*

*Simplify.*

**Simplify**  $\left(\frac{3a^4}{b^2}\right)^{-3}$ .

$$\left(\frac{3a^4}{b^2}\right)^{-3} = \left(\frac{b^2}{3a^4}\right)^3$$

$$= \frac{(b^2)^3}{(3a^4)^3}$$

$$= \frac{b^{2 \cdot 3}}{3^3 a^{4 \cdot 3}}$$

$$= \frac{b^6}{27a^{12}}$$

*Rewrite with a positive exponent.*

*Use the Positive Power of a Quotient Property.*

*Use the Power of a Power Property.*

*Simplify.*

**Fill in the blanks below.**

10.  $\left(\frac{3}{5}\right)^{-3} = \left(\frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}}\right)^3$

$$= \frac{\boxed{\phantom{00}}^3}{\boxed{\phantom{00}}^3}$$

$$= \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}$$

11.  $\left(\frac{xy^3}{z^7}\right)^{-5} = \left(\frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}}\right)^5$

$$= \frac{z^{\boxed{\phantom{00}} \cdot 5}}{x^{\boxed{\phantom{00}} \cdot 5} y^{\boxed{\phantom{00}} \cdot 5}}$$

$$= \frac{z^{\boxed{\phantom{00}}}}{x^{\boxed{\phantom{00}}} y^{\boxed{\phantom{00}}}}$$

12.  $\left(\frac{a^2b^3}{c}\right)^{-4} = \left(\frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}}\right)^4$

$$= \frac{c^{\boxed{\phantom{00}} \cdot 4}}{a^{\boxed{\phantom{00}} \cdot 4} b^{\boxed{\phantom{00}} \cdot 4}}$$

$$= \frac{c^{\boxed{\phantom{00}}}}{a^{\boxed{\phantom{00}}} b^{\boxed{\phantom{00}}}}$$

**Simplify.**

13.  $\left(\frac{x}{y}\right)^{-5}$

\_\_\_\_\_

14.  $\left(\frac{7}{3m^4}\right)^{-2}$

\_\_\_\_\_

15.  $\left(\frac{2a^2}{b^3}\right)^{-5}$

\_\_\_\_\_

16.  $\left(\frac{m}{3n}\right)^{-2}$

\_\_\_\_\_

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

\_\_\_\_\_

18.  $\left(\frac{r}{2s^3}\right)^{-4}$

\_\_\_\_\_

5. D  
7. B

6. H  
8. J

7.  $\frac{1}{x^7}$   
9.  $\frac{27}{8}$

8.  $\frac{s^4}{t^6}$   
10.  $\frac{16b^4}{81a^4}$

### Reading Strategies

- multiply
- add
- Power of a Product
- Power of a Product; with both properties, a number is applied to all parts.
- $m^{24}$
- $8^8$
- $9v^{10}$
- $\frac{d^8}{c^5}$
- 5832
- $-16y^{14}$

11.  $-\frac{81v^4}{t^4}$

12.  $\frac{49t^2}{16s^2}$

13.  $-\frac{32}{3cd^2}$

14.  $\frac{81m^4 n^4}{16}$

15.  $2 \times 10^{11}$

16.  $5 \times 10^6$

17. 300,000 yards

18.  $2.16 \times 10^7$  dresses

### LESSON 7-4

#### Practice A

- 4; 81
- 8; 5; 3
- $2; 7; -5; \frac{1}{t^5}$
- $6; 3; 6; 4; \frac{t^4}{s^3}$
- $\frac{1}{a^{13} b^4}$
- $\frac{1}{xy^5}$
- $\frac{64}{9}$
- $\frac{2^4}{3^4}; \frac{16}{81}$
- $\frac{x^3}{4^3}; \frac{x^3}{64}$
- $\frac{5}{4}; \frac{25}{16}$
- $\frac{81a^4 b^4}{256c^8}$
- $\frac{27c^3}{8b^3}$
- $\frac{4x^2 y}{3z^3}; \frac{256x^8 y^4}{81z^{12}}$
- $\frac{4}{n}; \frac{3n}{6}; 2n$
- 1.5; 8
- $0.2; 2; 2; -1; 2; 2 \times 10^1$
- a.  $3.5 \times 10^1$   
b. \$250,000

#### Practice B

- 2; 36
- $12; 7; t^5$
- $w^7$
- $\frac{1}{j^6}$
- $5m^3$
- $\frac{c}{d^3}$

#### Practice C

- $6^2$  or 36
- $h^7$
- $\frac{32}{5}$
- $\frac{x^4}{y}$
- $\frac{n^2}{mp^8}$
- $\frac{c^2}{a}$
- $\frac{49}{16}$
- $\frac{s^4}{t^6}$
- $-\frac{a^5 b^5}{7776c^5}$
- $-\frac{4d^6 f^8}{b^4 c^2}$
- $-\frac{x^5 y^5 z^{10}}{w^5}$
- $\frac{1}{10^{44}}$
- $4 \times 10^4$
- $9 \times 10^8$
- $4 \times 10^{10}$
- $8 \times 10^{-9}$
- 4
- 7
- 3
- \$20,000 per minute

#### Review for Mastery

- 25
- $x^6 y^2$
- $\frac{b}{a}$
- $\frac{2^3}{5^3}$  or  $\frac{8}{125}$
- $\frac{x^{18}}{y^{12}}$
- $\frac{9m^6}{n^4}$
- $\frac{a^3}{b^6}$
- $\frac{x^4}{y^2}$

9.  $\frac{9}{4}$                       10.  $\frac{5}{3}; \frac{5}{3}; \frac{125}{27}$
11.  $\frac{z^7}{xy^3}; 7; 1; 3; 35; 5; 15$
12.  $\frac{c}{a^2b^3}; 1; 2; 3; 4; 8; 12$
13.  $\frac{y^5}{x^5}$                       14.  $\frac{9m^8}{49}$
15.  $\frac{b^{15}}{32a^{10}}$                       16.  $\frac{9n^2}{m^2}$
17.  $\frac{27x^6}{8}$                       18.  $\frac{16s^{12}}{r^4}$

### Challenge

1.  $2^3 \times 3^1$                       2.  $2^2 \times 3^3$
3.  $2^2 \times 113^1$                       4.  $2^3 \times 3^2 \times 5^2$
5.  $\frac{2 \cdot 3^2}{2^3 \cdot 3} = \frac{3}{2^2}$
6.  $\frac{2^4 \cdot 3}{2^2 \cdot 3^2 \cdot 5} = \frac{2^2}{3 \cdot 5}$
7.  $\frac{2 \cdot 5^3}{2^5 \cdot 3^2} = \frac{5^3}{2^4 \cdot 3^2}$
8.  $\frac{2^2 \cdot 3^3 \cdot 5}{2^3 \cdot 3^2 \cdot 5^2} = \frac{3}{2 \cdot 5}$
9. If a prime number base  $b$  appear in the numerator (or denominator), it cannot occur in the denominator (or numerator) as well because then the rational number is not fully simplified.  
ex:  $\frac{b^n a}{b^m c} = \frac{b^{n-m} a}{c}$
10. Every rational number can be written as a quotient whose numerator is 1 or the product of prime numbers raised to positive integer exponents and whose denominator can be written as 1 or the product of prime numbers raised to positive integer exponents, and there are no prime bases common to the numerator and the denominator.

### Problem Solving

1. 0.056 acres                      2.  $6y^2$  meters
3.  $5.34 \times 10^2$  km/h
4. Laos: \$1817; Norway: \$39,869
5. C                                      6. F
7. C                                      8. H

### Reading Strategies

1. subtract                      2.  $\left(\frac{8}{5}\right)^4$
3. Positive Power of a Quotient
4. 144                                      5.  $\frac{16}{625}$
6.  $\frac{64}{81}$                                       7.  $\frac{g^3}{f^4h^5}$
8.  $\frac{t^{18}}{s^6}$                                       9.  $\frac{32}{c^{10}d^5}$
10.  $\frac{8}{27}$                                       11.  $\frac{x^4}{y^4}$
12.  $\frac{g^{14}}{25f^6}$

## LESSON 7-5

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### Practice A

1. B                                      2. D
3. C                                      4. A
5. 7                                      6. 3
7. 1                                      8. 12
9. 8                                      10. 9
11. 1                                      12. 32
13.  $x^8$                                       14.  $x^3y^4$
15.  $m^4n$                                       16.  $x^2$
17. 14 cm

### Practice B

1. 3                                      2. 11
3. 0                                      4. 11
5. 4                                      6. 8