THINK AND DISCUSS

1. Compare the Quotient of Powers Property and the Product of Powers Property. Then compare the Power of a Quotient Property and the Power of a Product Property.

2. **GET ORGANIZED** Copy and complete the graphic organizer. In each cell, supply the missing information. Then give an example for each property.

If a and b are nonzero real numbers and m and n are integers, then…		
$\frac{a^m}{a^n} =$ ▢	$\left(\frac{a}{b}\right)^n =$ ▢	$\left(\frac{a}{b}\right)^{-n} =$ ▢

7-4 Exercises

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GUIDED PRACTICE

SEE EXAMPLE 1 p. 467

Simplify.

1. $\frac{5^8}{5^6}$
2. $\frac{2^2 \cdot 3^4 \cdot 4^4}{2^9 \cdot 3^5}$
3. $\frac{15x^6}{5x^6}$
4. $\frac{a^5b^6}{a^3b^7}$

SEE EXAMPLE 2 p. 468

Simplify each quotient and write the answer in scientific notation.

5. $(2.8 \times 10^{11}) \div (4 \times 10^8)$
6. $(5.5 \times 10^3) \div (5 \times 10^8)$
7. $(1.9 \times 10^4) \div (1.9 \times 10^4)$

SEE EXAMPLE 3 p. 468

8. **Sports** A star baseball player earns an annual salary of $\$8.1 \times 10^6$. There are 162 games in a baseball season. How much does this player earn per game? Write your answer in standard form.

SEE EXAMPLE 4 p. 469

Simplify.

9. $\left(\frac{2}{5}\right)^2$
10. $\left(\frac{x^2}{xy^3}\right)^3$
11. $\left(\frac{a^3}{(a^3b)^2}\right)^2$
12. $\frac{y^{10}}{y}$

SEE EXAMPLE 5 p. 470

13. $\left(\frac{3}{4}\right)^{-2}$
14. $\left(\frac{2x}{y^3}\right)^{-4}$
15. $\left(\frac{2}{3}\right)^{-1}\left(\frac{3a}{2b}\right)^{-2}$
16. $\left(\frac{x^3}{y^2}\right)^{-4}$

PRACTICE AND PROBLEM SOLVING

Simplify.

17. $\frac{3^9}{3^6}$
18. $\frac{5^4 \cdot 3^3}{5^2 \cdot 3^2}$
19. $\frac{x^8y^3}{x^3y^3}$
20. $\frac{x^8y^4}{x^9yz}$

Simplify each quotient and write the answer in scientific notation.

21. $(4.7 \times 10^{-3}) \div (9.4 \times 10^3)$
22. $(8.4 \times 10^9) \div (4 \times 10^{-5})$
23. $(4.2 \times 10^{-5}) \div (6 \times 10^{-3})$
24. $(2.1 \times 10^2) \div (8.4 \times 10^5)$

Independent Practice

For Exercises	See Example
17–20	1
21–24	2
25	3
26–29	4
30–33	5

Extra Practice

Skills Practice p. S16

Application Practice p. S34

25. Astronomy The mass of Earth is about 3×10^{-3} times the mass of Jupiter. The mass of Earth is about 6×10^{24} kg. What is the mass of Jupiter? Give your answer in scientific notation.

Simplify.

26. $\left(\frac{2}{3}\right)^4$ **27.** $\left(\frac{a^4}{b^2}\right)^3$ **28.** $\left(\frac{a^3b^2}{ab^3}\right)^6$ **29.** $\left(\frac{xy^2}{x^3y}\right)^3$

30. $\left(\frac{1}{7}\right)^{-3}$ **31.** $\left(\frac{x^2}{y^5}\right)^{-5}$ **32.** $\left(\frac{8w^7}{16}\right)^{-1}$ **33.** $\left(\frac{1}{4}\right)^{-2}\left(\frac{6x}{7}\right)^{-2}$

Simplify, if possible.

34. $\frac{x^6}{x^5}$ **35.** $\frac{8d^5}{4d^3}$ **36.** $\frac{x^2y^3}{a^2b^3}$ **37.** $\frac{(3x^3)^3}{(6x^2)^2}$

38. $\frac{(5x^2)^3}{5x^2}$ **39.** $\left(\frac{c^2a^3}{a^5}\right)^2$ **40.** $\left(\frac{3a}{a^3 \cdot a^0}\right)^3$ **41.** $\left(\frac{-p^4}{-5p^3}\right)^{-2}$

42. $\left(\frac{b^{-2}}{b^3}\right)^2$ **43.** $\left(\frac{10^2}{10^{-5} \cdot 10^5}\right)^{-1}$ **44.** $\left(\frac{x^2y^2}{x^2y}\right)^{-3}$ **45.** $\frac{(-x^2)^4}{-(x^2)^4}$

46. Critical Thinking How can you use the Quotient of a Power Property to explain the definition of x^{-n}? (*Hint:* Think of $\frac{1}{x^n}$ as $\frac{x^0}{x^n}$.)

47. Geography *Population density* is the number of people per unit of area. The area of the United States is approximately 9.37×10^6 square kilometers. The table shows population data from the U. S. Census Bureau.

Write the approximate population density (people per square kilometer) for each of the given years in scientific notation. Round decimals to the nearest hundredth.

United States Population

Year	Population (to nearest million)
2000	2.81×10^8
1995	2.66×10^8
1990	2.48×10^8

48. Chemistry The pH of a solution is a number that describes the concentration of hydrogen ions in that solution. For example, if the concentration of hydrogen ions in a solution is 10^{-4}, that solution has a pH of 4.

Lemon juice
pH 2

Apples
pH 3

Water
pH 7

Ammonia
pH 11

a. What is the concentration of hydrogen ions in lemon juice?

b. What is the concentration of hydrogen ions in water?

c. How many times more concentrated are the hydrogen ions in lemon juice than in water?

49. Write About It Explain how to simplify $\frac{4^5}{4^2}$. How is it different from simplifying $\frac{4^2}{4^5}$?

Find the missing exponent(s).

50. $\frac{x^{\square}}{x^4} = x^2$ **51.** $\frac{x^7}{x^{\square}} = x^4$ **52.** $\left(\frac{a^2}{b^{\square}}\right)^4 = \frac{a^8}{b^{12}}$ **53.** $\left(\frac{x^4}{y^{\square}}\right)^{-1} = \frac{y^3}{x}$