



Reteach Chapter 8.1 page 52

■ **Lesson 8.1**

1. 7^{10}
2. $81y^{20}$
3. $-500x^4$
4. $x^{10}y^{10}$
5. $-2a^{11}b^3$
6. $(3x + 1)^{12}$
7. $64c^6d^6$
8. t^{12}
9. Cannot be further simplified.



Extra Practice 8.1

■ Lesson 8.1

1. 3^6 or 729 2. 2^{15} or 32,768
3. x^8 4. y^{16} 5. $8x^3$ 6. $9x^8$
7. x^{14} 8. $8x^5$ 9. $x^3y^3z^{12}$
10. $a^8b^{10}c^{15}$ 11. $-x^5y^{10}z^{10}$ 12. $4x^8y^{13}$
13. $x^6, 64$ 14. $x^3y^6, 8$
15. $3x^3y, 24$ 16. $x^4y^7, 16$
17. $-8x^3y^3, -64$ 18. $72x^2y^2, 288$
19. $5x^2y^7, 20$ 20. $144y^8, 144$
21. $-432x^3y^6, -3456$ 22. $x^6y^{20}, 64$
23. $x^4y^5, 16$ 24. $-2x^{11}y^7, -4096$
25. 256 ft^3 26. $8\pi \text{ ft}^3$ 27. \$108.16
28. 1,048,576, no 29. $(5x)^2, 1600 \text{ mi}^2$



EXERCISES

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Guided Practice

CRITICAL THINKING about the Lesson

- Can x^3y^4 be simplified? Explain.
No, the bases are not the same.
- Is $a^5 \cdot a^3 = a^{15}$? Why or why not?
- Simplify $a^3 \cdot a^4$. Confirm your result by letting $a = 2$ and evaluating the expression in both its original form and its simplified form. a^7
- In the general exponential equation $y = C(a)^x$, suppose that $a = 2$, and $x = 3$. Describe how y changes when x is increased by 1. y is doubled.
- No, $a^5 \cdot a^3 = a^{5+3} = a^8$
- No, $(-3b)^4 = (-3)^4b^4 = 81b^4$
- Simplify $(a^{10})^3$. What property did you use? a^{30} , Power of a Power
- Is $(-3b)^4 = -12b^4$? Why or why not?
- Use a calculator to evaluate $(1.06)^{11}$. Round your result to two decimal places.
1.90
- Identify each of these equations as a model of exponential growth or of exponential decay.

| | |
|------------------------------|-------------------|
| a. $y = 3^x$ | b. $y = 0.5(3)^x$ |
| c. $y = (0.5)^x$ | d. $y = 2(0.5)^x$ |
| growth, growth, decay, decay | |

Independent Practice



Raymond's last day as the band's sound technician

Independent Practice

In Exercises 9–41, simplify, if possible.

9. $4^2 \cdot 4^3$ **4^5 or 1024**

12. $10^2 \cdot 10^9$ **10^{11}**

15. $[(2x + 3)^3]^2$ **$(2x + 3)^6$**

18. $[(5 + x)^3]^6$ **$(5 + x)^{18}$**

21. $(4a)^2 \cdot a$ **$16a^3$**

24. $(x \cdot x^2)^3 \cdot 3x$ **$3x^{10}$**

27. $2x^3 \cdot (3x)^2$ **$18x^5$**

30. $(-rs)(rs^3)^2$ **$-r^3s^7$**

33. $(4a^2)^3(\frac{1}{2}a^3)^2$ **$16a^{12}$**

36. $(-y)^4(-y)^3(-y)^2$ **$-y^9$**

39. $(abc^2)^3(a^2b)^2$ **$a^7b^5c^6$**

10. $6^5 \cdot 6^4$ **6^9 or 10,077,696**

13. $x \cdot x^5$ **x^6**

16. $(2x)^3$ **$8x^3$**

19. $(-5a)^2$ **$25a^2$**

22. $6^2 \cdot (6x^3)^2$ **6^4x^6 or 1296x⁶**

25. $(3a)^2 \cdot (-4a)^4$

28. $3y^2 \cdot (2y)^3$ **$24y^5$**

31. $(-2xy)^3(-x^2)$ **$8x^5y^3$**

34. $(8b^3)^2(\frac{1}{4}b^2)^2$ **$4b^{10}$**

37. $(2t)^3(-t^2)$ **$-8t^5$**

40. $(r^2st^3)^2(s^4t)^3$ **$r^4s^{14}t^9$**

25. $3^2(-4)^4a^8$ or **$2304a^8$**

$(-9)^8$ or 43,046,721

11. $[(-9)^2]^4$

14. $(5^5)^4$ **5^{20}**

17. $(3 \cdot 7)^4$ **21^4 or 194,481**

20. $(16 \cdot 2)^2$ **32^2 or 1024**

23. $[(-3xy)^2]^3$

26. $(9a^3)^2 \cdot (2a)^3$

29. $(-ab)(a^2b)^2$ **$-a^5b^3$**

32. $(-3cd)^3(-d^2)$ **$27c^3d^5$**

35. $(-x)^5(-x)^2(-x)^3$ **x^{10}**

38. $(-w^3)(3w^2)^2$ **$-9w^7$**

41. $(-3xy^2)^3(-2x^2y)^2$
 $-108x^7y^8$

26. **$2^39^2a^9$ or 648a⁹**

44. $(a^2 \cdot b)^3$ **8**

47. $[(a + 4)^2]^3 \cdot (a + 4)$
 $78,125$

In Exercises 42–47, evaluate the expression when $a = 1$ and $b = 2$.

42. $(a^4)^3$ **1**

43. $b^3 \cdot b^4$ **128**

45. $(a^2b)^5$ **32**

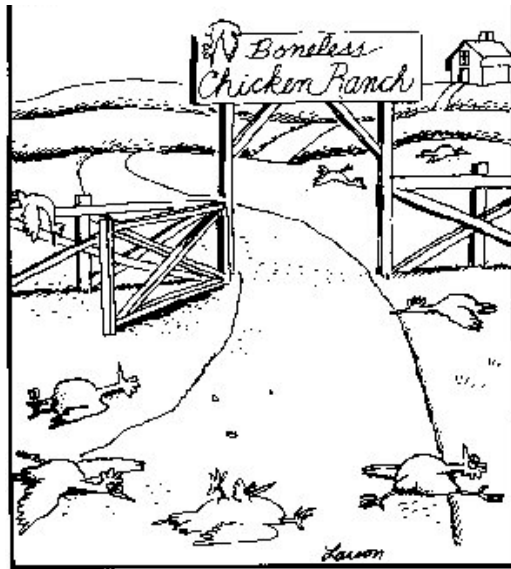
46. $(b^2 \cdot b^3) \cdot (b^2)^4$ **8192**

In Exercises 48–50, say which number is larger.

48. $(5 \cdot 7)^3$ or $5 \cdot 7^3$ **$(5 \cdot 7)^3$**

49. $5^4 \cdot 2^5$ or $(5 \cdot 2)^5$ **$(5 \cdot 2)^5$**

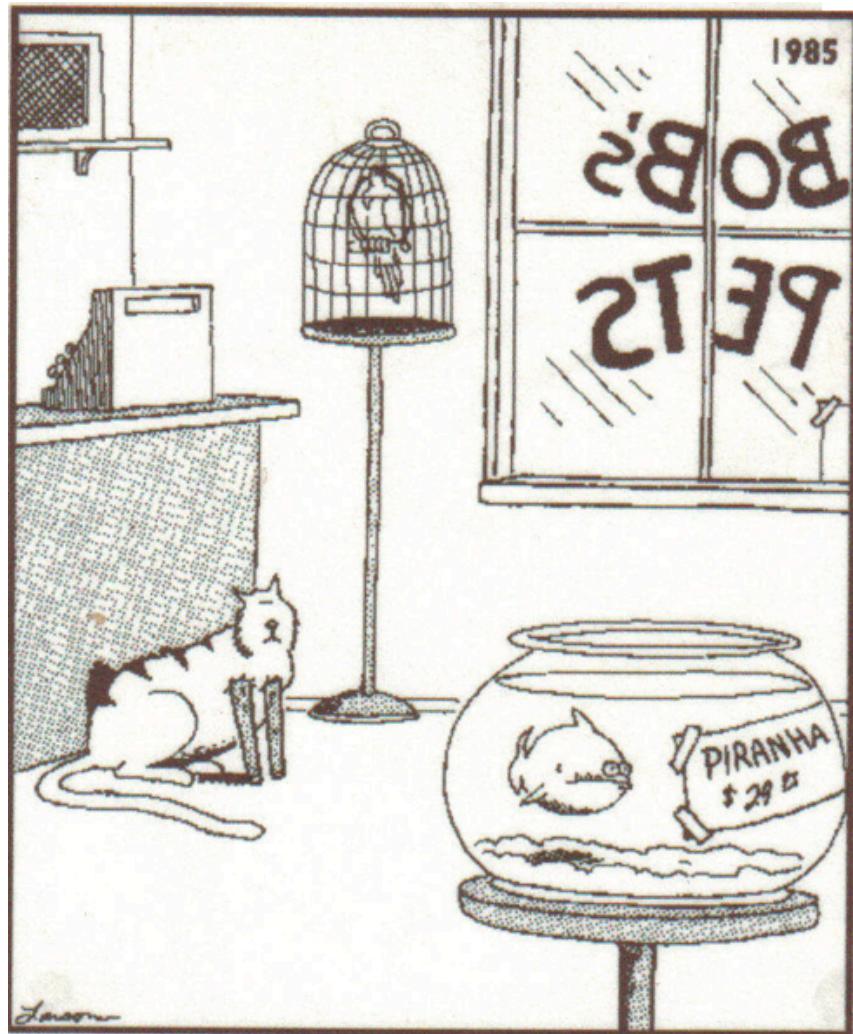
50. $(4^5 \cdot 4^{10})$ or 4^{50} **4^{50}**



Reteach 8.2 page 53

■ **Lesson 8.2**

- | | | | | |
|----------------------|----------------------|---------------------|-----------|---------------------|
| 1. $\frac{1}{14a}$ | 2. $\frac{8}{y^3}$ | 3. $\frac{1}{x}$ | 4. $7b^4$ | 5. $\frac{1}{3a^7}$ |
| 6. $\frac{d^6}{c^2}$ | 7. $\frac{y^5}{x^5}$ | 8. 1, if $x \neq 0$ | 9. 1 | |



Extra Practice 8.2

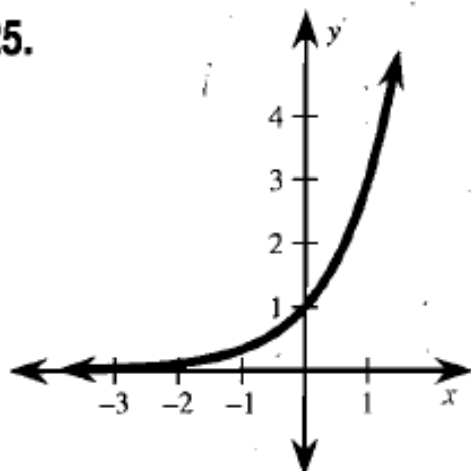
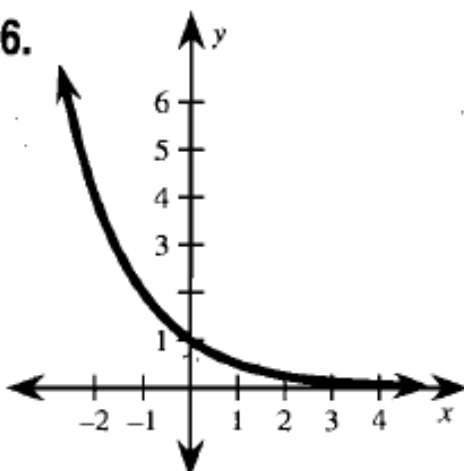
■ Lesson 8.2

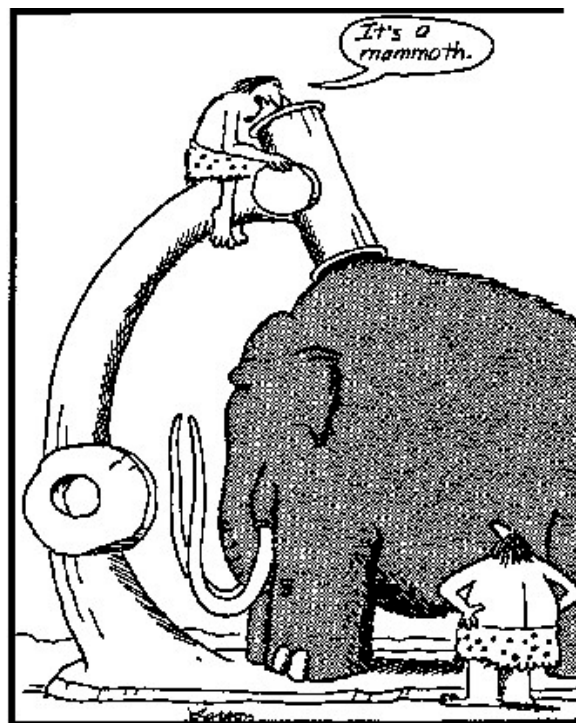
1. $\frac{1}{27}$
2. $\frac{1}{32}$
3. 16
4. $\frac{1}{8}$
5. 3
6. 25
7. 1
8. $\frac{1}{16}$
9. 8
10. $\frac{1}{64}$
11. $\frac{1}{36}$
12. $-\frac{1}{8}$
13. $\frac{1}{x^8}$
14. $\frac{3}{x^5}$
15. $\frac{x^2}{7}$
16. $9x^4$
17. $\frac{8}{x^7y^8}$
18. $\frac{x^4y^3}{6z^5}$
19. $3y^3$
20. $\frac{1}{16x^2}$
21. $\frac{1}{16x^4}$
22. $27x^3$
23. $\frac{1}{y^2}$
24. $\frac{3y^5}{4x^2}$



"Say ... what's a mountain goat doing way up here in a cloud bank?"

Lesson 8.2 (continued)

25.**26.****27.** 100, 50, 25, 12.5, 6.25, 3.125, 1.5625**28.** 1980: ≈ 1206 , 1985: 1200
1990: ≈ 1194 , 2000: ≈ 1182 **29.** 10,240 grams**30.** 1960: ≈ 1869 , 1970: ≈ 1933
1980: 2000, 1990: ≈ 2069



Early microscope

EXERCISES

Guided Practice

CRITICAL THINKING about the Lesson

1. True or False? If a is positive, a^{-n} is positive. Explain your reasoning.
2. Simplify $a^5 \cdot a^{-5}$. The result implies that a^5 and a^{-5} are ? of each other. 1, reciprocals
3. Rewrite $5a^{-3}b^{-2}$ with positive exponents. Why does the 5 stay in the numerator?
4. Simplify $3c^{-5} \cdot 4c^4$. Can a simplified form have a negative exponent? $\frac{12}{c}$, no
5. If $a^0 = 1$ ($a \neq 0$), what point do all graphs of the form $y = (a)^x$ have in common? Is this true for $y = 2(a)^x$? (0, 1); no

Independent Practice

In Exercises 6–17, rewrite the expression using positive exponents. 13. $\frac{x^6}{y^7}$

6. $x^{-7} \frac{1}{x^2}$

7. $x^{-9} \frac{1}{x^0}$

8. $5x^{-4} \frac{5}{x^4}$

9. $3x^{-2} \frac{3}{x^2}$

10. $\frac{1}{2x^{-3}} \frac{x^0}{2}$

11. $\frac{1}{4x^{-5}} \frac{x^0}{4}$

12. $x^{-2}y^3 \frac{y^3}{x^2}$

13. x^6y^{-7}

14. $3x^{-3}y^{-8} \frac{3}{x^3y^8}$

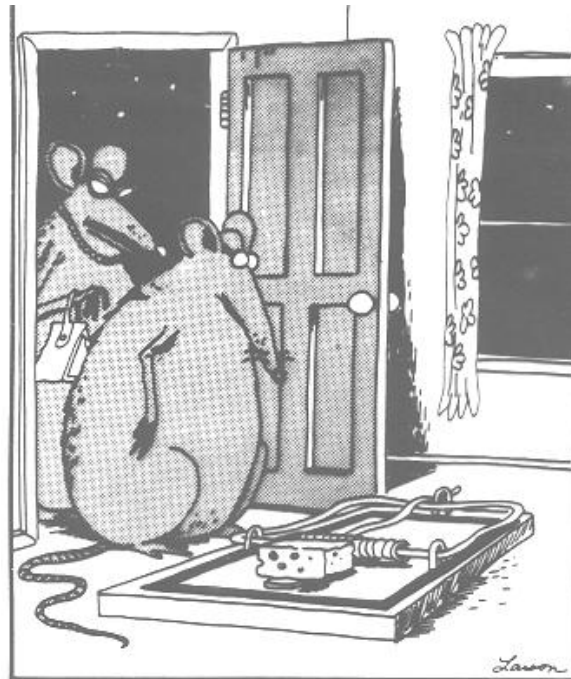
15. $6x^{-2}y^{-4} \frac{6}{x^2y^4}$

16. $\frac{1}{7x^{-4}y^{-1}} \frac{x^4y}{7}$

17. $\frac{1}{2x^{-10}y^{12}}$

In Exercises 18–29, evaluate the expression.

$\frac{x^{10}}{2y^{12}} \cdot \frac{1}{4}$



"Well, heaven knows what it is or where it came from
— just get rid of it. But save that cheese first."

14. $3x^{-3}y^{-8} \frac{3}{x^9y^8}$

15. $6x^{-2}y^{-4} \frac{6}{x^2y^4}$

16. $\frac{1}{7x^{-4}y^{-1}} \frac{x^4y}{7}$

17. $\frac{1}{2x^{-10}y^{12}}$

$\frac{x^{10}}{2y^{12}} \cdot \frac{1}{4}$

In Exercises 18–29, evaluate the expression.

18. $3^{-2} \frac{1}{9}$

19. $2^{-4} \frac{1}{16}$

20. $-4^0 \cdot \frac{1}{2^{-2}} - 4$

21. $4^{-3} \cdot 4^2$

22. $6^3 \cdot 6^{-1} 36$

23. $8^4 \cdot 8^{-4} 1$

24. $7^{-9} \cdot 7^9 1$

25. $(5^{-3})^2$

26. $(-4^{-2})^{-1} - 16$

27. $-6 \cdot (-6)^{-1} 1$

28. $5 \cdot 5^{-1} 1$

29. $2^0 \cdot 3^{-3}$

$\frac{1}{27}$

In Exercises 30–41, rewrite the expression using positive exponents.

30. $(-3)^0x x$

31. $(5y)^{-2} \frac{1}{25y^2}$

32. $(-2x)^{-3} - \frac{1}{8x^3}$

33. $(-4a)^0 1$

34. $(-3x)^{-1} \cdot 2y - \frac{2y}{3x}$

35. $(4xy)^{-2} \frac{1}{16x^2y^2}$

36. $(3x)^{-1} \frac{1}{3x}$

37. $(2a^{-3})^3$

38. $\frac{4}{b^{-2}} 4b^2$

39. $\frac{5}{a^{-4}} 5a^4$

40. $\frac{1}{(4x)^{-3}} 64x^3$

41. $\frac{1}{(2y)^{-5}} 32y^5$

In Exercises 42–45, say if the graph of the function contains the point (0, 1).

42. $y = -3^x$ No

43. $y = 4^x$ Yes

44. $y = 3 \cdot 1^x$ No

45. $y = 50^x$ Yes

46. **Population of Missouri** Between 1970 and 1990, Missouri's population increased at the rate of 0.47% per year. The population, P , in year t is given by

$$P = 4,903,000 \cdot 1.0047^t$$

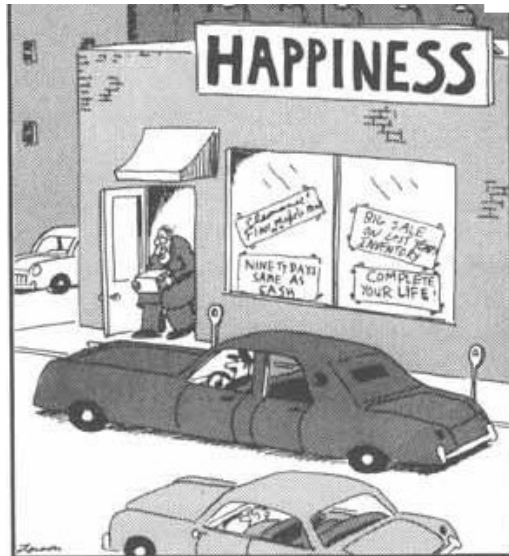
where $t = 0$ corresponds to 1980. Find the population in 1970, 1980, and 1990.

$$4,678,406; 4,903,000; 5,138,376$$

47. **Population of Buffalo** Between 1970 and 1990, the population of Buffalo, New York, decreased at the rate of 0.82% per year. The population, P , in year t is given by

$$P = 1,025,000 \cdot 0.9918^t$$

where $t = 0$ corresponds to 1980. Find the population in 1970, 1980, and 1990.



His few friends had told him he could never buy it, but Mr. Crawley surmised that they just didn't know where the store was.

Reteach 8.3

■ Lesson 8.3

1. c^6

2. $\frac{64x^3}{27y^3}$

3. $\frac{b^2}{a^2}$

4. $\frac{-15}{xy}$

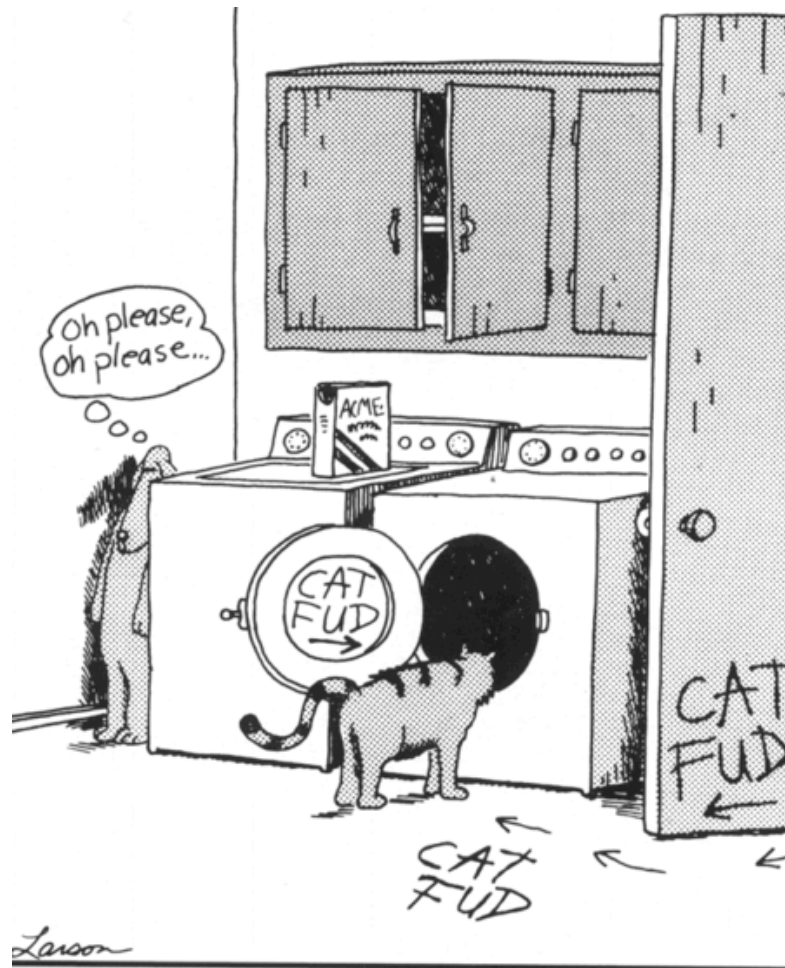
5. $\frac{8}{a^3b^4}$

6. $\frac{4}{y^8}$

Extra Practice 8.3

■ Lesson 8.3

1. 49 2. $\frac{1}{36}$ 3. 1 4. -1
5. 128 6. 16 7. $\frac{1}{27}$ 8. $\frac{8}{27}$
9. $\frac{16}{25}$ 10. $-\frac{1}{32}$ 11. $\frac{3}{11}$ 12. $\frac{4}{9}$
13. $\frac{x^4}{81}$ 14. x^5 15. $\frac{64}{x^6}$
16. $\frac{1}{x^3}$ 17. x^9 18. $4x^3y$
19. $\frac{9y^4}{4x^7}$ 20. $-\frac{4y^3}{x^3}$ 21. $\frac{y^4}{x^2}$
22. $\frac{x^3}{3}$ 23. $\frac{54y^6}{x^{14}}$ 24. $-\frac{5y^6}{8x^8}$
25. $\frac{3125}{7776}$ 26. 1.030301
27. 2, 2.4, 2.88, 3.456
28. 100, ≈ 51 , ≈ 26 , ≈ 13 , ≈ 7 , ≈ 4 , ≈ 2



Guided Practice

CRITICAL THINKING about the Lesson 1. No, the bases are not the same.

1. Can $\frac{x^{10}}{y^4}$ be simplified? Why or why not?

3. When you divide powers with the same base, do you add or subtract exponents?

Subtract

2. Does $\frac{x^{-4}}{x^{-5}}$ simplify as x or $\frac{1}{x}$? x

4. What is the relationship between $\frac{x^4}{x^2}$ and $\frac{x^{-4}}{x^{-2}}$? Are they equivalent or are they reciprocals of each other? Explain.

Reciprocals, their product is 1.

Independent Practice

In Exercises 5–16, evaluate the expression.

5. $\frac{6^6}{6^4}$ 36

6. $\frac{8^3}{8^1}$ 64

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

8. $\frac{(-3)^9}{(-3)^9}$ 1

9. $\frac{2^2}{2^{-3}}$ 32

10. $\frac{8^3 \cdot 8^2}{8^5}$ 1

11. $\frac{7^4 \cdot 7}{7^7}$ $\frac{1}{49}$

12. $\left(\frac{3}{4}\right)^2 \frac{9}{16}$

13. $\left(\frac{5}{3}\right)^3 \frac{125}{27}$

14. $\left(-\frac{2}{3}\right)^3 - \frac{8}{27}$

15. $\left(-\frac{4}{5}\right)^2 \frac{16}{25}$

16. $\left(\frac{9}{6}\right)^{-1} \frac{2}{3}$



"A cat killer? Is that the face of a cat killer?
Cat chaser maybe. But hey—who isn't?"

In Exercises 17–28, simplify the expression.

17. $\left(\frac{2}{x}\right)^4 \frac{16}{x^4}$

18. $\frac{x^4}{x^5} \frac{1}{x}$

19. $\left(\frac{1}{x}\right)^6 \frac{1}{x^6}$

20. $x^3 \cdot \frac{1}{x^2} x$

21. $x^7 \cdot \frac{1}{x^9} \frac{1}{x^2}$

22. $\frac{3x^2y^2}{3xy} \cdot \frac{6xy^3}{3y} 2x^2y^3$

23. $\frac{4xy^3}{2y} \cdot \frac{5xy^{-3}}{x^2} \frac{10}{y}$

24. $\frac{16x^3y}{-4xy^3} \cdot \frac{-2xy}{-x} - \frac{8x^2}{y}$

25. $\frac{-9x^5y^7}{x^2y^3} \cdot \frac{(2xy)^2}{-6x^2y^2} 6x^3y^4$

★ 26. $\frac{6x^{-2}y^2}{xy^{-3}} \cdot \frac{(4x^2y)^{-2}}{xy^2} \frac{3y}{8x^8}$

★ 27. $\frac{7x^{-1}y^3}{x^2y^{-2}} \cdot \frac{(3xy^2)^{-1}}{xy} \frac{7y^2}{3x^5}$

★ 28. $\left(\frac{2xy^{-2}y^4}{3yx^{-1}}\right)^{-2} \cdot \left(\frac{4xy}{2x^{-1}y^3}\right)^2 \frac{9}{y^6}$

Mercury Levels In Exercises 29 and 30, use the information from Example 4.

- ★ 29. As the FDA inspector, you test a $4\frac{1}{2}$ -kilogram fish and find that it has 4 milligrams of methylmercury. Does this fish meet FDA requirements? **Yes**
- ★ 30. A fish weighing 9 kilograms is found to contain 11 milligrams of methylmercury. As an FDA inspector, do you allow this fish to be sold? If not, how much would the fish have to weigh for 11 milligrams of methylmercury to be acceptable? **No, 11 kg**



