

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?
2. Does $\frac{x^{-4}}{x^{-5}}$ simplify as x or $\frac{1}{x}$? x
3. When you divide powers with the same base, do you add or subtract exponents?
Subtract
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. $(\frac{3}{4})^2 \cdot \frac{9}{16}$
13. $(\frac{5}{3})^3 \cdot \frac{125}{27}$
14. $(-\frac{2}{3})^3 - \frac{8}{27}$
15. $(-\frac{4}{5})^2 \cdot \frac{16}{25}$
16. $(\frac{9}{6})^{-1} \cdot \frac{2}{3}$

In Exercises 17–28, simplify the expression.

17. $(\frac{2}{x})^4 \cdot \frac{16}{x^4}$
18. $\frac{x^4}{x^5} \cdot \frac{1}{x}$
19. $(\frac{1}{x})^6 \cdot \frac{1}{x^6}$
20. $x^3 \cdot \frac{1}{x^2} \cdot x$
21. $x^7 \cdot \frac{1}{x^9} \cdot \frac{1}{x^2}$
22. $\frac{3x^2y^2}{3xy} \cdot \frac{6xy^3}{3y} \cdot 2x^2y^3$
23. $\frac{4xy^3}{2y} \cdot \frac{5xy^{-3}}{x^2} \cdot \frac{10}{y}$
24. $\frac{16x^3y}{-4xy^3} \cdot \frac{-2xy}{-x} \cdot \frac{-8x^2}{y}$
25. $\frac{-9x^5y^7}{x^2y^3} \cdot \frac{(2xy)^2}{-6x^2y^2} \cdot 6x^3y^4$
26. $\frac{6x^{-2}y^2}{xy^{-3}} \cdot \frac{(4x^2y)^{-2}}{xy^2} \cdot \frac{3y}{8x^8}$
27. $\frac{7x^{-1}y^3}{x^2y^{-2}} \cdot \frac{(3xy^2)^{-1}}{xy} \cdot \frac{7y^2}{3x^5}$
28. $(\frac{2xy^{-2}y^4}{3yx^{-1}})^{-2} \cdot (\frac{4xy}{2x^{-1}y^3})^2 \cdot \frac{9}{y^6}$

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

$S = 640(\frac{5}{4})^t$
where $t = 0$ corresponds to the ratio of the 1989 sales. ≈ 3.05
Human Memory Study vocabulary words. Fifth of the words that of words, S , you still
 $S = 200(\frac{4}{5})^n$

Complete the table after n weeks. How words? Explain your

Weeks, n	0
Words, S	?

33. **Olympic Rowing** Ally have 1, 2, 4, Olympic 2000-m
 $s = 16.3(1.0285)^n$

where s is the speed of an 8-r 2-rower shell.

34. **Olympic Par** 1988, the number participated in

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

$$\frac{2^2}{2^{-3}} = \frac{1}{a^{-m}} = a^m$$

$$2^2 \cdot 2^3 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 2^5 = \boxed{32}$$

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

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

23. $\frac{4xy^{-1}}{2y} \cdot \frac{5xy^{-1}}{x^1} \boxed{\frac{10}{y}}$

$\frac{4xy^3}{2y} \cdot \frac{5x}{x^2y^3} = a^{-m} = \frac{1}{a^m}$

$\frac{4xyyy5x}{2yxxyyy} = \frac{20}{2y} = \boxed{\frac{10}{y}}$ $\frac{20}{2} = \frac{10}{1}$

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

$$\frac{7x^{-1}y^3}{x^2y^{-2}} \cdot \frac{(3xy^2)^{-1}}{xy} =$$

$\rightarrow a^{-m} = \frac{1}{a^m} \text{ or}$
 $\frac{1}{a^{-m}} = a^m$

$$\frac{7y^3y^2}{x^2x} \cdot \frac{1}{xy(3xy^2)} = \frac{\cancel{7}y\cancel{y}y\cancel{y}}{\cancel{x}\cancel{x}\cancel{y}(xy\cancel{3}xy\cancel{y})}$$

$\rightarrow \boxed{\frac{7y^2}{3x^5}}$

$$43. \frac{4x^3y^3}{2xy} \cdot \frac{5xy^2}{2y}$$

$$= \frac{\cancel{4}x\cancel{x}x\cancel{y}y\cancel{y}}{\cancel{2}x\cancel{y}} \cdot \frac{5x\cancel{y}y}{\cancel{2}y}$$

$$= \frac{20x^3y^3}{4} = \boxed{5x^3y^3}$$



$$44. \frac{36a^8b^2}{ab} \cdot \left(\frac{6}{ab^2}\right)^{-1}$$

$$= \frac{36a^8b^2}{ab} \cdot \left(\frac{ab^3}{6}\right)^1$$

$$= \frac{\cancel{36}a\cancel{a}\cancel{a}\cancel{a}\cancel{a}\cancel{a}\cancel{a}\cancel{a}b\cancel{b}}{\cancel{a}b} \cdot \frac{a\cancel{b}b}{\cancel{6}}$$

$$= \boxed{6a^8b^3}$$



$$45. \frac{16x^5y^{-8}}{x^7y^4} \cdot \left(\frac{x^3y^2}{8xy}\right)^4$$

$$a^{-m} = \frac{1}{a^m}$$



$$= \frac{16x^5}{x^7y^4y^8} \cdot \frac{x^{12}y^8}{8^4x^4y^4}$$

$$(a^m)^n = a^{mn}$$

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$$

$$= \frac{16x^{17}y^8}{4096x^{11}y^{16}}$$

$$a^m a^n = a^{m+n}$$

$$= \frac{x^6}{256y^8}$$



$$\frac{a^m}{a^n} = a^{m-n}$$

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

$$= \frac{6y^2y^3}{xx^2} \cdot \frac{1}{xy^2(4x^2y)^2} \rightarrow a^{-m} = \frac{1}{a^m} \text{ or } \frac{1}{a^{-m}} = a^m$$

$$= \frac{\cancel{6y} \cancel{y} \cancel{y} \cancel{y} \cancel{y}}{xxx \cancel{xy} \cancel{y}^4 \cancel{xxx} \cancel{y}^4 \cancel{xxx} \cancel{y}} \rightarrow \text{cancel "form of ones"}$$

$$= \frac{6y}{16x^8} = \boxed{\frac{3y}{8x^8}} \quad \text{[Red and Blue Striped Circle]$$

$$47. \frac{5x^{-3}y^2}{x^5y^{-1}} \cdot \frac{(2xy^3)^{-2}}{xy}$$

$$48. \left(\frac{2xy^{-2}y^4}{3x^{-1}y} \right)^{-2} \cdot \left(\frac{4xy}{2x^{-1}y^{-3}} \right)^2$$