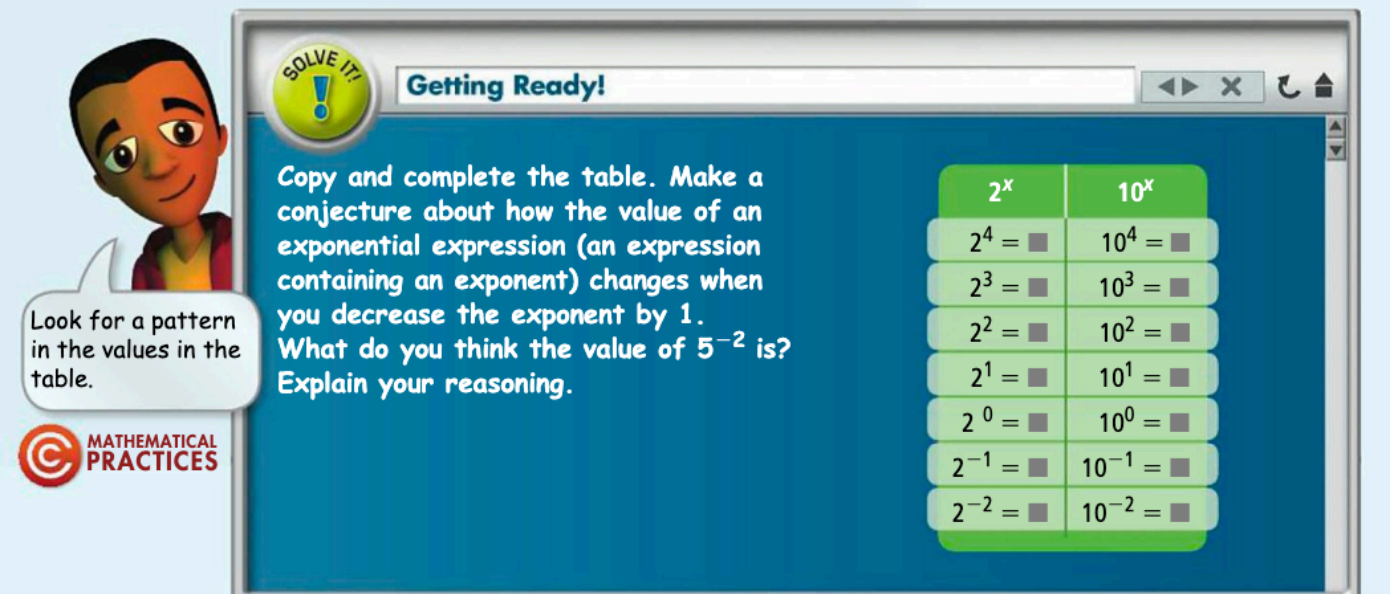
7-1: ZERO AND NEGATIVE EXPONENTS



1 Zero and Negative Exponents

PROPERTY: ZERO AS AN EXPONENT

For every nonzero number a,

PROPERTY: NEGATIVE EXPONENT

For every nonzero number a and integer n,

Why only nonzero numbers? What's wrong with zero?

EXAMPLE 1: SIMPLIFYING A POWER

Simplify each expression.

1. 16^0
2. 4^{-2}
3. 3^{-3}
4. 8^{-4}

5. 12^{-1}
6. -7^{-2}
7. $(-9)^{-2}$
8. $(-4.9)^0$

EXAMPLE 2: SIMPLIFYING AN EXPONENTIAL EXPRESSION

Simplify each expression.

9. x^{-8}
10. xy^{-3}
11. $a^{-5}b$
12. m^2n^{-9}

13. $\frac{1}{x^{-7}}$
14. $\frac{3}{a^{-4}}$
15. $\frac{5}{d^{-3}}$
16. $\frac{6}{r^{-5}s^{-1}}$

17. $3x^{-6}y^{-5}$
18. $8a^{-3}b^2c^{-2}$
19. $15s^{-9}t^{-1}$
20. $-7p^{-5}q^{-3}r^2$

21. $\frac{d^{-4}}{e^{-7}}$
22. $\frac{3m^{-4}}{n^{-8}}$
23. $\frac{6m^{-8}n}{p^{-1}}$
24. $\frac{a^{-2}b^{-1}}{cd^{-3}}$

2 Evaluating Exponential Expressions

When you evaluate an exponential expression, you can write the expression with positive exponents before substituting values for the variables.

EXAMPLE 3: EVALUATING AN EXPONENTIAL EXPRESSION

25. Evaluate $3m^2t^{-2}$ for $m = 2$ and $t = -3$.

Evaluate each expression for $a = -2$ and $b = 6$.

26. b^{-2}

27. a^{-3}

28. $(-a)^{-4}$

29. $-b^{-3}$

30. $4a^{-3}$

31. $2b^{-2}$

32. $(3a)^{-2}$

33. $(-b)^{-2}$

34. $2a^{-1}b^{-2}$

35. $-4a^{-2}b^{-3}$

36. $3^{-2}a^{-2}b^2$

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

EXAMPLE 4: REAL-WORLD PROBLEM SOLVING

38. A population of marine bacteria doubles every hour under controlled laboratory conditions. The number of bacteria is modeled by the expression $1000 * 2^h$, where h is the number of hours after a scientist measures the population size. Evaluate the expression for $h = 0$ and $h = -3$. What does each value of the expression represent in the situation?

Lesson Check

Do you know HOW?

Simplify each expression.

1. 2^{-5}
2. m^0
3. $5s^2t^{-1}$
4. $\frac{4}{x^{-3}}$

Evaluate each expression for $a = 2$ and $b = -4$.

5. a^3b^{-1}
6. $2a^{-4}b^0$

Do you UNDERSTAND? MATHEMATICAL PRACTICES

7. **Vocabulary** A positive exponent shows repeated multiplication. What repeated operation does a negative exponent show?

8. **Error Analysis** A student incorrectly simplified $\frac{x^n}{a^{-n}b^0}$ as shown below. Find and correct the student's error.

$$\frac{x^n}{a^{-n}b^0} = \frac{a^n x^n}{b^0} = \frac{a^n x^n}{0} \text{ undefined}$$

Name _____ ***7-1 Practice Worksheet*** Period _____

Simplify each expression.

1. $-(2.57)^0$
2. $\frac{1}{2^0}$
3. -3^{-4}
4. 2^{-6}
5. $(-4)^{-3}$
6. -4^{-3}
7. $\frac{5x^{-1}}{y^{-4}}$
8. $\frac{8}{2c^{-3}}$
9. $2^{-3}x^2y^0z^{-7}$
10. $9y^7t^{-11}$
11. $\frac{7s^0t^{-5}}{2^{-1}m^2}$
12. $2^3(5^0-6m^2)$

Evaluate each expression for r = -3 and s = 5.

13. $(2s)^{-2}$
14. $\frac{1}{r^{-4}s^2}$
15. r^0s^{-2}
16. $2^{-4}r^3s^{-3}$
17. $\frac{3r^{-2}s^3}{9r^3s^{-2}}$
18. s^r

Is the value of each expression *positive* or *negative*?

19. -2^2 20. $(-2)^2$ 21. 2^{-2} 22. $(-2)^{-3}$

23. Simplify $a^n \bullet a^{-n}$. What is the mathematical relationship between the two factors?

24. Which expressions equal ¼?

I. 4^{-1} II. 2^{-2} III. -2^{-2} IV. $\frac{1}{2^2}$

a) I, II, and III only b) I and II only c) I, III, and IV only d) I, II, and IV only

25. Suppose you are the only person in your class who knows a certain story. After a minute you tell a classmate. Every minute after that, every student who knows the story tells another student (sometimes the person being told already will have heard it). In a class of 30 students, the expression $\frac{30}{1+29 \bullet 2^{-t}}$ predicts the approximate number of people who will have heard the story after *t* minutes.

About how many students will have heard your story after 2 minutes?

After 5 minutes?

After 10 minutes?