

7-1

Zero and Negative Exponents



Vocabulary

● Review

Circle the *exponent* in each equation.

1. $3^5 = 243$

2. $7^2 = 49$

3. $2^7 = 128$

Write an equivalent expression using an *exponent*.

4. $35 \cdot 35 \cdot 35 =$

5. $19 \cdot 19 \cdot 19 \cdot 19 \cdot 19 \cdot 19 \cdot 19 \cdot 19 \cdot 19 =$

6. In the expression 4^3 , identify the *base* and the *exponent*.

base =

exponent =

● Vocabulary Builder

negative (adjective) NEG uh tiv

Definition: A **negative** quantity has a value less than zero.

Examples: -3 , $-\frac{1}{2}$, and $-\pi$ are all **negative** numbers.

The symbol for
negative
is
—

● Use Your Vocabulary

7. Write a number to represent each situation.

The temperature is 4 degrees below zero.

You owe your brother eight dollars.

A worker's hourly pay increases by \$.50.

Draw a line from each *negative* number in Column A to its opposite in Column B.

Column A

Column B

8. $-\frac{1}{2}$

17

9. $-3\frac{3}{5}$

$\frac{1}{2}$

10. -17

$3\frac{3}{5}$

Properties Zero and Negative Exponents

11. Complete the table.

Exponent	Property	Examples
Zero	For every nonzero number a , $(a)^0 = 1$	$6^0 = 1$
		$(-24)^0 = \boxed{}$
Negative	For every nonzero number a and integer n , $(a)^{-n} = \frac{1}{a^n}$	$7^{-3} = \frac{1}{7^3} = \frac{1}{343}$
		$4^{-2} = \frac{1}{4^2} = \frac{1}{\boxed{}}$
		$(-3)^{-5} = \frac{1}{(-3)^5} = \frac{1}{\boxed{}}$

Write T for *true* or F for *false*.

☐ 12. $9^{-2} = \frac{1}{81}$

☐ 13. $(-9)^0 = -1$

☐ 14. $9^{-1} = -\frac{1}{9}$

☐ 15. $9^{-3} = \frac{1}{27}$



Problem 1 Simplifying Powers

Got It? What is the simplified form of 4^{-3} ?

16. Complete each step to simplify 4^{-3} .

$$4^{-3} = \frac{1}{\boxed{}}$$

Move the power to the denominator and make the exponent positive.

$$= \frac{1}{\boxed{}}$$

Evaluate the power to simplify the expression.



Problem 2 Simplifying Exponential Expressions

Got It? What is the simplified form of each expression?

$$x^{-9}$$

$$\frac{1}{n^{-3}}$$

$$4c^{-3}b$$

$$\frac{2}{a^{-3}}$$

$$\frac{n^{-5}}{m^2}$$

Underline the correct word to complete each sentence.

17. To simplify a base in the numerator that has a negative exponent, move the base to the denominator and write a positive / negative exponent.

18. To simplify a base in the denominator that has a negative exponent, move the base to the numerator and write a positive / negative exponent.

19. Simplify each expression.

$$x^{-9} = \frac{1}{x^{\boxed{}}}$$

$$\frac{1}{n^{-3}} = 1 \div n^{\boxed{}} = 1 \cdot \boxed{}$$

$$4c^{-3}b = \frac{4 \cdot \boxed{}}{\boxed{}}$$

$$\frac{2}{a^{-3}} = 2 \cdot \boxed{}$$

$$\frac{n^{-5}}{m^2} = \frac{\boxed{}}{\boxed{} \cdot \boxed{}}$$



Problem 3 Evaluating an Exponential Expression

Got It? What is the value of $n^{-4}w^0$ for $n = -2$ and $w = 5$?

Complete each method to solve the problem.

20. **Method 1** Simplify first. $n^{-4}w^0 = \frac{w^0}{n^{\boxed{}}}$ Use the definition of negative exponent.

$$= \frac{\boxed{}^0}{(\boxed{})^4}$$

Substitute.

$$= \frac{\boxed{}}{\boxed{}}$$

Simplify.

21. **Method 2** Substitute first. $n^{-4}w^0 = (-2)^{-4} \cdot \boxed{}^0$ Substitute.

$$= \frac{\boxed{}}{(-2)^{\boxed{}}}$$

Use the definition of negative exponent.

$$= \frac{\boxed{}}{\boxed{}}$$

Simplify.



Problem 4 Using an Exponential Expression

Got It? A population of insects triples every week. The number of insects is modeled by the expression $5400 \cdot 3^w$, where w is the number of weeks after the population was measured. Evaluate the expression for $w = -2$, $w = 0$, and $w = 1$. What does each value of the expression represent in the situation?

22. Use the information in the problem to complete the problem-solving model below.

Know

Need

Plan



23. Now solve the problem.

24. What does each value represent?

For $w = -2$, the value represents the number of insects ? .

For $w = 0$, the value represents the number of insects ? .

For $w = 1$, the value represents the number of insects ? .



Lesson Check • Do you UNDERSTAND?

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

$$\begin{aligned} \frac{x^n}{a^{-n}b^0} &= \frac{a^n x^n}{b^0} \\ &= \frac{a^n x^n}{0} \text{ undefined} \end{aligned}$$

25. Did the student work correctly with —

base x ? Yes / No

base a ? Yes / No

base b ? Yes / No

26. What error did the student make?

27. Now simplify the expression correctly.



Math Success

Check off the vocabulary words that you understand.

☐ exponent

☐ zero exponent

☐ negative exponent

Rate how well you can *simplify zero and negative exponents*.

