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6.1 Notetaking with Vocabulary

I can identify and use properties of exponents.

I can use positive exponents and understand what they represent.
I can use negative and zero exponents.
I can solve real world problems involving exponents.

Write the meaning of each vocabulary term.

power - a shorthand way to write repeated multiplication

power $\begin{cases} 3^4 \leftarrow \text{exponent} \\ \uparrow\text{base} \end{cases} = 3 \cdot 3 \cdot 3 \cdot 3$ power function $\begin{cases} x^4 = x \cdot x \cdot x \cdot x \end{cases} \Rightarrow$ variable is the base

exponent } see above
base }

4^x } exponential function $\Rightarrow$ variable is the exponent

scientific notation - a number written in the form $a \times 10^b$ where $1 \leq a < 10$ and when $b < 0$ (neg), # < 1; when $b > 0$ (pos), # > 1

Core Concepts

Zero Exponent

Words For any nonzero number a, $a^0 = 1$ The power 0^0 is undefined.

Numbers $4^0 = 1$ **Algebra** $a^0 = 1$ where $a \neq 0$.

Negative Exponents

Words For any integer n and any nonzero number a, a^{-n} is the reciprocal of a^n.

Numbers $4^{-2} = \frac{1}{4^2}$ **Algebra** $a^{-1} = \frac{1}{a^1}$ where $a \neq 0$

Notes:

$\frac{1}{5^{-3}} = \frac{5^3}{1} = 5^3$ $\qquad \frac{1}{a^{-1}} = a^1$ $\qquad \frac{a^{-3}}{b^{-5}} = \frac{b^5}{a^3}$

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6.1 Exponent Properties

Product of Powers Property

Let a be a real number, and let m and n be integers.

Words To multiply powers with the same base, add the exponents.

Numbers $4^6 \cdot 4^3 = 4^{6+3} = 4^9$ **Algebra** $a^m \cdot a^n = a^{m+n}$

Quotient of Powers Property

Let a be a nonzero real number, and let m and n be integers.

Words To divide powers with the same base, subtract the exponents.

Numbers $\frac{4^6}{4^3} = 4^{6-3} = 4^3$ **Algebra** $\frac{a^m}{a^n} = a^{m-n}$ where $a \neq 0$ $\frac{4^2}{4^4} = 4^{2-4} = 4^{-2} = \frac{1}{4^2}$

Power of a Power Property

Let a be a real number, and let m and n be integers.

Words To find a power of a power, multiply the exponents.

Numbers $(4^6)^3 = 4^{6 \cdot 3} = 4^{18}$ **Algebra** $(a^m)^n = a^{m \cdot n}$

Power of a Product Property

Let a and b be real numbers, and let m be an integer.

Words To find a power of a product, find the power of each factor & multiply.

Numbers $(2 \cdot 3)^4 = 2^4 \cdot 3^4$ **Algebra** $(ab)^m$

not distributing

Power of a Quotient Property

Let a and b be real numbers with $b \neq 0$, and let m be an integer.

Words To find the power of a quotient, find the power of the numerator and denominator and divide.

Numbers $\left(\frac{3}{2}\right)^4 = \frac{3^4}{2^4}$ **Algebra** $\left(\frac{a}{b}\right)^m$ where $b \neq 0$

$= \frac{a^m}{b^m}$

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6.1 Notetaking with Vocabulary (continued)

$(-2)^4 \neq -2^4$

Practice

will have # as answer

$(-2)^4 = -2 \cdot -2 \cdot -2 \cdot -2 = 16$

$-2^4 = -1 \cdot 2^4 = -16$

In Exercises 1–8, evaluate the expression.

1. 3^0

2. $(-2)^0 = 1$

3. 3^{-4}

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

5. $\frac{2^{-3}}{5^0}$

6. $\frac{-3^{-2}}{2^{-3}} = \frac{-1^1 \cdot 3^{-2}}{2^{-3}} = \frac{-1 \cdot 2^3}{3^2} = \frac{-8}{9}$

7. $\frac{4^{-1}}{-7^0}$

8. $\frac{3^{-1}}{(-5)^0}$

$(-3)^4 = 81$

In Exercises 9–23, simplify the expression. Write your answer using only positive exponents.

9. z^0

10. a^{-8}

11. $6a^0b^{-2}$

* when you have both a numeric base and a variable base in an expression, evaluate the numeric base

numeric variable

12. $14m^{-4}n^0$

13. $\frac{3^{-2}r^{-3}}{s^0}$

14. $\frac{2^3a^{-3}}{8^{-1}b^{-5}c^0} = \frac{8 \cdot 8^1 \cdot b^5}{a^3 \cdot 1} = \frac{64b^5}{a^3}$

15. $\frac{3^5}{3^3} = 3^{5-3} = 3^2$

16. $\frac{(-2)^7}{(-2)^5}$

17. $(-5)^3 \cdot (-5)^3$

18. $(q^5)^3 = q^{15}$

19. $(a^{-4})^2$

20. $\frac{c^4 \cdot c^3}{c^6} = \frac{c^7}{c^6} = c^1$

21. $(-4d)^4 = (-4)^4 d^4 = 256d^4$

22. $(-3f)^{-3}$

23. $\left(\frac{4}{x}\right)^{-3} = \left(\frac{x}{4}\right)^3 = \frac{x^3}{4^3} = \frac{x^3}{64}$

24. A rectangular prism has length x, width $\frac{x}{2}$, and height $\frac{x}{3}$. Which of the expressions represent the volume of the prism? Select all that apply.

A. $6^{-1}x^3$

B. $6^{-1}x^{-3}$

C. $(6x^{-3})^{-1}$

D. $2^{-1} \cdot 3^{-1} \cdot x^3$