Essential Question

How do exponents and logs help us handle powers of ten?

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Multiplying: Add the Exponents

- Same base of 10
- Count all the tens together
- 3 tens and 4 tens make 7 tens

An exponent counts how many times the base is multiplied by itself, so 10^3 means $10 \times 10 \times 10$.

Dividing: Subtract the Exponents

- Subtract: top minus bottom
- Matching tens cancel out
- 6 tens over 2 tens leaves 4

When you divide powers of ten, each 10 on the bottom cancels one 10 on the top.

Power of a Power: Multiply

- Exponent outside parentheses
- Multiply the two exponents
- Squared means two copies

When a power of ten is raised to another power, the outside exponent tells you how many copies of the inside to multiply.

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Zero and Negative Exponents

- Each step down: divide by 10
- Zero exponent always gives 1
- Negative exponent: less than 1

Following that pattern down from $10^1 = 10$ gives $10^0 = 1$.

A Log Is an Exponent

- log asks: 10 to what power?
- For a power of ten, log = exponent

A **logarithm** (log) asks: 10 raised to what power gives this number?

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pH and Going Back

- pH: −log of hydrogen ion concentration
- Low concentration, higher pH
- 2nd LOG key undoes the log

The pH of a solution is defined as $pH = -\log[H^+]$, where $[H^+]$ is the hydrogen ion concentration in moles per liter (M).

Example: Sunlight Reaching Earth

Try it first!

Light travels at 3.0×10^8 m/s and takes about 5.0×10^2 s to reach Earth from the Sun. How far does it travel? (distance = speed × time)

Example: pH of Orange Juice

Try it first!

A sample of orange juice has $[H^+] = 3.2 \times 10^{-4}$ M. What is its pH?

Example: Acid Rain

Try it first!

A sample of acid rain has a pH of 4.30. What is its $[H^+]$?

Big Ideas

- Multiply: add exponents
- Divide: subtract exponents
- Power of a power: multiply exponents
- A log is the exponent on 10

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