

Scientific Notation for Huge and Tiny Numbers

Grade 8 math · Lesson · Standards: 8.EE.A.3, 8.EE.A.4

Quick answer: Scientific notation writes a number as $a \times 10^n$, with a between 1 and 10 and n an integer. Big numbers get a positive exponent, tiny numbers a negative one. It makes comparing sizes easy, and products and quotients follow the rules for powers of ten.

Standards: 8.EE.A.3, 8.EE.A.4 · **Level:** Grade 8

What is scientific notation?

Scientific notation

A number is in scientific notation when it is written as $a \times 10^n$, where $1 \leq a < 10$ and n is an integer. Large numbers have a positive n ; numbers between 0 and 1 have a negative n .

The exponent counts how far the decimal point travels. For a big number, slide the point left until one nonzero digit sits in front of it.



$45,200,000 = 4.52 \times 10^7$: the decimal point moves 7 places left.

How do you write a very small number?

Slide the point right until one nonzero digit is in front of it. The number of places becomes a negative exponent.



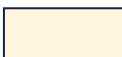
$0.00037 = 3.7 \times 10^{-4}$: the decimal point moves 4 places right.

Operation	What to do	Example
Multiply	Multiply the <i>a</i> parts, add the exponents	$(4 \times 10^3)(2.5 \times 10^5) = 10 \times 10^8 = 1 \times 10^9$
Divide	Divide the <i>a</i> parts, subtract the exponents	$(6 \times 10^7) \div (2 \times 10^3) = 3 \times 10^4$
Add or subtract	Give both the same power of 10 first	$3.5 \times 10^4 + 0.5 \times 10^4 = 4 \times 10^4$

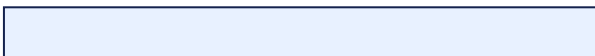
How do you compare numbers in scientific notation?

Compare exponents first; the larger exponent wins when both coefficients are between 1 and 10. When exponents match, compare coefficients. To say how many times as large one number is, divide.

Town: 6×10^4



City: 3×10^5



The city bar is 5 times as long: $(3 \times 10^5) \div (6 \times 10^4) = 0.5 \times 10^1 = 5$.

Method: operations

1. Write each number as $a \times 10^n$.
2. Apply the rule for the operation to the coefficients and to the powers of 10.
3. If the coefficient leaves the range 1 to 10, shift the decimal point and adjust the exponent.
4. Pick units that keep the numbers readable, such as micrometers for a cell.

Example: $(8.4 \times 10^9) \div (2.1 \times 10^4)$

Divide coefficients: $8.4 \div 2.1 = 4$. Subtract exponents: $9 - 4 = 5$.

Result: 4×10^5 , or 400,000.

Common mistake

Calculators show 3.2E5 or 7.5E−3. The letter E means "times 10 to the power", so 3.2E5 is $3.2 \times 10^5 = 320,000$. Never write E in a final answer.

Mathbot's tip

Beep! A negative exponent means a small number, not a negative one. Check with a sanity test: 10^{-3} is 0.001, a tiny positive value.

Key points to remember

- $a \times 10^n$ with $1 \leq a < 10$ and n an integer.
- Move the decimal point left for big numbers (n positive) and right for small ones (n negative).
- Multiply: multiply coefficients and add exponents. Divide: divide coefficients and subtract exponents.
- To add or subtract, first match the powers of 10.
- Calculator display 3.2E5 means 3.2×10^5 .

Scientific Notation for Huge and Tiny Numbers: frequently asked questions

Why must the first number be between 1 and 10?

That rule gives every number exactly one scientific form. Without it, 45×10^3 and 4.5×10^4 would both describe 45,000, which makes comparing sizes harder.

What does a negative exponent in scientific notation mean?

It means the number is between 0 and 1. For example 4×10^{-3} equals 0.004. The value is still positive.

How do you multiply numbers in scientific notation?

Multiply the coefficients and add the exponents. Then adjust if the new coefficient is 10 or more. For instance, $(5 \times 10^4)(6 \times 10^3) = 30 \times 10^7 = 3 \times 10^8$.

How do you tell how many times larger one number is than another?

Divide the larger by the smaller. Since $(9 \times 10^6) \div (3 \times 10^2) = 3 \times 10^4$, the first is 30,000 times as large as the second.

What does 4.5E-3 on a calculator mean?

It is 4.5×10^{-3} , which is 0.0045. The E stands for exponent of ten. Write it in full scientific notation when you copy it down.