

Scientific Notation

Scientific notation is used by mathematicians, scientists, and many others whenever the numbers they are dealing with are either really, really large or really, really small. It prevents us from having to write a bunch of zeroes.

Examples of numbers in scientific notation (and the equivalent expanded number):

6.0221415×10^{23} (Avogadro's Constant)	602,214,150,000,000,000,000,000
1.98892×10^{30} (mass of the sun in kg)	1,988,920,000,000,000,000,000,000,000,000
2.8×10^{-5} (mass of a grain of sand in g)	0.000028
2.5×10^{-2} (mass of a drop of water in g)	0.025

Notice that the first two numbers have positive exponents on the “10”, while the last two numbers have negative exponents on the “10”. This is because the first two are very large numbers (we’re multiplying by 10 repeatedly), whereas the last two are very small numbers (we’re dividing by 10 repeatedly).

Also notice that in all four of these numbers, there is exactly one digit to the left of the decimal place: $\underline{6}.0221415 \times 10^{23}$, $\underline{1}.98892 \times 10^{30}$, $\underline{2}.8 \times 10^{-5}$, $\underline{2}.5 \times 10^{-2}$. Scientific notation is always in the form $\underline{\quad}.\underline{\quad\quad\quad} \times 10^{\text{some power}}$, where there is one digit to the left of the decimal point.

So, here’s the process for changing a number into scientific notation:

- 1) Move the decimal point from its original position in the number to the right of the leftmost digit.
- 2) a) Count how many places you moved your decimal point from its original position. This number is going to be your “some power” in the format above.
b) If the number is large, the power will be large (positive). If the number is small, the power will be small (negative).
- 3) Drop any extra zeroes trailing at the right-side end of your number.

To change from scientific notation to decimal number notation, we just go the opposite way, keeping in mind that

- a) if the power on “10” is positive, we’re going to move the decimal point that many places in the direction that makes the number larger.
- b) if the power on “10” is negative, we’re going to move the decimal point that many places in the direction that makes the number smaller.

In both cases, you will most likely have to put in zeroes as placeholders.