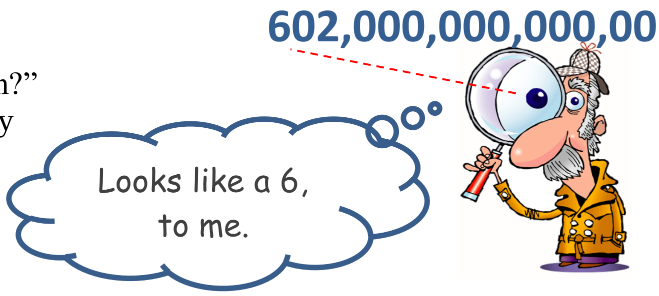
Scientific Notation

Scientific Notation is a way that scientists can write numbers that are either very large or very small, though all numbers can be written in Scientific Notation.

For example, there are about 602,000,000,000,000,000,000,000 molecules of water in a British tablespoon. Imagine how many there are in a whole cup! Or a bucket!

The width of a water molecule is about 0.0000000003m. That's pretty small, but typical of the kinds of measurements that scientists have to work with when talking about chemicals.

These numbers are ridiculously large or small, and to most of us are meaningless because of that.



Scientists look at any number and ask, "What does it start with?" They look at it first as a number between 1 and 10; that is, they look at the first **non-zero figure** and base their notation on that figure as the **unit** value. The first **non-zero figure** goes into the **units** place.

Any digits after that go *after* the decimal point.
For the number of water molecules, they would write 6.02;
For the width of the molecule they would simply write 3 or 3.0

From there, they write how many times you would multiply the number by ten (or divide by ten) to get the actual number you started with. That is, how any places they would move the decimal point to put it where it started.

10^{23}
is a 1 with 23 zeros after it.

In the first example, they would **multiply** 6.02 by 100,000,000,000,000,000,000,000; in other words, by 10^{23}, to put the decimal point at the end.

Remember, this is how many places to the right that the decimal point must be moved.
They would write, 6.02×10^{23}

In the second example, they would **divide** 3 by 10,000,000,000 to put the decimal point where it was; in other words, they would **divide** by 10^{10}. This is the same as **multiplying** by 10^{-10}. The negative index (exponent) tells that we are **dividing** by that many times, or moving the decimal point to the **left**.
They would write, 3.0×10^{-10}

Any number can be written in Scientific Notation.

In each example, follow these four steps.

Example 1: **236**

A. Write the number with the **first non-zero digit** as the **unit**; then add a decimal point, and then either a zero or the rest of the digits until the last non-zero digit. — 2 . 3 6

B. Put your pencil point on the original number, where the decimal point would go (after the first non-zero digit). — 2 . 3 6

C. Count to the left or right each place value until you get to the original decimal point or to the end of the number. — 2 3 6 . *(moved two places to the* ***right****, to get to the end)*

D. If you counted to the right, the power of ten is positive. If you counted to the left, the power of ten is negative. — 2.36×10^2

Example 2: **35,078**

A.	Write the number with the **first non-zero digit** as the **unit**; then add a decimal point, and then either a zero or the rest of the digits until the last non-zero digit.	3 . 5 0 7 8	
B.	Put your pencil point on the original number, where the decimal point would go (after the first non-zero digit).	3⊙5, 0 7 8	
C.	Count to the left or right each place value until you get to the original decimal point or to the end of the number.	3 5, 0 7 8⊙	*(moved four places to the* ***right****, to get to the end)*
D.	If you counted to the right, the power of ten is positive. If you counted to the left, the power of ten is negative.	3.5078×10^4	

Example 3: **0.0052604**

A.	Write the number as the **first non-zero digit** as the **unit**; then a decimal point, and then either a zero or the rest of the digits until the last non-zero digit.	5 . 2 6 0 4	
B.	Put your pencil point on the original number, where the decimal point would go (after the first non-zero digit).	0 . 0 0 5⊙2 6 0 4	
C.	Count to the left or right each place value until you get to the original decimal point or to the end of the number.	0⊙0 0 5 2 6 0 4	*(moved three places to the* ***left****, to get to the original point)*
D.	If you counted to the right, the power of ten is positive. If you counted to the left, the power of ten is negative.	5.2604×10^{-3}	

Example 4: **25.0326**

A.	Write the number as the **first non-zero digit** as the **unit**; then a decimal point, and then either a zero or the rest of the digits until the last non-zero digit.	2 . 5 0 3 2 6	
B.	Put your pencil point on the original number, where the decimal point would go (after the first non-zero digit).	2⊙5 . 0 3 2 6	
C.	Count to the left or right each place value until you get to the original decimal point or to the end of the number.	2 . 5⊙0 3 2 6	*(moved one place to the* ***right****, to get to the original point)*
D.	If you counted to the right, the power of ten is positive. If you counted to the left, the power of ten is negative.	2.5326×10^1	*(**Note:** Don't just write × 10)*

Example 5: **7.25**

A.	Write the number as the **first non-zero digit** as the **unit**; then a decimal point, and then either a zero or the rest of the digits until the last non-zero digit.	7.25	
B.	Put your pencil point on the original number, where the decimal point would go (after the first non-zero digit).	7⊙25	
C.	Count to the left or right each place value until you get to the original decimal point or to the end of the number.	7⊙25	*(moved zero places to get to the original point; that is, did not have to move at all)*
D.	If you counted to the right, the power of ten is positive. If you counted to the left, the power of ten is negative.	7.25×10^0	*(**Note:** Don't just write × 1, or just 7.25)*

Converting from Scientific Notation to Standard Notation

This is much easier. Just place your pencil tip on the decimal point, and count to the **right** (for **positive** powers of ten) to **left** (for **negative** powers of ten).

As you count, curved arrows help keep track and show the places for zeros.

Examples:

Move the point two places to the right.

6) $2.5\,3\,2\,6 \times 10^2$ 2.5 3 2 6 = 2.5 3⊙2 6 = 253.26

Move the point six places to the right.

You don't show the decimal point at the end of an integer.

7) $1.4\,9 \times 10^6$ 1.4 9 = 1.4 9 0 0 0 0⊙ = 1,490,000

Move the point four places to the left.

8) $9.3\,7\,5 \times 10^{-4}$ 9.3 7 5 = .0 0 0 9.3 7 5 = 0.0009375