SCIENTIFIC NOTATION

Chemists and other scientists often use scientific notation.
Therefore it would be a good idea to read these notes.

Many large numbers have a long string of zeroes at the end, while very small ones have a string of zeroes at the beginning. It is easy to lose track of these zeroes when doing your calculations.
You can avoid this problem by using scientific notation. Here numbers are written as powers of ten.

The term "power of ten" simply means how many tens are multiplied together.

$1,000 = 10 \times 10 \times 10 = 10^3$ Here the power of three shows that 3 tens were multiplied.

$10,000 = 10 \times 10 \times 10 \times 10 = 10^4$
$100,000 = 10 \times 10 \times 10 \times 10 \times 10 = 10^5$
$1,000,000 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^6$

There is a clear pattern. Each time the number grows by one digit, its power of ten *increases by one*.

For numbers smaller than one, the powers are always negative.

$0.1 = 1/10 = 10^{-1}$
$0.01 = (1/10) \times (1/10) = 10^{-2}$
$0.001 = (1/10) \times (1/10) \times (1/10) = 10^{-3}$

** IF YOU DO NOT KNOW HOW TO USE THE EXPONENT BUTTON ON YOUR CALCULATOR, THEN ASK FOR HELP NOW. **

Let's do an example where a large number is converted into scientific notation.

42,600 converts to 4.26×10^4. We came up with this answer in two steps.

STEP ONE - determine the number of significant figures. Here we have 3 significant figures. The two zeroes at the end of 42,600 are trailing zeroes. They are simply space fillers that keep our place.
In scientific notation ALWAYS PUT ONE DIGIT TO THE LEFT OF THE DECIMAL PLACE. All of the remaining sig. figs. go to the right of the decimal point.

Thus 4.26×10^4 is CORRECT.
42.6×10^3 is WRONG.

42.6×10^3 is like bad grammar. People will *probably* understand you, but confusion is possible if you don't follow the rules.

STEP TWO - determine the power of ten. Count along from the ones place to the beginning of the number.   42,600
                                                                                                        ↑   ↑

Here one has to move four places to the left, in order to get from the '0' in the ones place to the '4' at the front of the number. This four digit movement translates into a power of four.

There are other ways of looking at this. Mathematically-minded people might think of 42,600 as being the same thing as 4.26 times 10,000.
$10,000 = 10 \times 10 \times 10 \times 10 = 10^4 \rightarrow$ Thus $42,600 = 4.26 \times 10^4$

If you already have your own way of converting to scientific notation, and it works, then keep on using it.

Small numbers (decimal fractions) can be converted into scientific notation. For example: $0.082 = 8.2 \times 10^{-2}$

STEP ONE - we have two sig. figs.. The two zeroes in front of the '8' are just space fillers that take us to where are number really begins. So we start with '8.2'.

STEP TWO - find the power. For decimal fractions this is easy. The power is equal to the decimal place. In our example the number begins in the second decimal place, so the power is -2.

Lets try a third example - convert 1.62 to scientific notation.
Answer: 1.62×10^0.

Any number that begins in the ones place will always have a power of zero.

The next page has some practice questions. Some convert long form ("normal") numbers into scientific notation. Others convert scientific notation into long form.

2.

Scientific Notation Quiz

1. Convert 80,020 into scientific notation.

2. Convert 1.796 into scientific notation.

3. Convert 0.00900 into scientific notation.

4. Convert 4,000.00 into scientific notation.

----

5. Convert 2.000×10^2 into conventional notation.

6. Convert 7.290×10^{-4} into conventional notation.

7. Convert 1.39×10^0 into conventional notation.

8. Convert 3.28×10^3 into conventional notation.

** Answer Key is on the next page. **

3.

ANSWER KEY - Scientific Notation Quiz

1. 80,020 - has four significant figures.

   This number starts in the 10,000's place.
   $10,000 = 10 \times 10 \times 10 \times 10 = 10^4$

   ANSWER = 8.002 x 10^4

2. 1.796 - has four significant figures.

   This number starts in the ones place ($1 = 10^0$)

   ANSWER = 1.796 x 10^0

3. 0.00900 - has three significant figures.

   This number starts in the 3rd decimal place (10^{-3})

   ANSWER = 9.00 x 10^{-3}

4. 4,000.00 - has six significant figures.

   This number starts in the 1,000's place.
   $1,000 = 10 \times 10 \times 10 = 10^3$

   ANSWER = 4.00000 x 10^3

5. 2.000 x 10^2 - has four significant figures.

   10^2 = number starts in 100's place.

   ANSWER = 200.0

6. $7.\underline{290}$ x 10^{-4} - has four significant figures.

   10^{-4} = number starts in 4th decimal place.

   ANSWER = <u>0.000 729 0</u>

7. $1.\underline{39}$ x 10^{0} - has three significant figures.

   10^{0} = number starts in the one's place.

   ANSWER = <u>1.39</u>

8. 3.28 x 10^{3} - has three significant figures.

   10^{3} = 10 x 10 x 10 = thousand's place.

   ANSWER = <u>3,280</u>