Scientific Notation

A. What is scientific notation?

Scientific notation is a shorthand method for writing very large or very small numbers.

For example, the mass of an electron is:
0.000000000000000000000000000000911 kg

It would be very tedious to continually write out this number.

The above number may be written as 9.11×10^{-31} kg
- the number '10' is called the base
- the number '-31' is called the exponent

B. Writing a number in scientific notation.

Writing a number in scientific notation is very easy.
- notice that the decimal always comes after the first digit.

450000000 may be written as 4.5×10^{8}

4500 may be written as 4.5×10^{3}

7566000000 may be written as 7.566×10^{9}

The exponent is simply the number of digits (including zeroes) after the first digit.

By studying the above examples it should be quite obvious how to write a number in scientific notation.

Write these numbers in scientific notation.

55000000000 = _____

780 = _____

23010000 = _____

If the number is very small we follow the same procedure:
a. the decimal is still written after the first number
b. count the number of digits from the digit back to the decimal

Example:

0.00000000087 = 8.7×10^{-10}

Try these

0.0000000899 = _____

0.00000000000000000089 = _____

Uncertain Quantities and Significant Figures

Uncertainty:

Most often when we measure something it is not exact. When we count a small number of things, such as apples in a bag, we can be sure our results are exact. However, when we try to measure something, such as mass, there is always some uncertainty in our results. We usually assume that all of the digits in a measurement are certain except the last one.

E.g. If we measure a length of time with a stopwatch to be 39.43s, we assume that the 3, 9, and 4 are certain, while the 3 is uncertain.

Significant Digits:

Whenever we record a measurement in PHYSICS, we will include all of the digits that are certain plus the first uncertain digit. These are called the significant digits or significant figures ('sig figs') in a measurement. It is not always as straightforward as it sounds so there are some important rules for counting and using significant figures:

1. Digits that are non-zero always count as significant figures.
2. Leading zeros are not significant. E.g. In 0.0012, the three leading zeros simply show the position of the decimal point and are not significant.
3. "Captive" zeros always count. E.g. In 1.005, the zeros are significant.
4. "Trailing" zeros that are at the end of a number only count if there is a decimal point in the number. E.g. 100 has only one significant figure, but 1.00 has three. If you wrote 100. it would have three sig figs as well (but we don't do this). To show the number 100 with three sig figs you would have to use scientific notation: 1.00×10^2. If you wrote 100.0, it would have four sig figs!
5. 'Defined' numbers or counted numbers, such as 2 apples, 1 dozen, or 1000g = 1kg, are considered to be perfect and have infinite sig figs.

Doing Calculations With Sig Figs:

A. When adding or subtracting numbers, round off the answer to the least number of decimal places found in the calculation:
E.g. 112.008 + 34.2 = 146.208
= 146.2

B. When multiplying or dividing numbers that have different numbers of sig figs, do the math first, and then round the answer off to the least number of sig figs found in the calculation:
E.g. 112.008 x 34.2 = 3830.6736
= 3830