Scientific notation

1) What is the scientific notation?

Scientific notation is a method of writing or displaying numbers in terms of a decimal number between 1 and 10 multiplied by a power of 10.

In scientific notation all numbers are written like this: $a \times 10^b$ "a times ten to the power of b"

exponent

coefficient   *base*

Scientific notation has a number of useful properties and is commonly used in calculators, and by scientists, mathematicians, doctors, and engineers.

2) Examples
● An electron's mass is about 0.00000000000000000000000000000091093822 kg. In scientific notation, this is written $9.1093822 \times 10^{-31}$ kg.
● The Earth's mass is about 5973600000000000000000000 kg. In scientific notation, this is written 5.9736×10^{24} kg.
● The Earth's circumference is approximately 40000000 m. In scientific notation, this is 4×10^7 m.
● An inch is 25400 micrometers. This is written 2.5400×10^4

3) Order of magnitude

Scientific notation also enables simpler order-of-magnitude comparisons. For example, if you want to compare a proton's mass (about 0.0000000000000000000000000016726 kg) with an electron's mass (about 0.00000000000000000000000000000091093822 kg), it is easier to compare the scientific notations 1.6726×10^{-27} kg and $9.1093822 \times 10^{-31}$ kg. Indeed, 10^{-27} is much bigger than 10^{-31} so the proton's mass is bigger than the electron's mass

4) Rules for calculations
4.1) Rules for multiplication in scientific notation

1) Multiply the coefficients

2) Add the exponents (base 10 remains)

Example 1 : $(3 \times 10^4)(2 \times 10^5) = 6 \times 10^9$

What happens if the coefficient is more than 10 when using scientific notation?

Example 2 : $(5 \times 10^3)(6 \times 10^3) = 30. \times 10^6$

While the value is correct it is not correctly written in scientific notation, since the coefficient is not between 1 and 10. We then must move the decimal point over to the left until the coefficient is between 1 and 10. For each place we move the decimal over the exponent will be raised 1 power of ten.

$30. \times 10^6 = 3.0 \times 10^7$ in scientific notation.

Example 3 : $(2.2 \times 10^4)(7.1 \times 10^5) = 15.62 \times 10^9 = 1.562 \times 10^{10}$

Example 4 : $(7 \times 10^4)(5 \times 10^6)(3 \times 10^2) = 105. \times 10^{12}$ Now the decimal must be moved two places over and the exponent is raised by 2. Therefore the value in scientific notation is: 1.05×10^{14}

4.2) Rules for division in scientific notation

1) Divide the coefficients

2) Subtract the exponents (base 10 remains)

Example 1 : $(6 \times 10^6) / (2 \times 10^3) = 3 \times 10^3$

What happens if the coefficient is less than 10?

Example 2 : $(2 \times 10^7) / (8 \times 10^3) = 0.25 \times 10^4$

While the value is correct it is not correctly written in scientific notation since the coefficient is not between 1 and 10. We must move the decimal point over to the right until the coefficient is between 1 and 10. For each place we move the decimal over the exponent will be lowered 1 power of ten.

$0.25 \times 10^4 = 2.5 \times 10^3$ in scientific notation.