

# Exponential Notation Tutorial

The concept behind exponential notation is to express numbers using powers of 10

$$a \times 10^b \quad (1)$$

where  $a$  is a real number and the exponent,  $b$  is an integer. The number  $a$  is written in such a way that it is greater than 1 but less than 10. To find the value of  $b$

1. For numbers  $> 1$ , count right to left the number of digits up to but not including the leftmost one. Example:

$$123,400,000 = 1.234 \times 10^8 \quad (2)$$

2. For numbers  $< 1$ , count from the decimal point to just past the first non-zero digit;  $b$  is a negative number. Example:

$$0.0001234 = 1.234 \times 10^{-4} \quad (3)$$

Multiplication and Division are performed by multiplying the real numbers together then either adding or subtracting the exponents. If the resulting real number is larger than 10 or smaller than 1, the final exponent must be adjusted. Given

$$x_1 = a_1 \times 10^{b_1} \quad (4)$$

$$x_2 = a_2 \times 10^{b_2} \quad (5)$$

then,

$$x_1 x_2 = a_1 a_2 \times 10^{b_1 + b_2} \quad (6)$$

$$\frac{x_1}{x_2} = \frac{a_1}{a_2} \times 10^{b_1 - b_2} \quad (7)$$

To raise a number in scientific notation to some exponential power  $n$  (e.g. squaring a number), again raise the real number  $a$  to the power, then multiply the exponent by the power. For Example:

$$x_1^n = a_1^n \times 10^{b_1 \times n} \quad (8)$$

Some Examples:

1. Multiply  $2.5 \times 10^4$  by  $12.2 \times 10^2$ . This equals  $30.5 \times 10^6$ , but the first real number should not be bigger than 1, so this would be written as  $3.05 \times 10^7$
2. Square the distance between the Earth and sun ( $1.495 \times 10^8$  km). This is equivalent to  $(1.495)^2 \times 10^{8+8} = 2.235025 \times 10^{16}$ .
3. Divide the mass of an electron ( $9.1093826 \times 10^{-31}$ ) by 100. This results in:  $9.1093826 \times 10^{-33}$ .