Scientific Notation

Name	Symbol	Value
Universal gravitational constant	G	6.67×10^{-11} N•m²/kg²
Acceleration due to gravity	g	9.81 m/s²
Speed of light in a vacuum	c	3.00×10^{8} m/s
Speed of sound in air at STP		3.31×10^{2} m/s
Mass of Earth		5.98×10^{24} kg
Mass of the Moon		7.35×10^{22} kg
Mean radius of Earth		6.37×10^{6} m
Mean radius of the Moon		1.74×10^{6} m
Mean distance – Earth to the Moon		3.84×10^{8} m
Mean distance – Earth to the Sun		1.50×10^{11} m
Electrostatic constant	k	8.99×10^{9} N•m²/C²
1 elementary charge (charge of the electron)	e	1.60×10^{-19} C
1 coulomb (C)		6.25×10^{18} elementary charges
1 electronvolt (eV)		1.60×10^{-19} J
Planck's constant	h	6.63×10^{-34} J•s
1 universal mass unit (u or amu)		9.31×10^{2} MeV
Rest mass of the electron	m_e	9.11×10^{-31} kg
Rest mass of the proton	m_p	1.67×10^{-27} kg
Rest mass of the neutron	m_n	1.67×10^{-27} kg

Scientific Notation

In science, we deal with some very LARGE numbers:

1 mole = 602000000000000000000000

In science, we deal with some very SMALL numbers:

Mass of an electron = 0.00000000000000000000000000091 kg

Imagine the difficulty of calculating the mass of 1 mole of electrons!

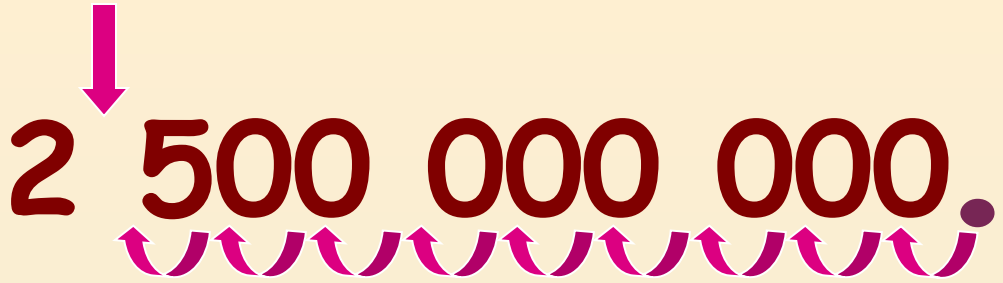
$$\begin{array}{r} 0.000000000000000000000000000091\ \text{kg} \\ \times\ 602000000000000000000000 \\ \hline ?????????????????????????????????????? \end{array}$$

Scientific Notation:

A method of representing very large or very small numbers in the form:

$$M \times 10^{n}$$

- **M** is a number between **1** and **10**
- **n** is an integer



Step #1: Insert an understood decimal point

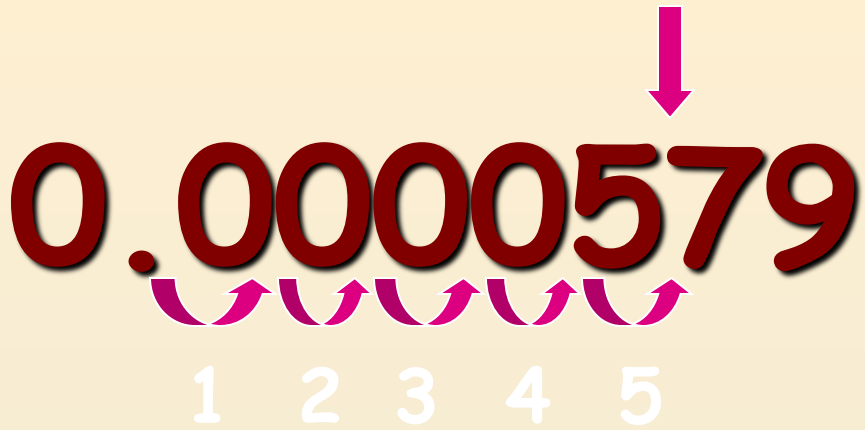
Step #2: Decide where the decimal must end up so that one number is to its left

Step #3: Count how many places you bounce the decimal point

Step #4: Re-write in the form $M \times 10^n$

2.5×10^{9}

The exponent is the number of places we moved the decimal.



Step #2: Decide where the decimal must end up so that one number is to its left

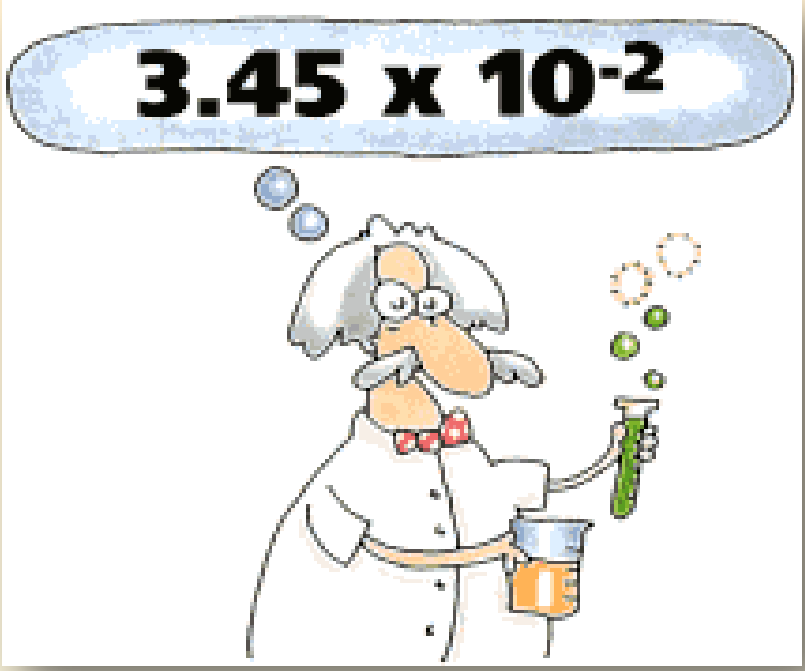
Step #3: Count how many places you bounce the decimal point

Step #4: Re-write in the form $M \times 10^n$

$$5.79 \times 10^{-5}$$

The exponent is negative because the number we started with was less than 1.

PERFORMING CALCULATIONS IN SCIENTIFIC NOTATION



ADDITION AND SUBTRACTION

Review:

Scientific notation expresses a number in the form:

$$M \times 10^n$$

$1 \leq M < 10$

n is an integer

$$\begin{array}{r} 4 \times 10^6 \\ +\ 3 \times 10^6 \\ \hline 7 \times 10^6 \end{array}$$

IF the exponents are the same, we simply add or subtract the numbers in front and bring the exponent down unchanged.

$$\begin{array}{r} 4 \times 10^6 \\ -\ 3 \times 10^6 \\ \hline 1 \times 10^6 \end{array}$$

The same holds true for subtraction in scientific notation.

$$\begin{array}{r} 4 \times 10^{6} \\ +\ 3 \times 10^{5} \\ \hline \end{array}$$

If the exponents are NOT the same, we must move a decimal to <u>make</u> them the same.

4.00×10^6

$+ 3.00 \times 10^5$

4.00×10^6

$+ .30 \times 10^6$

4.30×10^6

Move the decimal on the <u>smaller</u> number!

A Problem for you…

$$2.37 \times 10^{-6}$$
$$+\ 3.48 \times 10^{-4}$$

Solution…

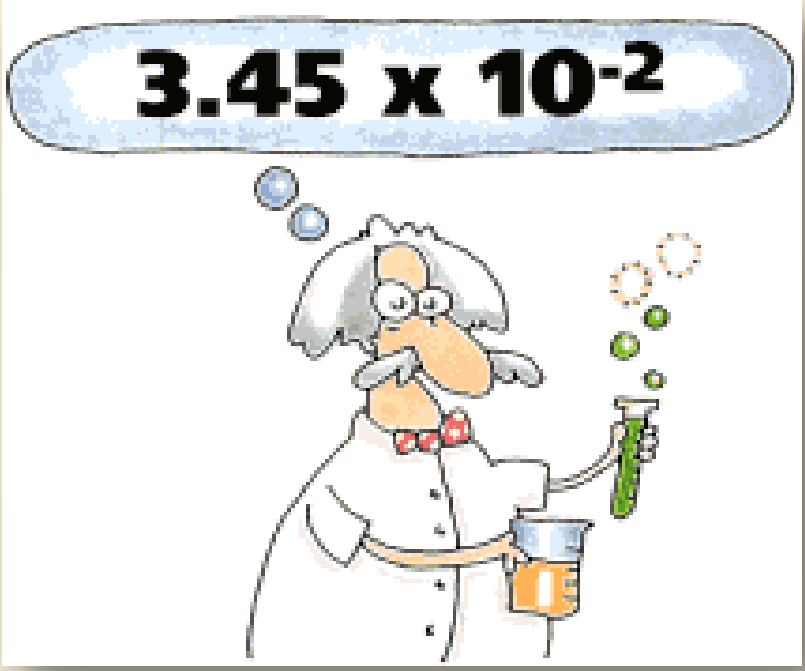
$$002.37 \times 10^{-6}$$

$$+\ 3.48 \times 10^{-4}$$

Solution…

$$\begin{array}{r} 0.0237 \times 10^{-4} \\ +\ 3.48 \times 10^{-4} \\ \hline 3.5037 \times 10^{-4} \end{array}$$

PERFORMING CALCULATIONS IN SCIENTIFIC NOTATION



Multiplication and Division

Multiplication and Division

Multiplication: You simply multiply the coefficients and then add the exponents

$(4.0 \times 10^{6}\ )\ (2.0 \times 10^{5}\ ) = 8.0 \times 10^{11}$

Division: You simply divide the coefficients and the subtract the exponents.

$(4.0 \times 10^{7}\ )\ /\ (2.0 \times 10^{5}\ ) = 2.0 \times 10^{2}$

Using a calculator with Scientific Notation

$$\frac{4.0 \times 10^{6} \times 3.0 \times 10^{8}}{1.2 \times 10^{15}}$$

1. Find your EE or EXP button on your calculator!!

2. Plug in 4.0 HIT EE/EXP then the exponent 6
(DO NOT PLUG IN THE X 10!!!)

3. Do the multiplication operation

4. Plug in 3.0 hit EE/Exp then the exponent 8

5. Then Equals VIOLA!!!