Scientific Notation and Conversion Factors

Chemistry Numbers

Numbers in chemistry are often very small or very large!

For example,

602300000000000000000000

= 1 mole

Scientific Notation

We can make numbers easier to work with by writing them in **scientific notation**

602300000000000000000000

= 6.02×10^{23}

Scientific Notation

Convert numbers **> 1** to scientific notation by moving the decimal to after the 1st digit.

$65000000.$
$7\ 6\ 5\ 4\ 3\ 2\ 1$
$\downarrow$
6.5×10^{7}

The exponent represents the number of digits the decimal was moved – it will be positive for numbers > 1

Scientific Notation

Convert numbers **< 1** to scientific notation by moving the decimal to after the 1st nonzero digit.

$.0000987$
$-1\ -2\ -3\ -4\ -5$
$\downarrow$
9.87×10^{-5}

The exponent represents the number of digits the decimal was moved – it will be negative for numbers < 1

Practice!

Rewrite the following numbers in scientific notation.

435,800	**4.358×10^{5}**
0.000249	**2.49×10^{-4}**
0.243	**2.43×10^{-1}**
3,479,209,400	**3.4792094×10^{9}**

Standard Notation

When a number is written the usual way it is called

standard notation

Standard Notation

Convert numbers > 1 (positive exponent) to standard notation by moving the decimal to right however many digits are equal to the exponent.

$6.5 \times 10^{7} = 65000000.$

1 2 3 4 5 6 7 →

Standard Notation

Convert numbers < 1 (negative exponent) to standard notation by moving the decimal to left however many digits are equal to the exponent.

$9.87 \times 10^{-5} = .0000987$

← 5 4 3 2 1

Practice!

Rewrite the following numbers in standard notation.

4.56×10^{-3}	**0.00456**
9.234×10^{7}	**92,340,000**
7.233×10^{3}	**7233**
3.9×10^{-6}	**0.0000039**

Calculator

Numbers in scientific notation MUST be entered into the calculator using the EE key as follows:

Ex. 6.02×10^{23}

6.02 2nd EE 23

2nd Function Key

Sig Figs

All of the digits in a number written in scientific notation are <u>significant</u>

(Ignore the "x 10^{x}" part!)

5.30×10^{3}
3sf

5.5×10^{-7}
2sf

Units

Units behave like variables in algebra!

$\frac{x \cdot y}{x} = y$ $\qquad \frac{\text{milligrams} \cdot \text{grams}}{\text{milligrams}} = \text{grams}$

$\frac{x \cdot x}{y} = \frac{x^2}{y}$ $\qquad \frac{\text{grams} \cdot \text{grams}}{\text{milligrams}} = \frac{\text{grams}^2}{\text{milligrams}}$

Practice!

Simplify the following expressions:

$\frac{mL \cdot L}{mL} =$ **L**

$\frac{g \cdot kg}{kg} =$ **g**

Calculating w/ Units

To make things easier, can write the expression

$$\frac{\text{milligrams} \cdot \text{grams}}{\text{milligrams}} = \text{grams}$$

like this,

multiply

$$\frac{\text{milligrams}}{\text{milligrams}} \quad \frac{\text{grams}}{} = \text{grams}$$

divide

Conversion Factors

When two quantities are set equal to one another, the expression is called a **conversion factor**.

1 dozen = 12 eggs

Conversion factors are used to convert the units of one quantity to another.

Conversion Factors

All conversion factors can be written as two equivalent ratios.

1 dozen = 12 eggs

$$\frac{\text{1 dozen}}{\text{12 eggs}} \quad \text{or} \quad \frac{\text{12 eggs}}{\text{1 dozen}}$$

Conversion Factors

To convert the units of a number, multiply it with a conversion factor.

Ex. Convert 9 eggs to dozens

$$\text{6 eggs} \times \frac{\text{1 dozen}}{\text{12 eggs}} = \text{0.5 dozen}$$

Conversion Factor

Conversion Factors

Always select a conversion factor which has the unit of the given substance on the bottom.

$$\frac{6\ \text{eggs}}{12\ \text{eggs}} \times \frac{1\ \text{dozen}}{} = 0.5\ \text{dozen}$$

Given Substance

The given unit cancels out!

Practice!

Pick the correct conversion factor to use for the following calculations.

$\frac{1000\ g}{1\ kg}$ $\frac{1\ kg}{1000\ g}$ $\frac{1000\ mL}{1\ L}$ $\frac{1\ L}{1000\ mL}$

$6.0\ g \times \frac{\quad}{\quad} = \text{kg}$ **$\frac{1\ kg}{1000\ g}$**

$2.0\ mL \times \frac{\quad}{\quad} = \text{L}$ **$\frac{1\ L}{1000\ ml}$**

Sig Figs!

Conversion factors are not used to determine the number of sig figs in the answer!

not used

$$\frac{2.34\ g}{3\ sf} \times \frac{1\ kg}{1000\ g} = \underset{3\ sf}{0.00234\ kg}$$

not used

Conversion Factor

Practice!

Perform the following calculations. Round the answers to the proper number of sig figs.

$$3.56\ \text{ml} \times \frac{1\ \text{L}}{1000\ \text{ml}} = \text{0.00356 L}$$ (3 sf)

$$4.567\ \text{g} \times \frac{1000\ \text{mg}}{1\ \text{g}} = \text{4567 mg}$$ (4 sf)

Finished!