Using Large and Small Numbers – Scientific Notation

Reading: Ch. 2 sections 1 - 2	Homework: 2.1, questions 2, 4, 6, 8,12*,14*

* = 'important' homework question

Large Numbers

Fact: Chemical problem solving *most often* involves using either very large or very small numbers (e.g. counting the number of molecules in a drop of water, or quoting the mass of the water drop in kilograms)

Recall: How many individual H_2O (l) molecules are there in a drop of water. Write this amount as a regular number:

Number H_2O (l) molecules in 1 drop water = _____

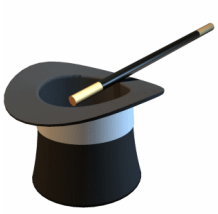
Problem: How do we represent and manipulate such numbers in an 'easier' way?

Answer:

Overview Example: Consider the statement "*eight million people live in London*". How can this quantity be *best* expressed numerically?

'Everyday':

'Better':



Just move the decimal point to the left until you get a single digit with decimals. The *power of ten* is the number of places the decimal point moved. Example:

$3000 = 3 \times 10^{(\text{number decimal places to } \textit{left} \text{ moved})} = 3 \times 10^{3}$

Examples: Write the following quantities using *regular numbers* and *powers of 10 (scientific notation).* Try to do this without a calculator at first, then see the below tip for how to do this with your calculator's SCI button

Quantity	**'Regular' quantity**	**'Power of ten' quantity (SCI)**
One hundred miles		
One thousand students		
Five million people		
Twenty million dollars		
Five and a half billion people		

TIP: Scientific notation (SCI) is different than the powers of 10 used in engineering (ENG). When converting to SCI powers of 10 from a 'real' number press the SCI button on your calculator, or put it in SCI mode and press the = key.

Example: Enter the number twelve million (12000000) into your calculator. Press the SCI key, and then repeat with the ENG key. What numbers do you get?

SCI: ENG:

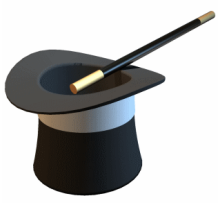
Wrap up: quote the number of H_2O molecules in 1 drop water using SCI notation:

1,000,000,000,000,000,000,000 molecules = _____ molecules

REMEMBER: In chemistry we ALWAYS use scientific notation (SCI) for expressing large (>100) or small (<0.1) numbers.

Small Numbers

Question: How can very small numbers be expressed in SCI notation?



Just move the decimal point to the right until you get a single digit with decimals. The ***negative*** *power of ten* is the number of places the decimal point moved. Example:

$0.00125 = 1.25 \times 10^{-}$ (number decimal places to *right* moved)

= _____

Examples: Convert the following *regular numbered quantities* to *powers of 10 (scientific notation).* Try to do this without a calculator at first, then check with your calculator.

'Regular' number (quantity)	**'Power of ten' number (SCI) (quantity)**
0.00015 grams	
0.125 %	
0.0458 mL	

Review: You now know how to convert large or small 'regular' numbers into SCI notation either on paper or using your calculator.

Entering and Manipulating Large and Small Numbers: (using the EE or EXP button)

Enter the following SCI notation **numbers** into your calculator - ***try*** to use EE or EXP key, then press the = (in 'FLO' mode) to obtain the 'real' number equivalent:

'Power of ten' number (SCI)	**Regular number**
5×10^{-1}	
1.5×10^{3}	
$3.56\ 10^{-3}$	

Did you get the answers right? PLEASE LET ME KNOW IF YOU NEED ASSISTACE WITH THIS EXERCISE

Task: Use your calculator to solve the following math problem – use the EE or EXP to enter the **numbers** in SCI notation. What happens if you try the same math using other keys, such as 10^x or ^?

$3 \times 10^7 \div 6 \times 10^3 =$ _____

What answer did you get? What problems were encountered?

Using ***only*** the EE or EXP keys to express powers of 10 values, calculate the following. PLEASE LET ME KNOW IF YOU NEED ASSISTACE WITH THIS EXERCISE:

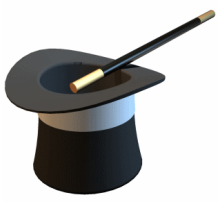
1. $(4 \times 10^{-9})(2 \times 10^4) =$ _____
2. $4 \times 10^{-9} \div 2 \times 10^4 =$ _____
3. See class examples

Making things even simpler – S.I. Prefixes

Certain powers of 10 can be replaced by a *symbol* known as a *decimal (or S.I.) prefix*

Use the slide shown or data from your book to complete the following table:

Prefix	Symbol	Meaning	Power of 10
Giga	G	1000000000 (billion)	
Mega	M	1000000 (million)	1×10^{6}
	k	1000 (thousand)	
Deci		0.1 (ten*th*)	
	c		
Milli			
	μ		1×10^{-6}
Nano	n		



For decimal (S.I.) prefixes, just swap the appropriate "x 10^{n}" part of the number for the equivalent prefix's symbol. Example:

1.25×10^{-3} g = 1.25 mg (milligrams)

Task: Convert the following quantities to SCI notation and decimal prefix notation:

Quantity	With SCI notation	With Decimal Prefix
0.0000020 meters		
0.0015 grams		
3,000 dollars		
12 million people		

Task: Now convert the following quantities to SCI notation and 'regular' numbers:

Quantity	With SCI notation	As a 'real' number (quantity)
2.5 mm		
5.2 km		
50 MW		
12 μm (microns)		

Discussion: Make a list of as many 'everyday' quantities as possible that use decimal prefixes (or similar related expressions):