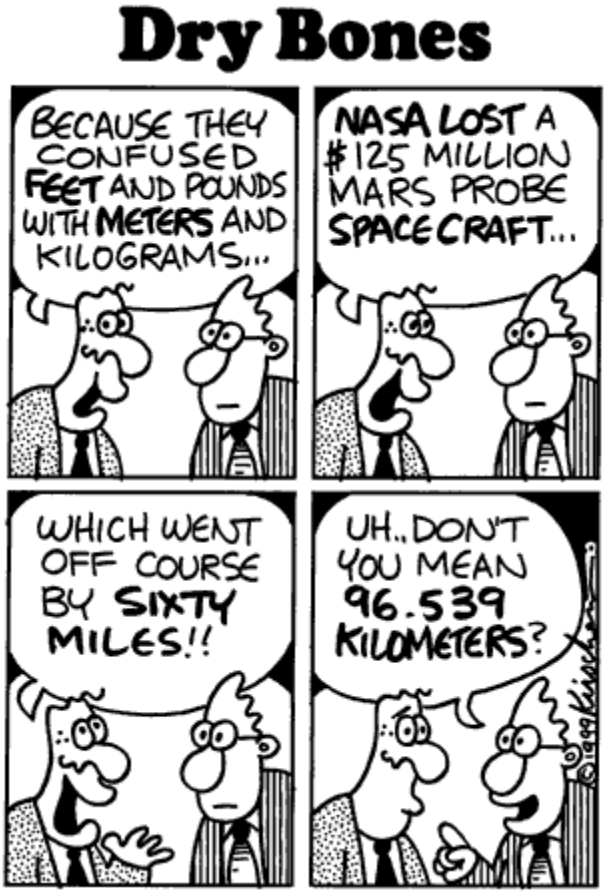
UNIT 2 NOTES: CHEMISTRY CALCULATIONS

STUDENT OBJECTIVES: Your fascinating teachers would like you amazing learners to be able to…

1. Identify and apply the 5 SI units and common units used in chemistry.
2. Define absolute zero and temperature.
3. Convert between the temperature units of Celsius and Kelvin.
4. Explain why Celsius units are not physically meaningful.
5. Express very large and very small numbers in scientific notation.
6. Use a scientific calculator to perform mathematical calculations involving numbers expressed in scientific notation.
7. Determine the number of significant figures in a value and determine the number of significant figures remaining in mathematical calculations involving multiplication and division.
8. Use dimensional analysis to convert between units.
9. Memorize the scientific notation conversions for the following metric prefixes: Kilo-, centi-, milli-, micro-, and nano-.
10. Use the density formula to solve for any of the three unknown variables.
11. Use experimental data to determine the density of a substance, including determine a volume by displacement of water.



Mars Probe Lost Due to Simple Math Error
By Robert Lee Hotz
October 01, 1999

"NASA lost its $125-million Mars Climate Orbiter because spacecraft engineers failed to convert from English to metric measurements when exchanging vital data before the craft was launched, space agency officials said Thursday.

A navigation team at the Jet Propulsion Laboratory used the metric system of millimeters and meters in its calculations, while Lockheed Martin Astronautics in Denver, which designed and built the spacecraft, provided crucial acceleration data in the English system of inches, feet and pounds.

As a result, JPL engineers mistook acceleration readings measured in English units of pound-seconds for a metric measure of force called newton-seconds.

In a sense, the spacecraft was lost in translation.

Leggett PAP Chemistry 2-1 Units	http://youtu.be/TybAotNMImA	http://vimeo.com/28275930

I. UNITS OF MEASUREMENT:

In 1960, scientists all over the world started to use a standard system of seven base units for all measurements. These are known as the _____ (Le Systeme International d'Unites). This was done so that laboratory data could be easily shared between scientists in different countries without having to convert units! If you read the article on the first page of this unit, you can understand the importance of doing this!

A. The 5 pure SI units that we will use in chemistry are:

LENGTH	
MASS	
TIME	
TEMPERATURE	
AMOUNT (of a chemical)	

B. Other commonly used units in science include…

MEASUREMENT	COMMON UNITS
Volume (L x W x H)	
Pressure (Force/Area)	
Energy	
Temperature	

IMPORTANT!

If you don't include units, you will lose points on tests, quizzes, and labs!

Leggett PAP Chemistry 2-2 Temperature Conversions	http://youtu.be/G_EYIbVx3uE	http://vimeo.com/28276036

II. TEMPERATURE:

There are two units commonly used in scientific measurements:

CELSIUS: This is a step better than Fahrenheit because it is based on water (which means it is easy to use to calibrate temperature sensing devices) and because the difference between the boiling point and freezing point of water is only 100°C. Unfortunately, while a convenient unit, it is not _____.

Let's explore this statement:

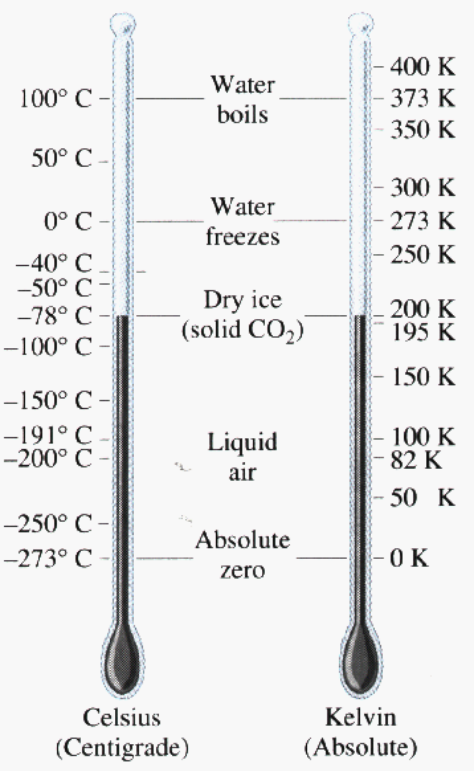
Point 1: **Temperature** is a measure of the _____

_____ of atoms or molecules in a substance.

Point 2: Kinetic energy is the _____. It depends on the mass and velocity squared of the atoms or molecules in a substance.

Point 3: Neither mass nor velocity squared can be negative numbers.

THEREFORE: A physically meaningful temperature scale should start at **ZERO**. It should **NEVER** be **NEGATIVE**, as you can't have a negative amount of energy.



Converting between Celsius and Kelvin is VERY easy!

$$0^\circ C = 273\ K \quad \text{(on Formula Chart!)}$$

Celsius to Kelvin $K = {}^\circ C + $ _____

Kelvin to Celsius $^\circ C = K - $ _____

Example 2-1. Complete the following table:

Kelvin	Celsius
	–167°C
	1100°C
321 K	

Leggett PAP Chemistry 2-3 Temperature & Scientific Notation	http://www.youtube.com/watch?v=zfvBMZPq6o0&feature=share&list=ULzfvBMZPq6o0	http://vimeo.com/28276165

Example 2-2. How much does the temperature change in Celsius if it changes from 20°C to 255 K? [NOTE: A change (Δ) in chemistry is almost always: FINAL − INITIAL.]

Calculation in Kelvin:

Calculation in Celsius:

What do you notice about the change in Kelvin and the change in Celsius?

Absolute Zero is often referred to as the point at which a perfect pure crystal exhibits perfect order. **Basically, it's the point at which all motion in matter stops completely!**

The current record for recreating (artificially) absolute zero conditions is 0.100 nK. That is 1×10^{-10} K or 0.0000000001 K! Very close, but not quite there.

Interesting Tidbit: The lowest natural temperature ever recorded at the surface of the Earth was −89.2 °C (−128.6 °F; 184 K) at the Russian Vostok Station in Antarctica on July 21, 1983.

III.SCIENTIFIC NOTATION:

This is an alternate way of writing numbers; usually used with very large or very small numbers!

General Guidelines:

- If the exponent would be more positive than 2 or more negative than −2, then use scientific notation.
- If the exponent is between −2 and 2 then you do not need to use scientific notation.
- **DO NOT USE SCIENTIFIC NOTATION WITH MONEY OR TEMPERATURE.**

A. **Writing and Converting to scientific notation:**

1. **Coefficient** must be a number greater than or equal to one (1) and less than ten (10)
2. **Exponent** (characteristic) is positive if original number is < -10 or > 10
3. Exponent is negative if original number 0 < # < 1 (a decimal)

Numbers in Scientific Notation are comprised of two parts…

3.0×10^{14}

Coefficient Exponent

B. **Converting from scientific notation to decimal form:**

1. If exponent is +, move decimal right (add zeros if needed)
2. If exponent is −, move decimal left (add zeros to left of coefficient)

C. **Calculations in scientific notation:**

1. Addition or Subtraction: Exponent must be the same
2. Multiplication: Multiply the coefficient and *add* the exponents
3. Division: Divide the coefficient and *subtract* the exponents

<u>USING YOUR CALCULATOR</u>: While any of the above conversions/calculations can be done by hand, your calculator will also do them for you! YAY! We will be using the "EE" key on the calculators.

CAUTION: The "EE" key replaces the keystrokes "x" and "10". <u>Do not do both</u>! Some calculators add an extra factor of 10 if you use "x 10" instead of "EE"! <u>BE CAREFUL</u>!

	Classroom TI-30	Graphing Calculators
Scientific notation	To enter 1.0 x 10^{-14}, **press the following buttons:** 	Same keystrokes
Converting to scientific notation display		<mode> Move cursor to highlight <sci> on top row <enter>, <clear>
Converting to decimal display		<mode> Move cursor to highlight <normal> on top row <enter>, <clear>
Setting the number of decimal places to display	2nd, FIX (above the decimal point), move cursor to highlight the desired number, <enter>	<mode> Move cursor to highlight the desired number next to the word "float" on the second line <enter>, <clear>

Example 2-3. Convert to scientific notation.

VALUE	SCIENTIFIC NOTATION	VALUE	SCIENTIFIC NOTATION
75100000		0.00000231	
−234900		0.95000	
9260		−0.00003549	

Example 2-4. Convert to decimal form.

VALUE	DECIMAL NOTATION	VALUE	DECIMAL NOTATION
5.39×10^{7}		5.39×10^{-7}	
1.12×10^{3}		1.12×10^{-3}	
-2.35×10^{5}		-2.35×10^{-5}	

Example 2-5. Perform the following mathematical functions and express the answer in correct scientific notation.

EQUATION	ANSWER	EQUATION	ANSWER
$3.20 \times 10^{3} + 9.77 \times 10^{2}$ =		$3.20 \times 10^{3} \times 9.77 \times 10^{2}$ =	

$3.20 \times 10^3 - 9.77 \times 10^2$ =		$3.20 \times 10^3 \div 9.77 \times 10^2$ =	

Leggett PAP Chemistry 2-4 Significant Figures	http://youtu.be/8kVKmJ8eZOE	http://vimeo.com/28276303

IV. SIGNIFICANT FIGURES:

What is significant in a calculation? Last unit we learned how to determine the number of significant figures when measuring. We need to take this a step further…..

WARNING!! If you do not use the correct number of **significant figures** in your answer on quizzes & tests, you will be **ZAPPED** with a small, but **significant** deduction! So, be sure you use the rules…they really are significant!

A. **Guidelines for Determining the number of Significant Figures/Digits…**

1. Any digit that is not zero is significant.
2. Zeros between nonzero digits are significant.
3. Zeros to the left of the first nonzero digit are not significant. These zeros are used to indicate the placement of the decimal point.
4. If the number is greater than one, all zeros written to the right of the decimal point count as significant.
5. Numbers that do not contain decimal points, the trailing zeros (i.e. zeros after the last nonzero digit) may or may not be significant. We will assume they are not significant.

Now, do we want to memorize all of these rules??!?!? NOOOOOOOOOOOOOO of course not! So, there's a handy method to know all these rules… but we do need to know a little geography…

Pacific Ocean
Present Decimal
Start from left, begin counting at first **non-zero**. Count all numbers…

Atlantic Ocean
Absent Decimal
Start from right, begin counting at first **non-zero**. Count all numbers…

NOTE: For Scientific Notation, any reported numbers are significant.

Leggett PAP Chemistry 2-5 Significant Figures	http://youtu.be/RY52XFYtUyA	http://vimeo.com/28276431

Example 2-6. Decide the number of sig figs in each of the following numbers.

VALUE	SF	VALUE	SF	VALUE	SF
100		1.0045		4.0×10^{-3}	
100.		4500		4.00×10^{-3}	
100.0		9.880		0.0045	

0.004500					

B. **Using Significant Digits with multiplication and/or division…**
   1. In multiplication and division, the number of significant digits in the final answer is determined by looking at the original numbers used in the problem. **The original number that has the smallest number of significant figures determines the number of sig figs in the answer.** (Always look to see if it is necessary to ROUND.)
   2. **Exact numbers obtained from definitions (counts, standard values or conversions) or by counting number of objects are NOT used in determining the number of sig figs in the answer.**
      Example: If an object has a mass of 0.2553 then 8 of those objects has a mass of 2.042.

Example 2-7. Perform the following mathematical operations and round your answer to the correct number of significant figures, and round your answer correctly.

OPERATION	SF NEEDED IN ANSWER	ANSWER
Multiply 89.5540 by 43.10		
Divide 3380 by 457.0		
Divide 0.006750 by the exact number 32		
Multiply 278.4 by 25.2		

C. **Determining Significant Figures using addition/subtraction:** There are subtly different rules for adding and subtracting that we will not be covering UNTIL YOU HAVE THE OPPORTUNITY TO TAKE AP OR IB CHEMISTRY!!

V. ORDER OF OPERATIONS

One of the biggest mistakes that students make is plugging items into their calculator.

$$\frac{(4.36 \times 10^{5})}{(6.7 \times 10^{-6})\,(3.259 \times 10^{2})}$$

We want to divide by BOTH numbers in the denominator. This will only work in your calculator if you either put parentheses around the entire bottom, or if you divide by each number individually. BE CAREFUL!!!

Example 2-8. Answer: _____

$$\frac{(45)\,(23)}{(65)\,(3.0)}$$

This problem works in a very similar way… see if you can get the right answer!

Example 2-9. Answer: _____

Leggett PreAP Chemistry 2-6 Dimensional Analysis	http://youtu.be/HQ_xgModysY	http://vimeo.com/28276564

VI. INTRODUCTION TO DIMENSIONAL ANALYSIS (Factor Label Method of Conversions):

We will be using a problem solving technique called DIMENSIONAL ANALYSIS to convert units. You must set your problems up as we show you to get credit. The key at this point is the process! The answer is important, but the process is key. ***DON'T FORGET TO INCLUDE UNITS AND FOLLOW SIG FIG RULES IN YOUR ANSWERS!***

$$\frac{\cancel{2}}{4}\times\frac{3}{\cancel{2}}=\frac{3}{4}$$

REMEMBER FROM MATH CLASS: When multiplying fractions, same numbers in the numerator and denominator cancel one another. We are going to do the same thing with units!

MODEL:

How many seconds are in 2.5 hours?

1. Set up your equality: ? sec = 2.5 hours
2. List your conversion factors: 60 min = 1 hour, 60 sec = 1 min *(We can invert these in order to have units cancel!)*
3. Start your dimensional analysis with the value opposite the question mark.
4. Notice that conversions are set up with units criss-cross from each other. If you want to cancel a unit in numerator, the same unit from the conversion must show up in the denominator. If you want to cancel a unit in denominator, the same unit from the conversion must show up in the numerator.

$$?\,\text{sec} = 2.5\ \text{hr} \times \left(\frac{60\ \text{min}}{1\ \text{hr}}\right) \times \left(\frac{60\ \text{sec}}{1\ \text{min}}\right) = 9.0\text{x}10^{3}\,\text{sec}$$

We have hours in the numerator and since we want hours to cancel we put them in the denominator of the conversion factor. Units cancel just like numbers!

This time we want to cancel min and end up with sec.

To solve the dimensional analysis, we multiply if the value is in the numerator, and divide if the value is in the denominator: CAUTION: Either hit " = " (enter/equals) every time you divide, or use your parentheses wisely!

Solving problems in this way of arranging labels so that they can cancel out is known as DIMENSIONAL ANALYSIS. Instead of writing fractions in parentheses beside each other and multiplying them, you can also place them on a straight-line dimensional analysis grid:

2.5 hours	60 min	60 sec
	1 hour	1 min

= 9.0 x 10^3 sec

PICK WHICH FORMAT YOU LIKE BETTER!!!

Are there other ways to solve these problems??? Sure.

However, **TO GET ANY CREDIT, YOU MUST USE DIMENSIONAL ANALYSIS, AND SHOW YOUR WORK.** No excuses. We care more about the technique than the final answer.

STEPS FOR DIMENSIONAL ANALYSIS…

1. Set up your equality: ? sec = 2.5 hours
2. List your conversion factors.
3. Start your dimensional analysis with the value opposite the question mark.
4. Set up your conversions with units criss-cross from each other, so units will later cancel.
5. Cancel out your units.
6. Multiply everything together that is in the numerator; divide by everything in the denominator. BE CAREFUL when plugging into your calculator!
7. Express your answer in the same number of significant figures as were given in the original starting value. (You will not need to look at your conversions as they do not count in significant figure rules! YAY!)
8. Put a unit with your answer! No naked numbers!

Example 2-10.Convert 3.179 hours to minutes.

Next, let's try some funky units. It is helpful to write conversions as an equality. For example, the accepted density of water is 1 g/mL. We can write that as 1 g = 1 mL, and then set it up as a conversion factor in two ways:

$$\frac{1\ g}{1\ mL} \quad \text{or} \quad \frac{1\ mL}{1\ g}$$

1 hogshead = 7 firkin	1 torr = 1 mm Hg	1 erg = 1 x 10^{-7} Joules (J)
18 pottie = 1 firkin	1 atm = 101325 pascal (Pa)	1 BTU = 1055 J
140 pottie = 1 puncheon	1 atm = 760 torr	1 oz = 16 dram
504 pottie = 1 tun	1 calorie = 4.184 J	1 dram = 27.343 grain
15 groans = 1 grunt	1 mile = 5280 ft	1 pennyweight = 24 grains
1 pain = 20 grunts	1 furlong = 220 yards	1 dram = 3 scruples
1 hurt = 8 pains	2 fardells = 1 nooke	1 pint = 4 gills
1 fot = 5 vum	4 nookes = 1 yard	4 quarts = 1 gallon
2 sop = 3 tuz	4 yards = 1 hide	1 bushel = 4 pecks
4 bef = 3 tuz	1 liter = 1.057 qt	1 peck = 8 quarts
9 fot = 2 bef	1 mile = 1.61 Km	1 lb = 454 grams (g)
1 inch = 2.54 cm	4 tolls = 3 smacks	1 lb = 16 oz
1 xack = 7 bips	8 lardos = 7 fleas	12 toils = 1 lardo
5 smacks = 1 bip	1 mole = 6.022 x 10^{23} molecules	1 inch = 2.54 cm

Leggett PAP Chemistry 2-7 Dimensional Analysis	http://youtu.be/hVCRhd3k_lQ	http://vimeo.com/28276684

Example 2-11. How many molecules are in 3.2 moles of platinum?

Example 2-12. A typical air conditioner uses 9000.0 BTU (British Thermal Units) in one hour. How many ergs does this represent?

Example 2-13. If a container of apples cost 2.80 sop, how many fot would you need to exchange?

Example 2-14. I have 24 pains (I am not talking about students!). How many groans do I have?

Sometimes, we have to read the problem to deduce our conversions… look for your "how much/how many/what is" statement to find your unknown and starting point!

Example 2-15. Jessica was so into One Direction. She loved their songs on the radio so much that she decided that wanted to buy the current album, which has 13 songs on it. When she went on iTunes, it was acting funny and showing the prices in terms of Kilobytes of space – stating that it cost $0.00015 for each Kilobyte downloaded. Jessica knew that each song takes up 5.50 Megabytes (MB) of space on the computer, and she knew that there are 1000 KB in every MB. How much did it cost for Jessica to download the album? (Give your answer in dollars and cents, and don't worry about sig figs.)

Example 2-16. What is the cost of 60 apples if 3 apples weigh 1.75 pounds and the price of apples is $1.45 per pound? (Give your answer in dollars and cents, and don't worry about sig figs.)

Leggett PAP Chemistry 2-8 Dimensional Analysis	http://youtu.be/85FzPOjflL0	http://vimeo.com/28276929

VII. METRIC SYSTEM CONVERSIONS:

The United States, Burma, and Liberia are weird – every other country on the planet (including ALL OF OUR WORK DONE IN SCIENCE) is calculated using the metric system. There are some common conversions to be used, which **MUST BE MEMORIZED**, as they are not on your formula chart…

Prefix	Symbol	S.N. equivalent	Example
Kilo	**K**	1 K = $\mathbf{1 \times 10^{3}}$	1 KJ = 1×10^{3} J
Centi	**c**	1 c = $\mathbf{1 \times 10^{-2}}$	1 cg = 1×10^{-2} g
Milli	**m**	1 m = $\mathbf{1 \times 10^{-3}}$	1 mL = 1×10^{-3} L
Micro	**μ**	1 μ = $\mathbf{1 \times 10^{-6}}$	1 μg = 1×10^{-6} g
Nano	**n**	1 n = $\mathbf{1 \times 10^{-9}}$	1 nm = 1×10^{-9} m

When using the Scientific Notation Equivalents…

ONE always goes with the _____,

and the SCIENTIFIC NOTATION always goes with the _____.

NO PREFIX IS EVER USED ALONE; IT IS ALWAYS ATTACHED TO A <u>METRIC BASE UNIT</u> OF SOME KIND… Liters (L), Grams (g), Meters (m), Joules (J), Pascals (Pa)…. Or any other unit you can think of!

Think about the conversions this way… you will always have lots of little things fitting in a bigger thing… so the larger number should always go with the smaller unit (lots of little things) in a conversion!

There are other ways of showing conversions… you may have seen some of these before!

Both of these conversions say the same thing!

1000 meters = 1 kilometer
1×10^3 m = 1 Km

100 centimeters = 1 meter
1 cm = 0.01 m
1 cm = 1×10^{-2} m

All three of these conversions say the same thing!

LET'S PRACTICE!

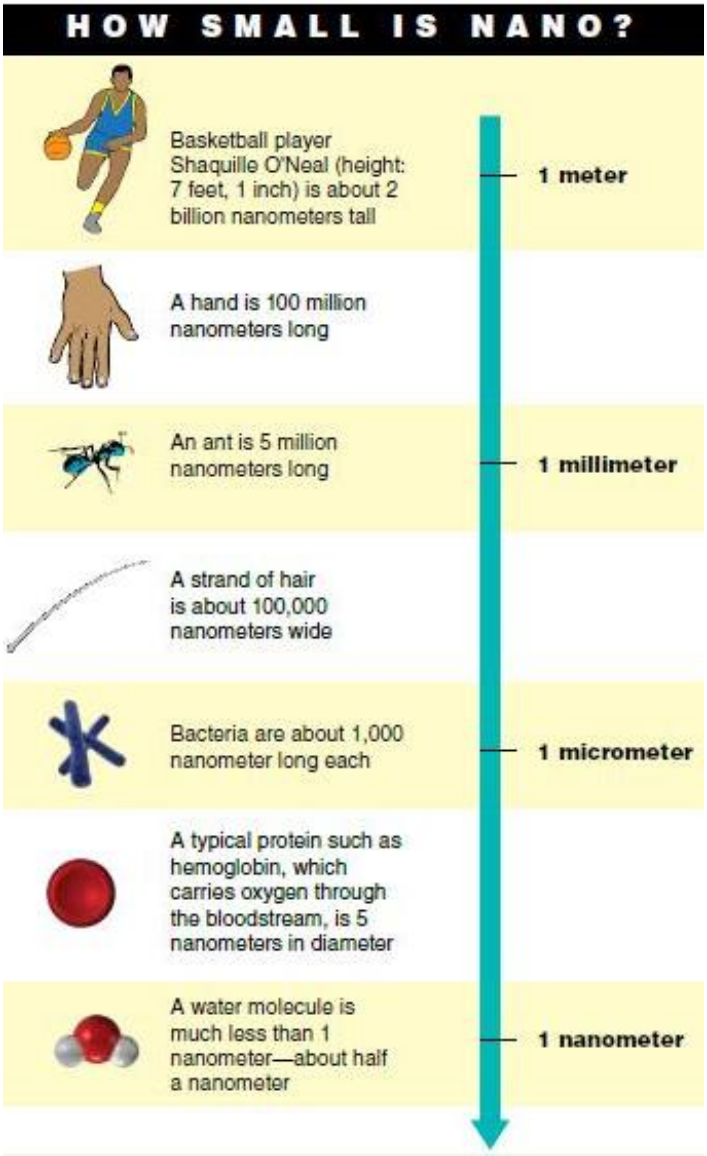
A. Metric System… Prefix to Base & vice-versa -- ONLY ONE STEP!

Example 2-17. Current computer transistor gate oxides are approaching 32 nm. How many meters is this?

Example 2-18. How many microliters are there in 4.56×10^{-3} liters?

Example 2-19. A student has a mass of 58.97 Kg. How many grams does this represent?

Example 2-20. The actual mass of one oxygen atom is 5.36×10^{-23} grams. How many milligrams is this?



Leggett PAP Chemistry 2-9 Dimensional Analysis	http://youtu.be/jUW5e800loM	http://vimeo.com/28277033

B. Metric System… Prefix to Prefix -- REQUIRES TWO STEPS!

We do not memorize conversion factors between prefixes, as there would be hundreds!
You MUST convert through the base unit – hence the two steps!

MODEL: How many KJ are equivalent to 367 mJ?
? KJ = 367 mJ
1 KJ = 1 x 10^3 J
1 mJ = 1 x 10^{-3} J

$$367\ mJ \times \frac{1x10^3\ J}{1\ mJ} \times \frac{1\ KJ}{1x10^3\ J} = 3.67x10^4\ KJ$$

NOTE: We went through the base unit because the problem went from one prefix to another! The base unit is the Joule (J) – your SI unit for energy!

Example 2-21. Convert 231 cm to nm.

Example 2-22. Convert 5.43 KL to mL.

Example 2-23. Convert 6.99 x 10^8 µg to cg.

Example 2-24. A typical atom is approximately 0.100 nanometers across. What is this value in centimeters?

C. "DOUBLE" UNIT Conversions: (such as miles/hour being converted to km/sec)

1. Put the number and the TOP (numerator) label in the upper left corner of the grid.
2. Put the bottom (denominator) label in the lower left corner of the grid.
3. You may begin working with either one—just be sure to arrange labels diagonally so they will cancel. (For the unit on bottom, this will mean you need to put the unit on top to cancel!)

4. Work until you get one of the labels to the unit that you want. ONCE YOU ARE THROUGH WITH THE FIRST LABEL, LEAVE IT ALONE AND BEGIN WORK ON THE SECOND LABEL by arranging labels diagonally and filling in correct numerical equivalents in each dimension.

MODEL: The speed of light is 3.00 x 10^8 m/sec. Convert this value to nm/hour.

$$\frac{3.00\times10^{8}\,\text{m}}{1\,\text{sec}}\times\frac{60\,\text{sec}}{1\,\text{min}}\times\frac{60\,\text{min}}{1\,\text{hour}}\times\frac{1\,\text{nm}}{1\times10^{-9}\,\text{m}}=1.08\times10^{13}\,\text{nm/hr}$$

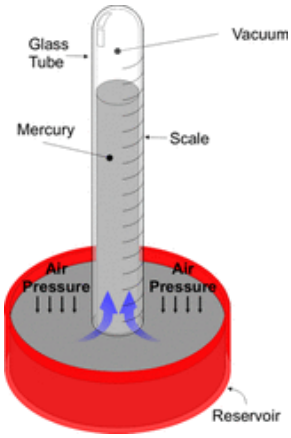
Example 2-25. A level of 0.7 micrograms per milliliter of lead in a child's bloodstream can cause severe damage in their body, and even lead to death. What is this amount in grams per liter?

Leggett PAP Chemistry 2-10 Pressure Unit Conversions	http://youtu.be/8J4WE26zEQo	http://vimeo.com/28277147

Example 2-26. Convert 2.178 x 10^{-19} J/bond to KJ/mol. Conversion factor: 6.022 x 10^{23} bonds = 1 mol.

Example 2-27. Convert 1.023 x 10^{7} nm/day to cm/sec.

VIII.PRESSURE:



Pressure is defined as $P = \frac{Force}{Area}$. We will not be concerned with the mathematical aspect of finding pressure, but only using pressures and converting between units.

Pressure Measurement

1. A _____ measures the pressure of the atmosphere. You can see a picture of an old-school mercury barometer to the right.
2. A _____ measures experimental pressures.

There are **FIVE UNITS** of pressure used in chemistry that we must be able to convert between…
(…and yes, these are found on your Formula Chart! Hooray!)

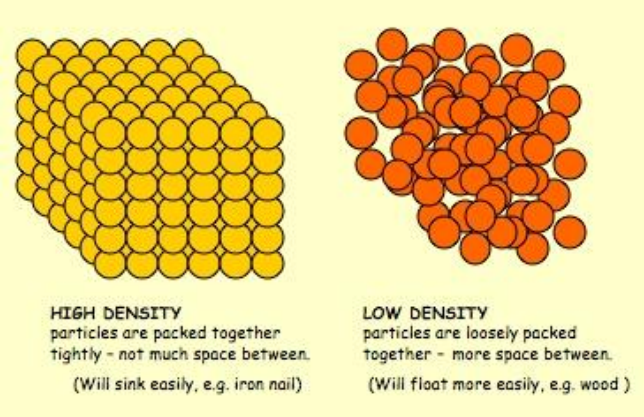
1 atmosphere (atm) = 760 mm Hg = 760 torr = 101.33 Kilopascals (KPa) = 14.7 pounds per square inch (psi)

Example 2-28. Convert 121.45 KPa to torr.

Example 2-29. How many mm Hg are there in 1.159×10^4 Pa?

Example 2-30. Your car tires require 35.0 psi to run optimally. How many atmospheres is this?

Leggett PAP Chemistry 2-11 Density	http://youtu.be/3KBij4Q34o8	http://vimeo.com/28336504



IX. DENSITY

Density is defined as the mass of a substance per unit volume; it is an *intensive property* and therefore can be used for identification. (Think of density as how tightly packed your molecules are with one another!)

The formula for density:

$$D = \frac{\text{Mass}}{\text{Volume}}$$

Mass: grams **Volume:** mL or cm^3 (liquids and solids), L (gases)

Remember: **1 cm^3 = 1 mL**

Problem solving rules:

- List givens
- Check units, convert if necessary
- Write down formula – you may want to solve for the unknown before substituting numbers.
- Substitute and solve (i.e. plug and chug!)

There are 3 variables in the equation, and you will be asked to solve for any one of these when the other two are given.

Example 2-31. If a metal block with a density of 5.00 g/mL was split into two equal halves, what would the density be of each individual block? Justify your answer.

Example 2-32. A certain solid has a volume of 35.7 cm^3 and weighs 85 grams. What is its density?

Example 2-33. If the density of gold is 19.3 g/cm^3, what is the volume of 200.00 g of gold?

Example 2-34. The density of liquid mercury is 13.6 g/mL. What is the mass of 0.035 L of mercury?

Example 2-35. A liquid fills a graduated cylinder to the 45.8 mL mark. The empty graduated cylinder weighs 26.5 grams and when it is filled with an unknown liquid to the 45.8 mL mark, the cylinder and the liquid together weigh 70.0 grams. What is the density of the unknown liquid?

Leggett PAP Chemistry 2-12 Density	http://youtu.be/CNonlTLL3I8	http://vimeo.com/28336611

Example 2-36. Amethyst is a colored form of the mineral quartz in which the purple color comes from traces of the element manganese. To determine density of amethyst, you take a stone having a mass of 15.25 g and place it in a 100.0 mL graduated cylinder containing 45.0 mL of water. On adding the stone, the water surface rises to the 50.8 mL mark. What is the density of the amethyst?

Example 2-37. Find the density of a rectangular solid whose dimensions are 3.4 cm by 1.2 cm by 1.7 cm if it is known to have a mass of 119.4. grams.

You need to know the density of water at 3.98°C !

- **Density of Water = 1.0 g/mL**
- This means that 1.0 gram of water has a volume of 1.0 mL and that 1.0 mL of water will weigh 1 gram.
- Technically, this is only true at 3.98°C… at all other temperatures the density of water is slightly different than 1.0 g/mL, but it will round to 1.0 g/mL. ☺

Example 2-38. How much would 500. mL of water weigh in grams?

Substances which are _____ DENSE than water WILL FLOAT on water, assuming that they do not dissolve in the water nor react with the water.

Example 2-39. A certain substance has a mass of 3.2 kg and a volume of 1950 mL. Would you expect this substance to float in water, assuming that it did not dissolve in the water nor react with it?

Example 2-40. Would you expect the substance in the previous example to float in mercury (D = 13.6 g/mL), assuming that it did not dissolve in the mercury nor react with it?