AP Chemistry Summer Assignment

There are three parts to the AP Chemistry Summer Assignment. Part 1 deals with the memorization of common ions used in the course. Part 2 provides information and practice on basic math skills which we will use regularly. Part 3 involves becoming oriented with the online companion (MasteringChemistry) to our textbook; more information on this later in the summer via email once the textbooks have been ordered.

PART 1: COMMON IONS

This part of the summer assignment for AP Chemistry is quite simple (but <u>not</u> easy). You need to master the formulas, charges, and names of the common ions. During the first week (perhaps even the first day…) of the school year, you will be given a quiz on these ions. You will be asked to:

- write the names of these ions when given the formula and charge
- write the formula and charge when given the names

I have included several resources in this packet. First, there is a list of the ions that you must know on the first day. This list also has, on the back, some suggestions for making the process of memorization easier. For instance, many of you will remember that most of the monatomic ions have charges that are directly related to their placement on the periodic table. There are naming patterns that greatly simplify the learning of the polyatomic ions as well.

Also included is a copy of the periodic table used in AP Chemistry. The AP table is the same that the College Board allows you to use on the AP Chemistry test. Notice that it has the symbols of the elements but <u>*not*</u> the written names. You need to take that fact into consideration when studying for the afore-mentioned quiz!

I have included a sheet of flashcards for the polyatomic ions that you must learn. I strongly suggest that you cut them out and begin memorizing them immediately. Use the hints on the common ions sheet to help you reduce the amount of memorizing that you must do. You should also log in to Quizlet and complete the online review activities. I will monitor your progress with this throughout the summer.

Do not let the fact that there are no flashcards for monatomic ions suggest to you that the monatomic ions are not important. They are every bit as important as the polyatomic ions. If you have trouble identifying the charge of monatomic ions (or the naming system) then I suggest that you make yourself some flashcards for those as well (these are included in the *Common ions* Quizlet deck).

Doubtless, there will be some students who will procrastinate and try to do all of this studying just before the start of school. Those students may even cram well enough to do well on the initial quiz. However, they will quickly forget the ions, and struggle every time that these formulas are used in lecture, homework, quizzes, tests and labs. All research on human memory shows us that frequent, short periods of study, spread over long periods of time will produce much greater retention than long periods of study of a short period of time. Learning to communicate in chemistry is like learning to communicate in grade school…the element symbols are our ABC's…chemical formulas are our words…chemical equations are our sentences.

I could wait and throw these at you on the first day of school, but I don't think that would be fair to you. Use every modality possible as you try to learn these – speak them, write them, visualize them.

<u>See the opposite side for Part 2</u>

PART 2: MATH SKILLS PRACTICE

SIGNIFICANT FIGURES IN CALCULATIONS

Unless you have been exposed to significant figure rules in another course, this topic will take a bit of study.

I have attached a two-sided page with explanations of the rules, and examples of problem solving in addition, subtraction, multiplication and division.

There is also a page of problems for you to complete. This page is due at the beginning of class on the first day of next school year.

DIMENSIONAL ANALYSIS (Factor-Label)

Solving conversion problems by explicitly showing the appropriate conversion factors used is best done using a method known as *dimensional analysis* or *factor-label method*. Refer to the attached "Solving Problems in Chemistry" handout for an explanation of this method; the example and first problem on the Dimensional Analysis worksheet are modeled to help you get started. The page of practice problems ("Time Problems & Dimensional Analysis") is due at the beginning of class on the first day of next school year.

SCIENTIFIC NOTATION & METRIC UNIT CONVERSIONS

In chemistry we deal with really big and really small numbers on a regular basis; therefore, using scientific notation to express these values can be a time (and space) saver. Plus, it helps with the identification of significant figures.

In terms of measurement units, the majority of the world utilizes the metric system, which utilizes prefixes to indicate the magnitude to which a given base unit is expressed. Familiarity with these prefixes/symbols & their multiplier equivalent will facilitate the conversion process.

The page of practice problems ("Scientific Notation & Metric Conversions") is due at the beginning of class on the first day of next school year.

Checklist

- □ Check school email weekly (http://www.swasd.org/email)
- □ Login to Quizlet and practice your element symbols, common ions, metric units. You should complete the "Learn" & "Speller" sections for the Elements & Common Ions decks.
- □ Read Ch. 1 & 2 in *Merrill Chemistry*. Take notes on these and be prepared to submit these notes on the first day of class. These must be hand-written & legible.
- □ Complete the worksheets in this packet; show work for all calculations (use an additional sheet of paper if necessary and attach)
  - Significant Figures
  - Time Problem & Dimensional Analysis
  - Scientific Notation & Metric Conversions
- □ Complete the introductory module on MasteringChemistry (the online companion to our textbook); access to this should be available later this summer; be watching your school email for information.

I look forward to seeing you all at the beginning of the next school year. If you need to contact me during the summer, you can email me (meisley@swasd.org) and I will get back to you as soon as I can.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1 **H** 1.008																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.91	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.02	89 **†Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (277)	109 **Mt** (268)	110 **Ds** (271)	111 **Rg** (272)							

*Lanthanide Series	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
†Actinide Series	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

The Metric Scale

	10^{12}	10^{9}	10^{6}	10^{3}	10^{2}	10^{1}	10^{0}	10^{-1}	10^{-2}	10^{-3}	10^{-6}	10^{-9}	10^{-12}
Prefix	Tera	Giga	Mega	Kilo	Hecto	Deka	**Base Unit**	Deci	Centi	Milli	Micro	Nano	Pico
Symbol	T	G	M	k	h	D *or* da		d	c	m	μ	n	p

You can convert metric units using two basic methods. One method is to use the factor-label (or dimensional analysis) method, which entails using one or more conversion factors until the desired unit is achieved. The second method is to simply move the decimal point in the numerical portion.

Because the metric system is "base 10", conversions are extremely easy. All conversion factors are multiples of 10, which basically equates to the digits in a number remaining the same, only the decimal point is moving. It is good to be able to show the factor-label method, to see step-by-step how the two measurements really are equal to one another. Looking at metric-metric conversions from a practical point of view, taking advantage of the "moving the decimal point" method is faster.

When using the moving decimal point method, you need to know two things: 1) which direction does the decimal point move, and 2) how many places does it move in that direction. To answer question #1, the direction the decimal point moves is dependent on the sizes of your units. Converting a small unit to a larger unit, you move the decimal point to the left. Converting a large unit to a small unit, you move the decimal point to the right. How far you move the decimal point (question #2) is determined by how many powers of 10 difference exists between your two metric units.

Example: 150. cm = ___1.50____m

cm → m is going from a smaller unit to a larger unit, so the decimal point will move to the left. Because there are 2 powers of ten difference between centi- (10^{-2}) and the base unit meter (10^{0}), the decimal point will move 2 places.

Base Units: **Length** → meter (m) **Mass** → gram (g) **Volume** → Liter (L)

Common Ions and Their Charges

A mastery of the common ions, their formulas and their charges, is essential to success in AP Chemistry. You are expected to know all of these ions on the first day of class, when I will give you a quiz on them. You will always be allowed a periodic table, which makes indentifying the ions on the left "automatic." For tips on learning these ions, see the opposite side of this page.

From the table:	
Cations	**Name**
H^+	Hydrogen
Li^+	Lithium
Na^+	Sodium
K^+	Potassium
Rb^+	Rubidium
Cs^+	Cesium
Be^{+2}	Beryllium
Mg^{+2}	Magnesium
Ca^{+2}	Calcium
Ba^{+2}	Barium
Sr^{+2}	Strontium
Al^{+3}	Aluminum
Anions	**Name**
H^-	Hydride
F^-	Fluoride
Cl^-	Chloride
Br^-	Bromide
I^-	Iodide
O^{-2}	Oxide
S^{-2}	Sulfide
Se^{-2}	Selenide
N^{-3}	Nitride
P^{-3}	Phosphide
As^{-3}	Arsenide
Type II Cations	**Name**
Fe^{+3}	Iron(III)
Fe^{+2}	Iron(II)
Cu^{+2}	Copper(II)
Cu^+	Copper(I)
Co^{+3}	Cobalt(III)
Co^{+2}	Cobalt(II)
Sn^{+4}	Tin(IV)
Sn^{+2}	Tin(II)
Pb^{+4}	Lead(IV)
Pb^{+2}	Lead(II)
Hg^{+2}	Mercury(II)

Ions to Memorize	
Cations	**Name**
Ag^+	Silver
Zn^{+2}	Zinc
Cd^{+2}	Cadmium
Hg_2^{+2}	Mercury(I)
NH_4^+	Ammonium
Anions	**Name**
NO_2^-	Nitrite
NO_3^-	Nitrate
SO_3^{-2}	Sulfite
SO_4^{-2}	Sulfate
HSO_4^-	Hydrogen sulfate (bisulfate)
OH^-	Hydroxide
CN^-	Cyanide
PO_4^{-3}	Phosphate
HPO_4^{-2}	Hydrogen phosphate
$H_2PO_4^-$	Dihydrogen phosphate
SCN- (*or* NCS^-)	Thiocyanate
CO_3^{-2}	Carbonate
HCO_3^-	Hydrogen carbonate (bicarbonate)
ClO^-	Hypochlorite
ClO_2^-	Chlorite
ClO_3^-	Chlorate
ClO_4^-	Perchlorate
BrO^-	Hypobromite
BrO_2^-	Bromite
BrO_3^-	Bromate
BrO_4^-	Perbromate
IO^-	Hypoiodite
IO_2^-	iodite
IO_3^-	iodate
IO_4^-	Periodate
$C_2H_3O_2^-$	Acetate
MnO_4^-	Permanganate
$Cr_2O_7^{-2}$	Dichromate
CrO_4^{-2}	Chromate
O_2^{-2}	Peroxide
$C_2O_4^{-2}$	Oxalate
NH_2^-	Amide
BO_3^{-3}	Borate
$S_2O_3^{-2}$	Thiosulfate

Tips for Learning the Ions

“From the Table”

These are ions can be organized into two groups.

1. Their place on the table suggests the charge on the ion, since the neutral atom gains or loses a predictable number of electrons in order to obtain a noble gas configuration. This was a focus in first year chemistry, so if you are unsure what this means, get help BEFORE the start of the year.
    a. All Group 1 Elements (alkali metals) lose one electron to form an ion with a 1+ charge
    b. All Group 2 Elements (alkaline earth metals) lose two electrons to form an ion with a +2 charge
    c. Group 13 metals like aluminum lose three electrons to form an ion with a +3 charge
    d. All Group 17 Elements (halogens) gain one electron to form an ion with a -1 charge
    e. All Group 16 nonmetals gain two electrons to form an ion with a -2 charge
    f. All Group 15 nonmetals gain three electrons to form an ion with a -3 charge

    Notice that cations keep their name (sodium ion, calcium ion) while anions get an “-ide” ending (chloride ion, oxide ion).

2. Metals that can form more than one ion will have their positive charge denoted by a roman numeral in parenthesis immediately next to the name of the

Polyatomic Anions

Most of the work on memorization occurs with these ions, but there are a number of patterns that can greatly reduce the amount of memorizing that one must do.

1. “ate” anions have one more oxygen then the “ite” ion, but the same charge. If you memorize the “ate” ions, then you should be able to derive the formula for the “ite” ion and vice-versa.
    a. sulfate is SO_4^{-2}, so sulfite has the same charge but one less oxygen (SO_3^{-2})
    b. nitrate is NO_3^-, so nitrite has the same charge but one less oxygen (NO_2^-)

2. If you know that a sufate ion is SO_4^{-2} then to get the formula for hydrogen sulfate ion, you add a hydrogen ion to the front of the formula. Since a hydrogen ion has a 1+ charge, the net charge on the new ion is less negative by one.
    a. Example:

PO_4^{-3}	→	HPO_4^{-2}	→	$H_2PO_4^-$
phosphate		hydrogen phosphate		dihydrogen phosphate

3. Learn the hypochlorite → chlorite → chlorate → perchlorate series, and you also know the series containing iodite/iodate as well as bromite/bromate.
    a. The relationship between the “ite” and “ate” ion is predictable, as always. Learn one and you know the other.
    b. The prefix “hypo” means “under” or “too little” (think “hypodermic”, “hypothermic” or “hypoglycemia”)
        i. Hypochlorite is “under” chlorite, meaning it has one less oxygen
    c. The prefix “hyper” means “above” or “too much” (think “hyperkinetic”)
        i. the prefix “per” is derived from “hyper” so perchlorate (hyperchlorate) has one more oxygen than chlorate.
    d. Notice how this sequence increases in oxygen while retaining the same charge:

ClO^-	→	ClO_2^-	→	ClO_3^-	→	ClO_4^-
hypochlorite		chlorite		chlorate		perchlorate

Solving Problems in Chemistry

Before solving *any* problem, the first thing you should do is read the problem completely. Determine what type of problem you need to solve…if you are solving for the same type of measurement (mass, length, velocity, etc.) just expressed in different units, it is a *conversion-based problem*. If you are using values to come up with a different type of measurement altogether (mass and volume used to find density), then you should use an *equation-based approach*.

Conversion-based Problems

1. Identify the known facts
    a. Write down the given value
    b. Write down the units (make sure the units match the measurement)
2. Define the units required
    a. What should my units be at the end of the conversion?
3. Determine how you can get from your starting unit to the final unit.
    a. What path(s) of units can you take to get from start to finish?
    b. For each step on the "path", define the equivalent relationship between those two units (i.e. – 1cm = 10 mm; 1kg = 1000g)
4. Multiply the original value by each conversion factor you defined along the path.
    a. This should be done "in-line" as one extended problem.
    b. Set up each conversion factor so that the units you want to get rid of cancel out. Cancel the units out as you go along.
    c. Continue to place each conversion factor in the problem (in order) until the units that remain are the units you need to solve the problem.
5. Multiply all of your numerator values together.
6. Multiply all of your denominator values together.
7. Divide the numerator by the denominator.
8. Finalize your answer.
    a. Make sure the answer has the proper number of sig figs.
    b. Make sure the answer has the proper units.
    c. Make sure the answer is circled.
    d. Use estimation to determine if the answer is reasonable.

Example: Convert 24 inches into millimeters

$$\frac{24\,\cancel{in}}{1} \times \frac{2.54\,\cancel{cm}}{1\,\cancel{in}} \times \frac{10\text{ mm}}{1\,\cancel{cm}} = 609.6\text{ mm} = 610\text{ mm}$$

Equation-based problems

1. Identify the known facts.
    a. Write down the known value(s).
    b. Write down the units (make sure the units match the measurements).
2. Define the unknown quantity that you are looking for.
    a. What value are you trying to determine?
    b. What units should the value have?
3. Identify any equations that will allow you to use the values you have to find the value that you want.
4. Write down the equation in its *original form*.
5. Substitute the known values into the equation.
6. Rearrange algebraically, as necessary, to solve for the unknown quantity.
7. Solve the equation using the appropriate operations.
    a. Make sure the answer has the proper number of sig figs.
    b. Make sure the answer has the proper units.
    c. Make sure the answer is circled.
    d. Use estimation to determine if the answer is reasonable.

Example: A metal sphere has a volume of 2.79 cm^3 and a mass of 48.0g. What is the density?

Known values: Mass (m) = 48.0g
Volume (V) = 2.79 cm^3

Unknown value: Density (D)

Equation to solve for density: D = m / V

Problem solving process:

D = m / V	D = 48.0g / 2.79 cm^3	D = 17.2 g/cm^3

Significant Figures in Measurement and Calculations

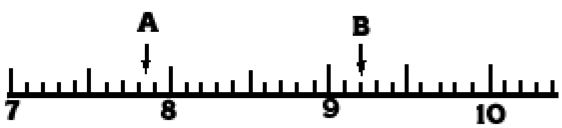
A successful chemistry student habitually labels all numbers, because the unit is important. Also of great importance is the number itself. Any number used in a calculation should contain only figures that are considered reliable; otherwise, time and effort are wasted. Figures that are considered reliable are called *significant figures*. Chemical calculations involve numbers representing actual measurements. In a measurement, significant figures in a number consist of:

Figures (digits) definitely known + One estimated figure (digit)

In class you will hear this expressed as "all of the digits known for certain plus one that is a guess."

Recording Measurements

When one reads an instrument (ruler, thermometer, graduate, buret, barometer, balance), he expresses the reading as one which is reasonably reliable. For example, in the accompanying illustration, note the reading marked *A*. This reading is definitely beyond the 7 cm mark and also beyond the 0.8 cm mark. We read the 7.8 with certainty. We further *estimate* that the reading is five-tenths the distance from the 7.8 mark to the 7.9 mark. So, we estimate the length as 0.05 cm more than 7.8 cm. All of these have meaning and are therefore significant. We express the reading as 7.85 cm, accurate to three significant figures. All of these figures, *7.85*, can be used in calculations. In reading B we see that 9.2 cm is definitely known. We can include one estimated digit in our reading, and we estimate the next digit to be zero. Our reading is reported as 9.20 cm. It is accurate to three significant figures. We keep the zero, because it indicates the precision allowed by the measuring instrument; it tells us that the smallest divisions on the instrument were 0.1 cm.



Rules for Zeros

If a zero represents a measured quantity, it is a significant figure. If it merely locates the decimal point (i.e. a placeholder), it is not a significant figure.

Zero Within a Number (I refer to these as “sandwich zeros”). In reading the measurement 9.04 cm, the zero represents a measured quantity, just as 9 and 4, and is, therefore, a significant number. <u>A zero between any of the other digits in a number is a significant figure</u>.

Zero at the Front of a Number (I refer to these as “leading zeros”). In reading the measurement 0.46 cm, the zero does not represent a measured quantity, but merely locates the decimal point. It is not a significant figure. Also, in the measurement 0.07 kg, the zeros are used merely to locate the decimal point and are, therefore, not significant. <u>Zeros at the beginning (left) of a number are not significant figures</u>.

Zero at the End of a Number (I refer to these as “trailing zeros”). In reading the measurement 11.30 cm, the zero is an estimate and represents a measured quantity. It is therefore significant. Another way to look at this: The zero is not needed as a placeholder, and yet it was included by the person recording the measurement. It must have been recorded as a part of the measurement, making it significant. <u>Zeros to the right of the decimal point, and at the end of the number, are significant figures</u>.

Zeros at the End of a Whole Number. Zeros at the end of a whole number may or may not be significant. If a distance is reported as 1600 feet, one assumes two sig figs. Reporting measurements in scientific notation removes all doubt, since all numbers written in scientific notation are considered significant.

1 600 feet	1.6×10^3 feet	Two significant figures
1 600 feet	1.60×10^3 feet	Three significant figures
1 600 feet	1.600×10^3 feet	Four significant figures

Sample Problem #1: Underline the significant figures in the following numbers.

(a) 0.0420 cm	answer = $0.0\underline{420}$ cm	(e) 2 403 ft.	answer = $\underline{2\ 403}$ ft.
(b) 5.320 in.	answer = $\underline{5.320}$ in.	(f) 80.5300 m	answer = $\underline{80.5300}$ m
(c) 10 lb.	answer = $\underline{1}0$ lb.	(g) 200. g	answer = $\underline{200}$ g
(d) 0.020 ml	answer = $0.0\underline{20}$ ml	(h) 2.4 x 10^3 kg	answer = $\underline{2.4}$ x 10^3 kg

Rounding Off Numbers

In reporting a numerical answer, one needs to know how to "round off" a number to include the correct number of significant figures. Even in a series of operations leading to the final answer, one must "round off" numbers. The rules are well accepted rules:

1. If the figure to be dropped is less than 5, simply eliminate it.
2. If the figure to be dropped is greater than 5, eliminate it and raise the preceding figure by 1.
3. If the figure is 5, followed by nonzero digits, raise the preceding figure by 1
4. If the figure is 5, not followed by nonzero digit(s), and preceded by an odd digit, raise the preceding digit by one
5. If the figure is 5, not followed by nonzero digit(s), and the preceding significant digit is even, the preceding digit remains unchanged

Sample Problem #2: Round off the following to three significant figures.

(a) 3.478 m	answer = 3.48 m	(c) 5.333 g	answer = 5.33 g
(b) 4.8055 cm	answer = 4.81 cm	(d) 7.999 in.	answer = 8.00 in.

Multiplication

In multiplying two numbers, when you wish to determine the number of significant figures you should have in your answer (the product), you should inspect the numbers multiplied and find which has the least number of significant figures. This is the number of significant figures you should have in your answer (the product). Thus the answer to 0.024 x 1244 would be rounded off to contain two significant figures since the factor with the lesser number of significant figures (0.024) has only *two* such figures.

Sample Problem #3: Find the area of a rectangle 2.1 cm by 3.24 cm.

Solution: Area = 2.1 cm x 3.24 cm = 6.804 cm^2

We note that 2.1 contains two significant figures, while 3.24 contains three significant figures. Our product should contain no more than *two* significant figures. Therefore, our answer would be recorded as 6.8 cm^2

Sample Problem #4: Find the volume of a rectangular solid 10.2 cm x 8.24 cm x 1.8 cm

Solution: Volume = 10.2 cm x 8.24 cm x 1.8 cm = 151.2864 cm^3

We observe that the factor having the least number of significant figures is 1.8 cm. It contains two significant figures. Therefore, the answer is rounded off to 150 cm^3.

Division

In dividing two numbers, the answer (quotient) should contain the same number of significant figures as are contained in the number (divisor or dividend) with the least number of significant figures. Thus the answer to 528 ÷ 0.14 would be rounded off to contain *two* significant figures. The answer to 0.340 ÷ 3242 would be rounded off to contain three significant figures.

Sample Problem #5: Calculate 20.45 ÷ 2.4

Solution: 20.45 ÷ 2.4 = 8.52083

We note that the 2.4 has fewer significant figures than the 20.45. It has only *two* significant figures. Therefore, our answer should have no more than two significant figures and should be reported as 8.5.

Addition and Subtraction

In adding (or subtracting), set down the numbers, being sure to keep like decimal places under each other, and add (or subtract). Next, note which column contains the first estimated figure. This column determines the last decimal place of the answer. After the answer is obtained, it should be rounded off in this column. In other words, round to the least number of decimal places in your data.

Sample Problem #6: Add 42.56 g + 39.460 g + 4.1g

Solution:

	42.56 g
	39.460 g
	4.1 g
Sum =	86.120 g

Since the number 4.1 only extends to the first decimal place, the answer must be rounded to the first decimal place, yielding the answer 86.1 g.

Average Readings

The average of a number of successive readings will have the same number of decimal places that are in their sum.

Sample Problem #7: A graduated cylinder was weighed three times and the recorded weighings were 12.523 g, 12.497 g, 12.515 g. Calculate the average weight.

Solution:

12.523 g
12.497 g
12.515 g
37.535 g

In order to find the average, the sum is divided by 3 to give an answer of 12.51167. Since each number extends to three decimal places, the final answer is rounded to three decimal places, yielding a final answer of 12.512 g. Notice that the divisor of 3 does not effect the rounding of the final answer. This is because 3 is an exact number - known to an infinite number of decimal places.

Name____

Give the number of significant figures in each of the following:

____ 402 m	____ 34.20 lbs	____ 0.03 sec
____ 0.00420 g	____ 3 200 liters	____ 0.0300 ft.
____ 5.1 x 10^4 kg	____ 0.48 m	____ 1 400.0 m
____ 78 323.01 g	____ 1.10 torr	____ 760 mm Hg

Multiply each of the following, observing significant figure rules:

17 m x 324 m = _________________ 1.7 mm x 4 294 mm = _________________

0.005 in x 8 888 in = ______________ 0.050 m x 102 m = _____________________

0.424 in x .090 in = _______________ 324 000 cm x 12.00 cm = _______________

Divide each of the following, observing significant figure rules:

23.4 m ÷ 0.50 sec = _______________ 12 miles ÷ 3.20 hours = ___________

0.960 g ÷ 1.51 moles = _____________ 1 200 m ÷ 12.12 sec = ____________

Add each of the following, observing significant figure rules:

3.40 m	102.45 g	102. cm
0.022 m	2.44 g	3.14 cm
0.5 m	1.9999 g	5.9 cm

Subtract each of the following, observing significant figure rules:

42.306 m	14.33 g	234.1 cm
1.22 m	3.468 g	62.04 cm

Work each of the following problems, observing significant figure rules:

Three determinations were made of the percentage of oxygen in mercuric oxide. The results were 7.40%, 7.43%, and 7.35%. What was the average percentage?

A rectangular solid measures 13.4 cm x 11.0 cm x 2.2 cm. Calculate the volume of the solid.

If the density of mercury is 13.6 g/ml, what is the mass in grams of 3426 ml of the liquid?

A copper cylinder, 12.0 cm in radius, is 44.0 cm long. If the density of copper is 8.90 g/cm^3, calculate the mass in grams of the cylinder. (assume pi = 3.14)

Name________________________________

TIME PROBLEMS & DIMENSIONAL ANALYSIS (Factor-Label Method)

As chemistry students, you have two goals with problems. First, get the correct answer. Second, be able to show others WHY your answer is correct. Dimensional analysis meets both of these goals.

Dimensional analysis is always a **Given** value and one or more **conversion factors** that allow you to determine the **Desired** value.

Any mathematical fact can serve as a conversion factor. 1 hour = 60 minutes ≈ $\boxed{\frac{1\,\text{hour}}{60\,\text{min}}}$ or $\boxed{\frac{60\,\text{min}}{1\,\text{hour}}}$

Ex. Convert 1.25 years into seconds.

$$\frac{125\,\cancel{yrs}}{1} \times \frac{365.25\,\cancel{days}}{1\,\cancel{yr}} \times \frac{24\,\cancel{hrs}}{1\,\cancel{day}} \times \frac{60\,\cancel{min}}{1\,\cancel{hr}} \times \frac{60\,sec}{1\,\cancel{min}} = \boxed{\textbf{39,420,000 sec}}$$

1. Convert 2.83 days into seconds.

$$\frac{2.83\,days}{1} \times \frac{\_\_\_\_\,hrs}{\_\_\_\_\,day} \times \frac{\_\_\_\_\,min}{\_\_\_\_\,hr} \times \frac{\_\_\_\_\,sec}{\_\_\_\_\,min} =$$

2. Convert 7.72 years into days.

3. Convert 0.0035 weeks into seconds.

4. Convert 180 days into minutes.

5. Convert your age into seconds

Density is often used as a conversion factor between the mass and volume of a sample. For example, the density of liquid mercury is 13.6 g/mL.

6. What is the volume of a 175 gram sample of mercury?

7. What is the mass of 1.00 gallon of mercury? [1 cup = 236.588 mL]

Name ____

SCIENTIFIC NOTATION & METRIC CONVERSIONS

Change the following to Scientific Notation (maintain the number of significant figures):

1.	5.280 =	________________	11.	2,560 =	________________
2.	2,000 =	________________	12.	.0009 =	________________
3.	15 =	________________	13.	8,900,000 =	________________
4.	6,589,000 =	________________	14.	.0920 =	________________
5.	70,400,000,000 =	________________	15.	6,300 =	________________
6.	.00263 =	________________	16.	.90 =	________________
7.	.00589 =	________________	17.	250 =	________________
8.	.006 =	________________	18.	.006087 =	________________
9.	.400 =	________________	19.	500,000 =	________________
10.	.08060 =	________________	20.	.0000000105 =	________________

Make the following Metric System conversions. For the **odd** numbered problems, make the conversion using the factor-label method & show your work. You may use scientific notation.

1.	100 mg	________________ =	________________	g
2.	20 cm	________________ =	________________	m
3.	50 L	________________ =	________________	kL
4.	22 g	________________ =	________________	cg
5.	825 cm	________________ =	________________	km
6.	2,350 kg	________________ =	________________	g
7.	19 mL	________________ =	________________	cL
8.	52 km	________________ =	________________	m
9.	36 m	________________ =	________________	cm
10.	18 cm	________________ =	________________	mm
11.	6 g	________________ =	________________	mg
12.	4,259 mg	________________ =	________________	g

Sulfite	**Sulfate**	**Hydrogen sulfate**
Phosphate	**Dihydrogen Phosphate**	**Hydrogen Phosphate**
Nitrite	**Nitrate**	**Ammonium**
Thiocyanate	**Carbonate**	**Hydrogen carbonate**
Borate	**Chromate**	**Dichromate**
Permanganate	**Oxalate**	**Amide**
Hydroxide	**Cyanide**	**Acetate**
Peroxide	**Hypochlorite**	**Chlorite**
Chlorate	**Perchlorate**	**Thiosulfate**

HSO_4^-	SO_4^{2-}	SO_3^{2-}
HPO_4^{2-}	$H_2PO_4^-$	PO_4^{3-}
NH_4^+	NO_3^-	NO_2^-
HCO_3^-	CO_3^{2-}	NCS^- SCN^-
$Cr_2O_7^{2-}$	CrO_4^{2-}	BO_3^{3-}
NH_2^-	$C_2O_4^{2-}$	MnO_4^-
$C_2H_3O_2^-$ CH_3COO^-	CN^-	OH^-
ClO_2^-	ClO^-	O_2^{2-}
$S_2O_3^{2-}$	ClO_4^-	ClO_3^-