REVIEW PACKET FOR STUDENTS ENTERING CHEMISTRY HONORS

Students entering the Chemistry Honors class are expected to possess skills and information which have been taught in previous science classes. This packet will serve as a review of those skills and knowledge. **YOU WILL BE ASSESSED ON THIS KNOWLEDGE EARLY IN THE YEAR – IF YOU CANNOT APPLY OR RECALL THIS INFORMATION, IT IS YOUR RESPONSIBILITY TO *RE*-LEARN IT BEFORE COMING TO SCHOOL IN SEPTEMBER.** The topics you learn over the course of this year will build upon this foundation. Please note that if you came from a *non-Honors* Physical Science course, it is imperative that you master this content if you want to be ready for this course. The pre-requisite material will **not** be re-taught in Honors Chemistry. **PLEASE HANDWRITE YOUR ANSWERS. YOU MAYWORK COLLABORATIVELY, BUT YOU MUST SHOW ALL WORK BACKING UP ANSWERS (especially for nomenclature or calculation-based problems). PLEASE BRING THIS ASSIGNMENT WITH YOU TO THE FIRST DAY (and rest of first week) OF CLASS.**

A. Basic mathematics skills.

1. Conversions within the Metric system (System International, SI system**)**
2. Calculations using Scientific Notation (exponential notation)
3. Graphing
   a.) Determining independent and dependent variables
   b.) Calculating slope
4. **Algebraic manipulation of equations** (It is not recommended that you take this course if your algebra skills are weak).

B Skills in chemistry

1. Measuring/ calculating: length, area, volume, mass, density
2. Using standard laboratory equipment such as, balances, thermometers, Bunsen burners.
3. Knowing the names of basic equipment and glassware.
4. Using a periodic table to predict formulas for simple ionic and molecular compounds and carbon compounds.
5. Balancing equations.
6. Predicting products of equations
7. Calculations of
   a) percent error
   b) formula mass.
   c) density.
   d) mole
   e) heat

C Topics

1. Scientific method
2. Elements, compounds, mixtures
3. Chemical and physical properties
4. Chemical and physical changes
5. Properties of solids, liquids, gases
6. Atomic structure (subatomic particles)
7. Periodic table
8. Chemical equations
9. Heat and energy.

SOME REVIEW OF PHYSICAL SCIENCE!

I. MATTER:

A Atoms, Isotopes, & the Periodic Table: Matter can be classified as being either element, compounds, or mixtures. All matter is made of atoms. Atoms that are combined into groups of two or more atoms are called **molecules**. Atoms are composed of **protons (p^+)**, **neutrons (n^0),** and **electrons (e^-)**. Protons are positive (charge = +1), electrons are negative (charge = -1), and neutrons are neutral (charge = 0). Protons are located in the nucleus and determine the **identity** of the atom; the **atomic number** of each element indicates the **number of protons**. **Neutrons** are located in the **nucleus**, which is a very small area at the center of an atom. **Electrons** are located in the large empty area outside of the nucleus and are responsible for the **chemical behavior** of an atom.

The protons and neutrons contribute to the overall mass of the atom. Each is ~1 amu, whereas the electron is 0.00055 amu. The sum of the protons and neutrons is called the **mass number**. **Isotopes** are atoms of the same element (i.e. same number of protons**)** that have a different mass (i.e. different number of neutrons). Isotopes are distinguished from each other by writing a symbol or name that includes their mass number (e.g. **^{37}Cl** and **^{35}Cl; Chlorine – 35** and **Chlorine -37**). Note that the atomic number for any given element is always the same (e.g. Chlorine's atomic number is always 17). Sometimes the atomic number is included on an isotope symbol (e.g. **$^{37}_{17}$Cl**). The **atomic mass** given on the periodic table is the **weighted average** of all the isotopes for a given element (e.g. Chlorine's atomic mass is 35.545 because about 75% of its atoms are ^{35}Cl, but 25% of its atoms are ^{37}Cl). The atomic mass can be calculated by multiplying the relative abundance (%) by each isotope's mass and then adding the numbers together.

In a NEUTRAL ATOM, protons and electrons must be present in equal numbers. However, **CHARGED IONS can be formed by losing or gaining <u>electrons</u>**. Note that the number of protons never changes when forming ions. If an atom gains electrons, it becomes negative and is called an **anion. Nonmetals** form anions, and the name of that ion is given by adding "-ide" to the root of the element name (e.g. O^{-2} is oxide). If an atom loses electrons, it becomes positive and is called a **cation**. **Metals** form cations, and the name of the ion is the same as the metal. If more than one charge for a metal is possible, a Roman numeral is written to indicate the charge (e.g. Fe^{+2} is iron (II) ion); Fe^{+3} is iron (III) ion). If there is only one charge for a metal is possible, then no Roman numeral is required.

Nonmetals gain electrons to get a full octet (8) of valence (or outermost) electrons. Metals lose electrons until they attain a full **octet of valence electrons**. Group 1 elements (the **alkali metals**) have 1 valence electron. Group 2 elements (the **alkaline earth metals**) have 2 valence electrons. Group 13 elements (the Boron group) have 3 valence electrons. Group 14 elements (the Carbon group) have 4 valence electrons. Group 15 elements (the Nitrogen group) have 5 valence electrons. Group 16 elements (the Oxygen group) have 6 valence electrons. Group 17 elements (the **halogens**) have 7 valence electrons. Group 18 elements (the **noble gases**) have 8 valence electrons. The alkali metals form +1 ions by losing an electron. The alkaline earth metals form +2 ions by losing 2 electrons. Group 15 NONMETALS, which have 5 valence electrons, form -3 ions by gaining 3 electrons. Group 16 NONMETALS, which have 6 valence electrons, form -2 ions by gaining 2 electrons. The halogens, which have 7 valence electrons, form -1 ions by gaining 1 electron. The noble gases do not form ions and are stable and unreactive because they have an octet or 8 valence electrons, which is a very stable electron configuration.

B Elements, Compounds, & Mixtures:

There are about 114 elements known; of these 90 are naturally occurring on earth. Each element has a one or two letter symbol with one capital letter (e.g. B and Br). **Elements are made from only one <u>kind</u> of atom** (which all share the same atomic number and elemental symbol), and all atoms of a given element have identical chemical properties, but not the same mass (**isotopes).** Elements can come in **atomic** form (e.g. Fe) or in **molecular** form (O_2 or C_{60}). About 80% of the elements are **metals** – these are to the left of the **staircase** on the periodic table (except for hydrogen – which is a **nonmetal**). The **nonmetals** are to the right of the staircase with the exception of hydrogen. Several elements are gases at room temperature. Only two are liquids at room temperature (Hg and Br_2). In nature, there are **7 diatomic elements** that always pair up when they are not in ion form (e.g. O^{-2}) or not bound to another element in a compound (e.g. H_2O). These seven elements are **H_2, O_2, F_2, Br_2, I_2, N_2, Cl_2**.

Compounds are composed of two or more different elements chemically bonded in a very definite ratio (both by number of atoms and by mass of atoms). Each compound has at two or more element symbols with **subscripts** indicating the number of each type of atom (e.g. $C_6H_{12}O_6$). Compounds can be decomposed into simpler compounds or into elements, but this requires chemical methods such as reaction with acid, electrolysis, or the input of heat energy. A few compounds, like nitroglycerine, decompose into simpler substances quite readily without much energy input. **When a compound is made from elements, the compound takes on entirely new properties than the original elements.** Common salt, NaCl, is nothing like the explosive metal sodium, nor the choking, poisonous gas chlorine.

There are two kinds of mixtures: **homogeneous**, which means smooth, uniform, even, and **heterogeneous**, which means uneven, or having different observable properties. For most purposes, consider a mixture to be

heterogeneous if you can see differences with your eyes or with a magnifying glass. Sand, however fine, would be considered heterogeneous, but air or brass is considered homogeneous. All **solutions** are homogeneous mixtures. A mixture is made by simply combining two substances together in almost any proportion. **No chemical combination occurs**, so the ratio among the components is **not definite**. The chemical formulas for mixtures are written using + or & between the different components to show that the components are not bonded (e.g. saltwater is $NaCl + H_2O$). Mixtures can usually be easily separated by using physical means (e.g. evaporating, filtering, and magnetism, freezing). **When a mixture is made, the original substances retain their properties.**

Suspensions like oil and vinegar or muddy water are considered to be heterogeneous mixtures. **Colloids,** like milk, smoke or fog are difficult to classify. The particles of soot in smoke or water droplets in fog are large enough to be seen but they do not settle our and appear to be homogeneous. These mixtures border between solution and suspensions.

E Physical & Chemical PROPERTIES: A property is a characteristic that describes matter. **A physical property is a characteristic of matter that can be determined without changing the chemical formula of the substance.** These properties include density, freezing point, or melting point (same point) boiling point, hardness, electrical conductivity, malleability, ductility, specific heat, and solubility. Physical properties are **intensive** if they are inherent to the sample of matter and **do NOT change with increasing or decreasing amount** (e.g. color, boiling point, magnetism); these properties are often used to identify the substance. Physical properties are **extensive** if they **change with increasing or decreasing amount** (e.g. mass, volume, length); these properties are often used to identify how much of a substance is present.

A chemical property only describes a substance's chemical reactivity or non-reactivity. Chemical reactivity can only be observed by attempting to change the chemical formula of the substance by reacting it with something.. Examples include combustibility, (flammability – ability to burn),, reaction with acid, ability to corrode, and ability to combine with other substances.

F Physical & Chemical CHANGES: **Physical changes do NOT break or form bonds within molecules, and therefore do not change the chemical formula of a substance.** These include phase changes, warming, tearing, grinding, and dissolving. You should know the names of all the phase changes (i.e. boiling, condensing, freezing, melting, subliming, depositing) **Chemical changes always break or form bonds and alter the chemical formula of a substance.** Usually chemical changes produce a color change, a gas, or a **precipitate** (a solid formed when two aqueous solutions are mixed). Chemical changes include burning, oxidizing, corroding, exploding, reaction with acid as well as other chemicals. Generally, chemical changes involve about 100 times more energy than do physical changes (e.g. burning wax releases about 100 times more heat than does freezing the same mass of wax.)

G Solids, Liquids, & Gases: These are the three common phases (states) of matter. The basic difference among the three is the extent of the attractive forces between their particles. Gases have low attractive forces so the kinetic energy (energy of motion) of the molecules keeps them spread apart. The warmer the particles, the faster they tend to move. A gas will completely fill any container into which it is placed, hence it has neither a definite shape nor a define volume. If the attractions become stronger, then the particles' attractions are stronger than the kinetic energy that tends to keep the particles apart. In this case, the molecules touch each other, but are still able to slide over and around each other, so a liquid is formed. A liquid has no definite shape and takes the shape of its container, but it does have a definite volume. In a solid, the attractions are so great that the particles are kept in rigidly fixed positions, able only to vibrate about these positions. A solid has definite shape and volume.

II. WRITING CHEMICAL FORMULAS & NAMING COMPOUNDS

Some terms you must know:

- ***Subscripts***: small numbers written to the lower right of the symbol to indicate the number of atoms of the element. If no number appears, the subscript is understood to be 1 (Ex. H_2O has 2 H atoms and 1 O atom)
- ***Coefficients:*** large numbers sometimes written before the formula, they indicate the total number of the particle (Ex. 6 H_2O indicates 6 molecules of water)

- ***Oxidation number:*** an apparent charge on an atom. It may be the same as the charge. These have been determined experimentally. **Evidence shows that atoms combine in such a way that total oxidation number of a compound equals 0.**
- ***Representative elements:*** elements that have only one oxidation number which can be predicted using the periodic table. These include metals in Group 1, 2, 3, 4; nonmetals in groups 5, 6, 7, & 8. (There are some exceptions like Sn and Pb.)
  - ***Ion:*** a charged atom.
    Cation: a positive ion
    Anion: a negative ion
    Monatomic ion: a single atom carrying a charge. (Ex. Ca^{+2} calcium ion; Cl^{-} chloride ion)
    Polyatomic atom (PAI): a group of bonded atoms carrying a charge. (Ex. NH_4^{+} ammonium; NO_3^{-} nitrate; See list to be memorized))

Topic	Video URL
Writing the formula of ionic compounds	https://www.youtube.com/watch?v=mHkrPT_NFCQ
Naming binary ionic compounds (with and without Roman numerals)	https://www.youtube.com/watch?v=G3PNjgeKhoM
Distinguishing between ionic and covalent (molecular) compounds	https://www.youtube.com/watch?v=i6JhcoITR6U
Writing the formula of binary molecular compounds	https://www.youtube.com/watch?v=DFw3AW2BFUw
Naming binary molecular compounds	https://www.youtube.com/watch?v=xoHy--MRvGY
Writing formulas for and naming acids	https://www.youtube.com/watch?v=0kQmZfKEWT8
Writing formulas for and naming basic hydrocarbons (alkanes, alkenes, and alkynes)	https://www.youtube.com/watch?v=J-h6Tt1kD0c

IONIC COMPOUNDS – metal and nonmetal or polyatomic ion

Formulas can be predicted from charges and oxidation numbers:

Binary ionic compounds: compounds containing only 2 elements.	***Ternary ionic compounds:*** compounds containing polyatomic ions.
Ex.1 Na^{+} and Cl^{-} = NaCl	Ex.1 Na^{+} and NO_3^{-} = $Na\ NO_3$
Ex.2 Ca^{+2} and Cl^{-} = CaCl2	Ex.2 Na^{+} and SO_4^{2-} = $Na_2\ SO_4$
Ex.3 Na^{+} and O^{2-} = Na_2O	Ex.3 Ca^{2+} and ClO_3^{-} = $Ca(ClO_3)_2$
	Ex.4 Ca^{2+} and PO_4^{3-} = $Ca_3(PO_4)_2$
	Ex 5 NH_4^{+} and CO_3^{2-} = $(NH_4)_2CO_3$

BASES – type of ionic compounds containing a metal (or cation) plus Hydroxide - OH^{1-} (Ex. Sodium hydroxide, NaOH, calcium hydroxide, $Ca(OH)_2$)

BINARY MOLECULAR COMPOUNDS – 2 nonmetals, cannot easily predict formulas

Stock system: the name can have a Roman numeral representing the oxidation number of the first element	***Prefix system***: the name can use prefixes indicating the number of atoms of each element
Ex. 1 sulfur(IV) oxide = SO_2	Ex. 1 sulfur dioxide = SO_2
Ex. 2 chlorine (III) oxide = Cl_2O_3	Ex. 2 dichlorine trioxide = Cl_2O_3
Ex. 3 nitrogen (V) sulfide = N_2O_5	Ex. 3 dinitrogen pentoxide = N_2O_5
Ex. 4 carbon (II) oxide = CO	Ex. 4 carbon monoxide = CO
Ex. 5 carbon (IV) oxide = CO_2	

<u>ACIDS</u> – type of molecular compounds containing H^{+1} as the cation(positive ion) plus a nonmetal or a polyatomic ion.

<u>Binary acids:</u> H^{+1} and a monoatomic anion Always have *hydro-* in the name The ending changes from: –ide to *-ic* Ex.1 *hydro*chlor*ic* acid **HCl** Ex.2 *hydro*sulfur*ic* acid **H_2S**	***<u>Ternary acids/ Oxyacids:</u>*** H^{+1} and a polyatomic anion **NEVER HAVE HYDRO-** in the name The ending of the polyatomic ion changes from: -ate → *-ic* or -ite → *-ous* Ex.1 chloric acid **$HClO_3$** Ex.2 chlorous acid **$HClO_2$** Ex.3 sulfuric acid **H_2SO_4** Ex.4 sulfurous acid **H_2SO_3**

<u>HYDROCARBONS</u> – type of molecular compound containing carbon and hydrogen

Prefixes indicate the number of CARBON atoms:

Meth – 1	**Prop – 3**	**Pent-5**	**Hept – 7**	**Non – 9**
Eth – 2	**But -4**	**Hex – 6**	**Oct – 8**	**Dec – 10**

<u>Alkanes:</u> This series of compounds contains all single bonds (called *saturated)*. Compounds end in the suffix *–ane*. C_nH_{2n+2} Ex.1 Methane CH_4 Ex. 2 Pentane C_5H_{12}	***<u>Alkenes:</u>*** This series of compounds contains a double bond (called *unsaturated)*. Compounds end in the suffix *–ene*. C_nH_{2n} Ex. 1 Ethene C_2H_4;	***<u>Alkynes:</u>*** This series of compounds contains a triple bond (called *unsaturated)*. Compounds end in the suffix *–yne*. C_nH_{2n-2} Ex.1 Propyne C_3H_4

<u>MEMORIZE THE POLYATOMIC IONS!</u>

POLYATOMIC IONS & SPECIAL METAL IONS

+3, +2. and +1 Charge (positive two and one)

Aluminum ion	Al^{3+}	Silver ion	Ag^{1+}	Ammonium	NH_4^{1+}
Zinc ion	Zn^{2+}	Mercury (I) ion	Hg_2^{2+}	Hydronium	H_3O^{1+}
Cadmium ion	Cd^{2+}				

-1 Charge (negative one)

Acetate	CH_3COO^{1-}	Cyanide	CN^{1-}		
	$C_2H_3O_2^{1-}$	Thiocyanate	SCN^{1-}		
Hydroxide	OH^{1-}				
Bromate	BrO_3^{1-}	Chlorate	ClO_3^{1-}	Iodate	IO_3^{1-}
Perbromate	BrO_4^{1-}	Perchlorate	ClO_4^{1-}	Periodate	IO_4^{1-}
Bromite	BrO_2^{1-}	Chlorite	ClO_2^{1-}	Iodite	IO_2^{1-}
Hypobromite	BrO^{1-}	Hypochlorite	ClO^{1-}	Hypoiodite	IO^{1-}
Nitrate	NO_3^{1-}	Nitrite	NO_2^{1-}		
Permanganate	MnO_4^{1-}	Vanadate	VO_3^{1-}		

-2 Charge (negative two) and their derivatives

		DERIVATIVES (note—different charge)	
Sulfate	SO_4^{2-}	Hydrogen sulfate (bisulfate)	HSO_4^{1-}
Sulfite	SO_3^{2-}	Hydrogen sulfite (bisulfite)	HSO_3^{1-}
Thiosulfate	$S_2O_3^{2-}$		
Selenate	SeO_4^{2-}		
Tellurate	TeO_4^{2-}		
Carbonate	CO_3^{2-}	Hydrogen carbonate (Bicarbonate)	HCO_3^{1-}
Silicate	SiO_3^{2-}	Hydrogen silicate	$HSiO_3^{1-}$
Chromate	CrO_4^{2-}		
Dichromate	$Cr_2O_7^{2-}$		
Molybdenate	MoO_4^{2-}		
Tungstate	WO_4^{2-}		
Tartrate	$C_4H_4O_6^{2-}$		
Tetraborate	$B_4O_7^{2-}$		
Oxalate	$C_2O_4^{2-}$	Hydrogen oxalate (binoxalate)	$HC_2O_4^{1-}$
Peroxide	O_2^{2-}		

-3 Charge (negative three) and their derivatives

		DERIVATIVES (note-different charge)	
Phosphate	PO_4^{3-}	Hydrogen Phosphate	HPO_4^{2-}
		Dihydrogen Phosphate	$H_2PO_4^{1-}$
Phosphite	PO_3^{3-}	Hydrogen Phosphite	HPO_3^{2-}
		Dihydrogen Phosphite	$H_2PO_3^{1-}$
Arsenate	AsO_4^{3-}		
Arsenite	AsO_3^{3-}		

III: IDENTIFYING & BALANCING CHEM. EQ.

CHEMICAL REACTIONS AND EQUATIONS: Since there are thousands of chemical reaction that have been identified, it is useful to categorize these into groups, or types. Five of the most common are described below.

REACTANTS $\rightarrow$ PRODUCTS

1. ***Synthesis:*** two elements or simple compounds $\rightarrow$ one compound

   $A + B \rightarrow AB$

2. ***Decomposition:*** a compound decomposes into two elements or simpler compounds

   $AB \rightarrow A + B$

3. ***Single replacement:*** a free element + compound $\rightarrow$ new free element + new compound (the element coming in must be MORE active than the element it is replacing in the compound…. Check the Activity Series)

   $A + BX \rightarrow B + AX$

4. ***Double replacement:*** two compounds switch ions

   $AX + BY \rightarrow AY + BX$

5. ***Combustion:*** reaction of compound or element with oxygen

   Carbon compound + oxygen $\rightarrow$ Carbon dioxide + water

IV. MATH SKILLS PRACTICE

A PERCENT ERROR: When concluding an experiment, scientists like to know how **accurate** their results are (how close their answer is to the "accepted" (literature or actual) answer in either absolute terms or in relative terms. For instance, if you measure the width of a room to be 4 meters, where in reality it is 5 meters, you are off by 1 meter (**absolute error**), but in relative terms you are off by 1 part in 5, or 20% (**relative error**). If you then measure the distance from your front door to the front door of the school and obtain 15352 meters, whereas in reality it is 15353, you are still off by 1 meter (**absolute error**), but in relative terms you are off by 1 part in 15353, or 0.0065% **(relative error)**. You can see therefore that both experiments give the same absolute error, but quite different relative errors. Therefore, we will express our experimental errors as a **relative or percent error**.

$$\textbf{Percent error} = \frac{\textbf{(actual value – experimental value)}}{\textbf{(actual value)}} \textbf{ X 100}$$

Percent error is always expressed as the **absolute value** (IT SHOULD NEVER BE NEGATIVE)**.**

B METRIC SYSTEM: You should memorize the metric prefixes and what they stand for:

10^{-9}	or	.000000001	=	nano (n)	10^{0}	or	1	=	BASE
10^{-6}	or	.000001	=	micro (μ)	10^{1}	or	10	=	deka (da)
10^{-3}	or	.001	=	milli (m)	10^{2}	or	100	=	hector (h)
10^{-2}	or	.01	=	centi (c)	10^{3}	or	1000	=	kilo (k)
10^{-1}	or	.1	=	deci (d)	10^{6}	or	1000000	=	mega (M)

*Please note the base units do not have prefixes (e.g. second, meter, ampere, liter, gram)

C DIMENSIONAL ANALYSIS: You should be able to convert metric and nonmetric units using the conversion factor or unit cancellation method. DO NOT JUST MOVE THE DECIMAL POINT OR YOU WILL GET THIS WRONG!

D SOLVING PROBLEMS WITH ALGEBRAIC FORMULAS: You should be able to determine what formula needs to be used and solve for the missing variable. SHOW ALL WORK – the WORK is more important that the correct answer, as I am assessing your ability to do the requisite math!!!

E SCIENTIFIC NOTATION You should know how to convert between standard and scientific notation. Remember, numbers larger than 1 have positive exponents; numbers less than 1 have negative exponents.

Also, you should know how to use your calculation to input a number in scientific notation (e.g. for 6.02×10^{23}) You would press ([6][.][0][2][EE][2][3]) The EE or EXP button on your calculator is often a 2^{nd} function (You need to press 2^{nd} and then another key). In TI calculators, you often need to press 2^{nd} and then x^{-1} (the key above the 7).

F GRAPHING When graphing, you should:

- Plot the independent variable (x) on the x-axis.
- Plot the dependent variable (y) on the y-axis.
- Make your scale (the size of your graph) as large as possible while making each box on a graph paper an easy to use round number.
- Label the axes with the variable and unit
- Title the graph.

DEMONSTRATE YOUR UNDERSTANDING OF CONCEPTS:

I. MATTER:

1. Fill in the table.

	electron	proton	neutron
Symbol			
Relative charge			
Relative mass (amu)			
Location in the atom			

2. Fill in the table.

Symbol or name (Write in the mass number on the symbol or name)	**Atomic number**	**Mass Number**	**Number of protons**	**Number of neutrons**	**Number of electrons**
a)	8			8	
b) As				42	
c)				21	20
d) Na		23			
e) Carbon - 14					
f) ^{10}B					
g)		56	26		

Symbol or name (Write in the mass number on the symbol or name)	**Atomic number**	**Mass Number**	**Number of protons**	**Number of neutrons**	**Number of electrons**	**Anion or cation?**
h) Ba^{+2}				81		
i) P^{3-}		31				

***The last two are ions! Make sure you adjusted the number of electrons to properly reflect the charge.**

3. Give the name of the ANIONS formed in the previous problem:

_____

4. Given the following relative abundances and isotopic masses, calculate the average atomic mass (SHOW WORK): If you are doing this correctly, the answer you get will be very close to the atomic mass found on the periodic table.

   Boron – 10 (10.0129 amu, 19.9%) and Boron 11 (11.0093 amu, 80.1%).

5. Indicate the number of **valence** electrons each of the following elements has, and the charge of the ion that it makes:

Element	**# of Valence e^-**	**Charge**	**Element**	**# of Valence e^-**	**Charge**
Ex. Barium	2	+2	f) Calcium		
a) Phosphorus			g) Nitrogen		
b) Potassium			h) Sulfur		
c) Chlorine			i) Fluorine		
d) Sodium			j) Rubidium		
e) Oxygen			k) Magnesium		

6. Are the following elements, compounds, or mixtures?
   a. $Cu(NO_3)_2$ b. Cu c. N_2 d. Saltwater e. H_2O

7. Are the following chemical or physical properties? If PHYSICAL, indicate whether they are intensive or extensive.
   a. Volume
   b. Flammability
   c. Hardness
   d. Odor
   e. Reactivity to light
   f. Boiling point
   g. Density
   h. Mass

8. Are the following chemical or physical changes?
   a. Boiling water
   b. Electrolysis (electrical decomposition) of water)
   c. Burning paper
   d. Heating water
   e. Melting gold and nickel together to make an alloy
   f. Dissolving salt in water
   g. Frying an egg
   h. Cracking a glow stick so it starts to glow

II. WRITING CHEMICAL FORMULAS & NAMING COMPOUNDS

Write the formula. Please note – you should be able to determine if something is ionic, binary molecular, acid, or hydrocarbon:

1. Magnesium fluoride _____
2. Sodium nitride _____
3. Ammonium chloride _____
4. Potassium carbonate _____
5. Aluminum sulfide _____
6. Strontium phosphide _____
7. Barium nitrate _____
8. Aluminum chromate _____
9. Zinc hydroxide _____
10. Mercury (II) fluoride _____
11. Iron (II) nitrate _____
12. Iron (III) sulfate _____
13. Cobalt (II) carbonate _____
14. Copper (I) chloride _____
15. Tin (II) sulfate _____
16. Carbon (IV) oxide _____
17. Sulfur (VI) oxide _____
18. Nitrogen monoxide _____
19. Diphosphorus pentoxide _____
20. Tetraphosphorus decaoxide _____
21. Hydrobromic acid _____
22. Hydrochloric acid _____
23. Hydrofluoric acid _____
24. Hydroiodic acid _____

25. Hydrosulfuric acid _____
26. Nitric acid _____
27. Chloric acid _____
28. Sulfuric acid _____
29. Phosphoric acid _____
30. Sulfurous acid _____
31. Nitrous acid _____
32. Chlorous acid _____
33. Methane _____
34. Hexane _____
35. Decane _____
36. Ethene _____
37. Propene _____
38. Octene _____
39. Butyne _____
40. Nonyne _____

Write the name. Please note – you should be able to determine if something is ionic, binary molecular, acid, or hydrocarbon:

1. CaF_2 _____
2. K_2S _____
3. NaH _____
4. Al_2Se _____
5. Li_2Te _____
6. SrI_2 _____
7. $AgCl$ _____
8. Na_3N _____
9. Mg_3P_2 _____
10. $NaClO_4$ _____
11. Li_2CO_3 _____
12. $Al_2(CrO_4)_3$ _____
13. $(NH_4)_2SO_3$ _____
14. SnO_2 _____
15. $FeSO_3$ _____
16. $CuNO_3$ _____
17. $Cu(NO_3)_2$ _____
18. $Pb(OH)_2$ _____
19. $Ni_3(PO_4)_2$ _____
20. $CuCH_3COO$ _____
21. $Sn(CrO_4)_2$ _____
22. Fe_2O_3 _____
23. N_2O_4 _____
24. CO _____
25. P_4O_{10} _____
26. N_2O _____
27. XeF_6 _____
28. O_2F _____
29. SBr_6 _____
30. HF _____
31. HAt _____
32. H_2S _____
33. HIO_3 _____
34. H_2SO_4 _____
35. HNO_3 _____
36. H_3PO_3 _____
37. C_4H_6 _____
38. C_3H_8 _____
39. C_2H_4 _____
40. C_6H_{10} _____

III: IDENTIFYING & BALANCING CHEM. EQ.

Identify each of the equations as synthesis (s), decomposition (d), single replacement (sr), double replacement (dr), or combustion (comb). Balance.

1. $HgO \rightarrow Hg + O_2$ _____
2. $NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$ _____
3. $Mg + HCl \rightarrow MgCl_2 + H_2$ _____
4. $H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2$ _____
5. $NaOH + HCl \rightarrow NaCl + H_2O$ _____
6. $Al_2(SO_4)_3 + Ca(OH)_2 \rightarrow Al(OH)_3 + CaSO_4$ _____
7. $H_2O_2 \rightarrow H_2O + O_2$ _____
8. $Cl_2 + NaBr \rightarrow Br_2 + NaCl$ _____
9. $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$ _____
10. $NaClO_3 \rightarrow O_2 + NaCl$ _____
11. $Fe + O_2 \rightarrow Fe_2O_3$ _____
12. $Ca(OH)_2 + HNO_3 \rightarrow Ca(NO_3)_2 + H_2O$ _____
13. $Na_2O + CO_2 \rightarrow Na_2CO_3$ _____
14. $H_2 + N_2 \rightarrow NH_3$ _____
15. $C_3H_8O + O_2 \rightarrow CO_2 + H_2O$ _____
16. $Na + Br_2 \rightarrow NaBr$ _____
17. $Al_2O_3 \rightarrow Al + O_2$ _____
18. $HgO + Cl_2 \rightarrow HgCl + O_2$ _____

IV. MATH SKILLS PRACTICE

1. You measure the density of water to be 1.3 g/ mL when the actual value is 1.0 g/ mL. What is your percent error?

2. You mass a 500 g object on a scale, but your reading is 502.3 g. What is your percent error?

3. According to your percentage error, which of your two measurements (from question #1 or from question #2) is MORE ACCURATE (on a relative scale – not based on absolute error)?

4. In a laboratory experiment a student measures the density of a piece of iron as 7.01 g/cm^3. The value given in a table of physical constants (literature value) is 7.87 g/cm^3. What is the student's percent error (relative error)?

B METRIC SYSTEM:

Give the relationships between each of the following UNITS WITH A METRIC PREFIX and the BASE UNIT:

1. 1 km = ____ m
2. 1 g = _____ cg
3. _____ mm = 1 m
4. 1 kL =_____ L
5. _____ μL = 1 L
6. _____dL = 1 L
7. _____dm = 1 m
8. 1 A = _____mA
9. 1 dam = _____m
10. 1 Mwt = _____ wt
11. 1 kwt = _____wt
12. 1 m = _____ cm
13. _____ g= 1 hg
14. _____nA = 1 A

C DIMENSIONAL ANALYSIS:

I want to see the work involving unit cancellation (dimensional analysis).
Use Kahn Academy if you need to re-learn this very important skill.

METRIC CONVERSIONS

1. How many kg are in 32,000 g?
2. How many mL are in 5 L?
3. How many km are in 140 cm?
4. How many mL are in 53 kL?
5. How many L are in 625 cm^3?
6. How many μm are in 576 m?
7. An object is traveling at a speed of 7500 cm/s. Convert to km/hr.
8. The speed limit in a town is 35 miles/hr. What is it in km/hr (1 mile = 5280 feet; 1 ft = 30 cm)

NON-METRIC CONVERSIONS

9. A child is sent to a store with $3.00 to buy donuts. If donuts cost $0.95 per dozen, how many can be bought? Assume they can be bought individually.

D SOLVING PROBLEMS WITH ALGEBRAIC FORMULAS:

SOME USEFUL FORMULAS

D = m/v	**Q = mCΔT**	**n = m/MM**	**% = part/ whole**
D = density	Q = heat transferred	n = number of moles	
m = mass	m = mass	m = mass	**rate = distance/ time**
v = volume	C = specific heat capacity	MM = molar mass from	
	$\Delta T = T_{final} - T_{initial}$	periodic table	

PURE ALGEBRA PROBLEMS:

10. $m_1C_1\Delta T_1 + m_1\Delta H_1 = m_2C_2\Delta T_2$ — Solve for m_1 in terms of the other variables.

11. $\frac{PV}{T} = \frac{mR}{MM}$ — Solve for MM in terms of the other variables.

12. D = m/v — Rearrange this equation to solve for m.
Rearrange this equation to solve for v.

WORD PROBLEMS:

13. A certain gas under given conditions has density of 1.34×10^{-4} g/cm^3. What volume will 250.0 g of this gas occupy (under the same conditions)?

14. A 5-gram sample of an alloy, composed of copper and zinc, contains 3.2 g copper. What percent of the alloy is zinc?

15. An organic substance containing chlorine was found to be 92.2% chlorine by mass. An analysis of a sample of the substance showed it to contain 52.5 g of chlorine. What was the mass of the sample analyzed?

16. Calculate the molar mass of $Ca(NO_3)_2$. (Hint: You need your periodic table)

17. How many moles are in 450.0 g of $Ca(NO_3)_2$. (Hint: You need your periodic table)

18. Given the equation,: $Al_2(SO_4)_3 + 3\ Li_2CO_3 \rightarrow Al_2(CO_3)_3 + 3\ Li_2SO_4$, how many moles of $Al_2(CO_3)_3$ will be produced from 5 moles of $Al_2(SO_4)_3$? (Hint: The coefficients in the equation tell you the MOLE RATIO)

19. What mass of water can be heated from 20.0°C to 98.0°C by the absorption of 5,425 J of heat? (Specific heat of water = 4.18 J/g °C)

20. A light year is the distance light can travel in one year. If the sun is 150 000 000 km away, how many light years is the sun from earth. Light travels at a speed of 3.0×10^{10} cm/s?

E SCIENTIFIC NOTATION

21. Convert the following from standard to scientific notation or vice versa WITHOUT the use of a calculator.

a) 0.00001020 b) 103.2 c) 0.0050 d) 16,540,000

22. Use a calculator to solve the following – CHECK YOUR ANSWER FOR REASONABLENESS!!!!) If it doesn't make sense you probably put it into your calculator incorrectly!!!):

a) $(2.0 \times 10^{-6})(4.0 \times 10^{18)} =$

b) $(9.0 \times 10^{2}) \div (6.0 \times 10^{-21}) =$

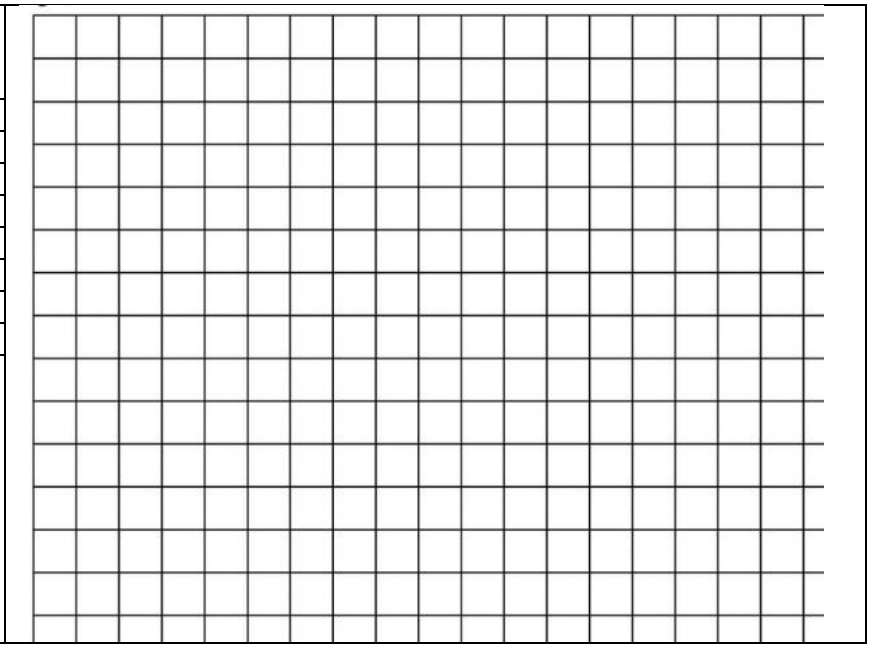
c) $8.25 \times 10^{24} \div (3 \times 7.20 \times 10^{-6}) =$

F GRAPHING When graphing, you should:

- Plot the independent variable (x) on the x-axis.
- Plot the dependent variable (y) on the y-axis.
- Make your scale (the size of your graph) as large as possible while making each box on a graph paper an easy to use round number.
- Label the axes with the variable and unit
- Title the graph.

Plot a graph of the following data: Draw the best fit line.

Dependent variable Mass (g)	*Independent variable* Volume (cm^3)
0.05	0.71
2.0	2.9
3.5	5.0
4.5	6.4
5.0	7.1
6.5	9.3
7.0	10.0
8.5	12.1
10.0	14.3



1. Calculate the slope. _____

2. What is the mass of a 3.0 cm^3 sample? _____

3. What would be the volume of a 45 g sample? _____

4. What type of relationship exists between mass and volume (i.e. direct or inversely proportional)? _____

5. What physical characteristic of the substance does the slope represent? (THINK! Replace y/x with the actual properties you are measuring!) _____