AP Chemistry Summer Assignment 2015

AP Chemistry is an extremely challenging course. While it is definitely not about memorization, having these items memorized is essential for success for learning the concepts covered in the course. I have include several resources in this packet.

1. There is a list of ions that you must know on the first day. Utilize the suggestions for making the process of memorization easier. For instance, most of you will remember that most of the monatomic ions have charges that are related directly to their placement on the periodic table. There are naming patterns that greatly simplify the learning of the polyatomic ions as well. I have include a sheet of flashcards for the polyatomic ions that you must learn. I strongly suggest 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.

   **There will be an test on the first day of class to assess your knowledge of polyatomic ions... BE PREPARED!!

2. Memorize the solubility rules and be able to identify whether a substance will break into ions when dissolved in water.

   **There will be an test on the first day of class to assess your knowledge of solubility rules... BE PREPARED!!

3. There are a number of questions that are meant to help you review the material that you learned in Honors Chemistry 2 will be expected to know as we begin AP Chemistry.

Also included is a copy of the Periodic Table used in AP Chemistry. Notice this is not the table that you used before. The AP table is the same that the College Board allows you to use on the AP Chemistry Exam. Notice that it has the symbols for the elements but not the written names. You need to take that into consideration when studying for the aforementioned quiz!

Do not let the fact that there are no flash cards for the monatomic ions suggest to you that monatomic ions are not important. They are every bit as important as the polyatomic ions. If you have trouble identifying the charges of monatomic ions (or the naming system) then I suggest you make yourself some flashcards for those as well.

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 and I will get back to you.

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1. **Nomenclature**

Rules for Naming Ionic Compounds (metal + nonmetal)

A. Balance Charges (charges should net zero)

B. Cation is always written first (in name and formula)

C. Change the ending of the anion to -ide (unless polyatomic ion, then named as given)

I. Name these binary compounds of two non metals

IF_7_____ N_2O_5_____ XeF_2_____

N_2O_4_____ As_4O_{10}_____ SF_6_____

PCl_5_____ S_2Cl_2_____

II. Name these binary compounds with a fixed charge metal.

$AlCl_3$_____ MgO_____ BaI_2_____

KI_____ $SrBr_2$_____ Na_2S_____

CaF_2_____ Al_2O_3_____

III. Name these binary compounds of cations with variable charges. (use roman numerals)

$CuCl_2$_____ Fe_2O_3_____ SnO_____

$PbCl_4$_____ Cu_2S_____ HgS_____

AuI_3_____ CoP_____

IV. Name these compounds with polyatomic ions.

$Fe(NO_3)_3$_____ $NaOH$_____ Cu_2SO_4_____

$Ca(ClO_3)_2$_____ KNO_2_____ $NaHCO_3$_____

NH_4NO_2_____ $Cu_2Cr_2O_7$_____

Acids- Foe simplicity the acids we will be concerned with naming are really just a special class of ionic compounds where the cation is always H^+. So, if the formula has hydrogen written first, then this usually indicates that the hydrogen is a H^+ cation and that the compound is an acid. When dissolved in water, acids produce H^+ ions (also called protons, since removing the single electron from a neutral hydrogen atom leaves behind one proton).

Rules for Naming an Acid

A. When the name of an anion ends in -ide, the acid name begins with hydro-, the stem of the anion has the suffix -ic and it is followed by the word acid.

-ide becomes hydro_____ic acid

Example: Cl^- is the Chloride ion so HCl = hydrochloric acid

HCl _____ H_2S _____

HI _____ HF _____

B. When the anion name ends in -ite, the stem of the anion has the suffix -ous and it is followed by the word acid.

-ite becomes _____ous acid

Example: ClO_2^- is the chlorite ion, so $HClO_2$ = chlorous acid

C. When the anion name ends in -ate, the stem of the anion has the suffix -ic and it is followed by the word acid.

-ate becomes _____ic acid

Example: ClO_3^- is the chlorate ion, so $HClo_3$ = chloric acid

I like to remember - "I ate something and got sick. I spend nite at the house.

I. Name the following acids using the correct naming rules.

$HClO_4$ _____ H_2SO_4 _____ $HC_2H_3O_2$ _____

H_3PO_4 _____ HNO_2 _____ H_2CrO_4 _____

$H_2C_2O_4$ _____ H_2CO_3 _____

II. Name these compounds appropriately.

Hint: Some of these compounds are covalently bonded (nonmetal + nonmetal) so you will have to use prefixes to indicate how many of each element is in the compound: *mono-, di-, tri-, tetra-, penta-, hexa-, hepta-, octa-, nona-, deca-.*

CO _____ NH_4CN_____ HIO_3 _____

NI_3 _____ AlP _____ OF_2 _____

$LiMnO_4$_____ HClO _____ SO_2 _____

$CuCr_2O_7$_____ K_2O _____ HF _____

FeF_3 _____ $KC_2H_3O_2$ _____ MnS _____

III. Write the chemical formula.

Tin (IV) phosphide _____ copper (II) cyanide _____

Magnesium hydroxide _____ sodium peroxide _____

sulfurous acid _____ lithium silicate _____

potassium nitride _____ chromium (III) carbonate _____

gallium arsenide _____ cobalt (II) chromate _____

zinc fluoride _____ dichromic acid _____

2. Composition

Complete the following problems showing all work.

1. A 0.941 gram piece of magnesium metal is heated and reacts with oxygen. The resulting magnesium oxide weighed 1.560 grams. Determine the percent composition of each element in the compound.

2. Determine the empirical formula given the following data for each compound:
   a) Fe = 63.53%, S = 36.47%

   b) Fe = 46.55%, S = 53.45%

3. A compound contains 21.6% sodium, 33.0% chlorine, 45.1% oxygen. Determine the empirical formula of the compound.

3. Solubility rules

I. Review solubility rules and identify each of the following compounds as soluble (S) or insoluble (I) in water. You must memorize the solubility rules given in this packet. *You may want to spend time memorizing the solubility rules before you compete the next two sections, try them without using your solubility chart, and then check them using the chart.*

Na_2CO_3 _____	$CoCO_3$ _____	$Pb(NO_3)_2$ _____
K_2S _____	$BaSO_4$ _____	$(NH_4)_2S$ _____
AgI _____	$Ni(NO_3)_2$ _____	KI _____
FeS _____	$PbCl_2$ _____	$CuSO_4$ _____
Li_2O _____	$Mn(C_2H_3O_2)_2$ _____	$Cr(OH)_3$ _____
$AgClO_3$ _____	$Sn(SO_3)_4$ _____	FeF_2 _____

II. Write out the balanced chemical equation for each of the following double replacement reactions. Predict whether each of these double replacement reactions will give a precipitate or not based on the solubility of the products. If yes, identify the precipitate.

silver nitrate and potassium chloride _____

magnesium nitrate and sodium carbonate _____

strontium bromide and potassium sulfate _____

cobalt (III) bromide and potassium sulfide _____

ammonium hydroxide and copper (II) acetate _____

lithium chlorate and chromium (III) fluoride _____

4. Balancing Equations

I. Balance the following equations with the lowest whole number coefficients.

____S_8 + ____ O_2 →____ SO_3

____$C_{10}H_{16}$ + ____ Cl_2 →____ C + ____ HCl

____Fe + ____ O_2 →____ Fe_2O_3

____$C_7H_6O_2$ + ____ O_2 →____CO_2 + ____ H_2O

____$KClO_3$ →____ KCl + ____ O_2

____H_3AsO_4 →____As_2O_5 + ____ H_2O

____V_2O_5 + ____ HCl →____$VOCl_3$ + ____ H_2O

____$Hg(OH)_2$ + ____ H_3PO_4 →____ $Hg_3(PO_4)_2$ + ____ H_2O

II. Balance the following equations and indicate the type of reaction taking place:

1) ____ NaBr + ____ H_3PO_4 →____ Na_3PO_4 + ____ HBr Type of reaction: _____

2) ____ $Ca(OH)_2$ + ____ $Al_2(SO_4)_3$ →____ $CaSO_4$ + ____ $Al(OH)_3$ Type of reaction: _____

3) ____ Mg + ____ Fe_2O_3 →____ Fe + ____ MgO Type of reaction: _____

4) ____ C_2H_4 + ____ O_2 →____ CO_2 + ____ H_2O Type of reaction: _____

5) ____ $PbSO_4$ →____ $PbSO_3$ + ____ O_2 Type of reaction: _____

6) ____NH_3 +____I_2 →____N_2I_6 + ____H_2 Type of reaction: _____

5. Stoichiometry and Limiting Factor

1. Given the equation below, what mass of water would be needed to react with 10.0g of sodium oxide?

$Na_2O + H_2O \rightarrow 2NaOH$

2. $2NaClO_3 \rightarrow 2NaCl + 3O_2$

What mass of sodium chloride is formed along with 45.0g of oxygen gas?

3. $4NH_3 + 5O_2 \rightarrow 4NO + 6\ H_2O$

What mass of water will be produced when 100.0g of ammonia is reacted with excess oxygen?

4. If the reaction in #3 is done with 25.0g of each reactant, which would be the limiting factor?

5. $Na_2S + 2AgNO_3 \rightarrow Ag_2S + 2NaNO_3$
If the above reaction is carried out with 50.0g of sodium sulfide and 35.0g of silver nitrate, which is the limiting factor?

What mass of the excess reactant remains?

What mass of silver sulfide would precipitate?

6. $6NaOH + 2Al \rightarrow 2Na_3AlO_3 + 3H_2$
What volume of hydrogen gas (measured at STP) would result from reacting 75.0g of sodium hydroxide with 50.0g of aluminum?

You will need to memorize these rules for the rest of the year... start memorizing over the summer!

SOLUBILITY RULES

1. Salts of ammonium (NH_4^+) and Group IA are always soluble.

2.

a. All chlorides (Cl^-) are soluble except AgCl, Hg_2Cl_2, and $PbCl_2$ which are insoluble.
b. All bromides (Br^-) are soluble except AgBr, Hg_2Br_2, $HgBr_2$, and $PbBr_2$ which are insoluble.
c. All iodides (I^-) are soluble except AgI, Hg_2I_2, HgI_2, and PbI_2 which are insoluble.

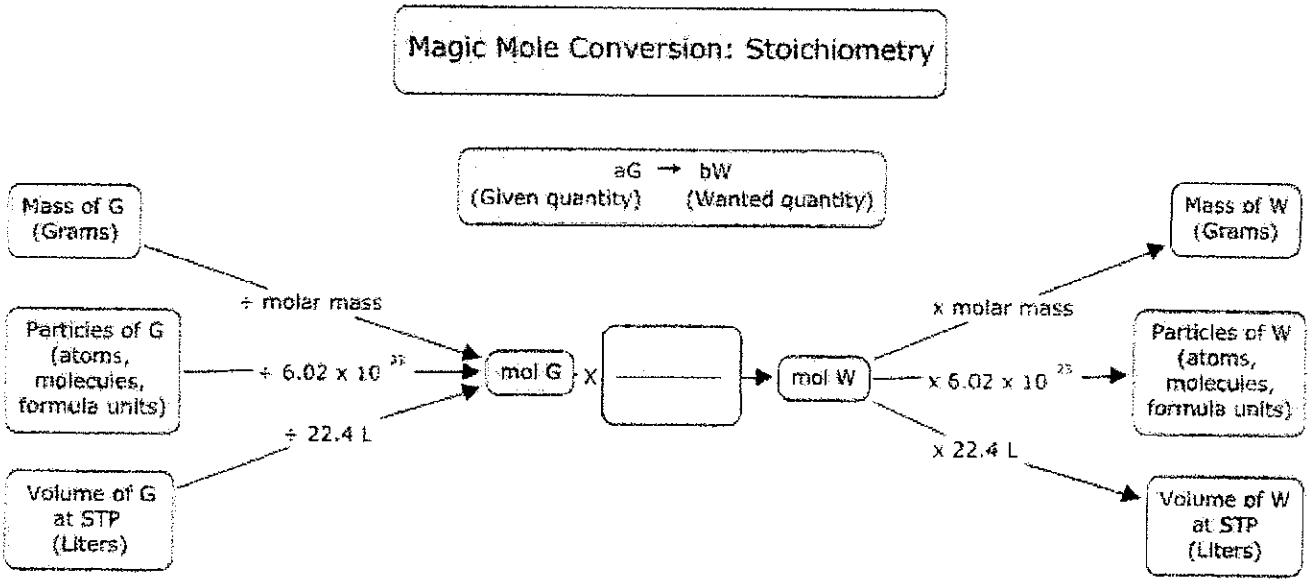
3. Chlorates (ClO_3^-), nitrates (NO_3^-), and acetates (CH_3COO^-) are soluble.

4. Sulfates (SO_4^{-2}) are soluble except $CaSO_4$, $SrSO_4$, $BaSO_4$, Hg_2SO_4, $HgSO_4$,$PbSO_4$, and Ag_2SO_4 which are insoluble.

5. Phosphates (PO_4^{-3}), and carbonates (CO_3^{-2}) are insoluble except NH_4^+ and Group IA compounds.
6. All metallic oxides (O^{-2}) are insoluble except NH_4^+ and Group IA compounds.

7. All metallic hydroxides (OH^-) are insoluble except NH_4^+ and Group IA and Group IIA from calcium down.

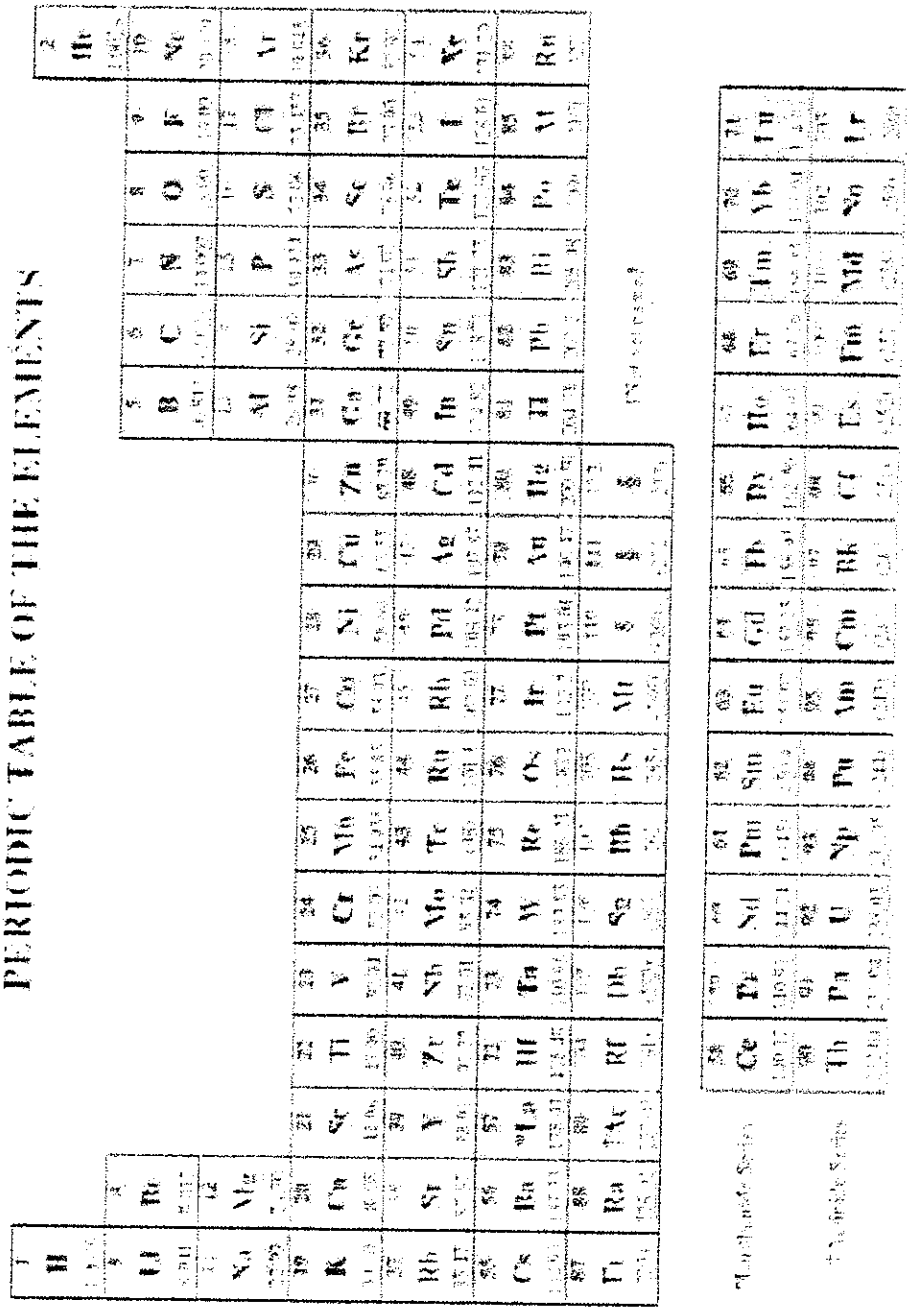
8. All sulfides (S^{-2}) are insoluble except NH_4^+ and Groups IA and IIA.



INFORMATION IN THE TABLE BELOW AND IN THE TABLES ON PAGES 3-5 MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS



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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
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
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

"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 sulfate 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

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^-