AP Chemistry Summer Assignment
Alta High School

Dear AP Chemistry Student,

Welcome to AP Chemistry. I am so happy that you are enrolled in this class and am looking forward to the work we will do in class!

In order to ensure the best start for everyone next fall, I have prepared a Summer Review Packet and Assignment that is meant to review some things that you have already learned so that you have them firmly in mind for the start of school, as well as some new things you will need to memorize. I could wait to throw the new things 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. I have included flash cards for the polyatomic ions to help you out.

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 test. However, they will quickly forget their solubility rules and the ions and will struggle every time we use this information in lectures, homework, quizzes, tests and labs. All research on memory shows us that frequent, short periods of study, spread over long periods of time will produce better retention than long periods of study of over a short period of time.

This packet includes A LOT of reference material followed by the assignment. There are also many chemistry resources available via the Internet. One of my favorite is the ChemTeam site:
http://www.chemteam.info/ChemTeamIndex.html

With the ready access to hundreds of websites either in your home or at the local library, I am confident that you will have sufficient resources to prepare adequately for the fall semester.

The text book we will be using is Chemistry the Central Science by Brown, Lemay and Bursten. You can find a pdf of the text book at this link:
http://mhschemistry.com/mhs/AP_Chemistry_files/Chemistry%20%20The%20Central%20Science%2012th%20Edition.pdf

Feel free to use it for reference.

You may contact me by email: Margaret.coleman@canyonsdistrict.org this summer. I will do my best to answer your questions ASAP.

This assignment will be collected and graded during the first week of the new school year. There will also be a short test on the information in the 2nd week of school.

In addition to the summer assignment, I would appreciate if you would email me with the following information by July 14th.

1. Make the Subject: AP Chem.: < Insert your name here>
2. Now introduce yourself (your name) and tell me a little about yourself like: What do you like to do (hobbies, sports, music, interests, etc)? Do you have a job? Tell me a little bit about what is important to you- friends, family, pets, etc. What are your strengths/weaknesses academically? What is your career goal? Is this your first AP course? Why are you taking this class? What are your study skills? Etc. Anything interesting?

I will see you in the fall!

M. Coleman

AP Chemistry Summer Review Packet and Assignement

Part One: Metric Prefixes and conversion table

You must memorize from mega to micro at the very least.
Here is a mnemonic device to help you:

"**M**ighty **K**ind **H**enry **D**ied **By** **D**rinking **C**hunky **M**ilk, **M**aybe"
(**M**ega, **K**ilo, **H**ecto, **D**eka, **B**ase unit, **D**eci, **C**enti, **M**illi, **M**icro)

METRIC PREFIXES			
Multiples and Submultiples	**Prefixes**	**Symbols**	**Meaning**
1,000,000,000,000 = 10^{12}	tera	T	trillion
1,000,000,000 = 10^{9}	giga	G	billion
1,000,000 = 10^{6}	mega	M	million
1000 = 10^{3}	kilo	k	thousand
100 = 10^{2}	hecto	h	hundred
10 = 10^{1}	deka	da	ten
Unit 1 = 10^{0}	Base unit		
1 = 10^{-1}	deci	d	tenth
.01 = 10^{-2}	centi	c	hundredth
.001 = 10^{-3}	milli	m	thousandth
.000001 = 10^{-6}	micro	µ	millionth
.000000001 = 10^{-9}	nano	n	billionth
.000000000001 = 10^{-12}	pico	p	trillionth

Part Two: Ionic Compound Solubility

The solubility of ionic compounds (in water) varies depending on the ions involved in the compound. General solubility guidelines are usually memorized.

<u>General Solubility Rules (to be memorized)</u>

Always Soluble:

- o All compounds containing alkali metal cations (Li^+, Na^+, K^+, Rb^+, Cs^+), and the ammonium ion (NH_4^+) are soluble.
- o All compounds containing NO_3^- , ClO_4^- , ClO_3^- , and $C_2H_3O_2^-$ anions are soluble.

Generally Soluble:

- o Bromides, Iodides and Chlorides are soluble except those containing Pb^{2+}, Ag^+, or Hg^{2+} (remember "brickle peebag hag" aka Br^- I^- ,Cl^- Pb^{2+},Ag^+, Hg^{2+})
- o Flourides (F^-) are soluble except except with Ca^{2+}, Ba^{2+} , Sr^{2+}, Pb^{2+}, Mg^{2+} (Remember: CBS-PM)
- o All sulfates (SO_4^{2-}) are soluble except with containing Ca^{2+}, Ba^{2+}, Sr^{2+}, Pb^{2+}, Hg^{2+}. (Remember: CBS-PH)

Generally Insoluble:

- o All hydroxides (OH^-)are insoluble except compounds of the alkali metals (Li^+, Na^+, K^+, Rb^+, Cs^+), Ca^{2+}, Ba^{2+}, Sr^{2+} (CBS) and NH_4^+.
- o All compounds containing PO_4^{3-} , S^{2-} , CO_3^{2-} , and SO_3^{2-} ions are insoluble except those that also contain alkali metals (Li^+, Na^+, K^+, Rb^+, Cs^+), or NH_4^+.

Part Three: Common Ions and their charges (to be memorized)

A mastery of the common ions, their formulas and their charges, is essential to success in AP Chemistry.

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

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

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

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)

GO ON TO THE NEXT PAGE.

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^-

Part Four: Nomenclature

IUPAC Nomenclature: The current convention for naming chemical compounds. IUPAC stands for "International Union of Pure and Applied Chemistry".

<u>Ionic Compound Nomenclature</u>

1. Cation is always written first (in name and in formula)
   a. If the cation is **not** a transition metal (d-block metal), then you just name as is.
   b. If the cation is a transition metal, you must give it a charge. Transition metals have variable charges. To find its charge, look at what it is bonded to.
      Ex: CuO
         Cation: Copper (II)
            (copper is transition. It is bonded to *one* oxygen that carries a -2 charge. Therefore the copper must have a +2 charge, hence the (II) after the copper)
         Anion: Ox~~ygen~~ ide
         Name: Copper (II) Oxide
2. Anion is written last: change the last syllable of any monatomic anion to –ide
   Ex: $MgCl_2$
      Cation: Magnesium
      Anion: Chlor~~ine~~ ide
      Name: Magnesium Chloride
3. Polyatomic ion names remain the same (don't change the ending.
   Ex: $NaNO_3$
      Cation: Sodium
      Anion: Nitrate
      Name: Sodium Nitrate

<u>Covalent compound nomenclature</u>

1. The first element is named first, using the elements name.
2. Second element is named as an Anion (suffix "-ide")
3. Prefixes are used to denote the number of atoms
4. "Mono" is not used to name the first element

Number	Greek prefix
1	Mono
2	Di
3	Tri
4	Tetra
5	Penta
6	Hexa
7	Hepta
8	Octa
9	Nona
10	Deca
12	Dodeca

Note: when the addition of the Greek prefix places two vowels adjacent to one another, the "a" (or the "o") at the end of the Greek prefix is usually dropped; e.g., "nonaoxide" would be written as "nonoxide", and "monooxide" would be written as "monoxide". The "i" at the end of the prefixes "di-" and "tri-" are never dropped.

Ex: CO_2 Carbon monoxide

P_2O_4 diphosphorus tetraoxide

N_2O dinitrogen monoxide

Acid Nomenclature

1. When the name of the anion ends in –ide, the acid name begins with the prefix hydro-, the stem o the anion has the suffix –ic and it is followed by the word acid
   -ide becomes hydro _____ic Acid
   Ex: HCl: Cl- is the Chlor**ide** ion so HCl = **hydro**chlor**ic acid**

2. When the anion name ends in –ite, the acid name is the stem of the anion with the suffix – ous, followed by the word acid.
   -ite becomes ______ous Acid
   Ex: ClO_2^{-1} is the Chlor**ite** ion so $HClO_2$. = Chlor**ous** acid.

3. When the anion name ends in –ate, the acid name is the stem of the anion with the suffix –ic, followed by the word acid.

   -ate becomes ______ic Acid
   ClO_3^{-1} is the Chlor**ate** ion so $HClO_3$ = Chlor**ic** acid.

Part Five: Sig Figs

A. **Rules for counting sig figs**: Read from the left and start counting sig figs when you encounter the first non-zero digit

1. All non zero numbers are significant (meaning they count as sig figs)
   613 has three sig figs
   123456 has six sig figs

2. Zeros located between non-zero digits are significant (they count)
   5004 has four sig figs
   602 has three sig figs
   6000000000000002 has 16 sig figs!

3. Trailing zeros (those at the end) are significant *only if* the number contains a decimal point; otherwise they are insignificant (they don't count)
   5.640 has four sig figs
   120000. has six sig figs
   120000 has two sig figs – unless you're given additional information in the problem

4. Zeros to left of the first nonzero digit are insignificant (they don't count); they are only placeholders!
   0.000456 has three sig figs
   0.052 has two sig figs
   0.0000000000000000000000000000000052 also has two sig figs!

B. **Rules multiplication/division problems** : The number of sig figs in the final calculated value will be the same as that of the quantity with the fewest number of sig figs used in the calculation.

In practice, find the quantity with the fewest number of sig figs. In the example below, the quantity with the fewest number of sig figs is 27.2 (three sig figs). Your final answer is therefore limited to three sig figs.

(27.2 x 15.63)/ 1.846 = 230.3011918 (this is what you calculator spits out)
In this case, since your final answer it limited to three sig figs, the answer is 230. (rounded down)

C. **Rules for addition/subtraction problems** : The number of *decimal places* in your calculate value will be the same as the number of *decimal places* of the quantitiy with the fewest number of decimal places in the calculation.
In practice, find the quantity with the fewest decimal places. In the example below, this would be 11.1 (this is the least precise quantity).

7.939 + 6.26 + 11.1 = 25.299 (this is what your calculator spits out)
In this case, your final answer is limited to one sig fig to the right of the decimal or 25.3 (rounded up).

D. Rules for combined addition/subtraction and multiplication/division problems
First apply the rules for addition/subtraction (determine the number of sig figs for that step), then apply the rules for multiplication/division.