AP Chemistry Summer Assignment

fig. 1 Democritus' atom

fig. 2 Rutherford's atom

fig. 3 modern atom

The purpose of the AP Chemistry summer assignment is to get or keep you "up to speed" with basic chemistry concepts so that we can hit the ground running in August. You will be tested (Major Test) on the material on this assignment at the end of the first week of school, so you need to be prepared. I would recommend that you look over your first year (Honors or Onlevel Chemistry) notes – if you don't have them, get with somebody who does. A "study buddy" is always a good idea. Seniors, it is especially vital that you pay attention to the material in this assignment as it has been some time since you've even "thought" about chemistry and these skills are going to need to be ready the very first week. There is also some basic information that you will need to memorize – it is important that you commit this information to memory (or become VERY familiar with it), since we will be using it all year. There are problem sets that you will need to work as well. The answers will be posted in my classroom (102) the week before school starts (teachers' pre-planning).

Since the test is not the first day of school, you will be able to check your work and make corrections and, hopefully, remember the basics. The test will be Friday of the first week of school, so be prepared!

I look forward to getting to know each of you better in the coming school year. Enjoy your summer, but don't forget the chemistry!

In addition to the assignment, if you have the time, here are some interesting and readable books about the history of chemistry, how chemistry drove human history and the development of our understanding about the world around us: **Atom** by Isaac Asimov, **Napoleon's Buttons** by Penny Le Couteur & Jay Burreson and **A Short History of Nearly Everything** by Bill Bryson – they are worth the time to read.

Ms. Azeem ☺

p.s. – if you need to reach me during the summer, please email me at azeema@fultonschools.org. I may not get back to you immediately (I'm on vacation, too, remember?), but I do check my email periodically during the summer. Following this page, there are several pages for the assignment, beginning with stuff that you will need to be very familiar with, as well as problem sets to work.

AP Chemistry Summer Assignment – Stuff You Need to KNOW (actually, REMEMBER 😊)!

1. Rules for Naming Acids
    a. When the name of the anion ends in –ide, the acid name begins with the prefix hydro-, the stem of the anion has the suffix –ic and it is followed by the word "acid".
    For example: HCl: Cl- is chlor**ide**, so HCl = hydrochloric acid
    b. 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".
    For example: ClO_2^- is the chlor**ite** ion, so $HClO_2$ = chlorous acid
    c. When the anion name ends in –ate, te acid name is the stem of the anion with the suffix –ic, followed by the word "acid"
    For example: ClO_3^- is the chlor**ate** ion, so $HClO_3$ = chloric acid
    d. When the anion name begins with per-, the acid name begins with per- and the stem of the anion has the suffix –ic and it is followed by the word "acid"
    For example: ClO_4^- is the **per**chlor**ate** ion, so $HClO_4$ = perchloric acid

2. Rules for Naming Ionic Compounds
    a. Balance charges – charges should always = 0
    b. Cation is always written first (in name and in formula)
    c. Change the ending of the anion (if an element) to –ide. If a polyatomic ion, the ion name does not change.
    d. Review the naming for covalent compounds as well!

3. Solubility Rules
    a. All compounds containing alkali metal cations or the ammonium ion are soluble.
    b. All compounds containing NO_3^-, ClO_4^-, ClO_3^-, and $C_2H_3O_2^-$ anions are soluble.
    c. All chlorides, bromides, and iodides are soluble except those containing Ag^+, Pb^{2+}, or Hg^{2+}.
    d. All sulfates are soluble except those containing Hg^{2+}, Pb^{2+}, Sr^{2+}, Ca^{2+}, or Ba^{2+}.
    e. All hydroxides are insoluble, except compounds of the alkali metals, ammonium, Ca^{2+}, Sr^{2+}, or Ba^{2+}.
    f. All compounds containing PO_4^{3-}, S^{2-}, CO_3^{2-}, and SO_3^{2-} are insoluble, except compounds of the alkali metals or ammonium.

4. Decomposition Rules
    a. Most binary compounds (composed of 2 elements) will decompose into the separate elements.
    b. Metal oxides → metal + oxygen gas
    c. Metal chlorates and perchlorates → metal halogen salt + oxygen gas
    d. Metal Carbonates → metal oxide + carbon dioxide
    e. Metal Bicarbonates (HCO_3^-) → metal oxide + carbon dioxide + water
    f. Metal Hydroxides → metal oxide + water
    g. Oxyacids → water + nonmetal oxide
    h. Hydrates → anhydrous salt

5. Polyatomic Ions (common)

Name	Symbol	Charge
Ammonium	NH_4^+	+1
Acetate	$C_2H_3O_2^-$	-1
Bromate	BrO_3^-	-1
Chlorate	ClO_3^-	-1
Chlorite	ClO_2^-	-1
Cyanide	CN^-	-1
Dihydrogen phosphate	$H_2PO_4^-$	-1
Hypochlorite	ClO^-	-1
Hydrogen carbonate (bicarbonate)	HCO_3^-	-1
Hydrogen sulfate (bisulfate)	HSO_4^-	-1
Hydrogen sulfite (bisulfite)	HSO_3^-	-1
Hydroxide	OH^-	-1
Iodate	IO_3^-	-1
Nitrate	NO_3^-	-1
Nitrite	NO_2^-	-1
Perchlorate	ClO_4^-	-1
Permanganate	MnO_4^-	-1
Thiocyanate	SCN^-	-1
Carbonate	CO_3^{2-}	-2
Chromate	CrO_4^{2-}	-2
Dichromate	$Cr_2O_7^{2-}$	-2
Oxalate	$C_2O_4^{2-}$	-2
Selenate	SeO_4^{2-}	-2
Sulfate	SO_4^{2-}	-2
Sulfite	SO_3^{2-}	-2
Phosphate	PO_4^{3-}	-3
Phosphite	PO_3^{3-}	-3
Silicate	SiO_4^{4-}	-4

This is for reference, not for memorization.

Variable Valences (charges) for Transition Metals (when they have > 1 charge option). Not necessary for memorization, but you need to be VERY familiar with these common ions (polyatomic ions, too) as the periodic table you will have for a reference in this class does not have the table of polyatomic ions from your first-year class.

Element Name	Symbol	Charge	Stock Name	Classical Name
Chromium	Cr	+2 +3	Chromium (II) Chromium (III)	Chromous Chromic
Manganese	Mn	+2 +3	Manganese (II) Manganese (III)	Manganous Manganic
Iron	Fe	+2 +3	Iron (II) Iron (III)	Ferrous Ferric
Cobalt	Co	+2 +3	Cobalt (II) Cobalt (III)	
Copper	Cu	+1 +2	Copper (I) Copper (II)	Cuprous Cupric
Lead	Pb	+2 +4	Lead (II) Lead (IV)	Plumbous Plumbic
Mercury	Hg	+1 +2	Mercury (I) Mercury (II)	Mercurous Mercuric
Tin	Sn	+2 +4	Tin (II) Tin (IV)	Stannous Stannic
Gold	Au	+1 +3	Gold (I) Gold (III)	Aurous Auric
Silver	Ag	+1 +2 (rarely)	Silver Silver (II)	
Bismuth	Bi	+3 +5	Bismuth (III) Bismuth (V)	
Antimony	Sb	+3 +5	Antimony (III) Antimony (V)	
Cadmium	Cd	+2	Cadmium	
Zinc	Zn	+2	Zinc	

Chapter 1 Problem Set – The Math Basics

1. How many significant figures are in each of the following?
   a. 12
   b. 1098
   c. 2001
   d. 2.001×10^3
   e. 0.0000101
   f. 1.01×10^{-5}
   g. 1000.
   h. 22.04030

2. Use scientific notation to express the number 480 to
   a. one significant figure
   b. two significant figures
   c. three significant figures
   d. four significant figures

3. Perform the following mathematical operations and express each result to the correct number of significant figures.
   a. 97.381 ÷ 4.2502 + 0.99195
   b. 171.5 + 72.915 – 8.23
   c. 1.00914 ÷ 0.87104 + 1.2012
   d. 21.901 – 13.21 – 4.0215

4. Perform the following mathematical operations and express each result to the correct number of significant figures.
   a. $\dfrac{0.102 \times 0.0821 \times 273}{1.01}$
   b. $0.14 \times (6.022 \times 10^{23})$
   c. $(4.0 \times 10^4) \times (5.021 \times 10^{-3}) \times (7.34993 \times 10^2)$
   d. $\dfrac{2.00 \times 10^6}{3.00 \times 10^{-7}}$
   e. $4.184 \times 100.62 \times (25.27 - 24.16)$
   f. $\dfrac{8.925 - 8.904}{8.925} \times 100$
   g. $(9.04 - 8.23 + 21.954 + 81.0) \div 3.1416$
   h. $\dfrac{9.2 \times 100.65}{8.321 + 4.026}$
   i. $0.6154 + 2.07 - 2.114$
   j. $8.27(4.987 - 4.962)$
   k. $\dfrac{9.5 + 4.1 + 2.8 + 3.175}{4}$ (assume that this operation is taking the average of four numbers, therefore the 4 in the denominator is an exact number.)
   l. $\dfrac{9.025 - 9.024}{9.025} \times 100$ (100 is exact)

5. The density of aluminum is 2.70 g/cm^3. Express this value in units of kilograms per cubic meter and pounds per cubic foot.

6. A material will float on the surface of a liquid if the material has a density less than that of the liquid. Given that the density of water is approximately 1.0 g/mL, will a block of material having a volume of 1.2×10^4 in^3 and weighing 350 lb float or sink when placed in a reservoir of water?

7. A star is estimated to have a mass of 2×10^{36} kg. Assuming it to be a sphere of average radius 7.0×10^5 km, calculate the average density of the star in units of grams per cubic centimeter.

8. A rectangular block has dimensions 2.9 cm x 3.5 cm x 10.0 cm. The mass of the block is 615.0 g. What are the volume and density of the block?

9. Calculate the percentage error for each case:
   a. The density of an aluminum block determined in an experiment was 2.64 g/cm^3. The true value is 2.70 g/cm^3.
   b. The experimental determination of iron in a sample of iron ore was 16.48 %. The true value was 16.12 %.

Chapter 2 Summer Assignment – Atoms, Ions, and Compounds

1. You have a chemical in a sealed glass container filled with air. The system has a mass of 250.0 g. The chemical is ignited by means of a magnifying glass focusing sunlight on the reactant. After the chemical is completely burned, what is the mass of the setup? Explain your answer.
2. In the periodic table, how many elements are found in
   a. the second period?
   b. the third period?
   c. Group 2A?
   d. the oxygen family?
   e. the fourth period?
   f. Group 5A?
   g. the nickel group?
   h. Group 8A?
5. Give the number of protons and neutrons in the nucleus of each of the following atoms:
   a. $^{238}_{94}Pu$
   b. $^{65}_{29}Cu$
   c. $^{52}_{24}Cr$
   d. $^{4}_{2}He$
   e. $^{60}_{27}Co$
   f. $^{54}_{24}Cr$
6. Complete the following table:

Symbol	Number of protons in the nucleus	Number of neutrons in the nucleus	Number of electrons	Net charge
	33	42		3+
$^{128}_{52}Te^{2-}$			54	
	16	16	16	
	81	123		1+
$^{195}_{78}Pt$				

7. Would you expect each of the following atoms to gain or lose electrons when forming ions? What ion is the most likely to form in each case?
   a. Ra b. In c. P d. Te e. Br f. Rb

8. Name each of the following compounds:

   a. NaCl
   b. Rb_2O
   c. CaS
   d. AlI_3
   e. Hg_2O
   f. $FeBr_3$
   g. CoS
   h. $TiCl_4$
   i. CrO_2
   j. Cr_2O_3
   k. Al_2O_3
   l. NaH
   m. $ZnCl_2$
   n. CsF
   o. Li_3N
   p. Ag_2S
   q. MnO_2
   r. TiO_2
   s. Sr_3P_2
   t. $CaBr_2$

9. Write the formula for each of the following compounds:

a. cesium bromide
b. barium sulfate
c. ammonium chloride
d. chlorine monoxide
e. silicon tetrachloride
f. chlorine trifluoride
g. beryllium oxide
h. magnesium fluoride
i. sulfur difluoride
j. sulfur hexafluoride
k. sodium dihyrdogen phosphate
l. lithium nitride
m. chromium (III) carbonate
n. tin (II) fluoride
o. ammonium acetate
p. ammonium hydrogen sulfate
q. cobalt (III) nitrate
r. mercury (I) chloride
s. sodium hydride
t. sodium oxide
u. sodium peroxide
v. potassium cyanide
w. copper (II) nitrate
x. silicon tetrachloride
y. lead (II) sulfide
z. lead (IV) sulfide

Chapter 3 Summer Assignment – Stoichiometry Review

1. Naturally occurring sulfur consists of four isotopes, ^{32}S (95.0 %), ^{33}S (0.76 %), ^{34}S (4.22 %), and ^{36}S (0.014 %). Using these data, calculate the atomic weight of naturally occurring sulfur. The masses of the isotopes are given in the table below.

Isotope	Atomic Mass (amu)
^{32}S	31.91
^{33}S	32.97
^{34}S	33.97
^{35}S	35.97

2. A noble gas consists of three isotopes of masses 19.99 amu, 20.99 amu, and 21.99 amu. The relative abundance of these isotopes is 90.92 %, 0.257 %, and 8.82 % respectively. What is the average atomic mass of this noble gas? What element might this be?
3. An element "X" has 5 major isotopes, listed below along with their relative abundances. What is this element? Does the atomic mass you calculate based on these data agree with that listed in your periodic table?

Isotope	% Natural Abundance	Atomic Mass
^{46}X	8.0 %	45.95269
^{47}X	7.3 %	46.951764
^{48}X	73.8 %	47.947947
^{49}X	5.5 %	48.947841
^{50}X	5.4 %	49.944792

4. How many moles are in a sample of 300 atoms of nitrogen? How many grams?
5. If you buy 38.9 moles of M & M's, how many M & M's do you have?
6. A sample of sulfur has a mass of 5.37 g. How many moles are in the sample? How many atoms?
7. Give the number of moles of each element present in 1.0 mole of each of the following substances:
   a. Hg_2I_2
   b. LiH
   c. $PbCO_3$
   d. $Ba_3(AsO_4)_2$
   e. $RbOH{\cdot}2H_2O$
   f. H_2SiF_6
8. How many grams of zinc are in 1.16×10^{22} atoms of zinc?
9. Calculate the molar masses of each of the following:
   a. Cu_2SO_4
   b. NH_4OH
   c. $C_{10}H_{16}O$
   d. $Zr(SeO_3)_2$
   e. $Ca_2Fe(CN)_6{\cdot}12H_2O$
   f. $Cr_4(P_2O_7)_3$
10. What is the mass of 4.28×10^{22} molecules of water?
11. How many milligrams of Br_2 are in 4.8×10^{20} molecules of Br_2?
12. How many sodium ions are present in each of the following:

a. 2 moles of sodium phosphate
b. 5.8 g of sodium chloride
c. A mixture containing 14.2 grams of sodium sulfate and 2.9 grams of sodium chloride?

13. Determine the molar mass of $KAl(SO_4)_2 \cdot 12H_2O$.
14. How many moles of cadmium bromide, $CdBr_2$, are in a 39.25 gram sample?
15. Bauxite, the principle ore used in the production of aluminum cans, has a molecular formula of $Al_2O_3 \cdot 2H_2O$.
    a. Determine the molar mass of bauxite.
    b. How many grams of Al are in 0.58 moles of bauxite?
    c. How many atoms of Al are in 0.58 moles of bauxite?
    d. What is the mass in grams of 2.1×10^{24} formula units of bauxite?
16. Calculate the mass percent of Cl in each of the following compounds:
    a. ClF
    b. $HClO_2$
    c. $CuCl_2$
    d. PuOCl
17. Calculate the mass percent of each element in potassium ferricyanide, $K_3Fe(CN)_6$.
18. Calculate the mass percent of silver in each of the following compounds:
    a. AgCl
    b. AgCN
    c. $AgNO_3$
19. Fill in the blanks to balance the following chemical equations:
    a. ___ AgI + ___ Na_2S → ___Ag_2S + ___NaI
    b. ___ $(NH_4)_2Cr_2O_7$ → ___ Cr_2O_3 + ___ N_2 + ___ H_2O
    c. ___ Na_3PO_4 + ___ HCl → ___ NaCl + ___ H_3PO_4
    d. ___ $TiCl_4$ + ___ H_2O → ___ TiO_2 + ___ HCl
    e. ___ Ba_3N_2 + ___ H_2O → ___ $Ba(OH)_2$ + ___ NH_3
    f. ___ HNO_2 → ___ HNO_3 + ___ NO + H_2O
20. Balance the following equation:
    ___$NH_4OH(l)$ + ___ $KAl(SO_4)_2 \cdot 12H_2O$ → ___ $Al(OH)_3(s)$ + ___ $(NH_4)_2(SO_4)(aq)$ + ___ KOH (aq) + ___ H_2O (l)
21. Balance the following equation:
    ___ $Fe(s)$ + ___ $HC_2H_3O_2(aq)$ → ___ $Fe(C_2H_3O_2)_3(aq)$ + ___ $H_2(g)$
22. How many grams of sodium hydroxide are required to form 51.63 g of lead hydroxide?
    $Pb(NO_3)_2$ (aq) + NaOH (aq) → $Pb(OH)_2$ (aq)+ $NaNO_3$ (aq) (**unbalanced**)
23. How many grams of water vapor can be generated from the combustion of 18.74 g of ethanol?
    $C_2H_6O(g) + O_2(g) \rightarrow CO_2 + H_2O$ (**unbalanced**)
24. How many grams of potassium iodide are necessary to completely react with 20.61 g of mercury (II) chloride?
    $HgCl_2$ (aq) + KI (aq) → HgI_2 (s) + KCl (aq) (**unbalanced**)
25. How many grams of oxygen are necessary to completely react with 22.8 g or methane, CH_4? (Please write the entire reaction.
26. If, in the previous problem, only 25.9 g of water vapor were formed, how much methane actually reacted with oxygen?
27. What mass of calcium carbonate, $CaCO_3$, would be formed if 248.6 g of carbon dioxide, CO_2, were exhaled into limewater, $Ca(OH)_2$? How many grams of calcium would be needed to form that amount of calcium carbonate? Assume 100% yield in each reaction.
28. The following reaction is used to form lead iodide crystals. What mass of crystal (PbI_2) could be formed from 1.0×10^3 g of lead (II) acetate [$Pb(C_2H_3O_2)_2$]?
    $Pb(C_2H_3O_2)_2$ (aq) + 2 KI (aq) → PbI_2 (s) + 2 K $C_2H_3O_2$ (aq)
29. How many grams of precipitate (Hg_2Cl_2) would be formed from a solution containing 102.9 g of mercury ions that are reacted with chloride ions as follows?
    $2\ Hg^+$ (aq) + $2\ Cl^-$ (aq)→ Hg_2Cl_2 (s)
30. You were hired by a laboratory to recycle 6 moles of silver ions. You were given 150. g of copper. How many grams of silver can you recover using the following reaction? Is this enough copper to recycle 6 moles of silver ions? $2\ Ag^+ + Cu \rightarrow 2\ Ag + Cu^{2+}$

31. Fermentation converts sugar into ethanol and carbon dioxide. If you were to ferment a bushel of apples containing 235 g of sugar, what is the maximum amount of ethanol in grams that would be produced?
    $C_6H_{12}O_6 \rightarrow 2\ C_2H_6O + 2\ CO_2$

32. The reaction between potassium chlorate and red phosphorus is highly exothermic and takes place when you strike a match on a matchbox. If you were to react 52.9 g of potassium chlorate ($KClO_3$) with red phosphorus, how many grams of tetraphosphorus decaoxide (P_4O_{10}) would be produced?

$KClO_3$ (s) + P_4 (s) → P_4O_{10} (s) + KCl (s) (**unbalanced**)