2018-2019 AP Chemistry-Summer Assignment

Students,

Congratulations on embarking on this exciting journey through AP Chemistry. Most of you have a strong background in foundational techniques from your Chemistry 1 class, but AP Chemistry is a different beast! Understanding the material (as opposed to memorizing the night before the test) and creating a successful plan of attack is crucial, as you will be asked to apply your knowledge to many unknowns. The days of spitting back information are behind you!

AP Chemistry is a difficult course. To succeed, you must keep up with the assignments and be willing to spend time working through the material. The purpose of this summer assignment will be make sure that everyone is at the same starting point come late August. It is due the first day of class and we will have a quiz on the material that is to be memorized the first week of school. The assignment will count as one test grade.

I check my e-mail frequently, so feel free to contact me if you are having problems doing the summer assignment. Please take the summer assignment seriously. We will use the National Math and Science Initiative throughout the year. The following link will provide copies of essential information (notes, videos, answers, PT, and formula chart). Go there now!

APChemistryNMSI - AP Chemistry Class Lecture Notes AND instructional videos

1. Print the official periodic table and formula chart.
2. Download the following notes:
    a. 01 Chemical Foundations
    b. 02 Atoms, Ions, and Molecules
    c. 03 Stoichiometry
3. Watch the companion videos and take notes. The password for the videos is **linuspauling**. Renee McCormick (an AP Chem reader) does an incredible job on her video notes… take advantage! We will only review the material for a few days before the first test, so have your questions ready.
4. The remaining assignments are all attached and due the first day of class.
    a. Polyatomic Ions: Start memorizing these guys!
    b. Determining oxidation numbers Handout- review from our last Pre-AP unit
    c. Naming and Writing Formulas Handout
    d. Writing Chemical Equations Handout
    e. Dimensional Analysis and Stoichiometry Handout
5. When you arrive in August, the expectation is that you can efficiently complete a, b, and c above. If you need additional help with naming/formula and equation writing/dimensional analysis, contact me right away!

Go forth and learn! Let me know if you need help ☺

Monica Flores
GRHS AP Chemistry
moflores@lcisd.org

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 identifying the ions on the left "automatic." Learning tips and flashcards are provided.

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

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**

Rules for Determining Oxidation Number

Oxidation Number: A number assigned to an atom in a molecular compound or molecular ion that indicates the general distribution of electrons among the bonded atoms.

1. The oxidation number of any uncombined element is zero.
2. The oxidation number of a monatomic ion equal the charge on the ion.
3. The more electronegative element in a binary compound is assigned the number equal to the charge it would have if it were an ion.
4. The oxidation number of fluorine in a compound is always –1
5. Oxygen has an oxidation number of –2 unless it is combined with F, when it is +2, or in a peroxide, when it is –1.
6. The oxidation state of hydrogen is+1 unless it combined with a metal, in which case it is –1.
7. In compounds, the elements of groups 1 and 2 as well as aluminum have oxidation number of +1, +2, and +3, respectively
8. The sum of the oxidation numbers of all atoms in a neutral compound is zero.
9. The sum of the oxidation number of all atoms in a polyatomic ion equals the charge of the ion.

Rules for Naming Ionic Compounds

1. Balance Charges (charges should equal zero)
2. Cation is always written first (in name and in formula)
3. Change the ending of the anion to -ide

Rules for Naming an Acid

1. 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.

-ide becomes hydro _____ic Acid

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

ClO_2^- 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- is the Chlor**ate** ion so $HClO_3$ = Chlor**ic** acid

Determining Oxidation Numbers

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1. Determine the oxidation number of each element in the following compounds.

		Oxidation Numbers for each Element							
a.	$SnCl_4$	Sn	_____	Cl	_____				
b.	Ca_3P_2	Ca	_____	P	_____				
c.	SnO	Sn	_____	O	_____				
d.	Ag_2S	Ag	_____	S	_____				
e.	HI	H	_____	I	_____				
f.	N_2H_4	N	_____	H	_____				
g.	Al_2O_3	Al	_____	O	_____				
h.	S_8	S	_____						
i.	HNO_2	H	_____	N	_____	O	_____		
j.	O_2	O	_____						
k.	H_3O^+	H	_____	O	_____				
l.	ClO_3^-	Cl	_____	O	_____				
m.	$S_2O_3^{2-}$	S	_____	O	_____				
n.	$KMnO_4$	K	_____	Mn	_____	O	_____		
o.	$(NH_4)_2SO_4$	N	_____	H	_____	S	_____	O	_____

2. Determine the oxidation number of carbon in each of the following compounds:

a. methane, CH_4

b. formaldehyde, CH_2O

c. carbon monoxide, CO

d. carbon dioxide, CO_2

Chemical Formulas:

Write the formulas for the following:

a. Barium sulfate _____

b. Ammonium chloride _____

c. Chlorine monoxide _____

d. Silicon tetrachloride _____

e. Magnesium fluoride _____

f. Sodium oxide _____

g. Sodium peroxide _____

h. Copper (i) oxide _____

i. Zinc sulfide _____

j. Potassium carbonate _____

k. Hydrobromic acid _____

l. Perchloric Acid _____

m. Lead (ii) acetate _____

n. Sodium permanganate _____

o. Lithium oxalate _____

p. Potassium cyanide _____

q. Iron (iii) hydroxide _____

r. Silicon dioxide _____

s. Nitrogen trifluoride _____

t. Chromium (iii) oxide _____

u. Calcium chlorate _____

v. Sodium thiocyanate _____

w. Nitrous acid _____

Name each of the following:

a. $CuSO_4$ _____

b. PCl_3 _____

c. Li_3N _____

d. $BaSO_3$ _____

e. N_2F_4 _____

f. $KClO_4$ _____

g. NaH _____

h. $(NH_4)_2Cr_2O_7$ _____

i. HNO_2 * _____

j. Sr_3P_2 _____

k. $Mg(OH)_2$ _____

l. Al_2S_3 _____

m. AgBr _____

n. P_4O_{10} _____

o. $HC_2H_3O_2$ * _____

p. CaI_2 _____

q. MnO_2 _____

r. Li_2O _____

s. FeI_3 _____

t. Cu_3PO_4 _____

u. PCl_5 _____

v. NaCN _____

w. HF * _____

* - Name as acids

Writing chemical equations

For each equation below, identify the type (synthesis, decomposition, single replacement, double replacement, or combustion), predict the products, and then write the balanced reaction. Remember to use the solubility rules for double replacement reactions. Hint: when writing these reactions, ignore all of the information about heat, or bubbling, or mixing. These are just excess words used to make complete sentences. Simply pull out the chemical formulas.

For example:

Solutions of silver nitrate and magnesium iodide are combined.

$2AgNO_{3(aq)} + MgI_{2(aq)} \rightarrow 2AgI_{(s)} + Mg(NO_3)_{2(aq)}$

1. Ammonium sulfate reacts with barium nitrate.

2. Zinc metal is added to a solution of copper (II) chloride.

3. Propane gas (C_3H_8) is burned in excess oxygen.

4. Solid calcium chlorate is heated strongly.

5. Magnesium and nitrogen gas are heated together.

6. Chlorine gas is bubbled through a solution of sodium bromide.

7. Solutions of lead nitrate and calcium iodide are combined.

8. Sulfuric acid is combined with sodium hydroxide.

9. Isopropyl alcohol (C_3H_7OH) is burned in oxygen.

10. Iron metal shavings are added to hydrochloric acid.

11. Solid sodium carbonate is heated in a crucible.

12. Sodium metal is added to distilled water.

Dimensional Analysis: Much of the work you will do in AP Chemistry evolves around using dimensional analysis.
Chapter 01 – Chemical Foundations – Download notes & watch videos
Show work for all problems – Use dimensional analysis when appropriate.

1. How many nanometers are there in 23.2 centimeters?

2. An iron sample has a mass of 3.50 lbs. What is the mass of this sample in grams?

3. Perform the following conversion: 6.00m/s = _____ mi/hr

4. Convert 23.2 ºC to _____ ºF

5. An experiment requires 75.0 g or ethyl alcohol (density 0.790 g/mL). What volume, in liters will be required?

6. Calculate the mass of a rectangular solid that has a density of 2.53 g/cm^3, and which measures 2.50 cm by 1.80 cm by 3.00 cm.

7. A sample containing 2.94 mol of calcium contains how many atoms?

8. A 14.8 g sample of magnesium represents how many atoms?

Stoichiometry: Show all of your work for the following problems:
Chapter 03 – Stoichiometry - Download notes & watch videos

1. Find the mass percent of nitrogen in each of the following compounds:
    a. NO

    b. NO_2

    c. N_2O_4

    d. N_2O

2. Benzene contains only carbon and hydrogen and has a molar mass of 78.1 g/mol. Analysis shows the compound to be 7.44% hydrogen by mass. Find the empirical and molecular formula of benzene.

3. Calcium carbonate decomposes upon heating, producing calcium oxide and carbon dioxide.
    a. Write a balanced chemical equation for this reaction.

    b. How many grams of calcium oxide will be produced after 12.25 grams of calcium carbonate are completely decomposed?

    c. What volume of carbon dioxide gas is produced from 12.25 grams of calcium carbonate at STP?

    d. What is the volume of carbon dioxide in L if the pressure is 785 mmHg and the temperature is 30.0°C? (R=62.4 mm ••L/mol••K)

4. Hydrogen gas and bromine gas react to form hydrogen bromide gas.
    a. Write a balanced equation for this reaction.

    b. 3.2 grams of hydrogen reacts with 9.5 grams of bromine. Which is the limiting reactant?

    c. How many grams of hydrogen bromide gas can be produced using the amounts in (b)?

    d. How many grams of excess reactant are left unreacted?

    e. What volume of HBr, measured at STP is produced in (b)?

5. When ammonia gas, oxygen gas and methane gas (CH_4) are combined, the products are hydrogen cyanide gas and water.
    a. Write a balanced equation for this reaction.

    b. Calculate the mass of each product produced when 225 grams of oxygen gas react with an excess of the other two reactants.

    c. If the actual yield of the experiment in (b) is 105 grams of HCN, calculate the percent yield.