AP Chemistry Summer Work

2018-2019

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Please, send me an email with the topic/subject you are most excited to learn about in this course!

Feel free to use online resources—there are so many! Focus on understanding the below topics, and email me if you have questions.

While I wholeheartedly believe in collaborating with others, please make sure YOU understand the below topics. Doing so will ensure you have a foundation for success. Failing to do so may result in a less than stellar year.

Complete the following *before* the first day of school:

READ chapters 1, 2 and 3 of the textbook— Chemistry: The Central Science (12th edition/AP edition) by Brown et. al

**bolded tables, page number, etc. are from the textbook.

- Bring a sheet of paper with your favorite element from the periodic table to class on August 6th. Indicate the symbol, atomic number, and atomic mass. Be prepared to explain both atomic number and atomic mass.
- You should know the symbol and charge for elements 1-86, excluding the lanthanides and actinides
- Review the periodic trends in atomic and ionic radii, electronegativity, and first ionization energy.
- Review the strong acids and strong bases (names and formulas)
    - Be able to list these.
- Be able to name and assign formulas to acids (**page 64**)
- Understand significant figures (**pages 22-25**)
- Review symbols and names of polyatomic ions (**see below**)
- Review symbols and names of common cations (**Table 2.4**) and anions (**Table 2.5**) (also see below)
- Review the prefixes for covalent compounds (mono, di, etc.)
- Understand how to write and name binary ionic *and* covalent compounds.
- Understand the variable valences of the transition metals (**see below**)
- Know the prefixes used in the SI system (giga through pico)—**Table 1.5**
- Review solubility rules and the exceptions (**see below**)
- Understand how to perform unit conversions.
- Understand how to assign oxidation numbers to elements.
- Know how to balance reactions and identify the limiting reagent (**pages 99-102)**

- Practice dimensional analysis (i.e. grams to moles, moles to grams, etc.) (**pages 25-30**)
- Know the common types of chemical reactions (combustion, single replacement, etc.) (**Chapter 3**) and be able to predict reaction products (**see below**)
- Practice determining empirical and molecular formulas (**Sample exercises 3.13-3.15**)

Complete as many online quizzes as possible in naming ions and compounds. Utilize any and all resources!

There will be a test the first week of school on this material!

Expect weekly quizzes throughout the year as well.

See below for resources, and, again, a quick Google search of AP chemistry summer resources should give you plenty of practice problems.

Common Ions

Many compounds consist of **ions** rather than molecules. Such compounds are said to be ionic. An ion is an electrically charged "package" consisting of one (**monatomic ion**) or more (**polyatomic ion**) atoms. An ion with a positive charge is called a **cation** (CAT-ion), while an ion with a negative charge is called an **anion** (AN-ion).

Ionic compounds do not exist as molecules and so do not have molecular formulas. Rather, ionic substances such as sodium chloride and magnesium chloride have only empirical formulas—NaCl and $MgCl_2$, respectively.

The charges on many atomic ions can be predicted using the periodic table. In general, for a nonmetal to form an ion, it will gain as many electrons as it needs in order to have the same number of electrons as a noble gas. Metals will lose electrons to become cations, while nonmetals will gain electrons to become anions.

Some transition metals can form more than one ion. Iron, for example, forms both Fe^{2+} and Fe^{3+}. To name such an ion unambiguously, we use the name of the element, a Roman numeral in parentheses to denote the charge, and the word "ion." Fe^{2+} and Fe^{3+} would be iron(II) ion and iron(III) ion, respectively. An older method, though still widely used, is to apply the endings *–ous* for the smaller ionic charges and *–ic* for the larger ionic charges. For example:

Fe^{2+} is a ferr**ous** ion	Fe^{3+} is a ferr**ic** ion
Cu^{+} is a cupr**ous** ion	Cu^{2+} is a cupr**ic** ion

Common Cations

Charge	Formula	Name	Charge	Formula	Name
+1	H^+	Hydrogen ion	+1	Cs^+	Cesium ion
	Li^+	Lithium ion		Ag^+	Silver ion
	Na^+	Sodium ion		Cu^+	Copper (I) or Cuprous ion
	K^+	Potassium ion		NH_4^+	Ammonium ion
				H_3O^+	Hydronium ion
+2	Mg^{2+}	Magnesium ion	+2	Co^{2+}	Cobalt or Cobaltous ion
	Ca^{2+}	Calcium ion		Cu^{2+}	Copper (II) or Cupric ion
	Sr^{2+}	Strontium ion		Fe^{2+}	Iron (II) or Ferrous ion
	Ba^{2+}	Barium ion		Hg_2^{2+}	Mercury (I) ion
	Zn^{2+}	Zinc ion		Hg^{2+}	Mercury (II) ion
	Cd^{2+}	Cadmium ion		Ni^{2+}	Nickel (II) ion
	Pb^{2+}	Lead or Plumbous ion		Mn^{2+}	Manganese (II)
	Sn^{2+}	Tin(II) or Stannous ion			

Common Anions

Charge	Formula	Name	Charge	Formula	Name
1-	H^-	Hydride ion	1-	CN^-	Cyanide ion
	F^-	Fluoride ion		OH^-	Hydroxide ion
	Cl^-	Chloride ion		$C_2H_3O_2^-$	Acetate ion
	Br^-	Bromide ion		ClO^-	Hypochlorite ion
	I^-	Iodide ion		ClO_2^-	Chlorite ion
	NO_2^-	Nitrite ion		ClO_3^-	Chlorate ion
	NO_3^-	Nitrate ion		ClO_4^-	Perchlorate ion
	MnO_4^-	Permanganate ion		$H_2PO_4^-$	Dihydrogen phosphate ion
	HCO_3^-	Hydrogen carbonate ion (or bicarbonate ion)		SCN^-	Thiocyanate ion
				HSO_4^-	Hydrogen sulfate ion
				N_3^-	Azide ion
2-	O^{2-}	Oxide ion	2-	CO_3^{2-}	Carbonate ion
	O_2^{2-}	Peroxide ion		CrO_4^{2-}	Chromate ion
	S^{2-}	Sulfide ion		$Cr_2O_7^{2-}$	Dichromate ion
	$S_2O_3^{2-}$	Thiosulfate ion		SO_3^{2-}	Sulfite ion
	HPO_4^{2-}	Hydrogen phosphate ion		SO_4^{2-}	Sulfate ion
				$C_2O_4^{2-}$	Oxalate ion
3-	N^{3-}	Nitride ion	3-	PO_4^{3-}	Phosphate ion
	P^{3-}	Phosphide ion		PO_3^{3-}	Phosphite ion

Note that polyatomic ions that contain oxygen have names that end in either *–ite* for the smaller number of oxygens or *–ate* for the larger number of oxygens. For Example:

NO_2^-	Nitr**ite** ion	SO_3^{2-}	Sulf**ite** ion
NO_3^-	Nitr**ate** ion	SO_4^{2-}	Sulf**ate** ion

Prefixes are used when the series of oxyanions of an element extends to four members. The prefix *per-* indicates one more oxygen, while the prefix *hypo-* indicates one less oxygen. For example:

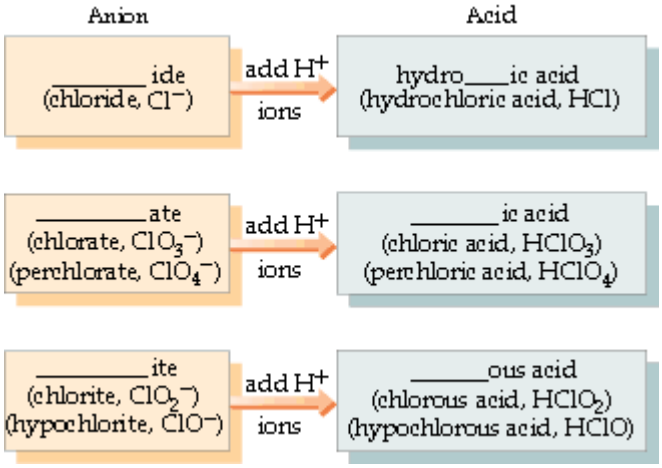
ClO^-	**Hypo**chlor**ite** ion	BrO^-	**Hypo**brom**ite** ion
ClO_2^-	Chlor**ite** ion	BrO_2^-	Brom**ite** ion
ClO_3^-	Chlor**ate** ion	BrO_3^-	Brom**ate** ion
ClO_4^-	**Per**chlor**ate** ion	BrO_4^-	**Per**brom**ate** ion

Naming Acids:

Names and formulas of acids follow naturally from the naming of ionic compounds. (Even though acids are *not* ionic!) A working definition of acid for this exercise will be: an anion with enough hydrogen ions attached to make it neutral. Thus, Cl^- requires one hydrogen ion to become HCl, a familiar acid. SO_4^{2-} requires two hydrogen ions to become H_2SO_4, another familiar acid.

To name an acid derived from an atomic anion, remove the *ide* ending from the anion, replace it with *ic*, and surround the new name with the prefix *hydro* and the word *acid*. Example: The anion in HCl is the chloride ion. Remove the *ide* ending, and replace it with *ic*. Surround the new word with *hydro* and *acid*, and you have hydrochloric acid.

For acids derived from polyatomic anions, simply replace the suffix of the anion name and add the word *acid*. The ending *ate* gets replaced with *ic*; the ending *ite* gets replaced with *ous*. The acid derived from nitrate ion becomes nitric acid. That derived from nitrite ion becomes nitrous acid. (Some of the anion roots change slightly for acid names. Example: The acids derived from sulfate and sulfite ions are sulfuric and sulfurous acids, respectively.)



Solubility Rules for Common Ionic Compounds in Water

Soluble Compounds		**Exceptions**
Most common acids		
Group 1 metals (Li^+, Na^+, K^+, Rb^+, Cs^+)		None
Nitrates	(NO_3^-)	None
Chlorates	(ClO_3^-)	None
Perchlorates	(ClO_4^-)	None
Hydrogen carbonate (HCO_3^-)		None
Acetates	($C_2H_3O_2^-$)	(silver acetate only slightly soluble)
Ammonium	(NH_4^+)	(ammonium hydroxide breaks up)
Halides (F^-, Cl^-, Br^-, I^-)		(Ag^+, Pb^{2+}, Hg_2^{2+})
Sulfates(SO_4^{2-})		(Ag^+, Pb^{+2}, Hg_2^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+})

Insoluble Compounds		**Exceptions**
Carbonates	(CO_3^{2-})	Group 1 metals, ammonium, dilute acids
Oxides	(O^{2-})	Group 1 metals, ammonium, dilute acids
Phosphates	(PO_4^{3-})	Group 1 metals, ammonium, dilute acids
Sulfides	(S^{2-})	Group 1 metals, Ca^{2+}, Sr^{2+}, Ba^{2+}, ammonium
Sulfites (SO_3^{2-})		Group 1 metals, ammonium, dilute acids
Hydroxides	(OH^-)	Group 1 metals, Ca^{2+}, Sr^{2+}, Ba^{2+}, dilute acids
Chromates	(CrO_4^{2-})	Group 1 metals, Ca^{2+}, Mg^{2+},ammonium, dilute ac

^^What do you notice? What group is ALWAYS soluble?? Tell me on the first day of class

Common mono, di & polyatomic ions—**test yourself by seeing if you can write the symbol (be able to do this by August 6th)!**

I)	Name (Ion)	Symbol(Ion)
a)	Sodium	
b)	Potassium	
c)	Cesium	
d)	Beryllium	
e)	Calcium	
f)	Strontium	
g)	Barium	
h)	Gallium	
i)	Aluminum	
j)	Nitrogen	
k)	Arsenic	
l)	Bismuth	
m)	Oxygen	
n)	Fluorine	
o)	Chlorine	
p)	Bromine	
q)	Iodine	

Common ions of transition elements—be able to write the ion based on the name (and vice-versa) by August 6th!

Ion Name	Ion
a) Chromium(III)	
b) Manganese(II)	
c) Iron(II) or Ferrous	
d) Iron(III) or Ferric	
e) Cobalt(II)	
f) Nickel(II) or nickel	
g) Copper(II) or Cupric	
h) Zinc	
i) Silver	
j) Cadmium	
k) Mercury(II) or mercuric	

Common Polyatomic Ions—be able to write the formulas (and vice-versa) by August 6th!

Name	Formula	Name	Formula
a) Acetate		b) Ammonium	
c) Carbonate		d) Chlorate	
e) Chlorite		f) Chromate	
g) Cyanide		h) Dichromate	
i) Dihydrogen Phosphate		j) Dihydrogen Phosphate	
k) Hydrogen Carbonate		l) Hydrogen Sulfate	
m) Hydrogen Sulfite		n) Hypochlorite	
o) Hydroxide		p) Nitrate	
q) Nitrite		r) Oxalate	
s) Perchlorate		t) Permanganate	
u) Perioxide		v) Phosphate	
w) Sulfate		x) Sulfite	
y) Thiosulfate			

Common Acids	Formula	Common Acids	Formula
Hydrochloric Acid		Phosphoric acid	
Carbonic acid		Sulfurous Acid	
Nitrous acid		Sulfuric Acid	
Nitric Acid		Hypochlorous Acid	
Chlorous Acid		Chloric Acid	
		Perchloric acid	

Predict the products in the following reaction. Write balanced chemical equation.

Solid potassium iodide decomposes.

Identify each type of reaction. Write the balanced chemical reaction for each.

1. Sodium oxide reacts with water to produce sodium hydroxide.

2. Aqueous barium chloride reacts with aqueous sodium chromate to produce solid barium chromate and aqueous sodium chloride.