AP Chemistry Summer Assignment

Date Due: First day of class
For Questions Contact: Laura Trout troutl@lancastercountryday.org

"Why is there a summer assignment for AP Chemistry?" Our AP Chemistry course assumes that you recall the concepts you learned in Honors Chemistry and can use those concepts with confidence. The summer work serves to review topics you studied in first-year chemistry. The AP Chemistry summer work will help you adjust to the course and will show you areas where you need to review.

"So how do I go about doing the summer assignment?"
Take a look at the problems in each section. If you remember how to do the problems without re-reading that material in the text, please do so. If not, use the resources you have to try and figure it out: e-book from Honors Chemistry, your notes from last year, etc. Feel free to use other resources as well such as Khan Academy. If you are really stuck, please e-mail me and ask a question. Working with others in the class, or those that have completed the class, is also fair. It would be a good idea to check your answers against someone else when you are finished. You will both feel more confident about what you are turning in. Do not just copy answers! If you can't do most of these on your own, you are going to have a hard time in AP Chemistry.

For mathematical problems ***I expect to see all work*** (with the exception of adding up molar masses and simple metric conversions, i.e. mL to L). ***Units should be included*** on all numerical values (within the problem and in the answer). This will be the rule in the class as well. Use your understanding of significant figures to round answers to an appropriate number of digits.

Please complete your summer assignment in hard-copy. Have it ready to submit on the first day of class. I will grade it on neatness, completion, being turned in on time, the showing of all calculations, the use of dimensional analysis/FLM when appropriate, and accuracy. A few random problems will be graded for accuracy. ***The summer assignment will count for 40 homework points of your first trimester grade.*** (This is equivalent to about four normal homework assignments.) You will lose 5 points for each day your assignment is late from the day it is due. *You must turn in the work, or it will count as a zero for your first trimester grade. It is required that you complete and submit the summer assignment.*

"Do I need to memorize anything for AP Chemistry?"
There are two things you MUST commit to memory in AP Chemistry. One of those things is the dreaded "IONS and RULES FOR NAMING COMPOUNDS." This is something that you learned in Honors Chemistry. You now have more ions to know and you will need to retain this information for the whole year because it is required for the AP test. As was the case in Honors Chemistry, this represents one of the greatest amounts of memorization that you must do in any aspect of AP Chemistry. Prepare flash cards (name of ion on one side, formula and charge on the other side) or make a Quizzlet on your iPad to learn the ions. The ions you need to know are attached to this assignment. There will be quizzes on the ions daily during the first two weeks of class. Use the summer to prepare for that. ***The other thing you need to memorize is the six strong acids.*** You won't need to know those until later in the year.

AP Chemistry Summer Assignment

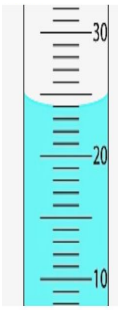
For each problem below show your work. Always use units and box your final answer.

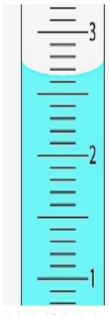
Can you work with significant figures and scientific notation?

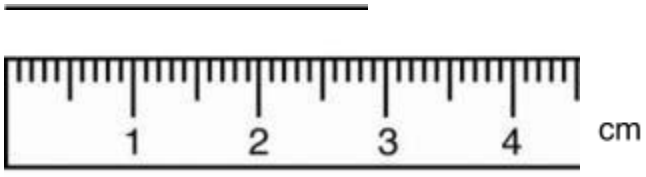
Round each of the following numbers to four significant figures, and express the result in scientific notation:

300.235800 456,500 0.006543210 – 0.000957830 – 0.035000

Record the measurement to the correct number of significant figures.







Carry out the following operations, and express the answers with the appropriate number of significant figures:

1.24056 + 75.80 _____

75 – 45.88 _____

890,000 x 112.3 _____

78,132 / 2.50 _____

Can you use dimensional analysis (FLM) to convert measurements to other units?

Perform the following conversions. Watch your significant figures. If the answer is less than 0.001 or greater than 1000, put the answer in scientific notation:

8.60 cm to nm _____

3.00 days to s _____

75.00 km/hr to m/s _____

55.35 m^3 to cm^3 _____

1.08 atm to kPa _____

900.0 mmHg to atm _____

Can you use density as a conversion factor in a FLM problem?

a. The density of pure silver is 10.5 g/cm^3 at 20^{o}C. If 5.25 g of pure silver pellets are added to a graduated cylinder containing 11.2 mL of water, to what volume level will the water in the cylinder rise?

b. The density of air at ordinary atmospheric pressure and 25^{o}C is 1.19 g/L. What is the mass, in kilograms, of the air in a room that measures 12.5 x 15.5 x 8.0 ft? (Note: 1 foot = 0.3048 m)

Do you have a good understanding of atomic theory?

1. Let's pretend you are holding two atoms of carbon that are isotopes. Describe what the two atoms have in common and what they have different.

2. Fill in the gaps in the following table, assuming each column represents a neutral atom:

Symbol	$^{39}_{19}K$				
Protons		25			82
Neutrons		30	64		
Electrons			48	56	
Mass #				137	207

3. Write the correct symbol, with both superscripts and subscripts, for each of the following :

(a) the isotope of sodium with mass 23 _____

(b) the atom of vanadium that contains 28 neutrons _____

(c) the isotope of chlorine with mass 37 _____

(d) an atom of magnesium that has an equal number of protons and neutrons

_____

Do you know the order of sublevels in an electron configuration (without a cheat sheet- only the PT)?

1. Write the full electron configuration for the following atoms. Underline the valence electrons.

   Mg :

   Br :

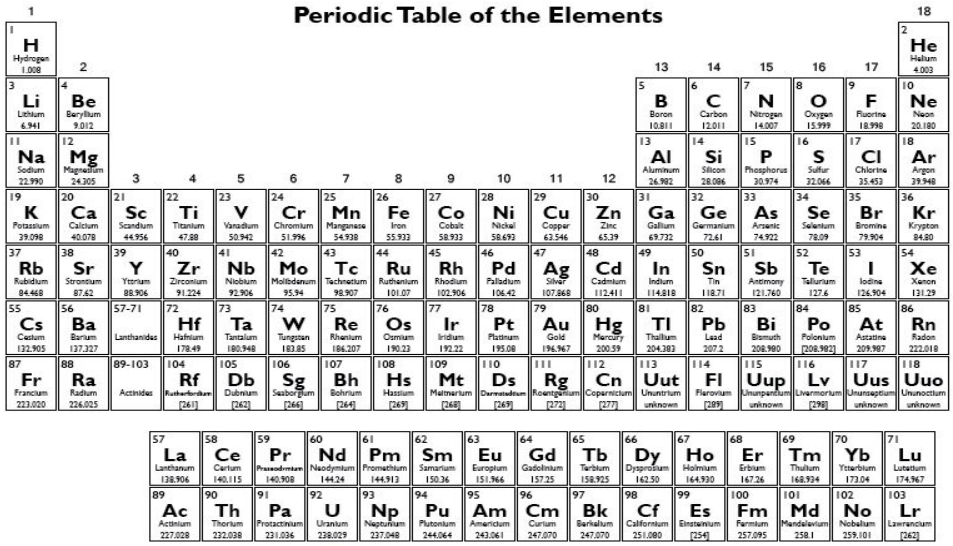
2. Draw an orbital diagram (lines and arrows) for the following atoms.

   P :

   Co:

Do you know your way around the Periodic Table?

On the diagram of the Periodic Table below, identify the location for:
metals nonmetals semimetals(metalloids) transition metals lanthanides



Do you understand how to calculate average atomic mass?

1. What isotope is used as the standard in establishing the atomic mass scale?

2. The atomic weight of magnesium is reported as 24.3, yet no atom of magnesium has the mass of 24.3 amu. Explain.

3. Only two isotopes of copper occur naturally, Cu-63 (abundance 69.09 percent) and Cu-65 (abundance 30.91 percent). Calculate the average atomic mass of copper.

Do you know your nomenclature rules?

Note: See attached ion list to memorize. There will be quizzes during the first week of school to see if you know your ions.

Give the name for each of the following ionic compounds:

AlF_3	Hg_2S
$Fe(OH)_2$	$Ca(C_2H_3O_2)_2$
$Cu(NO_3)_2$	$Cr_2(CO_3)_3$
$Ba(ClO_4)_2$	K_2CrO_4
Li_3PO_4	$(NH_4)_2SO_4$

Write the chemical formula for each of the following compounds:

copper (I) oxide	mercury (I) bromide
aluminum hydroxide	iron (III) carbonate
zinc nitrate	sodium hypobromite

Give the name or chemical formula, as appropriate, for each of the following acids:

$HBrO_3$	hypochlorous acid
HBr	iodic acid
H_3PO_4	sulfurous acid

Give the name or chemical formula, as appropriate, for each of the following molecular substances:

SF_6	dinitrogen tetroxide
IF_5	hydrogen cyanide
XeO_3	tetraphosphorous hexasulfide

Can you calculate percent mass? (show your work!)

Calculate the percentage by mass of oxygen in the following compounds:

NO_2 $Cr(NO_3)_3$

Can you balance a chemical equation and identify the type of reaction it illustrates?

Balance the following equations, and indicate what type of reaction each one is:

a. $Al\ (s) + Cl_2\ (g) \rightarrow AlCl_3\ (s)$ _____

b. $PbCO_3\ (s) \rightarrow PbO\ (s) + CO_2\ (g)$ _____

c. $C_7H_8O_2\ (l) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O\ (l)$ _____

d. $Al(NO_3)_3\ (aq) + Na_3PO_4\ (aq) \rightarrow AlPO_4\ (s) + NaNO_3\ (aq)$ _____

e. $AlCl_3\ (aq) + Zn\ (s) \rightarrow ZnCl_2\ (aq) + Al\ (s)$ _____

Can you write a net ionic equation for a reaction?

Write a net ionic equation for the reactions below.

$Al(NO_3)_3\ (aq) + Na_3PO_4\ (aq) \rightarrow AlPO_4\ (s) + NaNO_3\ (aq)$

$AlCl_3\ (aq) + Zn\ (s) \rightarrow ZnCl_2\ (aq) + Al\ (s)$

$HCl\ (aq) + NaOH\ (aq) \rightarrow H_2O\ (l) + NaCl\ (aq)$

$CH_3COOH\ (aq) + NaOH\ (aq) \rightarrow H_2O\ (l) + NaCH_3COO\ (aq)$

Can you predict the products of a chemical reaction?

Write a balanced chemical equation, including phase notations, for each of the reactions described.

Octane, $C_8H_{18}\ (l)$, is burned in air.

The metallic element calcium in heated in an oxygen rich environment.

A solution of silver nitrate is added dropwise to a solution of sodium sulfate. A white precipitate forms.

Sulfuric acid solution is neutralized with a solution of barium hydroxide.

Can you imagine a chemical reaction?

Write balanced chemical equations, including phase notations, to correspond to each of the following descriptions. Then draw a picture of what you would see if you were watching the reaction occur in the lab. Label all of the substances in the drawing.

Solid calcium carbide, CaC_2, reacts with water to form an aqueous solution of calcium hydroxide and acetylene gas, C_2H_2.

When solid potassium chlorate is heated, it decomposes to form solid potassium chloride and oxygen gas.

Solid zinc metal reacts with sulfuric acid to form hydrogen gas and an aqueous solution of zinc sulfate.

When liquid phosphorous trichloride is added to water, it reacts to form a solution of phosphorous acid and hydrochloric acid.

When hydrogen sulfide gas is passed over solid hot iron (III) hydroxide, the reaction produces solid iron (III) sulfide and gaseous water.

A solution of acetic acid (CH_3COOH) is titrated with a solution of sodium hydroxide.

Can you work with mass, moles and particle number in conversions?

1. The molecular formula of aspartame, the artificial sweetener marketed as NutraSweet, is $C_{14}H_{18}N_2O_5$.
    a. What is the molar mass of aspartame?

    b. How many moles of aspartame are present in 1.00 mg of aspartame?

    c. How many molecules of aspartame are present in 1.00 mg of aspartame?

    d. How many hydrogen atoms are present in 1.00 mg of aspartame?

Can you determine the empirical and molecular formula of a compound from mass or %mass data?

1. Determine the empirical formula of each of the following compounds if a sample contains
    a. 10.4 percent C, 27.8 percent S, and 61.7 percent Cl

    b. 21.7 percent C, 9.6 percent O, and 68.7 percent F

2. Determine the empirical and molecular formulas of each of the following substances:
    a. Ibuprofen, a headache remedy contains 75.69 percent C, 8.80 percent H, and 15.51 percent O by mass; molar mass about 206 g

    b. Benzene contains only carbon and hydrogen and is 7.74% hydrogen by mass. The molar mass of benzene is 78.1 g/mol.

<u>Can you perform stoichiometry calculations to predict quantities involved in reactions?</u>

1. Automotive air bags inflate when sodium azide, NaN_3, rapidly decomposes to its component elements:

$$2\ NaN_3\ (s) \rightarrow Na(s) + 3\ N_2\ (g)$$

    a. How many moles of N_2 are produced by the decomposition of 1.50 moles of NaN_3?

    b. How many grams of NaN_3 are required to form 5.00 g of nitrogen gas?

    c. How many grams of NaN_3 are required to produce 10.0 L of nitrogen gas if the gas has a density of 1.25 g/L?

2. A piece of aluminum foil 0.550 mm thick and 1.00 cm square is allowed to react with bromine to form aluminum bromide.
    a. How many moles of aluminum were used? (The density of aluminum is 2.699 g/cm^3.)

    b. How many grams of aluminum bromide form, assuming that the aluminum reacts completely?

Can you find the limiting reactant and theoretical yield for a reaction?

1. The fizz produced when an Alka-Seltzer tablet is dissolved in water is due to the reaction between sodium bicarbonate, $NaHCO_3$, and citric acid, $H_3C_6H_5O_7$:

    $$3\ NaHCO_3\ (aq) + H_3C_6H_5O_7\ (aq) \rightarrow 3\ CO_2\ (g) + 3\ H_2O(l) + Na_3C_6H_5O_7\ (aq)$$

    In a certain experiment 1.00 g of sodium bicarbonate and 1.00 g of citric acid are allowed to react.

    a. Which reactant is the limiting reactant? You must show work to support your answer.

    b. What is the theoretical yield of carbon dioxide (in grams)?

    c. How much of the limiting reactant is left when the reaction is complete?

    d. How many grams of the excess reactant remain after the reaction is complete?

2. When hydrogen sulfide gas is bubbled into a solution of sodium hydroxide, the reaction forms sodium sulfide and water. What is the theoretical yield of sodium sulfide if 2.50 g of hydrogen sulfide is bubbled into 150.0 mL of a 0.300 M solution of sodium hydroxide? Assume that the limiting reagent is completely consumed.

3. A student reacts benzene, C_6H_6, with bromine, Br_2, to prepare bromobenzene, C_6H_5Br, and HBr.

    a. What is the theoretical yield of bromobenzene in this reaction when 30.0 g of benzene reacts with 65.0 g of bromine?

    b. If the actual yield of bromobenzene was 56.7 g, what was the percent yield?

4. Hydrogen peroxide is oxidized with permanganate solution to produce oxygen gas by the following reaction.
   $2\ H^+(aq) + H_2O_2(aq) + 2\ MnO_4^{1-}(aq) \rightarrow 2\ MnO_2(aq) + 4\ H_2O + 3\ O_2(g)$

In the lab a student mixed 30.0 mL of 0.30 M hydrogen peroxide solution with 30.0 mL of 0.30 M potassium permanganate solution. The oxygen that was produced was collected by water displacement at 298 K and 1.00 atm of pressure. The volume of oxygen collected was 178 mL. (Ignore the effect of water vapor in the collection tube here.)

a. What is the limiting reactant?

b. What is the theoretical yield of oxygen gas, in milliliters?

c. What is the percent yield of oxygen gas?

<u>Can you assign oxidation numbers?</u>

Determine the oxidation number of the atoms indicated in the compound/molecule.

In $KMnO_4$	K:	Mn:
In $CaSO_4$	S:	O:
In NaOCl	O:	Cl:
In F_2	F:	
SO_2	S:	O:

Can you work with concentrations?

1. a) What is the concentration of a copper (II) chloride solution where 5.00 g of copper(II) chloride solid is placed in a volumetric flask and dissolved in deionized water up to the 250 mL mark?

   b) What is the concentration of copper(II) ions in the solution above?

   c) What is the concentration of chloride ions in the solution above?

2. A student is given a stock solution of sodium acetate that is 8.000 M.

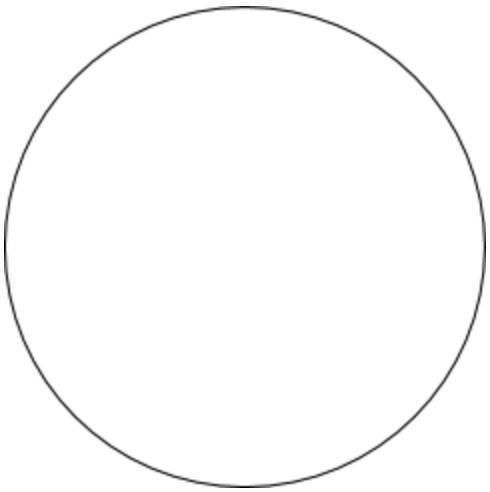
   a) If 25.00 mL of the stock solution was placed in a 100 mL volumetric flask and filled to the line with distilled water, what would be the concentration of the new solution?

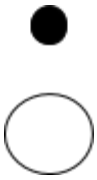
   b) How many milliliters of the stock solution would be needed if the student wanted to make 1.00 L of 0.250 M sodium acetate?

   c) Describe the procedure, including the specific glassware or tools that would be needed for the student to make the solution described in part b).

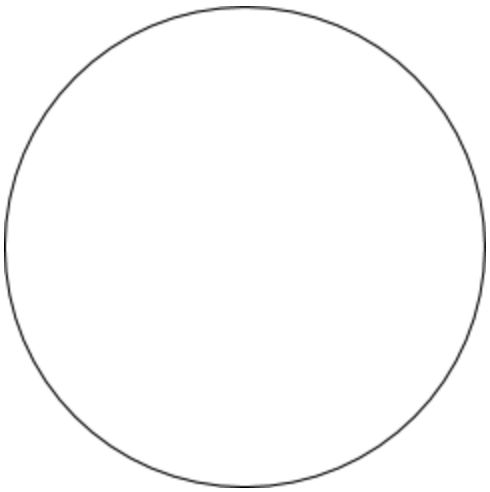
Can you draw particulate drawings of solutions? (Hint: Consider the effect of strong and weak electrolytes.)
Consider the relative size and number of ions. Show at least four formula units of the substance in the bubble. You do not need to include water molecules. Include a legend for each shaped used. The first one is done for you as an example.

NaCl

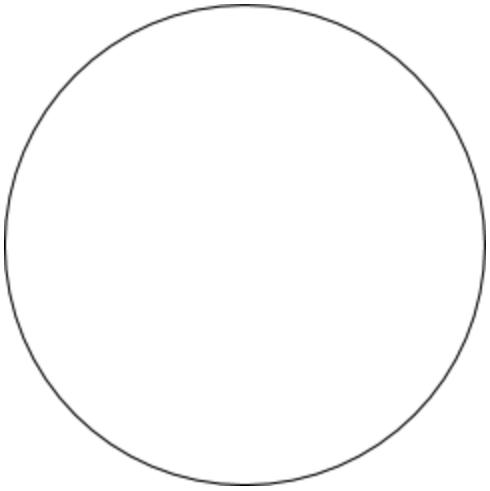




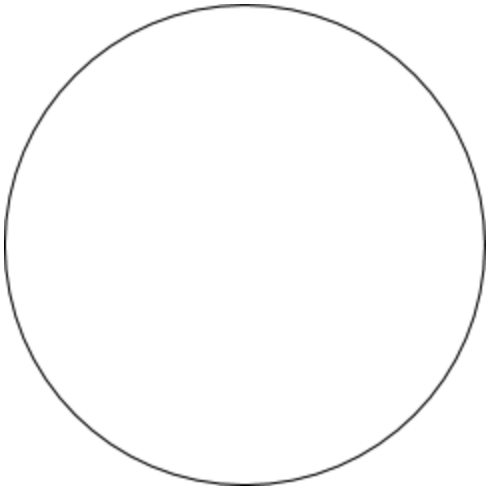
K_2SO_4



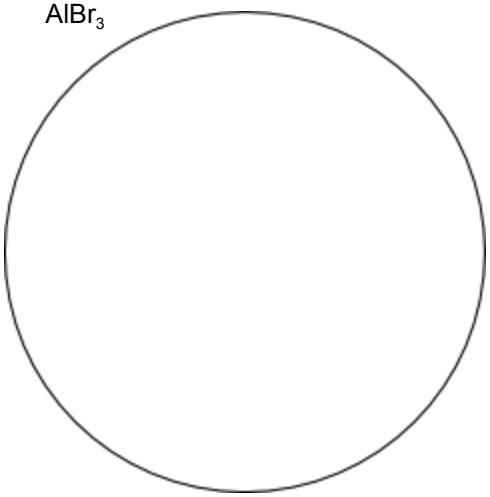
HF



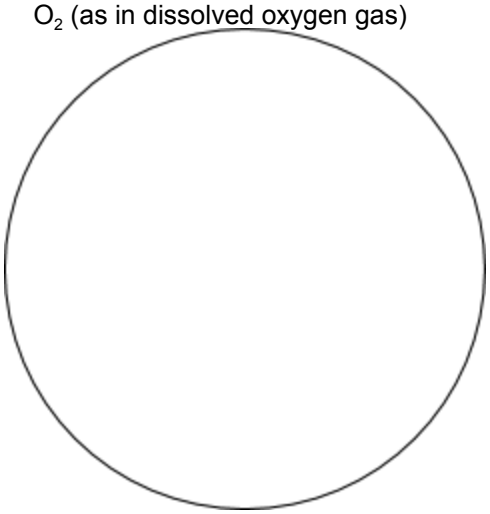
HBr



$AlBr_3$



O_2 (as in dissolved oxygen gas)



Names and Electrical Charges of Common Inorganic Ions

(note: students will always have a periodic table for all quizzes and tests, including ion quizzes)

CATIONS

Cations (1+ charge)

H^{1+}	hydrogen ion
Li^{1+}	lithium ion
Na^{1+}	sodium ion
K^{1+}	potassium ion
Rb^{1+}	rubidium ion
Cs^{1+}	cesium ion
Fr^{1+}	francium ion
Ag^{1+}	silver ion
NH_4^{1+}	ammonium ion
H_3O^{1+}	hydronium ion

Cations (2+ charge)

Be^{2+}	beryllium ion
Mg^{2+}	magnesium ion
Ca^{2+}	calcium ion
Sr^{2+}	strontium ion
Ba^{2+}	barium ion
Ra^{2+}	radium ion
Zn^{2+}	zinc ion
Cd^{2+}	cadmium

Cations (3+ charge)

Al^{3+}	aluminum ion

Transition Metal Ions (cations with variable oxidation numbers)

Cu^{1+}	copper(I) or cuprous ion	Cu^{2+}	copper(II) or cupric ion
Fe^{2+}	iron(II) or ferrous ion	Fe^{3+}	iron(III) or ferric ion
*Hg_2^{+2}	mercury(I) or mercurous ion	Hg^{2+}	mercury(II) or mercuric ion
Sn^{2+}	tin(II) or stannous ion	Sn^{4+}	tin(IV) or stannic ion
Cr^{2+}	chromium(II) ion	Cr^{3+}	chromium(III) ion
Mn^{2+}	manganese(II) ion	Mn^{3+}	manganese(III) ion
Co^{2+}	cobalt(II) ion	Co^{3+}	cobalt(III) ion
Ni^{2+}	nickel(II) ion		
Tl^{1+}	thallium(I) ion	Tl^{3+}	thallium(III) ion

*Note: mercury(I) ion exists as a diatomic ion and is written as Hg_2^{+2} and not Hg^{1+}.

ANIONS

Anions (1- charge)

F^{1-}	fluoride ion
Cl^{1-}	chloride ion
Br^{1-}	bromide ion
I^{1-}	iodide ion
H^{1-}	hydride ion
CN^{1-}	cyanide ion
OH^{1-}	hydroxide ion
**XO^{1-}	hypohalite ion
**XO_2^{1-}	halite ion
**XO_3^{1-}	halate ion
**XO_4^{1-}	perhalate ion
MnO_4^{1-}	permanganate ion
$C_2H_3O_2^{1-}$	acetate ion (also seen as CH_3COO^{1-})
$H_2PO_4^{1-}$	dihydrogen phosphate ion
NO_2^{1-}	nitrite ion
NO_3^{1-}	nitrate ion
HCO_3^{1-}	hydrogen carbonate ion (bicarbonate ion)
HSO_4^{1-}	hydrogen sulfate ion (bisulfate ion)
HSO_3^{1-}	hydrogen sulfite ion (bisulfite ion)

Anions (2- charge)

O^{2-}	oxide ion
S^{2-}	sulfide ion
CrO_4^{2-}	chromate ion
$Cr_2O_7^{2-}$	dichromate ion
CO_3^{2-}	carbonate ion
SO_3^{2-}	sulfite ion
SO_4^{2-}	sulfate ion
$S_2O_3^{2-}$	thiosulfate ion
HPO_4^{2-}	monohydrogen phosphate ion
O_2^{2-}	peroxide ion ("O" has -1 ox. state here)

Anions (3- charge)

PO_4^{3-}	phosphate ion	P^{3-}	phosphide ion	N^{3-}	nitride ion
PO_3^{3-}	phosphite ion				

**Note: X = halogen other than F (Cl, Br, I).

Examples: ClO^{1-} = hypochlorite ion BrO_2^{1-} = bromite ion IO_3^{1-} = iodate ion

IO_4^{1-} = periodate ion