Welcome to AP Chemistry!

I am excited that you decided to take on the challenge that AP Chemistry has to offer. This packet contains a review of basic chemistry concepts that are necessary for your success in this course. You should have your notes from Chemistry, your AP Chemistry textbook, and a periodic table in order to complete this review.

This "Summer Packet" contains three sections.

- The first is some 'Helpful Hints' to remind you about the topics we learned during first year Chemistry.
- The second part of this packet contains a 'Review Worksheet' with answers provided. It covers measurement, atomic structure, nomenclature, chemical formulas, equation writing and balancing, an introduction to organic compounds, stoichiometry, molarity, and redox.
- The last section is a list of information that you need to memorize. This includes element symbols, ion charges, polyatomic ion names, etc. This list also has some suggestions for making the process of memorization easier. I have included a sheet of flashcards for the polyatomic ions that you must learn. I strongly suggest that you cut them out and begin memorizing them immediately. Use the hints on the common ions sheet to help you reduce the amount of memorizing that you must do.

The majority of the material required in this assignment is review material that students should have learned in their first year chemistry class. Look it up if you don't know it off the top of your head! You have many resources available to you. Because this is a challenging problem-solving course, and for some of you, a year may have passed since you have had a chemistry course, it is imperative that you come to class the first day with some of the jargon, etc. second nature for you due to the pace at which this course progresses. Reviewing and committing to memory the topics in this summer assignment is not optional. Completing the assignment in a thorough and focused manner will contribute to a student's success in this course and on the AP Chemistry exam. It would most benefit you to wait until a week or two before school starts to begin working on it so that it is fresh in your head. This review packet will be collected and you will be taking a test over its contents during the first week or two of school. This test will cover the first Unit according to the College Board website.

With the use of Schoology as our LMS, I am not sure we need Remind anymore but I will continue to use it one more year as it grants you almost instant access to me. **Sign up for AP Chemistry Remind messages by texting @mrsstroz to 81010.** You should also create a College Board account if you have not done so already. We will utilize the AP Classroom portion to assist our learning of the material. The web address can be found on the following page. Our **AP Classroom class code is _____**. Feel free to browse the site to learn what day the AP Chem Exam is on 2024, what types of questions are on the exam, how long it takes, etc. You may contact me at my school e-mail address with questions or concerns but I won't check my messages every day during the summer. I will begin checking it more frequently as the beginning of the school year approaches.

I look forward to seeing you all at the beginning of the next school year.

Mrs. Strozewski

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If you have questions, here are some useful websites:

a. https://apstudents.collegeboard.org/courses/ap-chemistry (This is the official AP Chem site sanctioned by the College Board)
b. https://myap.collegeboard.org/login (This where you can log into AP Classroom or create an account if you don't already have one)
c. https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/ (Online textbook you can browse by chapter/topic to brush up on your skills from first year chem)
d. www.chemtutor.com (Wordy—reads like a textbook—but helpful)
e. http://proton.csudh.edu/lecture_help/lechelp.html (Quality varies—some topics better than others—lots of drill and practice problems.)
f. https://www.khanacademy.org/ Tutorials/lectures/help for every topic you can imagine)
g. http://www.chemmybear.com/groves/apchem.html (AP Chem teacher site – great stuff here)
h. https://adriandingleschemistrypages.com/ (AP Chem teacher site – great stuff here but some of it is only accessible through a paid subscription)

Helpful Hints for Summer Review

What all AP Chemistry students should know upon entering this course:

1. All diatomic elements: oxygen, nitrogen, hydrogen, and all halogens are diatomic in their uncombined form. You should also know that oxygen can take the form of O_3, sulfur can be S_8, and phosphorus can be P_4.

2. The group names for elements and which elements are in those groups: alkali metals, alkaline earth metals, halogens, noble gases.

3. Know the following common ions and their charges:
group 1 metals = +1, group 2 = +2, group 13 metals = +3, group 15 nonmetals = -3, group 16 nonmetals = -2,
group 17 nonmetals = -1, group 18 gases = 0. Silver is +1, zinc and cadmium are +2.

4. You should memorize the symbols/formulas, names, and charges for the common ions listed on the sheet contained in this packet. In AP Chemistry you will ***not*** be able to use your ion sheet on tests or quizzes. I have included some flashcards you can use to quiz yourself.

5. Know how to write the formulas and names of compounds (including acids).
Ionic compounds: use the "criss-cross" method. Ex: silver sulfide: Ag^+ S^{2-} written as Ag_2S
Ex: iron (III) hydroxide Fe^{3+} OH^- written as $Fe(OH)_3$

Covalent (molecular) compounds are composed of all nonmetals.
Prefix/Name of First element Prefix/Name of second element with –ide ending Ex: carbon dioxide CO_2-
(Mono, di or bi, tri, tetra, penta, hexa, hepta, octa, nona, and deca) Ex: dinitrogen pentoxide N_2O_5

Acids: binary (2 elements) = hydro*elementname* acid Ex: HCl hydrochloric acid
Polyatomic (ion name ends in "ate") = *polyatomicname*ic acid Ex: $HClO_3$ chloric acid
Polyatomic (ion name ends in "ite") = *polyatomicname*ous acid Ex: $HClO_2$ chlorous acid

6. All metric units of measurement

Quantity	Name of Unit	Abbreviation
length	meter	m
mass	gram ***NOTE: the standard unit is the kilogram!*	G, *kg*
volume	Liter ***NOTE: the standard unit is the cubic meter!*	L, m^3
temperature	Kelvin degrees Celsius	K °C
time	second	s
amount of substance	mole	mol
energy	Joule	J
electric current	ampere	A

7. Common Prefixes and Numerical Values for SI units

Prefix	Symbol	Numerical Value	Value in scientific notation
giga	G	1,000,000,000	1×10^9
mega	M	1,000,000	1×10^6
kilo	K	1,000	1×10^3
hecto	H	100	1×10^2
deka	D	10	1×10^1
deci	d	0.1	1×10^{-1}
centi	c	0.01	1×10^{-2}
milli	m	0.001	1×10^{-3}
micro	μ	0.000 001	1×10^{-6}
nano	n	0.000 000 001	1×10^{-9}

8. The universal gas constant, R, is 0.0821 L•atm / K•mol (or 8.314 KPa•atm / K•mol) and 1 atmosphere of pressure = 760 mm of Hg, 101.325 kPa, 760 torr.

9. Be able to write a number in scientific notation. Scientific notation is a product of two numbers: a coefficient and a power of 10. The coefficient is always greater than or equal to 1 and less than 10.
Examples: 24,000 cm is written as 2.4×10^4 cm
0.0035 mg is written as 3.5×10^{-3} mg
12 cookies can be written as 1.2×10^1 cookies

10. Be able to perform calculations using significant figures. Sig figs are a way of indicating the precision of a measurement. When you make measurements, you need to be responsible for indicating the uncertainty, so a large graduated cylinder might measure 8 ±1 mL while a small graduated cylinder might measure 8.0 ± 0.1 mL and a buret might measure 8.00 ± 0.01 mL. ***Remember:*** <u>all</u> measurements have <u>units</u>!

    The basic rules:
    a. All nonzero digits are significant.
    b. Zeros between nonzero digits are significant
    c. Zeros beyond the decimal point at the end of a number are significant. The volume 5.00 mL has 3 s.f.
    d. Zeros preceding the first nonzero digit in a number are not significant. The distance 0.0005 m has 1 s.f.
    e. In proper exponential notation, all digits are significant. In general, any ambiguity concerning the number of significant figures in a measurement can be eliminated by using scientific notation. (Example: 500 g can be expressed as 5×10^2 g has 1 sf, 5.0×10^2 has 2 sf, and 5.00×10^3 has 3 sf)

11. Be able to balance equations.
    Remember the rules for balancing equations. You may only change the coefficients, not the equations themselves. Check charges when writing formulas—remember: write formulas **first**, *then* balance.
    Example: $\mathbf{2}C_8H_{18} + \mathbf{25}\ O_2 \rightarrow \mathbf{16}CO_2 + \mathbf{18}\ H_2O$

12. Be able to classify reactions as one of the following five types.

Decomposition	(D)	$AB \rightarrow A + B$
Synthesis	(S)	$A + B \rightarrow AB$
Single replacement	(SR)	$A + BC \rightarrow AC + B$
Double replacement	(DR)	$AB + CD \rightarrow AD + CB$
Combustion	(C)	$A + O_2 \rightarrow A_nO_y$ or $C_xH_y + O_2 \rightarrow CO_2 + H_2O$

    Here are a few more tips for writing the products of a reaction:
    1. A non-metal oxide added to water will form an acid while a metal oxide added to water will form a base.
    2. An acid added to a base will form a salt (an ionic compound) and water.
    3. A metallic chlorate will decompose into the metallic chloride and oxygen.
    4. A metallic carbonate will decompose into the metallic oxide and carbon dioxide.

13. Be able to use stoichiometry and dimensional analysis to perform calculations. Remember that a mole is an amount of stuff—it is 6.022×10^{23} atoms, molecules, formula units, ions, or anything else. Remember that a mole of any gas at STP (273 K and 1 atm.) has a volume of 22.4 L. We can use the mole and dimensional analysis (the "factor-label method) for stoichiometry and limiting reactants.

    Using the mole for stoichiometry: grams → moles → moles → grams if we have a balanced equation. The first "grams" is the mass of the chemical we start with; to get to the first "moles" use the molar mass of that chemical; to get to the second "moles", use the coefficients of the balanced equation (the chemical we start with and the chemical we are moving toward); and to get to the second "grams" use the molar mass of the second chemical. Make sure all units cancel!

14. Be able to perform calculations using molarity. Remember these equations for molarity:
    $\text{molarity} = \frac{\text{moles}}{\text{liters}}$ and $M_{concentrated}V_{concentrated} = M_{dilute}V_{dilute}$ (also written as $M_1V_1 = M_2V_2$)

15. Know how to recognize acids and bases by their formula. Know when an acid and base combine during a neutralization reaction, they produce a salt and water.

16. Know how to determine if a substance is soluble or insoluble and use that information to write net ionic equations. Separate all aqueous ionic compounds into their + and – halves. DO NOT separate solids, liquids, gases, or weak acids/bases. Cancel out all spectator ions.
    Ex.) $Pb(NO_3)_2\ (aq) + 2\ HCl\ (aq) \longrightarrow PbCl_2\ (s) + 2\ HNO_3\ (aq)$
    $Pb^{2+}(aq) + \cancel{2\ NO_3^-}(aq) + \cancel{2\ H^+}(aq) + 2\ Cl^-(aq) \longrightarrow PbCl_2\ (s) + \cancel{2\ H^+}(aq) + \cancel{2\ NO_3^-}(aq)$
    $Pb^{2+}(aq) + 2\ Cl^-(aq) \longrightarrow PbCl_2\ (s)$

17. Know how to assign oxidation numbers using the rules we learned in Honor Chem. Remember exceptions like hydrides (NaH where H = -1) and peroxides (Na_2O_2, where O = -1). Recognize redox reactions when there is a change in ox.#.

    Be able to identify which substance has been oxidized and which has been reduced.
    The ***<u>substance oxidized</u>*** contains atoms which ***increase*** in oxidation number. Oxidation is ***electron loss*** (***LEO***).
    The ***<u>substance reduced</u>*** contains atoms which ***decrease*** in oxidation number. Reduction is ***electron gain*** (***GER***).

    Ex.) $\overset{0}{Fe} + \overset{+2\ +5\ -2}{Cu(NO_3)_2} \rightarrow \overset{+2\ +5\ -2}{Fe(NO_3)_2} + \overset{0}{Cu}$

    Fe is being **oxidized** b/c it had an **increase in ox. #**. The half reaction would be $Fe^0 \rightarrow Fe^{2+} + 2e^-$ (which is a loss of e-)

NAME_____ DATE_____ HOUR_____

AP Chemistry Summer Review Packet

I. Write formulas for the following substances:

a. Barium sulfate

b. Ammonium chloride

c. Chlorine monoxide

d. Silicon tetrachloride

e. Pentane (organic)

f. Sodium peroxide

g. Copper (I) iodide

h. Zinc sulfide

i. Potassium carbonate

j. Hydrobromic acid

k. Perbromic acid

l. Lead (II) acetate

m. Sodium permanganate

n. Lithium oxalate

o. Potassium cyanide

p. Iron (III) hydroxide

q. Silicon dioxide

r. Nitrogen trifluoride

s. Chromium (III) oxide

t. Butanol (organic)

u. Sodium thiocyanate

v. Cobalt (III) nitrate

w. Nitrous acid

x. Ammonium phosphate

y. Phosphoric acid

II. Name each of the following compounds. (Give acid names where appropriate)

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. C_2H_6 (organic)

m. P_4O_{10}

n. $HC_2H_3O_2$

o. CaI_2

p. MnO_2

q. CH_3OH (organic)

r. FeI_3

s. Cu_3PO_4

t. PCl_3

u. NaCN

v. Cs_3N

w. $Zn\ (NO_3)_2$

x. HF

y. HCN

III. Chemical Equations

Tell the type of reaction, predict the products and write a balanced chemical equation for each of the following, as shown in the example:

Ex: Solutions of silver nitrate and magnesium iodide are combined.
This is a double replacement reaction. $2AgNO_3 + MgI_2 \rightarrow 2AgI + Mg(NO_3)_2$

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. Diphosphorus pentoxide gas is added to distilled water.

5. Solid calcium chlorate is heated strongly.

6. Sodium hydroxide solution is added to a solution of iron (III) bromide.

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

8. Solutions of lead (II) nitrate and calcium iodide are combined.

9. Sulfuric acid is combined with solid magnesium hydroxide.

10. Solid barium oxide is added to distilled water.

11. Isopropyl alcohol (C_3H_7OH) is burned in air.

12. Iron (II) metal shavings are added to hydrochloric acid.

13. Solid sodium carbonate is heated in a crucible.

14. Sodium metal is added to distilled water.

15. Aqueous aluminum hydroxide is added to hydrochloric acid. (Write a net ionic equation as well)

16. Solutions of iron (III) iodide and sodium hydroxide are combined. (Write a net ionic equation as well)

17. Solutions of ammonium phosphate and calcium nitrate are combined. (Write a net ionic equation as well)

IV. **The metric system and metric conversions**:
Convert the units. Use scientific notation when there are more than 4 zeros before or after the decimal.

a. 2350 mm = _____ m
b. 0.000 468 g = _____ μg
c. 13.5 kg = _____ mg
d. 10 m = _____ dm
e. 17 ng = _____ g
f. 0.82 MJ = _____ J

V. Scientific Notation

Try these conversions *from* scientific notation:

a. 1.45×10^4 g _____
b. 7.02×10^3 mm _____
c. 9.0×10^2 mL _____
d. 8.1234×10^4 dg _____

Try these conversion *to* scientific notation:

a. 2500 mm _____
b. 0.000558 g _____
c. 3866 mg _____
d. 14 kg _____

VI. Significant figures

How many significant figures are in:

a. 5.44 mm
b. 0.0050065 kg
c. 900 K
d. 1.150 kJ
e. 900. ˚C
f. 4.5×10^4 J
g. 4.00 g
h. 0.01 m

Solve, using the proper significant figures:

a. 16 mm + 4.8 mm
b. 0.055 m x 1.995 m
c. 1.0×10^{-4} g ÷ 0.0289 mL
d. (19.00 g – 11.052 g) ÷ 2.580 mL

VII. Stoichiometry—use the factor-label method (dimensional analysis) and correct SF

1. Balance the equation below and use it to answer the following:

$$CuCO_3{\cdot}Cu(OH)_{2\,(s)} \rightarrow Cu_{(s)} + O_{2\,(g)} + H_2O_{(l)} + CO_{2\,(g)}$$

A) Calculate the mass of copper produced when 0.50 moles of malachite ($CuCO_3{\cdot}Cu(OH)_2$) decomposes.

B) Calculate the number of oxygen molecules produced when 225 g of malachite decomposes.

2. When ammonia gas, oxygen gas and methane gas (CH_4) are combined, the products are hydrogen cyanide gas and water.

   A) Write a balanced chemical equation for this reaction.

   B) Calculate the mass of each product produced when 225 g of oxygen gas is reacted with an excess of the other two reactants.

   C) If the actual yield of the experiment in B) is 105 g of HCN, calculate the percent yield.

3. Hydrogen gas and bromine gas react to form hydrogen bromide gas.
   A) Write a balanced chemical equation for this reaction.

   B) How many grams of hydrogen bromide gas can be produced from 3.2 g of hydrogen gas and 9.5 g of bromine gas?

   C) How many grams of which reactant is left unreacted?

   D) What volume of HBr, measured at STP, is produced in b)?

4. Benzene contains only carbon and hydrogen and has a molar mass of 78.1 g/mol. Analysis shows the compound to be 7.74% H by mass. Find the empirical and molecular formulas of benzene.

5. Find the mass percent of nitrogen in each of the following compounds:

   A) NO_2

   B) N_2O_4

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

   B) How many grams of calcium oxide will remain after 12.25 g of calcium carbonate is completely decomposed?

   C) What volume of carbon dioxide gas is produced from this amount of calcium carbonate? The gas is measured at 0.95 atm and 10 °C.

VII. Atomic Structure

1. How many protons, neutrons, and electrons are in a ^{88}Sr atom?

2. Hubbardium is found in three forms. H-18, H-16, and H-24. Their abundances are 27%, 34%, 39% respectively. Calculate the average atomic mass.

3. Which of the following two elements would you expect to have similar chemical and physical properties? S, Se, Br, Ge, P

4. Arrange the elements S, Ge, P, and Si in order of increasing atomic size.

5. Arrange the elements Be, Ca, N, and F in order of increasing electronegativity.

6. Which elements fit the following descriptions:
   a. the smallest alkaline earth metal
   b. has a valence shell configuration $4f^{14}\ 5d^{10}\ 6s^{1}$
   c. the halogen with the lowest ionization energy
   d. has 13 more electrons than argon
   e. the smallest non metal
   f. the Group 4A element with the largest ionization energy
   g. its 3+ ion has the electron configuration [Kr] $4d^{10}$

7. a. Write the complete ground state electron configuration for arsenic, As.

   b. How many unpaired electrons does arsenic have in its ground state? Justify your answer.

   c. Write the electron configuration of a As^{4+} ion.

8. Which element has the greater first ionization energy, Ca or Sr? Explain why using principles of atomic structure.

9. Which ion has the smaller radius, Sr^{2+} or Br^{-} ? Explain your reasoning using principles of atomic structure.

Questions I Have....

Answers to Summer Review Packet

I. Formula Writing

a. $BaSO_4$
b. NH_4Cl
c. ClO
d. $SiCl_4$
e. C_5H_{12}
f. Na_2O_2
g. CuI
h. ZnS
i. K_2CO_3
j. HBr
k. $HBrO_4$
l. $Pb(C_2H_3O_2)_2$
m. $NaMnO_4$
n. $Li_2C_2O_4$
o. KCN
p. $Fe(OH)_3$
q. SiO_2
r. NF_3
s. Cr_2O_3
t. C_4H_9OH
u. $NaSCN$
v. $Co(NO_3)_3$
w. HNO_2
x. $(NH_4)_3PO_4$
y. H_3PO_4

II. Naming Compounds

a. Copper (II) sulfate
b. Phosphorus trichloride
c. Lithium nitride
d. Barium sulfite
e. Dinitrogen tetrafluoride
f. Potassium perchlorate
g. Sodium hydride
h. Ammonium dichromate
i. Nitrous acid
j. Strontium phosphide
k. Magnesium hydroxide
l. Ethane
m. Tetraphosphorus decoxide
n. Acetic acid
o. Calcium iodide
p. Manganese (IV) oxide
q. Methanol
r. Iron (III) iodide
s. Copper (I) phosphate
t. Phosphorus trichloride
u. Sodium cyanide
v. Cesium nitride
w. Zinc (II) nitrate
x. Hydrofluoric acid
y. Cyanic acid

III. Chemical Equations

1. $(NH_4)_2SO_4 + Ba(NO_3)_2 \rightarrow 2\ NH_4NO_3 + BaSO_4\ (s)$
2. $Zn + CuCl_2 \rightarrow ZnCl_2 + Cu$
3. $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$
4. $P_2O_5 + 3\ H_2O \rightarrow 2\ H_3PO_4$
5. $Ca(ClO_3)_2 \rightarrow CaCl_2 + 3\ O_2$
6. $3\ NaOH + FeBr_3 \rightarrow Fe(OH)_3\ (s) + 3\ NaBr$
7. $Cl_2 + 2\ NaBr \rightarrow 2\ NaCl + Br_2$
8. $Pb(NO_3)_2 + CaI_2 \rightarrow PbI_2\ (s) + Ca(NO_3)_2$
9. $H_2SO_4 + Mg(OH)_2 \rightarrow MgSO_4 + 2\ H_2O$
10. $BaO + H_2O \rightarrow Ba(OH)_2$
11. $2\ C_3H_7OH + 9\ O_2 \rightarrow 6\ CO_2 + 8\ H_2O$
12. $Fe + 2\ HCl \rightarrow FeCl_2 + H_2$
13. $Na_2CO_3 \rightarrow Na_2O + CO_2$
14. $2\ Na + 2\ H_2O \rightarrow 2\ NaOH + H_2$
15. $OH^- + H^+ \rightarrow H_2O$
16. $Fe^{3+} + 3\ OH^- \rightarrow Fe(OH)_3$
17. $2\ PO_4^- + 3\ Ca^{2+} \rightarrow Ca_3(PO_4)_2$

IV. Metric Conversions

a. 2.350
b. 468
c. 1.35×10^{7}
d. 100
e. 1.7×10^{-8}
f. 8.2×10^{5}

V. Scientific Notation

a. 14500
b. 7020
c. 900
d. 81234

a. 2.5×10^{3}
b. 5.58×10^{-4}
c. 3.866×10^{3}
d. 1.4×10^{1}

VI. Significant Figures

a. 3
b. 5
c. 1
d. 4
e. 3
f. 2
g. 3
h. 1

a. 21 mm
b. 0.11 m
c. 3.5×10^{-3} g/mL
d. 3.08 g/mL

VII. Stoichiometry

1. A) 63.6 g Cu
   B) 6.12×10^{23} molecules O_2
2. A) $2\ NH_3 + 3\ O_2 + 2\ CH_4 \rightarrow 2\ HCN + 6\ H_2O$
   B) 127 g HCN, 253 g H_2O
   C) 82.7 %
3. A) $H_2 + Br_2 \rightarrow 2\ HBr$
   B) Br_2 is limiting reagent, 9.6 g HBr
   C) 3.1 g H_2 in excess
   D) 2.7 L HBr
4. empirical = CH, molecular = C_6H_6
5. A) 30.4% B) 30.4 %
6. A) $CaCO_3 \rightarrow CaO + CO_2$
   B) 6.87 g CaO
   C) 2.98 L CO_2

VIII. Atomic Structure

1. 38 p, 38 e, 50 n
2. 19.66 amu
3. S and Se
4. S, P, Si, Ge
5. Ca, Be, N, F
6. A. Be B. Au C. At or I D. Ga E. He F. C G. In^{3+}
7. b. 3 c. … $3p^{6}3d^{10}4s^{1}$
8. Ca b/c less shielding/e- closer to pull of protons etc.
9. Sr^{2+} b/c more p+ pulling on same # of e^{-}

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 indentifying the ions on the left "automatic." For tips on learning these ions, see the opposite side of this page.

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

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^-