ERHS AP Chemistry Summer Assignment

The main goal of this assignment is to help you prepare for your second year of chemistry. It is separated into 2 parts. The first part is loaded with information that you should have memorized. The topics are as follows:

1. Ions
2. Solubility Rules
3. Acids and Bases
4. Intermolecular Forces
5. Organic Chemistry

You need to know the names and symbols for most of the elements on the periodic table. The periodic table you get for AP Chem will NOT include any names of elements, so it is up to you to remember them. We realize how large this task is, but your success in AP Chemistry depends on your knowledge of this basic information. Make flashcards and study them for 15 minutes a day. Keep yourself on a schedule and don't fall behind.

The second part of your assignment will be practice problems so you don't forget things like naming compounds, balancing equations, or stoichiometry. If there is something you don't understand, LOOK IT UP! Google is everyone's friend and there are plenty of resources you can find on the internet. Here are some that we think would be most helpful:

www.sciencegeek.net and www.chemmybear.com

P.S. Don't forget about all those notes you took in your first year of Chemistry. You wrote all that stuff down for a reason!

We will not be collecting this assignment and we will not be testing you on it. HOWEVER, this class moves fast so we are expecting you to know this information starting on the first day of school. If you have any questions, feel free to email/text us over the summer and we will respond as soon as possible. Good luck and remember to pace yourself with this assignment. We look forward to seeing you next year!

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Sign up for Remind as soon as possible!

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

<u>"From the Table"</u>

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

<u>Polyatomic Anions</u>

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

2. Solubility Rules

The only solubility rule you are required to memorize is this:

All Na^+ (sodium), K^+ (potassium), NH_4^+ (ammonium), and NO_3^- (nitrate) salts are soluble in water.

*Remember, soluble means "able to be dissolved" and will form an aqueous solution

3. Acids and Bases

Strong Acids	Strong Bases
HCl	Group 1 hydroxides
HBr	Group 2 hydroxides
HI	
HNO_3	
$HClO_3$	
$HClO_4$	
H_2SO_4	

Note: Strong acids and bases are those that dissociate completely in water.

Example: $HCl_{(aq)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$

$Ca(OH)_{2(aq)} \rightarrow Ca^{2+}_{(aq)} + 2OH^-_{(aq)}$

Weak acids and bases do not dissociate completely, and will be present in the compound in water.

Example: $HC_2H_3O_{2(aq)} \leftrightarrow H^+_{(aq)} + C_2H_3O_2^-{}_{(aq)}$

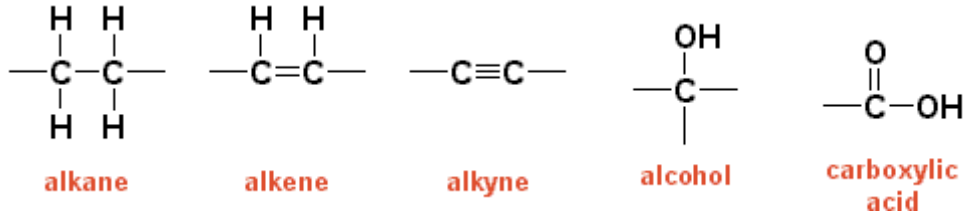
$NH_{3(aq)} \leftrightarrow NH_4^+{}_{(aq)} + OH^-_{(aq)}$

4. Intermolecular Forces

Forces between molecules that keep solids together.

Network Covalent	Directional covalent bonds C (graphite, diamond) Si, SiO_2(sand)	Strongest
Ionic (electrostatic attraction)	Forces between adjacent ions (Na^+ -- Cl^-)	
Metallic	Forces between metal nuclei (Cu, Ag)	
Hydrogen bonding	Forces between adjacent molecules with H & F, O, N or Cl. (H_2O, NH_3)	
Dipole-dipole	Forces between adjacent polar molecules (CO, NF_3)	
London Dispersion Force	Forces between adjacent nonpolar molecules (CO_2, Cl_2)	Weakest

5. Organic Chemistry Functional Groups (these are the important ones)



NAMING COVALENT MOLECULES, IONIC COMPOUNDS, AND ACIDS

Rules for Naming Covalent Compounds (nonmetal + nonmetal)

A. Use prefixes to indicate the number of each element in the molecule.

mono-, di-, tri-, tetra-, penta-, hexa-, hepta-, octa-, nona-, deca-.

B. Drop the mono prefix if there is only one of first element in the molecule. Exp: CO_2, carbon dioxide. (no mono)

C. Ending of the last element changes to *–ide*.

Rules for Naming Ionic Compounds (metal + nonmetal)

A. Balance Charges (charges should add up to zero).

B. Cation (+ ion) is always written first (in name and in formula).
Cation has same name as on periodic table. You may need to indicate the charge of the cation in the name using roman numerals if it is multivalent. Exp: $FeCl_3$ is Iron(III) chloride whereas FeO is iron(II) oxide.

C. Change the ending of the anion (-ion) to *–ide* (unless polyatomic ion, then named as given).

I. Name these binary compounds of two nonmetals.

IF_7_____ N_2O_5_____ XeF_2 _____
N_2O_4_____ As_4O_{10}_____ SF_6_____
PCl_3_____ S_2Cl_2_____

II. Name these binary compounds with a fixed charge metal.

$AlCl_3$ _____ MgO_____ BaI_2_____
KI_____ $SrBr_2$ _____ Na_2S _____
CaF_2 _____ Al_2O_3_____

III. Name these binary compounds of multivalent cations (use roman numerals).

$CuCl_2$ _____ Fe_2O_3_____ SnO_____
$PbCl_4$_____ Cu_2S_____ HgS_____
AuI_3_____ CoP_____

IV. Name these compounds with polyatomic ions.

$Fe(NO_3)_3$_____ NaOH_____ Cu_2SO_4_____
$Ca(ClO_3)_2$_____ KNO_2_____ $NaHCO_3$_____
NH_4NO_2_____ $Cu_2Cr_2O_7$ _____

Acids- If the formula has hydrogen written first, then this usually indicates that the hydrogen is an H^+ cation and that the compound is an acid.

Rules for Naming an Acid

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.

-ide becomes hydro _____ic Acid

Example: Cl^- is the Chloride ion so HCl = hydrochloric acid

HCl _____ H_2S _____
HI _____ HF _____

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.

-ite becomes _____ous Acid

Example: ClO_2^- is the Chlorite ion so $HClO_2$. = Chlorous acid.

C. 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

Example: ClO_3^- is the Chlorate ion so $HClO_3$ = Chloric acid.

I like to remember this rule as "I **ate something and it was **ic**ky."

HNO_3, which contains the polyatomic ion nitrate, is called nitric acid.

HNO_2, which contains the polyatomic ion nitrite, is called nitrous acid.

I. Name the following acids using the correct naming rule.

$HClO_4$_____ H_2SO_4_____ $HC_2H_3O_2$_____
H_3PO_4_____ HNO_2_____ H_2CrO_4_____
$H_2C_2O_4$_____ H_2CO_3_____

Nomenclature: Simple Inorganic Formulas and Nomenclature

I. In the first column, classify each of the following as molecular (M) or ionic (I). In the second column, name each compound:

	M or I	Name		M or I	Name
1) CaF_2			10) SrI_2		
2) P_4O_{10}			11) CO		
3) K_2S			12) Cs_2Po		
4) NaH			13) $ZnAt_2$		
5) Al_2Se_3			14) P_2S_3		
6) N_2O			15) AgCl		
7) O_2F			16) Na_3N		
8) SBr_6			17) Mg_3P_2		
9) Li_2Te			18) XeF_6		

II. Name/write the formula for the following substances:

Formula	Name	Formula	Name
1)	Sodium hydrogen carbonate	16) Fe_2O_3	
2) $Cu(NO_3)_2$		17)	Ammonium sulfite
3) Hg_2Cl_2		18) $Ca(MnO_4)_2$	
4) AgBr		19)	Vanadium (V) oxide
5)	Potassium chlorate	20) LiH	
6)	Mercury (I) nitrate	21)	Iodic acid
7) $BaSO_4$		22) $NaBrO_2$	
8)	Hydrobromic acid	23) $Ca_3(PO_4)_2$	
9) SnO_2		24)	Oxygen molecule
10) $Ni_3(PO_4)_2$		25) $Fe\ (IO_2)_3$	
11) $Pb(OH)_2$		26)	Calcium hypochlorite
12) $CuCH_3COO$		27)	Silver chromate
13)	Francium dichromate	28)	Cesium sulfide
14)	Potassium permanganate	29) H_3PO_3	
15)	Sodium cyanide	30)	Copper (II) acetate

Chemical Reactions

I. Net Ionic Equations: Write out the balanced chemical equation for each of the following double replacement reactions. For each of the following reactions, use your solubility rules and your notes to write the molecular equation, complete ionic equation, net ionic equation.

Chemical Equation:

$$NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow NaNO_{3(aq)} + AgCl_{(s)}$$

Total Ionic Equation:

$$\cancel{Na^{+}_{(aq)}} + Cl^{-}_{(aq)} + Ag^{+}_{(aq)} + \cancel{NO^{-}_{3\,(aq)}} \rightarrow \cancel{Na^{+}_{(aq)}} + \cancel{NO^{-}_{3\,(aq)}} + AgCl_{(s)}$$

Net ionic Equation:

$$Ag^{+}_{(aq)} + Cl^{-}_{(aq)} \rightarrow AgCl_{(s)}$$

a. silver nitrate and potassium chloride

complete: _____

molecular: _____

net: _____

b. magnesium nitrate and sodium carbonate

complete: _____

molecular: _____

net: _____

c. strontium bromide and potassium sulfate

complete: _____

molecular: _____

net: _____

II. Balance the following equations with the lowest whole number coefficients and determine the type of reaction occurring.

	Type:
____S_8 + ____ O_2 → ____ SO_3	_____
____$C_{10}H_{16}$ + ____ Cl_2 → ____ C + ____ HCl	_____
____Fe + ____ O_2 → ____ Fe_2O_3	_____
____$C_7H_6O_2$ + ____ O_2 → ____CO_2 + ____ H_2O	_____
___$KClO_3$ → ____ KCl + ____ O_2	_____
____H3AsO_4 → ____As_2O_5 + ____ H_2O	_____
___V_2O_5 + ____ HCl → ____$VOCl_3$ + ____ H_2O	_____
____$Hg(OH)_2$ + ____ H_3PO_4 → ____ $Hg_3(PO_4)_2$ + ____ H_2O	_____

III. Predicting products of chemical reactions: Predict the products, write the equation, then balance.

COMBUSTION

1. C_4H_9OH + oxygen

2. C_7H_{14} + oxygen

SYNTHESIS

1. sodium + oxygen

2. calcium + nitrogen

DOUBLE REPLACEMENT

1. Iron (III) sulfate + calcium hydroxide

2. Sodium hydroxide + sulfuric acid

3. sodium sulfide + manganese (VI) acetate

4. chromium(III) bromide + sodium sulfite

5. barium hydroxide + chlorous acid

SINGLE REPLACEMENT Use the activity series to complete and balance these equations. If no reaction occurs, write NR.

1. Sodium + calcium sulfate

2. Zinc + aluminum iodide

3. Magnesium + copper (II) chloride

Oxidation Numbers: Anions and Cations

Summary of Rules for Oxidation Numbers:

- **Rule 1:** Atoms in a pure element have an oxidation number of zero.
- **Rule 2:** The more electronegative element in a binary compound is assigned the number equal to the negative charge it would have as an anion. The less-electronegative atom is assigned the number equal to the positive charge it would have as a cation.
- **Rule 3:** Fluorine has an oxidation number of -1 in all of its compounds because it is the most electronegative element.
- **Rule 4:** Oxygen has an oxidation number of -2 in almost all compounds.
  Exceptions:
  Peroxides, such as H_2O_2, in which its oxidation # is -1
  When oxygen is in compounds with halogens, such as OF_2, its oxidation # is +2.
- **Rule 5:** Hydrogen has an oxidation # of +1 in all compounds that are more electronegative than it; it has an oxidation # of -1 in compounds with metals.
- **Rule 6:** The algebraic sum of the oxidation numbers of all atoms in a neutral compound is zero.
- **Rule 7:** The algebraic sum of the oxidation numbers of all atoms in a polyatomic ion is equal to the charge of the ion.
- **Rule 8:** Rules 1-7 apply to covalently bonded atoms; however, oxidation numbers can also be assigned to atoms in ionic compounds.

Determine the Oxidation Number of each underlined element in the table below:

1) $K_2\underline{S}$	**6) $\underline{S}_8$**	**11) $\underline{C}_{60}$**
2) $Na\underline{Cl}O_4$	**7) $\underline{Mg}$**	**12) $\underline{Zr}O_2$**
3) $\underline{Br}Cl$	**8) $K_2\underline{W}_4O_{13}$**	**13) $K_2\underline{Cr}_2O_7$**
4) $Li_2\underline{C}O_3$	**9) $Mg(\underline{B}F_4)_2$**	**14) $Al_2(\underline{Cr}O_4)_3$**
5) $\underline{O}F_2$	**10) $\underline{Au}_2O_3$**	**15) $Cs_2\underline{Te}F_8$**

Steps for BALANCING REDOX REACTIONS

Remember redox reactions ***always*** involve a transfer of electrons (e- lost must = e- gained).

STEPS:

1. Write the unbalanced equation. (Be sure all charges & subscripts are copied correctly.)
2. Divide into half reactions.
3. Balance all atoms in each half reaction, **EXCEPT** H and O.
4. Balance O by adding H_2O.
5. Balance H by adding H^+ - Check to see if the equation is now balanced.
6. Balance the charges of the half reactions by adding e- to the side with the greater positive charge.
7. Multiply the half reactions by coefficients so that the overall ***e- lost = e- gained***
8. Add the half reactions; cancel out (or reduce down) anything that appears on both sides.
9. Check to see if the equation is balanced.

*10. (***optional – only done if solution is basic***) If basic, add OH^- to <u>both</u> sides to cancel out the H^+ and make water.

<u>Use the Steps above to Balance the following redox reactions:</u>

$Cr_2O_7^{2-} + SO_3^{2-} \rightarrow Cr^{3+} + SO_4^{2-}$ (acidic)

$Cr(OH)_3 + ClO^{-1} \rightarrow CrO_4^{2-} + Cl_2$ (basic)

Practice Problems

How many significant figures does each of the following contain?

1.) 54	_____	4.00	_____	0.041	_____
2.) 45678	_____	400	_____	0.00010	_____

Which number in each of the additions/subtractions is the limiting term, and how many decimal places should the answer of each addition/subtraction have? Write the answer with the correct amount of significant figures.

3.) 55.43 + 44.333 + 5.31 + 9.2 = _____ # of sig figs _____

4.) 890.019 + 890.1234 + 890.88788 = _____ # of sig figs _____

5.) 69.99999 – 45.44444444 = _____ # of sig figs _____

6.) 3.461728 + 14.91 + 0.980001 + 5.2631 = _____ # of sig figs _____

Which number in each of the multiplication/division problems is the limiting term, and how many sig figs should the answer of each multiplication/division have? Write the answer with the correct amount of sig figs.

7.) 343.4 / 34.337 = _____ # of sig figs _____

8.) 0.000000003 x 30.03030 = _____ # of sig figs _____

9.) (1.3) x (5.724) = _____ # of sig figs _____

10.) (6305) / (0.010) = _____ # of sig figs _____

Density

$$\textbf{Density} = \frac{\text{mass}}{\text{volume}}$$

Determining Density

A chemist, trying to identify the main component of a compact disc cleaning fluid, finds that 25.00 cm^3 of the substance has a mass of 19.625 g at 20°C. The following are the names and densities of the compounds that might be the main component.

Compound	Density $\left(\frac{g}{cm^3}\right)$ at 20°C
Chloroform	1.492
Diethyl ether	0.714
Ethanol	0.789
Isopropyl alcohol	0.785
Toluene	0.867

Which of these compounds is the most likely to be the main component of the compact disc cleaner?

_____

An empty container weighs 121.3 g. Filled with carbon tetrachloride (density 1.53 g/cm^3) the container weighs 283.2 g. What is the volume of the container?

_____

A student has a cube of aluminum that measures 4 cm wide on each side. What is the volume of this cube? (Volume = length x width x height)

_____

When the student massed the cube on a scale they found that the cube of aluminum had a mass of 165 g. What is the density of this aluminum cube?

_____

Percent error is a measure of how inaccurate a measurement is.

$$\textbf{Percent Error} = \frac{|\textbf{Your Value} - \textbf{Accepted Value}|}{\textbf{Accepted value}} \times 100\%$$

Using a computer, look up the accepted value for the density of aluminum and calculate your percent error for your calculated density.

Percent error for Al _____%

Electromagnetic Spectrum

1. What is the wavelength of light with a frequency of 3.2×10^{14} Hz.
2. How much energy (in KJ) is associated with a radio wave of wavelength 1.2×10^{2}m?

Atomic Theory, Electron Configuration & Periodicity

3. **Copy** and **fill** in the following table:

Element/ion	# of protons	# of neutrons	# of electrons
Fe			
Na^{+}			
	27		25
S^{2-}			
Cr^{3+}			

4. Write the electron configurations for Ca^{2+} and Br^{-1}

   For Se write:

   A. the complete electron configuration
   B. the noble gas electron configuration
   C. the orbital diagram from the noble gas electron configuration
   D. the dot diagram

Bonding & Lewis Dot Structures

5 Draw the Lewis structures for the following and identify its VSEPR Shape (molecular geometry) and polarity (polar or nonpolar):

A. CH_4, methane B. H_2O C. SO_2 D. Ozone, O_3 B. phosphate ion

Equilibrium & LeChatelier's Principle:

6. When Phosphorus pentachloride gas decomposes to form phosphorus trichloride gas and chlorine gas, 120 J of heat are released.

   A. Write a balanced equation for this reaction.

   Explain any shift that would occur for the following and **explain why:**

   B. more phosphorus pentachloride is added.
   C. The temperature is decreased
   D. The pressure is increased
   E. Chlorine gas is removed

KMT, States of Matter, & Gas Laws

7. A sample of diborane gas (B_2H_6), a substance that bursts into flame when exposed to air, has a pressure of 345 torr at a temperature of –15^{0}C and a volume of 3.48 L. If conditions are changed so that the temperature is 36^{0}C and the pressure is 268 torr, what will be the volume of the sample?

8. The density of a gas was measured at 1.30 atm and 47^{0}C and found to be 1.95 g/L. Calculate the molar mass of the gas.

Acids, Bases, pH, and Titrations

9. What is the [H^+], [OH^{1-}], pH, and pOH of a 0.005 M solution of calcium hydroxide?

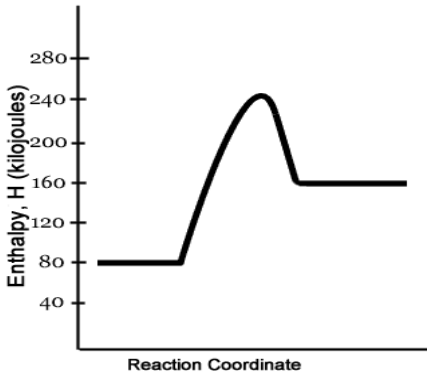
10. What is the concentration (in M) of 50.0 ml of hydrochloric acid, if 75.0 ml of 0.52 M sodium hydroxide is required to titrate to equivalence point?

Thermochemistry

11. The specific heat capacity of graphite is 0.71 J/^{0}C-g. Calculate the energy (in calories) required to raise the temperature of 1.8 kg of graphite by 100.0 ^{0}C.

12. Calculate the amount of energy released by the freezing of 13.3 g of water.

13. Calculate the amount of energy absorbed when 27.0 g of water is boiled.



14. Answer the following question about the reaction profile shown to the left:

a. Is the reaction exothermic or endothermic?

b. What is the value of ΔH?

c. What is the value of the activation energy of the reaction?

d. What is the potential energy of the products?

Average Atomic Mass

15. Find the mass of an element, if, out of a sample of 100:
    5 % have a mass of 176,
    19 % have a mass of 177,
    27 % have a mass of 178,
    14 % have a mass of 179 and
    35 % have a mass of 180?

    Identify this element by symbol and name?

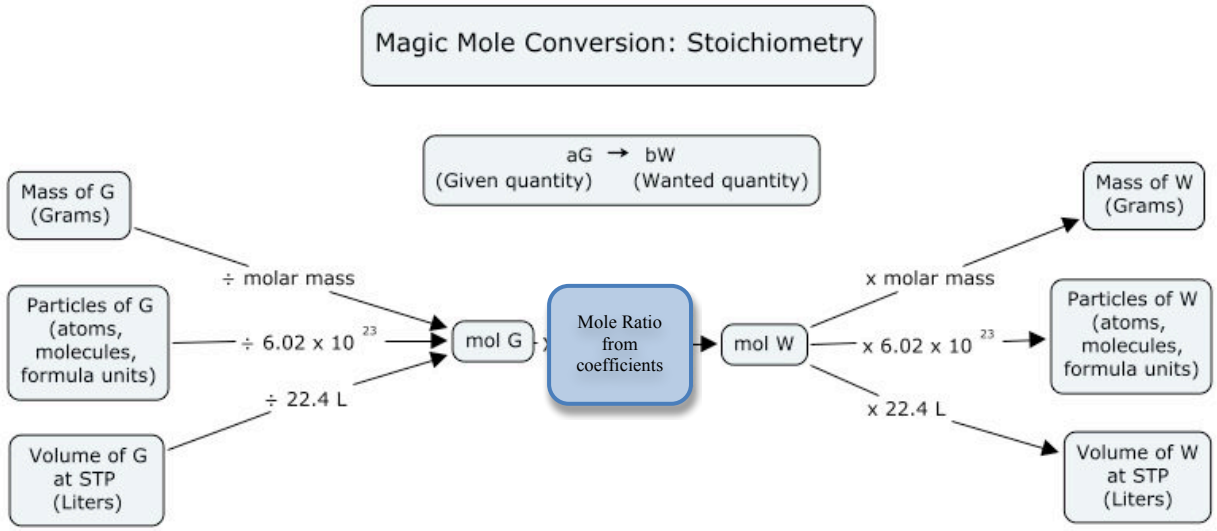
Mole Calculations

16. Convert 3.48×10^{20} molecules of SO_2 to moles. What is the mass of this quantity?
17. Calculate the following for quantities for 4.68g of $Ca_3(PO_4)_2$:
    a. formula units
    b. Ca^{2+} ions
    c. PO_4^{3-} ions
    d. O atoms

Empirical & Molecular Formula

18. The koala bear dines exclusively on eucalyptus leaves. The chief constituent in eucalyptus oil is a substance called eucalyptol, which contains 77.87 % C, 11.76 % H and the remainder O. If the molecular weight of eucalyptol is 154 amu, what is the empirical and molecular formula of this compound?

19. In an experiment, a 2.514-g sample of calcium was heated in a stream of pure oxygen, and was found to increase in mass by 1.004 g. Calculate the empirical formula of calcium oxide.



STOICHIOMETRY AND LIMITING REACTANTS

1. Given the equation below, what mass of water would be needed to react with 10.0g of sodium oxide?
   $Na_2O + H_2O \rightarrow 2NaOH$

2. $2NaClO_3 \rightarrow 2NaCl + 3O_2$
   What mass of sodium chloride is formed along with 45.0g of oxygen gas?

3. $4NH_3 + 5O_2 \rightarrow 4NO + 6\,H_2O$
   What mass of water will be produced when 100.0g of ammonia is reacted with excess oxygen?

4. If the reaction in #3 is done with 25.0g of each reactant, what is the maximum amount of product that could be made? Which reactant would be the limiting reactant?

5. $Na_2S + 2AgNO_3 \rightarrow Ag_2S + 2NaNO_3$
   If the above reaction is carried out with 50.0g of sodium sulfide and 35.0g of silver nitrate what is the maximum amount of silver sulfide that could be made?

   What is your limiting reactant?

   What mass of the excess reactant remains?

6. $6NaOH + 2Al \rightarrow 2Na_3AlO_3 + 3H_2$
   What volume of hydrogen gas (measured at STP) would result from reacting 75.0g of sodium hydroxide with 50.0g of aluminum?