AP Chemistry **awohlrab@ocsdnj.org**	**Dr. Wohlrab** **Due Dates: First Day of School, September, 2021**
Meets AP College Board approval	
Topic: AP Chemistry	
Purpose; Major Chem concepts	
Text/Novel(s) & Brief Description; Chemistry by Brown-Lemay	
Approximate Time on Task: 5 hours	
Suggested Timeline: Start immediately and finalize at end of August	
How It Will Be Assessed : Assignment will be checked for completion on the first day of class and counted as homework assignment #1.	

OnlineTextbook link: https://misterchemistry.com/wp-content/uploads/2017/06/Chemistry-the-central-science-.pdf

AP Chemistry Summer Work

Dear Prospective AP Chemistry Student,

Welcome to AP Chemistry! This is a college level course offered to meet the needs of our more able students. The text, labs, demos, and other materials are selected from those presently used at our nation's top colleges and universities. The class is a second year chemistry course for high school students, and is one year in length. Emphasis is directed towards topics covered during a first year college chemistry course. **You should expect this class to be SIGNIFICANTLY more difficult than your first chemistry class.**

The goal of this course is for students to understand chemistry to the extent that they are able to pass the AP chemistry exam given each May. Students enrolled in AP Chemistry are strongly urged to take the AP exam. Each college has their own rules and regulations about credits received upon passing the AP exam, and you should investigate your major and college at https://apstudent.collegeboard.org/creditandplacement.

Specific goals for this course include: 1) the establishment of a regime of study which will cover, as thoroughly as possible, the topics presented in the text before the May exam, 2) the acquisition of adequate knowledge and understanding to permit students to pass the AP Chemistry exam, 3) the further development of the ability to perform college level laboratory experiments.

Students in the course are expected to spend approximately twice as much time studying outside of class as students enrolled in the first year high school chemistry course. An **hour** of homework each night including weekends can often be expected. In addition, study sessions will occur intermittently at lunch or after school and some lab experiments may require extra time outside of class in order to complete them.

I appreciate your willingness to pursue this class. Your decision to take it cannot be made without your having considered how it might impact you as well as your GPA. You must realize that the goal of AP Chemistry is to provide you the opportunity to be successful in learning the content and applications of first year *college chemistry*. If you are allowed to take this class when you are unprepared or ill motivated, it can have a negative impact on you. You must consider how the following will either help or hinder your efforts:

-Do you work an outside job? How many hours do you work?

-Are you heavily involved in extracurricular activities?

-How many other AP classes do you want to take concurrently?

This course meets its goal by transferring more of the responsibility for learning onto you, the student. This helps free the time necessary for preparing and evaluating your laboratory work.

All of the information should be review from your Chemistry course, and is essential to your success in AP Chemistry. Accomplishing the challenges of AP Chemistry can be exhilarating! You must not only have the skills to do well, but you should also probably enjoy the subject you're studying.

If you have any questions throughout the summer, I am available by email, and would be happy to help you. My email is awohlrab@ocsdnj.org, I look forward to embarking on this experience with all of you, and will see you next year.

Sincerely,

Dr. Aaron Wohlrab
AP Chemistry Teacher
"There are no shortcuts to any place worth going!"

SO WHAT IS THE SUMMER WORK? All work should be done neatly and clearly. All work for every problem **including units throughout** is necessary for AP.

1. Memorize common ions and charges. You'll find these at the end of the packet in the "Resources" section.
2. Memorize the strong acids and bases.
3. Read and review and topics in the online textbook that you may have forgotten.
4. Complete the practice problems provided.
5. Complete the Mass spectrometry activity (after the practice problems)

The following chapters align with the Brown-Lemay Honors Text.

Chapter 1

1. List the number of significant figures in the following number:

   a) 0.004005 _____
   b) 34.00 _____
   c) 30,040,000 _____
   d) 25.00500 _____
   e) 3.00×10^{14} _____
   f) 0.00007 _____
   g) 0.000070000 _____
   h) 0.004500 _____

2. Perform the following operations and report answer with the correct number of significant figures.

   a) $2.05 \times .0005 =$ _____
   b) $542.01/.042 =$ _____
   c) $2.51 + .2 =$ _____
   d) $0.00451 - 0.003 =$ _____

3. Convert from Scientific notation the following:

   a) $2.51 \times 10^{8} =$ _____
   b) $6.20 \times 10^{-5} =$ _____

4. Convert the following to scientific notation:

   a) .004050 = _____
   b) 6,000,000 = _____

Chapter 2

5. Classify the following compounds as ionic or molecular (covalent).

   a) $CaCl_2$ _____
   b) CO_2 _____
   c) H_2O _____
   d) Na_2SO_4 _____
   e) K_2O _____
   f) CH_4 _____

6. Classify the following compounds as binary ionic or ternary ionic (polyatomic ionic).

   a) KOH _____
   b) CoO _____
   c) $Fe(NO_3)_2$ _____
   d) MgH_2 _____
   e) Cs_2S _____
   f) $Na_2Cr_2O_7$ _____

7. Write the names or formulas for the following ions.

   a) Ca^{2+} _____
   b) O^{2-} _____
   c) H^{+} _____
   d) H^{-} _____
   e) Fe^{3+} _____
   f) CO_3^{2-} _____
   g) NH_4^{+} _____
   h) NO_3^{-} _____
   i) acetate ion _____
   j) phosphide ion _____
   k) phosphate ion _____
   l) iron(II) ion _____
   m) hydronium ion _____
   n) nickel(II) ion _____
   o) sodium ion _____
   p) sulfate ion _____
   q) sulfite ion _____
   r) sulfide ion _____

8. Write the name or formula for the following binary ionic compounds. Be sure to use a Roman numeral if necessary.

a) KBr _____
b) V_2O_5 _____
c) cobalt(III) oxide _____
d) barium phosphide _____
e) cadmium nitride _____
f) Cu_3P _____

9. Write the name or formula for the following polyatomic ionic compounds. Be sure to use a Roman numeral if necessary.

a) calcium nitrite _____
b) BaSO4 _____
c) silver acetate _____
d) $SrSO_3$ _____
e) nickel(II) phosphate _____
f) Na_2CO_3 _____

10. Write the name or formula for the following ionic hydrates. Be sure to use a Roman numeral if necessary.

a) $MgCl_2 \cdot 6H_2O$ _____
b) $Co(NO_3)_2 \cdot 4H_2O$ _____
c) barium hydroxide octahydrate _____
d) sodium sulfate decahydrate _____

11. Write the name or formula for the following molecular (covalent) compounds

g) iodine tribromide _____
a) chlorine dioxide _____
b) sulfur hexafluoride _____
c) difluorine octachloride _____
d) tribromine nonatelluride _____
e) H_2O _____

12. Write the name or formula of the following acids.

a) nitric acid _____
b) sulfuric acid _____
c) HF(aq) _____
d) $H_3PO_4(aq)$ _____
e) $H_2CO_3(aq)$ _____
f) acetic acid _____
g) sulfurous acid _____
h) perchloric acid _____
i) HCl _____
j) ClO_3 _____

13. List the seven that exist as diatomic molecules in their elemental form.

a) _____
b) _____
c) _____
d) _____
e) _____
f) _____
g) _____

14. Using the periodic table complete the following table.

Symbol	^{52}Cr	^{75}As	^{40}Ca	^{222}Rn	$^{33}S^{2-}$
Protons		33			16
Neutrons		42	20		
Electrons			20	86	
Mass No.				222	

15. Using the data below, calculate the average atomic mass, in amu, for chlorine and silicon.

Silicon		
Mass Number	Exact mass (amu)	Percent abundance
28	27.977	92.23
29	28.9767	4.67
30	29.974	3.10

16. Would you expect each of the following atoms to gain or lose electrons when forming ions? What ion is the most likely in each case?

a) Na
b) Sr
c) P
d) Ba
e) I
f) O
g) Al
h) S

Chapter 3

Perform the following calculations: (show all work completely please, use separate paper. Be sure to include the units. A number means nothing in science without units! Correct answers are given in brackets [ ], I want to see the work you do to get them)

17. Calculate the following
    a) molar mass of of $Al_2(CO_3)_3$. [234.01 g/mol)]
    b) What is the mass percentage of each element in $Al_2(CO_3)_3$? [23.1% Al, 15.4% C, 61.5% O]
18. Calculate the number of moles present:
    a) 159 grams of aluminum sulfate [.465 mole]
    b) 3.00 kg of calcium carbonate [30.0 mole]
    c) 1.12×10^{20} formula units of sodium hydroxide [1.86×10^{-4} mole]
19. Calculate the number of grams present:
    a) 8.20 moles calcium carbonate [821 g]
    b) 3.01×10^{15} formula units of sodium hydroxide [2.00×10^{-7} g]
20. Calculate the number of ions/atoms present:
    a) number of hydrogen atom is in 5.00 molecules in isopropyl alcohol, C_3H_8O [40 atoms]
    b) number of ions in 5.00 moles of ammonium sulfide [9.03×10^{24} ions]

21. Consider the following reaction: $C_6H_6 + Br_2 \rightarrow C_6H_5Br + HBr$

    a) What is the theoretical yield of bromobenzene, C_6H_5Br in this reaction when 30.0 grams of benzene, C_6H_6, reacts with 65.0 grams of bromine, Br_2 ? [60.3g C_6H_5Br]

    b) Based on calculations above, identify the limiting and excess reagents.

    c) If the actual yield of bromobenzene was 56.7 grams, what was the percentage yield? [94%]

22. Caffeine if it is found to be 49.5 % C, 5.15 % H, 28.9 % N and 16.5 % O by mass.

    a) Determine the empirical formula of caffeine. [$C_4H_5N_2O$]

    b) Determine the molecular formula if the actual molar mass of caffeine is found to be 195 g/m. [$C_8H_{10}N_4O_2$]

23. Quinone, which is used in the dye industry and in photography, is an organic compound containing only C, H, and O.

    a) What is the empirical formula of the compound if you find that 0.105 g of the compound gives 0.257 g of CO_2 and 0.0350 g of H_2O when burned completely? (see section 3.5, page 99 sample exercise 3.15) [C_3H_2O]

    b) Given a molecular weight of approximately 108 g/mol, what is its molecular formula? [$C_6H_4O_2$]

Chapter 4

Solubilities

24. Based on the rules for solubility (which should be memorized) list each of the following compounds as either soluble or insoluble. Put an "**s**" or "**i**" after the compound.

a) calcium nitrate	_____	h) copper II hydroxide	_____
b) zinc carbonate	_____	i) silver chloride	_____
c) lead II chloride	_____	j) barium hydroxide	_____
d) aluminum sulfate	_____	k) iron III chloride	_____
e) potassium hydroxide	_____	l) nickel II phosphate	_____
f) silver acetate	_____	m) ammonium hydroxide	_____
g) sodium phosphate	_____	n) lead II sulfate	_____

Net Ionic Equations

25. Predict the products write the balanced net ionic equation for the following reactions.

    a) Ammonium sulfate reacts with barium nitrate.
    b) Zinc metal is added to a solution of copper (II) chloride.
    c) Propane gas (C_3H_8) is burned in excess oxygen.
    d) Magnesium and nitrogen gas are heated together.
    e) Chlorine gas is bubbled through a solution of sodium bromide.
    f) Sulfuric acid is combined with sodium hydroxide.
    g) Carbon dioxide is bubble through water.

Solution Stoichiometry (Show all work as always)

26. How many grams of K_2CrO_4 should be dissolved in enough water to make 1000 ml of a .25 M solution? [48.6g]

27. How many milliliters of a 5 M H_2SO_4 solution must be diluted with water to make 500 milliliters of a .2 M H_2SO_4 ? [20mL]

28. What is the concentration (in M) of 2.5 grams of NaCl in 500ml of solution? [0.085M]

Titration Calculations (WRITE OUT THE CHEMICAL EQUATIONS!!!!)

29. How many milliliters of .155 M HCl are needed to neutralize completely 35.0 ml of .101 M $Ba(OH)_2$ solution? [45.6 ml]

30. If 25.8 ml of $AgNO_3$ is required to precipitate all the Cl^- ion in a 785 mg sample of KCl (forming AgCl), what is the molarity of the $AgNO_3$ solution? [0.407 M]

Redox

31. Determine the oxidation number of each atom in the following substances

a) NF_3 N _____ F _____
b) K_2CO_3 K _____ C _____ O _____
c) NO_3^- N _____ O _____
d) HIO_4 H _____ I _____ O _____
e) MnO_4^- Mn_____ O _____

32. Balance the following redox reactions in acidic or basic solution. (see chapter 21)

a) $NO_2^- + MnO_4^- \rightarrow NO_3^- + Mn^{+2}$ (in acid solution)

b) $I^- + MnO_4^- \rightarrow I_2 + MnO_2$ (in basic solution)

Chapter 5

33. Complete the following chart:

Type of Reaction	Sign of ΔH_{rxn}	Which has more energy: reactants or products?
Exothermic		
Endothermic		

34. Consider the following reaction which occurs at room temperature and pressure:

$2H_2O_2 \rightarrow 2H_2O + O_2$; $\Delta H = -190$ kJ

a) Is the reaction endothermic or exothermic?

b) How much heat (kJ) will be released if 1.0 gram of hydrogen peroxide H_2O_2 composes? [-2.8kJ]

35. A 4.50 gram sample of KNO_3 is dissolved in 100.0 grams of water in a coffee cup calorimeter. The temperature decreases from 35.8^0C to 25.6^0C .

a) Calculate the heat (q) gained or lost by the water in joules.[-4460J]
b) What is molar enthalpy change (kJ/mol) for the KNO_3? [+100 kJ/mol]

36. Given the following reactions, calculate the enthalpy for Reaction 3 in kJ. [571.6 kJ]

Reaction 1: $CaCO_3\ (s) \rightarrow CaO\ (s) + CO_2\ (g)$ $\Delta H = 178.1$ kJ
Reaction 2: $C\ (s) + O_2\ (g) \rightarrow CO_2\ (g)$ $\Delta H = -393.5$ kJ

Reaction 3: $CaCO_3\ (s) \rightarrow CaO\ (s) + C\ (s) + O_2\ (g)$ $\Delta H = ?$

Chapter 6

Electron structure of the atom

37. Write out the full electron configuration of As (arsenic) below. $1s^2 2s^2$ stuff..

38. Write out an orbital configuration for the electrons for Si (silicon) those circles or squares with electrons in them with .

39. Write out a noble gas (condensed) configuration for Cu (copper).

Chapter 7

40. Define the terms
    a) effective nuclear charge
    b) Shielding

41. What are the periodic trends for the following?
    a) Z_{eff}
    b) Atomic radius
    c) Ionization energy
    d) Electronegativity
    e) Electron affinity
    f) Metallic character

Chapter 8 /9

You may have to look these up.

42. For each of the following, provide the Lewis structure and molecular geometry.

    a) NH_3

    b) H_2O

    c) NO_2^-

    d) O_3

    e) CH_4

    f) CO_3^{2-}

Chapter 10

1. The pressure exerted by 1.3 mol of gas in a 13 L flask at 22ºC is _____ atm. [2.4atm]

2. What volume (L) of NH_3 gas at STP is produced by the complete reaction of 7.5 g of H_2O according to the following reaction? [3.1L]

   $Mg_3N_2(s) + 6H_2O(l) \rightarrow 3Mg(OH)_2(aq) + 2NH_3(g)$

3. Ammonium nitrite undergoes thermal decomposition to produce only gases. What is the total volume (L) of gas produced by the decomposition of 35.0 g of $NH_4NO_2(s)$ at 525ºC and 1.5 atm? [72 L]

   $NH_4NO_2(s) \rightarrow N_2(g) + 2H_2O(g)$

Chapter 15

1. What is the pH of an aqueous solution at 25.0 °C that contains 3.98×10^{-9} M hydronium ion? [8.400]

2. An aqueous solution contains 0.150 M HCl at 25.0°C. What is the pH of the solution? [0.82]

3. The K_a of acetic acid ($HC_2H_3O_2$) is 1.8×10^{-5}. What is the pH at 25.0°C of an aqueous solution that is 0.100 M in acetic acid? [2.87]

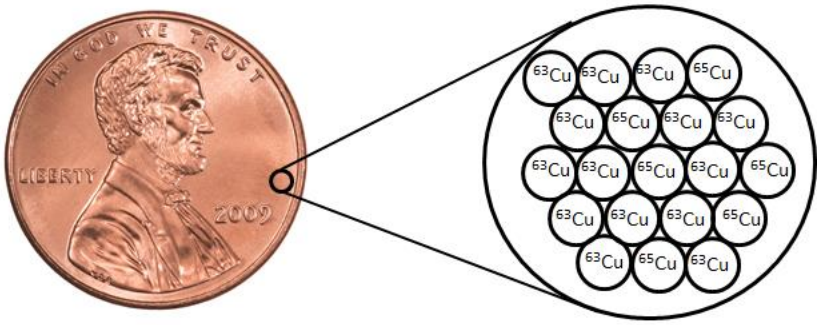
Isotopes and Mass Spectrometry

Why? In this activity we will address the questions:

- Are all atoms of an element identical and how do we know?
- How can data from mass spectrometry be used to identify the elements and the masses of individual atoms of a specific element.
- How can Data from mass spectrometry also demonstrate direct evidence of different isotopes from the same element?
- How can the average atomic mass be estimated from mass spectra.
- Explain how data from mass spectrometry supports or rejects early models of the atom.

Prior Knowledge
Model 1: Isotopes

Magnified 1 billion times (x 10^9)



1. Does the sample contain identical atoms of copper?

2. Use the picture above to determine the percent of ^{63}Cu in the sample. What is the percent of ^{65}Cu?

3. a) What is the average atomic mass of copper on the periodic table?

   b) Is it closer to 63 amu or 65 amu?

   c) How does the information from the picture above explain the answer to the previous question?

4. Consider the data given in the table below. Determine the average mass of an element based on data table the isotopic abundance and the mass of each isotope

Isotope	% Abundance
^{20}Ne	90.48
^{21}Ne	0.27
^{22}Ne	9.25

5. There are two stable isotopes of calcium: Ca - 40 (39.96) and Ca - 46 (45.95). Using the average atomic mass of calcium from the periodic table, calculate the % abundance of each isotope of calcium. (Hint: Avg mass = 40(X) + 46(1-X). Solve for X and 1-X to calculate % abundance of each isotope.)

Model 2: Mass spectrometry

Information:

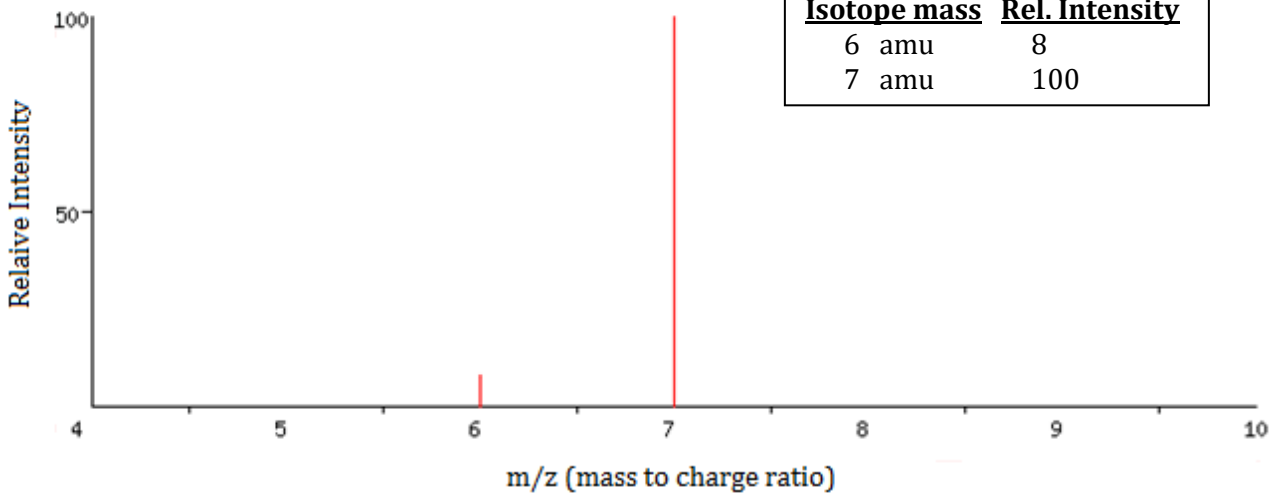
Mass Spectrometry is a powerful analytical tool used to determine the following information.

- The elemental composition of a sample
- The masses of particles and of molecules
- Potential chemical structures of molecules by analyzing the fragments
- The identity of unknown compounds by determining mass and matching to known spectra
- The isotopic composition of elements in a sample

A mass spectrometer is a device for separating atoms and molecules according to their mass.
In a mass spectrometer, a substance is first heated in a vacuum and then ionized. The ions produced are accelerated through a magnetic field that separates ions of different masses. The height of each peak is proportional to the amount of each isotope present (i.e. it's relative abundance). The m/z ratio for each peak is found from the accelerating voltage for each peak. Many ions have a +1 charge so that the m/z ratio is numerically equal to mass m of the ion.

The graph below was produced when an element, lithium, was analyzed in a mass spectrometer. Use the graph to answer the questions below.

Isotope mass	Rel. Intensity
6 amu	8
7 amu	100



Mass spectrum of Lithium

6. How many isotopes of Lithium exist?

7. What masses are present on the graph for the following

   a) The mass of the most abundant isotope

   b) The mass of the least abundant isotope.

8. Label the each peak with the nuclide symbol for each isotope

9. Without performing any calculations, predict the approximate atomic mass for lithium. Explain the basis for your prediction.

10. Now calculate the average atomic mass of the element from the mass spectrum data. The height of each peak is the relative intensity, not the % abundance. You will first need to calculate the % abundance and then the average atomic mass.

    a) What is the relative intensity of each peak?

    Peak 1 = _____

    Peak 2 = _____

    b) What is the total relative intensity of the peaks?

    Total = _____

    c) What is the % of the intensity of each peak? ($\% = \frac{Part}{Total}\ x\ 100$)

    Peak 1% = _____

    Peak 2% = _____

    d) You've just determined the % abundance for each isotope of the element. Complete the table and calculate the average atomic mass of the element.

Isotope	Mass	% Abundance

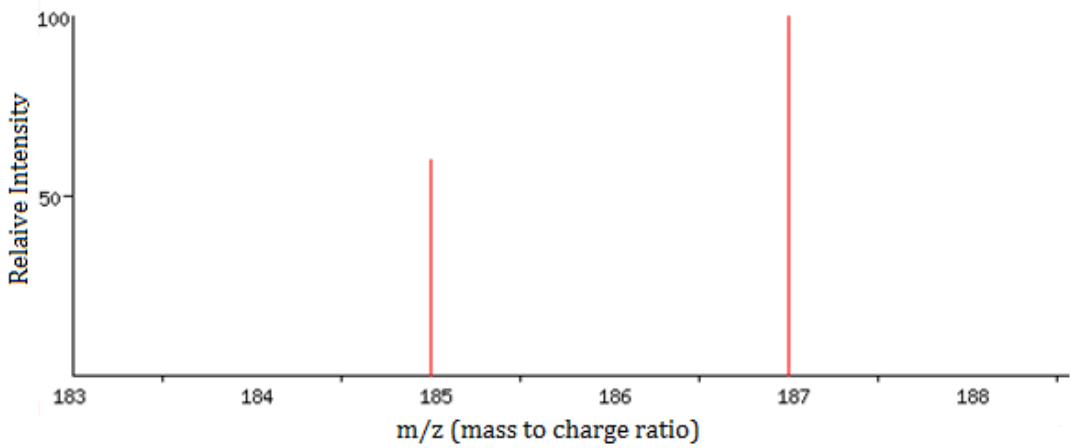
    Average atomic mass = _____amu

11. The modern use of mass spectrometry provides another example of how experimental data can be used to test or reject a scientific model.

    a) Does data from mass spectrometry demonstrate evidence which supports or contradicts Dalton's early model of the atom? Explain.

    b) How does data from mass spectrometry demonstrate direct evidence of different isotopes of the same element?

12. What element's mass spectrum is represented below? Explain your answer.



Model 3: Predicting Isotopic Abundances and Mass Spectrum

Based on what you've learned, answer the following questions and check your answers using one of the following websites

1. http://www.webelements.com Select the element of interest. Scroll to the bottom right of the page and click on "Isotopes" under the "Nuclear Properties" section.

2. http://www.sisweb.com/mstools/isotope.htm Enter in the formula of the element to generate its mass spectrum. (Note: formula entry is case sensitive; the first letter of the element must be capitalized will all others lower case.

13. a) What is the average atomic mass of Boron?

b) If there are two predominant isotopes of Boron on earth, ^{10}B and ^{11}B, which do you think is most abundant?

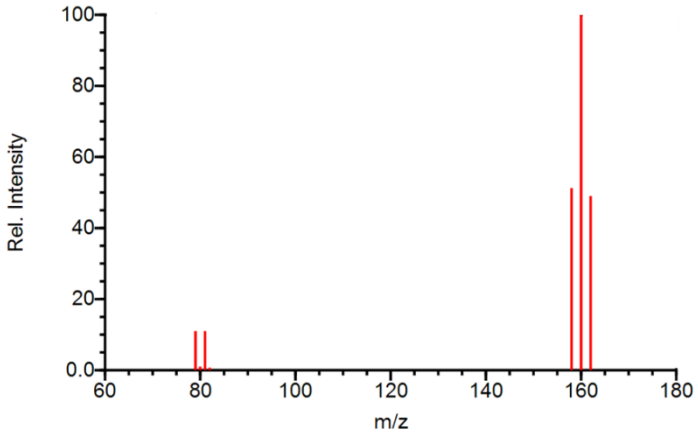
c) Make an estimate of the percentage of each isotope of Boron.

d) Draw a rough sketch for the mass spectrum of Boron. Label each axis and label each peak with the appropriate nuclide symbol

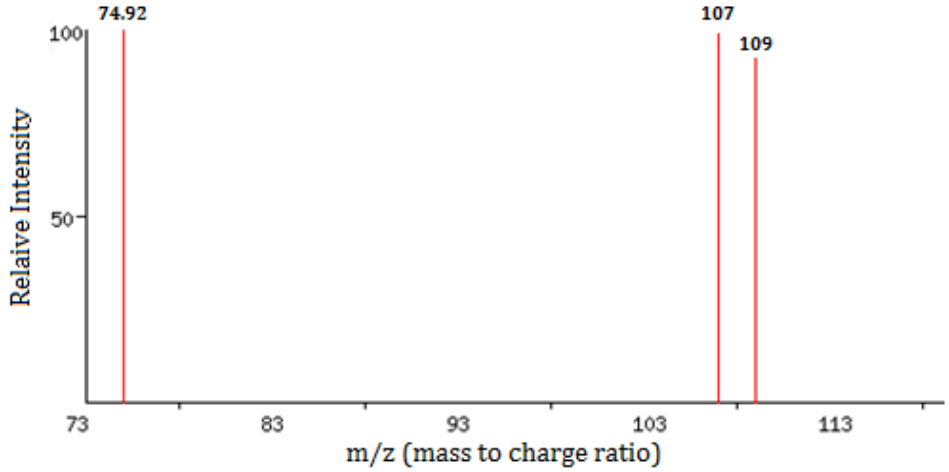
14. There are two naturally occurring isotopes of rubidium, ^{85}Rb and ^{87}Rb. Use the process above to draw a rough sketch for the mass spectrum of rubidium.

Exercises

15. The mass spectrum for elemental bromine is represented below. Label each peak with the appropriate nuclide symbols. Remember, not all elements exist as single atoms in nature.



16. The mass spectrum below represents a mixture of elements. What elements are present? Justify your answer. (Check your answer using the websites listed above.)



17. The mass spectrum of strontium gives four peaks. Use the data below to answer the following questions:

m/z	84	86	87	88
Relative intensity	0.68	11.94	8.48	100.00

a) Sketch the mass spectrum that would be obtained from naturally occurring strontium.

b) Label each peak on the mass spectrum with the appropriate nuclide symbols.

c) Calculate the average atomic mass of strontium in the sample rounded to two decimal places.

Resources

General Chemistry Sites:
http://chemteam.info/ChemTeamIndex.html
www.chemfiesta.com
www.chemistrygeek.com
http://www.collegeboard.com/ap/students/chemistry/index.html
www.chemmybear.com

Polyatomic Ion List

the polyatomic ions must committed to memory.

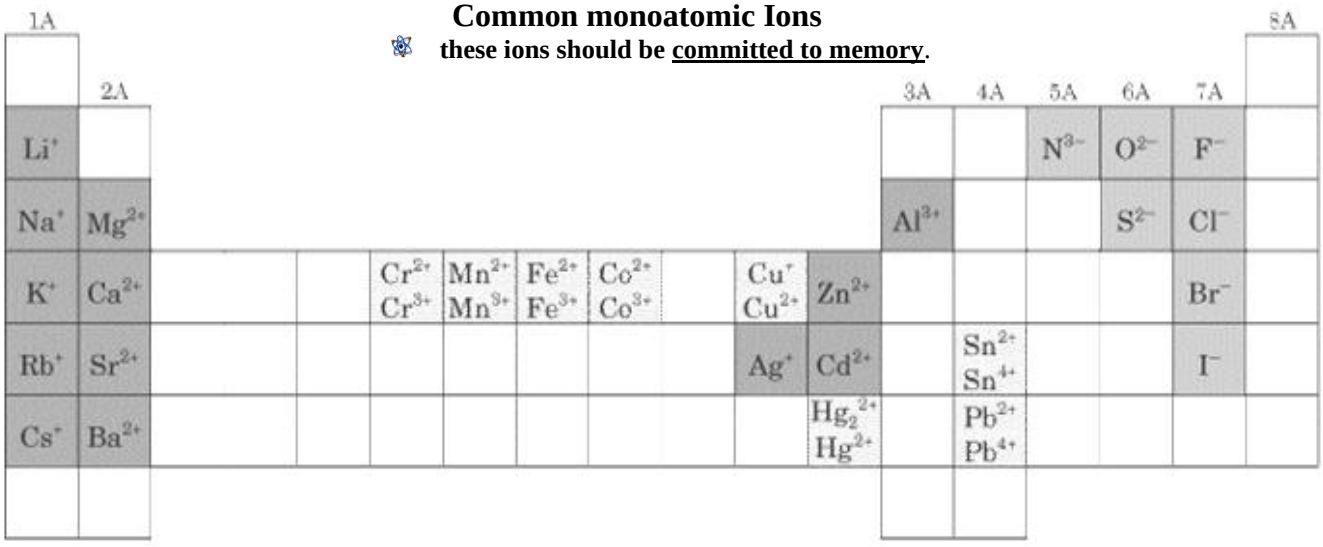
Formula	Name	Formula	Name
NO_3^-	nitrate	ClO_4^-	perchlorate
NO_2^-	nitrite	ClO_3^-	chlorate
CrO_4^{2-}	chromate	ClO_2^-	chlorite
$Cr_2O_7^{2-}$	dichromate	ClO^-	hypochlorite
CN^-	cyanide	IO_4^-	periodate
SCN^-	thiocyanate	IO_3^-	iodate
MnO_4^-	permanganate	IO_2^-	iodite
OH^-	hydroxide	IO^-	hypoiodite
O_2^{2-}	peroxide	BrO_4^-	perbromate
H_3O^+	hydronium	BrO_3^-	bromate
SO_4^{2-}	sulfate	BrO_2^-	bromite
SO_3^{2-}	sulfite	BrO^-	hypobromite
PO_3^{3-}	phosphite	CO_3^{2-}	carbonate
PO_4^{3-}	phosphate	HCO_3^-	hydrogen carbonate
HPO_4^{2-}	hydrogen phosphate	HSO_4^-	hydrogen sulfate
$H_2PO_4^-$	dihydrogen phosphate	HSO_3^-	hydrogen sulfite
$C_2H_3O_2^-$	acetate	HS^-	hydrogen sulfide
CH_3COO^-	acetate	NH_4^+	ammonium
H^-	hydride	H^+	Hydrogen ion

-ite is one less oxygen than the –ate
Hypo- is one less oxygen than the –ite
Per- is one more oxygen than the –ate

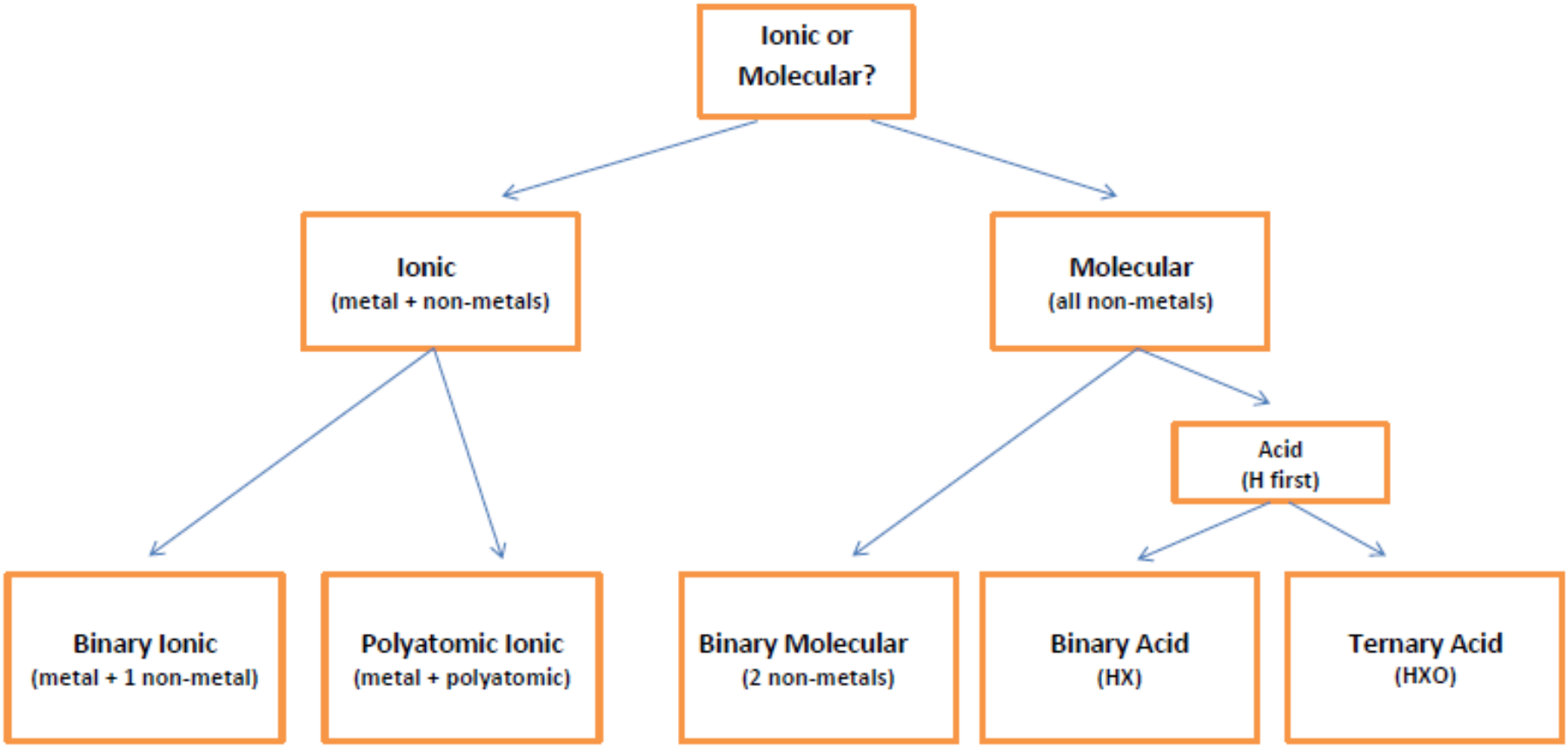
Hydrogen can be added to -2 or -3 ions to make a "new ion" i.e. $H_2PO_4^{-1}$ is dihydrogen phosphate (note the – charge went up 1 for each H^+ added)

Common monoatomic Ions

these ions should be committed to memory.



Nomenclature Flowchart



1.Name metal, use roman numeral if necessary

2. Name non-metal, change ending to "ide"

1.Name metal, use roman numeral if necessary

2. Name polyatomic ion

1.Name 1st non-metal, use a prefix, but never use mono

2. Name 2nd non-metal, use a prefix, and change ending to "ide"

1-mono 6-hexa
2-di 7-hepta
3-tri 8-octa
4-tetra 9-nona
5-penta 10-deca

Hydro_____ic

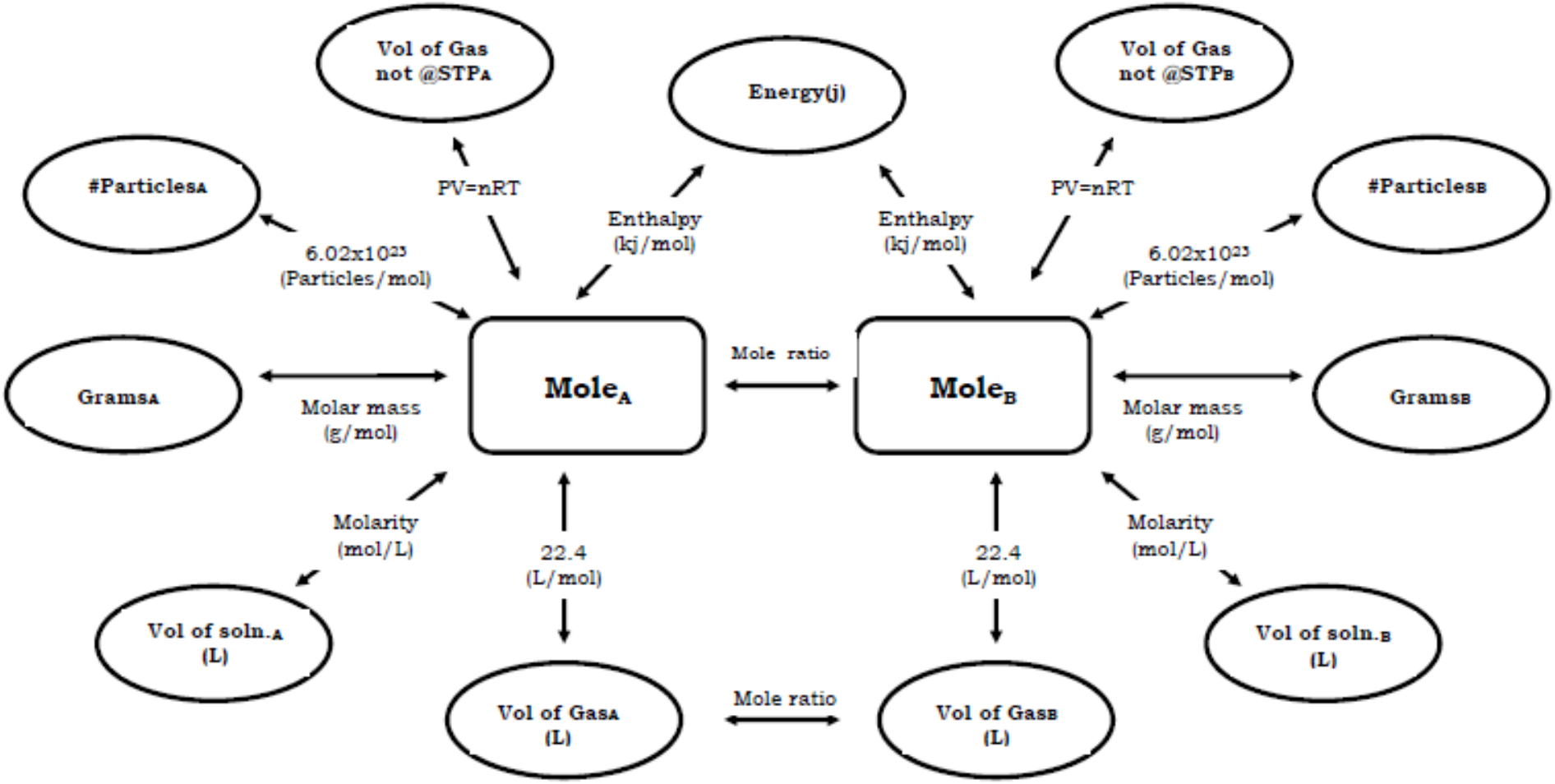
Build name from polyatomic:

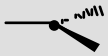
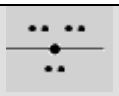
"ate" →"ic"
"ite" →"ous

Never use hydro

*All metals need a Roman numeral except:
Group I, Group II, Al^{+3}, Zn^{+2}, Cd^{+2}, Ag^{+1}

Mole Map


Vol of Gas not @STPA
Energy(j)
Vol of Gas not @STPB
#ParticlesA
PV=nRT
PV=nRT
#ParticlesB
Enthalpy (kj/mol)
Enthalpy (kj/mol)
6.02x10²³ (Particles/mol)
6.02x10²³ (Particles/mol)
GramsA
Molar mass (g/mol)
MoleA
Mole ratio
MoleB
Molar mass (g/mol)
GramsB
Molarity (mol/L)
22.4 (L/mol)
22.4 (L/mol)
Molarity (mol/L)
Vol of soln.A (L)
Vol of GasA (L)
Mole ratio
Vol of GasB (L)
Vol of soln.B (L)

Total # of e^- domains	***Electron Domain Geometry*** *(Hybridization)*	***Approximate Bond Angle***	***# of Bonding Directions (# of X)***	***# of Lone Pairs (# of E)***	***Molecular Geometry Name*** *(VSEPR class)*	***Shape***	***Examples***
2	*linear (sp)*	*180°*	2	0	**linear** (AX_2)		BeH_2, CO_2
3	*trigonal planar (sp^2)*	*120°*	3	0	**trigonal planar** (AX_3)		BF_3, NO_3^-
			2	1	**bent** (AX_2E)		SO_2
4	*tetrahedral (sp^3)*	*109.5°*	4	0	**tetrahedral** (AX_4)		CH_4
			3	1	**trigonal pyramidal** (AX_3E)		NH_3
			2	2	**bent** (AX_2E_2)		H_2O
5	*trigonal bipyramidal (sp^3d)*	*120° (in plane) & 90° (above & below)*	5	0	**trigonal bipyramidal** (AX_5)		PCl_5
			4	1	**seesaw** (AX_4E)		SF_4
			3	2	**T-shaped** (AX_3E_2)		ClF_3
			2	3	**linear** (AX_2E_3)		XeF_2
6	*octahedral (sp^3d^2)*	*90°*	6	0	**octahedral** (AX_6)		SF_6
			5	1	**square pyramidal** (AX_5E)		BrF_5
			4	2	**square planar** (AX_4E_2)		XeF_4
			3	3	**T-shaped** (AX_3E_3)		
			2	4	**linear** (AX_2E_4)