AP Chemistry
Mrs. Lemke

Contact Information:
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Text: Chemistry, 8th edition (published 2010), by Zumdahl and Zumdahl and associated materials
Other laboratory material Flinn Scientific

Materials: Scientific calculator
Laboratory Notebook
Three ring binder with dividers OR folder with notebook
Blue/Black pen and pencil

LABORATORY NOTEBOOKS CAN BE ORDERED FROM THE FOLLOWING WEBSITES:

Website	Item #
http://www.amazon.com/Notebook-Carbonless-Pages-Spiral-Perforated/dp/0978534425	**ISBN-10:** 0978534425 **ISBN-13:** 978-0978534424
http://www.amazon.com/Student-Lab-Notebook-Carbonless-Duplicate/dp/1930882009/ref=sr_1_4?ie=UTF8&qid=1460555142&sr=8-4&keywords=lab+notebook+carbonless+100	**ISBN-10:** 1930882009 **ISBN-13:** 978-1930882003
https://www.amazon.com/BookFactory-Carbonless-Notebook-Scientific-Format/dp/B008UCSMPU/ref=pd_lpo_229_bs_t_2/167-4946508-8155061?ie=UTF8&psc=1&refRID=3YQWQ98G8KFD2507118C	**Manufacturer Part Number:** LAB-050-WTG-D

Welcome to Advanced Placement Chemistry!

This course is designed to be the equivalent of the general chemistry course taken during the first year of college. You will need to apply yourself and work with the other students in order to be successful. In general, the course is divided into three components: laboratory, lecture/discussion, and test/problem-solving.

- The laboratory component is approximately 35% of class time. Since much of the class is centered on the laboratory, you will need to quickly develop lab skills that will allow you to rapidly, efficiently, correctly and above all, safely work in the lab. You are expected to prepared for the laboratory work on the day the lab begins, pre-lab work will be assigned and you will need to have an understanding of the procedure before you begin the "hands-on" lab work.
- The lecture/discussion component is approximately 30% of class time. You will be expected to read the text and do the assigned homework problems so that you can participate in class discussions. In addition, there are some topics that require repetition for proficiency (such as balancing equations).
- The test/problem solving component is approximately 25% of class time. In order to prepare you for the AP test, there will be free response problems assigned, which will be either from retired AP tests, be very similar to AP test questions, or be applications from laboratory work. In second semester, you will have a major project, which will be either a formal AP preparatory assignment or a paper on the production, uses and disposal of a material in industrial use today. Details will be provided during the first week of second semester.

I EXPECT EVERYONE TO TAKE THE AP EXAM!

AP CHEMISTRY UNIT and LAB and ACTIVITY/ASSIGNMENT BREAKDOWN

Each Unit is structured around the six big ideas of AP Chemistry:

BIG IDEA 1 – Structure of matter:

- The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.

BIG IDEA 2 – Properties of matter – characteristics, states, and forces of attraction

- Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.

BIG IDEA 3 – Chemical reactions

- Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.

BIG IDEA 4 – Rates of chemical reactions

- Rates of chemical reactions are determined by details of the molecular collisions.

BIG IDEA 5 – Thermodymanics

- The laws of thermodynamics describe the essential roles of energy and explain and predict the direction of changes in matter.

BIG IDEA 6 - Equilibrium

- Any bond or intermolecular attraction that can be formed can be broken. These two processes are in a dynamic competition, sensitive to initial conditions and external perturbations.

Each Lab is structured around the six science practices of AP Chemistry:

Science Practice 1 – The student can use representations and models to communicate scientific phenomena and solve scientific problems.

Science Practice 2 – The student can use mathematics appropriately.

Science Practice 3 – The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.

Science Practice 4 – The student can plan and implement data collection strategies in relation to particular scientific questions. [Note: Data can be collected from many different sources, e.g. investigations, scientific observations, the findings of others, historic reconstruction, and/or archived data.]

Science Practice 5 – The student can perform data analysis and evaluation of evidence.

Science Practice 6 – The student can work with scientific explanations and theories.

LABORATORY INVESTIGATIONS FOR THE YEAR

Unit	Investigation	Science Practices
1	- Determining the Formula of a Hydrated Compound - Determination of the Stoichiometry of Chemical Reactions	2,5,6
2	- Determination of Concentration by Redox Titrations - Gravimetric Analysis (Guided Inquiry Lab)	2,3,4,5,6
3	- Determining the Molar Volume of a Gas - Determination of Molar Mass using Vapor Density	2,5,6
4	- Heat Capacity of Metals Calorimetry - Enthalpy of Reaction and Hess's Law	2,5,6
5	- Energy Levels and Electron Transitions - Developing a Periodic Table by Discovering Trends (Guided Inquiry Lab)	1,2,3,4,5,6
7	- Molar Mass by Freezing Point Depression - Chromatography (Guided Inquiry Lab) - Relationship Between Concentration of Solution and the Amount of Light Transmitted (Guided Inquiry Lab)	1,2,3,4,5,6
8	- Rate Law of the Fading of Crystal Violet Using Beer's Law (Guided Inquiry Lab)	1,2,3,4,5,6
9	- Colorimetric Analysis and Determination of Equilibrium Constant for a Chemical Reaction	2,5,6
10	- Standardization of a Primary Standard and Acid-base titration	2,5,6
11	- Solubility Product Constant for Calcium Sulfate (Guided Inquiry Lab)	2,3,4,5,6
12	- Spontaneity	2,5,6
13	- Electrochemical cells	2,5,6

ASSIGNMENT/ACTIVITES

Every unit will have assigned AP practice free response problems assigned

Big Idea	Assignment/Activities **Students will:**
1	• Determine masses of isotopes given mass spectrometry data. • Be given a problem set and asked to determine limiting reactants (converts from particles, moles, mass, and volume of given substances)
2	• Work in groups to model molecules using molecular modeling kits and origami. • Be given a problem set of substances and be able to predict the bond type. • Be given a problem set of substances and their properties and be able to match the properties to the substances based on bonding.
3	• Work in groups to analyze given combustion data to determine empirical and molecular formulas. • Be given chemical equations to balance and classify. • Be given redox equations to balance and identify what is oxidized and what is reduced.
4	• Be given reaction rate data and determine the rate law. • Be able to predict the rate law by making graphs of concentration vs. time of supplied reaction data.
5	• Be given a problem set to determine the ΔG, ΔH, ΔS from thermochemical data.
6	• Be given sets of initial concentrations for various chemical equations and asked to determine equilibrium concentrations. • Be given equilibrium concentrations and asked to give the value of K. • Apply LeChatlier's principle to given equilibrium data to predict how equilibrium will be affected.
Current Topics	• Summarize a current scientific article (from *Chemical & Engineering News* or similar source) on a poster. The article could be based on chemistry, environmental concerns, and/or technological advancement in relation to science.

You will receive a syllabus outlining the chapters in the book to be read for each topic, along with suggested problems that go along with the topic being covered. In addition, each unit will have a specific AP problem set that will need to be turned in at the end of the unit. Each unit will have laboratories demonstrating the topics, which will be written up in a laboratory notebook. Several quizzes will be given through the course of a unit and every unit will end with an exam.

Absences:

This is an advanced class. If you are absent, you are responsible for getting the notes from another member of your class. You will be responsible for assigned homework. Any handouts will be in the file box, arranged by chapters.

Late Work:

I do not except late work. If you will have trouble getting an assignment in on time due to an excused absence or have a truly unusual circumstance, discuss this with your teacher BEFORE the assignment is due.

Lab Safety:

Before you can do any laboratory work, you will need to watch the safety video and pass the safety exam with a 90% correct score. Before any laboratory work, we will do a quick review of safety rules that apply to the particular lab work we will be doing. I take safety very seriously. If you are doing something unsafe in lab, you will be removed from the lab and get a zero for that assignment. This may also affect the ability of your lab partner(s) to complete the lab as assigned.

Laboratory Notebooks:

Every student will purchase a laboratory notebook. The notebook needs to be graphing paper. Each of you will record your laboratory data in your laboratory notebook.

Getting help with chemistry: There will be times when the material will be challenging. After all, this is a college level course. We will often work together in class on the topics we are exploring. If you don't understand something, ASK! Ask me, ask another chemistry teacher, ask another science teacher, ask a classmate, please ask. Don't decide you'll just figure it out later as chemistry topics build on one another. If you don't have a good foundation, your building will crumple. In addition, there are usually several ways of approaching any topic, and you may need a different approach than the one we've chosen.

If you think your teacher made a mistake, ask.

Finally, if you need additional assistance outside of class, I will be available in room 217 or 224 before school starting at 6:30am and after school until 2:45pm. Let me know that you are coming for help.

Grading:

The grade breakdown is:

Daily Work - 10%
Assessments – 40%
Labs/Projects - 30%
Final - 20%

- **AP Problems:**
  In order to prepare you for the AP test, there will be free response problems assigned for each unit, which will be either from retired AP tests, be very similar to AP test questions, or be applications from laboratory work. This is the only homework I collect.
- **Quizzes:**
  The quizzes are based off the suggested problems and/or additional problems I assign in class. Often the quiz questions will be same as a suggest problem or worksheet question so that I can check for understanding of the material.

- **Labs/Projects:**
  LAB: At least 25% of the time will be spent in laboratory. The laboratory is where chemistry happens. You will get specific lab notebook expectations for all labs when we do our first lab. Often what you learn in the laboratory will be included on quizzes or exams. Every lab will basically consist of these components: Title, Date, Partners, Pre-lab Information, Purpose/Hypothesis, Safety, Procedure, Data, Calculations, Post-lab Questions, and Conclusions

  PROJECT: You will be asked to summarize a current scientific article (from *Chemical & Engineering News* or similar source) on a poster and displayed about the room. The article could be based on chemistry, environmental concerns, and/or technological advancement in relation to science.
- **Exams:**
  Expect both multiple choice and free-response questions. Homework questions are an excellent study tool for exams. In order to give you time to process the information and ask questions, there will generally be several days between ending the unit and the exam on that unit. In that time we will move on to the next area. This is a common practice in colleges and universities.
- **Finals:**
  You will have a final in the first semester. It is a good practice for the AP test. In second semester, you will have a major project, which will be a formal AP preparatory assignment. Details will be provided during the first week of second semester.

I STRONGLY ENCOURAGE EVERYONE TO TAKE THE AP EXAM!

Student Name: _____

AP Chemistry
Summer Work Packet

WELCOME to AP chemistry! The AP curriculum includes all of the topics and the labs that we need to complete before the 2016 AP chemistry test on the first Monday in May. All of you will find AP chemistry to be challenging, some of you will find it to be down-right hard. There is a lot to cover and while we can do it we will all need to work very hard. **You should expect this class to be SIGNIFICANTLY more difficult than your first chemistry class.** This means that we cannot slow down if you don't understand a topic. You need to make sure that you are staying up with all assignments, and coming in for help if you need extra help.

We need to use our class time effectively so the goal of this summer packet is that you will have reviewed much of the material from your first chemistry class. This assignment should be completed by the **FIRST** day of class.

WHY DO WE HAVE TO DO SUMMER WORK?

- It is a review of basic content covered in chemistry, which you may not have seen for over a year.
- It provides the necessary fundamentals you will need to be successful in AP chemistry. To not do the summer assignment or to do it poorly is to seriously endanger your prospects of being successful in AP chemistry.
- There will not be enough time before the AP exam in May to cover the necessary content without this head start.

AP Chemistry will be taught with the expectation that all students are taking the AP exam in the spring.

SO WHAT IS THE SUMMER WORK? All work should be done neatly and clearly on paper and organized in the order it was assigned. All work for every problem **including units throughout** is necessary for AP. This is an expectation on the AP exam in the spring and we want to get into the good habit early

Remember on the AP exam you must show all work including units or you will lose points. If you get the correct answer but do not show work you will not receive any points. ***(Accordingly, in this class and this packet credit will NOT be given for answer-only responses!)***

SO. . . you need to show all work for every problem including: equation you will be using (if applicable), knowns/unknowns (if applicable), plugged in equation and any algebraic work

SUPPLIES NEEDED FOR AP CHEMISTRY:

Scientific calculator, **Laboratory Notebook**, Three ring binder with dividers OR folder with notebook, Blue/Black pen and pencil

LABORATORY NOTEBOOKS CAN BE ORDERED FROM THE FOLLOWING WEBSITES:

Website	Item #
http://www.amazon.com/Notebook-Carbonless-Pages-Spiral-Perforated/dp/0978534425	**ISBN-10:** 0978534425 **ISBN-13:** 978-0978534424
http://www.amazon.com/Student-Lab-Notebook-Carbonless-Duplicate/dp/1930882009/ref=sr_1_4?ie=UTF8&qid=1460555142&sr=8-4&keywords=lab+notebook+carbonless+100	**ISBN-10:** 1930882009 **ISBN-13:** 978-1930882003

Part 1 - Memorize Charges of Common Ions

- I am not a big memorization person however this is a vital part of AP chemistry. They **will not** give you an ion chart so it is essential that you have this done prior to school beginning. I suggest notecards and lots of practice.

POSITIVE IONS (Cations): - periodic table connections

+1	**+2**	**+3**	**+4**	**+5**
Group 1	**Group 2**	**Group 13**	**Group 14**	**Group 15**
Alkali	Alkaline Earth	Boron	Carbon	Nitrogen
Li^{+1} Lithium	Be^{+2} Beryllium	Al^{+3} Aluminum	Si^{+4} Silicon(IV)	As^{+5} Arsenic (V)
Na^{+1} Sodium	Mg^{+2} Magnesium	Ga^{+3} Gallium	Ge^{+4} Germanium(IV)	Bi^{+5} Bismuth (V)
K^{+1} Potassium	Ca^{+2} Calcium			
Rb^{+1} Rubidium	Sr^{+2} Strontium			
Cs^{+1} Cesium	Ba^{+2} Barium			
Fr^{+1} Francium	Ra^{+2} Radium			

NEGATIVE IONS (Anions): - periodic table connections

-4	**-3**	**-2**	**-1**
Group 14	**Group 15**	**Group 16**	**Group 17**
Carbon	Nitrogen	Oxygen	Halogens
C^{-4} Carbide	N^{-3} Nitride	O^{-2} Oxide	F^{-1} Fluoride
	P^{-3} Phosphide	S^{-2} Sulfide	Cl^{-1} Chloride
		Se^{-2} Selenide	Br^{-1} Bromide
			I^{-1} Iodide

VARIABLE CHARGES/ TRANSITION METALS:

Hydrogen	+1 or -1
Iron (II) or (III)	+2 or +3
Copper (I) or (II)	+1 or +2
Mercury (I) or (II)	+1 or +2
Tin (II) or (IV)	+2 or +4
Lead (II) or (IV)	+2 or +4
Cobalt (II) or (IV)	+2 or +4
Manganese (II) or (IV)	+2 or +4
Chromium (II) or (III)	+2 or +3

NO ROMAN NUMERALS

Silver	+1
Zinc	+2
Cadmium	+2
Nickel	+2

POLYATOMICS IONS

+1

ammonium	NH_4^{+1}
hydronium	H_3O^{+1}

-1

Acetate	$C_2H_3O_2^{-1}$ or CH_3COO^{-1}	Hydroxide	OH^{-1}
		Nitrate	NO_3^{-1}
Azide	N_3^{-1}	Nitrite	NO_2^{-1}
Bromate	BrO_3^{-1}	Perchlorate	ClO_4^{-1}
Cyanide	CN^{-1}	Chlorate	ClO_3^{-1}
Dihydrogen phosphate	$H_2PO_4^{-1}$	Chlorite	ClO_2^{-1}
Bicarbonate or Hydrogen carbonate	HCO_3^{-1}	Hypochlorite	ClO^{-1}
		Iodate	IO_3^{-1}
Bisulfate or Hydrogen sulfate	HSO_4^{-1}	Permanganate	MnO_4^{-1}
		Thiocyanate	SCN^{-1}

-2

Carbonate	CO_3^{-2}	Oxalate	$C_2O_4^{-2}$
Chromate	CrO_4^{-2}	Silicate	SiO_3^{-2}
Dichromate	$Cr_2O_7^{-2}$	Tetraborate	$B_4O_7^{-2}$
Hydrogen phosphate	HPO_4^{-2}	Peroxide	O_2^{-2}
Sulfate	SO_4^{-2}	Selenate	SeO_4^{-2}
Sulfite	SO_3^{-2}	Tartrate	$C_4H_4O_6^{-2}$
Thiosulfate	$S_2O_3^{-2}$		

-3

Phosphate	PO_4^{-3}
Phosphite	PO_3^{-3}
Arsenate	AsO_4^{-3}
Borate	BO_3^{-3}

**Reminder NH_3 = ammonia*

Prefixes for naming molecular (covalent) compounds – Greek

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

Elements that exist as diatomic molecules

BrINClHOF	Br_2	I_2	N_2	Cl_2	H_2	O_2	F_2
Other weirdos	P_4 and	S_8					

Naming Acids

Binary acids – named after anion

Hydro-(element)-ic acid	Ex.	HBr	**hydro**brom**ic acid**

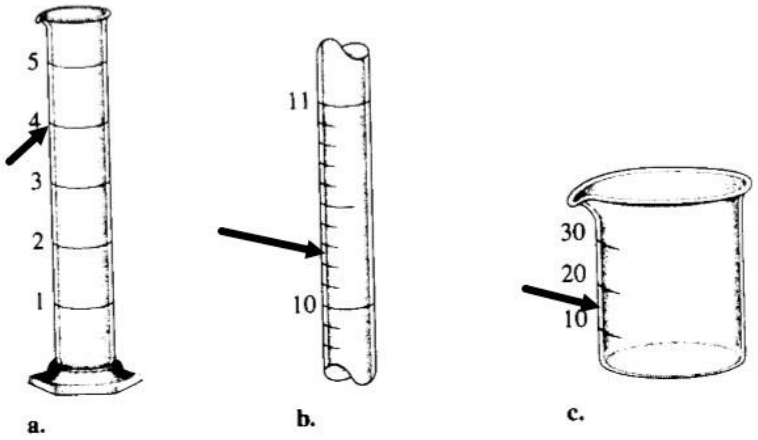
Oxyacids – named after polyatomic anion, no hydro prefix

-ate becomes –ic acid	Ex.	H_3PO_4	phosphor**ic acid**
-ite becomes –ous acid	Ex.	H_2SO_3	sulfur**ous acid**

Part 2 – Complete the practice problems: SHOW ALL YOUR WORK!!!!

Matter and Measurement

1. For each of the following pieces of glassware, provide a sample measurement at arrow and discuss the number of significant figures and uncertainty.



2. A student performed an analysis of a sample for its calcium content and got the following results: 14.92%, 14.91%, 14.88%, and 14.91%
   The actual amount of calcium in the sample is 15.70%. What conclusion can you draw about the accuracy and precision of these results?

3. Calculate the percent error for the following measurements.
   a. The density of an aluminum block determined in an experiment was 2.64 g/cm3. (Accepted value = 2.70 g/cm^3)
   b. The experimental determination of iron in ore was 16.48%. (Accepted value was 16.12%)

4. How many significant figures are in each of the following?
    a. 12
    b. 1098
    c. 2001
    d. 2.001×10^3
    e. 100
    f. 0.0000101
    g. 1000.
    h. 22.04030
    i. 1.00×10^3

5. Round of each of the following numbers to two significant figures, and write the answers in scientific notation.
    a. 0.00031254
    b. 35,900
    c. 31,254,000
    d. 0.00000399

6. Use scientific notation to express the number 480 to
    a. One significant figure
    b. Two significant figures
    c. Three significant figures

7. Perform the following mathematical operations, and express each result to the correct number of significant figures.
    a. 97.381 + 4.2502 + 0.99195
    b. 171.5 + 72.915 – 8.23
    c. $\dfrac{0.102 \times 0.0821 \times 273.5}{1.2}$
    d. (9.04 – 8.23 + 21.954 + 81.0) / 3.1416

8. Precious metals and gems are measured in troy weights in the English system:

    24 grains = 1 pennyweight (EXACT)
    20 pennyweights = 1 troy ounce (EXACT)
    12 troy ounces = 1 troy pound (EXACT)
    1 grain = 0.0648 gram
    1 carat = 0.200 gram

    a. Diamonds are measured in carats. If a lucky girl receives a 5 carat diamond how many pennyweights is it?
    b. What is the mass of 2.3 troy ounces of gold in grams?
    c. The density of gold is 19.3 g/cm^3. What is the volume of a troy pound of gold?

9. Apothecaries (druggists) use the following set of measures:

    20 grains ap = 1 scruple (EXACT)
    3 scruples = 1 dram ap (EXACT)
    8 dram ap = 1 oz. ap (EXACT)
    1 dram ap = 3.888 g

    a. An aspirin table contains 5.00×10^2 mg of active ingredient. How many grains ap of active ingredient does it contain?
    b. From (a) how many scruples?
    c. What is the mass of 1.00 scruple in grams?

10. The world record for the hundred meter dash is 9.79 s. What is the corresponding speed in units of m/s, km/hr, ft/s, and mi/hr?
    a. At this speed how long would it take to run a mile (5,820 ft)?

11. You're planning to buy a new car. One model that you're considering gets 32 miles per gallon of gasoline in highway travel. The one that your spouse likes gets 14 kilometers to the liter. Which car has the better gas mileage? (1 gal = 4 qt., 1.057 qt = 1 L)

12. You pass a road sign saying "New York – 112 km." If you drive at a constant speed of 65 mi/hr., how long should it take you to reach New York?
    a. If your car gets 28 miles to the gallon, how many liters of gasoline are necessary to travel 112 km?

13. You have a 1.0 cm_3 sample of lead and a 1.0 cm^3 sample of glass. You drop each in separate beakers of water. How do the volumes of water displaced by each sample compare? Explain.
    Density of lead = 11.35 g/cm^3
    Density of glass = 3.00 g/cm^3

14. A person has a temperature of 102.5 ^oF. What is this temperature on the Celsius scale? On the Kelvin scale?

15. Convert the following Celsius temperatures to Kelvin and to Fahrenheit degrees.
    a. The boiling-point temperature of ethyl alcohol, 78.1 ^oC
    b. A cold winter day, -25 ^oC
    c. The lowest possible temperature, -273 ^oC
    d. The melting-point temperature of sodium chloride, 801 ^oC

16. The density of diamond is 3.51 g/cm^3. What is the volume of a 4.5 carat diamond? 1 carat = 0.200 g

17. The volume of a diamond is found to be 2.8 mL. What is the mass of the diamond in carats? (See question #16)

18. A sample containing 33.42 g of metal pellets is poured into a graduated cylinder initially containing 12.7 mL of water, causing the water level in the cylinder to rise to 21.6 mL. Calculate the density of the metal.

19. Two spherical objects have the same mass. One floats on water; the other sinks. Which object has the greater diameter? Explain your answer.

20. What are some of the differences between a solid, a liquid, and a gas?

21. What is the difference between homogeneous and heterogeneous matter?

22. Classify each of the following as homogeneous or heterogeneous.
    a. soil
    b. the atmosphere
    c. a carbonated soft drink
    d. gasoline
    e. gold
    f. a solution of ethanol and water

23. Classify each of the following as a mixture or a pure substance. Of the pure substances, which are elements and which are compounds?
    a. Water
    b. f. Uranium
    c. Blood
    d. Wine
    e. The oceans
    f. Leather
    g. Iron
    h. Table salt (NaCl)
    i. Brass

24. Distinguish between physical and chemical changes.

25. List four indications that a chemical change (reaction) has occurred.

26. If you place a glass rod over a burning candle, the glass appears to turn black. What is happening to each of the following (physical change, chemical change, both, or neither) as the candle burns? Explain each answer
    a. the wax
    b. the wick
    c. the glass rod

27. The properties of a mixture are typically averages of the properties of its components. The properties of a compound may differ dramatically from the properties of the elements that combine to produce the compound. For each process described below, state whether the material being discussed is most likely a mixture or a compound, and state whether the process is a chemical change or a physical change.
    a. An orange liquid is distilled, resulting in the collection of a yellow liquid and a red solid.
    b. A colorless, crystalline solid is decomposed, yielding a pale yellow-green gas and a soft, shiny metal.
    c. A cup of tea becomes sweeter as sugar is added to it.

Atoms, Molecules, Ions

1. Describe Dalton's atomic theory.

2. What discoveries were made by J.J. Thomson, Henri Becquerel, and Lord Rutherford? How did Dalton's model of the atom have to be modified to account for these discoveries?

3. What is the distinction between atomic number and mass number?

4. What is the difference between atomic mass and average atomic mass?

5. What is an isotope?

6. How many protons and neutrons are contained in the nucleus of each of the following atoms?
    a. $^{42}_{22}Ti$
    b. $^{86}_{36}Kr$
    c. $^{64}_{30}Zn$
    d. $^{75}_{33}As$
    e. $^{76}_{32}Ge$
    f. $^{41}_{19}K$

7. Write the isotopic symbol for each of the isotopes below.
    a. Atomic number = 8, number of neutrons = 9
    b. The isotope of chlorine in which mass = 37
    c. Atomic number = 27, mass = 60
    d. Number of protons = 26, number of neutrons = 31
    e. The isotope of I with a mass number of 131
    f. Atomic number = 3, number of neutrons = 4

8. The element copper has naturally occurring isotopes with mass number of 63 and 65. The relative abundance of the isotopes are 69.2% for mass = 62.93 amu, and 30.8% for mass = 64.93 amu. Calculate the average atomic mass of copper.

9. An element consists of 1.40% of an isotope with mass 203.973 amu, 24.10% of an isotope with mass 205.9745 amu, 22.10% of an isotope with mass 206.9759 amu, and 52.40% of an isotope with mass 207.9766 amu. Calculate the average atomic mass and identify the element.

10. Distinguish between the terms *family* and *period* in connection to the periodic table. For which of these terms is the term *group* also used?

11. In the periodic table, what is the name of the following groups
    a. Group (2)
    b. Group (18)

12. An ion contains 50 protons, 68 neutrons, and 48 electrons. What is its symbol and charge?

13. Which of the following sets of elements are all in the same group in the periodic table?
    a. N, P, O
    b. Rb, Sn
    c. C, Si, Ge
    d. Mg, Ca

14. Identify each of the following elements:
    a. A member of the same family as oxygen whose most stable ion contains 54 electrons
    b. A member of the alkali metal family whose most stable ion contains 36 electrons
    c. A noble gas with 18 protons in the nucleus
    d. A halogen with 85 protons and 85 electrons

15. 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 d. Ba g. Al
    b. Sr e. I h. S
    c. P f. O

16. For each of the following ions, indicate the total number of protons and electrons in the ion. For the positive ions, predict the formula of the simplest compound formed between itself and oxide. For the negative ions predict the simplest compound formed between itself and aluminum.
    a. Fe^{+2} d. Cs^{+1} g. Br^{-1}
    b. Fe^{+3} e. S^{-2} h. N^{-3}
    c. Ba^{+2} f. P^{-3}

17. An element's most stable ion forms an ionic compound with bromine, having the formula XBr_2. If the ion of element X has a mass number of 230 and 86 electrons, what is the identity of the element, and how many neutrons does it have?

Writing Formulas and Naming Compounds – Do WITHOUT an ion chart! You need to have these memorized.

1. Name each of the following compounds:
    a. NaCl h. AlI_3 o. $BaSO_3$
    b. Rb_2O i. Al_2O_3 p. $KMnO_4$
    c. $FeBr_3$ j. $ZnCl_2$ q. Sr_3P_2
    d. Cr_2O_3 k. Li_3N r. $Ca_3(PO_4)_2$
    e. $CaBr_2$ l. Ag_2S s. $Pb(NO_3)_2$
    f. CsF m. $KClO_4$ t. $NaNO_2$
    g. CaS n. $Al_2(SO_4)_3$ u. $K_2Cr_2O_7$

2. Name each of the following compounds:
    a. NI_3 d. ICl_3 g. P_2S_5
    b. PCl_3 e. SF_2 h. N_2O_4
    c. SO_2 f. N_2F_4

3. Name each of the following compounds:
    a. HCl
    b. H_3PO_4
    c. HIO_3
    d. HNO_2
    e. HI
    f. H_2SO_3

4. Name each of the following compounds:
    a. HgO j. ICl
    b. CuI k. $Pb_3(PO_4)_2$
    c. CuI_2 l. KIO_3
    d. CoI_2 m. $Ca(OH)_2$
    e. Na_2CO_3 n. CoS
    f. $NaHCO_3$ o. S_3N_4
    g. $HC_2H_3O_2$ p. SF_6
    h. NH_4NO_2 q. NaClO
    i. Co_2S_3 r. $BaCrO_4$

5. Write the formula for each of the following compounds:
    a. Cesium bromide
    b. Barium sulfate
    c. Chlorine trifluoride
    d. Ammonium chloride
    e. Beryllium oxide
    f. Chlorine monoxide
    g. Magnesium fluoride
    h. Sulfur difluoride
    i. Sulfur hexafluoride
    j. Sodium dihydrogen phosphate
    k. Silicon tetrachloride
    l. Lithium nitride
    m. Chromium (III) carbonate
    n. Tin (II) fluoride
    o. Ammonium acetate
    p. Ammonium hydrogen sulfate
    q. Cobalt (III) nitrate
    r. Copper (I) sulfide
    s. Potassium chlorate
    t. Lithium tartrate

6. Write the formula for each of the following compounds:
    a. A. sodium oxide
    b. Sodium peroxide
    c. Potassium cyanide
    d. Copper (II) nitrate
    e. Silicon tetrafluoride
    f. Lead (II) sulfide
    g. Lead (IV) sulfide
    h. Copper (I) chloride
    i. Cadmium selenide
    j. Zinc sulfide
    k. Ammonium hydrogen phosphate
    l. Hydrobromic acid
    m. Bromous acid
    n. Perchloric acid
    o. Silicon dioxide
    p. Sodium sulfate
    q. Silicon tetrachloride
    u. Lithium nitride

Stoichiometry

1. Balance the following equations:
    a. _____ CO + _____ $O_2 \rightarrow CO_2$
    b. _____ N_2O_5 + _____ $H_2O \rightarrow$ _____ HNO_3
    c. _____ PCl_5 + _____ $H_2O \rightarrow$ _____ H_3PO_4 + _____ HCl
    d. _____ CH_4 + _____ $Br_2 \rightarrow$ _____ CBr_4 + _____ HBr
    e. _____ $C_5H_{10}O_2$ + _____$O_2 \rightarrow$ _____ CO_2 + _____ H_2O
    f. _____ $Cr(OH)_3$ + _____ $HClO_4 \rightarrow$ _____ $Cr(ClO_4)_3$ + _____ H_2O

g. _____ KNO_3 → _____ KNO_2 + _____ O_2
h. _____ La_2O_3 + _____ H_2O → _____ $La(OH)_3$
i. _____ NCl_3 + _____ H_2O → _____ NH_3 + _____ HOCl
j. _____ Mg_3N_2 + _____ HCl → _____ $MgCl_2$ + _____ NH_4Cl
k. _____ $AgNO_3$ + _____ K_2SO_4 → _____ Ag_2SO_4 + _____ KNO_3
l. _____ $Al(OH)_3$ + _____ H_2SO_4 → _____$Al_2(SO_4)_3$ + _____ H_2O
m. _____ CH_3NH_2 + _____ O_2 → _____ CO_2 + _____ H_2O + _____ N_2
n. _____ $(NH_4)_2Cr_2O_7$ → _____ Cr_2O_3 + _____ N_2 + _____ H_2O

2. Write balanced chemical equations to correspond to each of the following descriptions.
   a. When solid potassium chlorate is heated it decomposes to form solid potassium chloride and oxygen.
   b. Solid zinc metal reacts with sulfuric acid to form hydrogen gas and an aqueous solution of zinc sulfate.
   c. When liquid phosphorous trichloride is added to water, it reacts to form aqueous phosphorous acid, and hydrochloric acid.
   d. When hydrogen sulfide gas is passed over solid hot iron (III) hydroxide, the resultant reaction produces solid iron (III) sulfide and water vapor.

3. 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 3769.4 grams of aspartame?
   c. How many molecules of aspartame are present in 345.9 grams of aspartame?
   d. How many oxygen atoms are present in 23.6 grams of aspartame?

4. How many moles of ammonium ions are in 0.557 g of ammonium carbonate?

5. What is the mass, in grams, of 0.0438 moles of iron (III) phosphate?

6. What is the mass, in grams, of 2.69×10^{23} molecules of aspirin, $C_9H_8O_4$?

7. What is the molar mass of diazepam (Valium) if 0.05570 mol has a mass of 15.86 g?

8. Determine the empirical formulas of the following compounds.
   a. 10.4 % C, 27.8 % S, and 61.7% Cl
   b. Monosodium glutamate (MSG), a flavor enhancer in certain foods, 35.51 g C, 4.77 g H, 37.85 g O, 8.29 g N, 13.60 g Na

9. Find the molecular formulas of the following compounds.
   a. 73.8% carbon, 8.7% hydrogen, 17.5% nitrogen, molar mass = 166.0 g/mol
   b. 80.0% carbon, 20.0% hydrogen, molar mass = 30.0 g/mol

10. $4\ FeCr_2O_7 + 8\ K_2CO_3 + O_2 \rightarrow 2\ Fe_2O_3 + 8\ K_2CrO_4 + 8\ CO_2$
    a. How many grams of $FeCr_2O_7$ are required to produce 44.0 g of CO_2?
    b. How many grams of O_2 are required to produce 100.0 g of Fe_2O_3?
    c. If 300.0 g of $FeCr_2O_7$ react, how many grams of O_2 will be consumed?
    d. How many grams of Fe_2O_3 will be produced from 300.0 g of $FeCr_2O_7$?
    e. How many grams of K_2CrO_4 are formed per gram of K_2CO_3 used?

11. Given the reaction: $S + O_2 \rightarrow SO_2$
    a. How many grams of sulfur must be burned to give 100.0 g of SO_2?
    b. How many grams of oxygen must be required for the reaction in part (a)?

12. $6\ NaOH + 2\ Al \rightarrow 2\ Na_3AlO_3 + 3\ H_2$
    a. How much aluminum is required to produce 17.5 g of hydrogen?
    b. How much Na_3AlO_3 can be formed from 165.0 g of sodium hydroxide?
    c. How many moles of NaOH are required to produce 3 g of hydrogen?
    d. How many moles of hydrogen can be prepared from 1 gram of aluminum?

13. The following *unbalanced* reaction takes place at high temperatures.

$$Cr_2O_{3\,(s)} + Al_{(l)} \rightarrow Cr_{(l)} + Al_2O_{3\,(l)}$$

    If 42.7 g Cr_2O_3 and 9.8 g Al are mixed and reacted until one of the reactants is used up.
    a. Which reactant will be left over?
    b. How much will be left?
    c. How many grams of chromium will be formed?

14. Calculate the mass of water produced when 42.0 g of propane, C_3H_8, is burned with 115 g of oxygen.

CONGRATULATIONS, you have made it! Be proud of yourself, and get ready for a fun-filled and challenging year which will push you to your limits, but make you a better student, get you very prepared for college, and prove to yourself how brilliant you really are!

Remember, I am on your side, and just want to help! I am trying to give you the tools to succeed, and I pledge I will not ever give you an assignment or make you learn something that is not necessary for your success.

See you in the fall!

Mrs. Lemke

ADDENDUM 1: Some Preliminary Notes

Introduction: Matter and Measurement

Chemistry – study of the properties of materials and the changes that materials undergo

Matter – anything that has mass and occupies space

Atoms – building blocks of matter

Molecules – atoms combine to form these

A. Classifications of Matter

1. States of Matter
    a. Gas (vapor)
        i. Has no fixed volume or shape
        ii. Takes the shape of its container
        iii. Can be compressed or expanded
        iv. Molecules are far apart and moving at high speeds
    b. Liquid
        i. Definite volume, Cannot be compressed
        ii. Takes the shape of its container
        iii. Molecules are much closer than in gas but still move rapidly (they can slide past each other)
    c. Solid
        i. Definite shape and volume, cannot be compressed
        ii. Molecules are held tightly together, typically in definite arrangements

2. Pure Substances and Mixtures
    a. Pure substance – matter that has a fixed composition and distinct properties
        i. Two Types
            1. **elements** – substances that cannot be decomposed into simpler substances
            2. **compounds** – composed of two or more elements chemically bonded together
                a. **Law of Constant Composition** – (Joseph Proust) the makeup of compounds is always the same
    b. Mixtures – combinations of two or more substances in which each substance retains its own chemical identity and properties
        i. Properties can vary
            1. example – adding sugar to coffee is a mixture, you can make it very sweet, add a little, or none at all
        ii. Two Types
            1. **heterogeneous** – different composition throughout
                a. rocks, sand, wood, chocolate chip cookies
            2. **homogeneous aka solutions**– uniform composition throughout
                a. air (gaseous solution), gasoline (liquid solution), brass (solid solution)
    c. Separation of Mixtures
        i. **filtration** – separating a solid component from a liquid component using a funnel and gravity

j. **distillation** – separating liquid components utilizing different boiling points
k. **chromatography** – separating substances by how they adhere to surfaces (used frequently for ink)

3. Properties of Matter
   a. Physical properties – description of what something looks like
      i. Ex – color, odor, density, melting point, boiling point, hardness
   b. Chemical properties – how a chemical reacts with other chemicals
      i. Ex – flammability, reactivity with other chemicals

4. Changes in Matter
   a. Physical changes – physical appearance is changed
      i. Ex – ripping up paper, melting wax, **ALL CHANGES OF STATE (boiling, evaporating)**
   b. Chemical changes (reactions) – chemically transformed into a new substance
      i. Ex – sodium metal reacts with chlorine gas to form salt

B. Units of Measurement

1. Metric System/ Significant Figures/Dimensional Analysis
   a. you should ALREADY know this

Atoms, Molecules, Ions

A. The Atomic Theory of Matter

1. History of the Atom
   a. Democritus – first person to speculate that matter was mass of atoms, Greek philospher
      Plato and Aristotle refuted this idea, atomic theory faded for many centuries
   b. John Dalton – came up with first atomic theory, English schoolteacher
      i. Each element is composed of extremely small particles called atoms.
      ii. All atoms of a given element are identical; the atoms of different elements are different and have different properties (including different masses.)
      iii. Atoms of an element are not changes into different types of atoms by chemical reactions; atoms are neither created nor destroyed in chemical reactions.
      iv. Compounds are formed when atoms of more than one element combine; a given compound always has the same relative number and kind of atom.

Dalton thought that atoms could not be broken down any further, this was expressed in the atomic model – Billiard Ball Model.

Laws from this time period
Law of Constant Composition – see *Introduction: Matter and Measurement* notes
Law of Conservation of Mass (Lavoisier) – matter and energy cannot be created or destroyed
Law of Definite Proportions (Proust) – elements in a compound are always in the same mass proportion.
Law of Multiple Proportions – if elements combine to form more than one compound they must be different by whole numbers
Example – carbon monoxide, CO, carbon dioxide, CO_2

   c. J.J. Thomson – observed that cathode rays were the same no matter what type of material was used, concluded that the rays were actually particles with mass, these particles were called

electrons (Cathode Rays – a high voltage electricity passed through partially evacuated tubes produced radiation and mass glass fluoresce, called cathode rays because they originated from the cathode)

i Rays were deflected by electric and magnetic fields, suggesting the rays were charged.

ii Able to calculate the charge to mass ratio of an electron, 1.76 x 10_8 Coulombs/gram ii. *Came up with second atomic model – Plum-Pudding Model*

d. Robert Millikan – performed the oil drop experiment and determined the charge of an electron (1.60 x 10^{-19} C) and then determined the mass of an electron (9.11 x 10^{-28} g)

e. Henri Becquerel – studied an ore of uranium called pitchblende and discovered the spontaneous emission of radiation called **radioactivity** – three types of radiation: alpha (α) – helium atoms, beta (β) – high speed electrons, and gamma (γ) – high energy light

i. Marie Curie and her husband, Pierre also studied this

f. Ernest Rutherford – Utilizing alpha particles, performed the Gold Foil Experiment an determined that the atom had a nucleus (Actually his graduate students Geiger and Marsden discovered the nucleus)

i. Also discovered protons

g. James Chadwick – discovered neutrons

2. Modern View of Atomic Structure

a. Atoms are made of protons, neutrons, and electrons

b. Electronic charge is measured in Coulombs (C)

i. Electrons have a charge of –1.60 x 10^{-19} C

ii. Protons have a charge of +1.60 x 10^{-19} C

iii. For simplicity we change this to –1 and +1, but you should still know what the real value is

iv. Neutrons have no charge

c. Atoms are typically neutral, which means they have the same number of protons and electrons

d. Protons and neutrons are in the nucleus, electrons circle around

e. Vast majority of an atom's volume is the space where the electrons are

f. **Isotopes** – atoms of a given element that differ in the number of neutrons

g. **Protons** – all atoms of an element have the same number of protons in the nucleus, aka, **atomic number**

h. **Mass number** – number of protons + number of neutrons

3. Periodic Table

- You should know the general layout of periodic table (groups, rows, where the metals, nonmetals, and metalloids are)

4. Writing Chemical Formulas

a. Covalent (aka Molecular) Compounds

a. Contain only nonmetals

b. Prefixes are used to name them, first element only has a prefix if needed, **second element ALWAYS has a prefix**

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

example: CCl_4 = carbon tetrachloride S_2O = disulfur monoxide

b. Ionic Compounds
    a. Composed of an cation (+) and an anion (-)
    b. Can contain polyatomic ions (ions that have more than one atom in them)
    c. Make sure you balance charges

c. Naming Acids
    a. Two Types
        i. Binary Acids – hydrogen and another elements
            1. **Hydro-**_____**-ic acid** ex. H_2S = hydrosulfuric acid ii.
        Oxy Acids – contain oxygen, need to look at anion
            1. if anion ends in **–ate** ate goes to ic ex. HNO_3 = nitrate = nitric acid
            2. if anion ends in **–ite** ite goes to ous ex. HNO_2 = nitrite = nitrous acid
            3. only exception is HCN = hydrocyanic acid

Stoichiometry: Calculations with Chemical Formulas and Equations

1. All chemical equations need to be written correctly and balanced appropriately (kind of redundant I know)
2. We will go over all of the types of chemical reactivity but below are some for review
    a. Combusion – rapid reactions that produce a flame
        a. Most common involve oxygen as a reactant
        b. Often involve hydrocarbons (compounds that contain hydrogen and carbon) ex. C_3H_8
    b. Synthesis – when two or more reactants come together to form one product
    c. Decomposition – one substance undergoes a reaction to form two or more products
3. Atomic and Molecular Weights
        a. Atomic Mass Scale – is based off of Carbon-12, mass of carbon-12 = 12 amu
        b. Amu = atomic mass unit, 1 g = 6.022×10^{23} amu
4. Average Atomic Masses
    a. the masses listed on the periodic table are weighted averages based on the abundance in nature
    b. see example problems in book (pages 75-76)
5. Percent Composition from Formulas
    a. part/whole X 100%
    b. used to determine how much of a compound is a particular kind of element
6. The Mole
    a. used to convert between the microscopic and macroscopic
    b. Avogadro's Number = 6.02×10^{23}
7. Problems – review your chemistry notes for this as we covered it in more detail

AP Chemistry Class Perception and Reality

Students need to be realistic about the expectations for this course. Many students THINK they are ready for college level work, but really don't know what that means. In order to get a more realistic view of this course, I have included some perceptions entering students have, and the reality of the situation.

1. **PRECEPTION**: I can miss class (sports, activities, family vacations, jobs, field trips, etc.) and catch up on my own. I always have before.
   REALITY: You can't!!! In AP Chemistry, you have to give up a lot to get a lot. Missing class is the number one reason why students fall behind, get lost, give up, and either drop the class or get a low grade. You cannot be gone for three days, and expect to get caught up with a 10 minute session after school. I cannot teach in 10 minutes what it took 3 hours to teach earlier.

2. **PRECEPTION**: Like all teachers, Mrs. Lemke is exaggerating about how much work there is, and how tough it really is.
   REALITY: I'm not exaggerating. Probably the best way to check this is to talk with students who have taken the class before.

3. **PRECEPTION**: Mrs. Lemke is making this class a lot tougher than it really needs to be.
   REALITY: Never forget-this is a college level course. NOT an advanced high school course. If I am doing my job, students in this course should learn as much as they would if they were taking Freshman Chemistry at any college or university in the United States. A second goal is to properly prepare students for the AP Exam in May. I cannot make the course easier and still accomplish the above goals. Every former student who has taken Freshman College Chemistry has found he or she had a tremendous advantage over other students. I have NEVER had former students come back and say they wish I hadn't made it so tough.

4. **PRECEPTION**: If the majority of the class falls behind. Mrs. Lemke will just have to slow down so that we can catch up.
   REALITY: I can't!!! You will find that time is of the essence in this course. As much as I may like to and as much as the students may need it, our schedule cannot be adjusted to accommodate those who cannot keep up. Students will be expected to study the text on their own, and class time will be use more for clearing up questions than for introducing new material. There is really no other way to cover the vast amount of material required by the AP exam. If we slow down to make the course easier, or allow students to catch up, we will not cover the required subject matter, and students will have to face exam questions on material not covered in class. As a result I will make a schedule that will allow us to complete all required material prior to the exam, and students MUST keep to this schedule. Chemistry topics build on each other, and students who get behind have a (nearly) impossible task in catching up. Students can expect to spend about one hour outside of class time just in the study of chemistry each night. Certainly any students who have after-school jobs, or who are heavily involved in after-school activities will have to budget their time very carefully.

5. **PRECEPTION:** I have always been a "straight A" student and always will be.
   REALITY: AP Chemistry can mean death to a 4.0 grade average. Although there are many "A's (often as many as 1/3 to ½ the class) there are also "B's " C's "D's and "F's If your main purpose in taking this class is to collect one more "A" you are taking the class for the wrong reason, and may be disappointed. There are easier classes in which to get an "A".

Are you asking yourself WHY?

1) One of the most obvious benefits to this course is that when you take and pass the National AP exam given in May, you will receive **college credit** at most colleges and universities in the United States. This will save students both time and money. In the past students who have taken and passed AP courses in several subjects have been able to begin college with enough credits to be placed in the middle of their freshman or sophomore year!

2) Regardless of whether or not a student passes the national exam, he/she may choose to take freshman chemistry in college anyway. Those who opt for this find that they have a tremendous advantage over others who have not taken AP Chemistry. Often these students are finding most of the material presented a review and as a result find themselves in the top 10% of their class with only modest effort.

3) AP Chemistry looks great on your high school transcript! Many of the most prestigious universities in the US are looking for ways in which students have distinguished themselves during their high school career. One way of doing this is by taking AP courses.

4) As difficult as AP Chemistry is, you will find that it will never be as easy to learn Freshman Chemistry as it is now! There are several reasons for this:

   a. High school classes are generally smaller than college classes. It is not unusual for freshmen college classes to have 200 or more students! In this situation, it becomes nearly impossible to ask a question during class, or get any individual attention after class. In AP Chemistry, we always take time for questions and answers, and I am available for after school help.
   b. Most college professors don't regard teaching Freshman Chemistry as a job priority. Many are concentrated on their research, and consider teaching to be an interruption and distraction. At Palmyra teaching is our number one priority.
   c. At times Freshman Chemistry is used to "weed out" students. Most colleges prefer not to have large class sizes in their upper division courses. Therefore the grades and difficulty level of the freshman courses are adjusted so that only small numbers of very outstanding students will be able to move on. At Palmyra we don't have these kinds of pressures and all students are encouraged to become successful.

5) AP Chemistry will teach you to think at higher levels. You will be forced to think and apply concepts to new situations or even derive your own theories from application. This is excellent preparation for the higher levels of thinking required in college.