AP Chemistry Summer Assignment!

Welcome to AP Chemistry! AP Chemistry is a college-level course. You will need to be dedicated and work very hard during the school year to be successful. Below are some assignments that you need to complete during the summer to help you throughout the year. Do not wait until the last day of summer to begin!!

The following needs to be completed during the summer:

- Memorize the polyatomic ions (quiz over these will be given during the first week of school)
- Memorize the list of common elements
- Complete the Lab What a Gas!
- Zumdahl Assignment – please come by to pick up your book

Summer Experiment - What a Gas!
Please purchase a composition notebook for all of your AP Chemistry labs. Please put this lab into your notebook.

Zumdahl Assignment
The Zumdahl assignments correspond with chapters 1, 2, and 3 in your Zumdahl text. Please read and briefly summarize each chapter before doing the problems. Also, do the boxed Sample Exercises that the book works out for you. You'll be amazed at how simple the concepts become! There are additional practice exercises listed at the end of each Sample Exercise if you feel you need more practice on the concept! Also, answers to the blue questions in the back of each chapter are in the back of the book starting on page A43. (We will go over these chapters very quickly at the beginning of the year; if you skip reading them you may miss information that is very important in your fundamental understanding of chemistry.)

Extra Stuff
Make flashcards (or some other memorization device) to help you learn the polyatomic ions and common elements. Some other things that you might look over during the summer include the atomic structure, the mole concept and conversions, and balancing equations and predicting products

You may visit the College Board's website to learn more about AP Chemistry. I will also post the assignment and worksheets on my teacher page at Central Gwinnett's website www.centralgwinnett.net

I am located in room 711, so please feel free to come ask me any questions.

Have a great summer! See you in August!

Common Element/Symbol List

Quiz will be on ________________________

NOTE: Spelling counts! Capitalization counts on symbols!!!! In a symbol, the first letter is ALWAYS a capital letter. If the symbol has two letters, the second is ALWAYS a lower case letter.

Hydrogen	H	Gallium	Ga
Helium	He	Germanium	Ge
Lithium	Li	Arsenic	As
Beryllium	Be	Selenium	Se
Boron	B	Bromine	Br
Carbon	C	Krypton	Kr
Nitrogen	N	Rubidium	Rb
Oxygen	O	Strontium	Sr
Fluorine	F	Yttrium	Y
Neon	Ne	Zirconium	Zr
Sodium	Na	Palladium	Pd
Magnesium	Mg (NOT Manganese!)	Silver	Ag
Aluminum	Al	Cadmium	Cd
Silicon	Si	Tin	Sn
Phosphorous	P	Antimony	Sb
Sulfur	S (Sulphur is British spelling)	Tellurium	Te
Chlorine	Cl	Iodine	I
Argon	Ar	Xenon	Xe
Potassium	K	Cesium	Cs
Calcium	Ca	Barium	Ba
Scandium	Sc	Tungsten	W
Titanium	Ti	Platinum	Pt
Vanadium	V	Gold	Au
Chromium	Cr	Mercury	Hg
Manganese	Mn (not Magnesium!)	Thallium	Tl
Iron	Fe	Lead	Pb
Cobalt	Co (not CO)	Bismuth	Bi
Nickel	Ni	Radon	Rn
Copper	Cu	Radium	Ra
Zinc	Zn	Uranium	U

Polyatomic Ion List

+1

ammonium, NH_4^+

-1

acetate, $C_2H_3O_2^-$, or CH_3COO^-
bromate, BrO_3^-
chlorate, ClO_3^-
chlorite, ClO_2^-
cyanide, CN^-
hydrogen carbonate, HCO_3^- (also called bicarbonate)
hydroxide, OH^-
hypochlorite, ClO^-
iodate, IO_3^-
nitrate, NO_3^-
nitrite, NO_2^-
permanganate, MnO_4^-
perchlorate, ClO_4^-
thiocyanate, SCN^-

-2

carbonate, CO_3^{-2}
chromate, CrO_4^{-2}
dichromate, $Cr_2O_7^{-2}$
oxalate, $C_2O_4^{-2}$
peroxide, O_2^{-2}
sulfate, SO_4^{-2}
sulfite, SO_3^{-2}

-3

phosphate, PO_4^{-3}
phosphite, PO_3^{-3}
arsenate, AsO_4^{-3}

-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)

AP Chemistry – At Home Summer Experiment- What a Gas!

Your lab notebook entry should be organized as follows (this is how we set up all labs). Underline all section titles. Make sure you put the front flap between sets of pages so you don't copy your work on several pages.

Title: What a Gas: Stoichiometry & Gas Lab
Objective: To determine the starting amounts of baking soda and vinegar required to fill up a Ziploc bag.
Safety: Don't eat☺
Background Info:

- Look up the chemical formula for baking soda and vinegar (look online, in your kitchen cabinet, in your textbook, etc) and write them here.
- Write the balanced chemical equation for the reaction that takes place between baking soda and vinegar. (There are 3 products produced – one of them is a common gas.) For help, look on p. 50 in the Ultimate Chemical Equations Notebook for a similar reaction.
- Discuss briefly how stoichiometry works and give a simple mole to mole example.
- Give the Ideal Gas Law and the value of R (0.0821 L atm/K mol)
- For extra credit, look up the molecular structure of the pigment in red cabbage and draw it.

Prelab Questions (write the question, show all work, box answers):

1. How many moles of hydrogen gas can be produced when 10.0 g of Zn react with excess HCl? (Hint: you must write a balanced chemical reaction first.)
2. If the pressure is 1.2 atm and the temperature is 20.0ºC, what volume of hydrogen is produced in prelab question #1?
3. How many moles of hydrogen gas can be produced when 10.0 g of Zn react with 50.0mL of 2.0M HCl?
4. If the pressure is 1.2 atm and the temperature is 20.0ºC, what volume of hydrogen is produced in prelab question #3?

Procedure:

1. Fill your Ziploc bag with water and pour into a measuring cup. Convert from cups to mL and then to L.(½ cup = 123 mL) This will give you the volume of your Ziploc bag. You will need this info in your calculations.
2. Look up the barometric pressure for that day on the weather channel or website (they measure in inches of Hg, so you'll have to convert to mm of Hg [25.4 mm = 1 in] and then to atm [760 mmHg = 1 atm]). Find the temperature on your indoor thermostat and convert to the correct unit.
3. Using the Ideal Gas Law, calculate the # of moles of gas product from the volume of gas product (use the Ziploc bag's volume), temperature, and pressure (from the weather channel or website). If you forgot the Ideal Gas Law, look it up in the index of your book!
4. Use stoichiometry to convert from moles of gas to moles of each reactant. (You can find the exact amount of each reactant or just the exact amount of one and make the other excess.)
5. Using the chemical formulas and the periodic table, convert from moles of baking soda to grams of baking soda and from moles of vinegar to mL of vinegar.
6. Using the following conversions, calculate the amount of baking soda and vinegar you need using common measuring cups & spoons in the kitchen (1 tsp of baking soda has a mass of 6.80 g, the Molarity of vinegar is 0.80M, and ½ cup = 123 mL).
7. Once you calculate the amounts of reactants, try it! Experiment with different amounts of baking soda and vinegar needed to react to fill up the bag (tight) with gas if needed. Record amounts used in each trial in your data table.
8. For extra credit, chop some red cabbage, and use the juice as an indicator. Put a spoonful of red cabbage juice into the Ziploc bag along with the baking soda and vinegar and note the color before the reaction, during the reaction, and after the reaction.

Data Tables (use a ruler to create these data tables in your lab notebook):

Chemical	Chemical Formula	Balanced Chemical Equation (there will be 3 products)
Baking soda		
Vinegar		

Ziploc Baggie (size)	Volume in cups	Volume in mL	Volume in L

Chemical	Trial 1	Trial 2	Trial 3
Baking soda			
Amount measured	g	g	g
Vinegar			
Amount measured	mL	mL	mL
Success? (Did the bag fill with gas?)			

Reb Cabbage juice	Trial 1	Trial 2	Trial 3
Color before reaction			
Color during reaction			
Color after reaction			

Calculations (Show all your work for calculations above, use units, box answers)**:**

1. Ziploc Baggie volume calculations:
2. Gas volume (same as volume of baggie):
3. Gas pressure conversions:
4. Gas temperature conversions:
5. Solving for Moles of gas (using Ideal Gas Law):
6. Solving for Moles of Baking Soda needed (stoichiometry):
7. Amount of Baking Soda (in grams) needed (conversion):
8. Solving for Moles of Vinegar needed (stoichiometry):
9. Amount of Vinegar (in mL) needed (vinegar is 0.80M):

Post Lab Questions:

1. If the vinegar was watered down and had a molarity of 0.40M instead of 0.80M, would the bag have filled up totally? Why or why not?
2. If the pressure in the room was greater, would the bag have filled up to the same volume?
3. Red cabbage juice could have been used as in indicator in this lab.
   a. What type of indicator is it?
   b. What type of chemical is vinegar?
   c. What type of chemical is baking soda?
   d. Why does the indicator change color?

Conclusion: Using ____g of baking soda and ____mL of vinegar was the best combination to fill a Ziploc baggie with a volume of _____ mL of gas.

Error Analysis: In this section we usually calculate a % error, but in this case explain why the results you got differed from what you expected (i.e. what you calculated). (2-3 sentences)

Discussion of Theory: This lab reviewed the concept of gas laws, stoichiometry, indicators, and conversions. Write a 3-5 sentence paragraph discussing these concepts and what you learned through this lab or how you saw new connections in chemistry.

AP® Chemistry

Overview of AP Chemistry

AP Program: AP Chemistry is one of nine advanced placement courses offered at the school. Students who wish to enroll in the AP Chemistry course must have completed a first-year Honors level course in chemistry. AP Chemistry students are primarily juniors; most take other AP level courses and are enrolled in Honors or AP-level math courses. The majority of these students take the AP Exam at the end of the year. The class meets for a 50 minute period every day for the entire school year with at least two periods per week spent in the laboratory.

AP Class Size: Approximately 18 students

Course Design: This course is based on the most recent *AP Chemistry Course Description* available at http://apcentral.collegeboard.com and is designed for qualified students, most of whom have a strong interest in science. The course is taught with two goals in mind: 1) students will learn more chemistry than they did in their first-year course and build upon their understanding of chemical concepts and 2) students will prepare to take the AP Exam in May. A strong emphasis is placed on the fact that AP Chemistry is a college-level course designed to provide a solid, first-year college inorganic chemistry experience, both conceptually and in the laboratory, and therefore the pace is fast. Learning from the textbook and doing the homework are the students' responsibilities with the labs serving to supplement the learning in the lecture portion of the course. Emphasis is placed on problem-solving skills, both on paper and in the lab.

Course Objectives:

- Strengthen student quantitative reasoning and problem-solving skills
- Hold students responsible for their own learning
- Enable students to learn the year's curriculum so that they have a solid foundation in chemistry
- Provide students with the opportunity to develop lab skills equivalent to those of college freshmen.
- Provide students with the opportunity to develop and practice skills of communication, foster collaborative relationships, and improve problem-solving techniques
- Encourage a knowledge-based, positive attitude toward science/technology's influence on society.

Teaching Strategies:

A variety of teaching methods are used to conduct the course, including

- **Lecture/Discussion:** The traditional teacher/lecture mode of instruction is used minimally. Lectures are primarily used to introduce critical concepts and often incorporate many example problems that are solved in class by both the teacher and the students. As a result, class sessions are usually dominated by students' questions and sometimes teacher-initiated questions. Emphasis is placed on the correct interpretation of the problem and the application of chemical principles to solve it.
- **Demonstrations:** Demonstrations are often incorporated into lectures and discussions in order to reinforce critical concepts. While the demonstrations are usually performed by the teacher, the students are often asked to explain what is happening. Students participate as much as possible by reading data from instruments, recording data on the board, or igniting the reactions.
- **Homework Problems:** Homework problems from the text are assigned for each chapter; however, it is the students' responsibility to decide how much independent practice they need in order to master a skill. The homework due date is usually 48 hours before the next exam is given, with only a sampling of the problems from the assignments selected for grading.
- **Quizzes:** Every Friday a brief 10 minute quiz is given that consists of one or two of the topics that were covered during the week.
- **Laboratory Work:** Lab work is designed to supplement the material currently being covered in the class. Students work in self-selecting lab groups of two or three; however, each student is required to keep a lab notebook containing all of the work that is done. Formal lab reports are required for each lab, and sometimes statistical analysis of class data is also required. The grading of the formal lab write-ups is based on one or more of the following three criteria: 1) percent error, 2) error analysis, or 3) written discussion of theory, procedure, and conclusions.
- **Supplementary Reading:** Students are required to read one book in addition to the textbook. The purpose of the supplementary reading is to provide context for the content being studied, assist the students in their understanding of the content, and enable the students to gain an understanding of and appreciation for the development of technology and the role it plays in the study of chemistry.
- **Unit Tests:** Tests are given at the conclusion of each major unit and are designed so that students must demonstrate their mastery of the material in many ways- by answering multiple choice questions, writing concise concept narratives, and solving problems that have multiple parts. At least a portion of each test is written to be completed without calculators. Questions come from retired AP Exams whenever possible and are intended to challenge students from a time perspective as well as a knowledge perspective.
- **Final Exam:** Both semesters conclude with a two-hour comprehensive final exam on the material covered that semester. The format of the final exam is very similar to that of the AP Exam. Students that take the AP Exam may exempt the multiple choice portion of the Final Exam given at the end of the spring semester provided that certain grade and attendance requirements are met.

Grading: The student's final semester grade is a weighted average of the following four components:

• Unit Tests	50 percent
• Laboratory Work	25 percent
• Homework and Quizzes	10 percent
• Final Exam	15 percent

Ten points are added to the final cumulative average at the end of each semester with the assignment of a final letter grade being based on the following grading scale:

90-100	A
80-89	B
70-79	C
0-69	F

Resources:

- **Textbook**:
  Zumdahl, Steven. *Chemistry*. © 2007 by Houghton Mifflin Company. 7th ed.

- **Laboratory Resources:**
  Carmichael, Neal and Haines, David. *Laboratory Chemistry*. © 1987 by Merrill Publishing Co.

  Ehrenkranz, David and Mauch, John. *Chemistry in Microscale*. © 1993 by Kendall/Hunt Publishing.

  Nelson, John and Kemp, Kenneth. *Chemistry: The Central Science-Laboratory Experiments*. ©1994 by Prentice-Hall, Inc. 6th ed.

  Vonderbrink, Sally Ann. *Laboratory Experiments for Advanced Placement Chemistry*. © 2001 by Flinn Scientific, Inc.

- **Supplemental Required Reading:**
  Jaffe, Bernard. *Crucibles: The Story of Chemistry*. © 1976 by Dover Publications. 4th ed.

Course Outline

Fall Semester

Unit 1: Chemical Foundations — 2 weeks

Chapter 1 (p. 1-30)

Topics:
Measurement and units, dimensional analysis, uncertainty, significant digits, classification of matter

Homework Problems:
Chapter 1: 1, 4, 6, 10, 19, 20, 21, 24, 28, 38, 42, 49-52, 54, 56, 59, 61, 63, 66-72, 78- 83, 86, 90-94

Laboratory Experiments:
Introduction to Volume Measurements
Uncertainty in Density Measurements
Separation of a Solid Mixture
Paper Chromatography of Indicators

Unit 2: Atomic Structure and Periodicity — 3 weeks

Chapter 2 (p. 39-57)
Chapter 3 (p. 77-85)
Chapter 7 (p. 275-320)

Topics:
Early history of chemistry, law of conservation of mass, Dalton's atomic theory, Avogadro's hypothesis, early experiments to characterize atomic structure, modern view of the atom, atomic masses, electromagnetic radiation, Planck, photons, dual nature of light, DeBroglie equation, continuous vs. line spectra, Bohr atom, Heisenberg uncertainty principle, electron configurations, quantum numbers, orbital shapes and energies, electron spin and Pauli principle, Aufbau principle, Periodic trends, alkali metal properties

Homework Problems:
Chapter 2: 1, 3, 5, 21-23, 31, 41-46, 50-54, 72-74, 93
Chapter 3: 13, 27, 28, 30, 34, 36
Chapter 7: 2, 4, 5, 6, 20, 21, 24, 32, 34, 46, 48, 50, 53-55, 58, 60, 64, 66, 72, 74, 76, 78, 80, 84, 86, 88, 90, 96, 98-100, 122-124, 130, 140

Laboratory Experiments:
Flame Test
An Activity Series

Demonstrations:
Atomic Emission Spectrum

Unit 3: Chemical Bonding and Organic Chemistry 3 weeks

Chapter 2 (p. 57-68)
Chapter 3 (p. 86-96)
Chapter 8 (p. 329-381)
Chapter 9 (p. 391-417)
Chapter 22 (p. 997-1003, 1005-1008, 1011)

Topics:
Types of bonds, naming compounds (ionic, covalent, and organic), empricial/molecular formulas, electronegativity, electron affinity, ionization energies, bond polarity and dipole moment, electron configurations and sizes of ions, formations of ionic compounds, ionic character of covalent bonds, model of covalent bond energies, bond energies, localized electron bonding model, Lewis structures, exceptions to octet rule, resonance, VSEPR model, hybridization, molecular orbital model, introduction to organic chemistry

Homework Problems:
Chapter 2: 10, 11, 55-57, 59, 61, 64, 66, 68, 70, 75
Chapter 3: 22, 40, 44, 48, 53, 62, 68, 69, 70, 72, 74, 76, 80
Chapter 8: 1, 3, 6, 7, 10, 16, 20, 22, 24, 26, 33, 35, 38, 40, 42, 44, 68, 73, 78, 80, 86, 91, 92, 94, 96, 98, 110, 114, 131, 132
Chapter 9: 1, 2, 5, 7, 8, 22, 28, 33, 36, 37, 44, 53, 56, 60
Chapter 22: 13, 26, 34a, 47

Laboratory Experiments:
VSEPR Model Building
Gravimetric Analysis of a Chloride Sample
Determining the Formula of a Hydrate
Inquiry Lab: Determining the %CO_2 in an Alka Seltzer

Unit 4: In-Depth Studies of the States of Matter 3 weeks

Chapter 5 (p. 179-190, 194-216)
Chapter 10 (p. 425-474)

Topics:
Pressure, Boyle's law, Charles' law, Gay-Lussac's law, Ideal gas law, Dalton's law of partial pressure, kinetic molecular theory, effusion and diffusion, real gases, dipole-dipole interactions, hydrogen bonding, London forces, liquid state, types of solids, metallic bonding, network solids, vapor pressure, change of state, phase diagrams

Homework Problems:
Chapter 5: 9, 24, 28-31, 34, 38, 40, 44, 48, 52, 62, 66, 68, 77, 79, 81, 84, 86, 129
Chapter 10: 2-5, 10, 14, 19, 23, 29, 31, 33, 36, 37, 40, 48, 61, 62, 74, 75, 91-93

Laboratory Experiments:
Gas Laws
Molecular Mass of a Volatile Liquid
Molecular Mass of a Gas

Unit 5: Properties of Solutions 2 weeks

Chapter 4 (p. 127-140)
Chapter 11 (p. 485-519)

Topics:
Composition of solutions, factors affecting solubility, electrolytes and nonelectrolytes, molarity, molality, mole fraction, colligative properties, Raoult's law, Henry's law, freezing point depression, boiling point elevation, osmotic pressure, colloids

Homework Problems:
Chapter 4: 2, 18, 21, 22, 24, 27, 28, 32
Chapter 11: 6, 8-10, 12, 18, 21, 26, 28, 30, 32, 38, 39, 46, 48, 52, 53, 58, 60, 62, 64, 66, 68, 70, 83, 93, 95, 101, 102

Laboratory Experiments:
Colorimetric Analysis
Determining Molar Mass by Freezing Point Depression

Demonstrations:
Quick Freeze: Freezing Point Depression

Unit 6: Stoichiometry and Chemical Reactions 4 weeks

Chapter 3 (p. 96-115)
Chapter 4 (p. 140-170)
Chapter 5 (p. 190-194)

Topics:
Chemical equations and stoichiometric calculations, reaction types, limiting reagent calculations, percent yield, percent purity, precipitation reactions, acid/base reactions, oxidation/reduction reactions

Homework Problems:
Chapter 3: 1, 8, 11, 84, 86, 89, 95, 104, 106, 109, 118, 122, 143
Chapter 4: 5, 38, 44, 45, 51, 56, 58, 61, 68, 72, 74, 76, 81, 82, 83, 86, 112, 114, 115
Chapter 5: 36, 51, 56, 58, 96, 104, 110, 116, 118

Laboratory Experiments:
Molar Volume of a Gas
Solubility of Ionic Compounds
Oxidation Reduction Titrations
Analysis of Commercial Bleach
Copper to Copper

Demonstrations:
The Mirrored Flask
Oxidation States of Manganese
Redox Titration

Spring Semester

Unit 7: Rate Kinetics and Nuclear Reactions — 2 weeks

Chapter 12 (p. 527-566)
Chapter 18 (p. 841-849, 859-863)

Topics:
Reaction rates, rate law expressions, order of reactions, determining rate laws, integrated rate laws, rate constant, reaction mechanisms, catalysis, nuclear stability and radioactive decay, kinetics of radioactive decay, detection and uses of radioactivity, nuclear fusion and fission

Homework Problems:
Chapter 12: 4, 7, 11, 13, 23, 26, 30, 32, 34, 39-42, 44, 46, 48, 51-53, 55, 57, 65, 75, 79, 82, 89
Chapter 18: 3, 11, 12, 14, 16, 20, 22, 24, 28, 66

Laboratory Experiments:
Rates of Reaction
Study of the Kinetics of a Reaction: The Acid Catalyzed Iodination of Acetone

Demonstrations:
Cobalt (II), Peroxide, and Tartrate: Visualizing an Intermediate Product

Unit 8: Chemical Equilibrium — 2 weeks

Chapter 13 (p. 579-612)

Topics:
Laws of mass action, equilibrium expressions, calculations of K and equilibrium concentrations, LeChatelier's principle, how equilibrium is shifted by temperature, concentration, pressure, etc.

Homework Problems:
Chapter 13: 1, 3, 6, 11, 13, 16, 17, 20, 22, 24, 29, 30, 32, 34, 36, 38, 42, 48, 58, 60, 62, 65, 67, 76, 84, 93

Laboratory Experiments:
Equilibrium and LeChatelier's Principle

Unit 9: Acids and Bases 2 weeks

Chapter 14 (p. 623-672)

Topics:
Nature of acids and bases, acid strength, pH scale, calculating pH of strong and weak acid solutions, bases, K_a, K_b, and K_w expressions, polyprotic acids, acid/base properties of salts, Arrhenius, Bronsted-Lowry, Lewis acid/base theory, solving acid/base problems

Homework Problems:
Chapter 14: 2, 5, 8, 22, 25, 27, 29, 31, 32, 37, 38, 39, 42, 44, 48, 50, 58, 59, 70, 71, 75, 77, 78, 88, 92, 96, 100, 103, 105, 106, 113, 117, 120, 129, 138, 147, 161

Laboratory Experiments:
Hydrolysis of Salts

Unit 10: Applications of Aqueous Equilibria 3 weeks

Chapter 15 (p. 681-739)

Topics:
Acid or base solutions with a common ion, buffered solutions, buffer capacity, titrations and pH curves, choosing an appropriate indicator for titrations, solubility equilibria and solubility product, precipitation behavior as pH varies, equilibria involving complex ions

Homework Problems:
Chapter 15: 3, 4, 8, 11, 14, 16, 22, 23, 33-35, 38- 40, 42, 47, 51, 53-56, 65, 66, 74, 75, 78, 80, 86, 88, 89, 91, 96-98, 117, 124, 130, 140, 153

Laboratory Experiments:
Determination of the Equivalent Mass and pK_a of an Unknown Acid
Selecting Indicators for Acid-Base Titrations
Relating Equilibrium, pH, and Solubility Product Constant
Qualitative Analysis of Cations

Demonstrations:
Milk of Magnesia versus Acid

Unit 11: Thermodynamics, Entropy, and Free Energy — 3 weeks

Chapter 6 (p. 229-265)
Chapter 8 (p. 351-353)
Chapter 10 (p. 463-467)
Chapter 16 (p. 749-782)

Topics:
Nature of energy, three laws of thermodynamics, state functions, enthalpy and calorimetry, Hess's law, standard enthalpies of formation, present and future energy sources, spontaneous processes and entropy, free energy, entropy changes and chemical reactions, dependence of free energy on pressure, free energy and equilibrium, free energy and work

Homework Problems:
Chapter 6: 34, 35, 38, 42, 44, 47, 52, 56, 60, 62, 64, 66, 68, 72, 85, 92, 104
Chapter 8: 54, 56
Chapter 10: 89, 104
Chapter 16: 4, 11, 18, 23, 24, 28-30, 34, 39, 49, 52, 56, 59, 63, 74, 87b, 97, 98

Laboratory Experiments:
Thermochemistry and Hess's Law

Demonstrations:
Endothermic Reaction: Two Solids
Chemiluminescence-The Firefly Reaction

Unit 12: Electrochemistry — 2 weeks

Chapter 17 (p. 791-829)

Topics:
Galvanic cells, standard reduction potentials, cell potential, electrical work and free energy, cell potential and concentrations, batteries, corrosion, electrolysis, commercial electrolytic processes

Homework Problems:
Chapter 17: 1, 3, 5, 11, 13, 17, 18, 23, 27, 28, 34, 42, 44-46, 51, 56, 57, 69, 71, 77, 79, 82, 84, 89, 92, 102, 108, 120, 126

Laboratory Experiments:
Electrochemical Cells
Electrolysis of Potassium Iodide

Review for AP Exam — 3 weeks

Topics:
All concepts covered in course and practice writing net ionic equations

Homework Problems:
Supplemental problems revised from previous AP Exam free-response questions and problems.

Laboratory Experiments

The following laboratory experiments are student conducted.

Introduction to Volume Measurements (Unit 1) — 60 minutes

Students are asked to measure out 10.0 ml samples of water using a variety of equipment designed to measure volume including a graduated pipet, a buret, and various graduated cylinders in order to practice the skills required in using the lab equipment. Students will then measure the mass of each measured sample and calculate the density. By comparing the calculated density of each of their samples to the accepted density of water, students will also review concepts of accuracy, precision, uncertainty in measurements, significant digits, percent error, and average deviation.

Uncertainty in Density Measurements (Unit 1) — 60 minutes

Students are given two unknown metal samples and will determine the identity of the samples by calculating the density of each through mass and volume measurements. In addition to using the physical property of density in the identification of an unknown substance, students will also estimate the experimental uncertainty of the equipment used during their determination.

Separation of a Solid Mixture (Unit 1) — 90 minutes

Students are given a mixture that contains a sample of sodium chloride, silicon dioxide, iron filings, and potassium nitrate in order to become familiar with the methods of separating substances from one another using decantation, extraction, filtration, crystallization, and evaporation.

Paper Chromatography of Indicators (Unit 1) — 90 minutes

Students are given five samples of indicators and two unknown solutions consisting of two to three of the tested indicators in order to become acquainted with chromatographic techniques as method of separation (purification) and identification of substances. Students will also be introduced to the use of indicators in classifying acidic and basic solutions.

Flame Test (Unit 2) — 45 minutes

Students are given samples of seven metallic ions and five unknowns in order to observe the spectra emitted from the selected ions and become familiar with the identification of ions by the color emitted during vaporization of the element.

An Activity Series (Unit 2) — 90 minutes

Students are given samples of five metals and three nonmetals in order to find their relative reactivity. The first part of the lab derives an activity series for metals and uses a microscale technique. The second part derives an activity series for halogens and makes use of a solvent extraction technique. Students will also be introduced to the practice of writing net ionic equations.

VSEPR Model Building (Unit 3) — 90 minutes

Students must construct models of molecules representing five geometries and be able to distinguish between electron and molecular geometry.

Gravimetric Analysis of a Chloride Sample (Unit 3) **90 minutes**
Students are given an unknown sample in order to illustrate the typical techniques used in gravimetric analysis by quantitatively determining the amount of chloride in the unknown.

Determining the Formula of a Hydrate (Unit 3) **90 minutes**
Students are given samples of several unknown hydrates and will determine the empirical formula and the identities of the hydrates by determining the mass of the hydrate, the mass of water driven off by heating the hydrate, and the mass of the anhydrous salt that remains.

Determining the Mass %CO_2 in an Alka Seltzer (Unit 3) **60 minutes**
Students will determine by two separate methods and calculate the mass % of CO_2 found in a tablet of alka seltzer. Students will develop the procedures for both methods, complete the calculations, discuss the possible sources of error in both methods, and provide an explanation as to which of the two methods is probably the most accurate.

Gas Laws (Unit 4) **60 minutes**
Students will perform a variety of procedures in order to observe and determine the relationships that exist among the pressure, volume, temperature, and number of particles for a gas sample. Students will also experimentally compare the rates of effusion for two gases.

Molecular Mass of a Volatile Liquid (Unit 4) **60 minutes**
Students are given a small amount of an unknown volatile liquid and are asked to identify the liquid through the determination of its molecular mass. Students must be able to manipulate the equipment to enable the liquid to vaporize and condense and must also understand the ideal gas law and its application in this experiment.

Molecular Mass of a Gas (Unit 4) **60 minutes**
Students are given a small amount of an unknown gas and are asked to identify the gas through the determination of its molecular mass. Students must be able to manipulate the equipment to enable the gas to be collected over water and must also understand the law of partial pressures, the ideal gas law, and their applications in this experiment.

Colorimetric Analysis (Unit 5) **120 minutes**
Students will prepare standard cobalt chloride solutions of varying concentrations in order to prepare a calibration curve using the principles of colorimetric analysis. By comparing the intensity of the color of a solution of unknown concentration with the intensities of solutions of known concentrations, students will determine the concentration of an unknown solution.

Determining Molar Mass by Freezing Point Depression (Unit 5) **60 minutes**
Students will determine the molar mass of an unknown using the colligative properties of solutions.

Molar Volume of a Gas (Unit 6) **60 minutes**
Students will experimentally determine the molar volume of a gas through the reaction of magnesium with hydrochloric acid. Through the application of stoichiometry to the balanced equation for the reaction, students will determine the volume of one mole of gas at standard temperature and pressure.

Solubility of Ionic Compounds (Unit 6) **180 minutes**
Students prepare 0.1 M aqueous solutions of a variety of soluble ionic compounds. Through the reactions of these solutions with each other, students will develop a set of solubility rules, practice writing net ionic equations, and identify unknown solutions by noting their characteristic reactions with other unknown solutions.

Oxidation Reduction Titrations (Unit 6) **180 minutes**
The purpose of this lab is to standardize a solution of potassium permanganate by dedox titration with a standard solution of iron (II) ions. A solution of oxalic acid is then titrated with the permanganate solution to determine the exact concentration of oxalic acid. Through the completion of this lab, students will practice lab skills associated with the process of titration, apply their knowledge in the writing of and balancing redox reactions, and perform stoichiometric calculations.

Analysis of Commercial Bleach (Unit 6) **90 minutes**
This experiment involves analyzing a commercial chlorine bleach to determine the amount of sodium hypochlorite present through an oxidation-reduction titration procedure. In addition to the lab skills involved in performing the titration, students must also be able to write and balance oxidation-reduction equations and perform stoichiometic calculations.

Copper to Copper (Unit 6) **180 minutes**
Students are given a sample of copper and perform a series of reactions in which the copper is changed into a variety of copper compounds. The final step returns copper to its elemental state. Students write formulas and balanced chemical equations for each reaction, perform stoichiometric calculations, observe chemical and physical properties, review solubility rules, and calculate percent yield.

Rates of Reactions (Unit 7) **60 minutes**
Using hydrochloric acid and sodium thiosulfate, students will determine if concentration affects the rate of a chemical reaction.

The Acid Catalyzed Iodination of Acetone (Unit 7) **90 minutes**
Students will experimentally determine the rate law expression for the iodination of acetone.

Equilibrium and LeChatelier's Principle (Unit 8) **60 minutes**
Students will observe energy related equilibrium through the observation and use of cobalt (II) chloride hexahydrate. Students will also apply LeChatelier's Principle in explaining how changing the concentration of reactants and the temperature of the system affects the equilibrium of the reaction.

Hydrolysis of Salts (Unit 9) **60 minutes**
Students will observe hydrolysis and classify various salt solutions as neutral, acidc, or basic. Students will explain their results through the writing of net ionic equations for the aqueous reactions with each salt.

Determination of the Equivalent Mass and pK_a of an Unknown Acid (Unit 10) 120 minutes
In this lab, students will determine the equivalent mass of an unknown acid. The acid, a solid crystalline substance, will be weighed out and titrated with a standard solution of sodium hydroxide. Students will standardize the sodium hydroxide by titrating it against a solid acid, potassium hydrogen phthalate.

Selecting Indicators for Acid-Base Titrations (Unit 10) 120 minutes
Students will select the appropriate indicators for two titrations-a weak acid solution titrated with a strong base solution and a weak base titrated with a strong acid solution. The indicators are added to the solutions and the solutions are titrated. Titration curves of pH versus volume of titrant are generated and used to verify the appropriateness of the selected indicators.

Relating Equilibrium, pH, and Solubility Product Constant (Unit 10) 60 minutes
Students will determine the pH of a saturated solution of several bases as a means of calculating the equilibrium constant, in this case a solubility product constant, from their data.

Qualitative Analysis of Cations (Unit 10) 180 minutes
Students will observe an application of aqueous equilibrium through the process of qualitative analysis. In this lab, students will analyze a solution that can contain any combination of several different cations by separating them using a variety of techniques. Precipitation, dissolution of precipitates, formation of complex ions, and oxidation and reduction are some of the types of reactions involved.

Thermochemistry and Hess's Law (Unit 11) 60 minutes
In this lab, students will monitor temperature changes of reactions, graphically analyze data, calculate the heat capacity of a calorimeter, compute enthalpies of reactions, write net ionic equations, and combine equations and enthalpies algebraically.

Electrolysis of Potassium Iodide (Unit 12) 45 minutes
Students will be introduced to the process of electrolysis, electrolytic cells, oxidizing and reducing agents, and the writing of half-reactions through the carrying out of the electrolysis of potassium iodide.

Electrochemical Cells (Unit 12) 90 minutes
In this lab, students are required to construct small electrochemical cells using 24 –well microplates and then use a voltmeter to measure the voltages. Students will also be required to identify the anode and cathode of the cell, analyze the systems to determine the correct net ionic equations, and construct a chart of reduction potentials. Additional lab skills that will be involved are dilution of solutions, calculations of concentrations of solutes in diluted solutions, application of the Nernst equation, and calculations using equilibrium constants for solubility products and formation constants.

Demonstrations
The following demonstrations are teacher conducted.

Atomic Emission Spectrum (Unit 2)
Students will view the emission spectra of various gases through the observation of gas discharge tubes.

Quick Freeze: Freezing Point Depression (Unit 5)
Through the use of club soda, students will observe that the freezing point of a pure solvent is lowered by the addition of a solute, such as carbon dioxide. The concept that the concentration of gases is dependent upon pressure will also be reinforced.

The Mirrored Flask (Unit 6)
Students will observe the effects of a redox reaction through the silver plating of a flask.

Oxidation States of Manganese (Unit 6)
Students will observe the various oxidation states of manganese. After observing each oxidation state, students will write and balance the equations for the reactions forming the Mn (VI), (IV), and (III) ions.

Redox Titration (Unit 6)
Since many reactions occur in solutions, titrations are often used to determine the concentration of dissolved substances. In this demonstration, students will determine the percentage of hydrogen peroxide in a commercially prepared solution.

Cobalt(II), Peroxide, and Tartrate: Visualizing an Intermediate Product (Unit 7)
Students will observe the oxidation of tartaric acid by hydrogen peroxide in the presence of a cobalt chloride catalyst. Through the observation of this reaction, students will see the formation of a cobalt-intermediate product, as well as the consumption and reformation of the catalyst and as result. As a result, student understanding of these two types of compounds and the role they play in the kinetics of chemical reactions will increase.

Milk of Magnesia versus Acid (Unit 10)
Students will observe the neutralization reaction that occurs when milk of magnesia is added to a dilute acid. Through the addition of universal indicator, students will observe the gradual change in pH that occurs over time. Students will also be introduced to the concept of buffering through the carrying out of the same reaction, substituting Tums (calcium carbonate) or Rolaids (dihydroxylaluminum sodium carbonate) as the base that is added to the acid.

Endothermic Reaction: Two Solids (Unit 11)
Two solids, barium hydroxide crystals and ammonium thiocyanate, are placed in a beaker that is placed on a small block of wood with a small pool of water between the beaker and the block. This demonstration allows students to observe an endothermic reaction and reinforces that heats of reactions can occur without the presence of a solution.

Chemiluminescence-The Firefly Reaction (Unit 11)
This demonstration allows students to observe an exothermic reaction and reinforces that the energy released in exothermic reactions can be in the form of heat and/or light.