Quiz 1

Please write your lab section (8-11, 11-2, 2-5) on your quiz.

1. The following is a label taken from a 1.5 liter (50.7 oz.) bottle of Castle Rock Spring Water.

Nutrition Facts: Serving Size 8 oz. (240 ml)	**ANALYSIS** (mg/liter)
About 6 servings per container	Calcium 10
Amount per serving	Magnesium 5
Calories 0	Bicarbonates 65
Total Fat 0 g	Potassium 2
Sodium 0 mg	Chloride 2
Total Carb. 0 g	Nitrate ..... <1
Protein 0 g	TDS Approximately 80
	(TDS stands for Total Dissolved Solids)

a. Compare the analysis of calcium to bicarbonates on the label. Which substance has the larger uncertainty in the reported value? Provide reasoning to support your answer.

b. The label states that the bottle contains 1.5 L of water. How many grams of magnesium are present in this bottle of water?

c. The six substances (ignore TDS) in the Analysis section on the label exist in water as ions. You boil off all of the water and see a solid at the bottom of the container. Give the name and chemical formula of <u>one</u> <u>compound</u> that this solid could be. Identify this compound as molecular or ionic.

2. You are bathing in pure distilled water when your dog, Spot, jumps into the bathtub and accidentally knocks the toaster plugged into the 120 V outlet and a bottle filled with something. One bottle contained Tums tablets, which contains $CaCO_3$; a second bottle contained Epsom salts ($MgSO_4$); and a third bottle contained mineral water (water with various salts in it). You and Spot do not get electrocuted.

a. Which bottle did Spot knock into the water? Give reasons.

b. Draw a picture that represents this substance from part a in water.

2. You are given two colorless liquids, Liquid A and Liquid B, and are told that the liquids are either vinegar ($HC_2H_3O_2$), saline (NaCl in water), or caustic soda (NaOH in water). You are asked to identify each liquid. You perform the following tests: (i) Blue litmus turns Liquid A red but Liquid B stays blue.

(ii) When phenolphthalein is added to Liquid A <u>and</u> Liquid B, nothing happens.

Based on the results of these tests, Liquid A is _____ and Liquid B is _____.

Name: _____ Chem 1A, Instructor: L. Yee

Circle your Lab Section: 8 am 11 am 2 pm September 24, 2014

EXAM 1

Show all work!

Exam 1 is worth 7.5% of your grade. For full credit, show all work in a logical and legible sequence. Clearly underline or circle your final answer. Include units where needed. You may use your textbook, notes, and a calculator. You may ask me for a hint; however, each hint will cost you 0.25 units.

1. (1 units) You are at the beach and are not enjoying your unsweetened lemonade as much as your regular sweetened lemonade. You have one large packet of sugar and as you tear open the package and think about how good your sweet lemonade is going to taste, you spill all of the sugar in the sand. Describe how you will you separate the sugar from the sand. What property of a substance will you use to accomplish this separation?

2. (1.5 units) An amount of a substance is given below. Set up a dimensional analysis to convert each amount into moles. Show the relevant conversions and units. You do <u>not</u> have to calculate a final answer.

a. 1 tablespoon of baking soda (1 teaspoon = 5 g, 1 tablespoon = 3 teaspoons)

b. 50 ml of ethanol (C_2H_5OH, density = 0.79 g/ml)

c. Ca in 550 mg of $CaCO_3$

d. 25.0 ml of pH 4.5 HCl

3. (1.5 units) a. Which mass measurement (1 tablespoon of baking soda or 550 mg of $CaCO_3$) has the smallest uncertainty? Give reasons.

b. You are given a colorless liquid and are told it is an aqueous solution of baking soda, ethanol, $CaCO_3$, or HCl. You do a conductivity test on this liquid; the conductivity is low. What is the liquid? Draw a picture of this solution to support your answer.
c. You are given a second colorless liquid and are told it is an aqueous solution of baking soda, ethanol, $CaCO_3$, or HCl. You test this liquid with red litmus paper; the paper turns blue. What is the liquid? Give reasons.

4. (3.5 units) a. 5.0 g of baking soda is added to 25.0 ml of 2.5 M HCl with 1 drop of phenolphthalein to produce Solution 1 and a gas. What gas forms? Write a molecular equation and net ionic equation to support your answer.
b. Solution 1 from part (a) is colorless after mixing. Which substance (besides water) is Solution 1? Calculate the moles of this substance that remains in Solution 1 for full credit. (Hint: identify the limiting and excess reactants.)
c. 1.5 g of NaOH is added to Solution 1. A reaction occurs to form Solution 2. Write a molecular equation and net ionic equation that represents this reaction.
d. What color will Solution 2 be? Calculate the moles of substance (besides water) in Solution 2.
e. Colorless Solution 3 is added to Solution 2. A precipitate of $Mg(OH)_2$ forms. What substance is in Solution 3 that forms this precipitate? Write a molecular equation and net ionic equation that represents this reaction.

10/17/14 **Quiz 2**
1. When exposed to air, Al metal becomes coated with an oxide layer whereas Au metal does not become coated with an oxide layer.
Explain this observation in terms of the Activity Series of the Elements.
2. Butane, C_4H_{10}, is used in lighters and camping stoves.
a. Calculate the ΔH of combustion of C_4H_{10}. Use Hess' law.
b. You want to heat up 1.0 liter of water to its boiling point. The initial temperature of water is 25^oC. Calculate the mass of butane than needs to be burned to heat up the water. Show your calculations for full credit.

Name: _____ Chem 1A, Instructor: L. Yee
Circle your Lab Section: 8 am 11 am 2 pm November 7, 2014

EXAM 2
Show all work!

Exam 2 is worth 7.5% of your grade. For full credit, show all work in a logical and legible sequence. Clearly underline or circle your final answer. Include units where needed. You may use your textbook, notes, and a calculator. You may ask me for a hint; however, each hint will cost you 0.25 units.
Constants: c = 3.00 x 10^8 m/sec, h = 6.63x10^{-34} J sec, R_H = 2.18x10^{-18} J, N_A = 6.02x10^{23} /mole
1. (1 unit) Agree or disagree with the following statements. Support your answer with chemical reasoning, calculations, analogies, examples, etc.
a. In a flame test, sodium emits yellow light and lithium emits red light. This means sodium has a greater energy level difference than lithium and emits a longer wavelength of light than lithium and lower frequency of light than lithium.
b. Our body burns glucose ($C_6H_{12}O_6$, -2540 kJ/mole) as a fuel. Methane (CH_4, -802 kJ/mole) is the fuel used in our home stoves. Methane is the better fuel because it produces more work than glucose. Show your calculation of work for full credit.

2. (1.5 units) You have a zinc rod, copper strip, and silver spoon and their corresponding nitrate solutions.
a. You attach the copper strip to the zinc rod. Which metal is the sacrificial anode? Give reasons.
b. Write a chemical equation that represents the reaction that occurs at the sacrificial anode.
c. Which metal can you plate with copper? Write a chemical equation and net ionic equation that represents this reaction.

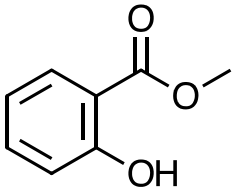
3. (1.5 units) Carbon dioxide and water are produced in a combustion reaction of a fossil fuel. These products absorb infrared radiation and are considered greenhouse gases.
a. Draw an absorption spectrum of CO_2. Label your axes and show the approximate wavelength in nm of the absorption peak. Calculate the energy in J that corresponds to this wavelength.
b. Determine the total number of valence electrons in CO_2 and water. Draw the Lewis structures of CO_2 and water.

4. (1.5 units) When a lithium salt is burned, a red color is emitted.
a. Why does lithium ion have a +1 charge and not a +2 charge? Support your answer by drawing an energy level diagram of the ground state electron configuration of the lithium ion. Show the 1s to 2p atomic orbitals in your diagram.

b. An electron in Li^+ ion is excited to a 2p orbital. How many possible lines would you observe in an emission spectrum? Show these possible transitions in your energy level diagram in part a. Which transition is most likely the red line?

5. (2 units) A chemical reaction can be used to heat water. Compare the three reactions: evaporation of water, condensation of steam, and solid LiCl dissolving in water.
a. Calculate ΔH of each reaction. (ΔH_f of LiCl (s) = -408.8 kJ/mole)
b. Which <u>two</u> of these reactions can you use to heat water? Give reasons.
c. 25 g of each substance in part b reacts. Which reaction heats up 1 cup of water (1 cup = 240 ml, $T_i = 25^oC$) to a higher temperature? Show your calculations for full credit.

Quiz 3
11/26/14
1. Methyl salicylate is the chemical that gives Wintergreen Lifesavers its taste.
a. Circle the functional group(s) in methyl salicylate. Write the name of the functional group next to each circle.
b. How many hydrogen atoms are in methyl salicylate?
c. How many carbons in methyl salicylate have a trigonal planar geometry?
d. Too much methyl salicylate is on your tongue. Will water remove methyl salicylate from your tongue? Draw water molecule(s) next to methyl salicylate. Use <u>dashed lines</u> to show hydrogen bonds between water and methyl salicylate to support your answer.



2. We use the breathing process to intake oxygen and expel CO_2. Use gas laws to explain the inhalation process.

Chem 1A, FINAL EXAM - TAKE-HOME PART
due Monday, December 15, 2014 at 11:30 am

The Take Home Part of the Final Exam is worth 7% of your grade. For full credit, show all work in a logical and legible sequence. Clearly underline or circle your final answer. Include units where needed. You may work with other CHM 1A students as a group on Questions 1 – 2 of the Final Exam. **<u>You must do Question 3 on your own.</u>** If you work in a group, make sure every member contributes to the solutions. Turn in one set of solutions with the names of each member of your group. If you discuss any question or part of a question with another student, you are working in a group.
1. (3 units) Chemical and Engineering News, 11/1/10, p. 2 Letter: "A Breath of Fresh Air". The writer states the "world's human population – people breathing – is a significant source of carbon dioxide added to our atmosphere daily. … Very simple calculations show that simply by being alive, the global population of human beings produces 5-10% of the estimated CO_2 generated from all sources.
A resting adult breathes 15 times a minute, and a breath is 0.5 L. Breathing by an adult increases the amount of CO_2 from a mole fraction of 0.000395 inhaled to 0.042 exhaled, which amounts to an increase of 0.88 kg CO_2 /person/day. Of course, a mole of CO_2 occupies 22.4 L at standard temperature/pressure (STP) and weighs 44 g. This simple model ignores the fact that we don't all live and breathe in an STP environment, we aren't all resting, and we aren't all adults. World CO_2 production is 29.3 billion metric tons per year, and world population is 6.9 billion people."
a. What is mole fraction? What is standard temperature/pressure? Do a calculation to confirm that one mole of an ideal gas has a volume of 22.4 L at STP.
b. Using the numbers given above, do a calculation to confirm that a resting adult produces 0.88 kg CO_2 /person/day.
c. Using the numbers given above, do a calculation to confirm that the global population of human beings produces 5-10% of the estimated CO_2 generated from all sources.
d. Burning 1 gallon of gasoline (assume octane, C_8H_{18}) produces about 20 lb of CO_2. Do a calculation to confirm this mass of CO_2 produced.
e. Electric cars, like the Chevy Volt and Nissan Leaf, produce no CO_2 but need electricity to charge the battery. One source of electricty is burning natural gas. Gasoline costs $3.00/gallon and natural gas costs $1.11/therm. Calculate the

cost in $/J of gasoline. Do the same for natural gas. Is it cheaper to have a gasoline powered car or an electric car? (1 therm = 105.4804 mega joules = 100,000 BTU = 29.3 kW•hr)
f. Name the chemical principle covered in Chem 1A Lab this semester that describes how CO_2 contributes to global warming. Briefly explain the big concern about CO_2.

2. (3 units) Determine the identity of this common household substance from these chemical and physical properties:
(i) white solid.
(ii) low solubility in water.
(iii) used in antacids, various analgesics, fire extinguishers, as an additive in swimming pools, and in the kitchen.
(iv) ionic compound.
a. The cation comes from a Group IA element which is easily oxidized (has a low ionization energy). This element is a strong reducing agent and reacts with water. The emission spectrum of this element shows a line in the yellow region of the visible spectrum. The cation gives off yellow light in a flame test. **Identify this cation.** Give the name and chemical formula for full credit.
b. The anion is a ternary polyatomic ion composed of non-metals. This ion consists of five atoms. It has a non-zero dipole moment. Its geometry is trigonal planar at one central atom. This central atom is the same central atom as the gas in parts (v) and (vi).
At the other central atom, the geometry is bent. This element comprises approximately 50% of the earth's crust and forms compounds with almost every other element in the periodic table.
Identify this anion. Give the name, chemical formula, and Lewis structure for full credit.
c. Removing one of the atoms from the polyatomic anion forms a binary polyatomic ion composed of second period elements. The Lewis structure shows a trigonal planar geometry at the central atom. **Identify this anion.** Give the name, chemical formula, and Lewis structure for full credit.
d. The atom that is removed behaves like a non-metal under most conditions but under extremely high pressures, this element shows characteristics of a Group IA element. **Identify this element.** Give the name and chemical formula for full credit.

(v) When this substance is heated to 175^{o}C, it decomposes into three substances. When these three products are cooled to room temperature, one substance is a solid, the second substance is a liquid, and the third is a gas. The liquid is unique in that the density of its liquid is greater than the density of its solid. **Write the chemical equation that describes this reaction.**

(vi) Reaction with acid, such as HCl, produces a salt, and liquid, and a gas. The liquid is the same liquid produced in (v). **Write the chemical equation that describes this reaction.**

(vii) The gas produced in (v) and (vi) is the same gas. The gas is a binary compound. This compound is linear at the central atom. An important property of this central atom is its ability to form bonds with itself to form chains and rings. This element is contained in all organic substances. The dipole moment of the gas is zero. **Identify this gas.** Give the name, chemical formula, and Lewis structure for full credit.

What is the identity of this common household substance? Give the name and chemical formula for full credit. Make sure your conclusion is consistent with the above observations.

3. (1 unit) According to the Chem 1A Course Information Handout, your "grade will be based on your performance and mastery of the last Course Objective." Each course objective is shown below.
a. For each objective, give yourself a grade (A – F) that reflects your understanding of that objective. Be honest and be fair to yourself. Don't be too easy but don't be too harsh either
b. Give yourself an overall course grade based on your understanding of the course objectives. (The grade you give yourself may not be your official course grade. Your instructor will determine your overall course grade.)

Objective	Description	Grade
1	apply scientific measurement in lecture and lab measurements and calculations	
2	use the Periodic Table to obtain information about elements, identify elements and compounds by type, write chemical formulas, name compounds, identify atomic structure, calculate molar mass	
3	predict properties of elements, compounds, and mixtures based on element or compound type and structure	
4	identify and describe acids and bases by name, structure, properties, and reactions; relate these compounds to pH	

5	determine the solubility of substances in water and perform solution calculations involving volume, concentration, and moles	
6	represent chemical reactions with balanced chemical equations; predict whether a reaction occurs from a net ionic equation	
7	perform chemical calculations, e.g., mass to moles, for compounds and reactions, such as empirical formula and stoichiometry	
8	distinguish between and describe the different states of matter, including the chemical forces that hold them together	
9	describe and calculate heat transfer calculations in physical and chemical processes; calculate the heat of reaction using Hess' law	
10	describe the atomic and electronic structure of atoms using quantum theory; describe the role of light in understanding atoms and molecules	
11	describe bonding in ionic and molecular compounds, draw molecular (Lewis) structures, determine molecular geometry using VSEPR theory to predict properties, such as polarity and solubility	
12	perform basic lab techniques and measurements; use scientific instruments to collect data	
13	design experiments, analyze and interpret data and results, draw conclusions	
	Overall Chem 1A Grade	

c. Go to the Chem 1A Homework, Exams, and Old Exams web page and take the "Take Home Final Exam Question 3c" survey.
(i) How many questions were on the survey?
(ii) Briefly explain your answer to Question 7.

Name: _____ Chem 1A, Instructor: L. Yee
Circle your Lab Section: 8 am 11 am 2 pm December 15, 2014

FINAL EXAM
Show all work!

The In Class part of the Final Exam is worth 13% of your grade. For full credit, show all work in a logical and legible sequence. Clearly underline or circle your final answer. Include units where needed. You may use your text book, notes, and a calculator. No computer, laptop, tablets, smart phones, mobile devices are allowed. You may ask me for a hint; however, each hint will cost you 0.25 units.

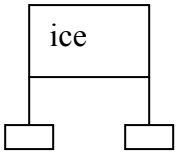
Constants: c = 3.00 x 10^{8} m/sec, h = 6.63x10^{-34} J sec, R_H = 2.18x10^{-18} J, N_A = 6.02x10^{23} /mole, $R = 0.082 \frac{\text{L atm}}{\text{mole K}}$

1. (2.5 units) a. Why are valence electrons important?
b. For what reason do chemical equations need to be balanced? (Hint: think of a law.)
c. What does "like dissolves like" mean?
d. Most chemical reactions are ____ because the energy of the reactants is higher than the energy of the products.
e. The blue dye on a blue t-shirt absorbs ____ light but emits _____ light. The blue color is quantified by ____.
f. You pour pancake batter in a hot pan. You see small bubbles form that get bigger because as the ____ increases, the ____ increases.

2. (2.5 units) a. Name two experimental methods that we used in Chem 1A lab to identify a substance.
b. Which experimental technique that we used in Chem 1A lab would you use to separate a solid-liquid mixture?
c. Your lab partner measured a volume of liquid and reported this volume as 9.3 ml. Did your partner use a 50 ml beaker, 10 ml graduated cylinder, or 50 ml graduated cylinder? Give reasons.
d. A white solid is soluble in water and shows low conductivity and a neutral pH. Is the solid sugar ($C_{12}H_{22}O_{11}$), salt, acetic acid, or NaOH? Draw a picture of this substance in water that shows its low conductivity and neutral pH.

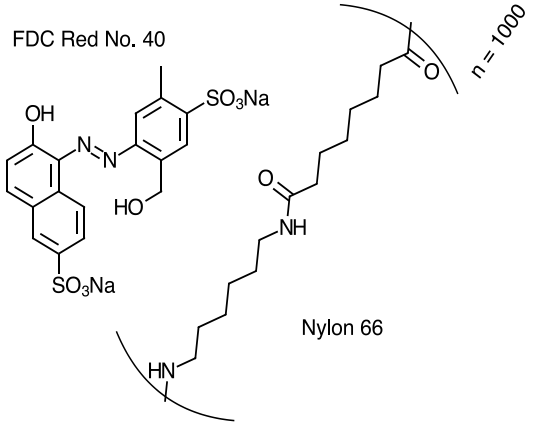
3. (2 units) a. Copper is used in electrical wires; diamond is used in cutting and polishing tools. Explain why copper is a conductor and diamond is hard.
b. A microwave oven emits a frequency of 2.45 GHz (2.45x10^{9} Hz). Are the holes in the microwave door (1.2 mm wide) small enough to block microwaves from passing through? Show your calculation of wavelength to suppport your answer.

c. A wire is placed on top of a large block of ice. Weights are securely attached to each end of the wire. The wire cuts through the block of ice, the weights and wire fall to the floor but the block of ice is not cut in half. Why was the block of ice not cut in half?

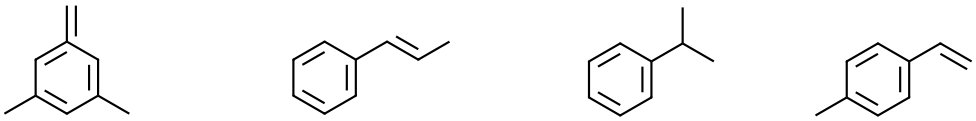


Weight Weight

4. (2 units) The structures of FD&C Red No. 40 and Nylon are shown below.
a. Circle **one** atom in FD&C Red No. 40 that has a trigonal planar geometry. How many hydrogens are bonded to this atom?
b. Identify the chemical force(s) that exist between FD&C Red No. 40 and Nylon. If hydrogen bonding exists, show a hydrogen bond by drawing a dashed line between the appropriate atoms.
c. Why is FD&C Red No. 40 soluble in water whereas Nylon is not?



5. (4 units) Your company is testing C_9H_{12} as a fuel. This fuel is a liquid at room temperature and pressure.
a. Which structure, A, B, C, or D, is a possible Lewis structure of this fuel? To support your answer, draw in the hydrogens in each structure.



A B C D

b. For the structure you chose in part a, circle the functional group(s) in your structure. Write the name of the functional group next to each circle. Draw a box around the atom(s) that is/are tetrahedral.
c. You accidentally spilled some of this fuel on the floor. Would you use water or vegetable oil ($C_{17}H_{35}COOH$) to clean up this spill? Give reasons.
d. 5.0 g of C_9H_{12} is burned in 12 g of O_2. Which reactant is the limiting reactant? Show your calculations for full credit.
e. The ΔH of formation of C_9H_{12} is -41.2 kJ/mole. Calculate the ΔH of combustion for this fuel.
f. As this fuel burns, what happens to the pressure inside the car engine cylinder? Give reasons using gas laws.