Chemistry 11

Final Exam Review

**Tuesday, June 13 – morning exam**

Students should use all class notes, quizzes, labs, problems sets, unit tests, worksheets and the workbook to prepare thoroughly for the final exam. Please visit [www.chamberlinchemistry.weebly.com](http://www.chamberlinchemistry.weebly.com) for relevant resources.

Unit One Review – Introduction

* Ionic Nomenclature (including hydrates, simple ionic compounds and multivalent compounds)
* Covalent Nomenclature (using prefix system)
* Acid Nomenclature
* Significant digits calculations
* Unit conversion calculations
* Precision, accuracy and uncertainty
* Relative Error

1. Diagram the best way to heat the contents of a test tube. Be thorough in your answer. Describe what might happen if you heat it incorrectly.

2. List the number of significant figures in the following questions:

 a) 12.34 d) 1010

 b) 103.0 e) 404 x 103

 c) 1.300 x 103

3. What is the smallest scale division on the instrument used to give the following measurement? In addition, list the uncertainties of the values using the +/- notation.

 a) 14.6 mL

4. A student was measuring the density of water. She found that 100.0 mL of water had a mass of 94.04 g. Given that the density of water is 1.0000 g/mL, what is the relative error of her measurement?

5. Write the names of the following compounds, and list whether they are an acid (A), base (B) or neither (N).

 a) H2CO3 b) NBr3 c) Ca3P2

 d) Rb2SO3 e) Mn(NO3)2 f) Mg(OH)2

6. Write the formulae of the following compounds:

 a) Sodium sulphide b) hydrofluoric acid c) Scandium hydroxide

d) Nitrous acid e) carbon tetraiodide f) Tin(IV)phosphate

7. Use the following groups of elements to make a compound. List the compounds name and chemical formula.

 a) sodium and oxygen b) iodine and aluminum c) nitrogen, oxygen and calcium

Answers:

1. The test tube should be heated evenly, with the opening away from you. If heat is concentrated on one spot the glass can break, and if pointed toward someone, the contents could boil out onto someone.

2. a) 4 b) 4 c) 4 d) 3 e) 3

3. if the uncertainty is in the 10ths position, the smallest scale must be between 0.5 mL and 1.0 mL. We can guesstimate 1/5 of the smallest scale, which would be +/- 0.1 mL (if the smallest scale was 0.5 mL) or +/-0.2 mL (if the smallest scale was 1.0 mL)

4. 5.96%

5. a) carbonic acid (A) b) nitrogen tribromide (N) c) calcium phosphide (N)

 d) rubidium sulphite (N) e) manganese (II) nitrate (N) f) magnesium hydroxide (B)

6. a) Na2S b) HF c) Sc(OH)2 d) HNO2 e) CI4 (capital c, capital i subscript 4) f) Sn3(PO4)4

7. a) sodium oxide, Na2O b) aluminum iodide AlI3 c) calcium nitrate Ca(NO3)2 (others are possible).

Unit Two Review – Percent Composition and Matter

A. Vocabulary:

* element
* atom
* molecule
* ion
* particle
* homogeneous
* heterogeneous
* pure substance
* mixture
* mechanical mixture
* solution
* Avogadro
* Gay-Lussac
* diatomic

B. Separation of Substances (Lab 2.4)

* hand separation
* filtration
* evaporation
* distillation
* solvent extraction
* recrystallization
* gravity separation
* chromatography

C. Percent Composition (Problem Set 2.1, Lab 2.1)

D. Multiple Proportions (Problem Set 2.1b and Lab 2.2)

D. Gas Volumes (Problem Set 2.2)

E. Relative Mass (Problem Set 2.3)

F. The Mole (Problem Set 2.4)

1. The following data was found for a giantium regularide lab much like the lab you have completed.

 mass of container 14.56 g

 mass of giantium used + container 16.86 g

 mass giantium regularide formed + container 17.44 g

 Calculate the percentage composition of both “elements” in the giantium regularide compound.

2. An ore consists of 28.7% lead sulphide. The lead sulphide compound is 71.5% lead. What mass of lead can be produced from 45.0 T (1 T = 1000 kg) of ore?

3. The masses recorded on the periodic table are relative masses.

 a) What is the mass of a titanium atom relative to a boron atom?

 b) What would the relative mass of titanium be if oxygen had been picked as the standard of comparison and assigned a value of 10.00 on the relative mass scale?

4. How many moles are there in 16.63 g of oxygen gas?

5. One volume of hydrogen will combine with one volume of Fluorine to form two volumes of hydrogen fluoride. Using this information and Avogadro's hypothesis, show that fluorine is diatomic.

6. Two volumes of nitrogen monoxide, NO, will react with one volume of oxygen gas, O2 to form two volumes of an unknown nitrogen oxide compound. If 30.0 L of oxygen reacted with nitrogen monoxide to form 40.0 L of the unknown nitrogen oxide:

 a] how much nitrogen monoxide was used?

 b] after the reaction is complete, what gases remain and what are the volumes of gases present?

 c] which of the reagents is the limiting reagent?

Answers:

1. giantium 2.3 g, giantium regularide 2.88 g. Gi 79%, Rg 21%.

2. 9.23 T

3. a) 4.43 times heavier b) 30 g/mole (Ti is 3.0 times heavier than O)

4. 0.5197 moles

5. If 2 volumes of HF are created, each volume must have one H and one F – so two total on the product side. If H was in one volume, the particle must be H2 to supply both H’s. Same for F.

6. a) 40 L (NO is limiting) b) 40 L of product, plus 10 L of O2. c) NO

Unit Three Review – The Mole

* Empirical Formulas (Problem Set 3.1)

Working from the percent composition, you should be able to work out the mole ratio, or the empirical formula of the compound, and vice versa.

* Working with molecular formulas (Problem Set 3.2-3.4)

The culmination of these problem sets is found in 3.4. You must be able to work out the percent composition of a compound given the empirical formula, find the molar mass of a compound, use relative mass data to work out the molecular mass of a compound, and use analysis data (mass CO2 and H2­O) to work out the molecular formula of an organic compound.

* Labs:

Be able to work out the ratio of moles of water to anhydrous salt in a hydrate in order to determine the ? in formulas such as CoCl2. ?H2O. Given lab data for the reaction of two elements, be able to calculate the percent composition, and from that the empirical formula.

Problem Set 3.1

1. What are the empirical formulas of the following compounds?

 a) compound 1: 25.8% oxygen by mass, the rest is sodium.

 b) compound 2: 28.2% potassium, 25.6% chlorine and 46.2% oxygen.

2. What mass of Ca(OH)2 can be made from 5.00 grams of Ca?

Problem Set 3.2

1. What is the percent composition of all of the elements of potassium carbonate?

2. Cobalt(II)chloride exists as a hydrate with 6 waters (CoCl2 6H2O). How many grams of the hydrate could be made from 10.0 grams of the anhydrous salt?

3. What is the mass of 2.61 moles of sodium oxide?

Problem Set 3.3

1. A compound has the empirical formula of CHO. Name 3 molecular formulas that have CHO as their empirical formula.

2. List the molar masses of the molecules you suggested in question 1.

3. A compound is 42.9% C, 7.1% H and 50.0%N. It has a molar mass of 140 g/mole. What is its molecular formula?

4. 3.36 g of C, 0.708 g of H and 2.24 g of O combine to form 0.0702 moles of compound. What are its empirical and molecular formulas?

Problem Set 3.4

1. 10.0 grams of a compound containing C, H and N is burned in oxygen. 16.28 grams of CO2 and 3.34 grams of water are produced. When a sample of the compound is compared to the same volume of Neon gas at the same temperature and pressure, it is found to be 6.75 times heavier. What is the molecular formula of the compound?

2. A compound containing C, S and O was burned. 12.36 grams of the sample produced 7.15 grams of CO2. The compound contained 5.20 grams of Sulphur. The same 12.36 gram sample was found to contain 0.0813 moles. What is the molecular formula of the compound?

Answers:

3.1: 1. a)Na2O b) KClO4 2. 9.25 g Ca(OH)2

3.2 1. K=56.5%, C=8.69%, O=34.8% 2. 18.31 g hydrate 3. 161.8 g Na2O

3.3 1. C2H2O2, C3H3O3, etc. 2. masses: 58 g/mol, 87 g/mol, etc. 3. C5H10N5 4. C4H10O2 (molecular)

3.4 1. C5H5N5 2. C2S2O4

Unit Four Review - Stoichiometry

* Types of Chemical Reactions
* Coefficients and Moles
* Moles ⮀ Mass and Mass ⮀ Mass Problems
* Volume ⮀ Mass and Volume ⮀ Volume Calculations
* Calculations Involving Molecules, Moles, Mass & Volume
* Stoichiometry of Excess Quantities (Limiting Reagents)
* Percentage Yield Problems

1. Consider the following unbalanced reaction:

Fe3O4(s) + H2(g) 🡪 Fe(s) + H2O(g)

 In the reaction of hot Fe3O4 with H2, what is the number of moles of H2O formed by the reaction of 3 moles of Fe3O4 with excess H2?

2. C2H2 burns completely in O2 to produce CO2 and H2O.

 a) If 8.30 moles of C2H2 are completely burned, how many moles of CO2 are produced?

 b) How many moles of oxygen would be required to produce 0.37 moles of water from the reaction above?

3. How many moles of CO2 are produced from the burning of 16 g of CH3OH according to the unbalanced reaction below?

CH3OH + O2 🡪 CO2 + H2O

4. Consider the decomposition of water: H2O 🡪 H2 + O2. What is the number of moles of O2 produced by the decomposition of 90 g of H2­O?

5. How many grams of CO2 are produced by burning 0.400 moles of C4H10 in excess oxygen?

6. N2 and H2 react to form NH3. How many litres of N2 are required to produce 60 litres of NH3?

7. Using the reaction in #6, How many litres of N2 are needed to react with 30 litres of H2?

8. Fe + H2O 🡪 Fe3O4 + H2. Balance the reaction and find how many grams of Fe are needed to make 6.0 g of H2.

9. C2H2 burns in O2 to produce CO2 and H2O.

 a) If 7500 L of C2H2 are completely burned in excess oxygen, how many litres of CO2 at STP could be produced?

 b) What volume of C2H2 at STP is needed to produce 56.0 g of water?

10. Fe + H2O 🡪 Fe3O4 + H2. What mass of iron would be needed to fill a 1.5 litre balloon with hydrogen?

Use the following unbalanced reaction for questions 11-13

K2SO3 + H3PO4 🡪 K3PO4 + H2SO3

11. 32.66 g of K2SO3 and 14.74 g of H3PO4 are reacted. What is the mass of the reactant that is not used up (the mass of excess reagent)?

12. What is the mass of H2SO3 that forms?

13. What is the mass of K3PO4 that forms?

Use the following unbalanced reaction for questions 14 –16.

Fe2(CO3)3­ + CaCl2 🡪 FeCl3 + CaCO3

14. 8.76 g of Fe2(CO3)3 and 9.546 g of CaCl2 were mixed. What is the limiting reagent?

15. What mass of FeCl3 forms?

16. How many moles of CaCO3 form?

17. 25.0 g of barium Chloride and 25.0 g of potassium sulphate are reacted.

a) What mass of barium sulphate forms?

b) What mass of potassium chloride forms?

18. An impure sample of zinc has a mass of 1.50 g. All of the zinc in the impure sample is converted into zinc oxide which was found to have a mass of 1.59 g. What is the percentage of zinc in the impure sample.

19. You wish to prepare as much magnesium acetate, Mg(CH3COO)2, as you can. You have 10.0 g of MgCrO4 and 15.0 g of MgSO4. Which reaction will yield more Mg(CH3COO)2?

20. Ammonia burns in oxygen according to the following reaction:

NH3 + O2 🡪 NO2 + H2O

 50.0 g of ammonia is reacted with 100.0 g of oxygen. How much NO2 will be produced?

21. The cylinders of a car have a volume of 6.15 litres. Assuming that air fills this volume at STP and is 21% oxygen, what mass of octane (C8H18) would be needed to combine with the oxygen?

Note: Significant figures were not considered when working out the answers. In some cases the rounded answers would result in an answer that would be misleading. (Eg. 12 moles of H2O in question 1 to 1 sig. fig. is 10 moles which is misleading)

1. 12 moles H2O (1:4 ratio) (would round to 10 moles)

2. a) 16.6 moles

 b) 0.925 moles

3. 0.5 moles of CO2 produced

4. 2.5 moles of O2

5. 70.4 g of CO2

6. 30 L of N2

7. 10 L of H2

8. 125.6 g of Fe

9. a) 15 000 L CO2

 b) 69.7 L acetylene

10. 2.80 g of Fe

11. Mass of unused H3PO4 is1.18 g

12. 16.97 g of H2SO3

13. 29.26 g of K3PO4

14. CaCl2

15. 9.3 g FeCl3

16. 0.086 moles CaCO3

17. a)28.0 g of barium sulphate

 b)17.9g

18. 85.3% Zinc.

19. reaction with magnesium sulphate yields the most; 17.79 g

20. maximum NO2 produced is 3.12 moles (82.1 g)

21. 0.526 g octane

Unit Five Review – Solution Chemistry

* Definitions and Types of Solutions
* Individual Ion Concentrations
* Precipitation Reactions

1. Describe how to make 200 mL of a 0.65 M solution of LiI

2. How many grams of CaCl2 are contained in 1.25 L of a 0.25 M solution of CaCl2?

3. What is the molarity of a solution made from dissolving 15.6 g of CaI2 into 1900 mL of water?

4. 14.5 g of calcium chloride and 13.76 g of aluminum chloride are dissolved in order to make a solution that is 2.5 L. What is the chloride ion concentration in the final solution?

5. 2.5 L of a 0.96 M solution of Li2CO3 are added to 3.0 L of water. What are the final concentrations of the Li+ and CO32- ions after mixing?

6. What volume of 1.37 M sucrose can be made from 300 mL solution that is 2.7 M sucrose?

7. What are the concentrations of each of the ions of AlCl3 as 1.40 L of a 0.45 M solution is concentrated to 0.23 L?

8. What are the final concentration of all ions when 2.5 L of 1.56 M Fe2(CO3)3 is mixed with 1.9 L of 1.36 M KCl?

9. 200.0 mL of 1.60 M aluminum bromide is mixed with 3.0 L of 1.40 M Barium bromide. What is the final bromide ion concentration?

10. FeCl3(aq) is mixed with Sr(OH)2. Write out the molecular, complete ionic and net ionic equations for the reaction.

11. 0.967 L of 0.90 M FeCl2 is mixed with 1.10 L of 1.10 M Na2S. What are the concentrations of all of the ions after mixing, and what mass of precipitate forms?

Answers:

**1**. dissolve 17 g of LiI into about 150 mLs of water, stir until dissolved. Top solution volume up to 200 mL.

**2**. 35 g **3**. 0.028 M **4**. 0.23 M **5**. [Li+]=0.87M, [CO32-]=0.44M **6**. 600 mL

**7**. [Al3+]=2.7 M, [Cl-]=8.2 M **8**. [K+]=0.59M, [Cl-]=0.59M, [Fe3+]=1.7M, [CO32-]=2.7M

**9.** 2.9M

**10**. molecular: 2FeCl3(aq) + 3Sr(OH)2(aq) 🡪 2Fe(OH)3(s) + 3SrCl2(aq)

 complete: 2Fe3+(aq) + 6Cl-(aq) + 3Sr2+(aq) + 6OH-(aq) 🡪 2Fe(OH)3(s) + 3Sr2+(aq) + 6Cl-(aq)

 net: Fe3+(aq) + 3OH-(aq) 🡪 Fe(OH)3(s)

**11.** [Cl-]=0.84M, [Na+]=1.2 M, [Fe2+]=0.0M, [S2-]=0.16M, FeS produced = 76g

Unit Six Review – Gas Laws

* Boyle’s Law
* Charles’ Law
* Combined Gas Law
* Dalton’s Law
* Ideal Gas Law
* Stoichiometry

1. What would the pressure of a gas be at 5.0 L if that same gas at the same temperature was 56.43 L at 50.0 kPa?

2. Convert the following pressures given into the other two values (from kPa, mm Hg, and atm) knowing that 101.3 kPa = 760 mm Hg = 1.00 atm.

 a) 35.0 kPa b) 500 mm Hg c) 0.024 atm

3. The volume of a gas at 27 oC is 35.67 L. What is its pressure if that same gas was found to be 35.0 atm at 567 oC and 2.00 L?

4. What would the volume of a gas be at STP if it was 4.5 L at 100.0 K and 100.0 atm

5. How many moles would the gas in question 4 contain?

6. 0.45 grams of a gas occupy 0.87 L at 0.35 atm and –40.0 oC. What is its molar mass? What is the gas?

7. Iron reacts with hydrochloric acid to produce hydrogen gas and iron(II)chloride. The H2 is collected from the reaction of 1.0 gram of iron and excess HCl into a 10.0 L flask at 22.0 oC. What is the pressure in the flask?

8. 0.50 grams of helium are mixed with hydrogen gas. The partial pressure of He is 102 mm Hg, and the partial pressure of H­2 is 45.0 mm Hg. What is the mass of hydrogen in the flask?

9. Equal masses of N2 and O2  are placed in two separate flasks which are the same volume. Both gases are at the same temperature. If the following statements are true, state they are true. If false, correct them so that they are true.

 a) The pressure in the flask with N2 is less than in the flask with O2.

 b) There are more moles in the flask with N2 than there are in the flask with O2.

 c) Since both volumes are the same, there must be the same number of particles in both boxes.

Answers

1. 560 kPa

2. a) 0.346 atm, 262 mm Hg b) 0.7 atm, 70 kPa c) 2.4 kPa, 18 mm Hg

3. 0.700 atm 4. 1 200 L 5. 55 moles

6. 28 g/mol (nitrogen gas) 7. 4.4 kPa 8. mole frac He = 0.694, moles H2 = 0.055, so mass is 0.11 grams

9. a) False, each nitrogen is lighter so you have more of them if you have equal masses.

 b) T c) F, see a). Note # of particles is same if same volume at same T and P.

1. 560 kPa

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Unit Seven Review – Periodic Trends and Atomic Structure

A. Periodic Trends (PS 7.1, Modern Periodic Table handout and Periodic Trends package)

* Electronegativity
* Ionization energy
* Size of atoms
* Size of ions

B. Bonding (PS. 7.6)

* Ionic, covalent (pure) and polar covalent bonding

C. Electron Configuration (core notation)

D. VSEPR Theory (PS. 7.5)

* Explanation and purpose
* Lewis Dot Diagrams
* Shapes of molecules, including angles (see chart on PS. 7.5)

E. Hybridization (sp, sp2, sp3, sp3d, sp3d2 – see chart on PS. 7.7)

1. Explain why members of the same family have the same chemical reactivity.

2. Write a statement about the trends on the periodic table of the following properties

 a) size of the atom

 b) size of the ion

 c) electronegativity

 d) ionization energy

3. How does the electronegativity trend explain all of the other trends?

4. Draw the Lewis diagrams for the following molecules:

 a) SF2 b) NSH c) SiS2 d) CHF3 e) PCl3 f) COF2

5. For each of the structures in 4, determine the following:

 a) polarity of bonds

 b) bond angles

 c) shape name

 d) hybridization of the central atom.

5. Draw the Lewis diagrams for the following molecules:

 a) OF2 b) NSH c) GeS2 d) CH2Cl2 e) SF6 f) IF5

6. For each of the structures in 4, determine the following:

 a) polarity of bonds

 b) bond angles

 c) shape name

 d) hybridization of the central atom.

 

7. Discuss the various types of intermolecular forces and how they relate to boiling and melting temperature of a substance.

Answers:

1. The periodic table is set up by grouping elements with similar valence electron organization. Valence electrons determine the reactivity trends of an element.

2. a) As you go from left to right in a period, the atom size decreases. As you go from top to bottom in a family the atom size increases.

 b) As you go from left to right in a period, the ion size decreases until family 15 where it shoots up. As you go from top to bottom in a family the atom size increases.

 c) As you go from left to right in a period, the electronegativity increases. As you go from top to bottom in a family the electronegativity decreases.

 d) As you go from left to right in a period, the ionization energy increases. As you go from top to bottom in a family the ionization energy decreases.

3. Electronegativity is the ability of an atom to draw electrons toward itself. High electronegativity, therefore, means small size. It also means that it will be hard to remove an electron and so the ionization energy will be high.

4-7 Will be discussed in class.

Unit 8 Review : Organic Chemistry

* Alkanes
* Alkenes
* Alkynes
* Cycloalkanes
* Aromatics
* Alcohol
* Aldehyde
* Ketone
* Ester (no naming)
* Ether
* Carboxylic acid
* Amine (no naming)
* Amide (no naming)
* Naming organic compounds
* Structural formulas, skeletal formulas and molecular formulas
* Isomers
1. Match the name to the structure by writing the correct number on the arrow beside the drawings.
2. Scratch out any names which are incorrect (not accurate naming).
3. Draw the remaining structures.

|  |  |  |
| --- | --- | --- |
| 1. 3-hexanol
2. 2-hexanol
3. 4,4-diethyl-1-pentene
4. cyclopentanol
5. butanoic acid
6. cyclopentene
7. 3 – ethyl – 4 – propylnonane
8. 2-methylbutane
9. 1,3 - hexadiene
10. 2,2-dimethylbutane
 | 1. 4 – methyl – 2 – hexyne
2. heptyl-butyl ether
3. 2-butyne
4. pentane
5. 2-hexanone
6. 1-bromo – 2 chloro pentane
7. 2-butanol
8. 3,5-dimethyl octanoic acid
9. 2-isopropyl-4-ethyl hexanoic acid
 | 1. 3 - methyl – 2,3 – pentadiol
2. 3-hexanone
3. 4 – ethylheptane
4. 4,4-diethyl-heptanal
5. cyclopropane
6. 3 - methylhexane
7. 2,4 – dimethylhexane
8. cyclopropyne
9. 3 – ethylcyclohexene
10. 2,3 – nonadiene
 |

Answers:

Open Problems for Practice

The last questions require an understanding of multiple units in order to solve. On the exam you will be given ONE question of this type that you can select from 4 different choices.

1. 10.00 grams of methane is reacted with 33.6 L of oxygen at STP. Predict the products and calculate how many grams of the product which contains carbon will be produced by the reaction. (3 marks)

2. A container filled with oxygen gas which has a mass of 12.06 grams. The same container is filled with HCl at the same temperature and pressure. All of the HCl in the container is dissolved into 1000.0 mL of water. This solution is reacted with CaO. How many grams of CaO will react? (3 marks)

3. A compound that contains only N and O contains 30.4% N by mass. 5.00 grams of the compound fill 1.32 L at 25 oC and a pressure of 101.3 kPa. Find the molecular formula of the compound and draw a lewis diagram of the compound, list the bond angles around the N as well as the hybridization of the N. (3 marks).

Answers:

1. 27.5 g

2. 10.55 g

3. N2O4

