QUIZZES AND EXAMS FOR WINTER 2006. ANSWERS ARE GIVEN AT THE END OF EXAM #2.

Chemistry 11 Winter 2006 Quiz #1

1. What is the chemical symbol for the following elements?

chlorine_____ iron____ sodium _____ copper _____

2. Write the symbols of the isotopes that contain the following:

An isotope of iodine whose atoms have 77 neutrons _____

An isotope of fluorine whose atoms have 9 neutrons _____

3. Which of the following is (circle the correct answer):

A noble gas: Se, H, Xe, Sr, Zn

A transition metal: Pb, W, Ca, Cs, P

An alkaline earth metal: Fe, Mg, K, Cl, Ni

4. One atom of silver-109 has a mass that is 9.0754 times that of a carbon-12 atom. What is the atomic mass of this isotope of silver expressed in atomic mass units?

Chemistry 11 Winter 2006 Quiz #2

1. Name the following compounds:

ClF_3 _____

Mg_2C _____

2.Naturally occurring copper is composed of 69.17% copper-63 (atomic mass = 62.9396 u) and 30.83% copper-65 (atomic mass = 64.9278 u). What is the average atomic mass of copper? Be sure to report the answer to the correct number of significant figures.

3. Use the data below and draw a graph of volume in units of liters versus temperature in units of Kelvin using the graph paper provided. Be sure to follow all the rules of graphing discussed in the lab workshop on graphing. Temperature in Kelvin is related to temperature in °C by the equation: $T_K = T_{°C} + 273$

T (°C)	**V(L)**
-150	1.1
-100	1.6
0	2.5
100	3.4

4. The mass of a 10-mL graduated cylinder is measured and found to be 11.251 g. A liquid is then added to the cylinder and the mass is measured again and is 15.215 g. The volume of the liquid in the cylinder is 6.1 mL. Calculate the density of the liquid. Answer the question with the correct units and correct number of significant figures.

Quiz #3

1. A sample of copper oxide reacts with carbon monoxide to form pure metallic copper and carbon dioxide according to the equation:

$Cu_xO_y(s) + CO(g) \rightarrow Cu(s) + CO_2(g)$

In the experiment the mass of copper oxide is 1.255 g. After the reaction is complete the mass of pure metallic copper is measured and found to be 1.113 g. Find the empirical formula for this copper oxide compound.
The atomic masses of copper and oxygen are 63.546 g/mol and 15.999 g/mol, respectively.

2. Balance the equation: ___$Fe(s)$ + ___$O_2(g)$ → ___$Fe_3O_4(s)$
How many moles of iron will react with 2.55 moles of oxygen gas?

3. Calculate the percentage composition by mass for $CaSO_4$
The atomic masses of calcium, sulfur, and oxygen are 40.078 g/mol, 32.065 g/mol, and 15.999 g/mol, respectively.

Quiz #4

1. In an acidic solution, HSO_3^- ion reacts with ClO_3^- ion to produce the SO_4^{-2} and the Cl^- ion.

a. Assign oxidation numbers to all of the elements in the four species.

b. Write the balanced net ionic equation for the reaction.

c. Describe what happens during the reaction at the molecular level using simple terms. Write an explanation that is easy to understand. You can draw a picture to help with your explanation.

Chemistry 11, Section D70A Quiz #5

Be sure to show your work in answering each of the questions.

1. (a) Determine the heat of reaction for the combustion of ammonia using the given heats of formation. (b) Then calculate the heat of reaction for one mole of ammonia. (c) Is the reaction endothermic or exothermic? Explain your answer. (d) Will the surroundings get warmer or colder as the reaction takes place? Explain your answer.

$4NH_3(g) + 7O_2(g) \rightarrow 4NO_2(g) + 6H_2O(g)$

	$\Delta H_f°$ (kJ/mol)
$NH_3(g)$	-46.19
$NO_2(g)$	33.8
$H_2O(g)$	-241.8

2. Calculate the standard enthalpy change for the following reaction:$CuO(s) + CO(g) \rightarrow Cu(s) + CO_2(g)$ using the following equations and enthalpy values:

$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$ $\quad \Delta H^o = -566.1$ kJ

$2Cu(s) + O_2(g) \rightarrow 2CuO(s)$ $\quad \Delta H^o = -310.5$ kJ

Chemistry 11, Section D70A Quiz #6

Be sure to show your work in answering each of the questions.

$PV=nRT$ $T_K = T_{°C} + 273$

1. Consider the following chemical reaction: $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

A 0.250 L sample of nitrogen monoxide at 0.450 atm and 20°C reacts with excess oxygen gas. The pressure of nitrogen dioxide produced is 0.150 atm at 30°C. What is the volume, in liters, of the nitrogen dioxide formed? R = 0.08206Latm/Kmol

2. How can we explain that the pressure of a gas increases with temperature using the kinetic molecular theory of gases? Assume that the volume of the gas and the amount of gas are constant. Write a paragraph on this question. If you want to use equations that's fine. But be sure to explain with words.

Exam #1Directions

When answering questions be sure to write clearly. Be sure to show your thinking as you answer the questions. You must show work in order to receive credit for your answers. For any answers greater than 1000 or less than 0.01 be sure to report the answer using scientific notation or metric prefixes. All answers should include units where appropriate.

1. Name the following compounds:

$V(NO_3)_3$ _____

$GeCl_4$ _____

NaF _____

Write the formulas for the following compounds:

dialuminum hexachloride _____

copper(II) sulfate _____

calcium phosphide _____

2. Naturally occurring oxygen exists in three isotopic forms, oxygen-16, oxygen-17, and oxygen-18. The atomic masses and natural abundances of each isotope are: 15.999u (99.76%), 16.999u (0.040%), and 17.999u (0.20%). Use this data to calculate the average atomic mass for oxygen.

3. How many atoms of oxygen are in 2.55 mol of Na_2SO_4?

How many moles of oxygen atoms are in 0.356 mol of $CaCO_3$?

How many moles of oxygen atoms are in 25.00 g of oxygen gas (O_2)?

4. The systematic name for the drug called ecstasy is 3,4-Methylenedioxymethylamphetamine, often abbreviated as MDMA. The molecular formula for the compound is $C_{11}H_{15}NO_2$. Determine the mass percentage composition for MDMA.

5. Balance the following chemical equations using the smallest whole numbers possible:

$SO_2(g) + H_2O(l) \rightarrow H_2SO_3(aq)$ _____

$P_4O_{10}(s) + H_2O(l) \rightarrow H_3PO_4(aq)$ _____

$Mg(s) + O_2(g) \rightarrow MgO(s)$ _____

6. Consider the following equation: $2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$

If 6 molecules of octane are mixed with an excess of oxygen gas how many molecules of carbon dioxide will be produced?

If 6 molecules of octane are mixed with 60 molecules of oxygen gas how many molecules of carbon dioxide will be produced?

If 2.5 g of oxygen gas (molecular mass = 32.00 g/mol) is mixed with excess octane, how many moles of water will be produced?

If 2.5 g of oxygen gas is mixed with excess octane, how many grams of water will be produced?

7. Complete the following chemical equations. Write the complete ionic equation for the first equation. Write the net ionic equation for the first equation. Be sure to write the states of matter for the products.

$AgClO_3(aq) + NaBr(aq) \rightarrow$

$K_2SO_4(aq) + Pb(NO_3)_2(aq) \rightarrow$

8. A solution of hydrochloric acid in water is made. In this solution 2.50 g of hydrochloric acid is dissolved in 250 mL of water. What is the concentration (molarity) of the solution?

A 150 mL sample of 0.60 M HNO_3 is diluted to 450 mL. What is the molarity of the resulting solution?

Data

$N_A = 6.022 \times 10^{23}$/mol

Solubility rules: Alkali metals, ammonium, nitrate, perchlorate (ClO_4^-), chlorate (ClO_3^-), nitrate, and acetate ($C_2H_3O_2^-$)salts are soluble.

Chlorides, bromides (Br^-), and iodides (I^-) are soluble unless combined with Ag^+, Pb^{+2}, or Hg_2^{+2}.

Sulfates are soluble unless combined with Pb^{+2}, Ca^{+2}, Sr^{+2}, Ba^{+2}, or Hg_2^{+2}

Metal hydroxides are insoluble unless combined with alkali metals, Ca^{+2}, Sr^{+2}, or Ba^{+2}.

Phosphates, carbonates, sulfates, and sulfites are insoluble unless combined with alkali metals or ammonium cations.

Metric prefixes
Nano (n) = 10^{-9}
Micro (μ) = 10^{-6}
Milli (m) = 10^{-3}
Centi (c) = 10^{-2}
Kilo (k) = 10^{3}
Mega (M) = 10^{6}
Giga (G) = 10^{9}

Exam #2

Directions

When answering questions be sure to write clearly. Be sure to show your thinking as you answer the questions. You must show work in order to receive credit for your answers. For any answers greater than 1000 or less than 0.01 be sure to report the answer using scientific notation or metric prefixes. All answers should include units where appropriate.

1. Balance the following redox equation using the ion-electron method:

$Ag(s) + NO_3^-(aq) \rightarrow NO_2(g) + Ag^+(aq)$

2. Consider the following equation and enthalpies of formation:

$CO_2(g) + 2SO_2(g) \rightarrow CS_2(l) + 3O_2(g)$

Species	**$\Delta H_f°$(kJ/mol)**
$CS_2(l)$	87.9
$SO_2(g)$	-296.8
$CO_2(g)$	-393.5

What is the enthalpy of reaction for the equation shown above?

3. Calculate **ΔH** for the following reaction: $3NO(g) \rightarrow N_2O(g) + NO_2(g)$

From the following enthalpies of reaction:

$NO(g) \rightarrow 1/2N_2(g) + 1/2O_2(g)$	-90.4 kJ
$N_2(g) + 1/2O_2(g) \rightarrow N_2O(g)$	-81.6 kJ
$NO(g) + 1/2O_2(g) \rightarrow NO_2(g)$	-56.6 kJ

4. What are the electron configurations (spdf) for the following elements?

Si

Cl

Ni

As

5. Calculate the wavelength in centimeters and in meters of light emitted from a hydrogen atom when the electrons relaxes from the n = 4 level to the n = 2 level.

6. (a) What is the value of `l` for an f-orbital? (b) What is the value of `l` for a d-orbital?
(c) How many 3d orbitals are there?

(a)

(b)

(c)

7. Draw the Lewis structure for $GeCl_4$

Draw the Lewis structure for CO_3^{-2}

8. Predict the geometric shapes of $SbCl_6^-$ and CS_2 . Include the angle(s) expected in the shape.

Metric prefixes
Nano (n) = 10^{-9}
Micro (μ) = 10^{-6}
Milli (m) = 10^{-3}
Centi (c) = 10^{-2}
Kilo (k) = 10^{3}
Mega (M) = 10^{6}
Giga (G) = 10^{9}

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \text{ where } R_H = 109{,}678\ \text{cm}^{-1}$$

$c = 2.999 \times 10^8$ m/s = $\lambda\nu$

$E = h\nu$

Quiz #1 ANSWERS

1. Cl, Fe, Na, Cu

2. $^{130}_{53}I$
$^{18}_{9}F$

3. Xe
W
Mg

4. Carbon-12 has a mass of exactly 12.000 u. So silver-109 has a mass of 9.0754(12.000u) = 108.905u

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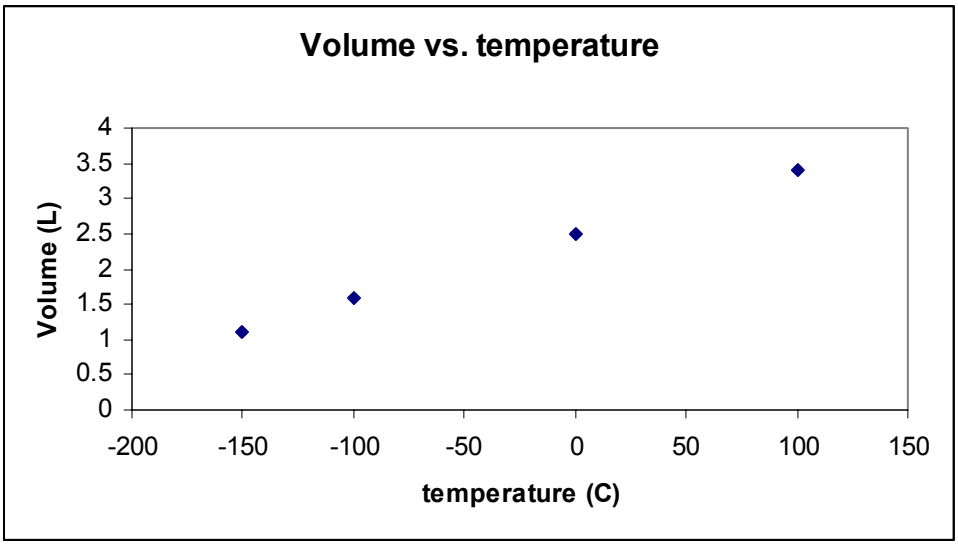
Quiz #2 ANSWERS

1. chlorine trifluoride
magnesium carbide

2.
copper-63: .6917(62.9396u) =43.535 u
copper-65: 0.3083(64.9278u) = 20.0172u
average = 43.535u + 20.0172u = 63.55u

3.



4.
mass of liquid = 15.215g-11.251g = 3.964g
volume of liquid = 6.1 mL
d = 3.964 g/6.1 mL = **0.65 g/mL**

Quiz #3 ANSWERS

1. mass of copper = 1.113 g mass of oxygen = 1.255 g -1.113 g = 0.142 g
moles of Cu = 1.113g(1 mol/63.546 g) = 0.0175 mol Cu
moles of O = 0.142 g(1 mol O/15.999 g) = 0.00888 mol O
Divide by smallest # of moles: Cu: 0.0175/0.00888 = 1.97 = 2 O: 0.00888/0.00888 = 1
Answer = **Cu_2O**

2. Balanced coefficients: **$3Fe + 2O_2 \rightarrow Fe_3O_4$**
2.55 mol O_2(3 mol Fe/2 mol O_2) = **3.83 mol Fe**

3. Molecular mass = 40.078 g/mol + 32.065 g/mol + 4(15.999 g/mol) = 136.14 g/mol
%Ca = (40.078/136.14) x 100% = 29.44%
%S = (32.065/136.14) x 100% = 23.55%
%O = (64.00/136.14) x 100% = 47.01%

Quiz #4 ANSWERS
1a.

HSO_3^-	H = +1	O = -2	S = +4
ClO_3-	Cl = +5	O = -2	
SO_4^{-2}	S = +6	O = -2	
Cl^-	Cl = -1		

1b.
Half-reactions: $HSO_3^- \rightarrow SO_4^{-2}$ $ClO_3^- \rightarrow Cl^-$

Balanced half-reactions:
$H_2O + HSO_3^- \rightarrow SO_4^{-2} + 3H^+ + 2e^-$
$6e^- + 6H^+ + ClO_3^- \rightarrow Cl^- + 3H_2O$
Combined equations:
$3(H_2O + HSO_3^- \rightarrow SO_4^{-2} + 3H^+ + 2e^-)$
$6e^- + 6H^+ + ClO_3^- \rightarrow Cl^- + 3H_2O$

Overall: $3HSO_3^- + ClO_3^- \rightarrow 3SO_4^{-2} + Cl^- + 3H^+$

1c. Electrons are taken from hydrogen sulfite ions by chlorite ions. As the chlorite ions obtain the electrons they decompose to form chloride ions.

Quiz #5 ANSWERS
1. Products - Reactants: 6mol(-241.8kJ/mol) + 4mol(33.8kJ/mol) + 4mol(-46.19kJ/mol) = -1130.8 kJ

2. Divide first equation by 2. Divide second equation by 2 and reverse.

$CO(g) + 1/2O_2(g) \rightarrow CO_2(g)$	-566.1 kJ/2 = -283.1 kJ
$CuO(s) \rightarrow Cu(s) + 1/2O_2(g)$	310.5 kJ/2 = 155.3 kJ
$CO(g) + CuO(s) \rightarrow CO_2(g)$	-283.1 kJ + 155.3 kJ = -127.8 kJ

Quiz #6 ANSWERS
1. Step 1. Find moles of NO: n=PV/RT = 4.68 x 10^{-3} mol NO
(P=0.450 atm, V=0.250L, R=0.08206, T=293K)

Step 2: Use stoichiometric ratios of NO_2 to NO:
4.68 x 10^{-3} mol NO(2 mol NO_2/2 mol NO) = 4.68 x 10^{-3} mol NO_2

Step 3: Find volume of NO_2: V=nRT/P = 0.776 L
(P = 0.150 atm, R=0.08206, T=303K, n = 4.68 x 10^{-3} mol)

2. When the temperature of a gas is increased the average velocity (v_{rms}) of the gas particles increases. This increase in average velocity has the effect of increasing the average kinetic energy of the gas particles. As gas particles strike the walls of the container they impart a greater force onto the surface of the walls. This increased average force is measured as an increase in pressure because Pressure = force/area where area is the surface area of the container which is constant.

Exam #1 ANSWERS

1. vanadium(III) nitrate germanium tetrachloride sodium fluoride

Al_2Cl_6 $CuSO_4$ Ca_3P_2

2.

oxygen-16 0.9976(15.999u)
oxygen-17 0.00040(16.999u)
oxygen-17 0.0020(17.999u)
Average = sum of all 3 = 15.99u

3.

2.55 mol Na_2SO_4(4 O/1 Na_2SO_4)(6.022 x 10^{23}) = 6.14 x 10^{24} atoms O
0.356 mol $CaCO_3$(3 O/1 $CaCO_3$) = 1.068 mol O
25.00 g O_2(1 mol O_2/32.00 g) (2 O/ 1 O_2) = 1.56 mol O atoms

4. Molecular mass = 11(12.011u) + 15(1.008u) + 14.011u + 2(15.999u) = 193.25u
%C = [11(12.011u)/193.25u] x 100% = 68.37%
%H = [15(1.008u)/193.25u] x 100% = 7.82%
%N = [14.011u/193.25u] x 100% = 7.25%
%O = [2(15.999u)/193.25u] x 100% = 16.56%

5.

$SO_2(g) + H_2O(l) \rightarrow H_2SO_3(aq)$
$P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(aq)$
$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

6.

6 molecules octane(16 CO2/2 octane) = **48 molecules CO_2**
48 molecules CO_2 from octane. 60 molecules O_2(16 CO_2/25 O_2) = 38 molecules CO_2 from O_2. **So 38 molecules CO_2.**
2.5 g O2(1mol O2/32.00 g)(18 mol H2O/25 mol O2) = **0.0562 mol H_2O**
0.0562 mol H_2O(18.016 g/1 mol) = **1.013 g H_2O**

7. $AgClO_3(aq) + NaBr(aq) \rightarrow AgBr(s) + NaClO_3(aq)$ bromides are generally insoluble with exceptions.
$Ag^+(aq) + ClO_3^-(aq) + Na^+(aq) + Br^-(aq) \rightarrow AgBr(s) + Na^+(aq) + ClO_3^-(aq)$ COMPLETE IONIC
$Ag^+(aq) + Br^-(aq) \rightarrow AgBr(s)$ NET IONIC

$K_2SO_4(aq) + Pb(NO_3)_2(aq) \rightarrow PbSO_4(s) + 2KNO_3(aq)$ sulfates are generally insoluble with exceptions.

8. Calculate moles of HCl using mass and molecular mass: 2.50 g HCl(1 mol HCl/36.461 g) = 0.0686 mol HCl
molarity = moles solute/liters solution = 0.0686 mol HCl/0.450 L = **0.152 mol/L** where 450 mL = 0.450 L

Second part: Find moles of HNO_3: 0.150L(0.60 mol/L) = 0.090 mol HNO_3
Divide moles by total volume: 0.090 mol/0.450 L = **0.200 mol/L**

Exam #2 ANSWERS

1.

Half-reactions: $Ag \rightarrow Ag^+$ $\quad\quad$ $NO_3^- \rightarrow NO_2^-$

Balance each half-reaction:

$Ag \rightarrow Ag^+ + 1e^-$ $\quad\quad$ $2e^- + 2H^+ + NO_3^- \rightarrow NO_2^- + H_2O$

Equate charge:

$2(Ag \rightarrow Ag^+ + 1e^-)$

$2e^- + 2H^+ + NO_3^- \rightarrow NO_2^- + H_2O$

Overall: $\mathbf{2Ag + 2H^+ + NO_3^- \rightarrow 2Ag^+ + NO_2 + H_2O}$

2. Products - Reactants

1mol CS_2(87.9 kJ/mol) + 0 - 1 mol CO_2(-393.5 kJ/mol) - 2 mol SO_2 (-296.8 kJ/mol) = **1075 kJ**

3.

Multiply the first equation by 2: 2(-90.4 kJ) = -180.8 kJ

No change to the second equation: -81.6 kJ

No change to the third equation: -56.6 kJ

Total: **-319 kJ**

4.

Si $\quad 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

Cl $\quad 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

Ni $\quad 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$

As $\quad 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^3$

5. $1/\lambda = 109{,}678\ cm^{-1}[1/4^2 - 1/2^2] = -2.056 \times 10^4\ cm^{-1}$ (- indicates the process releases a photon)

$\lambda = 1/-2.056 \times 10^4\ cm^{-1} =$ **4.86272×10^{-5} cm**

λ in meters = 4.86272×10^{-5} cm (0.01 m/1 cm) = **4.86272×10^{-7} m**

6.

a. 3

b. 2

c. 5 $\quad (d_{xy}, d_{xz}, d_{yz}, d_{x2}, d_{x2-y2})$

7. Germanium tetrachloride: Central atom is germanium (4 valence electrons). Four surrounding chlorine atoms (7 valence electrons). The Lewis structure has one single bond between each chlorine atom to the germanium atom. Each chlorine atom should have 3 lone pairs.

Carbonate ion: The central atom is carbon (4 valence electrons). The surrounding atoms are oxygen (6 valence electrons). There are 2 additional electrons because the ion has a -2 charge. The Lewis structure has one double bond between one of the oxygen atoms and the carbon atoms. This oxygen has 2 lone pairs of electrons. The other 2 oxygen atoms have single bonds to the carbon atom and 3 lone pairs of electrons each.

8. Antimony hexachloride ion: Octahedral structure with all angles at 90°.

Carbon disulfide is linear (2 double bonds). This structure has an angle of 180°.