SI Chemistry Semester Review – Spring 2008

Key objectives from our work this semester:

- **Be able to identify the alkali metals, alkaline earth metals, halogens, and noble gases.**
- **Know the three main subatomic particles, their charges, and their location in an atom.**
- **Know the periodic trends.**

<u>Examples:</u> What happens to atomic radius within a period? within a family? What happens to ionization energy within a period? within a family? What happens to electronegativity within a period ? within a family?

- **Know what an isotope is**
- **Using the periodic table, be able to determine the charge of an ion formed by an atom of the representative elements**

<u>Examples:</u> What ion does sulfur form? What ion does bromine form? What ion does strontium form? Sr^{+2} S^{-2} Br^{-1}

Be able to identify, name, and write formulas for ionic and covalent compounds

<u>Examples:</u> Write the formulas for the following compounds and determine whether they are ionic or covalent compounds.

Potassium iodide KI ionic
Dinitrogen oxide (MOA) N_2O covalent
Aluminum oxide Al_2O_3 ionic
Iron (III) sulfide Fe_2S_3 ionic
Copper (I) oxide Cu_2O ionic
Carbon tetrachloride CCl_4 covalent
Calcium Carbonate $CaCO_3$ ionic
Diphosphorus pentoxide P_4O_5 covalent

Name these compounds and identify them as ionic or covalent compounds:

$Fe(OH)_2$ iron(II) hydroxide ionic
N_2O_4 dinitrogen tetroxide covalent
K_2S potassium sulfide ionic
Al_2O_3 Aluminum oxide ionic
$CaSO_4$ Calcium sulfate ionic
CF_4 Carbon tetrafluoride covalent

- **Be able to determine the number of significant figures in a number and do metric conversions**

Examples: Determine the number of significant numbers in the following:

3 5 2 3 1 2

303 10.045 .0032 78.2 1000 1.2

Convert the following:

34 cm to meters $34\text{cm} \times \frac{1\text{m}}{100\text{cm}} = 0.34\text{m}$

567 mm to cm $567\text{mm} \times \frac{1\text{cm}}{10\text{mm}} = 56.7\text{cm}$

56 mg to grams $56\text{mg} \times \frac{1\text{g}}{1000\text{mg}} = 0.056\text{g}$

87 grams to cg $87\text{g} \times \frac{100\text{cg}}{1\text{g}} = 870\text{cg}$

- **Using the formula for density, know how to calculate the mass, volume or density of a substance** $D = \frac{\text{mass}}{\text{vol}}$
- **Know Avogadro's number** 6.02×10^{23}
- **Know how to calculate the molar mass of a substance**

Example Using a periodic table, determine the molar mass of the following:

74.0956g

KI **$Ca(OH)_2$** **$NaNO_3$** **Li_2S** 45.942g

165.992g/mol 85.0g

- **Know how to do all types of molar conversions**

$3.00\text{mol } CO_2 \times \frac{44.01\text{g}}{1\text{mol } CO_2} = 132\text{g } CO_2$

Examples

How many grams are present in 3.00 moles of CO_2?

How many moles of $Al(OH)_3$ are present in 50.0 grams? $50.0\text{g } Al(OH)_3 \times \frac{1\text{mol}}{78.0057\text{g}} = 0.641\text{mol } Al(OH)_3$

How many molecules of water are present in 0.25 moles of water? $.25\text{mol} \times \frac{6.02 \times 10^{23}\text{ molecules}}{1\text{mol}} = 1.51 \times 10^{23}\text{ molecules}$

How many moles of CO are present in 3.5×10^{21} molecules of CO?

How many grams of $CaCO_3$ are present in 1.5×10^{20} molecules of $CaCO_3$?

How many molecules of CCl_4 are present in 264 grams of CCl_4?

$3.5 \times 10^{21}\text{ molecules} \times \frac{1\text{mol CO}}{6.02 \times 10^{23}\text{ molecules}} = 0.0058\text{ mol CO}$

- **Be able to write balanced equations and use them to solve stoichiometry problems**

$1.5 \times 10^{20}\text{ molecules } CaCO_3 \times \frac{1\text{mol } CaCO_3}{6.02 \times 10^{23}\text{ molecules}} \times \frac{89.09\text{g}}{1\text{mol } CaCO_3} = 0.0222\text{g } CaCO_3$

Examples:

$264\text{g } CCl_4 \times \frac{1\text{mol } CCl_4}{153.822\text{g}} \times \frac{6.02 \times 10^{23}\text{ molecules}}{1\text{mol } CCl_4} = 1.03 \times 10^{24}\text{ molecules}$

Silver nitrate reacts with potassium chloride to form silver chloride and potassium nitrate

If you have 5 moles of silver nitrate how many moles of silver chloride will you form?

$AgNO_3 + KCl \rightarrow KNO_3 + AgCl$

1:1 mole ratio ∴ 5 moles AgCl

$67.0\text{g KCl} \times \frac{1\text{mol KCl}}{74.551\text{g}} \times \frac{1\text{mol AgCl}}{1\text{mol KCl}} \times \frac{143.323\text{g}}{1\text{mol AgCl}} = \boxed{129\text{g AgCl}}$

If you have 67.0 grams of potassium chloride how many grams of silver chloride can you form?

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

Pentane (C_5H_{12}) burns completely in the presence of oxygen producing carbon dioxide and water

$10\text{mol} \times \frac{8\text{mol } O_2}{1\text{mol } C_5H_{12}} = \boxed{80\text{ moles } O_2}$

If you have 10 moles of pentane how many moles of oxygen are required?

$30.0\text{g } C_5H_{12} \times \frac{1\text{mol } C_5H_{12}}{72.05\text{g}} \times \frac{6\text{mol } H_2O}{1\text{mol } C_5H_{12}} \times \frac{18.0158\text{g}}{1\text{mol } H_2O} = \boxed{45.0\text{g } H_2O}$

If you burn 30.0 grams of pentane how many grams of water will form?

- **Know how to identify synthesis, decomposition, single replacement, double replacement, and combustion reactions. (see packet)**

- **Know how to determine the percent composition of a compound**

Examples:

$Al_2O_3 = 101.96\text{g/mol}$

$\%\,Al = \frac{53.96}{101.96\text{g}} \times 100 = \boxed{52.9\%}$ $\therefore 47.1\%\ O$

What is the percent composition of Aluminum oxide? Iron(III) hydroxide?

$Fe(OH)_3 = 106.8737\frac{\text{g}}{\text{mol}}$ $\%Fe = \frac{55.85}{106.8737} \times 100 = \boxed{52.2\%}$

What is the percent of oxygen in calcium carbonate?

$CaCO_3$ $\frac{48\text{g/mol}}{100.09\frac{\text{g}}{\text{mol}}} \times 100 = \boxed{48.0\%}$ $\%O = \frac{48.0}{106.8737} \times 100 = \boxed{44.9\%}$

- **Know how to do Molarity problems**

Examples:

What is the molarity of a salt solution containing 42.0 grams of NaCl in 300.0 ml of solution? $\frac{42.0\text{g NaCl}}{300.0\text{mL}} \times \frac{1000\text{mL}}{1\text{L}} \times \frac{1\text{mol}}{58.443\text{g}} = \boxed{2.40\text{M}}$

$\therefore H = \boxed{2.9\%}$

How many moles of KI are present in 45.0 ml of .500 M KI?

$\frac{0.500\text{mol}}{\text{L}} \times 0.045\text{L} = \boxed{0.0225\text{mol KI}}$

- **Know the meaning of the terms, anode, cathode, oxidation, reduction, and salt bridge**

- **Know how to write half cell reactions (oxidation and reduction) and balanced redox reactions**

- **Know how to determine oxidation state**

Example: **Determine the oxidation state of each element in : $CaCO_3$, MnO_4^-, K_3PO_4**

$+2\ +4\ -2 \quad +7\ -2 \quad +1\ +5\ -2$

- **Know how to use a table of reduction potentials to determine the anode, cathode and voltage of a cell composed of two different metals and solutions of their ions**

- **Know the definition of equilibrium**

- **Know how Ka represents the equilibrium of a weak acid**

- **Know Le Chatlier's Principle and how to apply it**

- **Be able to determine the direction of shift in an equilbrium system which undergoes a "disturbance" or a perturbation**

Example:

For the equilibrium $2\ NO_{2\,(g)} \leftrightarrow N_2O_{4\,(g)}$ + energy ($\Delta H = \Theta$) **which is an exothermic reaction, determine the shift that will occur with the following "disturbances".**

Remove dinitrogen tetroxide Shift to products (right)

Add nitrogen dioxide Shift to products (right)

Cool the system Shift to products (right)

Decrease the volume of the container Shift to products (right)

Add Argon gas no effect

- **Know characteristics of acids and bases, including respective pH values**

- **Be able to calculate the molarity of an unknown acid or base given information in an acid- base titration**

$HCl + NaOH \rightarrow NaCl + HOH$

Example: What is the concentration of HCl if it takes 30.0 ml of this acid to completely neutralize 42.5 ml of .500 M NaOH? $0.500\,mol\,NaOH/L \times 0.0425\,L = 0.0212\,mol\,NaOH \times \frac{1\,mol\,HCl}{1\,mol\,NaOH} = 0.0212\,mol\,HCl$

$\frac{0.0212\,mol\,HCl}{0.0300\,L} = 0.708\,M$

How many ml of .400 M H_2SO_4 are needed to neutralize 35 ml of .200 M NaOH?

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2HOH$

$0.200\,mol\,NaOH/L \times 0.035\,L = 0.00700\,mol\,NaOH \times \frac{1\,mol\,H_2SO_4}{2\,mol\,NaOH} \times \frac{1\,L}{0.400\,mol\,H_2SO_4} \times \frac{1000\,mL}{1\,L} = 8.75\,mL$

- **Know some uses for indicators**

- **Know how to do a variety of gas law problems (refer to gas law practice sheets for review)**

- **Know how to use the equation q = m x c x ΔT to solve a variety of problems**

Example:

What is the specific heat of a metal, if 10.0 grams of the metal at a temperature of 86.0° C raises the temperature of 150.0 grams of water from 22.0°C to 23.4°C?

$q_{H_2O} = q_{metal}$

$(150.0\,g)\left(4.184\,\frac{J}{g^\circ C}\right)(1.4^\circ C) = (10.0\,g)(x)(62.6^\circ C)$

$1.40\,\frac{J}{g^\circ C} = x$