Name____

KAP Chemistry - Spring Semester Review

8. Chemical Reactions

- Balance chemical equations.
- Understand that balancing chemical equations is an application of the law of conservation of matter.
- Characterize reactions as synthesis, decomposition, double replacement, single replacement, precipitation reactions, neutralization reactions, or oxidation-reduction.
- Use memorized reaction types, solubility rules, and the activity series to predict the products of all types of reactions we have studied.
- Given the activity series of metals, predict whether single replacement reactions will occur. Know the activity order of the halogens: F > Cl > Br > I and predict whether single replacement reactions involving halides will occur based on this activity series.
- Given the solubility rules, determine whether a precipitate will form and identify the precipitate. Define soluble and insoluble, and interpret solubility rules when given a table.
- Determine oxidation numbers of atoms in compounds and polyatomic ions.

Examples:

Write the name and formula of the possible products from these combinations. Label the state of matter of all products. All take place in an aqueous solution.

a) barium chloride + silver nitrate → ______________+________________

b) sodium carbonate + iron (III) bromide→____________+______________

c) sodium hydroxide + copper (II) chloride→ ___________+_____________

Questions: **Identify** the type of reaction (S (synthesis), D (decomposition), SR (single replacement), DR (double replacement - precipitation or neutralization), C (combustion), and "O-R" (oxidation-reduction)). Some may be more than one type. **Predict** products. Identify precipitates as (s). If no reaction, indicate NR. Balance.

________1. ____ Al + _____ $CuSO_4$ →

________2. ____ P + _____ O_2 → P_2O_5

________3. ____ $HgO \xrightarrow{heat}$

________4. ____ $C_{10}H_{16}$ + _____ O_2 →

________5. ____ $Pb(NO_3)_2$ + _____ NaI →

________6. ____ Ag + $ZnCl_2$ →

________7. ____ $H_3C_6H_5O_7$ + ____$Zn(OH)_2$ →

8. What is the oxidation number for each atom in P_2O_5?

9. Stoichiometry

Questions – Some equations are not balanced!

1. What is a limiting reactant (aka reagent)? What is an excess reactant?
2. What volume in liters of oxygen is required to react completely with 2.4 liters of hydrogen to form water?
3. Using the following balanced equation,

   $$\mathbf{2\,KClO_3 \rightarrow 3O_2 + 2KCl}$$

   a. What is the mole ratio between oxygen and potassium chloride?
   b. Find the mass of $KClO_3$ needed to produce 200.g of KCl?
4. What mass in milligrams of Al is needed to react completely with 1.8 moles of FeO?

   $$\mathbf{Al + FeO \rightarrow Fe + Al_2O_3}$$

5. A 10.0 g sample of aluminum chloride decomposes. How many molecules of Cl_2 are produced?

   $$\mathbf{AlCl_3 \rightarrow Al + Cl_2}$$

6. Samples of 0.37 mol P_4H_{10}, 2.50 mol H_2O, and excess oxygen react according to this equation:

   $$\mathbf{O_2 + P_4H_{10} + H_2O \rightarrow H_3PO_4}$$

   a. Find the limiting reagent.
   b. Calculate the number of grams of product formed.
   c. Calculate the amount of excess reagent remaining.

7. What is the percent yield of Ag if 12.7g Cu produces 38.1g Ag?

$$\mathbf{Cu + AgNO_3 \rightarrow Cu(NO_3)_2 + Ag}$$

10. Gases

Vocabulary/Concepts: Kinetic Theory of Gases, pressure, vapor pressure, results of changing pressure/volume/temperature/moles, standard temperature, standard pressure,

Calculations: temperature conversions, pressure conversions, Dalton's Law, Boyle's Law, Gay-Lussacc's Law, Charles' Law, Combined Gas Law, Ideal Gas Law

Questions

1. Calculate the following conversions for pressure:
   a) 579 torr to mm Hg b) 2.4 atm to mm Hg c) 783 mm Hg to kPa
2. Convert 35.98 °C to Kelvin.
3. A gas occupies 2.00 L at 755 mm Hg. Calculate the volume it will occupy at a pressure of 1.2 atm.
4. Calculate the pressure of a 150 mL sample of hydrogen gas at 28.5°C and 805 kPa would occupy when its volume is changed to 100.0 mL and its temperature increases to 33.03°C.
5. A sample of helium gas at 27°C is heated at constant pressure to 57 ºC. Its final volume is 475 mL. What was its original volume?
6. Chorine gas is ordered by a research laboratory. The gas in the steel cylinder has a pressure of 1.30 atm and a temperature of 23°C. It is connected to an experimental apparatus where the pressure is increased to 2.045 atm. Calculate the temperature of the chlorine gas inside the experimental container.
7. A mixture of gases inside a gas cylinder is a combination of helium, oxygen and carbon dioxide. The total pressure of the mixture is 734.0 mm Hg. The partial pressure of helium is 0.67 atm and the partial pressure of oxygen is 0.003 atm. What is the partial pressure of the carbon dioxide?
8. What volume will 1.216 g of SO_2 gas occupy at 18°C and 755 mm Hg?
9. If you have three balloons at the same temperature, pressure, and volume, what can you say about the number of particles in the balloons?
10. What happens to pressure if you decrease the volume at constant temperature?

11. Bonding

Vocabulary/Concepts: electronegativity, use electronegativities to determine if bonds are ionic/polar covalent/nonpolar, covalent bonding, characteristics of ionic, covalent, and metallic compounds, relationship between bond energy and bond length, octet rule, resonance, VSEPR, electron domain geometry, molecular geometry (linear, trigonal planar, tetrahedral, bent, trigonal pyramidal), intermolecular attractions(dipole-dipole, hydrogen bonding, London dispersion)

Questions

1. NH_3 2. CO_2 3. CO_3^{2-}

For each of the above determine the:

- Lewis structure
- # e^- domains on central atom
- e^- domain geometry
- molecular geometry
- polar or nonpolar molecule

4. How many electrons are shared in a double covalent bond?
5. How many unshared pairs of electrons are there in a <u>molecule</u> of hydrogen iodide?
6. What types of elements make up an ionic compound? Covalent compound?
7. According to VSEPR theory, what influences/determines the shape of a molecule?
8. Which of the following would have the shortest bond length; single, double or triple covalent bonds? Greatest bond strength?
9. What type of intermolecular forces are present in the following: a. CH_4 b. PH_3 c. H_2O
10. Which type of compound has a high melting point and conducts electricity when dissolved in water?

12. Solutions

<u>Vocabulary/Concepts</u>:
universal solvent, solubility, solute, solvent, electrolyte/nonelectrolyte solute, solvation, rate of dissolution (surface area, agitation, temperature), solubility (nature of solute/solvent, temperature, pressure), types solutions (saturated, unsaturated, supersaturated), molarity, percent by mass, dilution, stock solution; dissociation equations, net ionic equations

<u>graph application</u>: identification of solubility and type of solution (saturated, unsaturated, supersaturated),

Questions

1. What is the molarity of a solution with 4.59 g of sodium hydroxide dissolved in 450.0 mL of solution?
2. What is the concentration of a solution that contains 3.0 moles of potassium sulfate dissolved in 2.75 L of solvent?
3. Determine the volume of 3.5 M aluminum nitrate solution needed to make a dilute solution of 50.0 mL with a molarity of 0.150 M.
4. If 25.9 g of solute dissolves in 100.0 g of water at 25.0°C then how many grams of the solute will dissolve in 225 g of water at the same temperature?
5. Describe the steps you would take to prepare a 300mL solution of 0.5M potassium chloride. How would you try to prepare a supersaturated solution?
6. Which is an electrolyte—water or tap water? Why?
7. Write the net ionic equation for hydrochloric acid and sodium hydroxide.

13. Acids and Bases

<u>Vocabulary/Concepts</u>: properties of acids/bases, nomenclature of acids and bases, what are indicators?, amphoteric, self-ionization of water and K_w, monoprotic/diprotic/triprotic, strong vs. weak acid/base, dilute vs. concentrated, pH, pOH, [H^+], [OH–], neutralization reactions, salts (neutral, acidic, basic), titration, titrant, analyte, equivalence point, endpoint.

Questions:

1. List the strong acids and strong bases.
2. Solve for the following unknowns.
   a. pH = 9.5 , [H^{1+}] = ?
   b. [H_3O^+] = 6.1 x 10^{-6} mol/L pH = ?
   c. [OH–] = 2.66 x 10^{-4} mol/L pOH = ?
   d. [H^+] = 3.33 x 10^{-12} mol/L pOH = ?
   e. pOH = 7.3 [OH^{1-}] = ?
   f. pOH = 1.04 [H^{1+}] = ?

3. Calculate the molarity of hydrochloric acid if 25.63 mL of 2.5 M $Ca(OH)_2$ is used to titrate 50.00 mL of the acid.
4. Describe HSO_4^{-1} (mono/di/tri prototic…mono/di/tribasic, etc)? Describe H_2CO_3

14. Thermochemistry

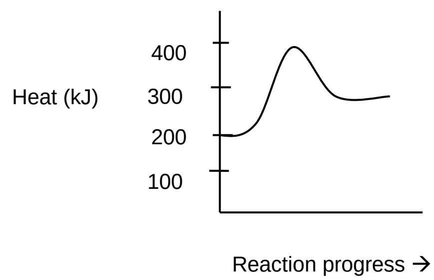
Vocabulary/Concepts: potential energy diagrams, activation energy, activated complex, catalyst, exothermic reaction, endothermic reaction, enthalpy (heat of reaction), system vs. surroundings; characterize thermochemical equations as endothermic or exothermic based on the location of heat in the equation, the sign of ΔH, reaction properties, an energy diagram, potential energies in the system. Calorimetry of physical and chemical processes, phase change curve.

Questions:

1. Which equations show endothermic reactions? ____________

   a. $SO_{3(g)}$ + heat $\leftrightarrow$ $SO_{2(g)}$ + $O_{2(g)}$
   b. $NaCl_{(aq)} \rightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)}$ ΔH = 3.87kj/mol
   c. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ ΔH = - 886 kJ/mol
   d. $NaOH \rightarrow Na^{+} + Cl^{-}$ + 445.1 kJ

2. For the potential energy diagram in the reaction shown below,
   a) What is the value of the enthalpy of reaction (give units)? ______________
   b) Is the reaction endothermic or exothermic? __________________



3. was omitted this year

4. When ammonium nitrate dissolves, 25.7 kJ/mol are absorbed by the system. How many kilojoules of energy are absorbed when 3.42 mol of ammonium nitrate dissolve?

5. Write the thermochemical equation for the heat of formation of sodium fluoride from its elements.

6. If the decomposition of one mole of aluminum oxide absorbs 1676 kJ/mol, what mass of aluminum oxide would absorb 2000. kJ of energy?

7. For the reaction $2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$ + 367.6 kJ, what is the enthalpy of reaction?

8. If a 150.0 g sample of an unidentified metal absorbs 6500. J of energy as it heats from 26.0ºC to 85.0 ºC, what is the specific heat of the metal?

9. What is the total heat change in kilojoules if 20.0 g of ice are heated from –10.0ºC to 130.0ºC?

10. was omitted this year