CHM 1010 GAGE

FINAL REVIEW QUESTIONS FOR CHM 101

Wow! It=s almost the end of the semester and you have a head full of chemical concepts. To get ready for the final exam and review those concepts work on the following material. Keep in mind that this is only a sample and does not cover every point we discussed.

1. Complete (if necessary), write in symbols (if necessary) and balance each of the following chemical equations. Indicate what type of reaction each one represents.

   $K + CuSO_4$ ---------->

   $C_3H_8O_2 + O_2$ ----------> $H_2O + CO_2$

   $S_8 + F_2$ ---------->

   $(NH_4)_2CO_3 + \Delta$ ----------> $NH_3 + H_2O + CO_2$

   $H_2SO_4 + Mg(HCO_3)_2$ ---------->

   strontium nitrate plus phosphoric acid ---------->

   magnesium chloride in water reacts with silver nitrate to form solid silver chloride and soluble magnesium nitrate

2. a. List every characteristic or piece of information you can about the element sulfur. Be sure to include all properties you can determine from the periodic table. Remember atomic structure.
   b. Sulfur can form ionic and covalent bonds. Explain why and how. Provide examples for each type of bond.

3. A gas has a volume of 380 mL at STP.
   a. What is its volume at 25^{o}C and 1.8 atm?
   b. How many moles does the sample contain?
   c. What pressure is needed to change the volume to 300 mL at standard temperature?
   d. How can you tell if the gas is really an ideal gas at all conditions?

4. Give an example of each of the following:
   a. chemical change
   b. physical property
   c. gas variable
   d. empirical and molecular formula
   i. endothermic physical process
   j. halogen
   k. homogeneous mixture
   l. diatomic element

e. element chemically similar to phosphorus
f. property unique to metals
g. compound that shows hydrogen bonding
h. exothermic chemical reaction
m. ionic compound
n. hypothesis
o. theory

5. Consider the compounds HNO_3, CH_3COOH, NaOH, NH_3, $CaCO_3$, and BF_3 in aqueous solution.
   a. Which are Arrhenius acids? Arrhenius bases?
   b. Which are considered strong and which weak?
   c. Which are Lewis acids and Lewis bases?
   d. Which would react with active metals? Which would taste bitter?
   e. Assume you had solutions of the same molarity of HNO_3, CH_3COOH, NaOH, and NH_3. Put them in order from highest to lowest pH and explain (using chemical equations) why they are in that order.

6. Consider the following reaction for the production of phosphoric acid from phosphorus pentoxide for use in fertilizer or explosive manufacture:

   $P_2O_5 + H_2O$ ----------> H_3PO_4

   a. How many grams of phosphoric acid can be made from 0.54 moles of water?
   b. How many atoms of hydrogen are needed to form 38 molecules of phosphoric acid?
   c. If you have 3.2×10^{22} molecules of water, how many grams of P_2O_5 will be needed to react with it?
   d. How many grams of phosphoric acid can be produced from 90. g of phosphorus pentoxide and 50.0 grams of water. How much of which reactant will remain?

7. Epsom salts is the common name for magnesium sulfate.
   a. If you have 35.0 grams of magnesium sulfate in 650 mL of solution, what is the g/v% and molarity of the solution?
   b. How many grams of magnesium sulfate would you need to make 750 mL of a 0.26M solution?
   c. What happens on a particle level when the magnesium sulfate dissolves in water. Would it be the same process when CH_3CH_2OH dissolves in water? Explain.

8. Explain how you could accomplish the following in the lab (or possibly at home):
   a. raise the boiling point of water without adding material
   b. lower the freezing point of water
   c. determine the molar mass of a mystery gas
   d. determine the identity of an element without using a chemical reaction
   e. determine if a substance is a compound or element

9. Complete the following table:

Substance	electron geometry	molecular geometry	polar or non-polar bonds?	Polar or non-polar molecule?	Type of Hybridization
nitrite ion					
arsenic pentachloride					
calcium oxide					
ammonia					
silicon dioxide					
boron trichloride					

10. A 1.60 gram sample of a compound contains 0.276 grams of hydrogen and 1.32 grams of carbon. The sample occupies a volume of 655 mL at 100^{o}C and 980.0 mmHg. What are the empirical and molecular formulas for the compound?

11. Ponder and answer the following questions or statements with a scientific explanation.
    a. Why does hot air rise?
    b. Water is very efficient at cooling our bodies as we sweat. Explain why.
    c. Why will a 0.1 M solution of table salt boil at a higher temperature than 0.1 M table sugar (sucrose)?
    d. Boron trifluoride and nitrogen trifluoride both have three bonds from the central atom. Do they have the same geometries? Why or why not?
    e. What happens on a particle level when water vapor at 120 degrees Celsius is cooled to minus 10 degrees Celsius?
    f. Silicon dioxide melts above 1500^{o}C while sulfur dioxide melts well below 0^{o}C. Explain why.
    g. All reactions require the input of some energy. Correct?
    h. Chemical equations have to be balanced. Why?
    i. Why did Bohr suspect that electrons moved about the nucleus in set orbits? Why did Rutherford think that the atom had a dense, positively charged nucleus?

12. A 3.50 x 10^2 g sample of a material is heated from -10^0C to gas at 80°C. How much energy is involved in the process?

mp = -5°C
bp = 80.0°C
sp.ht.$_{sol}$ = 1.5J/g °C
sp.ht.$_{liq}$ = 2.4 J/g °C
sp.ht.$_{vap}$ = 1.2 J/g °C

ΔH_{vap} = 566 J/g
ΔH_{fus} = 245 J/g

The molar mass of this compound is about 46 g/mol. Are the intermolecular forces between molecules of this compound stronger or weaker than water? Explain.

13. What are the intermolecular forces between molecules or units of each of the following compounds? Justify your answer by drawing and labeling chemical structures.

Compound	Structure and IMFs
CH_3F	
PH_3	
$CH_3CH_2CH_3$	
$CaCl_2$	
PCl_5	
CO_2	

14. Arrange the species in each set below from highest to lowest boiling point and explain they should be ordered that way:

Set	Compounds	Boiling Point Order and explanation
1	CH_4 H_2O NH_3	
2	SiH_4 GeH_4 CH_4	
3	RbBr AsH_2Br Br_2	

15. Consider a 10 L container of carbon dioxide gas at 10^oC. In the table below, indicate whether the frequency of collision of the gas particles with the walls of the container and the average kinetic energy of the particles will increase, remain the same or decrease with each change indicated and why:

Change	Average KE	Collisions
volume changed to 25 L		
number of moles doubled		
pressure decreased		
temperature changed to 30^oC		