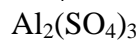
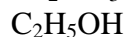
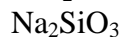
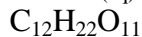
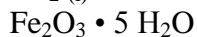


Chemistry 20

Lesson 36 – The Whole Enchilada

Unit I: Science 10 Review

1. Classify the substances as ionic (i), molecular (m), or acid (a) and provide the IUPAC name and the state of matter at SATP where required.



2. Provide a chemical formula for each of the substances and include the SATP state of matter as part of the formula.

hydrochloric acid

iron (II) sulfide

dinitrogen tetrahydride

sulfur trioxide

calcium hydrogen carbonate

sodium carbonate decahydrate

aluminum hydrogen sulfate

magnesium phosphate

3. For each of the following classify the reaction type and predict the balanced chemical equation.

a. Chlorine gas is bubbled into a sodium iodide solution.

b. Equal amounts of hydrochloric acid and aqueous sodium hydroxide are mixed.

c. Propane from a torch burns in air.

d. A piece of strontium metal is placed in water.

e. Aluminum metal is added to a copper (II) sulfate solution.

f. Nitrogen triiodide is broken down into its elements.

4. Calculate the molar mass of each of these substances.
- | | |
|-----------------------------------|----------------------------|
| a. CaCO_3 | d. I_2 |
| b. $(\text{NH}_4)_2\text{SO}_4$ | e. H_3PO_4 |
| c. $\text{C}_3\text{H}_6\text{O}$ | f. N_2O_5 |
5. Find the mass of each of these substances.
- a. 2.40 mol NaOH
- b. 3.21×10^3 mol Ni
- c. 0.780 mol $\text{Ca}(\text{CN})_2$
- d. 7.00 mol H_2O_2
6. How many moles of each of the following?
- a. 0.800 g Ca
- b. 79.3 g Cl_2
- c. 5.96 g KOH
- d. 937 g $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$

Unit II: Solutions

1. Explain the following terms as applied to solutions.
- | | |
|---------------------|----------------|
| a. solute | f. ionization |
| b. solvent | g. saturated |
| c. electrolytes | h. unsaturated |
| d. non electrolytes | i. solubility |
| e. dissociation | j. miscible |
2. Suppose you are given four, unlabelled beakers, each containing a colorless aqueous solution of one solute. The possible solutions are $\text{NaCl}_{(\text{aq})}$, $\text{HCl}_{(\text{aq})}$, $\text{Ba}(\text{OH})_{2(\text{aq})}$, and $\text{CH}_3\text{Cl}_{(\text{aq})}$. Write a series of diagnostic tests to distinguish each solution from the others.

3. Write dissociation or ionization equations for the following pure substances dissolving in water.
 - a. lithium sulfate
 - b. nitric acid
 - c. aluminum sulfate

4. Make a list of the major entities present when the following substances are placed in water.

a. sodium benzoate	e. hydrogen acetate
b. strontium hydroxide	f. copper (II) chloride
c. hydrogen nitrate	g. silver chloride
d. propane	h. methanol

5. Predict the formula or write the IUPAC name for the following acids.

a. hydrofluoric acid	b. $\text{HI}_{(\text{aq})}$
c. $\text{H}_3\text{BO}_3_{(\text{aq})}$	d. oxalic acid
e. carbonic acid	f. $\text{HNO}_2_{(\text{aq})}$

6. Classify the following solutions as acidic, basic, or neutral.

a. $\text{pH} = 8$	c. $\text{pH} = 3$
b. $[\text{H}^+_{(\text{aq})}] = 10^{-7} \text{ mol/L}$	d. $[\text{H}^+_{(\text{aq})}] = 10^{-10} \text{ mol/L}$

7. Calculate the pH of the following solutions.

a. $[\text{H}^+_{(\text{aq})}] = 6.54 \times 10^{-5} \text{ mol/L}$	c. $[\text{OH}^-_{(\text{aq})}] = 7.2 \times 10^{-12} \text{ mol/L}$
b. $[\text{OH}^-_{(\text{aq})}] = 8.93 \times 10^{-3} \text{ mol/L}$	d. $[\text{H}^+_{(\text{aq})}] = 1.91 \times 10^{-13} \text{ mol/L}$

8. Calculate the pOH of the following solutions.

a. $[\text{H}^+_{(\text{aq})}] = 6.54 \times 10^{-5} \text{ mol/L}$	c. $[\text{OH}^-_{(\text{aq})}] = 7.2 \times 10^{-12} \text{ mol/L}$
b. $[\text{OH}^-_{(\text{aq})}] = 8.93 \times 10^{-3} \text{ mol/L}$	d. $[\text{H}^+_{(\text{aq})}] = 1.91 \times 10^{-13} \text{ mol/L}$

9. Calculate the concentration of the following solutions.
 - a. 0.060 mol of NaHCO_3 in 1500 mL of solution.
 - b. 400 g of CuSO_4 in 4.00 L of solution.

10. Calculate the mass of solute in each solution.
 - a. 500 mL of 2.0 mol/L KNO_3
 - b. 250 mL of 0.10 mol/L CaCl_2
11. Calculate the mass of solute required to make the following.
 - a. 2.5 L of a 0.90 % W/V NaCl solution.
 - b. 50 mL of 4.0 % W/V MgCl_2 solution.
12. What is the % W/V of the following solutions?
 - a. 20 g KCl in 600 mL of solution
 - b. 32 g NaNO_3 in 2.0 L of solution.
13. Magnesium hydroxide is a low-solubility ionic compound. What mass of solute is needed to prepare 100 mL of 0.154 mmol/L of magnesium hydroxide solution?
14. An ammonia solution is made by diluting 150 mL of 14.8 mol/L concentrated commercial reagent until the final volume reaches 1.00 L. What is the final molar concentration?
15. A mechanic wishes to prepare 500 mL of a 3.75 mol/L solution of sulfuric acid to add to a car battery. What volume of the 17.8 mol/L concentrated solution is required?
16. What is the molar concentration of the cation and the anion in a 0.18 mol/L solution of each of the following chemicals?
 - a. potassium nitrate
 - b. calcium chloride
 - c. ammonium phosphate

Unit III: Gas Laws

1. Complete the following statements about gases.
 - a. At a constant temperature, as the pressure increases, the volume of gas
 - b. At a constant pressure, as the temperature decreases, the volume of gas
 - c. At a constant volume and temperature, if the amount of gas inside a container is increased, the pressure.
2. A 1.5 L volume of gas is compressed at a constant temperature from 1.0 atm to 5.0 atm. What is the final volume?

- A balloon can hold 800 mL of air before breaking. A balloon at 4.0°C containing 750 mL of air is brought into a house at 25.0°C. Assuming a constant pressure inside and outside the balloon, will the balloon break?
- A sample of argon gas at 101 kPa and 22.0°C occupies a volume of 150 mL. What is the new volume if the pressure is changed to 91.5 kPa and the temperature is increased to 150°C?
- What volume would 25.0 g of oxygen gas at 22.0°C and 98.1 kPa occupy?
- Compare the volume that 0.278 mol of hydrogen would occupy at STP and SATP.
- What mass of chlorine gas would occupy 86.0 L at SATP?

Unit IV: Stoichiometry

- Carbon disulfide is an important industrial solvent. It is prepared by the reaction of coke with sulfur dioxide.

$$5 \text{C}_{(\text{s})} + 2 \text{SO}_{2(\text{g})} \rightarrow \text{CS}_{2(\text{s})} + 4 \text{CO}_{(\text{g})}$$
 - How many moles of $\text{CS}_{2(\text{s})}$ form when 6.30 mol of $\text{C}_{(\text{s})}$ reacts?
 - How many moles of carbon are needed to react with 7.24 mol of $\text{SO}_{2(\text{g})}$?
- Methanol is used in the production of many chemicals. Methanol is made by reacting carbon monoxide and hydrogen at high temperature and pressure.
 - Write the balanced chemical reaction.
 - How many moles of each reactant are needed to form 600 g of methanol?
 - How many grams of hydrogen gas are necessary to react with 5.74 mol of $\text{CO}_{(\text{g})}$?
- In a hard water analysis, a calcium chloride solution is reacted with excess aqueous sodium oxalate to produce 0.452 g of a precipitate. Determine the mass of calcium chloride present in the original solution.
- Powdered aluminum metal is one of the fuels used in the solid rocket boosters for the NASA Space Shuttle. What volume of oxygen at SATP is required to react completely with 100 kg of aluminum?
- A portable hydrogen generator uses the reaction of calcium hydride and water to form calcium hydroxide and hydrogen. What volume of hydrogen at 96.5 kPa and 22.0°C can be produced from a 50.0 g cartridge of $\text{CaH}_{2(\text{s})}$?

- A volumetric analysis shows that it takes 32.0 mL of 2.12 mol/L $\text{NaOH}_{(\text{aq})}$ to neutralize 10.0 mL of sulfuric acid from a car battery. Calculate the molar concentration of sulfuric acid in the battery solution.
- A 250 mL sample of $\text{Na}_2\text{SO}_{4(\text{aq})}$ is reacted with an excess of $\text{BaCl}_{2(\text{aq})}$. If 5.28 g of precipitate is formed, what is the molar concentration of the $\text{Na}_2\text{SO}_{4(\text{aq})}$?
- Complete the analysis of the following investigation report.

Problem

What is the molar concentration of an unknown sodium carbonate solution?

Experimental Design

Samples of sodium carbonate solution were titrated with a standardized hydrochloric acid solution using methyl orange as the indicator

Evidence

Titration of 25.0 mL Samples of $\text{Na}_2\text{CO}_{3(\text{aq})}$ with 0.352 mol/L $\text{HCl}_{(\text{aq})}$

Trial	1	2	3	4
Final buret reading (mL)	16.5	31.8	47.0	16.4
Initial buret reading (mL)	0.6	16.5	31.8	1.2

Analysis

- How many milliliters of 2.50 mol/L $\text{HNO}_{3(\text{aq})}$ is required to dissolve an old copper penny with a mass of 3.94 g according to the following unbalanced equation?

$$\text{Cu}_{(\text{s})} + \text{HNO}_{3(\text{aq})} \rightarrow \text{Cu}(\text{NO}_3)_{2(\text{aq})} + \text{NO}_{(\text{g})} + \text{H}_2\text{O}_{(\text{l})}$$
- Hydrazine, $\text{N}_2\text{H}_{4(\text{g})}$, is used as a rocket fuel. It reacts with oxygen to form nitrogen and water vapor. How many liters of nitrogen (at STP) form when 1.0 kg of hydrazine reacts with 1.0 kg of oxygen?

Unit V: Bonding

- What is the basic idea behind all types of bonds?
- Based on general reactivity trends in the periodic table, list the elements from least active to most active for
 - Group 1
 - Groups 1 to 6, Period 4
 - Group 17

3. For each of the following elements, draw an electron dot diagram, list the group numbers, and list the numbers of valence electrons, lone pairs and bonding electrons.
 - a. calcium
 - b. aluminum
 - c. arsenic
 - d. oxygen
 - e. bromine
 - f. neon
4. Using electron dot diagrams of atoms and ions, write the formation equation for each of the following compounds.
 - a. sodium oxide
 - b. calcium fluoride
5. Write oxidation and reduction half-reaction equations and the net reaction equation to explain the following chemical reactions.
 - a. $2 \text{K}_{(s)} + \text{Br}_{2(l)} \rightarrow 2 \text{KBr}_{(s)}$
 - b. $2 \text{Sr}_{(s)} + \text{O}_{2(g)} \rightarrow 2 \text{SrO}_{(s)}$
6. The most common oxides of Period 2 elements are as follows:
 $\text{Na}_2\text{O}, \text{MgO}, \text{Al}_2\text{O}_3, \text{SiO}_2, \text{P}_2\text{O}_5, \text{SO}_2, \text{Cl}_2\text{O}$
 - a. Which oxides are classified as ionic and which are classified as molecular?
 - b. Calculate the difference in electronegativity between the two elements in each oxide.
 - c. How is the difference in electronegativity related to the properties of the compound?
- *7. Determine the molecular formula for nicotine from the following evidence.
 molar mass = 162.24 g/mol
 percentage by mass of carbon = 74.0%
 percentage by mass of hydrogen = 8.7%
 percentage by mass of nitrogen = 17.3%
8. Arrange the following intramolecular and intermolecular bonds in order from weakest to strongest.

hydrogen bond, polar covalent bond, London dispersion forces, ionic bond, nonpolar covalent bond

9. Explain the following observations in terms of intra/intermolecular bonds:
- The boiling point of fluorine is significantly less than that of chlorine.
 - Water will not remove a grease stain from a tablecloth.
 - Sodium chloride melts at a much higher temperature than wax.
 - Drops of ethanol are attracted to a charged strip.
 - Ice has a regular hexagonal structure.

10. Complete the following table:

Formula	Lewis Diagram	Structural Diagram	Shape Name(s)	Intermolecular Forces
CH ₄				
NCl ₃				
CO ₂				
C ₂ H ₄				
H ₂ O				
SiCl ₄				
OCl ₂				
CHClBr ₂				
CH ₃ Cl				
C ₂ H ₂				
NI ₃				

Formula	Lewis Diagram	Structural Diagram	Shape Name(s)	Intermolecular Forces
C_2Cl_4				
C_3H_6				
C_3H_6O				
$C_2H_4(OH)_2$				
CH_3COOH				
NH_3				
CF_4				
CH_3OH				
H_2O_2				

You have officially finished the Chemistry 20 course ... it's party time!!!