THE UNIVERSITY OF ZAMBIA
SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF CHEMISTRY
2018 ACADEMIC YEAR
TERM 1
CHE1000: INTRODUCTION TO CHEMISTRY

ASSIGNMENT 2: **4th April 2019**

Answer **ALL** questions in your **tutorial book** and submit in **Room 124** before **12:00hrs** on **Monday, 8th April 2019**

1. An expert analyzed a gaseous compound which showed that it contained 33.0 %Si and 67.0% F by mass. At 35°C, 0.210 L of the compound exerted apressure of 1.70 atm. If the mass of 0.210 L of the compound was 2.38 g, calculate themolecular formula of the compound.

2. In an experiment to identify unknown sample A, B and C, you performed a series of experiments. In experiment 1, you filled a glass container (658.572 g) with nitrogen gas at a pressure of 790 torr and 15°C and found the mass to be 659.452 g. After evacuating the container and refilling with a certain element (**A**) at a pressure of 745 torr and a temperature of 26°C, mass was 660.59 g. In experiment 2, you placed compound **B**, a gas that consists of 85.6% C and 14.4% H by mass, in a stainless steel vessel (10.68 L) with excess oxygen gas. The vessel was maintained at 22°C with internal pressure of 11.98 atm. At the bottom of the steel vessel was a container packed with a paste sodium hydroxide which **quantitatively** absorbs carbon dioxide and the desiccant (anhydrous magnesium perchlorate) which quantitatively absorbs the water produced by the combustion reaction as well as the water produced by the following reaction:

$$2NaOH(s) + CO_2(g) \rightarrow Na_2CO_3(s) + H_2O(l)$$

Neither NaOH nor the desiccant reacts with gas **B** or oxygen. The total mass of the container with the NaOH and desiccant is 765.3 g. After combustion reaction of gas **B** is initiated ,the pressure immediately rises, then begins to decrease, and finally reaches a steady value of 6.02 atm. The stainless steel vessel is carefully opened, and the mass of the container inside the vessel is found to be 846.7 g. **A** and **B** react quantitatively in a 1:1 mole ratio to form one mole of the single product, gas **C**.

   a) How many grams of C will be produced if 10.0 L A and 8.60 L B (**each at STP**) are reacted by opening a stopcock connecting the two samples?

   b) What will be the total pressure in the system? Assume ideal gas conditions in each case.

3. The vanadium in a sample of ore is converted to VO^{2+}. The VO^{2+} ion is subsequently titrated with MnO_4^- in acidic solution to form $V(OH)_4^+$ and manganese (II) ion. The unbalanced titration reaction is

$$MnO_4^-(aq) + VO^{2+}(aq) + H_2O(l) \rightarrow V(OH)_4^+(aq) + Mn^{2+}(aq) + H^+(aq)$$

To titrate the solution, 26.45 mL of 0.02250 M $MnO4^-$ was required. If the mass percent of vanadium in the ore was 58.1%, what was the mass of the ore sample?

* Pay attention to units.
* Emphasise on Units

4. The mass percentage of dry air at sea level is approximately N_2 = 75.5 %, O_2 = 23.2 %, Ar = 1.3 %. Calculate the partial pressure of each component when the total pressure is 1 bar.

5. Calculate the pressure for 10 mol CO_2 gas in 1 litre container at 800 K using ideal gas equation and Van der Waals equation to account for non-ideal behavior. [For CO_2: a= 3.59 atm L^2 mol^{-2} ; b = 0.0427 l mol^{-1}]

6. A given volume of N_2 requires 68.3 seconds to effuse from a hole into a vacuum chamber. Under same conditions another unknown gas required 85.6 seconds for the same volume to effuse. Calculate the molar mass of gas and identify it.