

THE UNIVERSITY OF ZAMBIA
SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF CHEMISTRY
2018 ACADEMIC YEAR

TERM 1

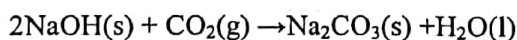
CHE1000: INTRODUCTION TO CHEMISTRY

ASSIGNMENT 2:

4th April 2019

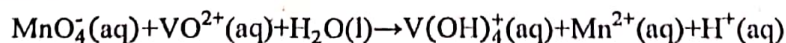
Answer ALL questions in your tutorial book and submit in Room 124 before 12:00hrs on Monday, 8th April 2019

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 a pressure of 1.70 atm. If the mass of 0.210 L of the compound was 2.38 g, calculate the molecular 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:



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 $\text{V}(\text{OH})_4^+$ and manganese (II) ion. The unbalanced titration reaction is



To titrate the solution, 26.45 mL of 0.02250 M MnO_4^- 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.
* Emphasis 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 : $a = 3.59 \text{ atm L}^2 \text{ mol}^{-2}$; $b = 0.0427 \text{ l mol}^{-1}$]
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.

