**THE UNIVERSITY OF ZAMBIA**
**SCHOOL OF NATURAL SCIENCES**
**DEPARTMENT OF CHEMISTRY**
**ACADEMIC YEAR 2022**
**TERM 1**
**CHE 1000: INTRODUCTORY CHEMISTRY**

**ASSIGNMENT SHEET 1** **14th April 2023**

**Answer all the problems in a HARD COVER book and submit in ROOM 124 before 10:00 hrs on Monday, 19th April 2023**

1. The major air pollutant of coal-burning power plants is a colorless, pungent gaseous compound containing only sulfur and oxygen. Chemical analysis of a 1.078 g sample of this gas showed that it contained 0.540 g of S and 0.538 g of O. What is the empirical formula of this compound?
2. A piece of iron ore is found to contain a compound containing 72.3% iron and 27.7% oxygen with a molecular mass of 231.4 g/mol. What is the molecular formula of the compound?
3. An ace chemistry student heats a piece of iron (Fe) metal in a crucible. The reaction is:

$$Fe(s) + O_2(g) \rightarrow Fe_xO_y(s)\ .$$

Complete the data below. Determine the empirical formula of iron oxide.

| | |
|---|---|
| Mass of crucible | 27.50 g |
| Mass of crucible + Fe | 28.62 g |
| Mass of Fe | |
| Mass of crucible +iron oxide | 29.10 g |
| Mass of iron oxide | |
| Moles of Fe | |
| Mass of oxygen | |
| Moles of oxygen | |

4. Silver nitrate solution is added to 25.00 mL of a 0.500 M potassium chloride solution until no more precipitate forms. What mass of silver chloride will be formed?
5. Calculate the number of moles of $CuSO_4$ contained in 100mL of 1 M $CuSO_4$ solution. Calculate the number of $SO_4^{-2}$ ions in $CuSO_4$.
6. What volume of a 0.01 M sodium carbonate solution is required to neutralise 25 $cm^3$ of a solution containing 0.98 g $l^{-1}$ of sulfuric acid? The equation for the reaction is

$$H_2SO_{4(aq)} + Na_2CO_{3(aq)} \rightarrow Na_2SO_{4(aq)} + H_2O_{(l)} + CO_{2(g)}$$

7. What would be the limiting reagent if 75 grams of $C_2H_3Br_3$ reacted with 50.0 grams of $O_2$ in the following reaction:

$$4C_2H_3Br_3 + 11O_2 \rightarrow 8CO_2 + 6H_2O + 6Br_2.$$

8. Suppose 316.0 g aluminium sulphide reacts with 493.0 g of water. What mass of the excess reactant remains?

$$Al_2S_3 + H_2O \rightarrow Al(OH)_3 + H_2S$$

9. How many grams of $IF_5$ would be produced using 44.01 grams of $I_2O_5$ and 101.0 grams of $BrF_3$?

$$6I_2O_5 + 20BrF_3 \rightarrow 12IF_5 + 15O_2 + 10Br_2$$

10. Hydrogen cyanide is produced industrially from the reaction of gaseous ammonia, oxygen and methane:

$$2NH_3(g) + 3O_2(g) + 2CH_4(g) \rightarrow 2HCN(g) + 6H_2O(g)$$

If 5.00 x $10^3$ kg each $NH_3$, $O_2$ and $CH_4$ are reacted, what mass of HCN and of $H_2O$ will be produced, assuming 100% yield?

11. A sample of 1.00L of $C_2H_2$ at a temperature of 373.15 K and pressure of 1.00 atmospheres reacted completely with oxygen according to the reaction:

$$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(g)$$

(a) Use the ideal gas equation to calculate the initial moles of $C_2H_2$
(b) Determine the moles of $CO_2$ and $H_2O(g)$ produced
(c) Given that the total volume of the gas mixture at the end of the reaction was 3.00 L at a total pressure 1.00 atmospheres. Calculate the partial pressure of Carbon dioxide and water.

12.

(a) The cylinder of a bicycle pump has a volume of 1131 $cm^3$ and is filled with air at a pressure of 1.02 atm. The outlet valve is sealed shut, and the pump handle is pushed down until the volume of the air is 517 $cm^3$. The temperature of the air trapped inside does not change. Compute the pressure inside the pump.
(b) At some point during its ascent, a sealed weather balloon initially filled with helium at a fixed volume of 1.0 x $10^4$ L at 1.00 atm and 30°C reaches an altitude at which the temperature is -10°C yet the volume is unchanged. Calculate the pressure at that altitude.
(c) What mass of Helium gas is needed to fill a weather balloon to a volume of 10,000 L, 1.00 atm and 30˚C?

13.

(a) Calculate the density of gaseous hydrogen at a pressure of 1.32 atm and a temperature of -66 °F.
(b) A hydrocarbon is burned in air in a closed container, producing a mixture of gases having a total pressure of 3.34 atm. Analysis of the mixture shows it to contain 0.340 g of water vapor, 0.792 g of carbon dioxide, 0.288 g of oxygen, 3.790 g of

nitrogen, and no other gases. Calculate the mole fraction and partial pressures of carbon nitrogen and water vapor in this mixture.

14.

(a) At a certain speed, the root-mean-square-speed of the molecules of hydrogen in a sample of gas is 1055 $ms^{-1}$. Compute the root-mean square speed of molecules of oxygen at the same temperature.

(b) A gas mixture contains equal numbers of molecules of $N_2$ and $SF_6$. A small portion of it is passed through a gaseous diffusion apparatus. Calculate how many molecules of $N_2$ are present in the product of gas for every 100 molecules of $SF_6$.