

# **GENSET EDUCATION ACADEMY**

**CHEMISTRY 1000**

**ASSIGNMENT SHEET 1 SOLUTIONS**

**COMPILED BY TUTOR POUL**

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# TUTOR POUL SOLUTIONS

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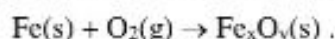
**THE UNIVERSITY OF ZAMBIA  
SCHOOL OF NATURAL SCIENCES  
DEPARTMENT OF CHEMISTRY  
ACADEMIC YEAR 2022  
TERM 1  
CHE 1000: INTRODUCTORY CHEMISTRY**

**ASSIGNMENT SHEET 1**

**14<sup>th</sup> April 2023**

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



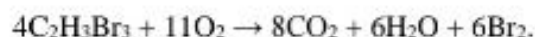
Complete the data below. Determine the empirical formula of iron oxide.

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	

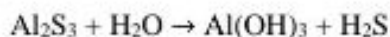
4. Silver nitrate solution is added to 25.00 mL of a 0.500 M potassium chloride solution until no more precipitate forms. What mass of silver chloride will be formed?
5. Calculate the number of moles of  $\text{CuSO}_4$  contained in 100mL of 1 M  $\text{CuSO}_4$  solution. Calculate the number of  $\text{SO}_4^{2-}$  ions in  $\text{CuSO}_4$ .
6. What volume of a 0.01 M sodium carbonate solution is required to neutralise 25 cm<sup>3</sup> of a solution containing 0.98 g l<sup>-1</sup> of sulfuric acid? The equation for the reaction is



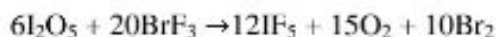
7. What would be the limiting reagent if 75 grams of  $C_2H_3Br_3$  reacted with 50.0 grams of  $O_2$  in the following reaction:



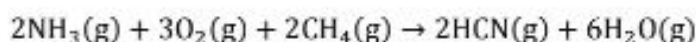
8. Suppose 316.0 g aluminium sulphide reacts with 493.0 g of water. What mass of the excess reactant remains?



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



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



If  $5.00 \times 10^3$  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:



- (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  $1131 \text{ cm}^3$  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  $517 \text{ cm}^3$ . 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  $1.0 \times 10^4$  L at 1.00 atm and  $30^\circ\text{C}$  reaches an altitude at which the temperature is  $-10^\circ\text{C}$  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  $30^\circ\text{C}$ ?
- 13.
- (a) Calculate the density of gaseous hydrogen at a pressure of 1.32 atm and a temperature of  $-66^\circ\text{F}$ .
- (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  $1055 \text{ ms}^{-1}$ . Compute the root-mean square speed of molecules of oxygen at the same temperature.
- (b) A gas mixture contains equal numbers of molecules of  $\text{N}_2$  and  $\text{SF}_6$ . A small portion of it is passed through a gaseous diffusion apparatus. Calculate how many molecules of  $\text{N}_2$  are present in the product of gas for every 100 molecules of  $\text{SF}_6$ .



## QUESTION 2

\* first find the Empirical Formula

Element $\Rightarrow$	Iron Fe		Oxygen O	$\frac{Mr(Fe)}{Mr(O_2)} = 56$ $Mr(O_2) = 16$
mass % $\Rightarrow$	72.3	:	27.7	
moles $\Rightarrow$	$\frac{72.3}{56}$	:	$\frac{27.7}{16}$	
	1.29107143	:	1.73125	
Ratio $\Rightarrow$	$\frac{1.29107143}{1.29107143}$	:	$\frac{1.73125}{1.29107143}$	
	1	:	1.34094052	
	3 (1	:	1.3)	
	3	:	3.9	
	3	:	4	

②

$\Rightarrow$  Empirical formula is Fe<sub>3</sub>O<sub>4</sub>

\* Let's find the molecular formula Now.

$$\text{factor} = \frac{\text{molar mass}}{\text{Empirical mass}}$$

\* Empirical mass (Fe<sub>3</sub>O<sub>4</sub>)  
 $(56 \times 3) + (4 \times 16)$   
 $\Rightarrow$  232

Molar Mass = 231.4 g/mol

$$\text{factor} = \frac{231.4}{232} = 0.99741 \approx 1$$

$$\begin{aligned} \therefore \text{Molecular formula} &= (\text{Empirical formula})_{\text{factor}} \\ &= (\text{Fe}_3\text{O}_4)_1 \\ &= \underline{\underline{\text{Fe}_3\text{O}_4}} \end{aligned}$$

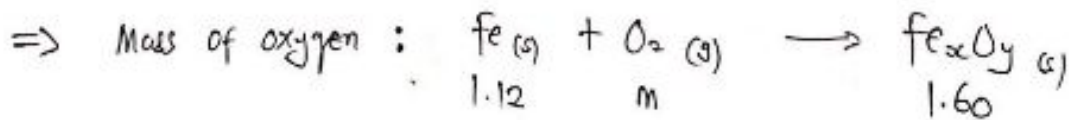
### QUESTION 3

(2)

$$\begin{aligned} \Rightarrow \text{Mass of Fe} &= (\text{Mass of crucible + Fe}) - (\text{mass of crucible}) \\ &= 28.62 - 27.50 \\ &= \underline{\underline{1.12\text{g}}} \end{aligned}$$

$$\begin{aligned} \Rightarrow \text{Mass of iron oxide} &= (\text{Mass of crucible + iron oxide}) - (\text{mass of crucible}) \\ &= 29.10 - 27.50 \\ &= \underline{\underline{1.60\text{g}}} \end{aligned}$$

$$\begin{aligned} \Rightarrow \text{Moles of Fe} &= \frac{\text{mass}}{\text{m.mass}} \\ &= \frac{1.12}{56} = \underline{\underline{0.02\text{ moles}}} \end{aligned}$$

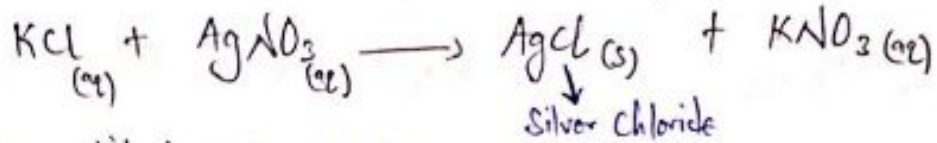


$$\begin{aligned} \therefore \text{Mass of oxygen} &= \text{Mass of iron oxide} - \text{Mass of iron} \\ &= 1.60 - 1.12 \\ &= \underline{\underline{0.48\text{g}}} \end{aligned}$$



## QUESTION 4

\* Let's write the balanced chemical equation.



\* Silver Nitrate is in excess.

\* Potassium Chloride is the limiting reagent

$$\text{moles of KCl} \Rightarrow \text{Concentration} \times \text{Volume}$$

$$= 0.500 \times \left(\frac{25}{1000}\right) \leftarrow \text{convert to litres}$$

$$= \underline{\underline{0.0125 \text{ moles}}}$$

\* Get mole ratio from the equation and find moles for AgCl formed.

$$\begin{array}{ccc} \text{moles ratios} & \text{KCl} & : & \text{AgCl} \\ & 1 & : & 1 \end{array}$$

⑤

$$\begin{aligned} \text{moles AgCl} &= 0.0125 \times \frac{1 \text{ mol AgCl}}{1 \text{ mol KCl}} \\ &= \underline{\underline{0.0125 \text{ moles}}} \end{aligned}$$

\* To find the mass, use the moles and the molar mass from the periodic table.

$$\text{moles (AgCl)} = 0.0125 \text{ moles} \quad \text{Mr (AgCl)} = 143.4 \text{ g}$$

$$\text{moles} = \frac{\text{mass}}{\text{m. mass}}$$

$$\begin{aligned} \text{mass} &= \text{moles} \times \text{m. mass} \\ &= 0.0125 \times 143.4 \end{aligned}$$

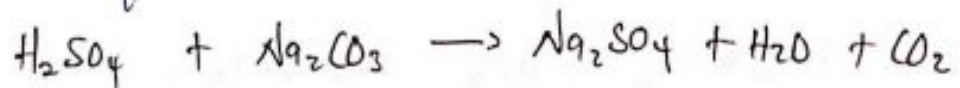
$$= 1.7925$$

$$= \underline{\underline{1.79 \text{ g}}}$$



## QUESTION 6

\* Balance the equation below



$$\text{moles} = \text{Conc} \times \text{Volume}$$

$$M_r(\text{H}_2\text{SO}_4) = 98.079$$

\* Find moles of  $\text{H}_2\text{SO}_4$

$$\text{moles}(\text{H}_2\text{SO}_4) = \text{Conc} \times \text{Volume}$$

$$= \left( \frac{0.98}{98.079} \right) \times \left( \frac{25}{1000} \right)$$

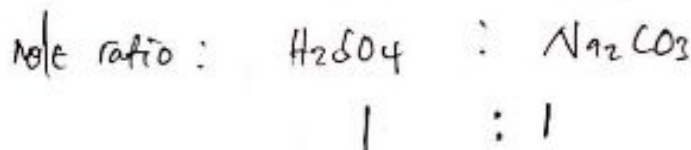
$$= 0.00999 \times 0.025$$

$$= 0.0024975$$

$$= \underline{\underline{0.00025 \text{ moles}}}$$

①

\* Get mole ratio from the equation.



$$\therefore \text{moles}(\text{H}_2\text{SO}_4) = \text{moles}(\text{Na}_2\text{CO}_3) = \underline{\underline{0.00025 \text{ moles}}}$$

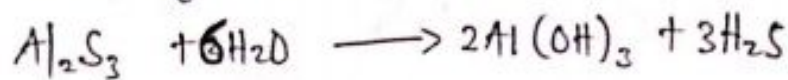
$$\text{moles}(\text{Na}_2\text{CO}_3) = 0.00025 \text{ moles} \quad \text{Conc}(\text{Na}_2\text{CO}_3) = 0.01 \text{ M}$$

$$\begin{aligned} \text{Volume} &= \frac{\text{moles}}{\text{Conc}} \\ (\text{Na}_2\text{CO}_3) &= \frac{0.00025}{0.01} \\ &= 0.024975 \text{ L} \\ &= 0.024975 \times 1000 \\ &= 24.975 \\ &= \underline{\underline{25 \text{ cm}^3}} \end{aligned}$$



## QUESTION 3

\* write balanced equation.



\* moles  $\text{Al}_2\text{S}_3$

$$\text{mass (Al}_2\text{S}_3) = 316\text{g}$$

$$\text{Mr}(\text{Al}_2\text{S}_3) = 150\text{g/mol}$$

$$n = \frac{\text{mass}}{\text{Mr}}$$

$$= \frac{316}{150}$$

$$= 2.1066667\text{ mol}$$

①

\* moles of  $\text{H}_2\text{O}$

$$\text{mass}(\text{H}_2\text{O}) = 493\text{g}$$

$$\text{Mr}(\text{H}_2\text{O}) = 18\text{g/mol}$$

$$n = \frac{\text{mass}}{\text{Mr}}$$

$$= \frac{493}{18}$$

$$= 27.388889\text{ mol}$$

\* Get mole ratio from the equation

mole ratio of  $\text{Al}_2\text{S}_3$  :  $\text{H}_2\text{O}$

1 : 6

$$2.1066667\text{ mol } \cancel{\text{Al}_2\text{S}_3} \times \frac{6\text{ mol } \text{H}_2\text{O}}{1\text{ mol } \cancel{\text{Al}_2\text{S}_3}}$$

12.64 mol of Water

$\therefore$  2.1066667 mol  $\text{Al}_2\text{S}_3$  need 12.64 mol of  $\text{H}_2\text{O}$ .

$\Rightarrow$  But in the question we have more than 12.64 mol of water (27.389 mol). Water is in Excess:

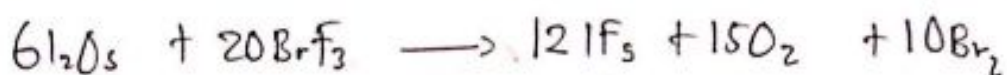
$$\text{Excess Water} = \text{water available} - \text{Water reacted}$$

$$= 27.388889 - 12.64$$

$$= 14.7\text{ g}$$

## QUESTION 9

\* Write the balance chemical equation.



FIND THE LIMITING REAGENT

\* finding moles of  $\text{I}_2\text{O}_5$

$$\text{mass}(\text{I}_2\text{O}_5) = 44.01 \text{ g}$$

$$\text{Mr}(\text{I}_2\text{O}_5) = 334 \text{ g/mol}$$

$$n = \text{mass} / \text{Mr}$$

$$= 44.01 / 334$$

$$= 0.13176647 \text{ mol}$$

0.13176647 mol

\* finding moles of  $\text{BrF}_3$

$$\text{mass}(\text{BrF}_3) = 101.0 \text{ g}$$

$$\text{Mr}(\text{BrF}_3) = 137 \text{ g/mol}$$

$$n = \text{mass} / \text{Mr}$$

$$= 101 / 137$$

$$= 0.73722628 \text{ mol}$$

0.73722628 mol

\* Get mole ratio from the equation.

mole ratio of  $\text{I}_2\text{O}_5$  :  $\text{BrF}_3$

6 : 20

$$0.13176647 \text{ mol } \cancel{\text{I}_2\text{O}_5} \times \frac{20 \text{ mol } \text{BrF}_3}{6 \cancel{\text{ mol } \text{I}_2\text{O}_5}}$$

$$0.43922156 \text{ mol of } \text{BrF}_3$$

0.43922156 mol

$\therefore$  0.13176647 mol of  $\text{I}_2\text{O}_5$  needs 0.43922156 mol of  $\text{BrF}_3$

$\Rightarrow$  But in the question, we have more than 0.43922156 moles of  $\text{BrF}_3$  (0.73722628 mol).  $\text{BrF}_3$  is in excess.

$\therefore$   $\text{I}_2\text{O}_5$  is the limiting reagent

$\Rightarrow$  we can use its relation to find how many grams of  $\text{IF}_5$  are produced.

\* Get mole ratio from the equation

mole ratio of  $\text{I}_2\text{O}_5$  :  $\text{IF}_5$   
6 : 12

$$0.13176647 \text{ mol } \cancel{\text{I}_2\text{O}_5} \times \frac{12 \text{ mol } \text{IF}_5}{6 \cancel{\text{ mol } \text{I}_2\text{O}_5}}$$

$$\underline{\underline{0.26353293 \text{ mol of } \text{IF}_5}}$$

$$\text{moles } (\text{IF}_5) = 0.26353293 \quad \text{Mr}(\text{IF}_5) = 222 \text{ g/mol}$$

(11)

$$\text{Mass} = \text{moles} \times \text{Molar Mass}$$

$$= n \times \text{Mr}$$

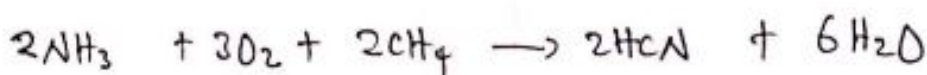
$$= 0.26353293 \times 222$$

$$= 58.5043114$$

$$\text{Mass}(\text{IF}_5) = \underline{\underline{58.5 \text{ g}}}$$

## QUESTION 10

\* write the balanced chemical equation.



⇒ FIND THE LIMITING REAGENT.

moles of  $\text{NH}_3$

$$m = 5.00 \times 10^3 \times 10^3 \text{g}$$

$$M_r = 17 \text{ g/mol}$$

$$n = \frac{\text{mass}}{M_r}$$

$$= \frac{5 \times 10^6}{17}$$

$$= 0.29411765 \times 10^6$$

$$= \underline{\underline{294,117.65 \text{ mols}}}$$

moles of  $\text{O}_2$

$$m = 5.00 \times 10^3 \times 10^3 \text{g}$$

$$M_r = 32 \text{ g/mol}$$

$$n = \frac{\text{mass}}{M_r}$$

$$= \frac{5 \times 10^6}{32}$$

$$= 0.15625 \times 10^6$$

$$= 156,250 \text{ mols}$$

$$\underline{\underline{156,250 \text{ mols}}}$$

moles  $\text{CH}_4$

$$m = 5.00 \times 10^3 \times 10^3 \text{g}$$

$$M_r = 16 \text{ g/mol}$$

$$n = \frac{\text{mass}}{M_r}$$

$$= \frac{5 \times 10^6}{16}$$

$$= 0.3125 \times 10^6$$

$$= \underline{\underline{312,500 \text{ mols}}}$$

\* find their stoichiometric moles by dividing the number of moles by their coefficient in the balanced chemical equation.

$$n(\text{NH}_3) = \frac{294,117.65}{2}$$

$$= \underline{\underline{147,058.8 \text{ mols}}}$$

$$n(\text{O}_2) = \frac{156,250}{3}$$

$$= \underline{\underline{52,083.3 \text{ mols}}}$$

$$n(\text{CH}_4) = \frac{312,500}{2}$$

$$= \underline{\underline{156,250 \text{ mols}}}$$

⇒ Oxygen has the lowest number of moles, and so it's the limiting reagent.

\* We can use its relation to find what mass of HCN and  $\text{H}_2\text{O}$  is produced.

\* Get mole ratio from the equation.

mole ratio of  $O_2$  :  $HCN$   
3 : 2

$$156250 \text{ ml of } O_2 \times \frac{2 \text{ mol HCN}}{3 \text{ mol of } O_2}$$

$$\underline{\underline{104,166.7 \text{ ml of HCN}}}$$

$$\text{ml of HCN} = 104,166.7 \text{ ml} \quad M_r = 27 \text{ g/mol}$$

$$\text{mass} = \text{Moles} \times \text{Molar Mass}$$

$$= 104,166.7 \times 27$$

$$= \underline{\underline{2,812,500 \text{ g of HCN}}}$$

(12)

# Get mole ratio from the equation.

mole ratio of  $O_2$  :  $H_2O$   
3 : 6

$$156250 \cancel{\text{ ml } O_2} \times \frac{6 \text{ ml } H_2O}{3 \cancel{\text{ ml } O_2}}$$

(14)

$$\underline{\underline{312,500 \text{ ml of } H_2O}}$$

$$\text{mass } (H_2O) = 312,500 \text{ ml} \quad M_r = 18 \text{ g/ml}$$

$$\begin{aligned} \text{Mass} &= \text{Moles} \times \text{Molar Mass} \\ &= 312500 \times 18 \\ &= 5,625,000 \text{ g of } H_2O \end{aligned}$$
$$\underline{\underline{\hspace{10em}}}$$

\* Get mole ratio from the equation.

mole ratio of  $O_2$  :  $H_2O$

3 : 6

$$156250 \text{ ml } O_2 \times \frac{6 \text{ ml } H_2O}{3 \text{ ml } O_2}$$

(14)

$$\underline{\underline{312,500 \text{ ml of } H_2O}}$$

$$\text{moles } (H_2O) = 312,500 \text{ ml}$$

$$M_r = 18 \text{ g/mol}$$

$$\text{Mass} = \text{Moles} \times \text{Molar Mass}$$

$$= 312500 \times 18$$

$$= 5,625,000 \text{ g of } H_2O$$

$$\underline{\underline{\hspace{10em}}}$$

QUESTION 14

15.

QUESTION 11, 12, 13, 14

⇒ Ah my ink has finished. Buy me pens. But anyway gas laws are simple. You guys can solve on your own.

⇒ Ah so iweh ufuna che mpaka utye zali mu Chemistry Assignment? ah iweh.

⇒ Nalema Ine. Nagona. Good Night guys.

⇒ Register for tuitions @ GENSET EDUCATION ACADEMY. You will never go wrong with us.

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