WORKSHEET 2

CHAPTER 5 – MOLE CONCEPT AND STOICHIOMETRY

A. Answer the following based on given sample of ammonium nitrate, when heated, yields 8.96 litres of steam (measured at S.T.P.):

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$

1. What volume of dinitrogen oxide is produced at the same time as 8.96 litres of steam?
2. What mass of ammonium nitrate should be heated to produce 8.96 litres of steam? (Relative molecular mass of ammonium nitrate is 80.)
3. Determine the percentage of oxygen in ammonium nitrate. (O = 16)

B. Answer the followng questions based on the equations given below related to the manufacture of sodium carbonate (Molecular weight of Na_2CO_3 = 106 g).

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$$

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

1. What mass of sodium hydrogen carbonate must be heated to give 21.2 g of sodium carbonate? (Molecular weight of $NaHCO_3$ = 84 g)
2. To produce the mass of sodium hydrogen carbonate calculated in Question 1. what volume of carbon dioxide, measured at S.T.P., would be required?

C. From the information given below, answer the following questions. Samples of the gases O_2, N_2, CO_2 and CO under the same conditions of temperature and pressure contain the same number of molecules, represented by X. The molecules of oxygen (O_2) occupy *V* litres and have a mass of 8 g.

1. What is the volume occupied by
   a. X molecules of N_2?
   b. 3X molecules of CO?
2. What is the mass of CO_2 in grams?
3. In answering the above questions, which law is used? (C = 12, N = I4, O = 16)

D. Answer the questions given below.

1. When gases react together, their reaction volume bears a simple ratio to each other under the same conditions of temperature and pressure. Who proposed this gas law?
2. What volume of oxygen would be required for the complete combustion of 100 litres of ethane according to the following equation?

   $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

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E. Answer the following questions.

1. What is the volume (measured in dm^3 or litres) occupied by one mole of a gas at S.T.P.?
2. 112 cm^3 (at S.T.P.) of a gaseous fluoride of phosphorus has a mass of 0.63 g. Calculate the relative molecular mass of the fluoride. If the molecule of the fluoride contains only one atom of phosphorus, then determine the formula of the phosphorus fluoride. (F = 19, P = 31)

ANSWERS

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A. 1. $NH_4NO_3 \rightarrow N_2O + 2H_2O$

1 mole : 2 moles

22.4 L : 2 × 22.4 L

When 2 × 22.4 L H_2O is formed, 22.4 L of N_2O is formed

When 8.96 L H_2O is formed, volume of N_2O formed = $\frac{22.4 \times 8.96 \text{ L}}{2 \times 22.4}$ = 4.48 L

Alternative method:

$2H_2O$: N_2O

2 : 1

8.96 L : 4.48 L

2.

$2H_2O$ steam	NH_4NO_3
2 × 22.4 L	80 g
∴ 8.96 L	x g

$x = \frac{8.96}{2 \times 22.4} \times 80 = 16$ g

3. NH_4NO_3 M wt = 80

$\% \text{ of O} = \frac{3 \times 16}{80} \times 100 = 60\%$

B. 1. $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

Na_2CO_3	$2NaHCO_3$
106 g	2 × 84 g
21.2 g	x g

$x = \frac{21.2 \times 2 \times 84}{106} = 33.6$ g

Mass of sodium bicarbonate needed is 33.6 g.

2.

$NaHCO_3$	CO_2
84 g	22.4 L
33.6 g	x L

$x = \frac{33.6 \times 22.4}{84} = 8.96$ L

Volume of CO_2 needed = 8.96 L

C. 1. a. V L

b. $3V$ L

2. $CO_2 = C + 2[O]$

$= 12 + 2 \times 16 = 12 + 32 = 44$ g

3. Gay Lussac's Law

D. 1. Gay Lussac

2. $2C_2H_6 = 7O_2$

2×22.4 L $= 7 \times 22.4$ L

100 L $= x$ L

$$x = \frac{7 \times 22.4 \times 100 \text{ L}}{2 \times 22.4}$$

$= 350$ L

Volume of oxygen required is 350 L.

E. 1. 22.4 L at S.T.P.

2. 112 cm^3 of a compound has 0.63 g weight

22400 cm^3 of a compound has ?

$$= \frac{0.63 \times 22400 \text{ g}}{112} = 126 \text{ g}$$

Thus, molecular weight of the compound is 126 g.

Let the formula of the Fluoride by PF_x

$PF_x = 126$ g

$P + xF = 126$ g

31 g $+ x \times 19 = 126$ g

$19\ x = 126$ g $- 31$ g

$19\ x = 95$ g

$x = 5$

Hence, molecular formula of the phosphorus fluoride is PF_5.