

# WORKSHEET 1

## CHAPTER 5 – MOLE CONCEPT AND STOICHIOMETRY

### A. Give suitable word/words for the following statements

1. It is a number that represents how many times an atom of an element is heavier than  $1/12$ th mass of carbon atom.
2. The molecular weight of an element expressed in grams.
3. The number of atoms present in 12 g of carbon-12.
4. Equal volumes of gases under similar conditions of temperature and pressure contain equal number of molecules.
5. A formula of a chemical substance which tells the actual number of atoms in one molecule of a substance.

### B. Fill in the blanks from the choices given within the brackets.

1. The relative molecular mass is a number that represents how many times one \_\_\_\_\_ (atom/molecule) of a substance is heavier than  $1/12$ th mass of carbon-12.
2. Whenever the gases react chemically, they do so in \_\_\_\_\_ (weights/volumes) which bear a simple ratio to each other and to the products, if gaseous, provided the temperature and pressure of reacting gases and products remains the same.
3. A/An \_\_\_\_\_ (atom/molecule) is the smallest unit of matter, which may or may not have an independent existence, but always takes part in a chemical reaction.
4. Equal volumes of all \_\_\_\_\_ (liquids/gases), under similar conditions of temperature and pressure, contain equal number of molecules.
5. The mass of substance containing particles equal to Avogadro's number is called \_\_\_\_\_ (molecule/mole).

### C. Answer the following.

1. A gaseous compound of nitrogen and hydrogen contains 12.5% hydrogen by mass. Find the molecular formula of the compound if its relative molecular mass is 37. [N = 14, H = 1].
2. Define mole.
3. A gas cylinder contains  $24 \times 10^{24}$  molecules of nitrogen gas. If Avogadro's number is  $6 \times 10^{23}$  and the relative atomic mass of nitrogen is 14, calculate
  - a. mass of nitrogen gas in the cylinder.
  - b. volume of nitrogen at S.T.P. in  $\text{dm}^3$ .
4. Commercial sodium hydroxide weighing 30 g has some sodium chloride in it. The mixture on dissolving in water and subsequent treatment with excess silver nitrate solution formed a precipitate weighing 14.3 g. What is the percentage of sodium chloride in the commercial sample of sodium hydroxide? The equation for the reaction is
$$\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$$
[Relative molecular mass of NaCl = 58; AgCl = 143]
5. A certain gas 'X' occupies a volume of  $100 \text{ cm}^3$  at S.T.P. and weighs 0.5 g. Find its relative molecular mass.

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**D. The volumes of gases A, B, C and D are in the ratio 1 : 2 : 2 : 4 under the same conditions of temperature and pressure.**

1. Which sample of gas contains the maximum number of molecules?
2. If the temperature and the pressure of gas A are kept constant, then what will happen to the volume of A when the number of molecules is doubled?
3. If this ratio of gas volumes refers to the reactants and products of a reaction, which gas law is being observed?
4. If the volume of A is actually  $5.6 \text{ dm}^3$  at S.T.P., calculate the number of molecules in the actual volume of D at S.T.P. (Avogadro's Number =  $6 \times 10^{23}$ )

**E. From the equation,  $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$**

1. Calculate the weight of calcium chloride obtained from 10 g of calcium carbonate.
2. Calculate the volume at S.T.P. of carbon dioxide obtained from 10 g of calcium carbonate. (Ca = 40; C = 12; O = 16; H = 1; Cl = 35.5 and 1 mole of a gas at S.T.P. occupies 22.4 litres)

# ANSWERS

## WORKSHEET 1

### A. Give suitable word/words for the following statements.

1. Atomic weight
2. Gram-molecular weight
3. Avogadro's number
4. Avogadro's law
5. Molecular formula

### B. Fill in the blanks from the choices given within the brackets.

1. molecule
2. volumes
3. atom
4. gases
5. mole

### C. Answer the following.

1. Calculation of Empirical Formula.

Element	Percentage by mass	Atomic weight	No. of moles	Simple Ratio
H	12.5	1	12.5	$\frac{12.5}{6.25} = 2$
N	87.5	14	6.25	$\frac{6.25}{6.25} = 1$

So, the empirical formula =  $\text{NH}_2$

Molecular weight = 37

Empirical weight. =  $14 + 2 \times 1 = 16$

$$n = \frac{\text{M.W.}}{\text{E.W.}} = \frac{37}{16} = 2.3 \cong 2$$

Molecular formula = (Empirical formula)<sub>n</sub>

$$= (\text{NH}_2)_2$$

$$= \text{N}_2\text{H}_4$$

2. One mole is the amount of a substance which contains as many entities (atoms, molecules, ions) as there are atoms in exactly 0.012 kg of C-12.

3. a. Molecular weight of  $\text{N}_2 = 2 \times 14 = 28$

$$\therefore 6 \times 10^{23} \text{ molecules of } \text{N}_2 \text{ weigh} = 28 \text{ g}$$

$$\therefore 24 \times 10^{24} \text{ molecules of } \text{N}_2 \text{ will weigh}$$

$$= \frac{28}{6 \times 10^{23}} \times 24 \times 10^{24} \text{ g}$$

$$= 28 \times 40 = 1120 \text{ g}$$

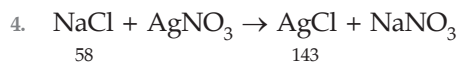
- b.  $\therefore 6 \times 10^{23}$  molecules of  $\text{N}_2$  occupy 22.4 L at S.T.P.

$$\therefore 24 \times 10^{24} \text{ molecules of } \text{N}_2 \text{ will occupy}$$

$$= \frac{22.4 \times 24 \times 10^{24}}{6 \times 10^{23}} \text{ L}$$

$$= 22.4 \times 40 = 896 \text{ L}$$

since 1 L = 1 dm<sup>3</sup>, so  $24 \times 10^{24}$  molecules of  $\text{N}_2$  will occupy 896 dm<sup>3</sup> of volume.



$\therefore$  143 g of AgCl is obtained from 58 g of NaCl

$$\therefore 14.3 \text{ g of AgCl is obtained from } \frac{58 \times 14.3 \text{ g}}{143}$$

$$= 5.8 \text{ g of NaCl}$$

Weight of commercial NaOH = 30 g

$$\% \text{ of NaCl in NaOH} = \frac{5.8 \times 100}{30}$$

$$= 19.33 \%$$

5.  $\therefore$  100 cm<sup>3</sup> of gas weighs 0.5 g at STP

$$\therefore 22400 \text{ cm}^3 \text{ of gas X will weigh} = \frac{0.5}{100} \times 22400 = 112 \text{ g}$$

$\therefore$  Relative molecular mass of gas = 112

**D. The volumes of gases A, B, C and D are in the ratio 1 : 2 : 2 : 4 under the same conditions of temperature and pressure.**

1. D

2. Volume doubles

3. Gay Lussac's Law

4. 22.4 dm<sup>3</sup> has Na molecules ( $6 \times 10^{23}$ )

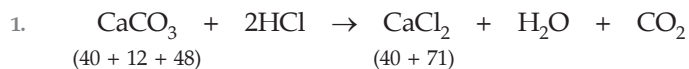
5.6 dm<sup>3</sup> has  $x$  molecules

$$x = \frac{5.6 \times 6 \times 10^{23}}{22.4}$$

$$= 1.5 \times 10^{23} \text{ molecules}$$

$$\text{Number of molecules of D} = 1.5 \times 10^{23} \times 4 = 6.0 \times 10^{23}$$

**E. From the equation,  $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$**



100 g of calcium carbonate produces calcium chloride = 111 g

$\therefore$  10 g of calcium carbonate produces calcium chloride

$$= \frac{111 \times 10}{100} = 11.1 \text{ g.}$$

2. 100 g of calcium carbonate produces carbon dioxide = 22.4 L at S.T.P.

$$\therefore 10 \text{ g of calcium carbonate produces calcium chloride} = \frac{22.4 \text{ L} \times 10 \text{ g}}{100 \text{ g}} = 2.24 \text{ L}$$

$\therefore 1 \text{ L} = 1 \text{ dm}^3$

so volume occupied = 2.24 dm<sup>3</sup> at S.T.P.