Girls' High School & College, Prayagraj

Worksheet No. : 1

Session : 2020-21

Class : XI A, B

Subject : Chemistry

Instructions: Parents are expected to ensure that the student spends 2 days to read and understand the chapter according to the books and websites referred and thereafter answer the given questions.

Note: Chapter : Basic concepts of chemistry

Topic : Significant Figures, Mole Concept,Stoichiometry,Empirical and Molecular Formulae

Book: ISC Chemistry by Dr. H.C.Srivastava, Vol.1 (Nageen Prakashan)

Websites:

https://www.youtube.com/watch?v=FcacQtwd8nw&list=TLPQMTEwNTIwMjDSvTlKTiY7gQ&index=1

https://www.youtube.com/watch?v=omuhMcN9z-M

https://www.youtube.com/watch?v=HDFswFmHkKU

1 . MEASUREMENT IN CHEMISTRY

a) Every measured physical quantity consists of two parts : a numerical value and the unit.

Physical quantity = numerical value x unit

b) The numerical value of a physical quantity is determined experimentally. Every scientific measurement has some degree of uncertainty due to two reasons.

(i) Skill of the observer

(ii) Limitation of measuring instrument

c) There are two ways of expressing this uncertainty.

(i) One method of expressing it is to use the notation ± along with the doubtful digit.

Ex : 63.7 ± 0.1cm.

(ii) Another method of expressing it is to use the concept of significant figures.

d) Rules for determining the number of significant figures:

Rule (i) All non zero digits are significant.

Ex : 6.324 has four, 7.92 has three and 1.2 has two significant figures.

Rule (ii) A zero appearing at the beginning of a number is not significant.

Ex: 0.32 has two, 0.018 has two, 0.0004 has one and 0.324 has three significant figures

Rule (iii) A zero appearing in the middle of a number or at the end of a number that included a decimal point is significant.

Ex : 6.023 has four, 3.01 has three , 1.050 has four and 1.5000 has five significant figures.

Rule (iv) If a number ends in zeros but these zeros are not to the right side of a decimal point, then they may or may not be significant.

Ex : 6500 may have two or three or four significant figures if 6500 is expressed as

(i) 6.5×10^3 then it has two significant figures.
(ii) 6.50×10^3 then it has three significant figures.
(iii) 6.500×10^3 then it has four significant figures.

In order to avoid the ambiguity in the rule generally very large and very small numbers are expressed in exponential form or scientific notation.In this notation a number is expressed as $N \times 10^n$ where N = a number with at least a single non zero digit to the left of the decimal point. n = an integer.

The number of significant figures present in N are taken to be the significant figures of the given quantity.

Ex : In Avogadro's number 6.023 x10^{23}, 6.023 is a number of 4 significant figures i.e. in the exponential notation ,the numerical portion represents the number of significant figures.

Calculations involving significant figures:

Rule 1: The result of addition or subtraction should be reported to the same number of decimal places of the term with least number of decimal places.

Addition example: 6.23 + 2.1 + 1.712 =10.042

This value should be taken as 10.0 only because 2.1 has only one decimal place.

Subtraction example: 16.3215 – 2.706 = 13.6155

This value should be taken as 13.615 because 2.706 has only three decimal places.

Rule 2:The result of multiplication or division should be reported upto the same number of significant figures as possessed by the least precise term.

Ex. For multiplication: 6.102 x 2.1 = 12.8142

This value should be taken as 12 because 2.1 has two significant figures.

Ex. For division: 5.2765/1.25 = 4.2212

This value should be taken as 4.22 because 1.25 has three significant figures.

2. DALTON'S ATOMIC THEORY :

Postulates.

(i) Every element consists of large number of small particles called atoms.

(ii) Atoms are invisible, indivisible, can neither be created nor destroyed.

(iii) Atoms of same element are identical in all respects such as size, shape, weight and properties

(iv) Atoms of different elements combine in simple ratio such as 1:1, 1: 2, 2:3 etc., to form

compound atoms.

(v) The compound atoms (molecules according to modern approach) of the same compound are identical.

Limitation

(i) It does not distinguish between the ultimate particles of an element and that of a compound.

(ii) It fails to explain the laws of combining volumes of gases.

(iii) It does not give the idea of isotopes and isobars.

ATOMIC MASS UNIT SCALE

Carbon as standard : The modern standard reference for atomic mass is carbon isotope of mass number 12.

IMPORTANT POINTS

→ Atomic mass is not a mass (weight) but a number

→ Atomic mass is not absolute but relative to the mass of the standard reference element C^{12}.

ATOMIC MASS :

(i) Atomic mass(relative atomic mass): The relative atomic mass (atomic weight) of an element is the relative mass of an atom of that element as compared to 1/12 the mass of an atom of C^{12}.

(ii) Gram Atomic Mass (GAM) or Gram Atoms: The gram atomic mass of an element is the atomic mass of it, expressed in g.

1 g atom of an element = Gram atomic mass of that element

Number of gram atoms = Mass(in grams) / Gram atomic mass

Ex : 1 gram atom of hydrogen = 1.008g

1 gram atom of chlorine = 35.5g

Q. Calculate the number of gram atoms present in 80.16 g of calcium.(At. Mass of Ca = 40.08)

Ans: No. of gram atoms = 80.16 / 40.08 = 2

MOLECULAR MASS

It is number of times a molecule is heavier than 1/12th of an atom of C^{12}.

IMPORTANT POINTS

→Molecular mass is not a mass (weight) but a number.

→Molecular mass is relative and not absolute.

(i) Molecular mass (relative molecular mass) :- The relative molecular mass (weight) of an element or a compound is the number that represents how many times one molecule of the substance is heavier than 1/12 of the mass of an atom of C^{12}.

(ii) Gram molecular mass (GMM) :- The molecular mass expressed in grams is called gram molecular mass (GMM).

Gram molecular mass of a compound = 1 g molecule of that compound

Number of gram molecules = Mass(in grams) / Gram molecular mass

Ex. 1 Gram molecule of ammonia = 17 g

Q. Calculate the number of gram molecules present in 4.4 g of CO_2.(At. Mass of C =12 , O=16)

Ans: No. of gram molecules = 4.4 / 44.0 = 0.1

Molar volume or gram molecular volume (GMV) : - The volume occupied by one mole of a gas at STP is called molar volume or gram molecular volume (GMV).

Mole concept:

(i) The quantitative aspect of a chemical reaction in chemistry is done by using the mole concept.

(il) Mole is the chemical counting unit. It expresses the amount of a substance.

(ii) The word 'mole' (Latin = heap or pile) was introduced by Wilhelm Ostwald in 1896.

(iii) A mole is the amount of substance that contains an many entities (atoms, molecules or other particles) as there are atoms in exactly 12g (or 0.012 kg) of carbon-12 (C^{12}) isotope.

(iv) 1 mole has 6.022137×10^{23} entities (atoms, molecules, ions, protons, electrons etc.) This number of entities is constant and is known as Avogadro's constant. It is represented by symbol N or N_A.

(v) Mole is SI unit, and can be used with a prefix.

IMPORTANT POINTS

1 Mole = 6.023×10^{23} particles

1 mole atoms = 6.023×10^{23} atoms

One mole molecule = 6.023×10^{23} molecules

Mass of one mole of atoms = Gram atomic mass (GAM)

Mass of one mole of molecules = Gram molecular mass (GMM)

Volume occupied by 1 mole of a gas at N.T.P. = 22.4 litres (Molar Volume)

1 mole of different substances have different masses.

CHEMICAL FORMULA: It is of two types -

Molecular formula : Chemical formula which indicates the actual number and type of atoms in a molecule is called molecular formula eg. - Molecular formula of benzene is C_6H_6.

Empirical formula : The chemical formula that gives only the relative number of atoms of each type in a molecule is called empirical formula eg. - empirical formula of benzene is CH.

Determination of empirical formula:

Step -I: Determination of the percentage of oxygen

Step - II: Determination of relative number of moles

Step –III: Determination of simplest mole ratio

Step - IV: Determination of whole number ratio

Step – V: : Determination of empirical formula

Determination of molecular formula :

Step - VI: Molecular formula = (Empirical fomula) n

where n = Molecular mass (weight)/ Empirical formula mass (weight)

Note: To find percentage of oxygen in organic compound add percentage of all other atoms and subtract it from 100

CHEMICAL EQUATION

Representation of the chemical change in terms of symbols and formulae of the reactants and products is called a chemical equation.

Information conveyed by a chemical equation :

(i)Qualitatively, a chemical equation tells us the names of the various reactants and products.

(ii)Quantitatively, it expresses

(a) The relative number of molecules of reactants and products

(b) The relative number of moles of reactant and products.

(c) The relative masses of reactants and products.

(d) The relative volumes of gaseous reactants and products

STOICHIOMETRY

(i) Stoichiometry is a Greek word .

(ii) Stoichiometry is a calculation of the quantities of reactant and product involved in a chemical reaction.

(iii) Stoichiometry can be classified into two groups -

(a) Gravimetric Analysis

(b) Volumetric analysis

Stoichiometry and Problem Solving

In problem solving we shall first discuss gravimetric analysis of chemical reaction. In gravimetric analysis we relate the weights of two substances or a weight of a substance with a volume of a gas or volumes of two or more gases.

Problems involving Mass-Mass relationship-

Ex. What amount of MgO is formed when 12g of Mg reacts with oxygen completely?

Problems involving Mass-Volume relationship.

Ex.: By heating 10 g of $CaCO_3$, what volume of CO_2 is obtained at STP?

Problems involving Volume-Volume relationship-

Ex.: Hydrogen reacts with nitrogen to produce ammonia according to this equation.

$3H_2(g) + N_2(g) \rightarrow 2NH_3(g)$

Determine how much ammonia would be produced if 200 L of hydrogen reacts completely with nitrogen to form ammonia.

Note : Quantity of a substance consumed or produced can be determined only if we use a balanced chemical equation.

LIMITING REAGENT

(i) Limiting Reagent : The reactant which is completely consumed during the reaction.

(ii) Excess Reagent : The reactant which is not completely consumed in a reaction.

NOTE: The moles of product formed are always determined by the initial moles of limiting reagent.

Answer the following questions:

1) Express the following numbers to three significant figures:
   (i) 6.022 x 1023
   (ii) 5.359
   (iii) 0.04597
   (iv) 34.216
2) Express the result of the following calculations to the appropriate number of significant figures:
   (i) 816 x 0.02456 + 215.67
   (ii) 943 x 0.00345 + 101
3) Match the following:

(i)	88 g of CO_2	a) 0.25 mol
(ii)	6.022 x 10^{23} molecules of H_2O	b) 2 mol
(iii)	5.6 L of O_2 at STP	c) 1 mol
(iv)	96 g of O_2	d) 6.022 x 10^{23} molecules
(v)	1 mol of any gas	e) 3 mol

4) Atomic mass of neon is 20. Calculate:

(i) the number of atoms in 1g of neon and

(ii) 1g atom of neon.

5) What is the mass of 1 molecule of dry ice (CO_2) ?

6) Calculate the number of atoms in each of the following:

(i) 52 mole of He

(ii) 52 g of He

(i) 52 amu of He

7) Find the volume of 20 g of hydrogen gas at STP.

8) An atom of some element Y weighs 6.644×10^{-23} g. Calculate the number of gram-atoms in 40 kg of it.

9) If the value of Avogadro's number is changed to 1.0×10^{20}, what would be the molecular mass of nitrogen gas?

10) Calculate the mass of sodium which contains the same number of atoms as are present in 10 g of magnesium.

11) An organic compound has 68.327 % C , 6.406 % H and 25.267 % Cl. Calculate the molecular formula of the compound if its vapour density is 70.25.

12) A hydrocarbon contains 85.7 % carbon. If 42 mg of the compound contains 3.01×10^{20} molecules ,find the molecular formula of the compound.

13) By heating 10 g of $CaCO_3$,what volume of CO_2 is obtained at STP?

14) Calculate the weight of iron which will be converted into its oxide by the action of 18 g of steam.($3 Fe + 4 H_2O \rightarrow Fe_3O_4 + 4H_2$)

15) Hydrogen reacts with nitrogen to produce ammonia according to this equation:

$3H_2(g) + N_2(g) \rightarrow 2NH_3(g)$

Determine how much ammonia would be produced if 200 L of hydrogen reacts completely with nitrogen to form ammonia?

16) During the formation of HCl from H_2 and Cl_2 ,two moles of hydrogen and three moles of Cl_2 have been used. What is the limiting reagent?

17) What amount of MgO is formed when 12 g of Mg reacts with oxygen completely.

18) How many grams of chlorine are required to completely react with 0.650 g of hydrogen to yield hydrogen chloride? Also calculate the amount of HCl formed.

19) 1.0 g of carbon is burnt in a closed vessel containing 1.5 g of oxygen. Which reactant is left in excess? Find the mass of the excess reactant and the mass of the product formed.

20) Chlorophyll ,the green colouring matter of plants contains 2.68% of magnesium by mass. Calculate the number of magnesium atoms present in 2.5 g of chlorophyll.

END