**Pakistan School , Kingdom of Bahrain**

**E- Support and Learning Material / Session 2020-2021**

**Subject: CHEMISTRY Grade : 11**

**Book: Textbook of Chemistry 11 FIRST TERM**

***NOTE: FOR HSSC CLASSES PRESCRIBED TEXTBOOKS ARE THE MAIN SOURCE OF INFORMATION. FOLLOW THE TEXTBOOK ACCORDING TO ONLINE LECTURES. SAMPLE NOTES ARE PROVIDED FOR YOUR ASSISSTANCE.***

 **Unit : 1.1-1.2.3 CHAPTER: 1 (STOICHIOMETRY)**

**Topic: Introduction/Mole/Avogadro’s Number/Conversation Factor or Mole Ratio.**

**Short question and answers.**

**Q1) Define Stoichiometry?**

**Ans)** It is the branch of chemistry which deals with the study of relative amounts of substances involved in a chemical reaction as given by the balanced chemical equation is called STOICHIOMETRY.

**Q2) Write the importance of Stoichiometry ?**

**Ans)** Calculation of materials is a common factor in several fields.

(i)Fireworks manufacturing: Calculated amount of chemical is required for firework manufacturing. A wrong calculated amount may cause violent explosions.

(ii)Engineering work: For efficient combustion in combustion engines correct ratio of fuel and oxygen is needed.

(iii)Chemical work: A chemist used calculated amount of reactants to produce exact amount of products.

* These Calculation problems are studied in stoichiometry.
* These studies gives quantitative information about a chemical reaction.
* These studies can predict the yields of chemical products.

Example 1 .Combustion of hydrogen fuel in rockets.

**Q3) State law of conversation of mass? Give example.**

**Ans) Statement:** This law states that “Mass can neither be created nor destroyed during a chemical reaction.” For example: combustion in gas barbecue.

**Q4) Define Mole? Give example.**

**Ans)** MOLE: The atomic mass, molecular mass or molecular mass of a substances expressed in grams called mole of a substance.

**OR**

The amount of a substances which contains Avogadro’s number (6.022\*1023) of particles (atoms, ions, molecules or formula units) is called a mole.

Examples: 1mole of O=16g, 1mole of O2=32g. 1mole of NaCl=58.5g. Since NaCl is an ionic compound it cannot exist as individual, neutral, independent molecule. Therefore we use formula mass instead of molecular mass.

Formula to calculate mole: Number of moles = Given mass in grams/Molar mass

**Q5) Define Avogadro’s number? Give example.**

* AVOGADRO’S NUMBER: The number of atoms, ions or molecules present in one mole of a substance is called Avogadro’s number.
* It is denoted by NA .
* Its numerical value is 6.02\*1023
* One mole of any gas at S.T.P occupies volume 22.414dm3 and contains 6.02\*1023 particles.
* Example: Formation of water.
* Mole calculations: The relationship between NA No. for different substances is given as. For Elements :e.g: 1mole of O=6.02\*1023 atoms. For covalent molecules: e.g: 1mole of O2=6.02\*1023molecules =22.414 dm3at S.T.P.1mole of H2O =6.02\*1023 molecules. For ionic compounds: e.g: 1mole of NaCl=6.02\*1023 formula units.

**Q6)Define conversion factor? Give example.**

**Ans) Mole Ratio or Conversion Factor:** The ratios between the number of moles of reactants taking part and the number of moles of products formed during a chemical reaction is called Mole ratio.

For example:C3H8 + 5O2--------3CO2 +4H2O

Thus one mole of propane reacts with five moles of oxygen to give three moles of carbon dioxide and four moles of water. The amount of propane used will not affect these ratios.

In Stoichiometry, Mole ratio are also called as Conversion Factor i.e. Mole ratios=Conversion factor.

A ratio of co-efficient found in a balanced chemical equation, which can be used to interconvert the amount of any two participants (reactants or products)is called **Conversion factor.**

Conversion factor is calculated from balanced chemical equation as: Conversion factor =Co-efficient of substance whose quantity to be determined/Co-efficient of substance whose quantity is given.

**Q7) Calculation.N2 +3H2--------2NH3. How many moles of following are required to manufacture 5.0 moles of NH3. (a)Nitrogen (b)Hydrogen**

SOLUTION. (a)Given: Number of moles of Ammonia=5.0moles.Required: Number of moles of Nitrogen=?

According to the balanced chemical equation

N2+3H2-------2NH3

2moles of Ammonia ------=1mole of Nitrogen

5moles of Ammonia --------=5\*1/2=2.5moles of N2.So the number of moles of nitrogen=2.5moles.

(b)Given: Number of moles of Ammonia=5.0moles.Required:Number of moles of Hydrogen.

According to balanced chemical equation.N2 + 3H2----2NH3

2moles of Ammonia ------=3mole of Hydrogen

5 moles of Ammonia-----=5\* 3/2=7.5moles Hydrogen. So the number of moles of H2=7.5moles.

 Point to ponder: Do self-check 1.2 from text book.

**HOME-WORK (Do any one)**

**(i)Methanol burns according to the equation.2CH3OH +3O2--------2CO2+4H2O**

**If 5moles of Methanol are burnt in oxygen. Calculate:**

**(a)How many moles of oxygen are consumed. (b)How many moles of water are formed.**

**(ii)Write down the conversion factor for the preparation of NH3 from 4 moles of N2 according to the following reaction. N2 +3 H2---------2NH3.**

**Topic: Volume Of Gases/Volume Of Gases At S.T.P/ % Composition/Excess &Limiting Reactants/Calculations**

**Q8) State and explain volume of gases?**

**Volume of gases**: Gay Lussacs law of combining volumes states that the gases react in simple whole number ratio of their volume to products. For e.g.H2+Cl2-------2HCl. It shows that one volume of hydrogen gas reacts with one volume of chlorine gas to produce two volumes of hydrogen chloride gas.

**Q9) State and explain volume of gases at S.T.P?**

**Molar Volume**: The volume occupied by one mole of a gas at S.T.P. is called Molar volume. Its value is 22.414dm3. So mass of gas can be converted into volume of a gas at S.T.P and vice versa. Hence molar volume of gases is also related to their density.

* 22.414dm3 of any gas at S.T.P=1mole=6.02\*1023molecules.
* 22.414dm3 of H2gas at S.T.P=2g=6.02\*1023molecules.
* 22.414dm3of NH3gas at S.T.P=17g=6.02\*1023molecules.

**CALCULATION :(SELF-CHECK-1.3)**

**(a)How moles of oxygen molecules are there in 50.0dm3 of oxygen gas at S.T.P?(b)What volume does 0.80 mole of N2 gas occupy at S.T.P?**

SOLUTION:(a)GIVEN :Volume of O2 gas =50.0dm3. REQUIRED:Moles=?

Since 1mole of O2 occupies volume of 22.414dm3at S.T.P,therefore

22.414dm3of Oxygen at S.T.P=1Mole of oxygen gas

50.0dm3of oxygen at S.T.P== 1\*50.0/22.414=2.23moles

(b)GIVEN:NO.of moles of N2=0.80moles.REQUIRED:Volume=?

Since 1mole of N2 occupies a volume of 22.414dm3 at S.T.P,therefore

1mole of N2 occupy a volume =22.414dm3of nitrogen at S.T.P

0.80moles of N2 occupy a volume=0.80x22.414/1=17.931dm3

**Q10)What do you know about % composition? How will you determine the % composition of each element in the substance?**

**PERCENTAGE COMPOSITION:** The relative amount of each element present in a compound is called its percentage composition.

STEPS: To determine the percentage composition of a compound.

* Calculate the molar mass of the compound.
* Calculate the percentage of each element in the compound by the formula.
* % of an element=Mass of element in 1mole of compound X 100

Molar mass of the compound

% of Mg= $\frac{24}{40}\*100$=60%

% of O= $\frac{16}{40}\*100$=40%

The sum of percentage of all elements in the substance must be equal to 100. Thus in MgO, 60 +40=100.

**Q11) What do you know about excess and limiting reactants?**

**Excess and limiting Reactants**

*The reactant that is consumed completely in a chemical reaction is called limiting reactant.*

*Or*

*The reactant which produces the least number of moles of products in a chemical reaction.*

*Excess Reactant*

*The reactant left unused or unreacted after completion of reaction is called “Reactant in excess”*

**IDENTIFICATION OF A LIMITING REACTANT IN A REACTION**

1. The limiting reactant in a chemical reaction can be identified by following procedure.
2. Using balanced chemical equation, amount of product from each reactant is calculated.
3. The reactant which gives least amount of product is the limiting reactant.

**Self check 1.4**

Zinc and sulphur react to form Zinc sulphide according to the following reaction

Zn + S----🡪 ZnS

If 6 gm of Zinc and 4 gms of Sulphur are available for the reaction then determine

1. Limiting Reactant
2. The mass of Zinc Sulphide.

Solution:

Given: Required:(a)Limiting reactant =? (b)Mass of Zinc Sulphide produced=?

Mass of Zinc = 6gms

Atomic mass of Zinc= 65.41 g/mole

No of Moles Zn= 6/ 65.41= 0.0917moles

Mass of Sulphur= 4 gms

Atomic mass of S= 32g /mole

No of moles of S = 4/32=0.125 moles

According to the reaction :Zn +S-------ZnS

1 mole of Zn = 1 mole of Zn S

0.0917 moles of Zinc = 0.0917 moles of ZnS

Also

1 mole of S = 1 mole of Zn S

So 0.125moles of S = 0.125 moles of ZnS

 Since Zn procedures least amount of product therefore it is the limiting reactants.

Hence moles of ZnS produces =0.0917 moles of ZnS

Molar mass of ZnS = 65.41+32=97,41 g/moles

Mass of 0.0467 Moles of Zn S = 97.41\*0.0917g=8.93g

**Q12) Define theoretical, actual and percent yield?**

**THEORETTICAL YIELD:** The quantity of product calculated to be obtained from given quantities of initial reactants is called theoretical yield.

**ACTUAL YIELD:** The given quantity of product that is actually produced in a chemical reaction is called actual yield.

**PERCENT YIELD:** The percent yield can be calculated as :

Percent yield =Actual yield/Theoretical yieldX100

* There are many reactions for which the actual yield is almost equal to theoretical yield .Such reactions are quantitative. Their percent yield is almost 100%.They can be used in chemical analysis.
* On the other hand, for some reactions the actual yield is less than theoretical yield. These reactions particularly involve organic compound. In these reactions percent yield is less than 100%.

**Q13) Why actual yield is less than theoretical yield?**

**Ans)** The actual yield is less than theoretical yield due to following reasons:

* Formation of by product due to side reactions.
* Reversible reactions may not go to completion.
* Mechanical loss due to filtration, distillation and separation by separating funnel washing and crystallization etc.

**Q14) Differentiate between actual and theoretical yield?**

|  |  |
| --- | --- |
| **Actual yield**  | **Theoretical yield**  |
| It is the amount of a product actually obtained during a chemical reaction. | It is the amount of a product calculated from a balanced chemical equation. |
| It is always less than the theoretical yield.  | It is always greater than actual yield |
| Reversible nature of the reaction and the side reaction decreases the actual yield. | While calculating theoretical yield, it is assumed (i)No side reaction occurs.(ii)Reactants are completely converted into products. Therefore yield is not decreased |
| Mechanical losses during the experiment also decreases the yield.  | No mechanical losses occurs, since it is calculated theoretically. |
| It is an experimental term  |  It is a theoretical term. |

**Q15) Science Titbits:** The overall balanced equation for the production of ethanol

C6H12O6 🡪 2 C2H5OH + 2 CO2

(a)What is the theoretical yield of ethanol available from 10.0g of glucose.

(b)If in a particular experiment 10.0g of glucose produces 0.664g of ethanol. What is the %yield?

Solution:(a)Given: Mass of glucose =10.0g. Required: Theoretical yield=?

Molar mass of C6H12O6 =12X2+1X12+6X16 =180g/mole

No.of moles of glucose=10/180=0.056moles.

According to equation

1mole of C6H12O6 ---- 2moles of C2H5OH

0.056moles of glucose----=2x0.056/1=0.112moles

Molar mass of ethanol C2H5OH =2X12+5X1+1X1=46g/mole

Mass of ethanol=46x0.112=5.152g.

Hence theoretical yield =5.152g

(b)Solution :Given :Theoretical yield ethanol =5.152g. Actual yield =0.664g

 %Yield =Actual yield x100

 Theoretical yield

%yield=0.664/5.152=12.89%

**Q16) 58.5amu are termed as formula mass and not molecular mass of NaCl. Why?**

**Ans)** Since NaCl is an ionic compound, therefore, it cannot exist as individual, neutral independent molecules. Therefore term Formula mass is used to express its mass instead of molecular mass**.**

**Q17) Concept of limiting reactant is not applicable to the reversible reactions. Explain.**

**Ans)** The reactant that is consumed completely in a chemical reaction is called limiting reactant. However in reversible reactions, reactants are not completely converted into products. Hence concept of limiting reactant is not applicable to reversible reactions.

**Q18) How many covalent bonds are present in 9g of H2O?**

**SOLUTION:** Given: mass of water=9g. Molar mass of water=18g/mole. Required: No. of covalent bond

NO.of molecules of water=Mass of water/molar mass of waterxNA

NO.of molecules of water=9/18x6.022x1023=3.01x1023molecules.

1molecule of water contains =2 covalent bonds

3.01x1023molecules of water contains=2x3.01x1023=6.02x1023covalent bonds.

**Q19) One mole of Sulphuric acid should completely reacts with 2moles of NaOH. How does Avogadro,s number help to explain it?**

**Ans)** Chemical reaction:2NaOH + H2SO4 -----Na2SO4 +2H2O

2 formula units + 1molecule--------------------1formula unit 2molecules or

2moles + 1mole---------------------------1mole + 2moles

Thus according to Avogadros the above equation shows that 2x6.02x1023 formula units of NaOH reacts with 6.02x1023 molecules of H2SO4 to produce 6.02x1023 formula units of Na2SO4 and 2x6.02x1023 molecules of water.

**Q20) Give reasons that 1 mole of different compounds have different masses but have same number of molecules?**

**Ans)** One mole of different compound has different masses but same number of molecules. It is because individual molecules of different compounds have different masses, therefore equal number of moles of different compounds will also have different masses although same number of molecules. E.g.1mole of H2O = 6.02x1023 molecules of H2O =18g of water.1mole of CO2 =6.02x1023molecules of CO2 =44g of CO2.

**Q21)Why do 23g of Sodium and 238g of Uranium have equal number of atoms in them?**

**Ans)** Since 1mole of sodium(Na)=23g. 1mole of uranium (U)=238g. As 1 mole of each element contains Avogadros number of atoms and there is 1mole of each of Na and U. Hence 23g of Na and 238g of U contains equal number of atoms.i.e.6.02x1023.

**Q22)What is the relationship between mass and volume of a gas at S.T.P?**

**Ans)**The volume occupied by one mole of a gas at S.T.P is called its molar volume. Its value is 22.414dm3.

Moreover, mass of 1 mole of a gas is called its molar mass. Hence 22.414dm3 of a gas at S.T.P equals its molar mass. For e.g.221414dm3 of CO2 =1mole= 44g of CO2.

22.414dm3of O2 at S.T.P=1mole=32g of O2

**Q23)What are representative particles in one mole of gas at S.T.P?**

**Ans)**One mole of H2 gas at S.T.P occupies 22.414 dm3 and contains 6.02x1023particles.For example

22.414dm3of H2 gas at S.T.P=2g=6.02x1023molecules.

22.414dm3of NH3 at S.T.P=17g=6.02x1023molecules.

**Q24)Which contains more atoms 1mole of Fe or 1mole of H2 ?Justify your statement.**

Ans)1mole of Fe contains Avogadros number of atoms i.e.6.02x1023atoms. However 1mole of H2 contains

Avogadros number of molecules i.e. 6.02x1023molecules. Since 1 molecule of H2 contains two hydrogen atoms therefore 1mole of H2 will contain=2x6.02x1023atoms of hydrogen. Hence 1mole of H2 contains more atoms than 1mole of Fe.

**Select the most suitable answer in the following MCQs**

(i)How many molecules are there in 1 mole of water.

(A)6.023x1019 (B)6.023x1023 (C)1.084x1018 (D)None

(ii)A flask contains 500 cm3 of SO2 at S.T.P. The flask contains

(A)40g (B)100g (C)50g (D)1.427g

(iii)Percentage of Oxygen in water is :

(A)80% (B)88.8% (C)8.8% (D)9.8%

(iv)How many moles of oxygen are needed for the complete combustion of 2moles of methane.

1. 2 (B) 8 (C)10 (D)13

(v)What is the mass of aluminium in 204 g of Al2O3 :

(A)26g (B)27g (C)54g (D)108g

(vi) The NO. of molecules in 64 g of sulphur is:

1. 2NA (B)16NA (C)0.25NA (D)None

(vii) 14.20dm3 of H2 gas at STP weighs :

 (A)12.2g (B)448g (C) 1.28g (D)20g

(viii)One mole of ethanol and one mole of ethane have an equal:

(A)Mass (B)Number of atoms (C)Number of electrons (D)Number of molecules

(ix)How many moles of oxygen are needed for the complete combustion of two moles of butane?

(A)2 (B)8 (C) 10 (D)13

(x)The relative mass of chlorine is 35.5.What is the mass of 2 moles of Chlorine gas ?

(A) 142 g (B)71g (C)35.5g (D)18.7g

(xi)What volume of H2 can be obtained from 100cm3 of methane at S.T.P.

(A)300cm3 (B)200cm3 (C)150cm3 (D)100cm3

(xii)If four moles of SO2 are oxidized to SO3, how many moles of Oxygen are needed.

(A)0.5 (B)1.0 (C)1.5 (D)2.0

 **HOME-WORK:**

(i) 2Al +3Br2------2AlBr3.

If 15.8g of Al and 55.6g of Br2 are available for the reaction, then determine: (a)The limiting reactant (b)The mass of AlBr3 formed.

(ii)Solid carbon dioxide (dry-ice) may be used for refrigeration.

CH4 +2H2O---CO2+ 4H2O.

(a)What mass of CO2 should be obtained from the complete reaction of 1250g of methane.

(b)If the actual yield obtained is 3000g then what is the %yield ?

(iii)How many covalent bonds are present in 10g of CH4? (C=12,H=1)

(iv)Calculate the %composition of glucose? (C=12,H=1,0=16)

(v)Calculate the weight of oxygen gas evolved when 5g of KClO3 are completely burnt? (K=39,Cl=35.5,0=16).KClO3----🡪 2KCl +3O2

(vi)The liquid CHBr3 has a density of 2.89g/dm3.What volume of this liquid should be measured to contain a total of 4.8x1024 molecules of CHBr3.

(vii)Ammonia is formed as :N2 +3H2------🡪2NH3. If 42.0g of H2 produces 120.2g of ammonia. Calculate the %yield of ammonia.

(viii)A small piece of pure Al metal having a volume of 1.25cm3 is reacted with excess of HCl. What is the weight of H2 liberated? The density of Al=2.70g/cm3.(Al=27,H=1,Cl=35.5)

2Al +6HCl---🡪2AlCl3+3H2

(ix)How much Silver chloride will be formed by mixing 120.0g of Silver nitrate with a solution of 52.0g of NaCl. (Na=23,Cl=35.5,N=14,Ag=107.87)

AgNO3 +NaCl---🡪AgCl +NaNO3