
INTRODUCTION TO CHEMISTRY

DEFINITION:

"The branch of Natural science which deals with the study of composition, properties, structure, changes and the laws governing the changes that occurring inside the matter is called Chemistry."

MATTER:

Anything having mass and occupy space is known as Matter.

There are three commonly known states of matter. According to latest Information there are four states of matter

1. Solid
2. Liquid
3. Gas
4. Plasma (newly discovered fourth state of matter but not known commonly)

LANDMARKS IN THE HISTORY OF CHEMISTRY

THE GREEK PERIOD:

Famous Greek philosophers: Plato
(347-428 B.C)

Aristotle (322-384 B.C)

Democritus (357-460 B.C)

- They introduced the concept of element, atom and chemical reactions.
- They thought that all matter was derived from four elements earth, air, fire and water.
- These elements have properties of their own such as dry, hot, cold and wet.
- According to them, fire was hot and dry, earth was cold and dry, water was cold and wet and air was hot and wet.

The Romans developed the chemical arts still further:

- They improved the metallurgical processes and introduced the enameling of pottery. However, they developed little theoretical knowledge in this regard. Their works were all empirical.

THE MUSLIM PERIOD:

The Muslim period was from 600 to 1600 A.D in the history of chemistry and is known as period of alchemist.

The modern scientific knowledge is based on the contribution of these Muslim scholars.

Jabir-Ibne-Hiyan(721-803 A.D):

He is generally known as the father of alchemy (founder of Chemistry).

➤ **Achievements:**

- i) He invented experimental methods for preparation of Nitric acid, Hydrochloric acid and sulphuric acid.
- ii) He discovered white lead. iii) He also developed methods for the extraction of metals from their ores. iv) He also developed methods of dyeing clothes. v) He developed method of distillation.
- vi) He also developed many laboratory apparatus.

Al Razi (862-930 A.D):

Al Razi was a physician, chemist (at that time they were known as alchemist) and a philosopher.

➤ Achievements:

- i) He was an expert surgeon and was the first to use opium as anesthesia.
- ii) He divided the substances into living and non-living origins, which was later adopted by Berzelius, in 1806 to classify chemical compounds on the basis of their origins as organic and inorganic compounds.
- iii) Al-Razi prepared ethyl alcohol by the fermentation of sugar.

Al-Beruni(973-1048 A.D):

Contributed a lot in physics, metaphysics, mathematics, geography and history. In the field of chemistry, he determined the densities of different substances.

Ibne-Sina(980-1037):

Ibne-Sina was famous for the contribution in the field of medicines, medicinal chemistry, philosophy, mathematics and astronomy.

DIRECTION OF RESEARCH OF MUSLIM SCIENTISTS:

- These Muslim alchemists were interested more in finding a way to prolong life and to convert base metals like lead, copper into gold but they could not do so.
- Their researches led to the discoveries of many substances and laid the foundation of chemistry. Many important reagents like sulphuric acid, Nitric acid, Hydrosulphuric acid, Silver nitrate etc were discovered.
- Chemists of that period, however, devoted their energies mainly to the production of drugs for the use of medicines.

THE MODERN PERIOD (FROM 1600 A.D AND ONWARD):

NAME OF SCIENTISTS CONTRIBUTION IN CHEMISTRY:

- 1. ROBERT BOYLE (1627-1691):** He is affectionately known as the father of modern chemistry and was the first to put forward the idea that chemistry should be regarded as a systematic investigation of nature with the sole aim of promoting knowledge. As a result, lots of discoveries were made during later years.
- 2. J.BLACK (1728-1799):** He made a study of Carbon dioxide.
- 3. J.PRIESTLY (1733-1804):** He discovered Oxygen, Sulphur dioxide and Hydrogen chloride.
- 4. SCHEELE (1742-1786):** He discovered Chlorine.
- 5. CAVENDISH (1731-1810):** He discovered Hydrogen.

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- 6. LAVOISIOR (1743-1794):** He discovered that oxygen constituted about one fifth of air.
 - 7. GAY-LUSSAC (1778-1850):** He discovered relationship between volume of given mass of a gas and temperature.

CHEMISTRY AND SOCIETY

SIGNIFICANT REASONS TO STUDY CHEMISTRY (Importance of chemistry):

There are three significant reasons to study chemistry.

1. Chemistry has important practical application in the society. The development of life saving drugs is one and a complete list would touch upon the most areas of modern chemistry.
2. Chemistry is an Intellectual enterprise, a way of explaining our material world.
3. Chemistry figures prominently in other fields, such as in biology in the advancement of medicines.

EXAMPLES OF CHEMICAL SUBSTANCES USED IN DAILY LIFE:

Use of chlorine and fluorine in daily life:

It is used in making poly vinyl chloride (PVC) as plastic pipes. Other chlorine compounds are used as bleaching agent, disinfectants, solvents, pesticides, refrigerants, flame retardant and drugs.

Chlorine: is used in treating water to kill pathogenic (disease causing) organism. In this way the disease like Cholera, Typhoid, Fever and Dysentery are dangerous disease are all eliminated from most of the part of the world.

Fluorine: is used in compounds like sodium fluoro phosphate and NaF (sodium fluoride) in our toothpastes to protect and control tooth decay. It is great advantage of chemistry on the society.

BRANCHES OF CHEMISTRY

1. PHYSICAL CHEMISTRY:

The branch of chemistry which deals with the laws and the principles governing the combination of atoms and molecules in chemical reaction and study of physical properties of matter is called PHYSICAL CHEMISTRY.

2. ORGANIC CHEMISTRY:

The branch of chemistry which deals with the study of Hydrocarbon and their derivatives with the exception of CO₂, CO, metal carbonates Bicarbonates and carbides is known as ORGANIC CHEMISTRY.

3. INORGANIC CHEMISTRY:

The branch of chemistry which deals with the study of chemistry of elements and their compounds, generally obtained from non-living organism, i.e. from minerals is known as INORGANIC CHEMISTRY.

4. ANALYTICAL CHEMISTRY:

The branch of chemistry which deals with the study of the methods and techniques involved to determine the kind, quality of various components in a given substance is known as ANALYTICAL CHEMISTRY.

5. BIOCHEMISTRY:

The branch of chemistry which deals with the study of compounds chemical reaction involves in living organism i.e. plants and animals and their metabolism in the living body is known as BIOCHEMISTRY.

6. INDUSTRIAL OR APPLIED CHEMISTRY:

The branch of chemistry which deals with the study of different chemical processes involved in the chemical industries for the manufacturing of synthetic products like glass, cement, paper, soda asli, fertilizers, medicines etc. is known as INDUSTRIAL CHEMISTRY.

7. NUCLEAR CHEMISTRY:

The branch of chemistry which deals with the study of changes occurring in the nuclei of atoms, accompanied by the emission of invisible radiations is known as NUCLEAR CHEMISTRY.

8. ENVIORMENTAL CHEMISTRY:

The branch of chemistry which deals with the study of the interaction of chemical materials and their effects on the environment of animals and plants is known as ENVIORMENTAL CHEMISTRY.

9. POLYMERIC CHEMISTRY:

The branch of chemistry which deals with the study of polymerization and the product obtained through the process of polymerization such as plastic, synthetic fibers, paper etc. is ~~known~~ as POLYMERIC CHEMISTRY.

THE SCIENTIFIC APPROACH IN CHEMISTRY

Science has developed through series of discoveries from many years which started off as observed natural phenomenon which had to be explained. This was done by using scientific method in a systematic manner.

SCIENTIFIC METHOD:

There are four main stages of scientific method:

1. Observation.
2. Hypothesis
3. Theory
4. Scientific Law of principle

1. OBSERVATION:

“Observation is a basic tool to elaborate a phenomenon varies from person to person and depends upon person’s own skills and elaboration.”

Different people observe a phenomenon in different ways. Some of us observe something very critically to extract from it a new point.

Observation of a thing is one of the scientific approaches in chemistry.

2. HYPOTHESIS:

“The explanation obtained by the pondering of a scientist after observing a phenomenon which is still on a trial is called Hypothesis.”

When a phenomenon is observed, a scientist ponders over it and carries out relevant experiments. He sieves through the data and arrives at a possible explanation for the nature of the phenomenon. This explanation, which is still only a trial is called hypothesis. It may or may not undergo a change which results further investigations and accumulation of more knowledge or facts.

3. THEORY:

“The Hypothesis which is supported by a large number of different types of observations and experiments given by many scientists is known as Theory.”

The scientist conveys his hypothesis to other workers of the same fields for the discussion and for further experimentation. When the hypothesis is supported by a large amount of different types of observation and experiments, then it becomes a theory i.e. scientifically acceptable idea or principle explain a phenomenon. A good theory predicts new facts and unravels new relationship between occurring phenomenon.

4. SCIENTIFIC LAW OR PRINCIPLE:

“A theory which is tested again and again and found to fit the facts and from which valid predictions maybe made is then known as scientific law or principle.”

Science cherishes all form of ideas and proposals. Even obsolete (outdated) ideas are kept as reference. It is said that there is no end to knowledge, so development in science too may have no limits.

EXERCISE

1. Fill in the blanks:

- i) The early Greeks believed that everything in the universe was made up of four elements Earth, Air, Fire and Water.
- ii) Al-Razi divided chemical substances on the basis of their origin as living and non-living. iii) Organic chemistry is the branch of chemistry which deals with the carbon compounds.
- iv) Bio chemistry is the backbone of Medical science.
- v) PVC which is a plastic is the short name of Poly Vinyl Chloride.
- vi) Oxygen was discovered by J. priestly.
- vii) The best disinfectant is Chlorine. viii) The periodic arrangement was the result of Mendeleev's work.

LAWS OF CHEMICAL COMBINATION

CHEMICAL REACTIONS:

When two or more substances combined together or a single substance changes up to produce one or more substances with entirely different properties, such a change is called chemical reaction.

- $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$
- $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

LAWS OF CHEMICAL COMBINATION:

Chemistry deals with chemical reactions. Chemist had found that these changes are governed by some empirical law known as Laws of Chemical Combinations.

These laws are:

- Law of conservation of mass.
- Law of constant composition OR Law of definite proportions.
- Law of multiple proportions.
- Law of reciprocal proportions.

1. LAWS OF CONSERVATION OF MASS:

Lavoisier in 1785 gave the law of conservation of Mass. This law states that:

"Matter can neither be created nor be destroyed by chemical change." OR
"in any chemical reaction the initial mass of reacting substance is equal to the final mass of products."

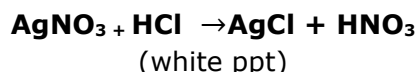
After latest research law can be stated as:

"There is no detectable gain or loss of mass in an ordinary chemical reaction."

PRACTICAL VERIFICATION: (Landolt Experiment)

This law was verified by many experiments performed by H. Landolt. He was a German chemist. His most popular and the simplest experiment is as follows:

Experiment: He took an H- shaped tube having two limbs 'A' and 'B' as shown in figure. One limb 'A' was filled with AgNO_3 solution and the other limb was filled with HCl solution. The upper portion of the limbs were sealed to avoid the escaping of any material. Both solutions are colourless. The H-shaped tube was weighed in vertical position to avoid mixing. Then the tube was inverted and shaken to mix the two solutions. Following reaction took place.



Due to formation of AgCl precipitates of white color, the entire tube became white. The reaction was completed by shaking and inverting the tube. H-shaped tube was weighed again. It was observed that the tube mass of the substances before the reaction was equal to the total mass of the substances after reaction.

CONSERVATION OF MASS TO ENERGY:

Certain radioactive substances like uranium undergo changes of such nature that very small quantity of mass is conventional to energy by the following equation given by Albert Einstein in 1906.

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Where "m" is mass of the substance in gm and "c" is the velocity of light in cm/sec (**3x 10¹⁰ cm/sec**). By putting these values in equation (A) we can calculate the amount of Energy obtained by the conversion of the mass. This change of mass in ordinary experiments is so small that it cannot be detected by ordinary weighing techniques.

FINALLY THE LAW OF CONSERVATION OF MASS:

Law of conservation of mass can be stated as:

"There is no detectable gain or loss of mass in an ordinary chemical reaction."

2. LAW OF CONSTANT COMPOSITION OR LAW OF DEFINITE PROPORTIONS:

Statement:

"Different samples of the same compound always contain the same element combined together in the same proportion by mass" Example:

Water obtained from any source (prepared in laboratory, or obtained from rain, river or water pump), but if it is pure water always contains Hydrogen and Oxygen in the ratio of 1:8 by mass.

H₂O

2:16 (Atomic mass of H is 1 and O is 16)

1:8 (parts by mass)

Experimental verification:

Swedish chemist J.J Berzelius performed an experiment to prove this law.

10gm of lead (Pb) was heated with excess of sulphur but only 1.56gm of sulphur combined to give 11.56 gm of PbS.

Again this experiment was repeated by heating 18gm of Pb and 1.56gm of "S", it was observed that 11.56gm of PbS was prepared and 8g of Pb remained unused.

This indicates that Pb and S always combine in the fixed ratio by mass. This is according to the law of constant composition.

3. LAW OF MULTIPLE PROPORTIONS:

Statement:

"If two elements combined to form more than one compound, the masses of one element that combines with a fixed mass of the other element are in the ratio of small whole numbers or some multiple of it" Example:

Carbon and oxygen combine to form two stable compounds CO and CO₂

COMPOUND	MASS OF CARBON (C)	MASS OF OXYGEN (O)	RATIO OF (O)
Carbon monoxide CO	12	16	1

Carbon dioxide CO ₂	12	32	2
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From above chart it is very clear that 12g 'C' combines with 16g of 'O' in CO and 32gm of 'O' in CO₂. Hence the ratio of 'O' is 16:32 or 1:2 which is the simple multiple ratio.

4. LAW OF RECIPROCAL PROPORTIONS:

Statement:

"when two different elements separately combine with the fixed mass of third element the proportions in which they combine with one another shall be either in the simple ratio or some multiple of it." Example:

'C', 'H' and 'O' combine separately to form CH₄, H₂O and CO₂

METHANE CH ₄	MASS OF C-12	MASS OF H-4	RATIO OF H:C 4:12 OR 1:3
Water H ₂ O	Mass of H '2'	Mass of O-16	RATIO OF H:O 2:16 OR 1:8
Carbon dioxide CO ₂	Mass of C 12	Mass of O-32	RATIO OF C:O 12:32 OR 3:8

From the above chart it is clear that in CH₄ 1gm H combines with 3 gm of C and in H₂O 1gm H combines with 8 gm O. Also in CO₂ the ratio of C and O is 3:8 which is according to the law of Reciprocal proportion.

ATOMIC MASS:

"The atomic mass of an element is the average mass of natural mixture of isotopes which is compared to the mass of 1/12th part of an atom C-12." Its unit is a.m.u.

The mass of an atom depends upon Neutrons and protons present in nucleus

The mass of an atom is so small that it can't be measured by any ordinary weighing instrument.

The mass of Hydrogen atom is **1.6xg** (a very small mass) C-12 has 6 protons and 6 neutrons, so the mass of C is 12 atomic mass unit(a.m.u).

The mass of C-12 is taken as a standard. Hence (a.m.u is 1/12th of the mass of C-12 atom. For example the mass of H is 1/12th mass of C-12, so its atomic mass is 1 a.m.u. Most of the elements consist of isotopes. The average of the mass of isotopes gives the atomic mass of the atom.

The atomic mass of O=16, S=32, H=1, Ca=40, Mg=24.

EMPIRICAL FORMULA (E.F) OR SIMPLEST FORMULA:

"The formula that shows the simplest ratio between the atoms of different elements of a compound is called empirical formula."

COMPOUND	MOLECULAR FORMULA	EMPIRICAL FORMULA
Benzene	C ₆ H ₆	CH
Gulucose	C ₆ H ₁₂ O ₆	CH ₂ O
water	H ₂ O	H ₂ O

The empirical formula of Benzene, Glucose and Hydrogen Peroxide are different from their Molecular Formulae.

Hence for a compound, Empirical and Molecular Formula may be similar or different.

MOLECULAR FORMULA:

“Molecular Formula is the formula which represents a molecule of an element or a compound with exact number of atoms.” Relationship between molecular and empirical formula:

Molecular formula = $n \times$ Empirical Formula

OR $n = \frac{\text{Molecular Formula}}{\text{Empirical Formula}}$

Similarly

$n = \frac{\text{Molecular Formula mass}}{\text{Empirical Formula mass}}$

MOLECULAR FORMULA MASS OR MOLECULAR MASS:

“Molecular Formulae Mass of a substance is the sum of the atomic mass of all atoms present in the molecular formula of a substance or molecule.”

COMPOUND	MOLECULAR FORMULA	MOLECULAR MASS
Carbon dioxide	CO ₂	$12 + 2(16) = 12 + 32 = 44$
Glucose	C ₆ H ₁₂ O ₆	$6(12) + 12(1) + 6(16) = 180$
water	H ₂ O	$2(1) + 16 = 2 + 16 = 18$

FORMULA MASS:

“Formula mass of a substance is the sum of the atomic masses of all atoms in a formula unit of the substance” Explanation:

Some compounds are not available in molecular form. For example NaCl is available in ionic form NaCl, so we can consider its formula mass and not molecular mass.

MOLAR MASS:

“Molar mass of the substance is its relative Atomic mass, Molecular mass or Formula mass expressed in grams.”

MOLE:

“The atomic mass, Molecular mass or Formula mass of a substance expressed in grams is known as Mole.”

AVOGADRO'S NUMBER (N_A):

“One mole of any substance contains 6.02×10^{23} particles (atoms, molecules, ions or formula units). This constant number is called Avogadro's number.”

INTERCONVERSION OF MASS AND MOLE:

Number of moles = $\frac{\text{Mass of substance in grams}}{\text{Gram Atomic mass OR formula mass}}$

Mass of substance = Number of moles $\times$ Gram Atomic mass or Formula mass

PROBLEM: Calculate the number of moles in 50g of each: (a) Na (b) H₂O

Solution:

Method # 1 Number of moles of

Na = ?

Given mass of Na = 50g

Atomic mass of Na = 23 a.m.u

Number of moles of Na = (Mass of Na in grams)/(Gram Atomic mass of Na)
= 50/23

Number of moles of Na = 2.173 moles of Na.

Solution:

Method # 2

Number of moles of H₂O = ?

Given mass of H₂O = 50g

Atomic mass of H₂O = 18 a.m.u

Number of moles of H₂O = (Mass of H₂O in grams)/(Gram Atomic mass of H₂O)
= 50/18

Number of moles of H₂O = 2.777 moles of H₂O.

USE OF AVOGADRO'S NUMBER:

PROBLEM: Calculate the number of Atoms in 10g of Al.

Solution:

Method # 1

According to Avogadro's number.

1 mole of Al = 27g = 6.02x10²³ atoms.

This shows that.

27g of Al contain 6.02x10²³ atoms of Al

1g of Al contain 6.02x10²³ / 27g

10g of Al contain (6.02x10²³ x 10) / 27g = **2.23x 10²³ atoms of Al** Answer

Solution:

Method # 2

Number of atoms = (N_A x Mass of substance in grams) / (Gram Atomic mass)

Number of atoms of Al = (6.02x10²³ x 10g) / 27g

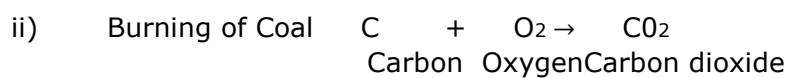
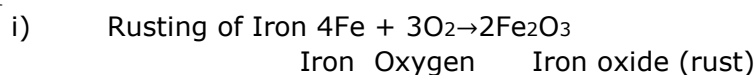
Number of atoms of Al = **2.23x 10²³ atoms of Al** Answer

CHEMICAL REACTION OR CHEMICAL CHANGE:

"A chemical reaction is that change in which the chemical composition of a substance is altered."

During a chemical reaction, the original substances produce one or more new substances.

Examples:



TYPES OF CHEMICAL REACTION:

Chemical reaction is divided into five different types.

- i) Decomposition reactions.
- ii) Addition reaction (Combination reaction)
- iii) Single displacement reaction
- iv) Double displacement reaction
- v) Combustion reaction

1. DECOMPOSITION REACTIONS:

"Decomposition reaction is that chemical reaction in which a substance is divided into two or more simpler substances."

Example:

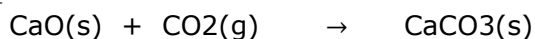


In this reaction Calcium Carbonate on heating is divided into Calcium oxide and Carbon dioxide gas.

2. ADDITION REACTION (Combination Reaction):

"Addition reaction is that reaction in which two or more substances combine to form a single substance." Addition reaction is the reverse of decomposition reaction.

Example:

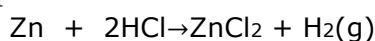


In this reaction Calcium Oxide and Carbon dioxide are added to give Calcium carbonate.

3. SINGLE DISPLACEMENT REACTION:

"Displacement reaction is that reaction in which one atom or group of atoms of a compound is replaced by another atom or group of atoms."

Example:

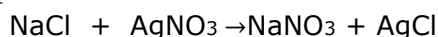


In this reaction H of HCl is replaced by Zn

4. DOUBLE DISPLACEMENT REACTION:

"In double displacement reaction the two compound exchange their partners so that new compounds are formed."

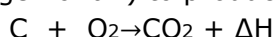
Example:



In the above reaction the exchange of partners takes place.

5. COMBUSTION REACTION:

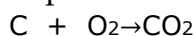
"In combustion reaction substances react with oxygen (free oxygen or oxygen of air) to produce heat energy and flame." Example:



In this reaction carbon is burnt with oxygen to form carbon dioxide along with evolution of heat and flame.

CHEMICAL EQUATION:

"Chemical equation is a method of expressing the chemical reaction in terms of symbols and formulae of the substances involved in the chemical equation." Example:



POINTS TO REMEMBER:

1. Reactants are on the left hand side of the reaction and product are on the right hand side of the reaction.
2. Balancing of Equation is done by coefficients.
3. Delta over an arrow indicates that reactant is heated to give product.
4. Catalyst is represented by its symbol written over arrow.

BALANCE CHEMICAL EQUATION:

Balanced chemical equation gives the following information.

- i) The nature of reactants and products.
- ii) The relative number of each reactants and products.

RULES OF BALANCE CHEMICAL EQUATION:

- i) Write the given formulae for all reactants on the left hand side and the formulae of products on right hand side of an equation.
- ii) Mention the number of atoms on both sides of chemical equation
iii) If the number of atoms appear more on one side than the other, balance the equation by inspection method. For this purpose multiply the formula by coefficient so as to make the number of atoms, same on both sides of an equation.
- iv) The covalent molecule of hydrogen, oxygen, nitrogen and chlorine exist as diatomic molecule e.g H_2 , N_2 , O_2 and Cl_2 , rather than isolated atoms hence we must write them as such in chemical equation.
- v) Finally, check the balanced equation, to be sure that the number and kind of atoms are the same on both sides of the equation.

BALANCE THE CHEMICAL EQUATION:

Example:

1. $KClO_3 \rightarrow KCl + O_2$ Write down the number of atoms on each side.

Reactants	→	Products
K (1)		K (1)
Cl (1)		Cl (1)
O (3)		O (2)

It is clear that K and Cl elements have same number of atoms on both sides of equation, but the Oxygen atoms are not balanced so we place 2 on left hand side and 3 on right hand side (cross multiply) to balance the Oxygen atoms.

$2KClO_3 \rightarrow KCl + 3O_2$		
Reactants	→	Products
K (2)		K (1)
Cl (1)		Cl (1)
O (6)		O (6)

Now we simply balance K by placing 2 in front of KCl.

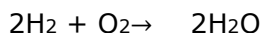
$2KClO_3 \rightarrow 2KCl + 3O_2$		
Reactants	→	Products
K (2)		K (2)
Cl (1)		Cl (1)
O (6)		O (6)

The Equation is now balanced.



CONCEPT OF MOLE RATIO TO CALCULATE THE AMOUNT OF REACTANTS:

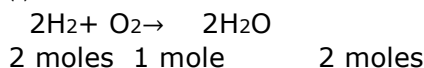
Q. Consider the following reaction.



- i) How many moles of Oxygen are needed to react with 4.5 moles of Hydrogen.
- ii) How many grams of Hydrogen will completely react with 100g of Oxygen to form water?

ATOMIC MASSES : H=1 and O= 16

Solution(i):

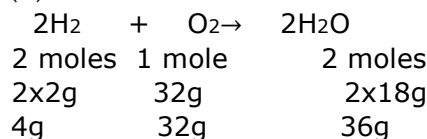


Given: 4.5 moles

Required: Moles of Oxygen

2 moles of H₂ react with 1 mole of O₂
 1 mole H₂ react with ½ mole of O₂
 4.5 moles H₂ react with ½ x 4.25 moles of O₂
 4.5 moles H₂ reacts with 2.25 moles of O₂ ANS.

Solution(ii):



32g of O₂ react with 4g H₂
 1g of O₂ react with 4/32 g H₂
 100g of O₂ react with 4/32 x 100g H₂
 100g of O₂ react with 12.5g H₂ ANS

RESULT:

- i) Number of moles of Oxygen = 2.25 moles
- ii) 100 g of Oxygen require 12.5g of H₂

EXERCISE

- i) 18 grams of H₂O contains 6.02x molecules. ii) A change which alters the composition of a substance is called chemical change.
- iii) A reaction in which a chemical substance breaks down to form two or more simpler substance is called decomposition reaction.
- iv) The reaction of NaCl with AgNO₃ is given as:

$$\text{NaCl} + \text{AgNO}_3 \rightarrow \text{NaNO}_3 + \text{AgCl}$$
 Is the reaction of a type double displacement
- v) When metals react with acid or water then produce H₂ gas.
- vi) Addition is the reaction in which two or more substances combine together to form a single substance. vii) A reaction in which a substance burns in oxygen to produce heat and flame is called combustion reaction.
- viii) Chemical equation is the short hand method to describing chemical reaction.
- ix) The reaction $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2(\text{g})$ is the single replacement reaction.