Spring Day School
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Class-11th
Subject- Chemistry
Chapter-1 Basic Concept of Chemistry

Definition of chemistry- the branch of natural science which deals with the study of matter properties of its constituent particles like atoms molecules and their structure, the effect of energy on it is called chemistry.

Importance and scope of chemistry- chemistry plays an important role in several fields. Some of the important fields are--

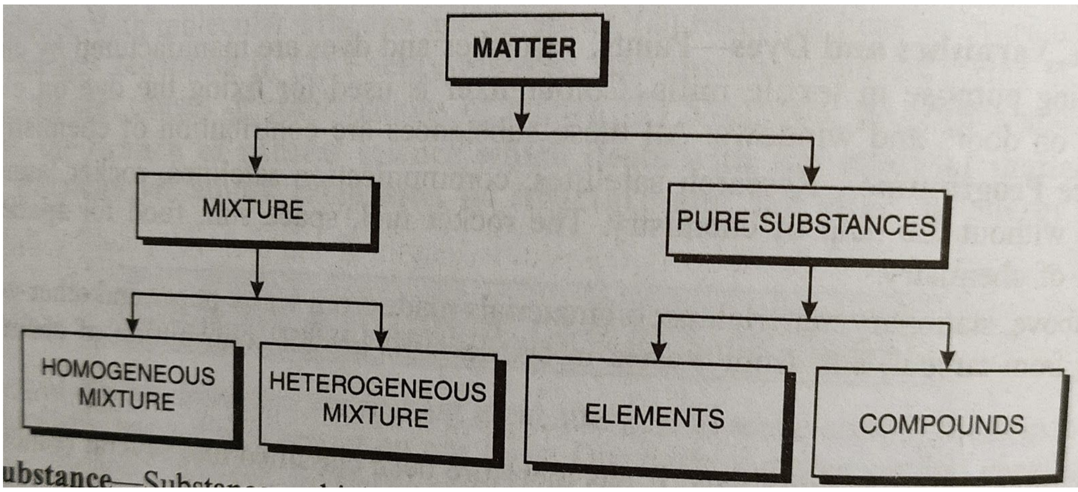
1) Health protection
2) life saving drugs
3) analgesics and anaesthetics and antiseptics
4) disinfectants and germicides
5) antibiotics and tranquilizer
6) industrial fields
7) agricultural field
8) food and beverage industry
9) textile industry
10) plastic and glass industry
11) cosmetics industry
12) paints,varnishes and dyes industry
13) space programming
14) metal and alloy industry
15) building raw material industry
16) fuel industry

Branches of chemistry-- The feel of chemistry is quite vast. It has therefore been classified into several branches. These branches are-

1) Organic Chemistry
2) Inorganic Chemistry
3) Physical Chemistry
4)Biochemistry
5) Analytical chemistry
6) Applied chemistry
7)Agriculture chemistry
8)Industrial chemistry
8)Soil chemistry
9)Medicinal Chemistry
10)Space Chemistry
11)Environmental Chemistry
12)Nuclear chemistry
13)Forensic chemistry
14)Poison chemistry
15)Food Chemistry
16)Green Chemistry

17)Energy chemistry

Nature of matter- Anything which has mass and occupies space is called matter. For example water,air, books,animals etc. Matter is found in three physical States. These states are solid, liquid and gas.



The international system of units (SI units)--

In 1960 International committee of weight and measure introduce International system of units which is popularly known as SI units, to bring uniformity in systems of units throughout the world. It has seven basic units and all other units are derived units from these basic units.

Table 1.1. Seven Basic SI Units

S. No.	Physical Measurement	Symbol	Name of unit	Symbol of unit
1.	Length	l	metre	m
2.	Mass	m	kilogram	kg
3.	Time	t	second	s
4.	Electric current	I	ampere	A
5.	Temperature	T	kelvin	K
6.	Amount of Substance	n	mole	mol
7.	Intensity of illumination	Iμ	candela	cd

Derived units-- Units for all physical quantities can be obtained by using basic units. These units are known as derived units.

Table 1.3. Some Important Derived S.I. Units

Physical quantity	Symbol	Mathematical relation	Name of unit	Symbol of unit	In terms of basic S.I. units
1. Area	A	$= l \times l$	Square metre	—	m^2
2. Volume	V	$= l \times l \times l$	Cubic metre	—	m^3
3. Density	ρ or d	$= \frac{m}{V}$	kilogram per cubic metre	—	$kg\ m^{-3}$
4. Velocity	c, u, v	$= \frac{l}{t}$	metre per second	—	$m\ s^{-1}$
5. Angular velocity	ω	$= \frac{\text{angle}}{\text{time}}$	radian per second	—	$rad\ s^{-1}$
6. Acceleration	a	$= \frac{l}{t^2}$	metre per second square	—	$m\ s^{-2}$
7. Concentration	C	$= \frac{\text{mole}}{\text{litre}}$	mole per litre	—	$mol\ dm^{-3}$
8. Force	F	$= m \times a$	newton	N	$kg\ m\ s^{-2}$
9. Work	W	$= F \times d$	joule	J	$kg\ m^2\ s^{-2}$
Energy	E				
Heat	H				
10. Power	P	$= \frac{\text{energy}}{\text{time}}$	watt	W	Js^{-1}
11. Pressure	P	$= \frac{\text{force}}{\text{area}}$	pascal	Pa	Nm^{-2} or $kg\ m^{-1}\ s^{-2}$
12. Electric charge	q	$=$ current $\times$ time	coulomb	C	As
13. Electric potential difference	V	$= \frac{\text{work}}{\text{charge}}$	volt or joule per unit charge	V	$kg\ m^2\ s^{-3}\ A^{-1}$ or $JA^{-1}\ s^{-1}$
14. Electrical resistance	R	$= \frac{\text{potential}}{\text{current}}$	ohm	Ω	VA^{-1}
15. Frequency	υ	$= \frac{1}{\text{time}}$	hertz	Hz	s^{-1}

Significant figures-. The uncertainty in the experimental for the calculated values is indicated by using numbers of significant figures. Significant figures are meaningful digits and are known with certainty. In significant figures all except last one are certain. For example in 2.35232352 are certain and last three is uncertain digit. In the last digit uncertainty is +or -1. Some rules to determine significant digits are-

1). All digits except zero are significant.

2). All zeros between non zero digits are significant.

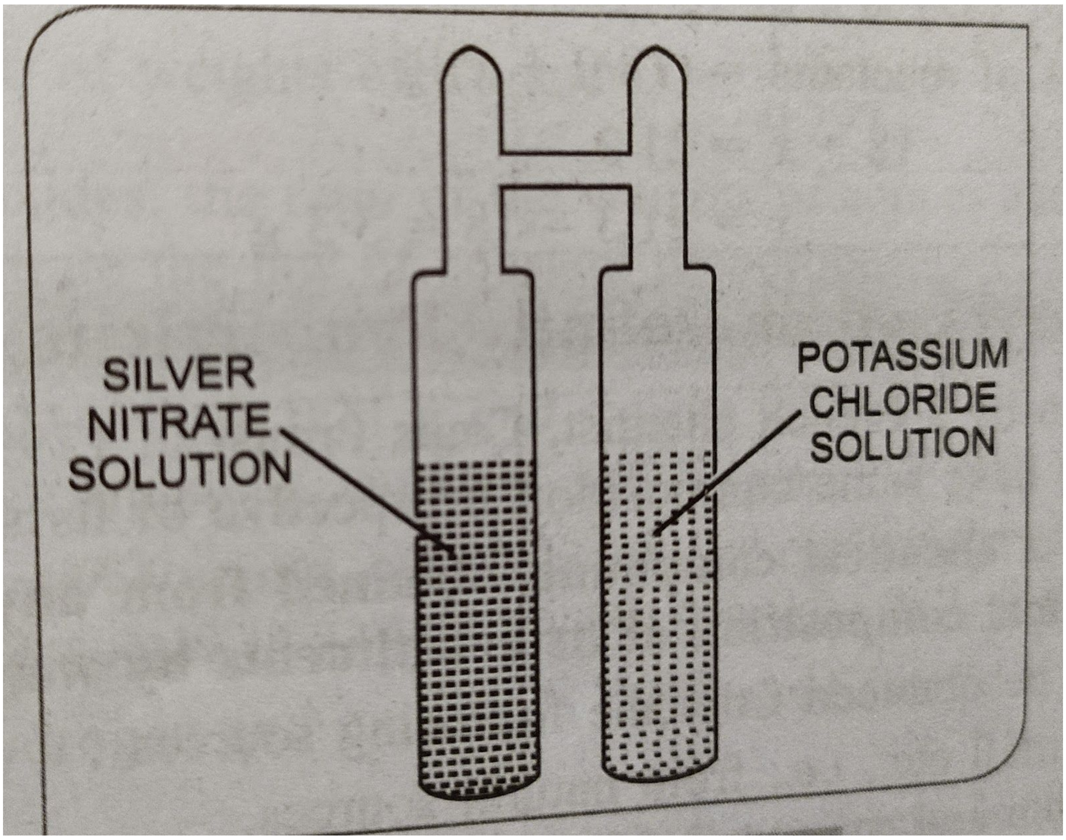
3)full stop zeros at the end of a decimal number that is zeros at the right of the last non zero digits are significant provided they are at the right side of the decimal points. Example in 2.0500 total significant figures are 5.

4). All zeros before first non zero digit are insignificant.for example in in 0.0020 there are two significant digits.

5) In counting things there are infinite significant figures for example 2 bananas,20 pens etc.

6)full stop in a non decimal figure all zeros after last non zero digit are insignificant. Such a number is indicated by scientific notation.For example in 102500 total four significant digits.

Laws of chemical combination- All chemical reaction between two or more than two substances are governed by some laws. These laws are known as law of chemical combination. These laws are-
1) law of conservation of mass
2)law of constant or fixed or definite proportion
3) law of multiple or simple proportion
4) gay lussac's law of gaseous volume
5) avogadro's law
6) law of reciprocal or equivalent proportion
1) law of conservation of mass-- this law was given by the Russian scientist Lomonosoff in the year 1756. Which was later confirmed by Lavoisier and Landolt. According to this law matter can neither be created nor destroyed as a result of any physical or chemical change. in other words the total mass of the product formed is always equal to the mass of the reacting substance after the physical or a chemical change. To show this landolt did an experiment in which he took a h shaped tube which is made of of glass. In one limb of the tube hi to potassium chloride solution and in the other limb silver nitrate solution was taken full stop the tube was filled and then weighed. Now the tube was shaken to mix the two solution thoroughly. A white precipitate of silver chloride was formed
Potassium chloride+silver nitrate=potassium nitrate+silver chloride



2) law of constant or fixed or definite proportion-- This law was given by a French chemist Louis prost in 1799. he observed that a chemical compound is always found to have some composition irrespective to its source. According to this law"chemical compound obtained from any source or prepared by any method has the same chemical composition of its constituents by weight."

For example water can be obtained from any of the source like river,well,sea aur aur can be obtained by the reaction of hydrogen and oxygen in laboratory. By chemical analysis it was found that in terms of weight ratio of hydrogen and oxygen was always 1:8.

3) law of multiple aur simple proportion- this law was first put forward by John delton in 1803. According to this"when two elements combine together to form two or more than two chemical compounds, then the weight of one of the element which combine with a fixed weight of the other bears a simple ratio to one another.

For example the elements nitrogen and oxygen combine to produce 5 oxides of nitrogen. In all these oxides the weight of nitrogen and oxygen which combined together bears a simple ratio.

Oxides	Ratio by Weight of Nitrogen and Oxygen
Nitrous oxide, N_2O	28 : 16 or 14 : 8
Nitric oxide, NO	14 : 16 or 14 : 16
Dinitrogen trioxide, N_2O_3	28 : 48 or 14 : 24
Dinitrogen tetroxide, N_2O_4	28 : 64 or 14 : 32
Dinitrogen pentoxide, N_2O_5	28 : 80 or 14 : 40

4) Gay lussac's law of gaseous volume- it was put forwarded by Gay-Lussac in 1808. According to this law"gases combine with each other in the simple ratio of their volume.If product is a gas it also bears the simple ratio with the volume of reactants provided all volumes are measured under similar conditions.

For example one volume of hydrogen react with 1 volume of chlorine to form two volume of HCl gas.

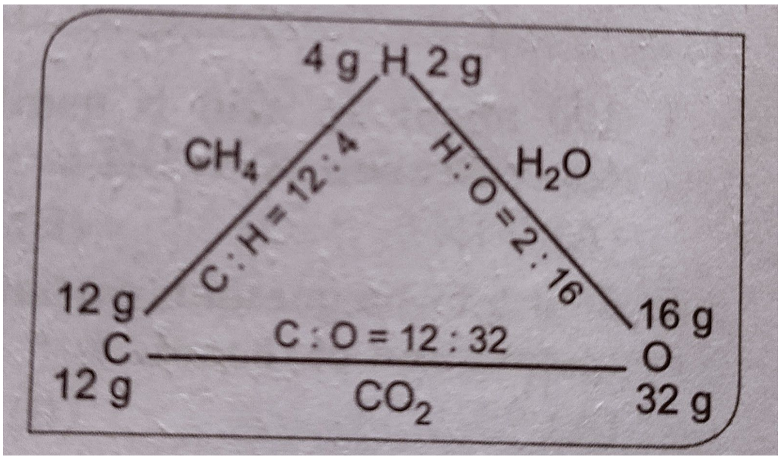
H_2+ Cl_2---->2HCl

5) Avogadro's law- this law was proposed by avogadro in 1811.According to this law,"at equal temperature and equal pressure, in equal volume of gases number of molecules must be equal".

For example at equal temperature and equal pressure in containers off to litre each having hydrogen,helium,CO_2 and SO_2 there will be equal number of molecules.

6) law of reciprocal or equivalent proportion- This hello was given by Ritcher in 1792. According to this law the ratio of the weight of two elements a and b which combines separately with a fixed weight of of the third element c is either the same for some simple multiple of the ratio of the weight in which a and b combine directly with each other.

For example the element C and O combined separately with the third element H to form CH_4 and water and they combine directly with each other to form CO_2.



Delton atomic theory-- This theory was proposed by John Dalton in 1808 after studying law of chemical combination. The main points of this theory are--
1). Matter is made up of extremely small and indivisible particles called atoms.
2). Atom of same substance are identical in all respect.
3). Atoms of different substance are different in all respect.
4). Atom is the smallest particle that takes part in chemical reaction.
5)full stop atoms of different elements may combine with each other in a fixed simple whole number ratio to form compound atoms.
6). Atoms can neither be created nor destroyed.
7). An atom exhibits all the properties of an element.
8). It is the smallest particle taking part in a chemical reaction that maintains its in divisibility even after the chemical change.
9). Atom cannot be divided further means it is indivisible (A-cannot tom-cut).

Limitations of Dalton's atomic theory-
1) it is unable to explain the difference between the atoms of two different elements.
2) it is unable to explain the cause of compound formation by the combination of atoms of substance.
3) it is unable to explain the bonding forces between the atoms of a compound atom (molecule).
4)it is unable to explain the gay lussac's law of gaseous combination.
5)it is unable to differentiate between an individual atom and a compound atom (molecule).

Concept of elements,atoms and molecules

Element-Pure substances are of two types. First type is compound and II type is element. British scientist Robert Boyle mentioned in 1660 about element. The definition of element was modified by lavoisier. According to him an element is a pure substance which can neither be decomposed into nor built from simpler substances by any physical or chemical method. Elements contain similar types of atoms. For example- In Nitrogen element all atoms will be of Nitrogen..

Atom-An atom is the smallest part of an element which participates in chemical reactions but does not exist in free state.

Molecule- A molecule is the smallest part of a substance which has the properties of that substance and can exist freely. In other word atom is the smallest part of an element which exhibits all of its properties and take part in chemical reactions. Molecules can be further subdivided-

1) molecules of an element-(H_2,N_2,O_2)
2) molecules of a compound-(HCl,CH_4,NH_3)

Atomic mass- atomic mass of an element is the number which shows as to how many times in atom of the element is heavier than 1/12th part of a carbon atom.

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$$\text{Atomic mass of an element} = \frac{\text{Mass of an atom of the element}}{\text{1/12th part of mass of a carbon (C-12) atom}}$$

xample, atomic mass of nitrogen is 14. It ...

Molecular mass- molecular masses of substances are determined relative to mass of an atom of carbon-12 resuming 12 atomic mass unit fullstop the molecular mass of a compound is is the number which shows that how many times a molecule is is heavier than one twelfth of mass of one atom of carbon-12.

han one twelfth of mass of one atom of carbon-12.

$$\text{Molecular mass of a compound} = \frac{\text{Mass of one molecule of a compound}}{\text{1/12th part of mass of one carbon-12 atom}}$$

xample, the molecular mass of H_2O is 18. It means the mass of one molecule o

Mole concept- Number of atoms present in 1 gram atom of carbon 12 is called avogadro number. It is denoted by 'N'. Its numerical value is also 6.022×10^{23}. This number is called Mole. There are 1 mole atoms in 1 gram atomic mass. It is observed that at NTP 1 mole of molecules of every gas has a volume of 22.4 litre. This is known as molar volume.

Empirical formula- empirical formula is the formula which represents the atoms of elements present and the simplest whole number ratio between atoms in 1 molecule of the compound.

- For example mercurius chloride (Hg_2Cl_2) has empirical formula HgCl.. similarly acetic acid (CH_3COOH) has empirical formula CH_2O.

elements. This gives the empirical formula of the compound.

Example 1. *A compound contains 20·15% iron, 11·51% sulphur, 23·02% oxygen and 45·32% water of crystallisation. Calculate the empirical formula of the compound.* [Fe = 56, S = 32, O = 16]

Solution : Calculation of Empirical Formula

Element	% Amount	Atomic mass	Number of atoms	Simple ratio
Fe	20·15	56	$\frac{20.15}{56} = 0.359$	$\frac{0.359}{0.359} = 1$
S	11·51	32	$\frac{11.51}{32} = 0.36$	$\frac{0.360}{0.359} = 1$
O	23·02	16	$\frac{23.02}{16} = 1.44$	$\frac{1.44}{0.359} = 4$
H_2O	45·32	18	$\frac{45.32}{18} = 2.518$	$\frac{2.158}{0.359} = 7$

Ratio between the constituents Fe, S, O and H_2O is 1 : 1 : 4 : 7

∴ Empirical formula of the compound will be $FeSO_4.7H_2O$.

... element is 56, calculat

Method for expressing concentration of a solution

1)**Strength--** Amount of solute in grams in 1 litre that is 1000 ml solution is known as strength. It is expressed in grams per litre.

2) **Molarity(M)**-- Molarity of a solution is defined as the number of moles of the solute dissolved in 1 litre of a solution. It can be expressed by the formula--

M=w×1000/m×V

3)**Molality(m)**-- Molality of a solution is defined as the number of moles of the solute dissolve in kilograms it is denoted by by m.

m=w×1000/m×W

4)**Normality (N)**--Normality is defined as the number of equivalent or gram equivalent of solute in one litre solution it is denoted by by N.

N=w×1000/E×V

5) **Mole fraction--** In a solution ratio of number of mole of solute to number of moles of solute and solvent is known as mole fraction of solute. Ratio of number of mole of solvent to number of moles of solute and solvent is known as mole fraction of solvent. If number of mole of solute and solvent in a solution are n and N.respectively then number of mole of solution =n+N. Therefore

Mole fraction of solute=n/n+N
Mole fraction of solvent=N/n+N

6)**Formality (F)**-- Number of gram formula mass of solute in one litre solution is known as its formality it is denoted by F. Formality can be formulated by the formula...

F=w×1000/Fm×V

7)Concentration of solution in parts per million (ppm)---Number of parts of solute in 1 million parts of solution by weight is known as concentration parts per million.. it can be formulated by the formula--

ppm=mass of solute in gram/mass of solution in gram×1000000

Limiting reagent-- In chemical reaction reactants react according to the balanced chemical equation i.e. moles of reactants react in the ratio given in the equation.If one of the reactant is present in lesser amount than the requirement then this reactant is called limiting reactant. Now this reaction takes place according to the amount of limiting reagent. Rest of the reagent being in excess are left behind.
