SOME BASIC CONCEPTS OF CHEMISTRY
PROPERTIES OF MATTER AND THEIR MEASUREMENT

❖ Basic concepts of Chemistry

Chemistry (derived from the Egyptian word came (chem), which means "earth") is a science that studies the composition, structure and properties of matter and the changes it undergoes during chemical reactions. Chemistry is often referred to as core science because it plays a role in linking physical sciences (including chemistry) with life sciences and applied sciences (such as medicine and engineering).

❖ Chemistry is divided into following branches:

Physical chemistry The branch of chemistry which deals with macroscopic as well as physical phenomena in a universe. It is generally the impact of physical property on the chemical property as well as structure of a substance.

❖ Inorganic chemistry

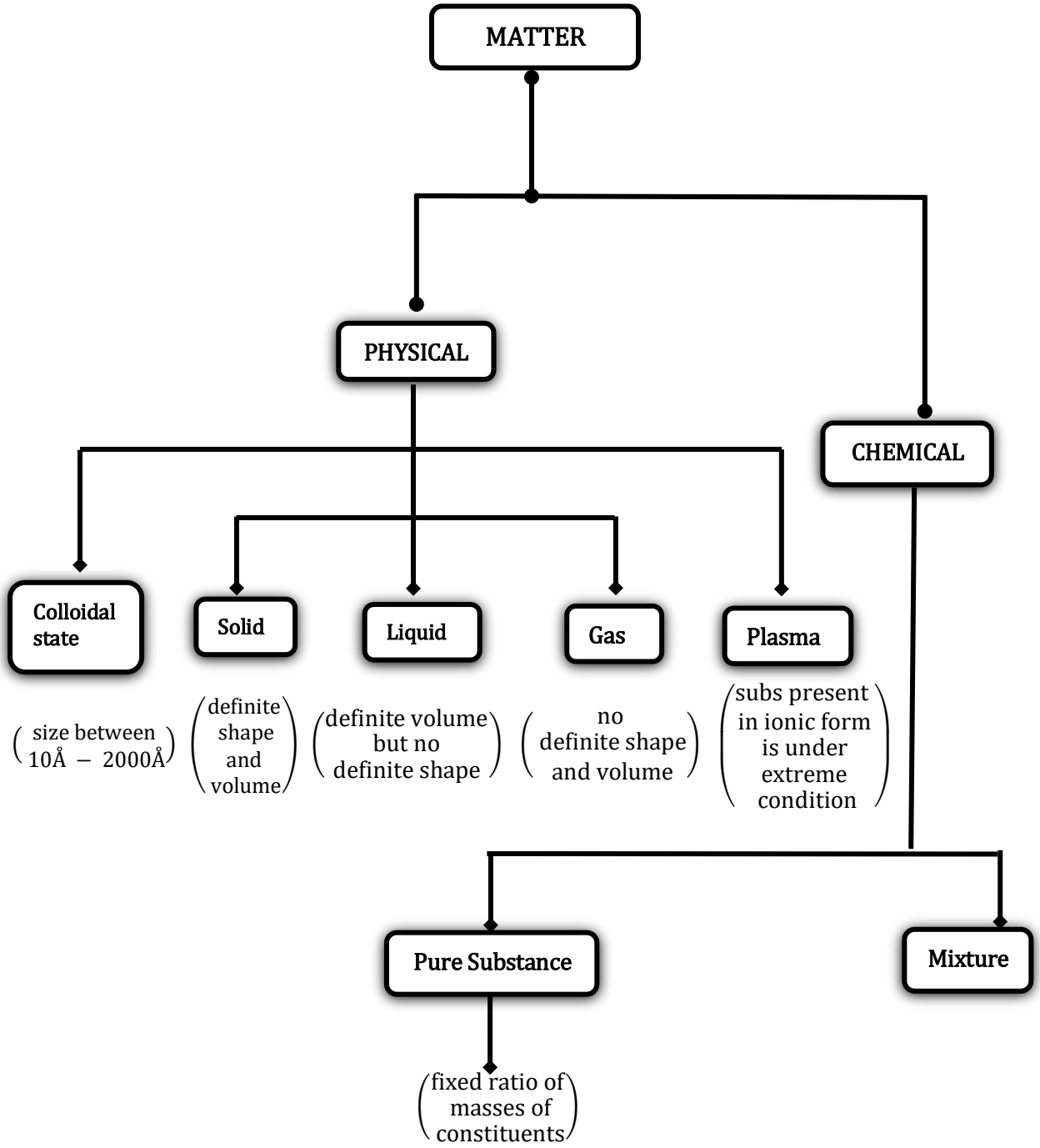
The branch of chemistry that studies compounds that do not contain carbon and hydrogen atoms is called "inorganic chemistry." Simply put, it is the opposite of organic chemistry. Substances that do not have carbon-hydrogen bonds include metals, salts, and chemicals.

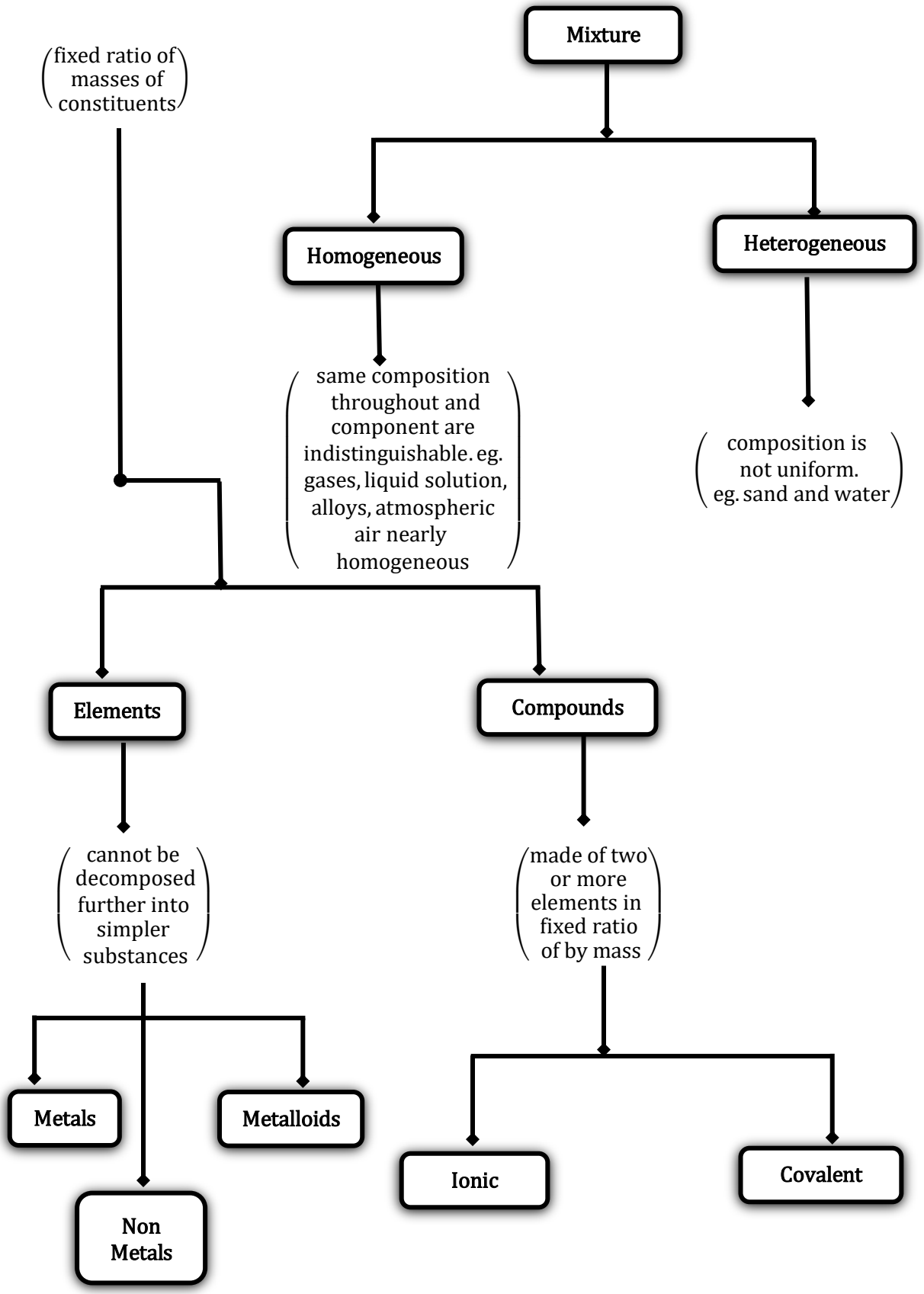
❖ Organic chemistry

The discipline which deals with the study of the structure, composition and the chemical properties of organic compounds is known as organic chemistry. It involves the study of Carbon and its compounds.

Biochemistry Biochemistry is that branch of chemistry that explores the chemical processes in organisms and associated with them. It's a laboratory-based science that connects biology and chemistry. By using chemical knowledge and technology, biochemists can understand and solve biological problems

Analytical chemistry It is the branch of chemistry which uses instruments and analytical techniques to determine structure, functionality and properties of a substance.


MATTER
PHYSICAL
CHEMICAL
Colloidal state
Solid
Liquid
Gas
Plasma
(size between 10Å − 2000Å)
(definite shape and volume)
(definite volume but no definite shape)
(no definite shape and volume)
(subs present in ionic form is under extreme condition)
Pure Substance
Mixture
(fixed ratio of masses of constituents)


Mixture
Homogeneous
Heterogeneous
same composition throughout and component are indistinguishable. eg. gases, liquid solution, alloys, atmospheric air nearly homogeneous
composition is not uniform. eg. sand and water
fixed ratio of masses of constituents
Elements
Compounds
cannot be decomposed further into simpler substances
made of two or more elements in fixed ratio of by mass
Metals
Metalloids
Non Metals
Ionic
Covalent

Matter is defined as anything that have some mass and also occupies a certain volume in a space. Generally, matter is classified into three phases:

- **Solid-** The substance which have a definite shape as well as maintain its volume as per it's shape, also they have least freedom of movement. e.g., sugar, iron, gold, wood etc.
- **Liquid-** A substance is a substance which generally possess the shape of a container but have a fixed volume. Also liquids have the property to flow or to be poured. E.g., water, milk, oil, mercury, alcohol etc.
- **Gas-** Substances which do not have a definite volume as well as definite shape. Gases generally completely fill the container they are kept in. E.g., hydrogen, oxygen etc.

The three states are interconvertible by changing the conditions of temperature and pressure as follows:

❖ CLASSIFICATION OF MATTER AT MACROSCOPIC LEVEL

Matter can further be classified into following at bulk or macroscopic level:

(a) Mixtures

(b) Pure Substances

These can be further classified as shown below:

(a) Mixtures: A mixture is a substance in which two or more substance are present in any ratio. Primarily It is of two types: Heterogeneous and Homogeneous mixtures.

- **Homogeneous mixture-** Two substances are mixed to form a mixture such that there exists one single uniform phase i.e., composition of substances present is uniform. Sugar solution and air are thus, the examples of homogeneous mixtures.
- **Heterogeneous mixtures-** Two or more substances are mixed which result in non-uniform composition throughout the mixture. Some of the examples are suspensions, mixture of two solids suppose salt and sugar.

Note: Any distinct portion of matter that is uniform throughout in composition and properties is called a Phase.

(b)Pure substances: - A material containing only one type of particle is called a pure substance.

Note: In chemistry, Form of matter having constant chemical composition and chemical properties and they cannot be separated into component by physical methods. Pure substances are further divided as given below:

Element- An element is defined as a pure substance that contains only one kind of atoms and cannot be further broken down.

The elements are further split into three classes based on their physical and chemical properties i.e.

(1) Metals

(2) Non- metals and

(3) Metalloids.

Compound- A compound is a pure material that consists of two or more elements mixed in a defined mass proportion. Furthermore, a compound's qualities are distinct from those of its constituting elements. Moreover, the constituents of a compound cannot be separated into simpler substances by physical methods. They can only be separated by chemical methods.

PROPERTIES OF MATTER Unique or characteristic properties is depicted by every substance. Physical properties and chemical properties are the two types of properties that are observed.

Physical properties are those that may well be measured or observed without affecting the substance's identity or composition. Colour, fragrance, melting point, boiling point, density, and other physical qualities are some of the examples.
Chemical properties are the properties of specific substances that can be observed in chemical reactions. Some of the main chemical properties include flammability, toxicity, heat of combustion, pH, radioactive decay rate, and chemical stability.

❖ MEASUREMENT

Physical quantities Physical quantities are quantities which we encounter during our scientific study. Any physical quantity can be measured in two parts:

(1) The number

(2) The unit: Unit is defined as the reference standard chosen to measure any physical quantity.

S.I. UNITS The International System of Units (in French Le System International d'Unités – abbreviated as SI) was established by the eleventh General Conference on Weights and Measures (CGPM from Conference Generali des Poids at Measures). The CGPM is an inter-governmental treaty organization created by a diplomatic treaty known as Meter Convention which was signed in Paris in 1875.

There are seven base units in SI system as listed below These units pertain to the seven fundamental scientific quantities. The other physical quantities such as speed, volume, density etc.

can be derived from these quantities. The definitions of the SI base units are given below: Unit of length Unit of mass Unit of time Unit of electric current Meter Kilogram Second Ampere The meter is the length of the path travelled by light in vacuum during a time interval of 1 299 792 458 of a second. The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram. The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium—133 atom. The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 meter apart in vacuum, would produce between these conductors a force Unit of thermodynamic Temperature Unit of amount of substance Unit of luminous intensity Kelvin mole Candela equal to $-7\ 2\ 10 \times$ newton per meter of length. The kelvin, unit of thermodynamic temperature, is the temperature fraction 1 273. 16 of the thermodynamic temperature of the triple point of water.

The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon—12 ; its symbol is "mol.".

When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles. The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency $540\ 1012 \times$ hertz and that has a radiant intensity in that direction of 1 683 watt per steradian.

Note: The mass standard is the kilogram since 1889. It has been defined as the mass of platinum-iridium (Pt-Ir) cylinder that is stored in an airtight jar at International Bureau of Weights and Measures in Sevres, France. Pt-Ir was chosen for this standard because it is highly resistant to chemical attack and its mass will not change for an extremely long time.

❖ SOME IMPORTANT DEFINITION

Mass and Weight The mass of a substance is the amount of substance present in it and the weight is the force exerted by gravity on the object. The mass of matter is constant, and due to changes in gravity, its weight can vary from place to place. The SI unit of mass is kilogram (kg). The SI derived unit of weight (the derived unit of the SI base unit) is Newton.

Volume is the amount of three-dimensional space surrounded by certain closed boundaries, for example, the space occupied or contained by a substance (solid, liquid, gas, or plasma) or shape. Volume is usually quantified numerically using SI derived units (cubic meters).

Density The mass density or density of a material is defined as its mass per unit volume. The density is represented by the symbol ρ (the lower-case Greek letter rho).

SI unit of density is -3 kg m.

Temperature is a physical property of matter, which quantitatively expresses the common concepts of heat and cold. There are three common scales for measuring temperature: (Celsius), (Fahrenheit) and (Kelvin).

The temperature on two scales is related to each other by the following relationship:

$$°F = 9 / 5\ C^0 + 32$$

$$K = C^0 + 273.15$$