Chemistry – XI

Chapter - 1

SOME BASIC CONCEPTS OF CHEMISTRY

Topics included in this Lecture

- ❑ Classification of Matter
- ❑ Properties of Matter
- ❑ Units for Measurement
- ❑ Interconversion of units

Matter

- Anything which has mass and occupies space is called **matter**.
- Each substance in the universe is made of matter.
- The basic constituents of matter are **atoms** and **molecules**.

H

He

H_2

He

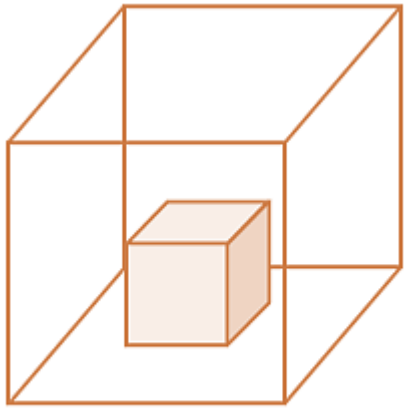
Classification of Matter

Matter can be classified on the basis of its

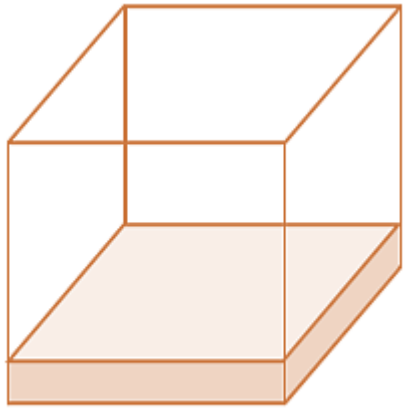
- physical state
- chemical composition.

On the basis of Physical State, matter can exist in three physical states **viz. solid, liquid and gas.**

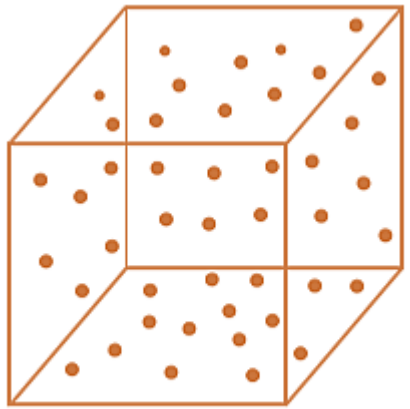
1. Interparticle spaces
2. Intermolecular forces
3. Thermal energy



Solid



Liquid



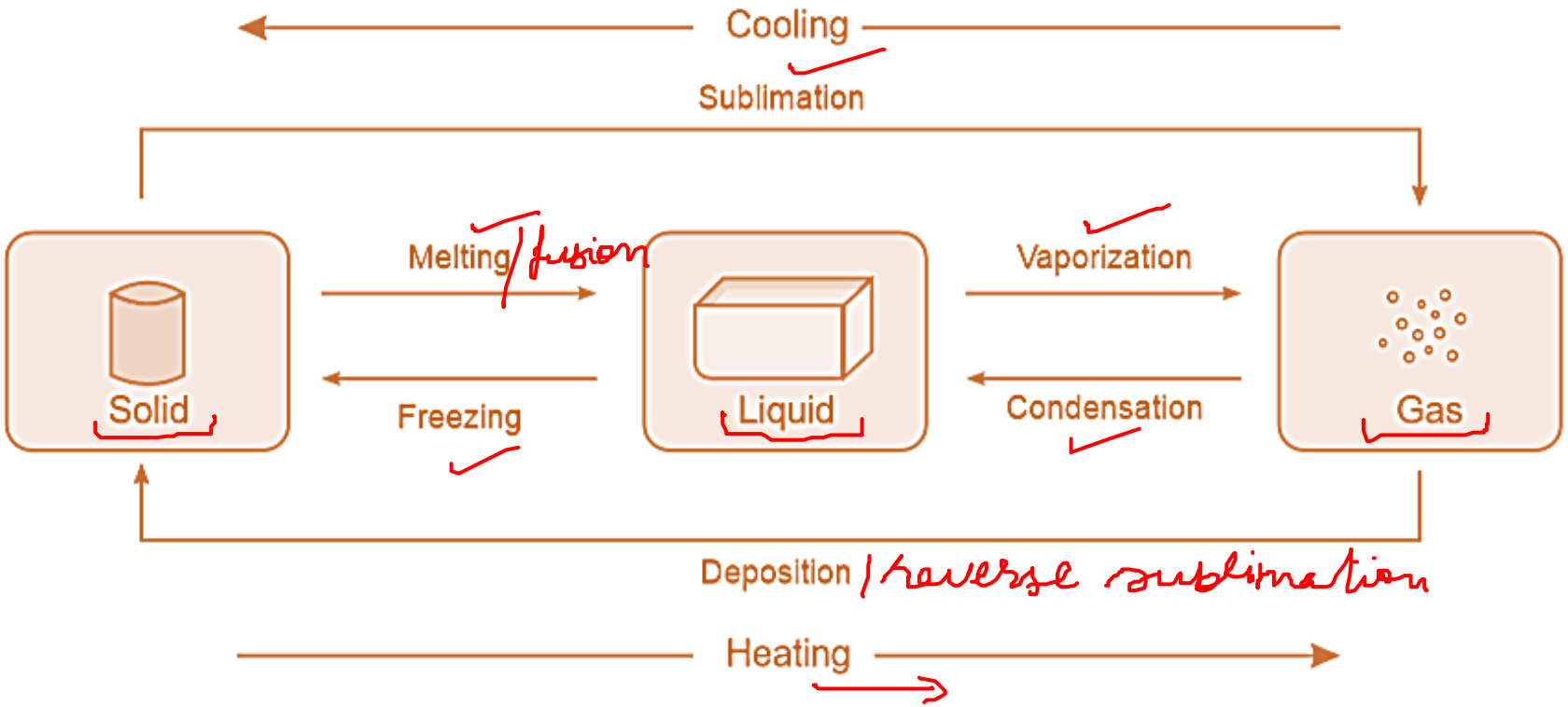
Gas

Solid	Liquid	Gas
▪ In **solids**, the particles are held very close to each other and their constituent particles have fixed positions and oscillate about their mean positions. ▪ Solids have definite mass, volume and shape.	▪ In **liquids**, the particles are close to each other but they can move around. ▪ Liquids have no fixed shape but have a fixed volume. They take up the shape of the container in which they are kept.	▪ In **gases**, the particles are far apart as compared to those present in solid or liquid states and their constituent particles move randomly, at high speed. ▪ Due to high speed of particles and large space between them, gases show the property of diffusing very fast into other gases. ▪ These are highly compressible.

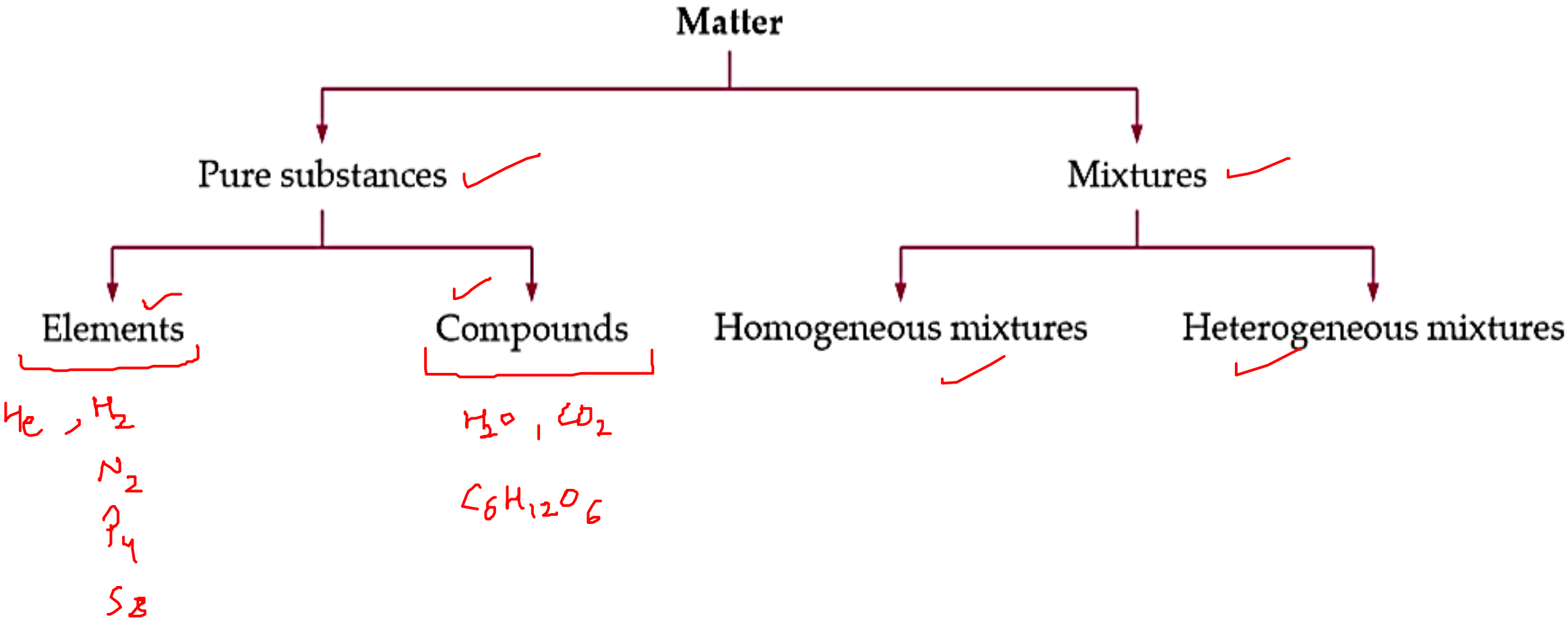
Shape: Indefinite

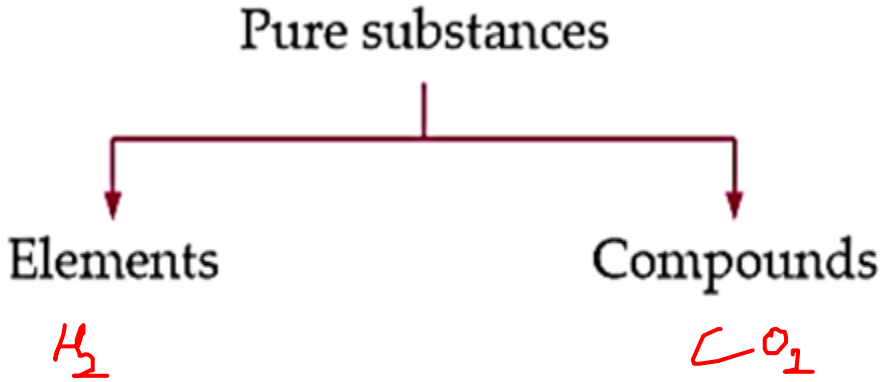
Volume: Indefinite

These three states of matter are **interconvertible** by **changing** the conditions of **temperature** and **pressure**.

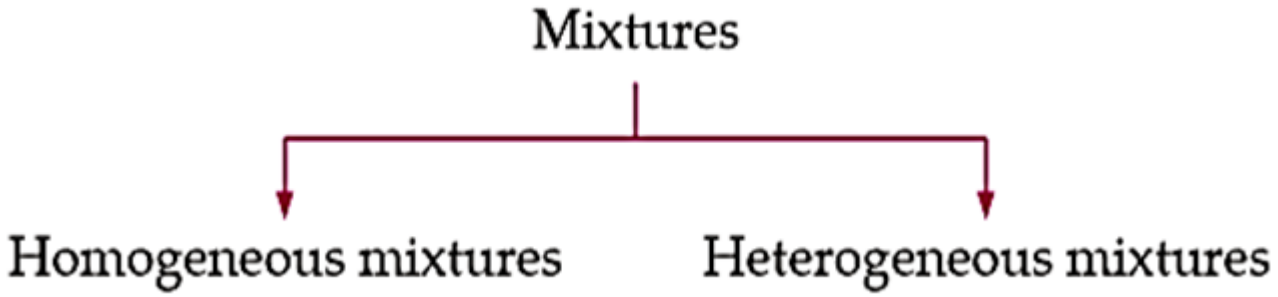


On the basis of chemical composition, matter can be classified as **pure substances** and **mixtures.**


Matter
Pure substances
Mixtures
Elements
Compounds
Homogeneous mixtures
Heterogeneous mixtures
He , H_2
N_2
P_4
S_8
H_2O , CO_2
$C_6H_{12}O_6$



- **Pure substance** is a substance in which all the constituent particles are of the same chemical nature.
- An ***element*** consists of only one type of particles (atoms or molecules). For example, sodium (Na), copper (Cu), silver (Ag), hydrogen (H_2), oxygen (O_2) etc.
- A ***compound*** consists of two or more atoms of different elements combined in a definite ratio by mass. For example, water (H_2O), ammonia (NH_3), carbon dioxide (CO_2) etc.

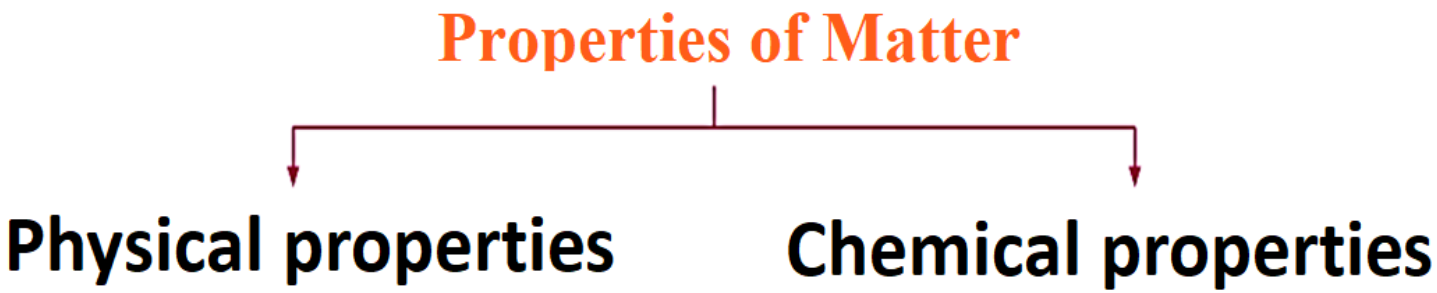


- **A mixture** consists of two or more substances mixed in any ratio. A mixture may be either ***heterogeneous*** that consists of distinct phases or ***homogeneous*** that consists of single phase.
- In a *homogeneous mixture*, composition is uniform throughout. For example, sugar in water.
- In *heterogeneous mixtures*, the composition is not uniform throughout. For example, sand in water.

Properties of Matter

Every substance has characteristic properties which can be classified into two categories:

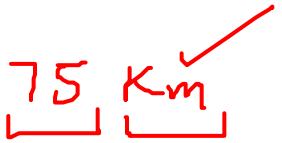
- **Physical properties**
- **Chemical properties**



- The property which can be measured without changing the chemical composition of the substance is known as **physical property**. For example, mass, volume, density, refractive index etc.
- The property which can be evaluated at the cost of matter, i.e., require a chemical change to occur is known as **chemical property**. For example, acidity or basicity, combustibility etc.

Units for Measurement

- All physical quantities have to be measured.
- Any measurement is represented by a **number followed by unit** in which it is measured.



S.I. System of Units

- The International System of Units (**S.I. system** of units) was introduced as a common standard system for measurement of physical quantities.
- The S.I. system has **seven fundamental units** and the other units are derived from these units (**Derived units**).

Fundamental Units

Fundamental units are those units which can neither be derived from one another nor be further resolved into any other units.

Physical Quantity	Name of Unit	Abbreviation
Mass	Kilogram	kg
Length	Metre	m
Temperature	Kelvin	K
Amount of substance	Mole	mol
Time	Second	s
Electric current	Ampere	A
Luminous intensity	Candela	cd

Derived Units

Derived units are the units which are expressed as a function of more than one fundamental units.

Quantity with formula	Unit
Speed = $\frac{\text{Distance (m)}}{\text{time (s)}}$	ms^{-1} or m/s
Area = $l \times b = m \times m$	m^2
Volume = $l \times b \times h = m \times m \times m$	m^3
Density = $\frac{\text{mass (kg)}}{\text{volume } (m^3)}$	$kg\,m^{-3}$

The S.I. system allows the use of prefixes to indicate the **multiples** or **submultiples** of a unit.

Multiple	Prefix	Symbol
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m
10^{-2}	centi	c
10^{-1}	deci	d

Multiple	Prefix	Symbol
10	deca	da
10^2	hecto	h
10^3	kilo	k
10^6	mega	M

$1\,MHz = 10^6\,Hz$

$1\,pm = 10^{-12}\,m$, $1\,nm = 10^{-9}\,m$, $1\,\mu m = 10^{-9}\,m$ $1\,km = 10^3\,m$

Practice Question

Que. Convert the following measurements in base fundamental units.

(i) $23.4\ km = 23.4 \times 10^{3}\ m$

(ii) $98.45\ pm = 98.45 \times 10^{-12}\ m$

(iii) $0.0098\ \mu m = 0.0098 \times 10^{-6}\ m$

$1\ km = 10^{3}\ m$

$1\ pm = 10^{-12}\ m$

$1\ \mu m = 10^{-6}\ m$

(iv)845 $mmol$ $= 845 \times 10^{-3}$ mol

(v) 74.23 Å $= 74.23 \times 10^{-10}$ Å $\quad [1 \text{ Å} = 10^{-10} \text{ m}]$

(vi)400 nm $= 400 \times 10^{-9}$ m

Practice Question

Que. Find the relationship between picometer and nanometer.

Ans. $1\,pm = 10^{-12}\,m$

$= 10^{-12} \times 10^{9}\,nm$ [$1\,m = 10^{9}\,nm$] or ($1\,nm = 10^{-9}\,m$)

$= 10^{-3}\,nm$

or $\boxed{1\,pm = 10^{-3}\,nm}$

$1\,pm = \frac{1}{1000}\,nm$

$\Rightarrow \boxed{1000\,pm = 1\,nm}$

Practice Question

Que. Compare the magnitude of intermolecular forces in three states of matter.

Ans. Gas < Liquid < Solid

⟶ Increasing intermolecular forces ⟶

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