



# General Chemistry

## Foundation of Chemistry

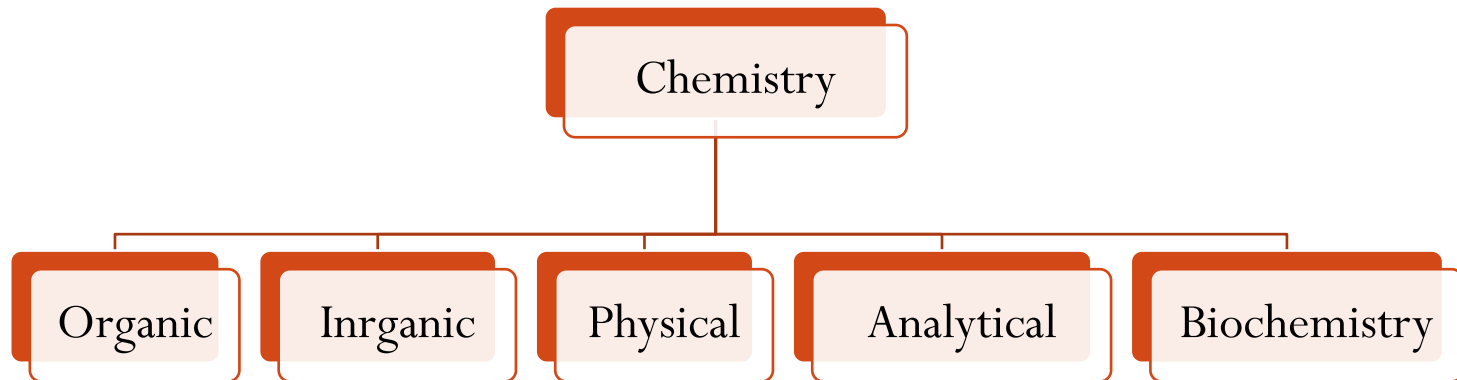
### Lec2

# OUTLINE

1. **Matter and Energy**
2. **States of Matter**
3. **Chemical and Physical Properties**
4. **Chemical and Physical Changes**
5. **Mixtures, Substances, Compounds, and Elements**
6. **Measurements in Chemistry**
7. **Units of Measurement**

# What is Chemistry ?

- Chemistry is the science that describes matter - its properties, the changes it undergoes and the energy changes that accompany those processes.



# Chemistry

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graph LR; C[Chemistry] --- O[Organic]; C --- I[Inorganic]; C --- P[Physical]; C --- A[Analytical]; C --- B[Biochemistry]; O --- O_desc[The chemistry of compounds of carbon and hydrogen]; I --- I_desc[The study of substances that do not contain carbon combined with hydrogen]; P --- P_desc[Applies the mathematical theories and methods of physics to the properties of matter and to the study of chemical processes and the accompanying energy changes.]; A --- A_desc[The detection or identification of substances present in a sample or with the amount of each that is present]; B --- B_desc[is the study of the chemistry of processes in living organisms];
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## Organic

The chemistry of compounds of carbon and hydrogen

## Inorganic

The study of substances that do not contain carbon combined with hydrogen

## Physical

Applies the mathematical theories and methods of physics to the properties of matter and to the study of chemical processes and the accompanying energy changes.

## Analytical

The detection or identification of substances present in a sample or with the amount of each that is present

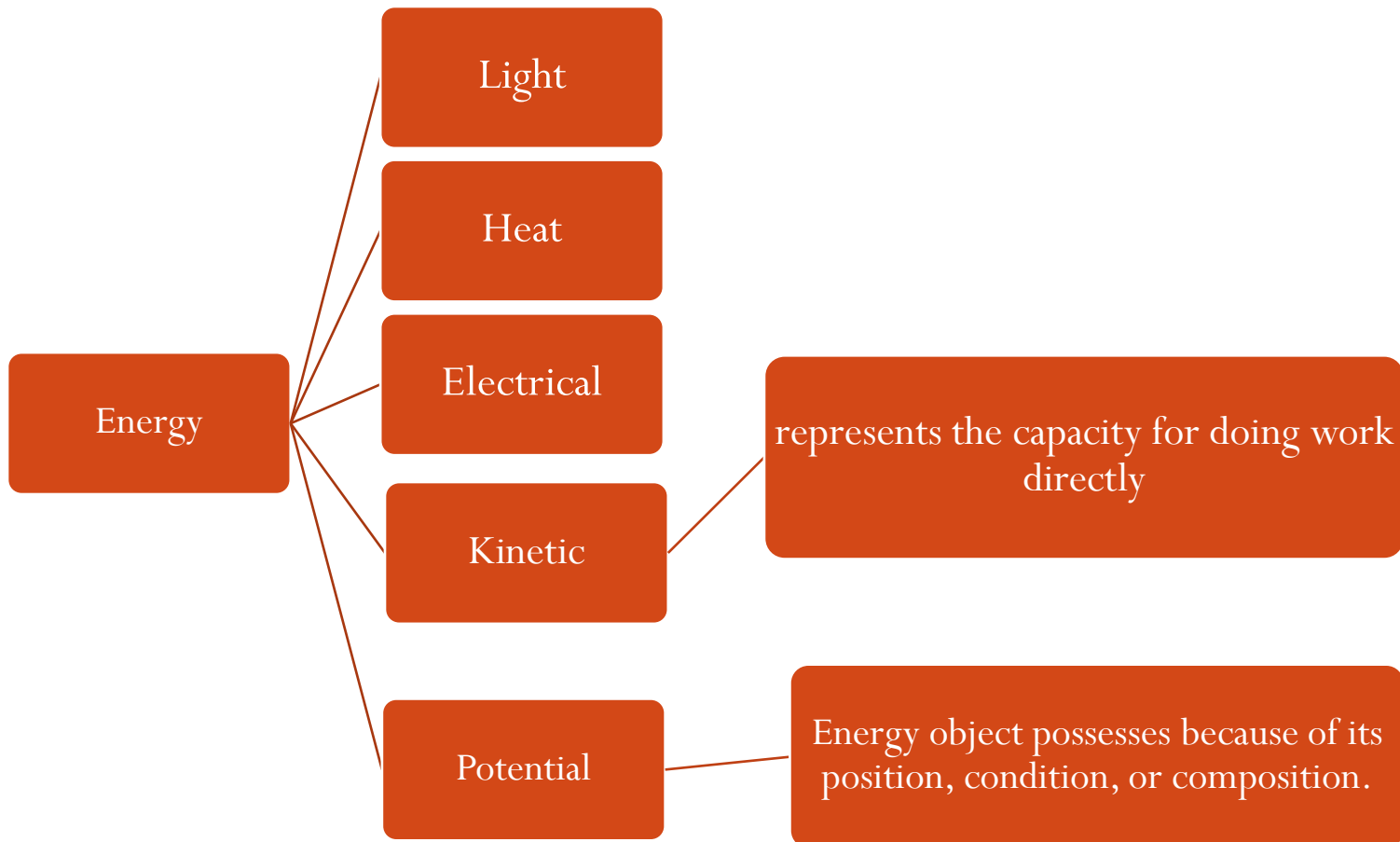
## Biochemistry

is the study of the chemistry of processes in living organisms

# MATTER AND ENERGY

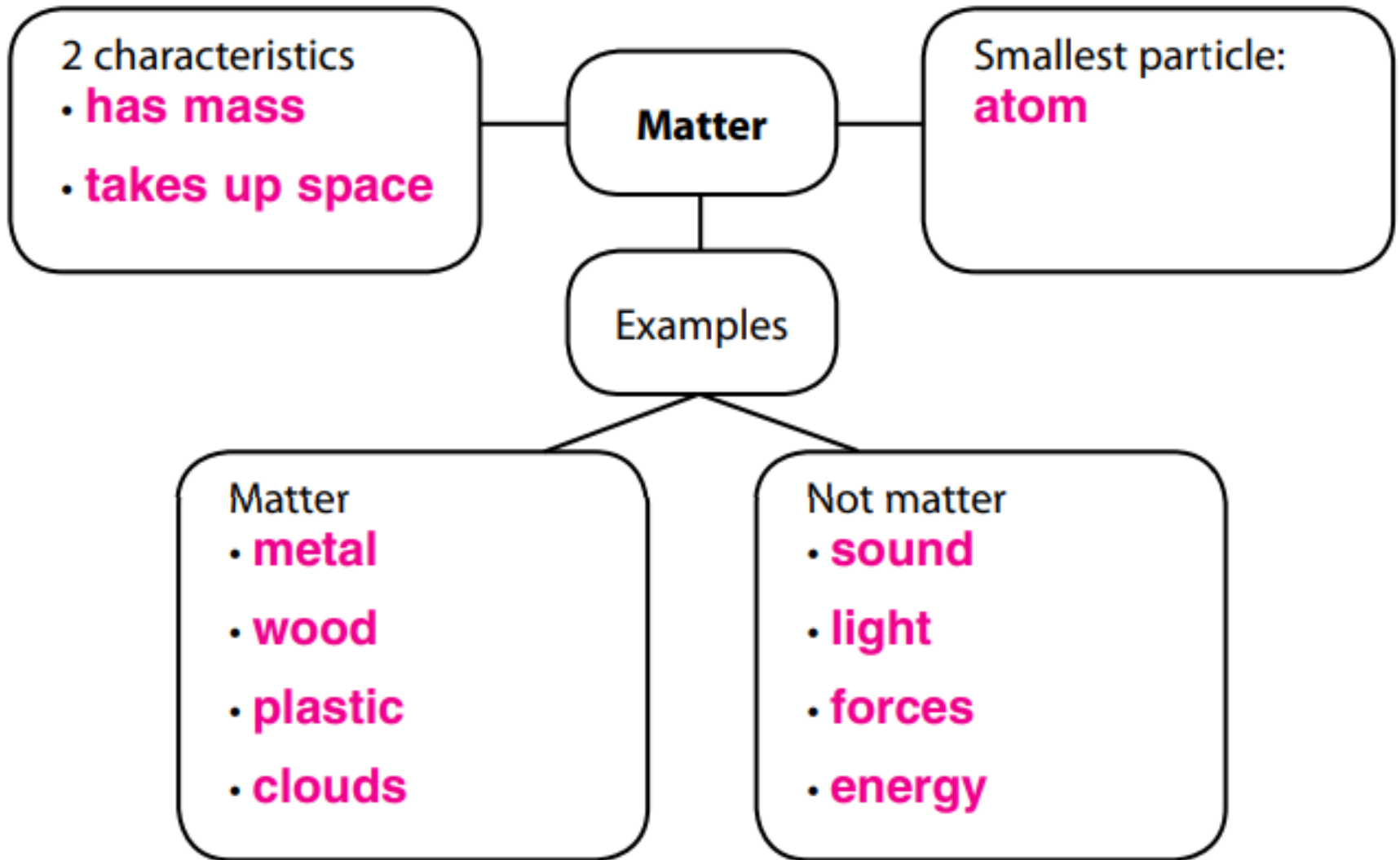
**Matter** is anything that has mass and occupies space.

**Energy** is defined as the capacity to do work or to transfer heat.





**Organize** *information about matter.*



# STATES OF MATTER

In the **solid state**:

- 1- **Substances** are rigid and have definite shapes.
- 2- Volumes of solids do not vary much with changes in temperature and pressure.

In the **liquid state**:

- 1- **The individual particles are confined to a given volume.**
- 2- **A liquid flows and assumes the shape of its container up to the volume of the liquid.**
- 3- Liquids are very hard to compress.

**Gases**

- 1- **They are much less dense than liquids and solids.**
- 2- **They** occupy all parts of any vessel in which they are confined.
- 3- Gases are capable of infinite expansion and are compressed easily.

# STATES OF MATTER

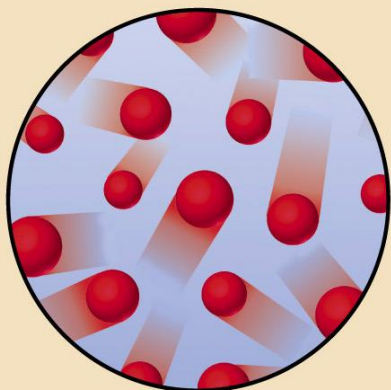


<u>Property</u>	<u>Solid</u>
Rigidity	Rigid
Expansion on heating	Slight
Compressibility	Slight

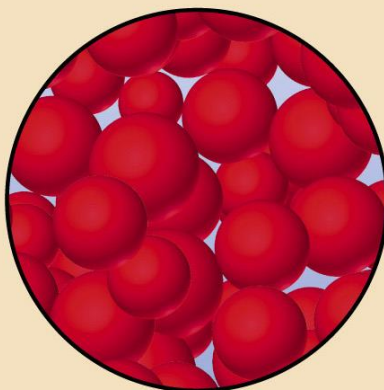
<u>Liquid</u>
Flows and assumes shape of container
Slight
Slight

<u>Gas</u>
Fills any container completely
Expands infinitely
Easily compressed

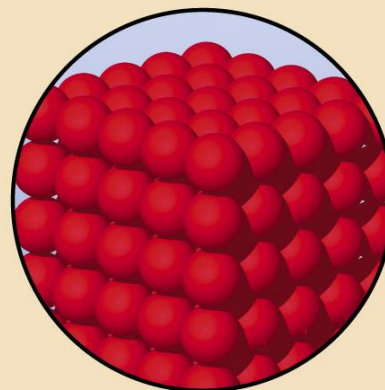




(a)



(b)



(c)

<b>Gases</b>	<b>Liquids</b>	<b>Solids</b>
Variable shape and volume	Variable shape, fixed volume	Fixed shape and volume
May expand or compress	May flow, not compressible	Non-compressible crystalline solids
Low densities	High density	High density
Mix to form homogeneous mixtures	Mix if soluble	Do not mix by diffusion

# Phase Transitions

Vaporization

Liquid to gas transition

Melting

Solid to liquid transition

Condensation

gas to liquid transition

Freezing

liquid to solid transition

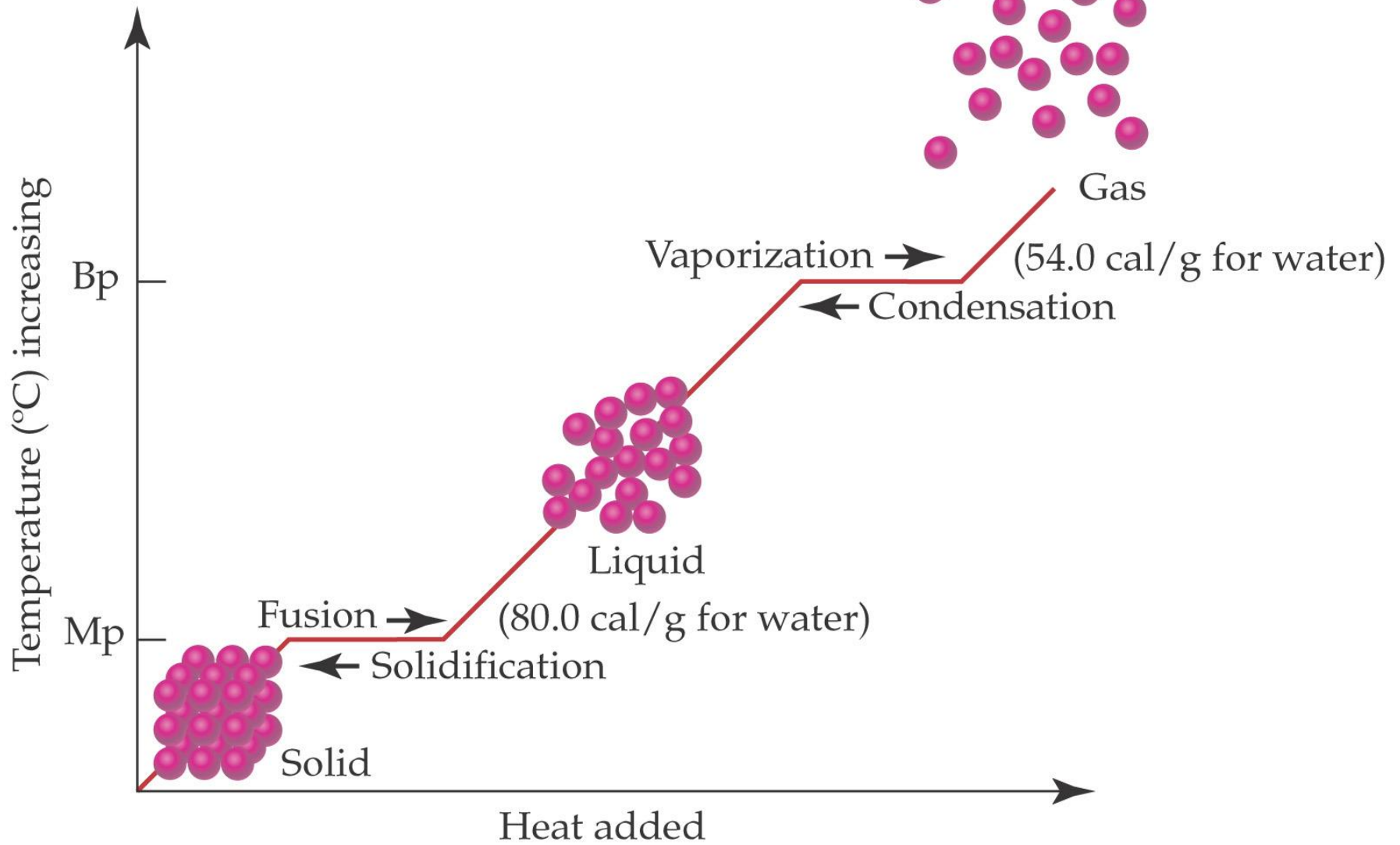
Sublimation

solid to gas transition

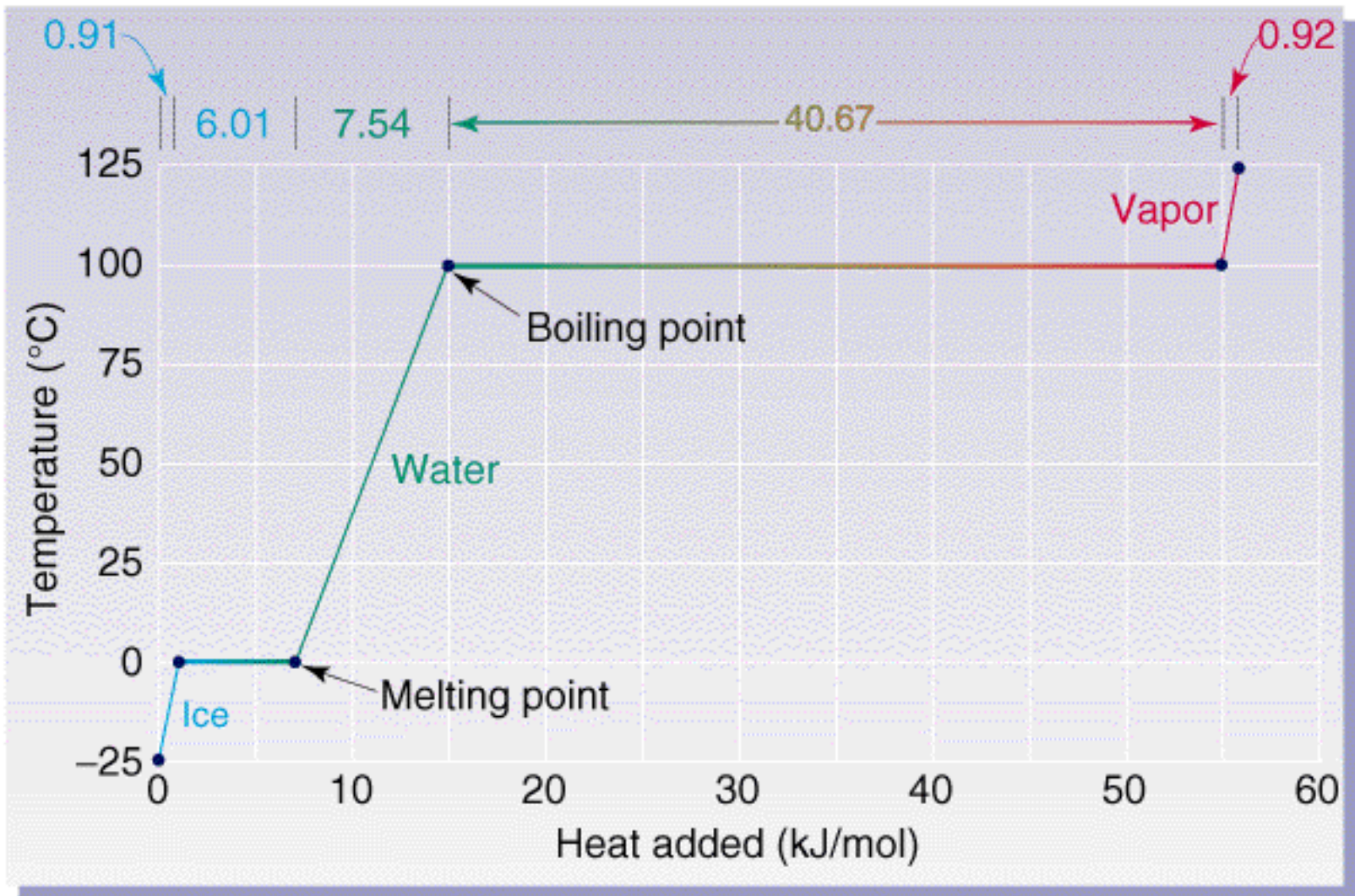
Deposition

gas to solid transition

# Phase Transitions



# Phase Transitions



# CHEMICAL AND PHYSICAL PROPERTIES

## Changes in matter occurs when

- 1- Food is digested
- 2- Paper is burned
- 3- Pencil is sharpened
- 4- Iron is rusted
- 5- Browning of apple
- 6- Breaking of glass

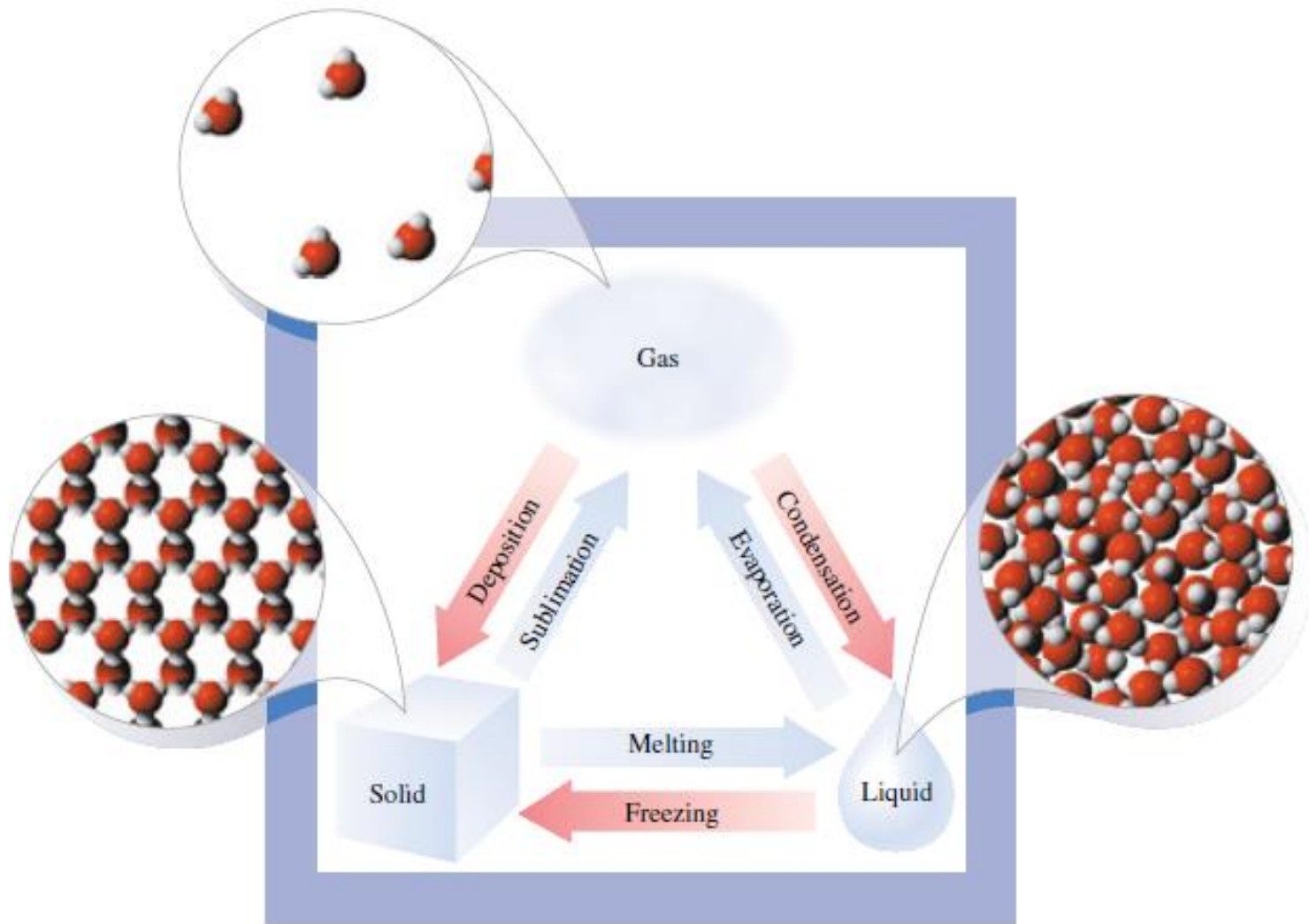
### Physical Change

- Change in the form of substance
- No new substance is produced
- Change in physical appearance
- No change in chemical composition

### Chemical Change

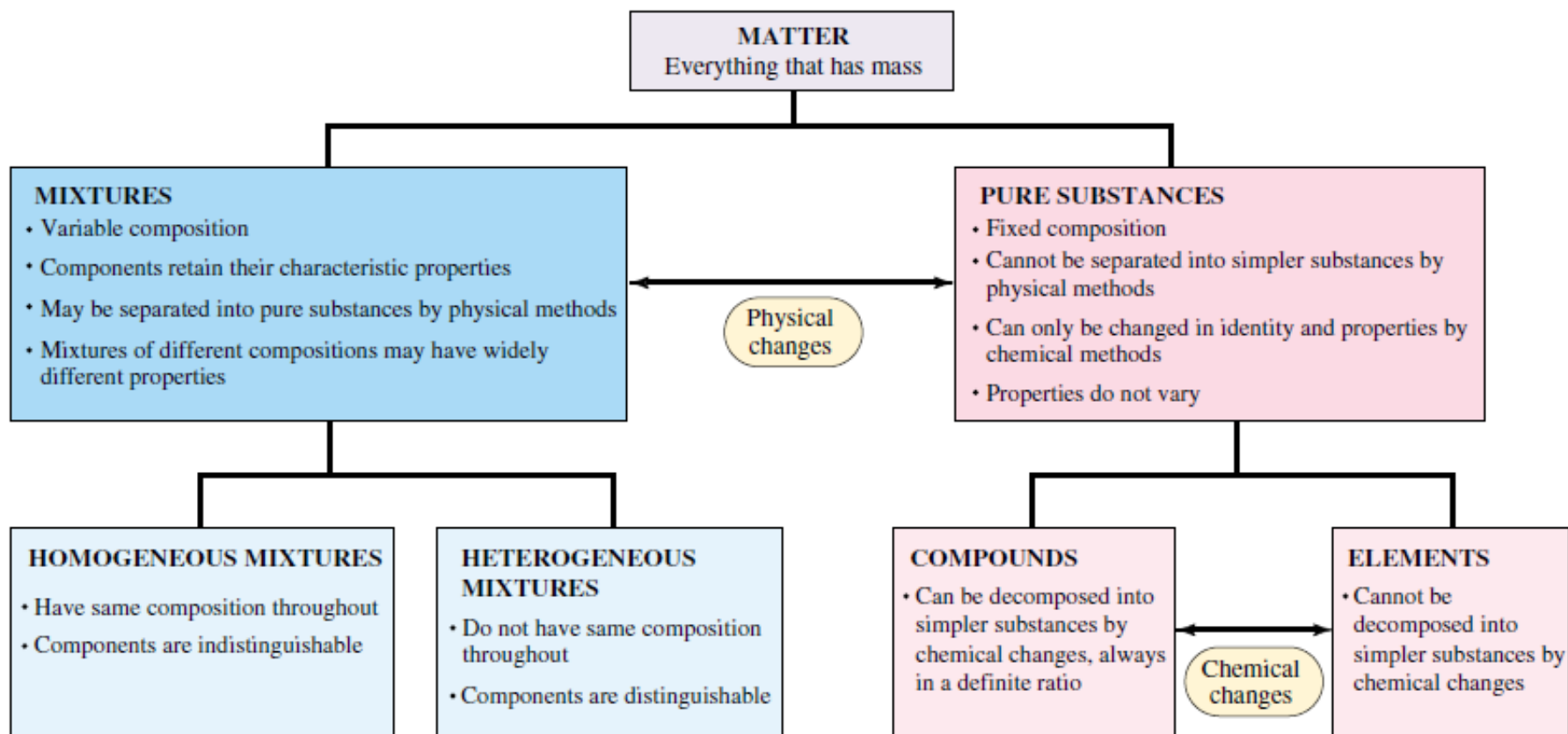
- New substance is produced
- change in chemical composition

# CHEMICAL and PHYSICAL Changes



Physical changes that occur among the three states of matter.

# MIXTURES, SUBSTANCES, COMPOUNDS, AND ELEMENTS



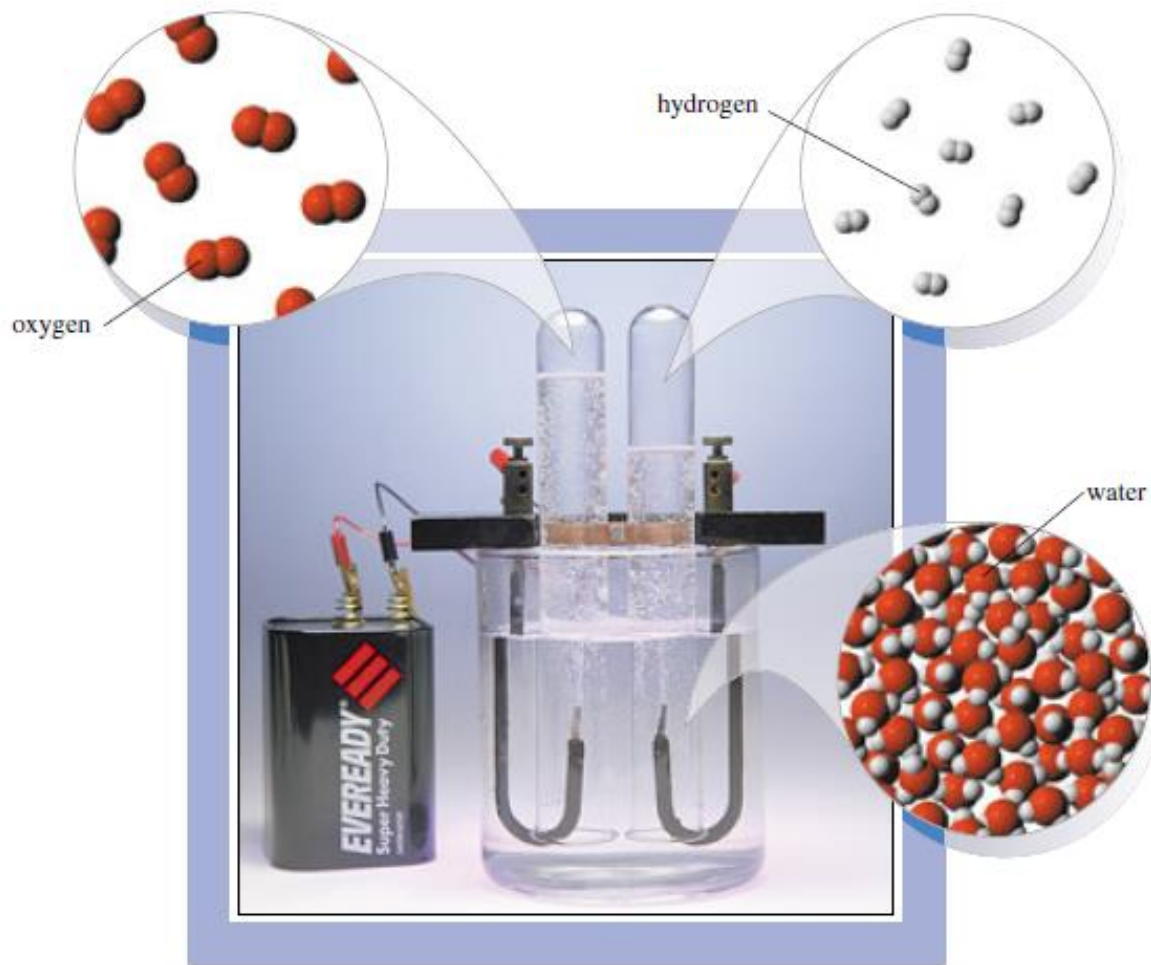
*Figure 1-7* One scheme for classification of matter. Arrows indicate the general means by which matter can be separated.

# MIXTURES, SUBSTANCES, COMPOUNDS, and ELEMENTS

**Differentiate** elements *from* compounds.








<b>Element</b>	<b>Compound</b>
a substance that consists of just one type of atom	a substance containing atoms of two or more different elements chemically bonded together




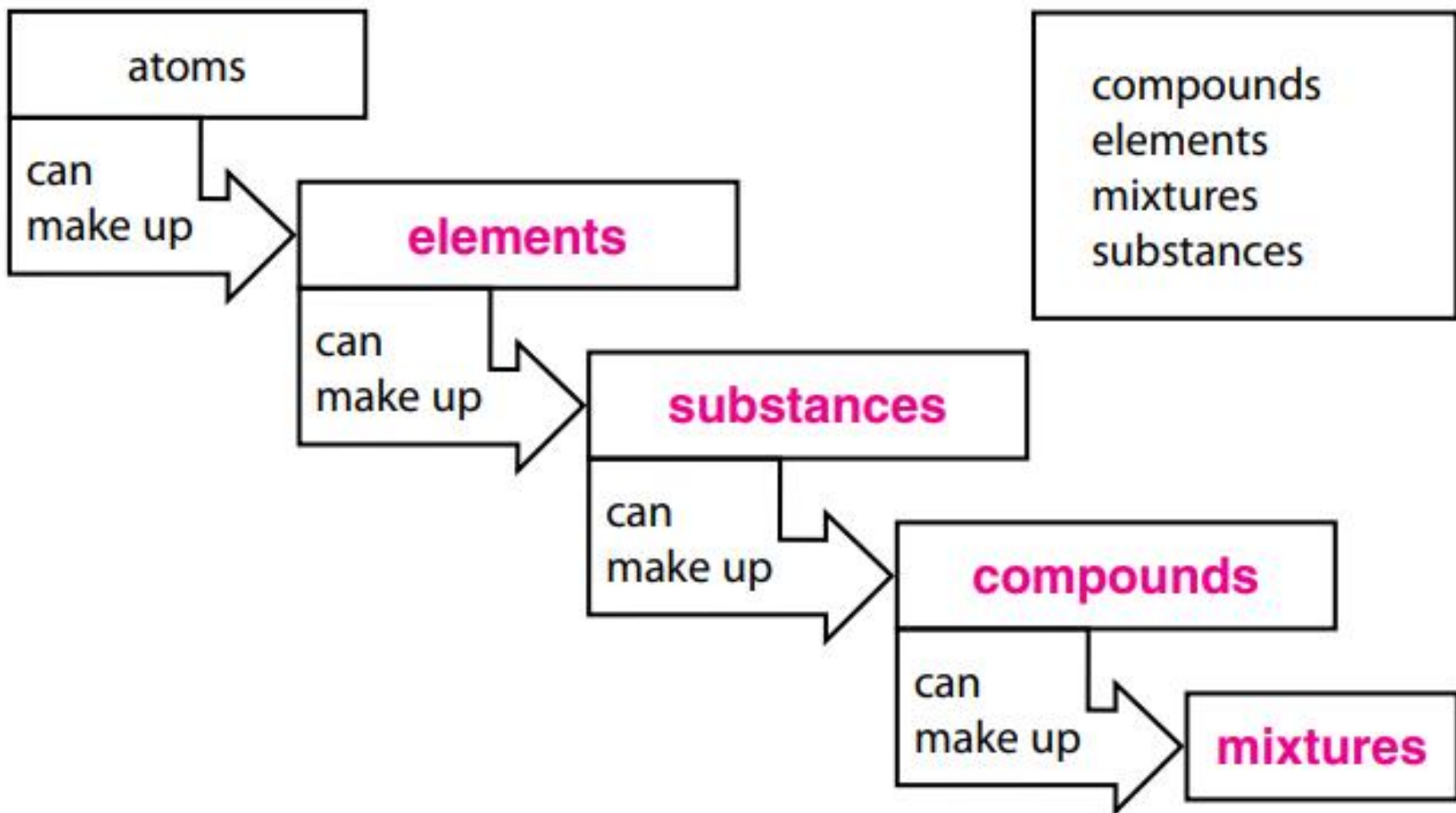


**Electrolysis** apparatus for small-scale chemical decomposition of water by electrical energy.

**Classify each of the following as an element, a compound, or a mixture.**

Matter	Mixture	Element	Compound
1- Water			
2- Sea Water			
3- Milk			
4- Calcium carbonate			
5- Silver			
6- Oxygen			
7- Chicken noodle soup			

 **Order** the classifications of matter. Use the words in the box to make a sequence that is true.



# Name and chemical symbols of elements

**TABLE 1-2** *Some Common Elements and Their Symbols*

Symbol	Element	Symbol	Element	Symbol	Element
Ag		F		Ni	
Al		Fe		O	
Au		H		P	
B		He		Pb	
Ba		Hg		Pt	
Bi		I		S	
Br		K		Sb	
C		Kr		Si	
Ca		Li		Sn	
Cd		Mg		Sr	
Cl		Mn		Ti	
Co		N		U	
Cr		Na		W	
Cu		Ne		Zn	

# 1-6 MEASUREMENTS IN CHEMISTRY

**TABLE 1-4** *The Seven Fundamental Units of Measurement (SI)*

Physical Property	Name of Unit	Symbol
length	meter	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
temperature	kelvin	K
luminous intensity	candela	cd
amount of substance	mole	mol

**TABLE 1-5** *Common Prefixes Used in the SI and Metric Systems*

Prefix	Abbreviation	Meaning	Example
mega-	M	$10^6$	1 megameter (Mm) = $1 \times 10^6$ m
kilo-*	k	$10^3$	1 kilometer (km) = $1 \times 10^3$ m
deci-	d	$10^{-1}$	1 decimeter (dm) = $1 \times 10^{-1}$ m
centi-*	c	$10^{-2}$	1 centimeter (cm) = $1 \times 10^{-2}$ m
milli-*	m	$10^{-3}$	1 milligram (mg) = $1 \times 10^{-3}$ g
micro-*	$\mu^\dagger$	$10^{-6}$	1 microgram ( $\mu\text{g}$ ) = $1 \times 10^{-6}$ g
nano-*	n	$10^{-9}$	1 nanogram (ng) = $1 \times 10^{-9}$ g
pico-	p	$10^{-12}$	1 picogram (pg) = $1 \times 10^{-12}$ g

# MCQ 1

**Which of the following is an example of a mixture?**

- a) Hydrogen gas ( $\text{H}_2$ )**
- b) Table sugar ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ )**
- c) Pure water ( $\text{H}_2\text{O}$ )**
- d) Orange juice**

# MCQ 2

**Which of the following is a compound?**

- a) Oxygen gas ( $O_2$ )**
- b) Table salt ( $NaCl$ )**
- c) Copper ( $Cu$ )**
- d) Helium gas ( $He$ )**

## MCQ 3

**Which of the following is a characteristic of a mixture?**

- a) It has a fixed composition.**
- b) It cannot be separated into its components by physical means.**
- c) Its properties are different from the properties of its components.**
- d) It consists of only one type of atom.**



# MCQ 4

**Which of the following is a heterogeneous mixture?**

**a) Air**

**b) Salad**

**c) Pure water**

**d) Carbon dioxide gas (CO<sub>2</sub>)**

# MCQ 5

**What is the smallest unit of an element that retains its chemical properties?**

- a) Atom**
- b) Molecule**
- c) Compound**
- d) Ion**

# MCQ 6

**Which of the following is a characteristic of a physical change?**

- a) Formation of new substances with different chemical properties.**
- b) Change in the chemical composition of the substance.**
- c) Change in the molecular structure of the substance.**
- d) Change in the physical appearance or state of the substance.**

# MCQ 7

**What happens to the temperature of a substance during a phase change?**

- a) It remains constant.**
- b) It decreases.**
- c) It increases.**
- d) It fluctuates randomly.**

# MCQ 8

**Which of the following phase changes is an example of sublimation?**

**a) Melting**

**b) Freezing**

**c) Condensation**

**d) Solid-to-gas transition without passing through the liquid phase**

# MCQ 9

**Which of the following is an example of a phase transition from a solid to a liquid?**

- a) Freezing**
- b) Condensation**
- c) Sublimation**
- d) Melting**

# MCQ 10

**Which of the following phase transitions involves the release of heat energy?**

- a) Melting**
- b) Freezing**
- c) Condensation**
- d) Sublimation**