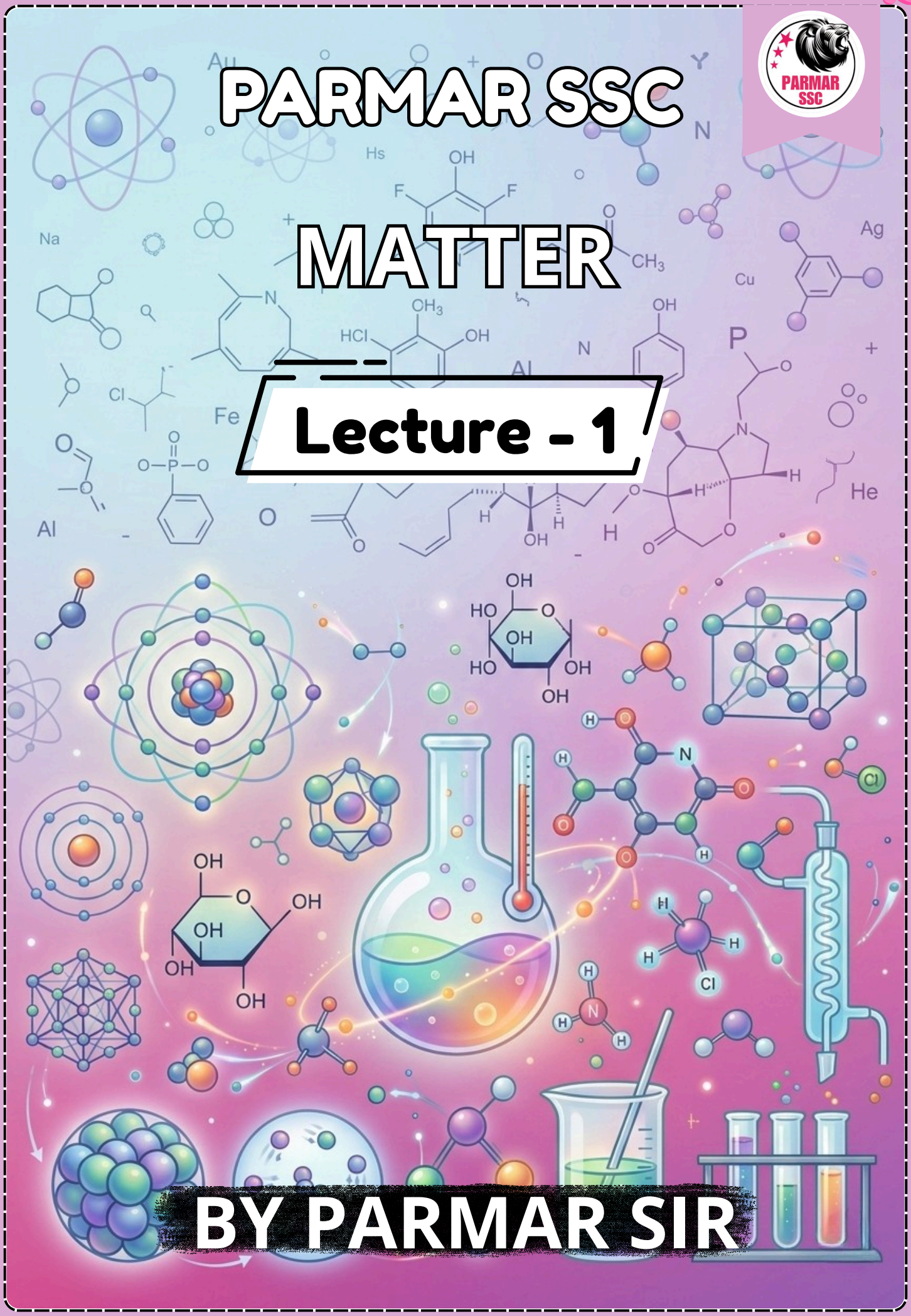
# PARMAR SSC

# MATTER

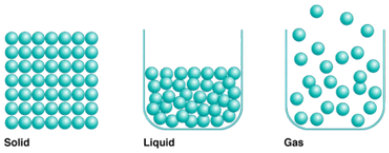
## Lecture - 1



BY PARMAR SIR

# MATTER

- Matter is anything that has mass and takes up space.
- It can be solid, liquid, or gas.
- Matter is made up of tiny particles called atoms and molecules.




**Matter has three fundamental states: solid, liquid, and gas; however, under special conditions other states such as plasma and Bose-Einstein condensate also exist.**

## Solids

- They have distinct boundaries and fixed volumes.
- They have a definite shape.
- They have a tendency to maintain the shape when subjected to outside force.

### TYPES OF SOLIDS

| Amorphous Solids | Crystalline Solids |
|---|---|
| Isotropic in nature (same properties in all direction) | Anisotropic in nature (properties vary with direction) |
| They have irregular shape | They have a definite shape |
| They are pseudo solids | They are true solids |
| They have an irregular arrangement of constituent particles | They have a regular arrangement of constituent particles |
| They do not have sharp melting point | They have sharp melting point |
| E.g. Glass, rubber, plastic, etc. | E.g. Copper, Silver, NaCl |

## Liquid

- A liquid is a state of matter that can flow and take the shape of its container.

## Gas

- A gas is a substance that is in a gaseous, or vaporous, state of matter.
- It exhibits behaviour uniformity.

### The Anomalous Expansion of Water

- **Generally:** When a substance is heated, its volume increases (expansion), and when it is cooled, its volume decreases (contraction).
- **Exception in water:** Water does not follow this normal rule between 0°C and 4°C.
- **Cooling from above 4°C:** When water is cooled from a higher temperature to 4°C, its volume decreases and density increases.
- **At 4°C:** Water becomes maximum dense (densest) and its volume is minimum.
- **Cooling from 4°C to 0°C:** When water is cooled further below 4°C, instead of contracting it expands, so its volume increases and density decreases.

## Plasma

- It is the 4th state of matter.
- A plasma is an ionised gas, with roughly equal numbers of positively and negatively charged particles.
- It can be produced in laboratory by heating a gas to an extremely high temperature.
- Stars are made of plasma.

### Comparison of States

| States of Matter | Intramolecular Space | Kinetic Energy | Movement | Force of Attraction |
|---|---|---|---|---|
| **Solid** | Low | Low | Low | High |
| **Liquid** | Medium | Medium | Medium | Medium |
| **Gas** | High | High | High | Low |

## Bose-Einstein Condensate (BEC)

- The fifth state of matter is Bose-Einstein condensate (BEC).
- It is typically formed when a gas of bosons at very low densities is cooled to temperatures very close to absolute zero, i.e., 0 K (-273.15°C; -459.67°F)
- **Origin of Name:** The term "Boson" comes from the name of Dr. Satyendra Nath Bose, an Indian physicist whose work on quantum mechanics was extended by Albert Einstein in 1925.
- **Discovery:** Dr. Bose published a research paper in 1924 and sent it to Einstein, who further developed the concept and predicted the existence of BEC in 1925.

### First Production (1995)

- Eric Cornell and Carl Wieman experimentally produced the first BEC condensate in a rare field gas of rubidium atoms.
- Wolfgang Ketterle later created a BEC condensate with sodium atoms in 1995.
- All three received the Nobel Prize in Physics in 2001.

# CHANGE IN STATE OF MATTER

## Evaporation

- Evaporation is the surface phenomenon where a liquid changes into vapour at any temperature below its boiling point.
- **E.g.** Evaporation of nail polish remover.

### Favourable Conditions for Evaporation

- Temperature increase >>>> rate of evaporation increases.
- Surface area increases >>>> rate of evaporation increases.
- Wind speed increases >>>> rate of evaporation increases.
- Humidity increases >>>> rate of evaporation decreases.

## Condensation



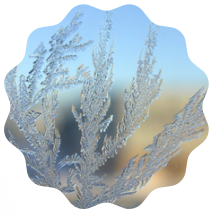
- The process by which water vapour in air changes into liquid.
- **E.g.** Dew, Fog

## Sublimation

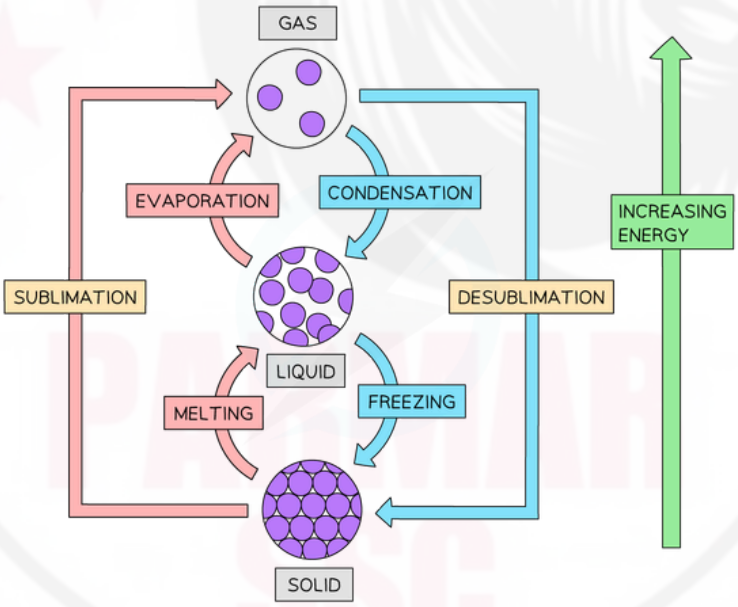
- The process of changing a solid directly into a gas without passing through a liquid state.
- **E.g.** Naphthalene, dry ice, etc.




## Deposition



- The opposite of sublimation, where a gas turns into a solid without passing through a liquid state.
- **E.g.** The formation of frost or ice-crystals on surface







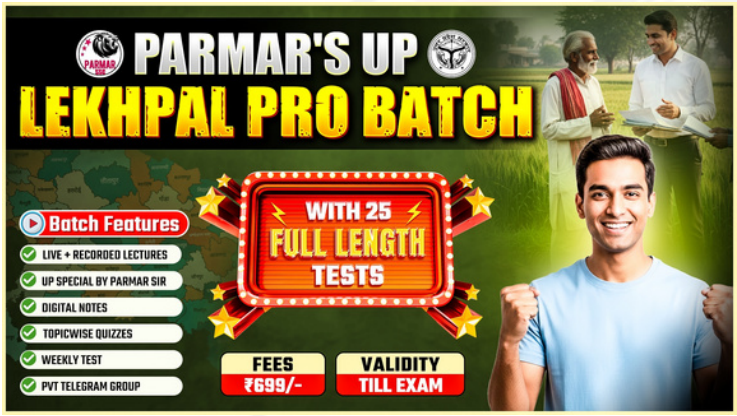


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