Chapter-3

MATTER

STUDY NOTES

- **Kinetic energy** is the energy that is produced when an object is in motion. It is defined as the work required to accelerate a body from rest to a particular velocity. If an object is not moving, then the object is said to have zero kinetic energy.

Definition of Matter

- Any substance that has mass and occupies space is called matter. Matter,
- Is made up of basic building blocks commonly called as elements.
- Exists in solid, liquid, gaseous and plasma states.
- Can be defined with respect to atoms, mass, volume, space etc.

Definition of Element

- An element is a substance which cannot be subdivided into two or more similar substances by any chemical or physical means.
- All matter is made up of elements and each element has its own physical and chemical properties.
- Elements are often referred to as pure substances as they are made up of only one kind of atom.

Definition of Atom

- An atom is the smallest divisible part of the element that retains the physical and chemical properties of an element.
- For example, take an inch of gold and keep cutting into tiny pieces. The smallest of pieces will still retain the same properties as the original piece.

Molecule

A molecule is formed when two or more atoms of the same element or of different elements unite. It is the smallest unit of matter that can take part in a chemical reaction.

- Molecules can exist freely in nature.
- They are very small in size.
- They have spaces between them.
- They are in constant motion as they possess kinetic energy.
- They attract each other

Kinetic Theory of Matter

Assumptions

- Molecules are in a state of continuous motion and hence they possess kinetic energy.
- The kinetic energy of molecules increases with an increase in temperature and decreases with a decrease in temperature.
- The molecules of a similar kind attract each other by a force called the force of cohesion.
- The force of cohesion is maximum in solids, less in liquids and least in gases.
- The force of attraction between different types of molecules is called the *force of adhesion.*
- The force of attraction between the molecules (either cohesive or adhesive) is called the *intermolecular force of attraction*.
- The space between any two consecutive molecules is called *intermolecular space.*
- If the intermolecular space between the molecules decreases, the intermolecular force increases.

Arrangement of Molecules

In solids	In liquids	In gases
Molecules are very tightly packed.	Molecules are less tightly packed.	Molecules are loosely packed.
The intermolecular force of attraction is very strong.	Intermolecular force of attraction is less.	Intermolecular force of attraction is the least.
The molecules are fixed at one particular place with very small vibrations about their mean position.	The molecules do not stay in the same position and they move from one place to another.	The molecules can spread across the entire space in which they are enclosed.
Due to the fixed position of molecules, solids have a definite shape and volume.	The liquids do not have any particular shape but have definite volume.	Gases have neither a definite shape nor definite volume as their molecules move about a lot.

Distinction between solids liquids and gases:

Solid	Liquid	Gas
It is a form of matter having a rigid structure and firm shape	They are substances flowing freely with no permanent shape but a definite volume	Gas is a state of matter which does not have a shape but takes the shape of the container you put it in
It has the lowest energy	It has medium energy	They have the highest energy
These are hard to compress	You can compress them a little difficulty	These are easily compressible
It has a fixed shape plus volume	No fixed shape but they do have volume	They have neither definite shape nor volume
Molecules are regular and arranged closely	Randomly molecules arranged sparsely	Their molecules are random and arranged more sparsely
They have very less intermolecular space	They have more intermolecular space	These have the most intermolecular space

They cannot flow	These flow from a higher level to lower	They flow in all directions
They do not require a container for storage	These require a container for storage	These require a close container for storage
They have the maximum intermolecular attraction	These have a medium intermolecular attraction	They have the lowest intermolecular attraction

CHANGE OF STATE:

- The process of change from one state to another state either by absorption or rejection of heat at a constant temperature is called change of state.

Melting:

Melting or fusion, is a physical process that results in the phase transition of a substance from a solid to a liquid. This occurs when the internal energy of the solid increases, typically by the application of heat or pressure, which increases the substance's temperature to the melting point.

- Melting point of solid: The temperature at which solid changes into liquid without further increase in temperature is called the melting point of the solid.
- The amount of heat absorbed or rejected during the change of state for a unit mass of a substance is called specific latent heat.

Freezing:

- Freezing is a phase transition where a liquid turns into a solid when its temperature is lowered below its freezing point.
- Freezing means the solidification phase change of a liquid or the liquid content of a substance, usually due to cooling.

Boiling or vaporization:

- When a liquid is heated, it changes into its vapour. This process is called boiling or vaporization.
- **Boiling point of a liquid:** The temperature at which a liquid changes into vapour without further increase in temperature is called the boiling point of the liquid.
- **Condensation:** The change from vapor state to liquid state at a constant temperature on rejecting heat or on cooling is called condensation.

Evaporation

- The process of a liquid changing into vapor (or gas) even its boiling point is called evaporation.

- The wet clothes dry due to evaporation of water present in them. Common salt is also recovered from sea-water by the process of evaporation.
- The process of evaporation can be explained as follows: Some particles in liquid always have more kinetic energy than the others. So, even when a liquid is well below its

boiling point, some of its particles have enough energy to break the forces of attraction between the particles and escape from the surface of the liquid in the form of vapor (or gas). Thus the fast moving particles (or molecules) of a liquid are constantly escaping from the liquid to form vapor (or gas).

Factors affecting Evaporation:

The evaporation of a liquid depends mainly on the following factors:

- Temperature
- Surface area
- Humidity
- Wind speed
- Nature of liquid

Temperature: The rate of evaporation increases on increasing the temperature of the liquid.

Surface area of the liquid: The rate of evaporation increases on increasing the surface area of the liquid. For e.g. If the same liquid is kept in a test tube and in a china dish, then the liquid kept in the china dish evaporate more rapidly.

Humidity of Air: The amount of water present in air is represented by a term called humidity. When the humidity of air is slow, then the rate of evaporation is high, and water evaporates more readily.

Wind Speed: The rate of evaporation of a liquid increases with increasing wind speed.

Nature of liquid: Volatile liquids with low boiling point such as alcohol, spirit, ether etc evaporate much faster than water.

Cooling caused by evaporation:

- The cooling caused by evaporation is based on the fact that when a liquid evaporates, it draws or takes the latent heat of vaporization from 'anything' which it touches. By losing heat, this 'anything' gets cooled.
- During hot summer days, water is usually kept in an earthen pot (called pitcher or matka) to keep it cool. The earthen pot has large number of extremely small pores (or holes) in its walls. Some of the water continuously keeps seeping through these pores to the outside of the pot. This water evaporates (changes into vapor) continuously and takes the latent heat required for vaporization from the earthen pot and the remaining water. In this way, the remaining water loses heat and gets cooled.

- Perspiration (or sweating) is our body's method of maintaining a constant temperature.
- We should wear cotton clothes in hot summer days to keep cool and comfortable.

Difference between evaporation and boiling

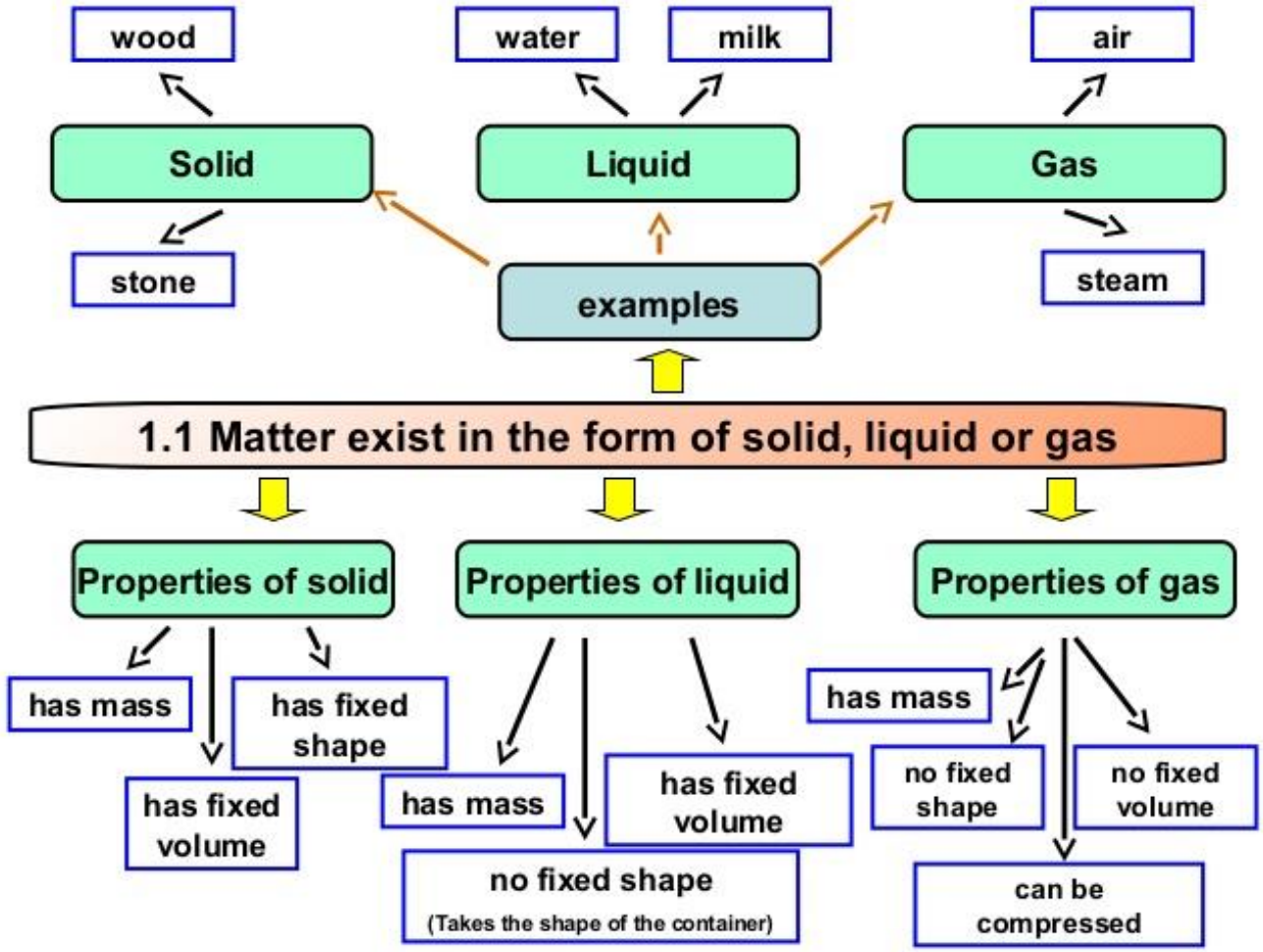
Answer:

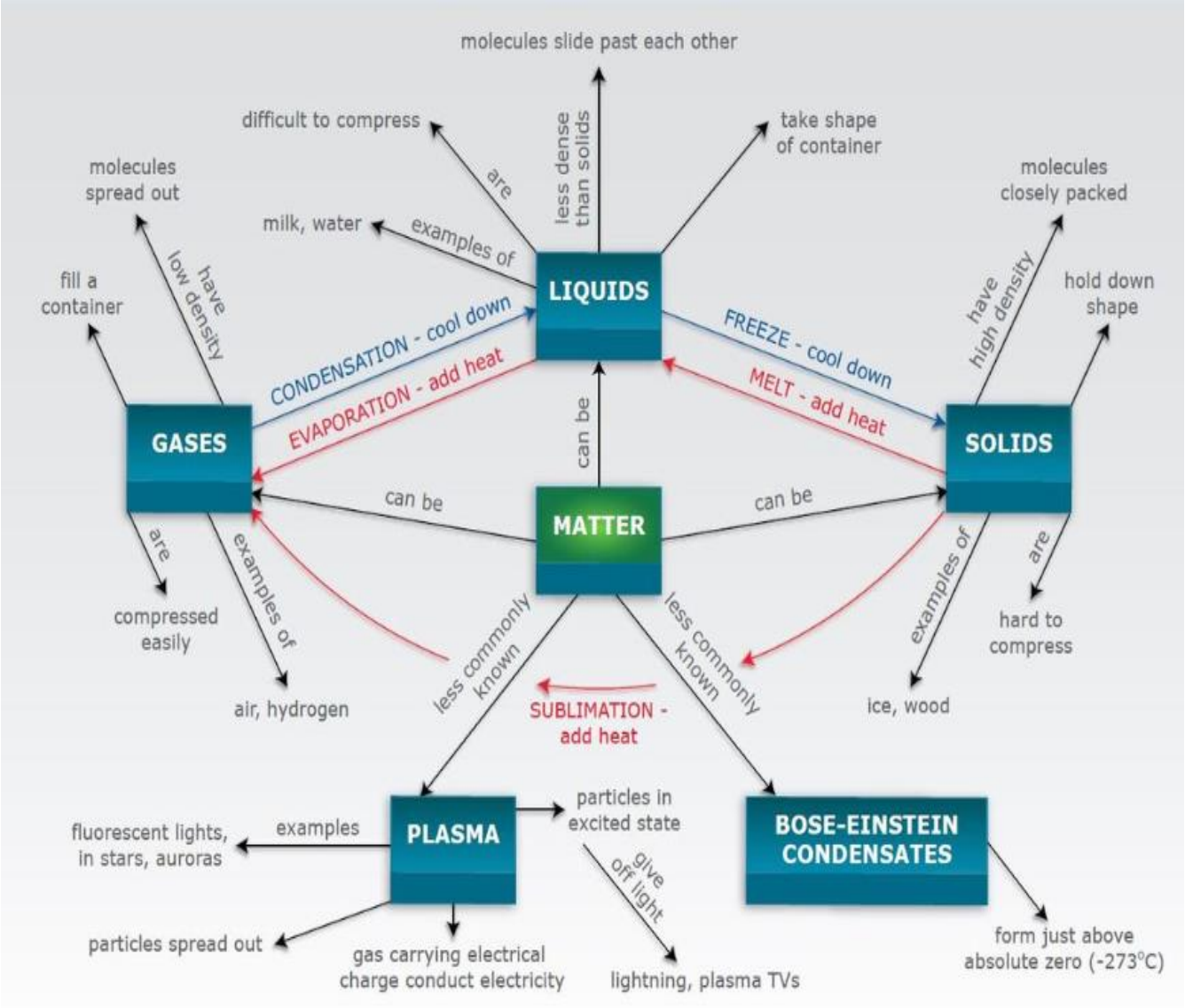
Boiling	Evaporation
1. Occurs at a fixed temperature	1. Occurs at any temperature
2. Quick process	2. Slow process
3. Takes place throughout the liquid	3. Takes place only at the liquid surface
4. Bubbles are formed in the liquid	4. No bubbles are formed in the liquid
5. Temperature remains constant	5. Temperature may change
6. Thermal energy supplied by an energy source	6. Thermal energy supplied by the surroundings

Sublimation: The process by which a solid when heated directly changes into its vapor without changing into liquid.

Deposition or Solidification: It is a process when a vapor or gas on cooling changes directly into a solid without changing into liquid.

CONCEPT MAP


wood
water
milk
air
Solid
Liquid
Gas
stone
examples
steam
1.1 Matter exist in the form of solid, liquid or gas
Properties of solid
Properties of liquid
Properties of gas
has mass
has fixed shape
has fixed volume
has mass
has fixed volume
no fixed shape
(Takes the shape of the container)
has mass
no fixed shape
no fixed volume
can be compressed


molecules slide past each other
less dense than solids
difficult to compress
are
take shape of container
molecules spread out
milk, water
examples of
molecules closely packed
have low density
LIQUIDS
have high density
fill a container
hold down shape
CONDENSATION - cool down
EVAPORATION - add heat
FREEZE - cool down
MELT - add heat
GASES
SOLIDS
can be
can be
MATTER
can be
are
examples of
are
compressed easily
air, hydrogen
less commonly known
SUBLIMATION - add heat
less commonly known
examples of
hard to compress
ice, wood
PLASMA
particles in excited state
BOSE-EINSTEIN CONDENSATES
fluorescent lights, in stars, auroras
examples
give off light
particles spread out
gas carrying electrical charge conduct electricity
lightning, plasma TVs
form just above absolute zero (-273°C)