Chapter-2

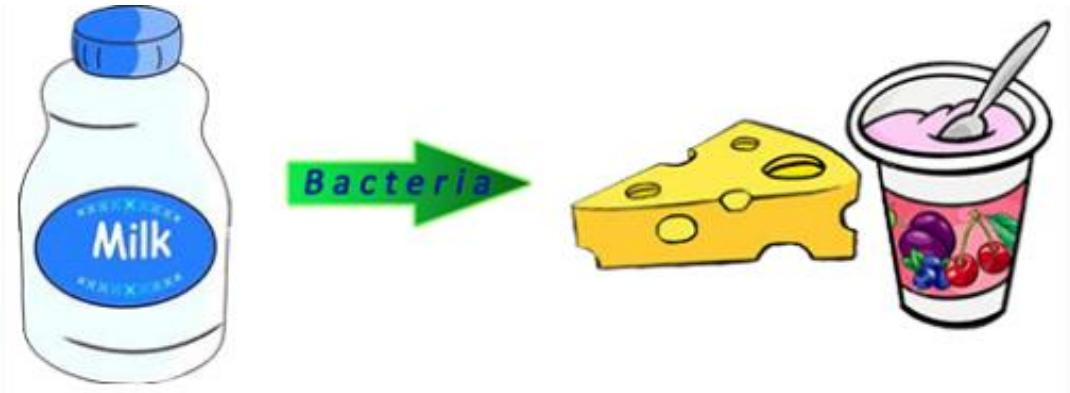
PHYSICAL AND CHEMICAL CHANGES

STUDY NOTES

What is change?

In chemistry, change can be explained on physical grounds. Changes are very random or uncertain phenomena, it can be better or worse depending on your view. Every day we see different objects changing around us like melting of ice, cooking of food etc. In some cases, you get back the original substance and in some, you won't get it back. Some changes are slow while some are fast, some are natural and some are man-made. You will find that many changes are taking place around us for e.g. growing of plants in your balcony, sometimes there is a change in colour and sometimes you will find drying of leaves.

Every day we come across many changes that are taking place all around us. These changes may involve one or more substances. Sometimes, milk becomes sour. Souring of milk is a change. Making a sugar solution is a change. Similarly, setting of curd from milk is a change.



Some changes that we have noticed around us are melting of ice, making of ice cream, melting of wax, stretching a rubber band, evaporation of water, cutting of paper, breaking of glass pane, bending of glass tube by heating, boiling of water, sublimation of camphor, etc.

TYPES OF CHANGES

1. SLOW AND FAST CHANGES-

Fast changes occur within seconds or minutes. Whereas slow changes take place very slowly and may take hours, days or months to complete.

Examples for fast changes: Burning of paper, burning of a candle.
Examples for slow changes: Rusting of iron, Germination of seed, curdling of milk etc.

Slow change	Fast change
Changes which occur - very slowly over days, months or years.	Changes which occur - very rapidly in seconds or minutes.
Examples : Growth of a tree from a seed - a few years, tooth decay, change of seasons, growth of many rusting of iron.	***Examples :*** Occurrence of lightning - a few seconds, burning of paper or match, lighting a bulb, bursting of fire works.

2. NATURAL AND MANMADE CHANGE

Natural changes	Man-made changes
1. The changes which are brought about by nature itself and are not under the control of humans are called natural changes.	The changes which are brought about by humans are called man-made changes.
2. Examples- change of season, tides in the sea, aging of plants, etc.	Examples- burning of fuels, cutting hair, switching on lights, etc.

3. PERIODIC AND NON PERIODIC CHANGES

Changes that repeat at regular intervals are called periodic changes.

Examples:

1. The occurrence of day and night and the waxing and waning of the moon.
2. A pendulum swinging.
3. The sun rises and falls.
4. Modification of seasons.
5. Changing Moon Phases,
6. Heart-beating,
7. Clock striking an hour.

Certain changes that do not repeat themselves at regular intervals of time, and such changes are called non-periodic changes.

Example:

1. Change of weather,
2. Swaying of the branches of a tree.
3. Motion of a bouncing ball under the action of gravity and friction.
4. The running of a batsman between the wickets.
5. Motion of the pestle in a mortar when operated manually

4. DESIRABLE AND UNDESIRABLE CHANGES

Desirable Changes:

Those changes which are desired to occur that is, we want them to take place are known as desirable changes.

Examples:

1. ripening of fruits,
2. germination of seeds
3. change in season

Undesirable change:

Those changes which we do not want to take place are called undesirable changes.

Examples-

1. Earthquakes,
2. hurricanes,
3. tsunami,
4. rusting of iron,
5. souring of milk,
6. rottening of fruits,
7. global warming

5. REVERSIBLE AND IRREVERSIBLE CHANGES

Reversible Changes

- Any changes which can be reversed or are a temporary conversion are known as reversible changes.
- The reactions which are reversible are called reversible reactions.
- In this reaction, one substance is modified into another form but a new compound is not formed.
- Processes such as melting, boiling, evaporation, freezing, condensation, dissolution are reversible changes.
- Few examples are melting of wax, freezing of ice, boiling water which evaporates as steam and condenses back to water.
- Reactions are an interaction of two or more compounds called reactants to produce a product(s).
- In a reversible reaction, reactants and products formed are connected by a two-way arrow (⇌). This means reactants can be obtained back from the products.
- Consider the reaction below,

A +B ⇌ C + D

- Here, A and B are two reactants which react to give C and D. The two-headed arrow indicates that reaction is reversible and the reactants, A and B can be obtained from C and D.

Irreversible changes

- In contrast to reversible changes, irreversible changes are permanent changes.
- Reactants react to form an entirely new compound and cannot be reversed.
- Heating, burning, mixing, powdering are few processes which cause irreversible changes.
- A common observable example is the cooking of raw egg which can't be converted back to its original form.
- Ash obtained by the combustion of paper or any other substances is another example.
- When a reaction is taking place in a unidirectional way such reactions are called irreversible reactions.
- In such reactions in a period of time reactants react completely to form a product.
- Here reaction is denoted by a one-way arrow (→).

For example,

A → B +C

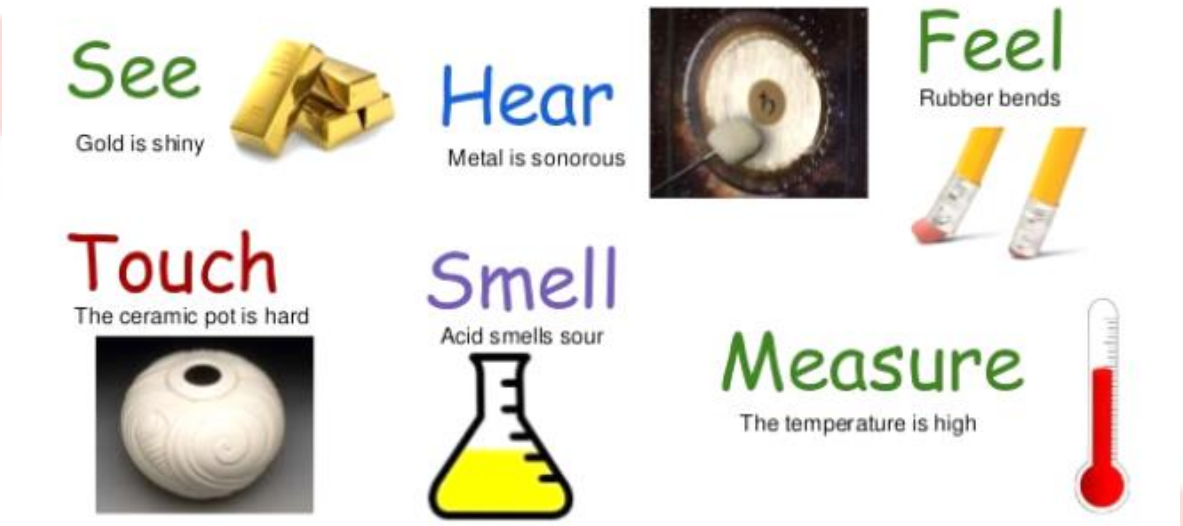
Here, A is the reactant which is completely converted into products B and C which do not react to form A.

Change	Can it be reversed
Raw egg to boiled egg	×
Batter to idli	×
Wet clothes to dry clothes	√
Woollen yarn to knitted sweater	√
Grain to its flour	×
Cold milk to hot milk	√
Straight string to a coiled string	√
Bud to flower	×
Milk to paneer	×
Cow dung to biogas	×
Stretched rubber band to its normal size	√
Ice cream to molten ice cream	√

6. PHYSICAL AND CHEMICAL CHANGE-

Physical change

- Physical Properties of a substance are those characteristic of a substance that describes its physical nature.
- For Example color, density, shape, size and volume are some physical properties.
- Physical Change is a change which occurs when there is an alteration in the physical properties of a substance.
- The physical change does not result in the formation of any new substance but can alter the shape and size of the existing substance.
- Some of the physical properties are given below-



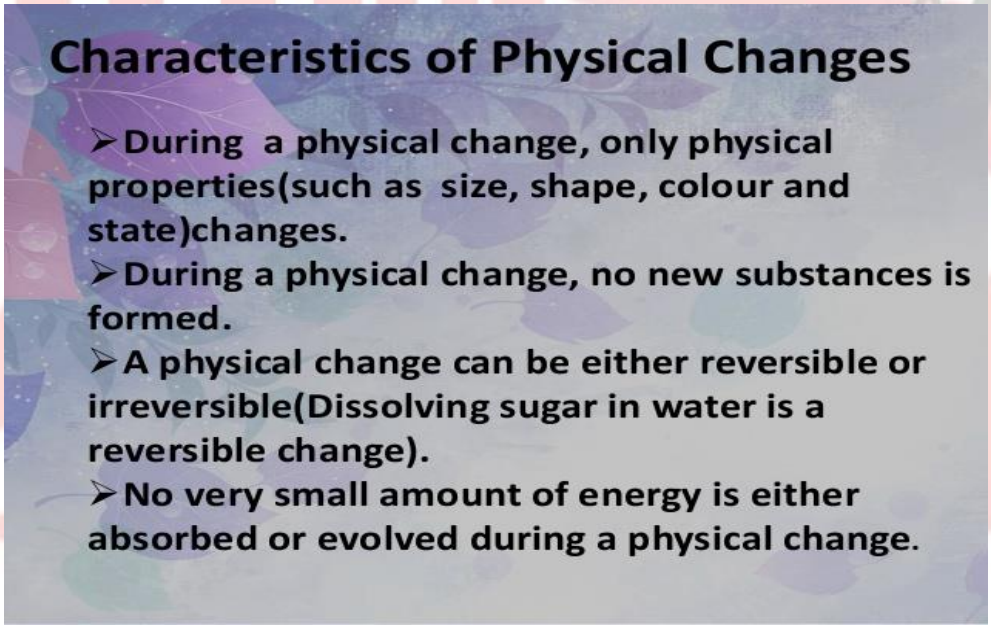
Different examples of physical changes-

Characteristics of Physical Changes

The physical changes are temporary changes which can be easily reversed to form the original substance. In such a change, no new substance is formed.

Thus, we noticed that the important characteristics of physical changes are as follows:

- No new substance is formed in this change.
- It is a temporary change and is generally reversible.
- A temporary change in color may take place.
- Very little energy (heat, etc) is either absorbed or evolved.



TERMS INVOLVED IN SOME PHYSICAL CHANGES

DISSOLVING-

Dissolving is a process in which a substance known as **solute** mixes completely with another substance known as **solvent** to form a homogeneous mixture called as solution.

Example -sugar dissolves in water

FREEZING-

Freezing the process in which a substance in a liquid state changes into its solid state on cooling at a particular temperature is called freezing or solidification

FREEZING POINT-

The temperature at which liquid starts changing into a solid state at a given pressure is called its freezing point. All pure substances have a definite freezing point.

Example- pure water freezes at zero degrees Celsius into ice.

MELTING –

Melting is a process in which a substance in solid state changes into liquid state at a particular temperature.

MELTING POINT –

Melting point of a solid is the temperature at which it starts melting solids have definite melting point.

Example- melting point of ice is zero degrees Celsius. Numerically the melting point and freezing point of a substance are the same.

BOILING-

The process in which a liquid on heating changes into its vapor state at a particular temperature is called boiling.

BOILING POINT-

The temperature at which a liquid start changing into its vapor on heating at a given pressure is called it boiling point all pure liquids have a definite boiling point example boiling point of water is hundred degrees Celsius.

EVAPORATION-

Process due to which a substance in liquid change state changes into its vapor state at any temperature below is boiling point is called evaporation of vaporization .Example water from rivers, lakes, Ponds etc change into vapor due to evaporation.

CONDENSATION –

The process in which a substance in vapor of gaseous state changes into liquid state is called condensation.

CONDENSATION POINT - the temperature at which a gaseous substance start changing into liquid state is called condensation point numerically the boiling point and the condensation point of a liquid at the space.

DIFFERENCE BETWEEN EVAPORATION AND BOILING

Difference Between Evaporation and Boiling	
Evaporation	Boiling
Evaporation always occurs at a fixed temperature.	Boiling can occur at any temperature.
in this process, the bubbles are formed as a result in the liquid	No bubbles are formed.
It takes place throughout the liquid.	Only takes place on the surface of the liquid.
The temperature of the liquid body decreases when evaporation takes place.	In contrast, the temperature remains constant in this process.
It is a quick process rather than Boiling.	Boiling is a slow process.
Continues as long as the air above the surface of liquid remains unsaturated.	It takes place until the internal temperature of the liquid is equal to the external temperature of the surroundings.
To initialize this process, a heat energy source is supplied to the liquid.	Sunlight or surrounding temperature is major source to initialize the boiling process.

Factors That Affect the Rate of Evaporation

- Many factors influence how quickly a liquid evaporates. They include:
- Temperature of the liquid. A cup of hot water will evaporate more quickly than a cup of cold water.
- Exposed surface area of the liquid. The same amount of water will evaporate more quickly in a wide shallow bowl than in a tall narrow glass.
- Presence or absence of other substances in the liquid. Pure water will evaporate more quickly than salt water.
- Air movement. Clothes on a clothesline will dry more quickly on a windy day than on a still day.

- Concentration of the evaporating substance in the air. Clothes will dry more quickly when air contains little water vapor.

Chemical Changes

- The chemical property of a substance is those characteristic of a substance that describes its chemical nature.
- For Example toxicity of a substance or how a substance reacts with other substances is its chemical property.
- A chemical change or chemical reaction is any change in the chemical properties of a substance.
- Whenever a substance undergoes a chemical change, a new substance is formed.

Examples of Chemical Changes:

- Rusting of iron occurs when iron gets in contact with moisture
- When a magnesium ribbon is burnt it radiates white light and converts into ashes
- Formation of Medicines
- Extracting of iron from the iron ore
- Formation of plastic

Some chemical properties are given below

Examples of chemical changes

Characteristics of Chemical Changes

- During a chemical change, one or more new substance are formed.
- Chemical changes are permanent. Thus, a chemical change cannot be reversed by simple physical methods.
- During a chemical change, relatively larger amount of heat, light or any other radiation may be given out or absorbed.
- During a chemical change, both the physical and chemical properties of a substance are changed.

NOTE-

Some changes can be classified in more than one type

For example formation of a curd from milk is a

- **desirable change or**
- **chemical changes**
- **slow change and**
- **Irreversible change**

BURNING- is a chemical change in which substance reacts with oxygen or there to produce a new substance called oxide with the evolution of energy in the form of heat and light.

Example- burning of fuel, candle etc.

RUSTING OF IRON

when an iron object is left exposed to moist air, it chemically reacts with oxygen and water in the air to form a red-brown flaky substance called rust. The process of rusting can be represented by the following equation:

Iron (Fe) + Oxygen (O_2) (From air) + Water (H_2O) → Rust (Iron oxide, Fe^2 O^3)

Rusting occurs in the presence of both oxygen and water. The more humid the air, the faster the rusting occurs. The rust slowly eats away or corrodes the iron, leading to considerable loss. Since iron is used in making bridges, ships cars, truck bodies and many other articles, the monetary loss due to the rusting is huge.

HOW WILL YOU KNOW A CHEMICAL CHANGE HAS TAKEN PLACE?

Change in Property	Example
Radiation or absorption of heat	Burning of a substance such as coal, wood or candle results in production of heat and hence is a chemical change. Similarly, melting of ice results in absorption of heat and therefore it is a chemical change.
Production of	Bursting of fireworks is a chemical change. It results in production of sound, heat,

sound	radiation as well as gas.
Change in the colour of the substance	Raw fruits and vegetables when cut and left in open air start acquiring brown color due to a chemical change. Similarly, rusting of iron results in change of color of iron to reddish brown is also a chemical change.
Formation of a gas	When antacids are mixed in water bubbles are formed indicating the production of a gas and therefore it is a chemical change.
Change in the smell of the substance	When food gets spoiled, it produces foul smell. This is because of a chemical change in food. Rotten eggs often produce a bad odour due to production of sulphur.
Formation of Solids	Two liquids combine with each other and form a solid called precipitate. For Example, shells of animals are precipitates formed by chemical cha

IMPORTANCE OF CHEMICAL CHANGE

- Burning of paper and log of wood
- Digestion of food
- Boiling an egg
- Chemical battery usage
- Electroplating a metal
- Baking a cake
- Milk going sour
- Various metabolic reactions that take place in the cells
- Rotting of fruits
- Decomposition of waste
- The explosion of fireworks
- The reaction between salts and acids.
- Rusting of iron
- Lighting a matchstick

SIMULTANEOUS PHYSICAL AND CHEMICAL CHANGE

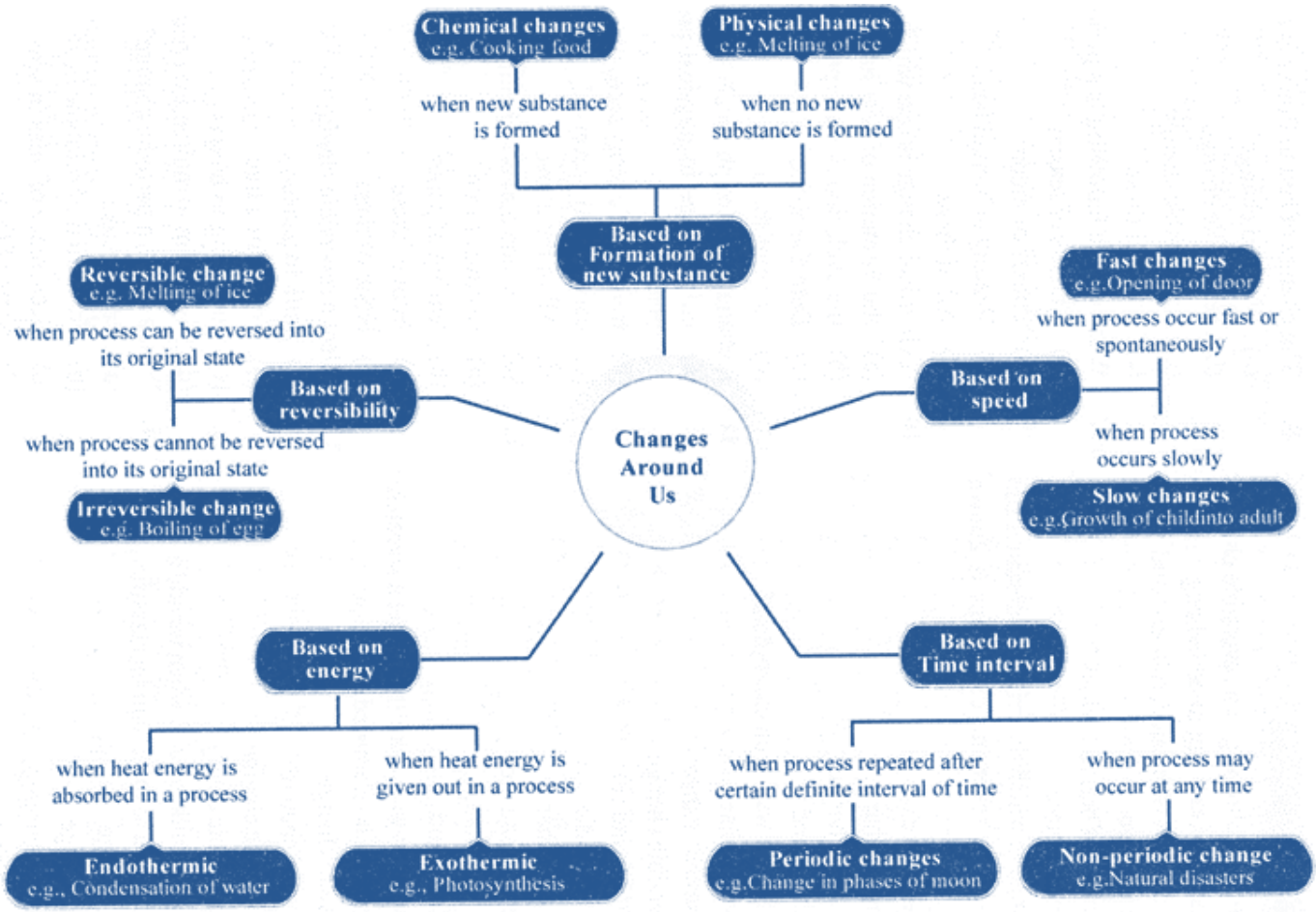
A change can't be both physical and chemical, but physical and chemical changes can occur simultaneously. This is what's happening with the burning candle: the wax is melting, which is a physical change, and it's combusting, which is a chemical change.

DIFFERENCE BETWEEN PHYSICAL AND CHEMICAL CHANGE

Difference Between Physical and Chemical Change

Physical Change	Chemical Change
• Change is temporary.	• Change is permanent.
• No new substance is formed. There is change only in physical properties.	• New substances are formed with entirely different physical and chemical properties.
• Change can be reversed by simple physical methods.	• Change cannot be reversed by simple physical methods.
• Energy may or may not be released or absorbed.	• Energy is released or absorbed during chemical change.
• Most of the time original form of the substance can be obtained easily by simple physical methods.	• The original substance cannot be obtained by simple physical methods.

CONCEPT MAP


Changes Around Us
Based on Formation of new substance
Chemical changes e.g. Cooking food
when new substance is formed
Physical changes e.g. Melting of ice
when no new substance is formed
Based on reversibility
Reversible change e.g. Melting of ice
when process can be reversed into its original state
when process cannot be reversed into its original state
Irreversible change e.g. Boiling of egg
Based on speed
Fast changes e.g.Opening of door
when process occur fast or spontaneously
when process occurs slowly
Slow changes e.g.Growth of childinto adult
Based on energy
when heat energy is absorbed in a process
Endothermic e.g., Condensation of water
when heat energy is given out in a process
Exothermic e.g., Photosynthesis
Based on Time interval
when process repeated after certain definite interval of time
Periodic changes e.g.Change in phases of moon
when process may occur at any time
Non-periodic change e.g.Natural disasters