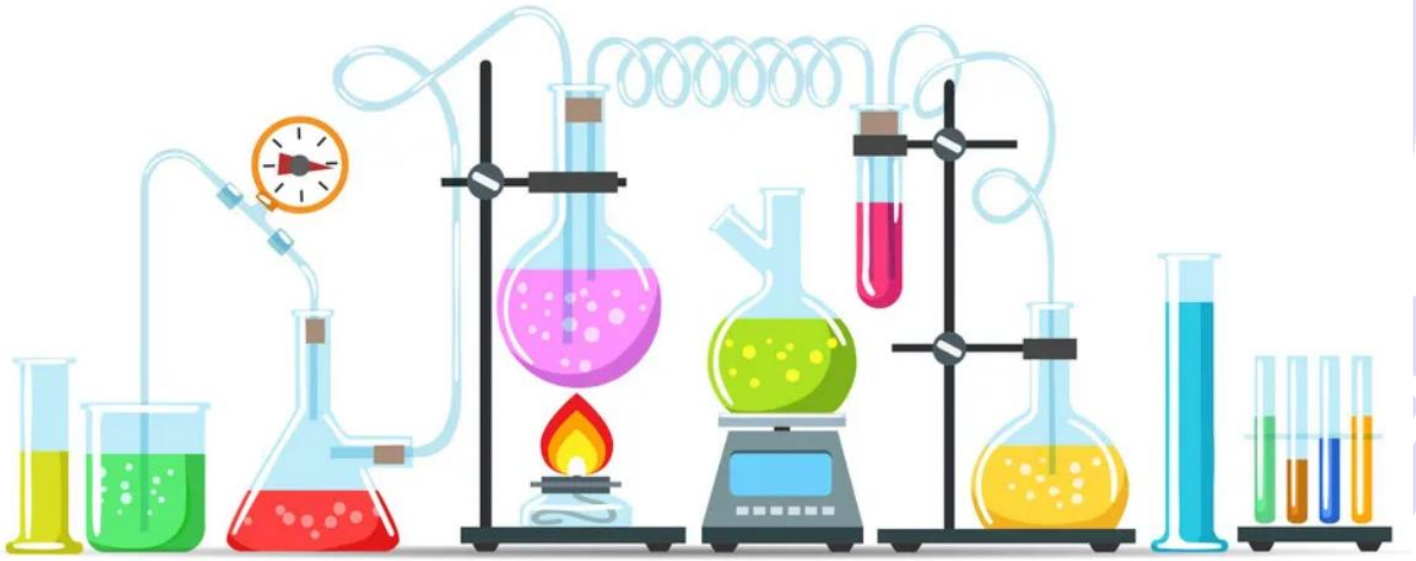
SCIENCE

CHAPTER 6: PHYSICAL AND CHEMICAL CHANGES



Physical and Chemical Changes

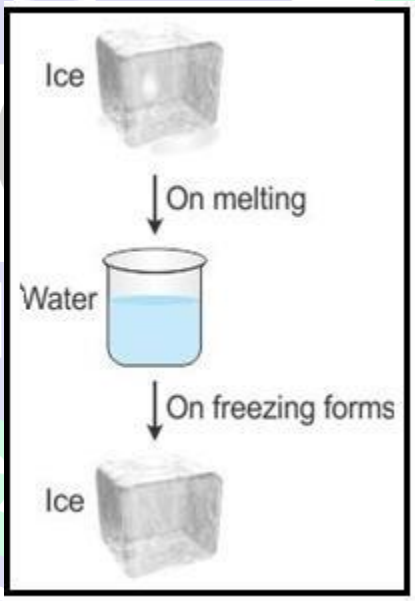
There are two types of changes, physical and chemical changes.

Physical Changes

- In a physical change, no new substances are formed.
- Changes in size, shape, state and colour of a substance are physical changes.
- In a physical change, the changes are temporary and can be easily reversed to form the original substance.

  Example:

  Melting of ice and freezing of water.



Examples of physical change:

- Making of ice-cream
- Boiling water into steam.

- Crystallization of sugar from its solution,
- Sublimation of camphor.
- Bending of glass tube by heating.
- Melting of wax.
- Evaporation of water.
- Glowing of an electric bulb
- Magnetising an iron bar by means of electricity.
- Dissolving sodium chloride in water.

Definition of Chemical Change

Chemical change is a permanent change which cannot be reversed and in which the chemical properties of a substance change with the change in its composition. It also alters the specific properties of a compound by bringing about a change in its molecular composition followed by a change in state,

All of us are familiar is the rusting of iron. If we leave a piece of iron in contact of air for some time, it is observe that the piece of iron acquires a film of brownish substance. This substance is called rust and the process is called rusting. Iron gates of parks or farmlands, iron benches kept in lawns and gardens, almost every article of iron, kept in the open gets rusted. At home you must have seen shovels and spades getting rusted when exposed to theatmosphere for some time.

Characteristics of Chemical Changes

- Heat, light or any other radiation may be given off or absorbed.
- Sound may be produced.
- A change in smell may take place or a new smell may be given off.
- A colour change may take place.

Examples:

i. **Burning of Magnesium Ribbon**

- Burning of a magnesium ribbon is a chemical change. When a magnesium ribbon is held over the flame of a burner, it burns with a dazzling white light to form magnesium oxide.
- $Mg + O_2 \rightarrow MgO$
- The magnesium oxide obtained on dissolving in water also forms a new substance, magnesium hydroxide which turns red litmus paper blue, indicating that it is basic in nature. Hence, the dissolving of magnesium oxide in water is a chemical change.

  $MgO + H_2O \rightarrow Mg(OH)_2$

ii. Reaction between Copper sulphate and Iron

- The reaction between copper sulphate and iron is a chemical change. When an iron object is placed in a copper sulphate solution, a chemical reaction takes place to give two new substances, iron sulphate and copper.

iii. Reaction Between Baking soda and Vinegar

The reaction between baking soda and vinegar is a chemical change. Baking soda is sodium bicarbonate and vinegar contains acetic acid. On mixing baking soda with vinegar, a chemical change takes place to form three new substances, sodium acetate, carbon dioxide and water.

Distinguish between Physical and Chemical Change

Physical Change	Chemical Change
• No new substance is formed.	• New substance is formed.
• Change is temporary.	• Change is permanent.
• It is easily reversible.	• It is usually irreversible.

Protective Shield of Ozone

- There is a layer of ozone gas high up in the atmosphere.
- The ozone layer protects us from the harmful radiations coming from the Sun.

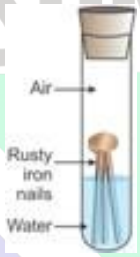
- The ozone absorbs these harmful radiations and breaks down to form oxygen.
- This breaking down of ozone into oxygen is a chemical change.

Rusting of Iron

Iron objects, on being left in damp air (or water) for a considerable period of time get covered with a red flaky substance called rust. This is called rusting of iron.

Iron combines with oxygen in the air, in the presence of water (moisture), to form iron oxide. This hydrated iron (III) oxide is nothing but rust.

Conditions Necessary for Rusting



- Two reasons necessary for rusting are:
- Presence of oxygen (in the air)
- Presence of water or water vapour (moisture)

How to Prevent Rusting?

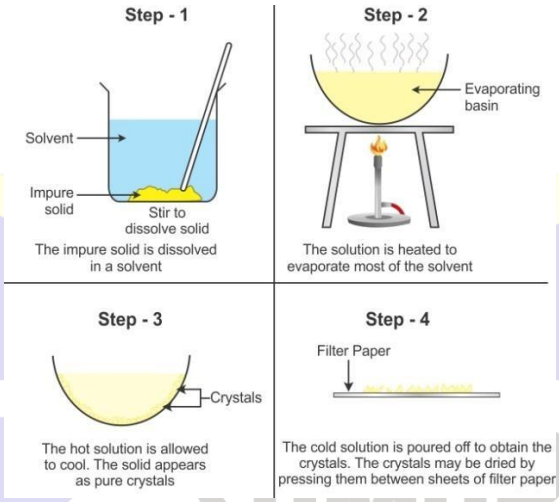
Methods to prevent rusting of iron: Painting or Greasing: Applying a coat of paint or grease to the surface of the iron object prevents the surface from coming in contact with the air and moisture and thus prevents rusting.

Galvanisation: The process of depositing a layer of zinc on iron is called galvanisation. A thin layer of zinc is deposited on the surface of the iron object and protects it from rusting.

Alloying: Stainless steel, an alloy is made by mixing iron with carbon and metals such as chromium, nickel and manganese, so that it does not rust.

Crystallisation: The salt obtained from seawater by the process of evaporation is not pure and its crystals are small. Moreover, the shape of the crystals cannot be seen clearly.

However, large crystals of pure substances can be obtained from their solutions by the process of crystallisation.



The process of cooling a hot, concentrated solution of a substance to obtain crystals is called crystallisation.

About Energy Changes

All chemical reactions take place either by the absorption or the release of energy, generally in the form of heat energy.

Exothermic reactions:

These chemical reactions which proceed with the release of heat energy, are called exothermic reactions.

For example, When magnesium ribbon is heated from its tip in a Bunsen flame, it catches fire and burns with a dazzling white flame with release of heat and light energy. The product formed is magnesium oxide.

$$\underset{\text{Magnesium}}{2Mg} + \underset{\text{Oxygen}}{O_2} \longrightarrow \underset{\text{Magnesium oxide}}{2MgO} + \text{Energy}$$

Endothermic reactions :

The chemical reactions which proceed with the absorption of heat energy, are called endothermic reactions. The following is an example of endothermic reaction.

$$\underset{\text{Sodiumbicarbonate}}{2NaHCO_3} + \text{Heat energy} \longrightarrow \underset{\text{Sodiumcarbonate}}{Na_2CO_3} + \underset{\text{Steam}}{H_2O} + \underset{\text{Carbondioxide}}{CO_2}$$

Process of Crystallisation

Crystallization is a process by which a pure soluble substance separates out in the form of crystals from its hot and saturated solution on cooling.

The process is employed in the separation of pure common salt from the impure common salt obtained from sea. Similarly, it is used to obtain pure nitre from impure nitre (KNO3) pure copper sulphate (CuSO4), from its impure sample and pure alum (phitkari) from the impure alum.

1. Separation of pure copper sulphate from impure sample:

10 g of impure sample of copper sulphate, containing sand particles or dirt particles an impurity is taken in a beaker. This sample is dissolved in minimum amount of water. The impurities are filtered and the clear copper sulphate solution is collected in a china dish. The china dish containing copper sulphate solution is placed over sand bath.

When sand is heated in an iron vessel by placing it over a tripod stand, this arrangement is called sand bath.

The solution is allowed to evaporate, so that more than half of the volume of water evaporates. The solution is now saturated at higher temperature. The china dish is removed from the sand bath and covered with filter paper. The copper sulphate solution in it is allowed to cool for 24 hours. After 24 hours blue crystals of copper sulphate are separated out. The crystals are filtered and dried in the folds of filter paper.

GALVANISATION

The process in which depositing a layer of zinc on iron occurs is known as galvanisation. The iron pipes we use in our homes to carry water are galvanised to prevent rusting. You know that ships are made of iron and a part of them remains under water. On the part above water also water drops keep clinging to the ship's outer surface. Moreover, the water of the sea contains many salts. The salt water makes the process of rust formation faster. Therefore, ships suffer a lot of damage from rusting in spite of beingpainted. So much so, that a fraction of ship's iron has to be replaced every year.

Corrosion of Aluminium:

Due to the formation of a dull layer of aluminium oxide when exposed to moist air, the aluminium metal loses its shine very soon after use. This aluminium oxide layer is very tough and prevents the

metal underneath from further corrosion (because moist air is not able to pass through this aluminium oxide layer). This means sometimes corrosion is useful.

Corrosion of Copper:

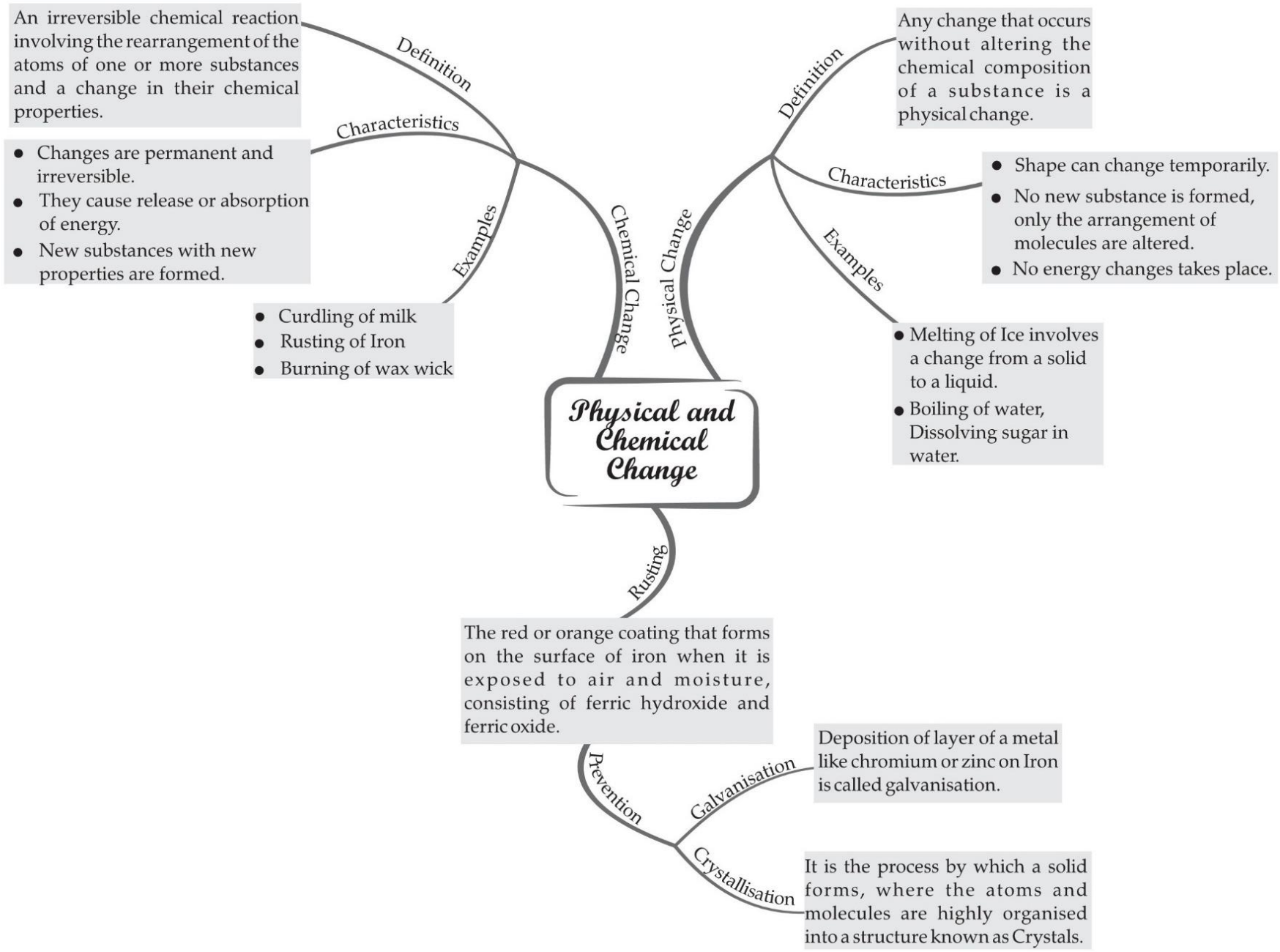
When a copper object remains in damp air for a considerable time, then copper reacts slowly with carbon dioxide and water of air to form a green coating of basic copper carbonate [$CuCO_3.Cu(OH)_2$] on the surface of the object. Since copper metal is low in the reactivity series, the corrosion of copper metal is very, very slow.

Corrosion of Silver:

Silver is a highly unreactive metal, so it does not reacts with oxygen of air easily. But, air usually contains a little of sulphur compounds such as hydrogen sulphide gas (H_2S), which reacts slowly with silver to form a black coating of silver sulphide (Ag_2S). Silver ornaments gradually turn black due to the formation of a thin silver sulphide layer on their surface and silver is said to be tarnished.

MIND MAP : LEARNING MADE SIMPLE

CHAPTER-6



Important Questions

➢ Multiple Choice Questions:

Question 1. Which of the following statement is incorrect for a chemical reaction?

(a) Heat may be given out but never absorbed

(b) Sound may be produced

(c) A colour change may take place

(d) A gas may be evolved

Question 2. Properties like size, shape, colour, state of a substance are

(a) chemical properties

(b) mental properties

(c) physical properties

(d) physico-chemical properties

Question 3. A physical change is generally

(a) reversible

(b) irreversible

(c) considerable

(d) all of these

Question 4. During a physical change, a substance undergoes a change in its

(a) physical properties

(b) chemical properties

(c) both (a) and (b)

(d) none of these

Question 5. Rusting of iron is a

(a) physical change

(b) chemical change

(c) both (a) and (b)

(d) all of these

Question 6. Rusting occurs when iron is exposed to

(a) oxygen and water

(b) soil and rain

(c) breeze and sunlight

(d) salt water and clouds

Question 7. When carbon dioxide is passed through lime water, the substance formed is

(a) calcium oxide

(b) calcium carbonate

(c) both (a) and (b)

(d) none of these

Question 8. A chemical change is also called a

(a) chemical reaction

(b) rusting

(c) both (a) and (b)

(d) all of these

Question 9. Burning of any substance is a/an

(a) physical change

(b) chemical change

(c) irreversible change

(d) both (b) and (c)

Question 10. The process of depositing a layer of zinc over iron is known as

(a) aluminisation

(b) galvanisation

(c) fertilisation

(d) ironing

Question 11. Two drops of dilute sulphuric acid were added to 1 g of copper sulphate powder and then small amount of hot water was added to dissolve it (step I). On cooling, beautiful blue-coloured crystals got separated (step II). Step I and step II are

(a) physical and chemical changes respectively.

(b) chemical and physical changes respectively.

(c) both physical change

(d) both chemical change

Question 12. Which among the following is a physical change?

(a) Burning of wood

(b) Ripening of fruit

(c) Cutting a log of wood in small pieces

(d) Cooking of food

Question 13. Which of the following is a chemical change?

(a) Germination of seeds

(b) Cutting a piece of paper

(c) Bursting of fire crackers

(d) Both (a) and (c)

Question 14. A chemical change may bring

(a) evolution of gas

(b) change in colour

(c) change in taste

(d) all of these

Question 15. Which is the formula of ozone?

(a) Fe_2O_3

(b) Fe_3O_2

(c) O_2

(d) O_3

➢ Fill In the Blanks:

1. Setting curd from milk is a _____ change.
2. Broadly, changes are of two types, _____ and _____ .
3. Physical properties of a substance consists of_____ , _____ , _____ and state.
4. No new substance is formed in a _____ change.
5. Calcium carbonate is decomposed to form _____ and _____
6. Magnesium on burning produces _____.

➢ True or False:

1. Stainless steel is made by mixing aluminium with carbon.

2. Burning of any substance is a chemical change.
3. Stretching of rubber band is a physical change.
4. We must use concentrated sulphuric acid for crystallisation of copper sulphate.
5. Changes are broadly classified as physical and chemical changes.
6. Galvanizing is a physical change.

➢ Very Short Question:

1. What is rust?
2. What type of change in rust?
3. What type of change is photosynthesis?
4. What is a chemical change?
5. Write the chemical formula of blue vitriol.
6. State the two important conditions for rusting.
7. What is freezing point of water?
8. What is freezing of water?
9. What is melting?
10. Name the process by which water molecules continuously change to vapour.

➢ Short Questions:

1. Explain physical reaction along with examples.
2. Explain chemical reaction along with examples.
3. State the condition necessary for the occurrence of any reactant.
4. State rate of chemical reaction.
5. Why new products are formed in a chemical reaction?
6. Explain the process of rusting.
7. How can we prevent rusting?
8. Setting of curd is regarded as a chemical change, explain why?

➢ Long Questions:

1. Which one is better technique to obtain sugar from sugar solution- crystallization or evaporation to dryness?
2. Explain the changes occurring in burning of candle.

3. Explain why burning of wood and cutting it into small pieces are considered as two different types of changes.

4. Explain the formation of crystal of copper sulphate.

5. A part from new products, many other things accompany a chemical change, what are those things?

✓ Answer Key-

➢ Multiple Choice Answers:

1. (a) Heat may be given out but never absorbed
2. (c) physical properties
3. (a) reversible
4. (a) physical properties
5. (b) chemical change
6. (a) oxygen and water
7. (b) calcium carbonate
8. (a) chemical reaction
9. (d) both (b) and (c)
10. (b) galvanisation
11. (c) both physical change
12. (c) Cutting a log of wood in small pieces
13. (d) Both (a) and (c)
14. (d) all of these
15. (d) O_3

➢ Fill In the Blanks:

1. chemical
2. physical, chemical
3. shape, size, colour
4. physical
5. calcium oxide, carbon dioxide
6. magnesium oxide

➢ True or False:

1. False
2. True
3. True

4. False
5. True
6. True

➢ Very Short Answers:

1. Answer: When iron oxide is hydrated, it is known as Rust (Fe2O3. xH2O)
2. Answer: Chemical change
3. Answer: Chemical change
4. Answer: A change, in which a new substance with different properties is formed, is known as a chemical change.
5. Answer: Crystals of copper sulphate pent hydrate (CuSO4.5H2O) are blue in colour. So, it is commonly known as blue vitriol.
6. Answer: Presence of water and presence of oxygen
7. Answer: The freezing point is 0°C at which water freezes.
8. Answer: Freezing is the process in which water turns to ice when cold enough (below 0°C temperature).
9. Answer: Melting is the process of turning a solid to a liquid.
10. Answer: Evaporation.

➢ Short Answer:

1. Answer: A change in which a substance undergoes a change in its physical properties is called a physical change. For example; melting of ice.
2. Answer: A change in which one or more new substances are formed is called a chemical reaction. For example; rusting of iron.
3. Answer: For the occurrence of any reaction, the molecules or atoms of the reactants must collide with one another, in order to break old bonds and form new bonds.
4. Answer: The reaction rate or rate of reaction is the speed at which reactants are converted into products.
5. Answer: In a chemical reaction the old bonds of the reactants are broken down and fresh bonds are formed, resulting in formation of new products with different properties of that of earlier products.
6. Answer: When an iron object is left in damp air (or water) for a considerable time, it gets covered with a red-brown flaky substance called rust. This is called rusting of iron. During the rusting of iron, iron metal combines with the oxygen (of air) in the presence of water

(moisture) to form a compound iron oxide.

7. Answer: Whenever you get iron, water and oxygen together, you get rust. So the best way to prevent it is to keep them apart; that's what paint does, or the spray-on wax and oil coatings that the car protection companies sell. Keep your tools dry; wipe down your bike after a ride; keep the water away and it can't rust.
8. Answer: Setting of curd is a chemical change because we cannot get the original substance (milk) back. The new substance, i.e. curd is different from the milk in taste, smell and chemical properties.

➢ Long Answer:

1. Answer: Crystallization is better because,
   - It occurs on the entire surface.
   - We get solid in the pure crystallized form.
   - The soluble impurities get removed in this process.
   - It doesn't require very high temperature conditions.
2. Answer: When a candle burns, both physical and chemical changes take place. On a burning candle, the wax melts but can be solidified again on cooling. This shows that melting of wax is a physical change. Burning of candles also produces light and some gases like carbon dioxide. Hence, burning the wick of the candle is a chemical change.
3. Answer: Burning of wood produces ash and smoke. Hence the properties of wood are changed, and new substances are formed. So, it is a chemical reaction. When a log of wood is cut into small pieces, there is no new substance formed. Each small piece bears the properties of wood. So, its a physical change. Obviously, burning and cutting of wood are two different types of changes.
4. Answer: A cup of water taken in a beaker and a few drops of dilute Sulphuric acid are added into it. The water is hated. When it starts boiling copper sulphate powder is added slowly while stirring continuously till no more powder can be dissolved. The solution is filtered and allowed to cool down. Crystals of copper sulphate slowly form at the bottom of the beaker.
5. Answer: Part from new products, many other things accompany a chemical change, those things are:
   - Heat, light or any other radiation may be given off or absorbed.
   - Change in smell may take place.
   - Sound may be produced.
   - Change in colour may take place.

- A gas may be formed