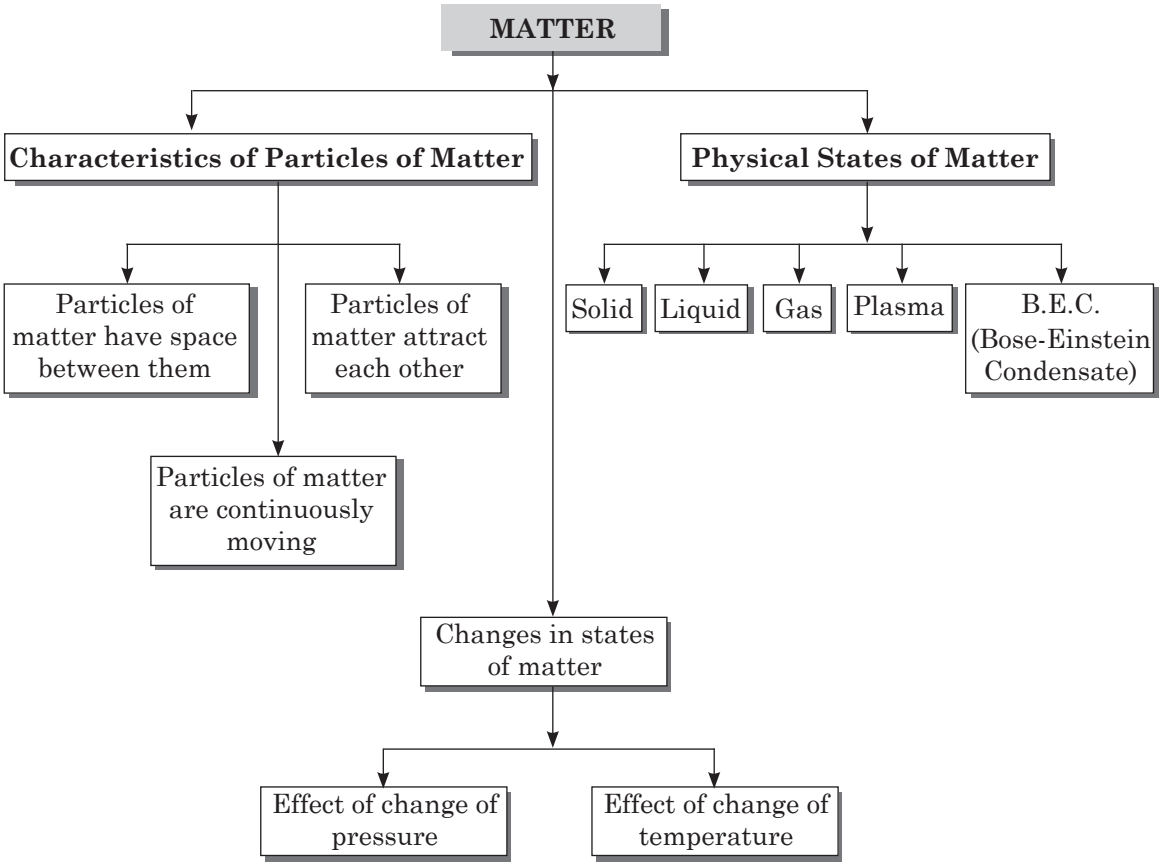
1 Matter in Our Surroundings

Topics Covered

1.1 Characteristics of Particles of Matter
1.2 Physical States of Matter
1.3 Changes in States of Matter

CHAPTER MAP



Quick Revision Notes

- **Matter** is a substance which has mass and occupies space.
- Everything in the universe is made up of 'matter', e.g. air, water, books, copy, pen, pencil.
- Indian philosophers classified matter into five elements, air, water, fire, sky and earth.
- Matter can be classified on the basis of physical and chemical properties.
- On the basis of physical properties, matter is classified into solid, liquid and gaseous state. Plasma is the fourth state of matter whereas B.E.C. (Bose-Einstein Condensate) is considered as the fifth state of matter.
- **Solids** have least space between the consituting particles, liquids have more intermolecular spaces while gases have maximum spaces between its particles.
- When we dissolve salt in water, level of water remains the same because particles of salt occupy the space between the water molecules. This process is called **dissolution**.
- The particles of matter are very small, can't be seen with an ordinary microscope. STM (Scanning tunneling microscope) has been used to see these particles, i.e. atoms.
- The particles of one type get into the spaces between the particles of the other, this process is called **diffusion** (intermixing of particles).
- Gases have maximum rate of diffusion, e.g. smell of perfume can be observed from a distance.
- Liquids like ink can diffuse (intermix) in water slowly.
- Solids can diffuse in liquids very slowly, e.g. copper sulphate crystals will make the aqueous solution blue gradually.
- Solids can diffuse in solids also, e.g. chalk gets diffused into blackboard. However the rate of diffusion of particles is quite slow.
- Particles of matter are continuously moving, therefore possess kinetic energy.
- Kinetic energy of particles in gaseous state is maximum while in solid state it is minimum.
- Kinetic energy of particles increases with increase in temperature.
- Particles of matter have spaces between them.
- Particles of matter attract each other.
- Solids have maximum inter-particle forces of attraction, followed by liquids. Gaseous state has least forces of attraction between the constituting particles.
- We can change the state of matter by changing the conditions of temperature and pressure.
- The state of matter is decided by temperature and pressure, e.g. below 0°C water is solid in the form of ice, above 0°C, it is liquid but above 100°C it is in gaseous state, i.e. steam.
- Every pure solid melts at a fixed temperature called its melting point, e.g. ice melts at 0°C which is equal to 273.15 K.
- Kelvin is a scale of temperature. If we add 273 to the temperature of a substance in °C, we will get its temperature in Kelvin.
- Temperature in Kelvin can be changed into °C by subtracting 273.
- Heat is required to melt 1 kg of a solid into liquid completely at its melting point. It is an endothermic process because heat is absorbed. The amount of heat required is called latent heat of fusion.
- Heat is required to convert 1 kg of a liquid into vapours at its boiling point, so as to overcome the inter-particle forces of attraction, e.g. water changes into steam at 100°C (373 K). This heat is called latent heat of vapourisation.
- The process in which solid changes into vapours directly is called **sublimation**, e.g. naphthalene balls kept in toilets disappear after few days because they undergo sublimation.
- Pressure will reduce the intermolecular spaces and increase the forces of attraction, e.g. a gas is liquified at high pressure and at low temperature.
- **Evaporation** is the process in which liquid changes into vapours.

- The rate of evaporation depends upon temperature, pressure, nature of liquid, wind speed, exposed surface area, humidity, etc.
- Evaporation causes cooling effect.
- We use cotton clothes during summer because it can effectively absorb water i.e. sweat and also provides better air circulation that further helps in adsorption of sweat. Therefore they keep us cool.
- Water vapours are present in air which get condensed when come in contact with a cool surface.
- In plasma, particles are in the form of ionised gas particles. In fluorescent tubes, CFL, neon sign bulbs, plasma is present.
- **BEC:** It is formed by cooling a gas of very low density at super low temperature. Its density is $\frac{1}{100,000}$ of the density of air.
- Evaporation is a surface phenomenon whereas boiling is a bulk phenomenon.
- Substance that gets dissolved is termed as solute. Liquid in which the substance is dissolved is termed as solvent.

1. Characteristics of Particles of Matter

Matter: The substance which has mass and occupies space. It is made up of small particles.
Dissolution: The process in which a substance gets dissolved in a liquid forming homogeneous solution is called dissolution, e.g. when salt is dissolved in water, level of water remains the same because particles of salt occupy the space between the water molecules.
Crystal: It has a well defined geometrical shape. One crystal of potassium permanganate contains millions of small particles which keeps on dividing into smaller and smaller particles when dissolved in water.
Intermolecular Space: The space between the constituting particles of a matter is called intermolecular space. That is why particles of one type of matter get into the spaces between particles of the other type of matter.
Diffusion: The process of intermixing of molecules is called diffusion, e.g. we get the smell of dettol and perfume from a distance because these particles mix up with air.
Kinetic Energy: The energy due to the movement of particles is called kinetic energy.
Rate of Diffusion: The amount of substance diffused per unit time is called rate of diffusion.
Intermolecular Forces of Attraction: The force of attraction between the particles of matter called intermolecular force of attraction. It is maximum in solids, while minimum in gases of matter.

Exercise 1.1

I. Very Short Answer Type Questions (1 Mark)

1. Give reasons for the following observation:
   The smell of hot sizzling food reaches you several metres away, but to get the smell from cold food you have to go close.
2. A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?
3. A substance has no mass, can we consider it as matter? [*CBSE* 2014]
4. Why is light not considered as a form of matter?
5. Is smell of clove or cardamom (*Elaichi*) a form of matter?
6. What is the effect of temperature on the rate of diffusion?

7. Which term is used to describe the mixing of copper sulphate and water in a beaker? **[HOTS]**
8. Even two or three crystals of $KMnO_4$ (potassium permanganate) can impart colour to a very large volume of water. Which characteristic property of the particles of matter is illustrated here? **[HOTS]**
9. A piece of chalk can be broken easily but iron cannot, why?
10. What name is given to the particles of matter?

II. Short Answer Type Questions (2 Marks)

11. Which of the following are matter?
Chair, air, love, smell, hate, almonds, thought, cold, cold-drink, smell of perfume.
12. What are the characteristics of the particles of matter? [*CBSE* 2011]
13. (*i*) When common salt is dissolved in water, what will be the change in volume and why?
(*ii*) Write one similarity between the three states of matter.[*CBSE* 2016]
14. Can solid diffuse in solids? Give an example. **[HOTS]**

Answers 1.1

1. It is because the rate of diffusion increases with increase in temperature, i.e. particles giving flavour of food moves faster with increase in temperature.
2. It shows that the force of attraction exist between particles of matter, i.e. particles of matter attract each other.
3. No, it cannot be considered as matter.
4. It is because it does not occupy any space.
5. No, it is not a form of matter. However the clove or cardamom particles which are responsible for their smell is a form of matter.
6. Rate of diffusion increases with increase in temperature.
7. Diffusion. It is also called dissolution.
8. Each $KMnO_4$ crystal is made up of millions of small particles.
9. Iron particles have stronger forces of attraction than particles of chalk.
10. Atoms or molecules
11. Chair, air, almonds, cold-drink are matter.
12. (*i*) Particles of matter are very small.
(*ii*) Particles of matter are continuously moving.
(*iii*) Particles of matter attract each other.
(*iv*) Particles of matter have space(s) between them.
13. (*i*) No, there will not be any change in volume because particles of salt occupy the space between the particles of water.
(*ii*) All the states of matter are made up of particles.
14. Yes, solids can diffuse in solids, e.g. blackboard becomes slightly white because chalk particles diffuses into blackboard.

2. Physical States of Matter

There are three states of matter — solids, liquids and gases.

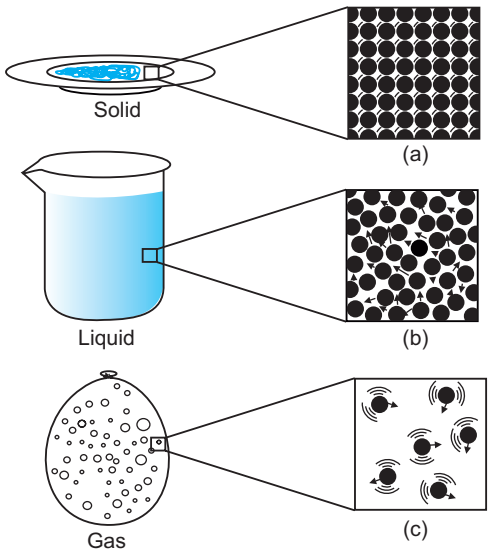
Solids

- They have fixed shape.
- They have fixed volume.

- The particles do not flow.
- Many solids are crystalline i.e. have well defined geometerical shape.
- Particles have fixed positions and can only vibrate about their fixed positions.
- Forces of attraction between the particles is maximum.
- They cannot be compressed, except sponge, rubber.
- Particles are closely packed.
- Particles have least interparticle spaces.
- Particles have least kinetic energy.
- They have maximum density.
- They have high melting and boiling points.
- They diffuse very slowly.

Liquids

- They have fixed volume.
- They do not have fixed shape.
- They can flow from higher level to lower level.
- The forces of attraction between the particles is less than solids but more than gases.
- The intermolecular spaces is more than solids but less than gases.
- Kinetic energy of particles is more than solids but less than gases.
- Liquids cannot be compressed easily.
- Particles are less closely packed.
- They have less density than solids.
- They have less boiling points than solids.
- They diffuse faster than solids but slower than gases.



Gases

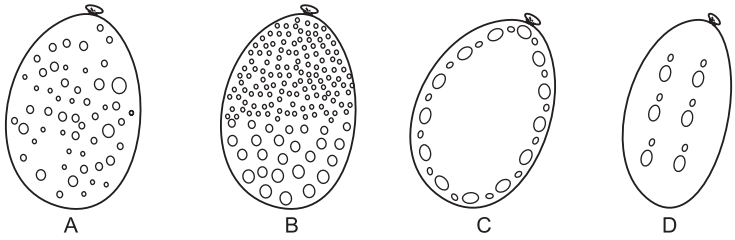
- They do not have fixed volume.
- They do not have fixed shape.
- They can flow in all the directions.
- They exert pressure on the walls of container in which it is kept.
- Their particles have maximum kinetic energy.
- They have least forces of attraction between their particles.
- They have maximum intermolecular spaces.
- They can be most easily compressed.
- They diffuse at the fastest rate.
- They have the least density.

Exercise 1.2

I. Very Short Answer Type Questions (1 Mark)

1. What is physical state of water at: (*a*) 250 °C, (*b*) 100 °C?
2. Rubber band changes its shape. Is it a solid? [*CBSE* 2012, 2013]
3. Name the property of gases due to which it is possible to fill CNG in cylinders for using as a fuel in car.
4. The melting point of these solids X, Y and Z are 298 K, 314 K and 398 K, respectively. Arrange these in increasing order of their interparticle forces of attraction. [*CBSE* 2011]

5. How do we liquify the gases? **[HOTS]**
6. Which gas is supplied in liquified form: (*i*) at home, (*ii*) in hospitals. [*DOE*]
7. Compare the forces of attraction between iron, rubber band and chalk.
8. Arrange sugar, water and oxygen in increasing order of forces of attraction between their particles.
9. Which diagram shows the arrangement of particles inside the balloon filled with a mixture of hydrogen and bromine?



II. Short Answer Type Questions (2 Marks)

10. The mass per unit volume of a substance is called density. (density = mass/volume). Arrange the following in order of increasing density – air, exhaust from chimneys, honey, water, chalk, cotton and iron.
11. Give reasons for the following:
    (*i*) A gas completely fills the vessel in which it is kept.
    (*ii*) A gas exerts pressure on the walls of the container.
    (*iii*) A wooden table should be called a solid.
    (*iv*) We can easily move our hand in air but to do the same through a solid block of wood we need a karate expert.
12. Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Find out why? [*CBSE* 2013, 2014] **[HOTS]**
13. What is the full form of CNG? Mention its one property that makes it so important?
14. Sponge is a solid but still it can be compressed, why?
15. Among solids, liquids and gases which one has:
    (*i*) Maximum forces of attraction between particles.
    (*ii*) Maximum space in between the particles.
    Give reason in support of your answer. [*CBSE* 2015]
16. What is tincture of iodine? Identify solute and solvent in it. [*CBSE* 2016]
17. Ice, water and steam are three states of a substance and not different substances. Justify. [*CBSE* 2012] **[HOTS]**
18. Arrange the three states of matter in the increasing order of:
    (*i*) rate of diffusion, (*ii*) motion of particles. [*CBSE* 2012]
19. Why is iron almirah solid at room temperature? Give two reasons.
20. Cotton being a solid, floats on water, why?
21. Diffusion of a gas in water is essential. Explain.
22. Classify the following substances present in our body into solids, liquids and gases:
    Bones, Blood, Teeth, Air in Lungs, Water **[HOTS]**
23. What is meant by pressure of gas?

    OR

    Why do gas exert pressure? [*DOE*]

24. Write the characteristic responsible for:
(*i*) Smell of perfume spreads in the room.
(*ii*) Water takes the shape of the container in which it is kept.

25. What will happen if inflated balloon is kept in a fridge and why? **[HOTS]**

III. Long Answer Type Question (5 Marks)

26. (*i*) Tabulate the differences in the characteristics of states of matter.
(*ii*) Comment upon the following: rigidity, compressibility, fluidity, filling a gas container, shape, kinetic energy and density.

Answers 1.2

1. (*i*) Steam (gaseous state)
(*ii*) Exist as both liquid and vapours (gaseous state).
2. Yes it is a solid, it regains its shape when force is removed.
3. Gases can be easily compressed.
4. X < Y < Z
5. We can liquify gases at low temperature and high pressure.
6. (*i*) LPG, (*ii*) Oxygen
7. Chalk < Rubber Band < Iron
8. Oxygen < Water < Sugar
9. Although bromine is heavier than hydrogen, but they will intermix and form a mixture as shown in 'A'.
10. Air < Exhaust from chimneys < Cotton < Water < Honey < Chalk < Iron.
11. (*i*) It is due to weak forces of attraction and maximum intermolecular spaces among the gas particles.
(*ii*) The kinetic energy of gas molecules is maximum, therefore they exert pressure on the walls of container due to collision of gas molecules on the walls of container.
(*iii*) It has fixed shape and volume.
(*iv*) The forces of attraction between the particles of wood are more than in between the particles of air.
12. It is because there are empty spaces among H_2O molecules in ice, therefore it has less mass but more volume and hence less density than water.
13. Compressed Natural Gas. It creates less pollution than petrol and diesel yet it can act as an efficient fuel for vehicles plying on roads.
14. Sponge has pores in which air is filled, that is why it can be compressed.
15. (*i*) Solid, because particles are closely packed.
(*ii*) Gases, because particles are far away from each other.
16. Iodine dissolved in alcohol is called tincture of iodine. Solute is iodine, solvent is alcohol.
17. (*i*) All of them have same chemical properties but different physical properties, that is why they are different physical states of water and not different substances.
(*ii*) Secondly, all of them are made up of water molecules, they differ in arrangement and spaces between the molecules.
18. (*i*) Rate of diffusion—solids < liquids < gases
(*ii*) Rate of motion of particles—solids < liquid < gases.
19. (*i*) It has fixed shape and volume. (*ii*) It is rigid, does not move on its own.
20. It is because density of cotton is less than water due to weak intermolecular forces of attraction.

21. Aquatic animals take up oxygen dissolved in water, therefore diffusion of oxygen gas in water is highly essential.

22. (*i*) Bones and teeth are solids. (*ii*) Blood and water are liquids.
(*iii*) Air in our lungs is gas.

23. It is the force per unit area applied on the walls of container by collision of gas molecules on the walls of the container.

24. (*i*) It is due to movement of molecules of gas which leads to intermixing of perfume molecules with air. This process is called diffusion.
(*ii*) Water is liquid having less forces of attraction and more intermolecular spaces, thus it takes the shape of the container in which it is kept. It has fluidity.

25. It will shrink because molecules of gases will move slowly and come closer to each other, occupying less volume.

26. (*i*)

Solids	Liquids	Gases
1. They have fixed shape and volume.	1. They do not have fixed shape but have fixed volume.	1. They neither have fixed shape nor fixed volume.
2. Particles in solids do not flow.	2. Particles in liquids can flow from higher level to lower level.	2. Particles in gases flow in all the directions.
3. Particles are located at fixed positions and these particles can only vibrate about their fixed positions.	3. Particles are moving continuously with some velocities and are not fixed at a position.	3. Particles in gases are haphazardly moving and exert pressure on the walls of the container.
4. Inter-particle spaces are minimum.	4. Inter-particle spaces are more than solids.	4. Inter-particle spaces are maximum.
5. Forces of attraction between the particles is maximum.	5. Forces of attraction between the particles is less than solids but more than gases.	5. Forces of attraction between the particles is minimum.
6. Particles are closely packed and thus, solids cannot be compressed.	6. Particles are not closely packed and thus they can be compressed to some extent.	6. Particles are freely moving and thus gases are highly compressible.
7. Particles have least kinetic energy.	7. Kinetic energy of particles is more than the solids.	7. Particles have highest kinetic energy.
8. Solids have maximum density.	8. Density of liquids is less than solids.	8. Gases have minimum density
9. Solids have high melting and boiling points.	9. They have low melting and boiling points than solids.	9. They have least melting and boiling points.
10. They diffuse very slowly.	10. They diffuse faster than solids, but slower than gases.	10. They diffuse at the fastest rate.

(*ii*) (*a*) **Rigidity:** The property of a substance due to which particles do not change their position.
(*b*) **Compressibility:** The property due to which particles of a substance come closer and occupy small volume.
(*c*) **Fluidity:** The ability to flow is called fluidity.

(*d*) **Filling a Gas Container:** It is the ability of a substance to fill the container in which these are present.

(*e*) **Shape:** Solids have fixed shape due to strong forces of attraction. Liquids and gases take the shape of the container due to less force of attraction.

(*f*) **Kinetic Energy:** The energy due to motion of particles is called kinetic energy. Gases have maximum kinetic energy.

(*g*) **Density:** It is defined as mass per unit volume. Solids have high density.

3. Changes in States of Matter

Endothermic Process: The process in which heat is absorbed.

Exothermic Process: The process in which heat is evolved.

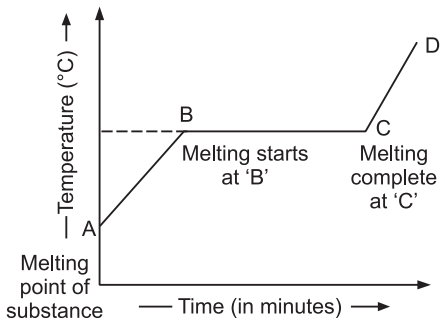
Physical Change: The change in which no new substance is formed is called physical change.

Melting

- The process of changing solid into liquid is called melting.
- As the substance is heated, it absorbs energy and kinetic energy of molecules increases. Particles of solids absorb enough energy to overcome the forces of attraction holding them in fixed position. They rearrange to form a liquid. It is an endothermic process.

Graphical Representation of Melting:

- AB represents a solid, kinetic energy is increasing with increase in temperature.
- BC represents both solid and liquid. It will be observed at its melting point. At 'C' solid melts completely and changes into liquid.
- CD represents the liquid state in which kinetic energy of molecules is increasing due to increase in kinetic energy.

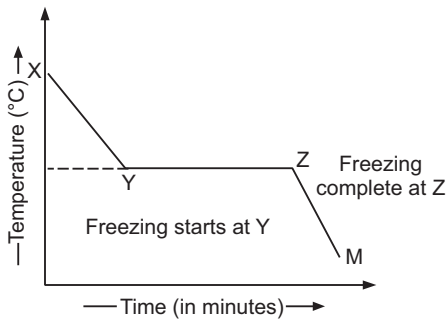


Melting Point: It is the temperature at which both solid and liquid co-exist, i.e. solid changes into liquid. Impurities decreases the melting point of a solid.

Freezing: It is the process of changing liquid into solid state. It is an exothermic process.

Graphical Representation of Freezing:

- XY represents liquid but kinetic energy of particles is decreasing and particles are coming closer.
- At 'Y' freezing starts. At 'Z', it is complete. YZ represents both solid and liquid states.
- ZM represents solid state in which kinetic energy of molecules decreases due to decrease in temperature.



Freezing Point: It is the temperature at which liquid changes into solid state. It is equal to the melting point for a pure substance. It is the temperature at which vapours of a solid is equal to the vapour pressure of liquid.

- Impurities decreases the freezing point of solid, e.g. common salt reduces the freezing point of ice.

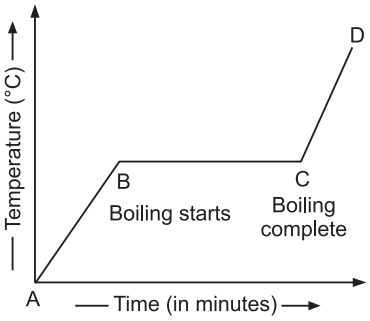
Boiling:

- It is a process in which liquid changes into vapours.
- As the substance is heated, kinetic energy of molecules increases.

- It absorbs energy and overcome intermolecular forces of attraction.
- It takes molecules far away and changes into gaseous or vapour state.
- It is also an endothermic process.

Graphical Representation of Boiling:

- It is a bulk phenomenon.
- AB represents the liquid state at which boiling starts.
- BC represents both liquid and vapours.
- CD represents gaseous state in which molecules will become more energetic with increase in temperature.



Boiling Point: It is the temperature at which vapour pressure of liquid becomes equal to the atmospheric pressure. Pure liquid has a fixed boiling point. Soluble impurities increases the boiling point of a liquid, e.g. Sea water boils above 100 °C.

Condensation: It is the process in which vapours of liquid changes into liquid state again due to decrease in temperature and decrease in kinetic energy.

- It is an exothermic process.
- At hill stations water boils below 100 °C because atmospheric pressure is low.
- In a pressure cooker, boiling point of water is raised due to high pressure exerted by the steam formed, which makes it super heated water [boiling point > 100 °C].

Evaporation: It is a process in which liquid changes into vapours.

- It is an endothermic process, therefore it causes cooling by absorbing heat from the surroundings.
- It is a surface phenomenon, because it starts from the surface, due to high kinetic energy of surface molecules.

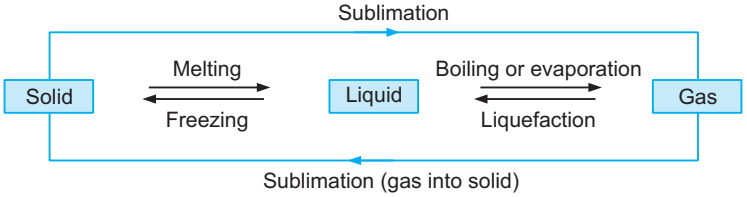
Factors:

- *Surface area:* More the surface area more will be the rate of evaporation.
- *Nature of liquid:* Liquids having low boiling point has less intermolecular forces of attraction and they evaporate faster.
- *Wind speed:* It increases the rate of evaporation.
- *Humidity:* It decreases the rate of evaporation.

Humidity: It is the amount of water vapour present in air.

Sublimation: The process in which solid changes into vapours directly without becoming liquid is called sublimation, e.g. Iodine, Camphor, Ammonium chloride, solid CO_2 (dry ice), naphthalene can undergo sublimation.

- These substances which can sublime have weak intermolecular forces of attraction.



Kinetic energy possessed by molecules increases with increase in temperature.

Latent Heat of Fusion: It is defined as the heat required to convert 1 kg of a solid into liquid completely at its boiling point. That is why temperature remains constant at the melting point.

Latent heat of Vapourisation: It is defined as the heat required to convert 1 kg of a liquid into vapours completely at its melting point and that is why temperature remains constant.

Latent Heat of Sublimation = Latent heat of fusion + Latent heat of vapourisation

Evaporation always causes cooling because liquid evaporate by taking heat of vapourisation from surrounding which causes cooling, e.g.

- Acetone on palm causes cooling.
- We should wear cotton clothes to keep us cool in summers because it effectively absorbs water, so it absorbs sweat which on evaporation leads to cooling.
- Ice is used to bring down high temperature during fever.
- People sprinkle water on ground which on evaporation causes cooling.

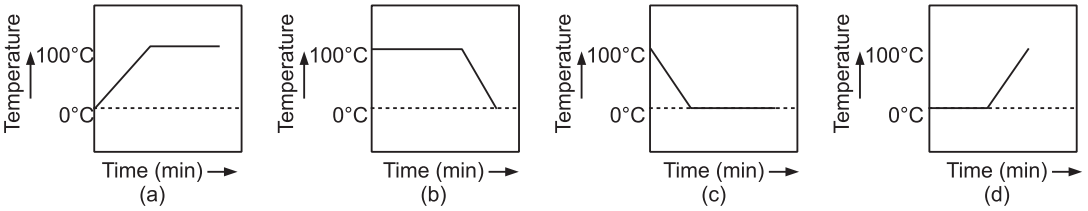
Conversion of temperature: Temperature in Kelvin = °C + 273

Temperature in °C = K – 273.

Exercise 1.3

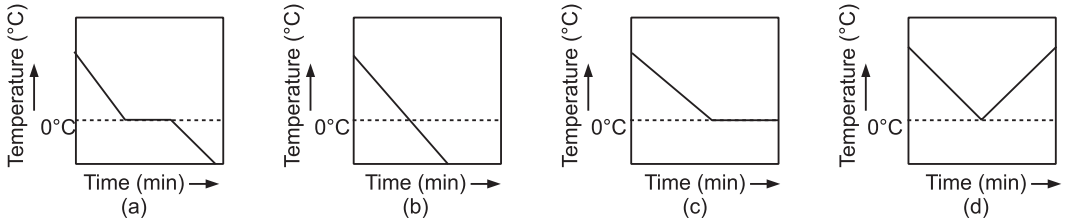
I. Very Short Answer Type Questions (1 Mark)

1. What is the melting point of ice? [*DOE*]
2. Boiling point of alcohol is 78 °C. Change it into kelvin scale of temperature.
3. Which has more density: liquids or solids?
4. Why solid carbon dioxide is called dry ice?
5. Why do we keep ether and acetone at cool places?
6. Under what conditions natural gas can be liquified? [*NCERT Exemplar*]
7. The property to flow is unique to fluids. Which one of the following statements is correct?
   (*i*) Only gases behave like fluids
   (*ii*) Gases and solids behave like fluids
   (*iii*) Gases and liquids behave like fluids
   (*iv*) Only liquids behave like fluids
8. During summer, water kept in an earthen pot becomes cool because of the phenomenon of
   (*i*) diffusion (*ii*) transpiration (*iii*) osmosis (*iv*) evaporation
9. Few substances are arranged in the increasing order of 'forces of attraction' between their particles. Which one of the following represents a correct arrangement?
   (*i*) Water, air, wind (*ii*) Air, sugar, oil
   (*iii*) Oxygen, water, sugar (*iv*) Salt, juice, air
10. Which condition out of the following will increase the rate of evaporation of water?
    (*i*) Increase in temperature of water (*ii*) Decrease in temperature of water
    (*iii*) Less exposed surface area of water (*iv*) Adding common salt to water **[HOTS]**
11. In which of the following conditions, the distance between the molecules of hydrogen gas would increase?
    (*i*) Increasing the pressure on hydrogen gas contained in a closed container
    (*ii*) Some hydrogen gas leaking out of the container
    (*iii*) Increasing the volume of the container of hydrogen gas
    (*iv*) Adding more hydrogen gas to the container without increasing the volume of the container
    (*a*) (*i*) and (*iii*) (*b*) (*i*) and (*iv*) (*c*) (*ii*) and (*iii*) (*d*) (*ii*) and (*iv*)
12. A student heats a beaker containing ice and water. He measures the temperature of the content of the beaker as a function of time. Which of the following would correctly represent the result? Justify your choice. **[HOTS]**



13. Alka was making tea in a kettle. Suddenly she felt intense heat from the puff of steam gushing out of the spout of the kettle. She wondered whether the temperature of the steam was higher than that of the water boiling in the kettle. Comment.

14. A glass tumbler containing hot water is kept in the freezer compartment of a refrigerator (temperature < 0°C). If you could measure the temperature of the content of the tumbler, which of the following graphs would correctly represent the change in its temperature as a function of time.



15. Explain how camphor disappears without leaving reside?

16. On a hot humid day, why do people sweat a lot?

17. (*i*) Convert 574 K to Celsius scale. [*CBSE* 2016]

(*ii*) What will be state of water at: (*a*) 108 °C (*b*) 275 K (*c*) 370 K

(*iii*) Give reason why water at room temperature is liquid.

II. Short Answer Type Questions (2 Marks)

18. (*i*) Give common properties of gases and liquids.

(*ii*) Give one property common to all states of matter.

19. Name two factors which increases the rate of evaporation.

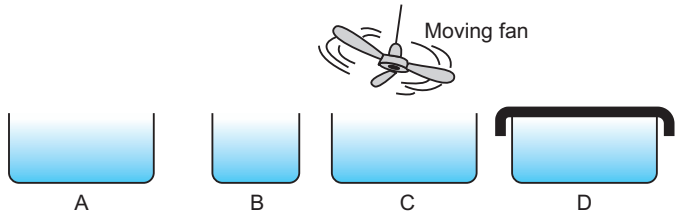
20. (*i*) Why do we wear cotton clothes in summers?

(*ii*) Why do we feel cold, when we keep acetone and ether on our palm?

21. A sample of water under study was found to boil at 102°C at normal atmospheric pressure. Is the water pure? Will this water freeze at 0°C? Comment.

22. Water as ice has a cooling effect, whereas water as steam may cause severe burns. Explain these observations.

23. Look at the figures given below. and suggest in which of the vessels A, B, C or D the rate of evaporation will be the highest? Explain.



24. You want to wear your favourite shirt for a party, but the problem is that it is still wet after a wash. What steps would you take to dry it faster?

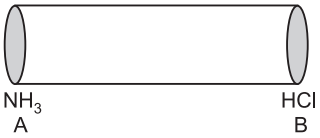
25. Change the following temperature(s) into kelvin:
(a) – 273°C (b) – 100°C (c) – 40°C (d) + 30°C

26. Give two reasons to justify that water is liquid.

27. Differentiate between evaporation and boiling. [*CBSE* 2012]

28. Particles in liquid and gases show random motion. What does it mean and why does it occur?

29. Ammonia is absorbed on cotton on end 'A' whereas HCl is absorbed by cotton at 'B' end of the hollow tube. Where will they meet to form the white ring and why?
[Molecular weight of NH_3 = 17 u, HCl = 36.5 u]



III. Short Answer Type Questions–II (3 Marks)

30. Define boiling point, melting point and evaporation.

31. Substance 1 is brittle, Substance 2 melts at 5 °C and boils at 150 °C, Substance 3 has high melting point of 800 °C. What is the state of these substances at room temperature and pressure? Give reason. **[HOTS]**

32. Name the phenomenon which occurs in the following processes:
(i) Formation of clouds (ii) Drying of wet clothes
(iii) Wax melting in sun

33. Describe an activity to show particles have space among them. [*CBSE* 2013]

34. Describe an activity to show that air contains water vapours. [*CBSE* 2016]

35. With the help of an activity show that diffusion becomes faster with increase in temperature. [*CBSE* 2015]

36. With the help of an activity show that gases are more easily compressible than liquids and solids. [*CBSE* 2015]

37. Show by an activity that rate of intermixing of particles depends upon the forces of attraction between them.

38. Give reasons for the following:
(i) Why does ice float on water?
(ii) Why does a gas fill completely in the vessel in which it is kept?
(iii) Latent heat of vapourisation of two liquids 'A' and 'B' is 100 and 150 J/Kg. Which one will produce more cooling effect and why?

39. (i) What is meant by the word 'Latent' in latent heat?
(ii) Explain with the help of water:
(a) latent heat of fusion, and
(b) latent heat of vapourisation. [*CBSE* 2016]

40. Describe an activity to determine the boiling point of water and melting point of ice. [*CBSE* 2015]

41. What is meant by plasma? Explain. **[HOTS]**

42. How are Bose-Einstein Condensate (BEC) formed? **[HOTS]**

Answers 1.3

1. 0°C or 273 K.

2. 78°C + 273 = 351 K.

3. Solids have more density except ice has less density than water.

4. It changes into CO_2 gas without becoming liquid.

5. It is because they get evaporated at room temperature due to low boiling point which is due to of weak intermolecular forces of attraction.

6. Low temperature and high pressure.

7. (*iii*) Both liquids and gases can flow, i.e. they are fluids.

8. (*iv*) Evaporation of water causes cooling.

9. (*iii*) O_2 is gas, water is liquid, sugar is solid.

10. (*i*) Increase in temperature will increase the rate of evaporation because kinetic energy of molecules increases.

11. (*c*) (*ii*) and (*iii*) will take H_2 molecules far away, thus increasing the distance between molecules.

12. (*i*) Ice melts at 0°C, water boils at 100°C.

13. Temperature of steam was not higher, but kinetic energy of its constituting particles was higher than the boiling water due to latent heat.

14. (*iii*) The temperature of hot water decreases to 0°C and then it becomes constant.

15. It undergoes sublimation, i.e. changes into vapours completely ∴ no residue is left.

16. Rate of evaporation decreases due to high amount of water vapours in air, therefore lot of sweating occurs.

17. (*i*) 574 K – 273 = 301°C

(*ii*) At 108°C, water will be in the form of steam (gaseous state).

At 275 K, water will be in liquid state.

At 370 K, water will be in the form of liquid which is hot.

(*iii*) It is because room temperature is higher the 0°C, therefore ice changes into liquid above 0°C.

18. (*i*) (*a*) Gases and liquids do not have fixed shape.

(*b*) Particles of gases and liquids are in a state of motion.

(*ii*) All are made up of a small particles.

19. (*i*) Temperature, (*ii*) Surface area.

20. (*i*) Cotton clothes absorb sweat which causes cooling.

(*ii*) Acetone and ether take up the heat from the palm to change into vapours which causes cooling.

21. No, water is not pure. No, it will not freeze at 0°C. It will freeze below 0°C because impurities decreases the freezing point and increases the boiling point of liquids.

22. Ice takes heat away from body, thus it causes cooling effect.

Steam has high energy particles due to high latent heat of vapourisation, thus causing severe burns.

23. 'C', moving fan will increase the rate of evaporation because it will take vapours away and increases the rate of evaporation.

24. (*i*) Spread shirt under fan. (*ii*) Dry it with the help of hot iron.

25. (*i*) – 273 °C + 273 = 0 K (*ii*) – 100 °C + 273 = 173 K

(*iii*) – 40 °C + 273 = 233 K (*iv*) 30° C + 273 = 303 K

26. (*i*) It has fixed volume but not fixed shape.

(*ii*) It can flow from higher level to lower level.

27.

S.No.	Evaporation	Boiling
(*i*)	It takes places at all temperatures.	It takes place at boiling point.
(*ii*)	It is a surface phenomenon.	It is a bulk phenomenon.
(*iii*)	It causes cooling.	It does not cause cooling.

28. The random movement of molecules of gases and liquids is called **Brownian movement**. It is more in gases than liquids, due to collision between molecules of gases and liquid among themselves and with the walls of the container.

29. They will meet near HCl, forming a white ring of a ammonium chloride.
It is because NH_3 diffuses faster due to lower molecular weight than HCl which is heavier.

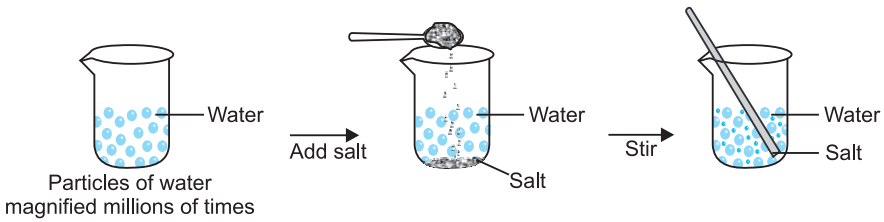
30. **Boiling Point:** It is the temperature at which vapour pressure of liquid becomes equal to atmospheric pressure. Pure liquids have fixed boiling point. Soluble impurities increases the boiling point of liquid, e.g. Sea water boils above 100 °C.
Melting Point: It is the temperature at which both solid and liquid co-exist, i.e. solid changes into liquid. Impurities decreases the melting point of solid.
Evaporation: It is the process in which liquid changes into vapours.
It is an endothermic process, therefore it causes cooling by absorbing heat from the surroundings.
It is a surface phenomenon, because it starts from the surface due to high kinetic energy of molecules of surface.

31. Substance 1 is solid, because it can break into pieces. Solid crystal can break into pieces.
Substance 2 is liquid at room temperature due to low melting point but moderate boiling point.
Substance 3 is solid, because of its high melting point due to strong forces of attraction between particles.

32. (*i*) Condensation, (*ii*) Evaporation, (*iii*) Melting.

33. **Activity:**

1. Take a 250 mL beaker.
2. Pour 100 mL water in it.

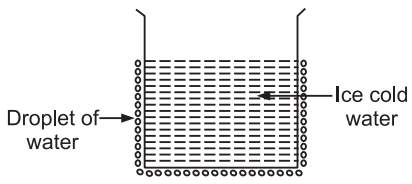


3. Mark the level of water with a marker.
4. Add 2 g of salt into it.
5. Shake well the help of glass rod.
6. Mark the level of water again.

Observation: The level of water remains the same.
Conclusion: Water has spaces between its molecules which salt particles occupy on dissolving, thus leading to no increase in volume.

34. **Activity:**

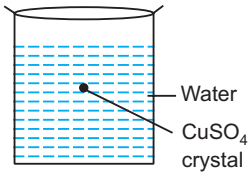
1. Take a beaker and pour 100 ml ice cold water in it.
2. Keep it for sometime.
3. Observe what happens.



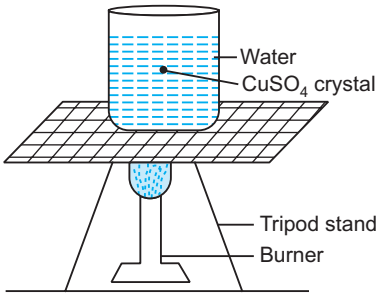
Observation: Droplets of water are formed at the outer surface of the beaker.
Conclusion: It shows water vapours are present in air which get condensed when comes in contact with the cold surface of beaker.

35. Activity:

1. Take 100 mL of water in a 250 ml beaker.
2. Add a crystal of copper sulphate into it.
3. Observe what happens.
4. Now heat the beaker slowly with the help of burner.
5. Observe what happens.



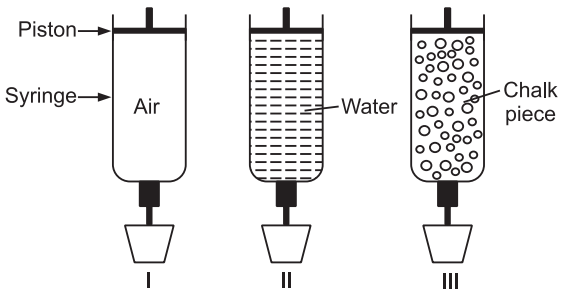
Observation: In the first case copper sulphate solution was becoming blue very slowly, but on heating solution becomes blue very fast.



Conclusion: It shows that rate of diffusion increases with increase in temperature.

36. Activity:

1. Take three syringes of equal volume.
2. Set the apparatus as shown in diagram.
3. Take air in syringe I, water in syringe II and chalk pieces in the third syringe.
4. Apply pressure on the piston.
5. Observe what happens.



Observation: Piston moves very easily in first case because air is highly compressible. In the second case, more force is needed to move the piston. It shows liquids are not easily compressible. Maximum force is needed to push the piston in III case. It hardly moves. It shows solids cannot be compressed.

37. Activity:

1. Take a 250 mL beaker and add 100 mL of water.
2. Add 2-3 crystals of $KMnO_4$.
3. Observe what happens.
4. Now take 5 mL of this solution in another beaker and 5 mL water. Observe what happens.
5. Now, transfer 5 mL solution from the 2nd beaker in a 3rd beaker and add 5 mL of water.
6. Observe what happens.

Observation: The colour of the solution is dark purple in the first beaker, in which purple colour spreads up very slowly.

In the second beaker, light purple colour is formed quickly.

In the third beaker, very light purple colour is observed quickly.

Conclusion: In the first case crystal of $KMnO_4$ is made up of millions of particles which are attached with each other.

In the second case, small particles separate and mix with water easily.

In the third case, particles are even smaller, mix up very fast in water.

38. (*a*) Ice has lower density than water.

(*b*) It is because of weak intermolecular forces of attraction and more intermolecular space, it takes up the shape of container.

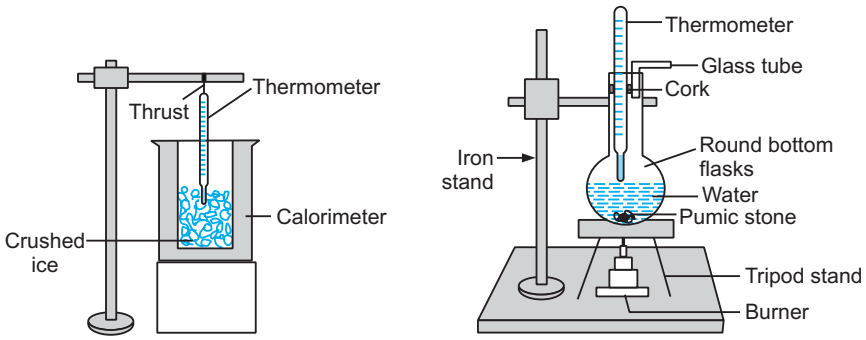
(*c*) 'B', because it will take more heat from the surroundings and will cause more cooling.

39. (*a*) The meaning of latent means it is stored in liquid or solid.

(*b*) When we melt ice at 0 °C, it changes in liquid, but the temperature remains constant because latent heat of fusion overcomes the forces of attraction between the particles of a solid.

(*c*) When we boil water, latent heat of vapourisation is used to overcome the forces of attraction between particles of a liquid. It is called latent heat of vapourisation.

40.



(a) Melting of ice to form water

(b) Boiling of water to form water vapour

Melting point:

1. Take crushed ice in a calorimeter.
2. Set up the apparatus as shown in the diagram.
3. Leave the apparatus for sometime.
4. Observe what happens.
5. Note down the temperature, when it becomes constant.

Observation: At 0°C the temperature of thermometer remains constant.

Conclusion: The melting point of ice is 0°C.

Boiling point:

1. Take water in a round bottom flask.
2. Set the apparatus as shown in the diagram.
3. Heat the round bottom flask with the help of burner.
4. Note down the temperature when it becomes constant.

Observation: The temperature becomes constant at 100°C.

Conclusion: Boiling point of water is 100°C.

41. Plasma is considered as the fourth state of matter. It consists of super energetic and super excited particles in the form of ionised gases.

The fluorescent tubes and neon sign bulbs consist of a plasma of helium and neon gases, respectively.

The gas gets ionised, that is, charged and electrical energy flows through it.

This charging up creates a plasma glowing inside the tube or CFL bulb.

The plasma glows with a special colour depending upon the gas. That is why neon gas is used in coloured advertising lights.

Sun and stars glow because of the presence of plasma state, due to the presence of high temperature.

42. BEC is formed by cooling the gas of a very very low density, $\frac{1}{1,00,000}$ of the density of normal air to super low temperature.

Value Based Questions

1. Mrs. Renuka keeps naphthalene balls in woollen garments so as to protect them from moths. She gets surprised as there are no balls left after sometime. Mrs. Renuka advised her friend also to protect woollen garments with naphthalene balls.

(*i*) What values are associated with Mrs. Renuka?

(*ii*) Why do naphthalene balls disappear?

(*iii*) Comment on the nature of forces of attraction between the particles in naphthalene.

2. Mr. Gunwant takes bath with cold water even in winters. He remains fit throughout the winter. Mr. Bipin takes bath with hot water every day. His skin has become dry and he often keeps on suffering from cold and cough. Mr. Gunwant advised him to take bath with cold water to remain healthy.

(*i*) What values are associated with Mr. Gunwant?

(*ii*) Do we feel more cold after taking bath with hot water or cold water?

(*iii*) Why?

Answers

1. (*i*) Renuka is a helpful person and has knowledge about the applications of science in daily life.

(*ii*) It is due to sublimation, i.e. solid changes directly into vapours by passing the liquid state.

(*iii*) The forces of attraction between the particles of naphthalene are weak.

2. (*i*) He is a helpful person and has sound knowledge of science.

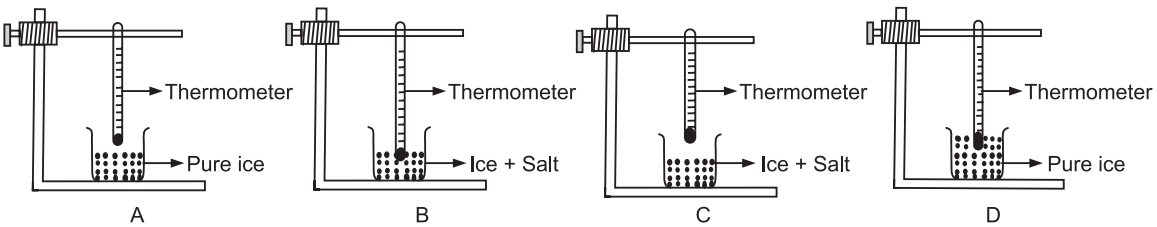
(*ii*) We feel more cold after taking bath with hot water.

(*iii*) It is because hot water gets evaporated faster than cold water and this causes rapid cooling.

Practical Based Questions

Experiment: *To determine the melting point of ice and boiling point of water.*

Q1. Which of the following depicts the correct method for determining the melting point of ice? Give reason. (Experimental Skills)



Ans. 'D' is the correct method because bulb of the thermometer should dip into pure ice to determine the melting point of ice.

Q2. In an experiment to determine the boiling point of water, state the reasons for the following precautions: (Reasoning Skills)

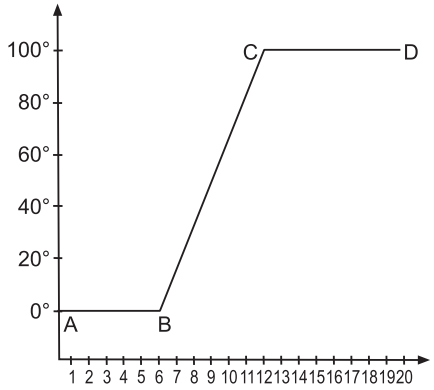
(*i*) The bulb of thermometer should not touch the sides of the beaker.

(*ii*) Pumice stone should be added while boiling the water.

Ans. (*i*) The sides of the beaker gets heated and the thermometer may break if it is touching the sides of the beaker.

(*ii*) Pumice stone absorbs excess of heat and passes it on to water so that bumping of liquid can be prevented.

Q3. In the given graph which lines will represent the melting of ice and boiling of water. Give reasons. (Interpretation and Reasoning Skills)



Ans. AB represents melting of ice as ice melts at 0°C and the temperature remains constant. CD represents boiling of water as water boils at 100°C and the temperature remains constant.

Q4. What should be the source of water while determining the boiling point of water and why? (Observation Skills)

Ans. Distilled water should be taken as it is the pure form of water and it boils at 100°C. Tap water should never be taken because it will have boiling point greater than 100°C due to the presence of impurities in it.

Q5. Why does temperature become constant at 100°C while determining boiling point of water? (Reasoning Skills) [*CBSE* 2016]

Ans. It is due to the absorption of latent heat of vapourisation at the time of boiling of water. The heat supplied is used up in converting the liquid to vapours by overcoming the forces of attraction between the particles and temperature remains constant.

Q6. What are the observations at boiling point of water? (Observation Skills)

Ans. (*i*) The liquid changes into vapours completely.

(*ii*) The temperature remains constant during the boiling process.

(*iii*) The liquid and vapour co-exists at the boiling point of water.

Q7. At room temperature (30°C) a student sets up an apparatus to determine the melting point of ice. He take a beaker half filled with ice and dips a thermometer in it. What are the correct observations? (Observation Skills) [*CBSE* 2012]

Ans. The temperature keeps on falling till 0°C and at 0°C, temperature will remain constant.

Q8. What is the boiling point of water and steam? Why? (Observation Skills) [*CBSE* 2012]

Ans. The boiling point of the water and steam are 100°C.

Reason: The boiling point is the temperature at which liquid and vapours co-exist.

Q9. A thermometer has 20 equal divisions between 90°C and 100°C marks. A student while determining the boiling point of water finds that the mercury level becomes stationary at the 19th mark above 90°C. What should he record the boiling point of water?

(Conceptual Skills) [*CBSE* 2011]

Ans. Least count = $\frac{\text{Range}}{\text{Number of divisions}} = \frac{100° - 90°}{20} = \frac{10}{20} = 0.5°C.$

Boiling point of water = 90° + 19 × 0.5 = 90° + 9.5° = 99.5°C.

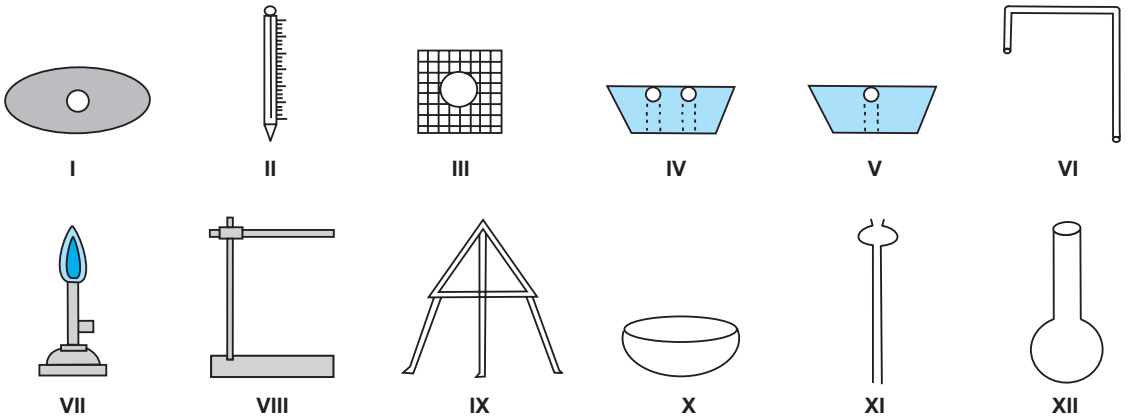
Q10. What is the melting point of ice and the boiling point of water in °C and Kelvin?

(Conceptual Skills) [*CBSE* 2016]

Ans. The melting point of ice is 0°C or 273 K.

The boiling point of water is 100°C or 373 K.

Q11. The figures of apparatus given below show different components of apparatus to be chosen for the determination of boiling point of water. (Identification Skills)



Name the set of components of apparatus which are not required for performing the above experiment.

Ans. **I**, Disc with a hole; **V**, Cork with one hole; **X**, China dish; **XI**, Thistle funnel are not required for performing the experiment others are needed.

IMPORTANT FORMULAE

- Density = $\frac{\text{Mass}}{\text{Volume}}$
- Conversion of temperature from Celsius Scale to Kelvin Scale = °C + 273
- Conversion of temperature Kelvin Scale to Celsius Scale = K – 273
- Least count = $\frac{\text{Range of temperature}}{\text{Number of divisions}}$
- Boiling point = Lower temperature + (Stationary mark × Least count)

COMMON ERRORS

Errors	Corrections
• Children are not able to decide whether love, hate, smell are matter or not.	☞ Matter is something that occupies space and has mass. These are only feelings and not any form of matter.
• Children get confused between the terms: melting and fusion; melting point and freezing point.	☞ These are all the same.
• Children are not able to differentiate between gas and vapours.	☞ Vapours are formed from liquid, gas is a natural state of matter.
• Rubber, sponge can change their shape, children get confused how they considered as solid.	☞ They are solids because they regain their shape when force is removed.
• Children do not understand the effect of temperature on solubility of gas in liquids.	☞ It decreases with increase in temperature.

REVISION CHART

Matter

Substances which have mass and occupy space are called matter. They comprise of very small particles.

Characteristics of Particles of Matter

Particles of Matter have Spaces between Them

There is enough space between particles of matter due to which different particles can intermix with each other, i.e. diffusion can take place.

Particles of Matter are Continuously Moving

Particles of matter are in continuous motion, i.e. they have kinetic energy which increases with increase in temperature. This also results in increase of diffusion.

Particles of Matter Attract Each Other

Particles of matter have forces of attraction between them which keeps them together.

Physical States of Matter

States of matter arises due to variation in their characteristics

Solids

They have fixed shape and volume, negligible compressibility, maximum forces of attraction and least kinetic energy.

Liquids

They have no fixed shape but definite volume, they have comparatively higher diffusion, greater space between particles and higher kinetic energy as compared to solids.

Gases

They have higher compressibility, diffusion rate, space between their particles, kinetic energy as compared to that of solids and liquids.

Effect of Change of Temperature

On increasing the temperature, forces of attraction between the particles decreases, thus solid changes into liquid which ultimately changes into gas. Also, reverse order is true when temperature is decreased.

Effect of Change of Pressure

On increasing the pressure, gases can be compressed to liquids and then to solids provided that the temperature is also reduced. This happens due to increase in forces of attraction when particles come closer to each other.

Changes in States of Matter

All the three states of matter are interconvertible by change in temperature and pressure conditions.