Matter in Our Surroundings

Assess Yourself

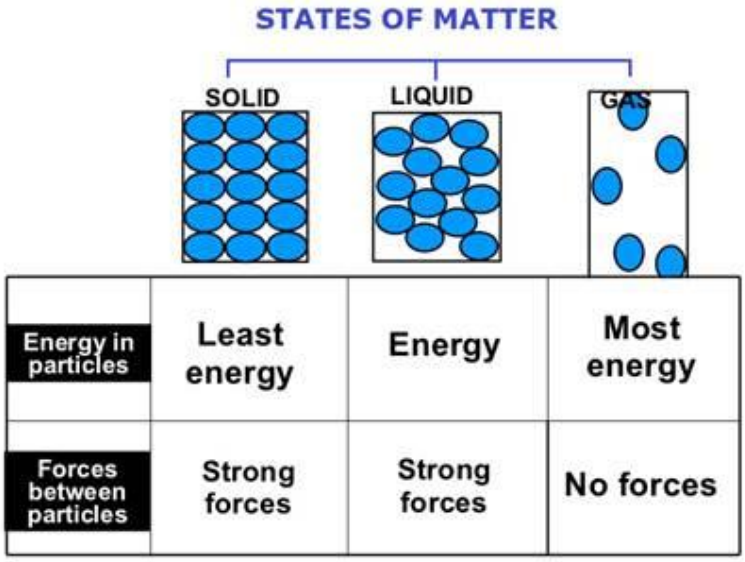
Q.1. Why gases are compressible but not liquids?

Answer: The intermolecular space between the gas particles is very large as compared to the intermolecular space between the liquid particles. Hence, gases are more compressible.

Q.2.How is matter classified on the basis of physical state?

Answer: Based on its physical state, matter can be classified into solid, liquid and gas. In solids, the particles of the matter are very compactly arranged, in liquids the particles are loosely arranged and in gases, they are completely dissociated.

The classification is shown below:



Q.3. What do you think, matter is made up of small particles or not?

Answer: Yes, the matter is made up of very small particles. Any bulk material is made up of millions of smaller particles.

For eg, when sugar crystals are dissolved in water, the smaller particles dissociate from the crystal and dissolve in water.

Q.4. Why does the level of water not change when salt is dissolved in water?

Answer: The level of water does not change when salt is dissolved in water because the salt particles dissociate and occupy the intermolecular spaces between the water

particles. Since only the empty spaces are occupied, the level of water does not increase.

Q.5. What about a rubber band, can it change its shape? Is it solid?

Answer: Yes, a rubber band can change its shape when a force is applied to it and can regain its shape when the force is removed. It is solid in nature but upon the application of force, the shape can change due to the elastic nature of the rubber band.

Q.6. Sugar and salt kept in different jars gain the shape of their respective jars. Are they solids?

Answer: Sugar and salt are both solids. They take the shape of their respective jars as the individual crystals of each are small and many of these small sugar or salt crystals can fill up the empty spaces of a container.

Q.7. What is CGS unit of volume?

Answer: The CGS unit of volume is the Litre.

Q.8. How many cm^3 are there in 1 L?

Answer: There are 1000 cm^3 in 1L.

Q.9. What is meant by density?

Answer: Density is the degree of compactness of the particles. It is also defined as the mass per unit volume of a material.

Q.10. Why is the density of solids mostly higher than that of liquids?

Answer: The density of solids is higher than that of liquids because the particles are more compactly arranged in a solid with very less intermolecular spaces between them. In liquids, these intermolecular spaces are more and hence they are less dense.

Q.11. A sponge can be compressed. Is it solid or not? Why?

Answer: Yes, a sponge is solid and it can be compressed because there are many small holes in it in which air is trapped. When a force is applied, for example, when the sponge is pressed, this air gets released and hence it can be compressed.

Q.12. What is meant by kinetic energy?

Answer: The energy possessed by moving objects is known as kinetic energy. It depends on the mass of the object and also the velocity or speed at which the object is moving.

The unit of kinetic energy is Joules.

Q.13. Why do liquids flow?

Answer: Liquids flow because the particles in a liquid are not very tightly bound to each other and they have high intermolecular spaces between them, which allows the particles to be displaced or move causing the liquids to flow.

Q.14. Why do people in villages use earthen pots in summer to cool water?

Answer: The temperature during summer is high which increases the rate of evaporation. Earthen pots are made of clay that has many pores in it. The pores increase the rate of evaporation of water as the water can move via the pores through capillary action. With the increase in the rate of evaporation, the heat energy leaves the pots in the form of kinetic energy of the evaporated water. This, in turn, keeps the inside of the pot cool and the remaining water cooler. Hence, people in villages use earthen pots in summer to cool the water.

Q.15. Convert 100 °C to kelvin scale.

Answer: We know,

0°C = 273 K

Therefore,

100°C = 273K + 100 = 373K.

Q.16. Write the name of two substances that sublime.

Answer:

1) Solid Carbon dioxide

2) Naphthalene

Explanation: Both these substances are solids and directly evaporate into their gaseous state depending on the temperature and pressure of the environment in which they are placed. Generally, these substances are solid at lower temperatures and evaporate into their gaseous state when the temperature increases.

Q.17. Give two factors which increase the rate of evaporation.

Answer:

1) Temperature: The increase in temperature causes an increase in the kinetic energy possessed by the particles which make the rate of their evaporation faster. Eg: When we increase the cooking gas flame from medium to high, the water boils faster.

2) Surface area: The higher the surface area, the more exposed are the particles and hence higher will be the rate of their evaporation. Eg: Water spilled on the floor dries faster when it is spread on the surface using a mop.

Q.18. Why does water have higher boiling point than alcohol? At what temperature in Kelvin, it can be changed into solid state and into vapours?

Answer: The intermolecular forces of attraction that hold the water molecules together are stronger than the forces that hold the alcohol particles together. Hence, more energy is required to break these intermolecular forces of attraction of water particles than that of alcohol. This gives water a higher boiling point as more heat energy will be used than that for alcohol.

Water changes into solid state at a temperature of 273.15 K and turns into vapour at 373.15 K.

Q.19 A. Name the term used for:

(i) Solid directly formed from the gas:

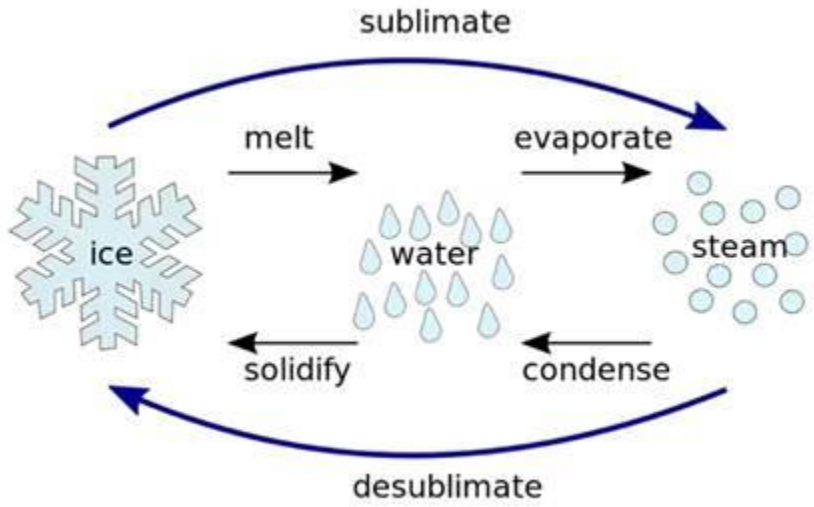
(ii) Gas directly formed from the solid:

Answer:

(i) Solid directly formed from the gas: Deposition

(ii) Gas directly formed from the solid: Sublimation

The figure is shown below:



Q.19 B. Ice at 0 °C is more effective in cooling than water at 0 °C. Give reason.

Answer: When ice melts or gets converted to liquid, it absorbs latent heat of fusion which is the heat energy required to change a solid into liquid at a constant pressure. Ice at 0°C absorbs much more heat to increase its temperature and melt as compared to water at 0°C. This makes ice at 0°C more effective in cooling than water at 0°C.

Q.20. Show experimentally that matter is made up of small particles.

Answer:

Experiment:

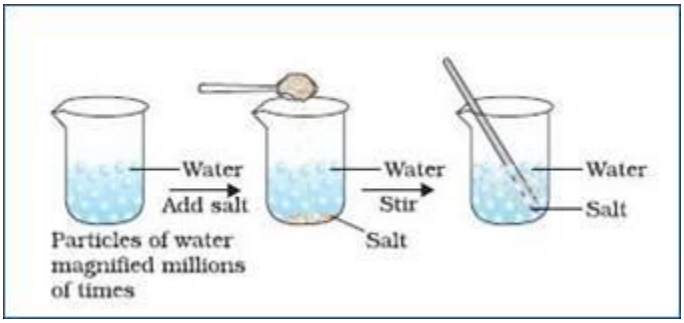
i) Take a 100ml beaker and fill it with 50ml water. Mark the level of water in the beaker.

ii) Add 1 tablespoons of salt to it.

iii) Stir the water until the salt crystals can no longer be seen and are completely dissolved. Note the level of water.

iv)The level of water does not increase.

Diagrammatic Representation:



Explanation: The level of water does not increase after the addition of salt. This observation supports the assumption that matter is made up of particles as a tablespoon of salt contains many salt crystals which are made up of salt particles. These particles were able to dissociate in water and got evenly distributed in the intermolecular spaces present in water due to which the level of water did not change.

Q.21. Describe by experiment the relationship between the rate of diffusion and density of the liquid.

Answer:

Experiment:

i) In a glass filled with water, add 2 tablespoons of sugar and keep stirring until the sugar dissolves.

ii) Gradually increase the amount of sugar added to the water and notice that it takes more time for the sugar to dissolve than it did when only 2 tablespoons of sugar were added.

Explanation: The rate at which the sugar crystals dissolve in water is called the rate of diffusion. This rate was higher when the amount of sugar dissolved was less. As the amount or the density of sugar in the liquid increases the time taken for the sugar to

dissolve also increases, i.e, the rate of diffusion decreases. Hence, the rate of diffusion and density of liquid are inversely proportional to each other.

Q.22. How is melting point related to intermolecular forces of attraction? Why is latent heat of vaporization higher than latent heat of fusion?

Answer: The intermolecular forces of attraction are the bonds that the particles in the matter form with each other. The stronger the bond, the stronger are the intermolecular forces of attraction between them. When the intermolecular forces of attraction are strong, a higher amount of heat energy will be needed to breaks these bonds and hence the melting point of strong intermolecular forces of attraction will be higher.

The latent heat of vaporization is higher than latent heat of fusion because the intermolecular space between gas particles is the greatest and the intermolecular forces of attraction are almost negligible. Hence more energy is needed to convert liquid into a gas. The transition of solid into liquid requires less energy because the energy used for this is only needed to decrease the intermolecular attraction between the particles.

Q.23. Show by an experiment that by increasing the temperature, the substance can be changed into liquid and then into vapours.

Answer:

Experiment:

i) Take a few ice cubes in a beaker and heat it using a burner. Suspend a laboratory thermometer into the beaker with the bulb in contact with the ice cubes to monitor the increase in temperature.

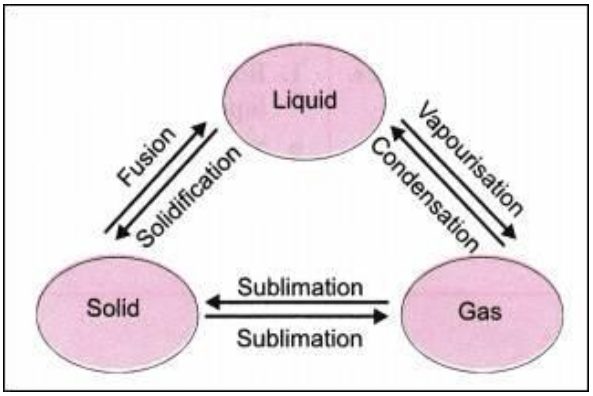
ii) As the temperature increases, the ice cubes start to melt and get converted into liquid water.

iii) Upon further increase in temperature, the water starts to boil and gets converted into gaseous water vapour.

Explanation: Increase in temperature causes an increase in the kinetic energy possessed by the particles. The increased kinetic energy starts breaking the intermolecular forces of attraction in solid ice and converts it into liquid water with more intermolecular space. Further, increase in the temperature results in a greater increase in the kinetic energy of liquid water particles which in turn get converted into their gaseous state and evaporate.

Q.24. Draw a cyclic figure to show interconversion of states and explain fusion, vaporisation, condensation, solidification and sublimation.

Answer: Diagrammatic representation of the interconversion of the 3 states of matter:



Fusion: The transition of a substance from its solid state to its liquid state is known as fusion.

Vaporisation: The transition of a liquid into its gaseous state is known as vaporization.

Condensation: The conversion of a gas into its liquid state when the temperature is lowered is known as condensation.

Solidification: The transition of a substance from its liquid to its solid state is known as solidification.

Sublimation: The direct vaporization of a solid into its liquid state is known as sublimation.

Q.25. Write an activity to show that water can be made to boil even at a temperate below its normal boiling point (100 °C).

Answer:

Activity:

i) Take some warm water in a cup. Gently, fill a 12ml plastic syringe with around 3ml of the warm water from the cup.

ii) Hold the syringe horizontally and press your index finger tightly over the tip of the syringe.

iii) Slowly pull out the plunger. The plunger will show some resistance and it pulls back in the opposite direction.

iv) Allow the plunger to slide back slowly into the syringe and then pull the plunger out again. Release the plunger quickly.

v) Pull the plunger out the 2nd time. Bubbles will start forming as the water in the syringe boils.

Explanation: The boiling of water does not only depend on temperature. Pressure also plays a role in the boiling of any liquid. When the pressure goes down below the

atmospheric pressure of 1atm, water starts to boil at a temperature lower than its boiling temperature. By pulling the plunger out, we increase the volume inside the syringe but decrease the pressure. This causes the water molecules to gain more kinetic energy. The increase of energy breaks the forces of attraction between the water molecules and they begin to move freely. Hence the water starts to boil.

Q.26. How will you determine the melting point of ice experimentally with the help of a neat and labelled diagram?

Answer:

Experiment:

i) Take around 10-15 ice cubes in a glass beaker and arrange it on a tripod stand with the burner below it.

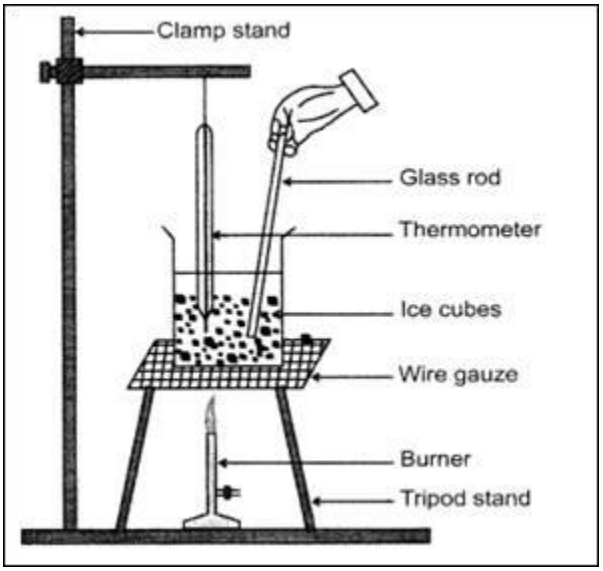
ii) Suspend a thermometer in the beaker in such a way that the bulb is in contact with the ice cubes. A clamp stand could be used to hold the thermometer and shown in the diagram.

iii) Switch on the flame of the burner and keep checking the readings on the thermometer.

iv) Record the initial temperature when the ice has just started to melt.

v) Constantly keep stirring the melting ice cubes and record the temperature when the ice has completely melted into liquid water.

Diagrammatic Representation:



Explanation: The melting point of ice is the temperature at which ice gets converted from its solid state to its liquid state. For this, the solid ice needs energy to break the forces of attraction between the ice particles so that the particles can be separated and

the intermolecular space between them can increase. This energy is provided in the form of heat and is known as the latent heat of fusion.

In the experiment demonstrated above, the heat from the burner is used to melt the ice. The thermometer helps to note the temperature at which the ice melts. After the initial and final readings are recorded, it can be observed that there has been no change in the temperature while the ice has been melting. The reading showed 0°C (273.15K) at the beginning and remained the same when all the ice had melted. The reason for this is the latent heat of fusion which is the energy that does not raise the temperature but at the same time increases the kinetic energy to break the bonds between in the ice particles.

Hence, the melting point of ice is 0°C or 273.15K.

Q.27. How will you determine the boiling point of water experimentally? Draw a neat and labelled diagram.

Answer:

Experiment:

i) Take around 100ml of water in a glass beaker and arrange it on a tripod stand with the burner below it.

ii) Suspend a thermometer in the beaker in such a way that the bulb is in contact with the water. A clamp stand could be used to hold the thermometer and shown in the diagram.

iii) Switch on the flame of the burner and keep checking the readings on the thermometer.

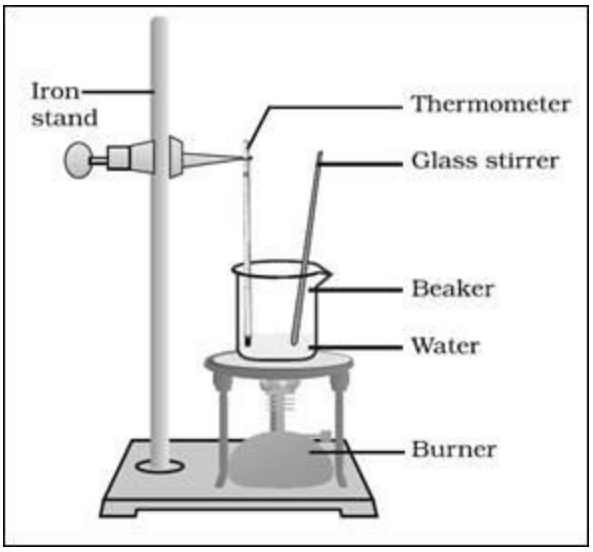
iv) Record the initial temperature when the water is just beginning to heat up.

v) Keep monitoring the temperature change in the thermometer while the water is heating up further.

vi) After a while, notice the vapours coming out of the boiling water. Record the temperature till half of the water has evaporated.

vii)Notice that the temperature in the thermometer will not rise above 100°C.

Diagrammatic Representation:



Explanation: The boiling point of water is the temperature at which the liquid water gets converted into its gaseous form of water vapour. The energy for this conversion is provided in the form of heat and is known as the latent heat of vaporisation.

As the temperature increases gradually, the water starts heating as the kinetic energy is increasing along with the rise in temperature. This rise in kinetic energy keeps on increasing the intermolecular space between the water molecules and they start to move about freely. At a certain temperature, the intermolecular space increases up to such an extent that the water molecules break free from each other and vaporise. This temperature is called the boiling point of water.

The temperature at which the water in the beaker was seen to evaporate is 100°C or 373.15K. This is the boiling point of water.