MATTER IN OUR SURROUNDINGS

NCERT Textbook Questions

Q.1. Which of the following are matter?
Chair, air, love, smell, hate, almonds, thought, cold, cold-drink, smell of perfume

Ans. Chair, air, smell, almonds, cold drink and smell of perfume are matter (because they occupy space and have mass). It should be noted that 'smell' is a matter because it is due to the presence of some volatile substances in air which occupy space and have mass.

Q.2. Give reasons for the following observations: The smell of hot sizzling food reaches you several metres away but to get the smell from cold food, you have to go close.

Ans. The smell of food reaches us by the process of diffusion of gases (released by the food) into the air. The rate of diffusion of hot gases into air is faster than that of cold gases. So, the smell of hot sizzling food reaches us quickly even when we are several metres away because the rate of diffusion of hot gases (released by the hot sizzling food) is much faster than the rate of diffusion of cold gases released by the cold food.

Q.3. A diver is able to cut through water in a swimming pool. Which property of matter does this observationshow?

Ans. Water is a liquid form of matter. The observation that a diver is able to cut through water in a swimming pool shows that though there is a quite strong force of attraction between the particles of a liquid (like water) which holds them together but the force is not strong enough to hold the particles of the liquid in fixed positions. So, by applying somewhat greater force, a diver is able to overcome the forces of attraction present among the particles of water and hence cut through water in the swimming pool.

Q.4. What are the characteristics of the particles of matter?

Ans. The important characteristics of the particles of matter (like atoms or molecules) are the following:

(*i*) The particles of matter are very, very small.

(*ii*) The particles of matter have spaces between them.

(*iii*) The particles of matter are constantly moving.

(*iv*) The particles of matter attract one another.

Q.5. 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

Ans. The order of increasing densities of the given substances is:

Air < Exhaust from chimneys < Cotton < Water < Honey < Chalk < Iron

Explanation:

(*i*) Air is mainly a mixture of comparatively light gases like nitrogen, and oxygen, etc., so it has the lowest density.

(*ii*) Exhaust gases from chimneys, in addition to air, also contain heavier gases like carbon dioxide, sulphur dioxide and nitrogen dioxide, etc., so they have slightly higher density than air.

(*iii*) Cotton is a fluffy solid which has a lot of air trapped in its pores. Due to lot of trapped air, solid cotton has higher density than exhaust gases from chimneys.

(*iv*) Water is a liquid having quite closely packed particles, so the density of water is higher than that of cotton.

(*v*) Honey is a thick liquid having closely packed heavy particles, so the density of honey is higher than that of water.

(*vi*) Chalk is a porous solid in which the particles are comparatively less closely packed but it has higher density than honey (which is a liquid).

(*vii*) Iron is a highly compact solid in which the particles are very, very closely packed due to which its density is much higher than that of chalk.

Q.6. (*a*) Tabulate the differences in the characteristics of the three states of matter.

(*b*) Comment upon the following:

Rigidity, Compressibility, Fluidity, Filling a gas container, Shape, Kinetic energy and Density.

Ans. (*a*) The main differences in the characteristics of the three states of matter, solids, liquids and gases are given below:

Solids	Liquids	Gases
(*i*) Solids have a fixed shape and a fixed volume.	(*i*) Liquids have a fixed volume but they have no fixed shape. Liquids take the shape of the container in which they are placed.	(*i*) Gases have neither a fixed shape nor a fixed volume. Gases acquire the shape and volume of the container in which they are kept.
(*ii*) Solids cannot be compressed much.	(*ii*) Like solids, liquids cannot be compressed much.	(*ii*) Gases can be comressed easily (into a small volume).

Solids	Liquids	Gases
(*iii*) Solids have high densities. They are heavy.	(*iii*) Liquids have moderate to high densities. They are usually less dense than solids.	(*iii*) Gases have very low densities. They are very, very, light. A gas is much lighter than the same volume of a solid or a liquid.
(*iv*) Solids do not fill their container completely.	(*iv*) Liquids do not fill their container completely.	(*iv*) Gases fill their container completely.
(*v*) Solids do not flow.	(*v*) Liquids generally flow easily.	(*v*) Gases flow easily.

(*b*) (*i*) **Rigidity.** Rigidity refers to the property of a solid to resist change in its shape (or resist deformation) when an outside force is applied. In most simple terms, rigidity means 'stiffness'. The particles in a solid are very closely packed and there are very strong forces of attraction between them, so solids possess high rigidity. Liquids and gases are not rigid because the positions of their particles are not fixed.

(*ii*) **Compressibility.** Compressibility is the property of a fluid (or a solid) due to which its volume decreases when pressure is applied. The particles in gases have large spaces between them due to which their volume decreases too much when pressure is applied on them. So, gases have high compressibility. On the other hand, the particles in solids and liquids are closely packed, so solids and liquids do not have much compressibility.

(*iii*) **Fluidity.** The property of flowing easily is called fluidity. Gases and liquids exhibit the property of fluidity, so they are called fluids. Due to large interparticle distances and very weak forces of attraction, gases can flow extremely easily. So, the gases have very high fluidity. And because of comparatively smaller interparticle distances and stronger forces of attraction between their particles, the fluidity of liquids is less than that of gases. Solids are not fluids, they have no fluidity.

(*iv*) **Filling a gas container.** A gas fills its container completely because due to high kinetic energy and negligible interparticle forces of attraction, the particles in a gas move with high speeds in all directions and occupy all the space in the container.

(*v*) **Shape.** The external form or appearance of a substance is called its shape. A solid has a fixed shape because the particles in a solid are closely packed and their positions are fixed due to strong forces of attraction between them. The liquids and gases do not have fixed shapes because the positions of particles in them are not fixed due to comparatively weaker forces of attraction between them.

(*vi*) **Kinetic energy.** The energy possessed by a material due to the motion of its particles is called kinetic energy. At a given temperature, the particles in a gas have the maximum kinetic energy because they move with high speeds due to weakest forces of attraction among them. Liquids have lesser kinetic energy (than gases) whereas solids have the the least kinetic energy at a given temperature.

(*vii*) **Density.** The mass per unit volume of a material is called its density. Solids have high densities because their particles are very close together. Liquids have usually lower densities than solids because their particles are somewhat more loosely packed than that in solids. Gases have the lowest densities because their particles are very far apart from one another.

Q.7. Give reasons:

(*a*) A gas fills completely the vessel in which it is kept.

(*b*) A gas exerts pressure on the walls of the container.

(*c*) A wooden table should be called a solid.

(*d*) We can easily move our hand in air but to do the same through a solid block of wood, we need a karate expert.

Ans. (*a*) The particles of a gas have high kinetic energy and negligible forces of attraction amongst them. Due to this the particles of a gas are constantly moving with high speeds in all the directions and the gas completely fills the vessel in which it is kept.

(*b*) Because of high kinetic energy and negligible forces of attraction, the particles of a gas move with high speeds in all directions. When the fast moving gas particles hit the walls of its container from inside, they exert a pressure (called gas pressure). Thus, the pressure exerted by a gas is due to the constant collisions of the fast moving gas particles against the inner walls of the container.

(*c*) A wooden table is a rigid object having a definite shape and a definite volume. Since a wooden table has these basic characteristics of solid state (rigidity, definite shape and definite volume), it should be called a solid.

(*d*) Air is a gas (or a mixture of gases) whose particles are very far apart and there are very weak forces of attraction between them. The extremely weak forces between particles of air can be overcome easily due to which we can easily move our hand in air. On the other hand, the particles of a solid block of wood are very closely packed and there are very strong forces of attraction between the particles of wood. It needs a huge outside force to overcome the strong interparticle attractions of a block of wood and break it apart by moving hand which only a karate expert can apply.

Q.8. Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Find out why?

Ans. Ice is formed by the freezing of water. When water freezes to form ice, then a number of empty spaces are created in solid ice (which were not present in liquid water) giving it a cage-like structure. Due to the presence of some empty spaces, the volume of ice becomes

more than an equal mass of water. Because of its greater volume, the density (mass per unit volume) of ice decreases. And due to its lower density than water, ice floats on water (even though it is a solid).

Q.9. Convert the following temperatures to celsius scale:

(a) 300 K (b) 573 K

Ans. (a) We know that:

Temperature on Kelvin scale = Temperature on Celsius scale + 273

So, 300 = Temperature on Celsius scale + 273

And, Temperature on Celsius scale = 300 – 273

= 27°C

(b) Temp. on Kelvin scale = Temp. on Celsius scale + 273

573 = Temp. on Celsius scale + 273

And, Temp. on Celsius scale = 573 – 273

= 300°C

Q.10. What is the physical state of water at:

(*a*) 250°C? (*b*) 100°C?

Ans. (*a*) The boiling point of water is 100°C. So, the physical state of water at a temperature of 250°C (which is much above its boiling point) will be 'gaseous state'.

(*b*) The physical state of water at its boiling point temperature of 100°C will be both 'liquid state' as well as 'gaseous state'. This is because at its boiling point (of 100°C), the liquid state of water starts changing into its gaseous state (steam).

Q.11. For any substance, why does the temperature remain constant during the change of state?

Ans. The heat energy supplied to a substance during the change of state (at its melting point or boiling point) is all used up in overcoming (or breaking) the force of attraction between its particles without increasing its kinetic energy. Since the heat (or latent heat) supplied during the change of state does not increase the kinetic energy of the substance, therefore, no rise in temperature takes place. The temperature remains constant.

Q.12. Suggest a method to liquefy atmospheric gases.

Ans. Atmospheric gases can be liquefied by applying pressure and lowering temperature. When enough pressure is applied, the gases are highly compressed into a small volume. The particles of gases get so close together that they start attracting one another sufficiently to form a liquid. When a gas is compressed too much by applying high pressure, a lot of

heat is produced. So, while applying pressure to liquefy gases, it is necessary to lower their temperature (or cool them) to take away the heat produced during compression.

Q.13. Why does a desert cooler cool better on a hot dry day?

Ans. The cooling in a desert room cooler is caused by the evaporation of water. A desert cooler cools better on a hot and dry day because the higher temperature on a hot day increases the rate of evaporation of water, and the dryness of air (low humidity of air) also increases the rate of evaporation of water. And due to increased rate of evaporation of water, a desert room cooler cools better on a hot and dry day.

Q.14. How does the water kept in an earthen pot (*matka*) become cool during summer?

Ans. The earthen pot (or *matka*) has a large number of extremely small pores in its walls. Some of the water kept in the earthen pot continuously keeps seeping through these pores to the outside of the pot. This water evaporates (changes into vapour) continuously by taking the latent heat of vaporisation from the earthen pot and the remaining water. In this way, the earthen pot and remaining water lose heat and get cooled.

Q.15. Why does our palm feel cold when we put some acetone or petrol or perfume on it?

Ans. Acetone, petrol and perfume are volatile liquids (which can change into vapours easily). When we put some acetone , petrol or perfume on our palm, the acetone, petrol or perfume evaporate rapidly and our palm feels cold. This is due to the fact that to change from the liquid to the vapour state, acetone, petrol or perfume require latent heat of vaporisation. The acetone, petrol or perfume take this latent heat of vaporisation from our palm. The palm loses heat and feels cold.

Q.16. Why are we able to sip hot tea or milk faster from a saucer than a cup?

Ans. If the hot tea (or milk) is taken in a cup, then due to the narrow shape of the cup, the surface area of hot tea (or milk) in the cup is comparatively small. Because of small surface area, the evaporation of hot tea (or milk) taken in the cup is slow, cooling caused by evaporation is less, and hence the hot tea (or milk) remains appreciably hot for a much longer time, making it difficult to sip. On the other hand, saucer has a large surface area. Due to the large surface area of hot tea (or milk) taken in the saucer, the evaporation of hot tea (or milk) from the saucer is faster. The faster evaporation cools the hot tea (or milk) much more quickly making it convenient to sip (or drink).

Q.17. What type of clothes should we wear in summer?

Ans. We should wear cotton clothes in hot summer days to keep us cool and comfortable. This is due to the following reason: During hot summer days, we perspire more (give out more sweat through the pores of the skin). Sweat (*pasina*) is mainly water. The cotton clothes are good absorber of sweat. So, cotton clothes absorb the sweat produced on our skin quickly and expose it to the atmosphere for evaporation. The evaporation of sweat from cotton clothes takes the latent heat of vaporisation from our skin. In this way, our skin loses heat and makes us feel cool and comfortable.

NCERT Exercises

Q.1. Convert the following temperatures to the celsius scale:

(*a*) 293 K (*b*) 470 K

Ans. (*a*) Temp. on Kelvin scale = Temp. on Celsius scale + 273

293 = Temp. on Celsius scale + 273

So, Temp. on Celsius scale = 293 – 273

= 20°C.

(*b*) Temp. on Kelvin scale = Temp. on Celsius scale + 273

470 = Temp. on Celsius scale + 273

So, Temp. on Celsius scale = 470 – 273

= 197°C.

Q.2. Convert the following temperatures to the Kelvin scale:

(*a*) 25°C (*b*) 373°C

Ans. (*a*) We know that:

Temperature on Kelvin scale = Temperature on Celsius scale + 273

= 25 + 273

= 298 K

(*b*) Temp. on Kelvin scale = Temp. on Celsius scale + 273

= 373 + 273

= 646 K

Q.3. Give reasons for the following observations:

(*a*) Naphthalene balls disappear with time without leaving any solid.

(*b*) We can get the smell of perfume sitting several metres away.

Ans. (*a*) Naphthalene is a volatile solid organic compound which can undergo sublimation (change from solid state directly into vapour state). The solid naphthalene balls keep subliming slowly (keep changing into vapours slowly). And after a certain time, the naphthalene balls sublime completely forming naphthalene vapours (which go into air), and hence they disappear without leaving any solid residue.

(*b*) We can get the smell of perfume sitting several metres away due to the diffusion of perfume vapours into air. This can be explained as follows: Perfume is a volatile liquid. When liquid perfume is applied by aperson, it quickly changes into vapours (or gas). The perfume vapours move very rapidly in all directions in air, mix up with air particles and spread in the air by diffusion. When this air containing perfume vapours reaches several metres away, we can smell the perfume.

Q.4. Arrange the following substances in increasing order of forces of attraction between the particles – water, sugar, oxygen.

Ans. The forces of attraction between the particles in a solid are the strongest, in liquids are less strong whereas in gases are the weakest. Now, out of water, sugar and oxygen:

(*i*) oxygen is a gas, so it has the weakest forces of attraction between its particles.

(*ii*) water is a liquid, so it has stronger forces of attraction between its particles (than oxygen).

(*iii*) sugar is a solid, so it has the strongest forces of attraction between its particles.

Thus, the increasing order of forces of attraction between the particles of water, sugar and oxygen will be:

oxygen < water < sugar

Q.5. What is the physical state of water at:

(*a*) 25°C? (*b*) 0°C? (*c*) 100°C?

Ans. (*a*) The physical state of water at 25°C is liquid.

(*b*) 0°C is the melting point of ice (which is a solid) as well as the freezing point of water (which is a liquid).

So, the physical state of water at 0°C can be either a solid (as ice) or liquid.

(*c*) 100°C is the boiling point of water (which is a liquid) as well as the condensation temperature of steam

(which is a gas). So, the physical state of water at 100°C can be either a liquid or a gas (steam).

Q.6. Give two reasons to justify:

(*a*) water at room temperature is a liquid.

(*b*) an iron almirah is a solid at room temperature.

Ans. (*a*) The two general properties of liquids are that liquids have 'a fixed volume' but 'no fixed shape'. Now, water is a liquid at room temperature because:

(*i*) water has a fixed volume (which does not change on changing its container).

(*ii*) water has no fixed shape (it takes the shape of the container in which it is kept).

(*b*) The two general properties of solids are that solids have 'a fixed shape' and 'a fixed volume'. An almirah is a solid at room temperature because:

(*i*) an almirah has a fixed shape (which cannot be changed by pressing it with hands).

(*ii*) an almirah has a fixed volume (which depends on the dimensions according to which it is made).

Q.7. Why is ice at 273 K more effective in cooling than water at the same temperature?

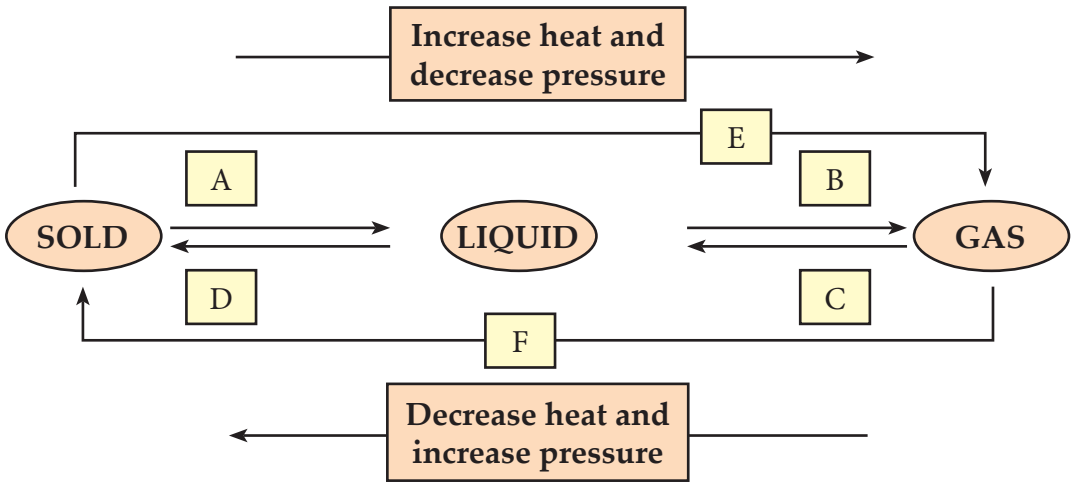
Ans. First of all please note that the temperature of 273 K is equal to 0°C and it is the melting point of ice (to form water) at the same temperature. Another point to be noted is that the latent heat of melting of ice (or fusion of ice) is 3.34 × 105 joules per kilogram. Now, ice at 273 K

(or 0°C) is more effective in cooling a substance than water at the same temperature of 273 K (or 0°C) because for melting, each kilogram of ice takes 3.34 × 105 joules of its latent heat from that substance and hence cools the substance more effectively. On the other hand, water at the same temperature of 273 K (or 0°C) cannot take away any such latent heat from the substance and hence does not cool it more effectively.

Q.8. What produces more severe burns – boiling water or steam?

Ans. When water changes into steam at its boiling point, it absorbs latent heat of vaporisation (which is 22.5 × 105 joules per kilogram). This means that steam at 100°C contains much more heat (in the form of latent heat) than boiling water at the same temperature of 100°C. So, when steam falls on our skin and condenses to form water, it gives out 22.5 × 105 joules per kilogram of more heat than boiling water at the same temperature. Since steam gives out much more heat than boiling water, it causes more severe burns.

Q.9. Name A, B, C, D, E and F in the following diagram showing changes in state:



Ans. (*i*) In process A, a solid is changing into a liquid, so A is melting (or fusion).

(*ii*) In process B, a liquid is changing into a gas, so B is vaporisation (or boiling).

(*iii*) In process C, a gas is changing into a liquid, so C is condensation.

(*iv*) In process D, a liquid is changing into a solid, so D is freezing.

(*v*) In process E, a solid is directly changing into a gas, so E is sublimation.

(*vi*) In process F, a gas is changing directly into a solid, so F is also sublimation.