1 Matter in Our Surroundings

Fastrack Revision

- **Matter:** Anything that has mass and occupies space (volume) is called matter.
- **Physical Nature of Matter**
  - Matter is made up of small particles called atoms.
  - These particles of matter are too small, so they cannot be seen by naked eyes or simple microscope.
- **Characteristics of Particles of Matter**
  - Particles of matter have space between them.
  - Particles of matter are continuously moving, *i.e.*, they possess kinetic energy.
  - Particles of matter attract each other.
- **Diffusion:** Intermixing of particles of two different types of matter on their own is called diffusion.

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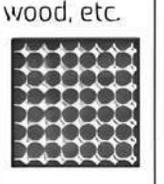
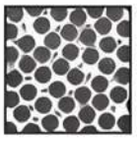
The rate of diffusion increases with increase in the temperature due to increase in kinetic energy of the particles.

- **States of Matter:** Matter exists in three different states- Solid, Liquid and Gas.
  - Comparison of Properties of Solids, Liquids and Gases

Property	Solid	Liquid	Gas
Shape	Definite	Acquires the shape of the container	Acquires the shape of the closed container
Volume	Definite	Definite	Indefinite
Packing of particles	Most closely packed	Less closely packed	Least closely packed
Interparticle space	Minimum	Larger than those of solids but smaller than those of gases	Maximum
Interparticle force	Very strong	Weak	Very weak
Compressibility	Not possible	Almost negligible	Highly compressible
Fluidity	Not possible	Can flow	Can flow
Rigidity	Highly rigid	Less rigid	Not rigid
Diffusion	Slow	Fast	Very fast
Density	High	Slightly lower	Very low
Kinetic energy of particles	Least	Large	Very large
Examples	Sand, sugar, metals like iron, stones, wood, etc.	Water, oil, milk, honey, petrol, etc.	LPG (Liquefied Petroleum Gas) and CNG (Compressed Natural Gas)


- **Change of States of Matter:** All the three states of matter are inter convertible and can be changed from one state to another by:

  (I) Change in temperature (II) Change in pressure

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Water exists in three states of matter—solid as ice, liquid as water and gas as water vapour.

- **Effect of Change of Temperature:** On increasing the temperature of solids, the kinetic energy of the particles increases which overcomes the forces of attraction between the particles, thereby, solid melts and is converted to a liquid.
- **Melting Point:** It is the temperature at which a solid melts to become a liquid at the atmospheric pressure. The melting point of ice is 273.16 K.
- **Latent Heat:** It is the hidden heat which breaks the force of attraction between the molecules. It does not increase the temperature but changes the state of substance only.
- **Latent Heat of Fusion:** It is the amount of heat energy which is required for changing 1 kg of a solid into liquid at atmospheric pressure, at its melting point. Latent heat of fusion of ice is 3.34×10^5 J/kg.
- **Boiling Point:** It is the temperature at which a liquid starts boiling at the atmospheric pressure. Boiling point of water is 100°C (373 K).

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Boiling is a bulk phenomenon where the particles from the bulk of the liquid gain energy to change into the gaseous state.

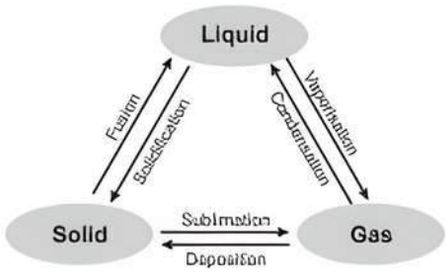
- **Latent Heat of Vaporisation:** It is the amount of heat energy which is required for changing 1 kg of a liquid into gas without increase in temperature at its boiling point. Latent heat of vaporisation of water is 2.25×10^5 J / kg.
- **Condensation:** It is the process in which a gas on cooling, turns into a liquid at a specific temperature. It is also called as **liquefaction.**
- **Sublimation:** The change of state of a substance directly from a solid to gas without changing into the liquid state is called sublimation.
- **Freezing Point:** The temperature at which the state of a substance changes from a liquid to a solid.
- **Scales of Measuring Temperature**
  - Temperature on Celsius Scale

    $t(°C) = T(K) - 273.16$
  - Temperature on Kelvin Scale

    $T(K) = t(°C) + 273.16$
  - Temperature on Fahrenheit Scale

    $°F = \frac{9}{5}(°C) + 32$
- **Effect of Change of Pressure:** Gases can be liquefied by applying pressure and reducing temperature. When high pressure is applied to a gas, it gets compressed. The interparticle spaces become less and interparticle forces become strong. As a result, the gaseous state may change to the liquid or solid state.

  The interchange of states of matter can be shown as below:



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Solid CO_2 gets converted directly to gaseous state on decrease of pressure to 1 atmosphere without coming into liquid state. So, solid CO_2 is called dry ice.

- **Evaporation:** It is the process of conversion of a substance from the liquid state to the gaseous state at any temperature below its boiling point. It is also called as vaporisation.
- **Factors Affecting the Rate of Evaporation**
  - Increased surface area (For example, spreading of clothes dries them easily)
  - Increased temperature (For example, fast evaporation in a hot summer day as compared to winter)
  - Decreased humidity (For example, fast drying of clothes on a dry day than a rainy day)
  - Increased wind speed (For example, fast drying of clothes on a windy day)

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Evaporation is a surface phenomenon and occurs only from the surface of the liquid.

- **Evaporation Causes Cooling:** The particles of liquid absorb energy from the surroundings to regain the energy lost during evaporation. This absorption of energy from the surroundings make the surroundings cold.

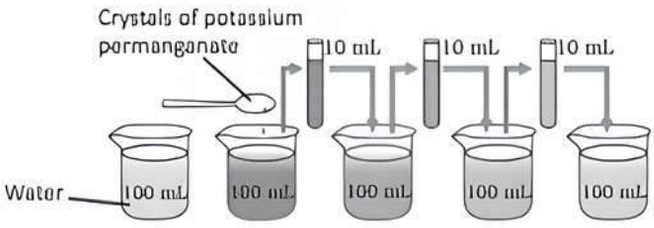
Practice Exercise

Multiple Choice Questions

Q 1. Which of the following is not matter?

a. Air b. Feeling of cold
c. Dust d. Humidity

Q 2. Consider the following experimental set-up.



The conclusions obtained from the above experiment are:

(i) particles of matter are in a state of continuous motion.

(ii) particles of matter have some spaces in between them.

(iii) particles of matter are very tiny.

The correct statement(s) is/are:

a. (i) and (ii) b. (ii) and (iii)
c. Only (ii) d. All of these

Q 3. Which of the following statement is incorrect?

a. Matter is made up of particles.
b. Matter is continuous in nature.
c. Particles of matter are continuously moving.
d. Particles of matter attract each other.

Q 4. A few substances are arranged in the increasing order of forces of attraction between their particles. Which one of the following represents a correct arrangement? *(NCERT EXEMPLAR)*

a. Water, air, wind b. Oxygen, water, sugar
c. Air, sugar, oil d. Salt, juice, air

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Q 5. The interparticle forces are the strongest in:

a. ammonia b. ethyl alcohol
c. carbon dioxide d. sodium bromide

Q 6. On increasing the temperature of a gas:

a. its KE increases
b. its KE decreases
c. it gets converted into liquid
d. its particles come closer to each other

Q 7. Physical state of water at 0°C is:

a. solid b. liquid
c. gas d. None of these

Q 8. The property to flow is unique to fluids. Which one of the following statements is correct? *(NCERT EXEMPLAR)*

a. Only gases behave like fluids
b. Gases and solids behave like fluids
c. Gases and liquids behave like fluids
d. Only liquids are fluids

Q 9. In which of the following conditions, the distance between the molecules of hydrogen gas would increase?

(i) Increasing pressure on hydrogen 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.

(NCERT EXEMPLAR)

a. (i) and (iii) b. (i) and (iv)
c. (ii) and (iii) d. (ii) and (iv)

Q 10. The melting point of ice is:

a. 273.15 K b. 173.15 K
c. 373.5 K d. 100 K

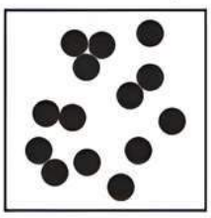
Q 11. The latent heat of vaporisation of water is:

a. 2.26×10^5 J/kg b. 2.26×10^6 J/kg
c. 22.6×10^6 J/kg d. 6.22×10^5 J/kg

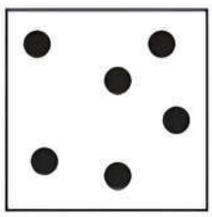
Q 12. Which of the following will not undergo sublimation?

a. Camphor b. Ammonium chloride
c. Iodine d. Sodium chloride

Q 13. The diagrams show the arrangement of particles of a substance at temperatures 20°C and 40°C.



At 20°C



At 40°C

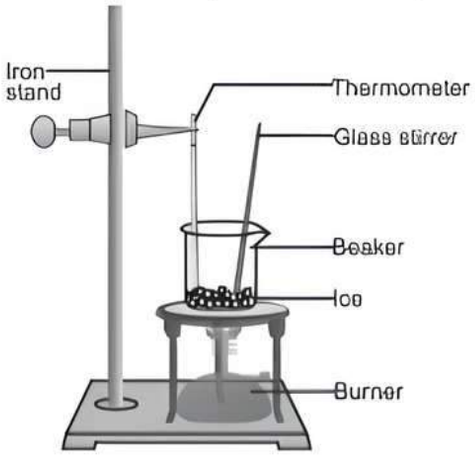
What are the likely melting and boiling points of the substance?

	Melting point/°C	Boiling point/°C
a.	–12	35
b.	–25	45
c.	–98	100
d.	44	80

Q 14. Choose the correct statement of the following: *(NCERT EXEMPLAR)*

a. Conversion of solid into vapours without passing through the liquid state is called sublimation.
b. Conversion of vapours into solid without passing through the liquid state is called vaporisation.
c. Conversion of vapours into solid without passing through the liquid state is called freezing.
d. Conversion of solid into liquid is called sublimation.

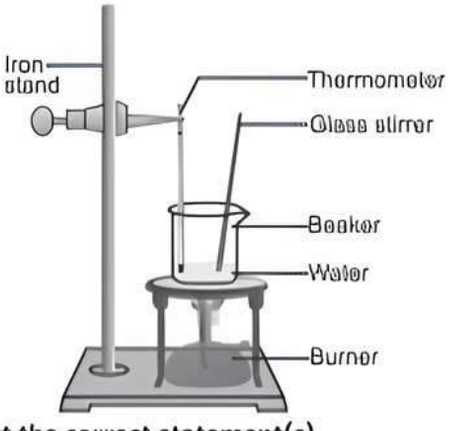
Q 15. Observe the given experimental set-up.



Select the correct statement(s).

a. The temperature does not change after the melting point is reached, till all the ice melts.
b. The heat gets used up in changing the state by overcoming the forces of attraction between the particles.
c. Once the ice is converted to water, the temperature starts rising till the water begins to boil.
d. All of the above

Q 16. Observe the given experimental set-up.



Select the correct statement(s).

a. Once the water starts boiling, the temperature remains constant till all the water has changed into vapours.
b. The temperature at which a liquid starts boiling at the atmospheric pressure is known as its boiling point.
c. The heat energy supplied is used up in overcoming the forces of attraction.
d. All of the above

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Q 17. The boiling points of diethyl ether, acetone and *n*-butyl alcohol are 35°C, 56°C and 118°C, respectively. Which one of the following correctly represents their boiling points in Kelvin scale? *(NCERT EXEMPLAR)*

a. 306 K, 329 K, 391 K b. 308 K, 329 K, 392 K
c. 308 K, 329 K, 391 K d. 329 K, 392 K, 308 K

Q 18. Dry ice is:

a. freon b. liquid chlorine
c. solid carbon dioxide d. plaster of paris

Q 19. Seema visited a natural gas compressing unit and found that the gas can be liquefied under specific conditions of temperature and pressure. While sharing her experience with friends, she got confused. Help her to identify the correct set of conditions. *(NCERT EXEMPLAR)*

a. Low temperature, low pressure
b. High temperature, low pressure
c. Low temperature, high pressure
d. High temperature, high pressure

Q 20. Which one of the following sets of phenomena would increase on raising the temperature? *(NCERT EXEMPLAR)*

a. Diffusion, evaporation, compression of gases
b. Evaporation, compression of gases, solubility
c. Evaporation, diffusion, expansion of gases
d. Evaporation, solubility, diffusion, compression of gases

Q 21. During evaporation, particles of a liquid change to vapours only:

a. from the surface b. from the bulk
c. Both a. and b. d. Neither a. nor b.

Q 22. Which condition out of the following will increase the evaporation of water? *(NCERT EXEMPLAR)*

a. Increase in temperature of water
b. Decrease in temperature of water
c. Less exposed surface area of water
d. Adding common salt to water

Q 23. During summer, water kept in an earthen pot becomes cool because of the phenomenon of: *(NCERT EXEMPLAR)*

a. diffusion b. transpiration
c. osmosis d. evaporation

Q 24. Match the physical quantities given in Column I to their S.I. units given in Column II. *(NCERT EXEMPLAR)*

Column I	Column II
A. Pressure	(i) Cubic metre
B. Temperature	(ii) Kilogram
C. Density	(iii) Pascal
D. Mass	(iv) Kelvin
E. Volume	(v) Kilogram per cubic metre

a. A-(iii), B-(iv), C-(i), D-(ii), E-(v)
b. A-(iii), B-(iv), C-(v), D-(ii), E-(i)
c. A-(v), B-(iv), C-(iii), D-(i), E-(ii)
d. A-(iv), B-(iii), C-(v), D-(ii), E-(i)

Q 25. The non S.I. and S.I. units of some physical quantities are given in Column I and Column II, respectively. Match the units belonging to the same physical quantity: *(NCERT EXEMPLAR)*

Column I	Column II
A. Degree celsius	(i) Kilogram
B. Centimetre	(ii) Pascal
C. Gram per centimetre cube	(iii) Metre
D. Bar	(iv) Kelvin
E. Milligram	(v) Kilogram per metre cube

a. A-(iv), B-(v), C-(iii), D-(i), E-(ii)
b. A-(ii), B-(iii), C-(v), D-(i), E-(ii)
c. A-(v), B-(iii), C-(ii), D-(iv), E-(i)
d. A-(iv), B-(iii), C-(v), D-(ii), E-(i)

Assertion & Reason Type Questions

Directions (Q. Nos. 26-35): *Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:*

a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
b. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
c. Assertion (A) is true but Reason (R) is false.
d. Assertion (A) is false but Reason (R) is true.

Q 26. **Assertion (A):** When sugar crystals dissolve in water, the level of water does not change.
Reason (R): Sugar particles occupy the intermolecular space between the water molecules.

Q 27. **Assertion (A):** Particles of matter are continuously in motion.
Reason (R): The kinetic energy of particles increases with increase in temperature.

Q 28. **Assertion (A):** The intermolecular forces in solid state are stronger than those in the liquid state.
Reason (R): The space between the particles of matter is called intermolecular space.

Q 29. **Assertion (A):** Liquids diffuse easily as compared to gases.
Reason (R): Intermolecular forces in liquids are greater than in gases.

Q 30. **Assertion (A):** The melting point of ice is 0°C or 273.15 K.
Reason (R): The conversion of a solid into liquid is also called fusion of the solid.

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Q 31. **Assertion (A):** Naphthalene, camphor, iodine, ammonium chloride are some common examples of the substances which undergo sublimation.

Reason (R): All solids are first converted to liquids and then to gases on heating.

Q 32. **Assertion (A):** At normal pressure (1 atm), the boiling point of water is 100°C or 373.15 K.

Reason (R): The atmospheric pressure at sea level is 1 atm and is taken as normal atmospheric pressure.

Q 33. **Assertion (A):** There is no change in the temperature of a substance when it undergoes a change of state though it is still being heated.

Reason (R): The heat supplied is absorbed either as latent heat of fusion or as latent heat of vaporisation.

Q 34. **Assertion (A):** A gas can be easily compressed by applying pressure.

Reason (R): Since, the interparticle spaces in the gaseous state are very small, they cannot be compressed by applying pressure.

Q 35. **Assertion (A):** Perspiration keeps our body cool.

Reason (R): Latent heat of vaporisation is absorbed from the body during perspiration.

Answers

1. (b) Feeling of cold
2. (d) All of these
3. (b) Matter is continuous in nature.
4. (b) Oxygen, water, sugar

   Forces of attraction between the particles increase in the order of Gases < Liquids < Solids. Hence, the correct arrangement is oxygen, water, sugar.
5. (d) sodium bromide

   We know that solids have the strongest interparticle force of attraction. In the given substances, sodium bromide is solid, ethyl alcohol is liquid and ammonia and carbon dioxide are gases. Thus, the particles of sodium bromide have the strongest interparticle force of attraction.
6. (a) its KE increases

   Increase in temperature leads to increase in kinetic energy of a gas.
7. (a) solid

   At 0°C, water exists as ice in solid state.

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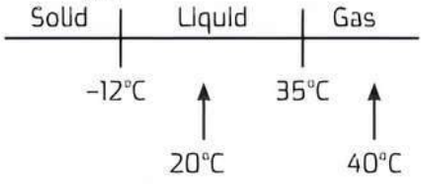
The freezing point of water is 0°C.

8. (c) Gases and liquids behave like fluids
9. (c) (ii) and (iii)

   When hydrogen gas leaks out of the container, the molecules of the gas remaining in the container have more free space. Hence, distance between the gas molecules increases. If the volume of the container is increased, same number of molecules will occupy that space. Hence, the distance between the molecules will increase.
10. (a) 273.15 k
11. (b) 2.26×10^6 J/kg
12. (d) Sodium chloride

    Sodium chloride will not undergo sublimation, *i.e.*, it doesn't convert from the solid state to the gaseous state without forming the liquid state when heated gently.
13. (a) –12°C, 35°C

    At 20°C, substance is liquid. At 40°C, substance is a gas. Thus, its melting point is below 20°C and its boiling point is below 40°C.



14. (a) Conversion of solid into vapours without passing through the liquid state is called sublimation.
15. (d) All of the above

    During the experiment of melting, the temperature of the system does not change after the melting point (0°C) is reached, till all the ice melts. This happens even though we continue to supply heat. This heat gets used up in changing the state by overcoming the forces of attraction between the particles. Since, this heat is absorbed by ice without showing any rise in temperature, therefore it is called latent heat of fusion.
16. (d) All of the above

    When we supply heat energy to water particles, they start moving even faster. At a certain temperature, a point is reached when the particles have enough energy to break free the forces of attraction of each other. At this temperature, the liquid starts changing into gas. The temperature at which a liquid starts boiling at the atmospheric pressure is known as boiling point. Once the water has begun to boil, the temperature remains at 100°C until all the water has changed into steam. The heat supplied does not increase the kinetic energy and hence no rise in temperature takes place during the boiling of water. Since, this heat is absorbed without showing any rise in temperature, therefore, it is called latent heat of vaporisation.
17. (c) 308 K, 329 K, 391 K

    35°C = 273 + 35 = 308 K

    56°C = 273 + 56 = 329 K

    118°C = 273 + 118 = 391 K

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18. (c) solid carbon dioxide
19. (c) Low temperature, high pressure
Gases can be compressed at low temperature and high pressure. Under these conditions, the particles of gases come closer and get liquefy.
20. (c) Evaporation, diffusion, expansion of gases
21. (a) from the surface
22. (a) Increase in temperature of water
23. (d) evaporation
24. (b) A–(iii), B–(iv), C–(v), D–(ii), E–(i)
25. (d) A–(iv), B–(iii), C–(v), D–(ii), E–(i)
26. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
27. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
28. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
29. (d) Assertion (A) is false because gases diffuse easily than liquids.
30. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
31. (c) Reason (R) is false because certain solids directly change to the gaseous state upon heating.
32. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
33. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
34. (c) Reason (R) is false because the interparticle spaces in the gaseous state are very large, so they can be compressed by applying pressure.
35. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

Case Study Based Questions

Case Study 1

Every matter is made up of tiny particles. These particles are so tiny that they can't be seen with naked eyes.

The three characteristics shown by particles of matter are as follows:

(i) There are small voids between particles in a matter. This characteristic is the concept behind the solubility of a substance in other substances.

(ii) Particles of matter show continuous random movements, that is they possess kinetic energy. The spreading of ink in a beaker of glass, smell of *agarbattis*, etc. are few illustrations that show the movement of particles of a substance.

(iii) The particles of matter attract each other with a force called interparticle force of attraction.

Read the given passage carefully and give the answer of the following questions:

Q 1. Spreading of fragrance of a burning incense stick in a room shows that:
a. particles of matter have spaces between them.
b. particles of matter attract each other.
c. particles of matter are constantly moving.
d. None of the above

Q 2. What happens when we add sugar to water?
a. Volume of water doubles.
b. Volume of water decreases.
c. Volume of water remains the same.
d. None of the above

Q 3. A stream of water cannot be cut by fingers. Which property of matter does this observation show?

a. Particles of matter attract each other.
b. Particles of matter have spaces between them.
c. Particles of matter are continuously moving.
d. None of the above

Q 4. When we put some crystals of potassium permanganate in a beaker containing water, we observe that after sometime, the whole water turns pink. This intermixing of particles of two different types of matter on their own is called:
a. Brownian motion
b. melting
c. sublimation
d. diffusion

Q 5. Why is the rate of diffusion of liquids higher than that of solids?
a. In the liquid state, particles are tightly packed as compared to solids.
b. In the liquid state, particles move freely as compared to solids.
c. In solid state, particles have least force of attraction between the particles.
d. In solid state, particles cannot be compressed easily.

Answers

1. (c) particles of matter are constantly moving.
2. (c) Volume of water remains the same.
3. (a) Particles of matter attract each other.
4. (d) diffusion
5. (b) In the liquid state, particles move freely as compared to solids.

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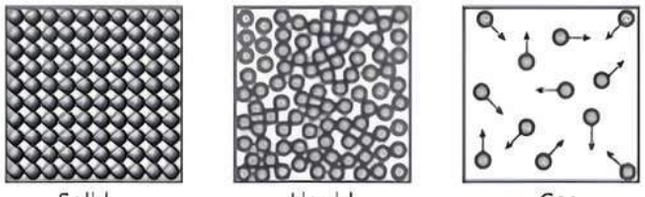
Case Study 2

All the materials we see in our daily life are made up of matter. Matter can be classified into different states such as solid, liquid and gas on the basis of intermolecular forces and the arrangement of particles.

In a solid, particles are tightly packed together and have very low kinetic energy. They have a definite shape and a certain volume.

In a liquid, particles are loosely packed than in a solid and are able to flow around each other, giving the liquid an indefinite shape. In a gas, the particles have a great deal of space between them and have high kinetic energy. A gas has neither definite shape nor volume.



Solid Liquid Gas

Read the given passage carefully and give the answer of the following questions:

Q 1. The forces of attraction between the particles of matter is maximum in:

a. Iron rod b. kerosene oil
c. glycerine d. dry air

Q 2. The substance with least interparticle space is:

a. methanol b. acetic acid
c. copper d. oxygen

Q 3. Which of the following indicates the relative randomness of particles in the three states of matter?

a. Solid > Liquid > Gas b. Liquid < Solid < Gas
c. Liquid > Gas > Solid d. Gas > Liquid > Solid

Q 4. Which of the following statements does not go with the liquid state?

a. Particles are loosely packed in the liquid state.
b. Fluidity is maximum in the liquid state.
c. Liquids cannot be compressed much.
d. Liquids take up the shape of any container in which they are placed.

Q 5. The description of the particles of four substances (I), (ii), (iii) and (iv) is shown in the table given below. Which of the following is a gas?

	Force of attraction between particles	Arrangement of particles	Position of particles
(I)	Strong	Fixed	Closely packed
(II)	Strong	Not fixed	Close together
(III)	Weak	Fixed	Far apart
(iv)	Weak	Not fixed	Far apart

a. I b. II c. III d. iv

Answers

1. (a) Iron rod
   In iron rod (solid), there is maximum force of attraction between the particles.
2. (c) copper
   in solid, particles have least interparticle space between them.
3. (d) Gas > Liquid > Solid
   Gas particles have the highest kinetic energy, hence the randomness is highest in gas.
   The solid particles are very closely packed.
   hence the solids have least kinetic energy.
4. (b) Fluidity is maximum in the liquid state.
   Fluidity is maximum in the gaseous state.
5. (d) iv

Case Study 3

The word 'matter' refers to everything in the universe that has mass and takes up space. States of matter are generally described on the basis of qualities that can be seen or felt. Three states of matter can be found in daily life: solid, liquid and gas.

Matter that feels hard and maintains a fixed shape is called a solid, matter that feels wet and maintains its volume but not its shape is called a liquid. Matter that can change both shape and volume is called a gas.

Read the given passage carefully and give the answer of the following questions:

Q 1. In which form, do the water molecules have less kinetic energy?

a. Ice
b. Water
c. Steam
d. All of them have equal kinetic energy

Q 2. Which of the following describes the liquid phase?

a. It has a definite shape and a definite volume.
b. It has a definite shape but not definite volume.
c. It has a definite volume but not a definite shape.
d. It has neither a definite shape nor a definite volume.

Q 3. Which one of the following statements is wrong for gases?

a. Gases do not have a definite shape and volume.
b. Volume of the gas is equal to the volume of the container confining the gas.
c. Confined gas exerts uniform pressure on the walls of container in all directions.
d. Mass of the gas cannot be determined by weighing a container in which it is enclosed.

Q 4. 'Gases are easily compressed but liquids cannot be compressed.' What can be inferred from this statement?

a. The forces of attraction between gas particles are stronger than that between liquid particles.
b. The gas particles are spaced further apart than liquid particles.

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c. The gas particles have less energy than liquid particles.
d. The gas particles move more rapidly than liquid particles.

Q 5. As the solid melts to form liquid:
a. interparticle forces of attraction decrease
b. the kinetic energy of particles increases
c. compressibility increases
d. All of the above

Answers

1. (a) Ice
Ice (solid) has less kinetic energy as compared to water (liquid) and steam (gas).
2. (c) It has a definite volume but not a definite shape.
3. (d) Mass of the gas cannot be determined by weighing a container in which it is enclosed.
The mass of a gas can be determined by weighing the empty container first, then filling it with gas and again weighing the container filled with gas. The difference of two readings gives the mass of gas.
4. (b) The gas particles are spaced further apart than liquid particles.
The large space between the particles of gas allow the gas to be easily compressed when pressure is applied.
5. (d) All of the above
When a solid is heated, the interparticle force decreases and kinetic energy of the particles increases. Compressibility of liquids is slightly more than solids, hence increases.

Case Study 4

In an experimental activity, crushed ice was taken in a beaker. A thermometer is fitted in such a way that its bulb was thoroughly surrounded by ice. The beaker is now slowly heated and temperature was regularly noted. Temperature rises gradually as the heating is continued and becomes constant when ice starts changing into liquid.

Read the given passage carefully and give the answer of the following questions:

Q 1. What name is associated with conversion of ice into water?
a. Evaporation b. Sublimation
c. Freezing d. Fusion

Q 2. What specific name is given to the constant temperature?
a. Latent heat of fusion b. Boiling point
c. Melting point d. Condensation point

Q 3. The heat added to the system at constant temperature is called:
a. specific heat b. latent heat
c. residual heat d. None of these

Q 4. In this experiment, the ice melts because its particles:
a. change their size
b. gain heat energy and escape
c. gain heat energy and become closer
d. gain heat energy and move away from their fixed positions

Q 5. Where does the heat energy go when the temperature does not rise?
a. It makes the molecular motion of the liquid faster.
b. It raises the temperature of the beaker only.
c. It is utilised for bringing out the complete change of state.
d. It slows down the molecular motion.

Answers

1. (d) Fusion
The process of change of solid state into liquid state is known as fusion.
2. (c) Melting point
The minimum temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point.
3. (b) latent heat
4. (d) gain heat energy and move away from their fixed positions
5. (c) It is utilised for bringing out the complete change of state.
The heat energy is used up in changing the state of the solid substance by overcoming the force of attraction between its particles, so that they become somewhat loose and form liquid water.

Case Study 5

We know that particles of matter are always moving and are never at rest. At a given temperature in any gas, liquid or solid, there are particles with different amounts of kinetic energy. In the case of liquids, a small fraction of particles at the surface, having higher kinetic energy, are able to break away from the forces of attraction of other particles and gets converted into vapour. This phenomenon of change of a liquid into vapours at any temperature below its boiling point is called evaporation.

The rate of evaporation increases with an increase in surface area of the liquid, an increase in temperature of the liquid and increase in wind speed. The rate of evaporation decreases with an increase in humidity.

Read the given passage carefully and give the answer of the following questions:

Q 1. Which of the following statements about evaporation is incorrect?
(i) It is a bulk phenomena.
(ii) It is a fast process.
(iii) It causes cooling.
a. (ii) and (iii) b. (i) and (ii)
c. (i) and (iii) d. (i), (ii) and (iii)

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Q 2. Evaporation is directly proportional to:

(i) humidity (ii) surface area
(iii) temperature (iv) wind speed

a. (i) and (iv) b. (ii) and (iii)
c. (iii) and (iv) d. (ii), (iii) and (iv)

Q 3. The evaporation of a liquid can be best carried out in a:

a. measuring cylinder b. china dish
c. test tube d. flask

Q 4. Evaporation of a liquid can take place:

a. at its boiling point
b. below its boiling point
c. above its boiling point
d. at fixed temperature

Q 5. Which of the following does not involve evaporation?

a. During summer, we perspire more.
b. Sprinkling water on the roof in a hot sunny day.
c. Spreading of virus on sneezing.
d. Water kept in an earthen pot becomes cool during summer.

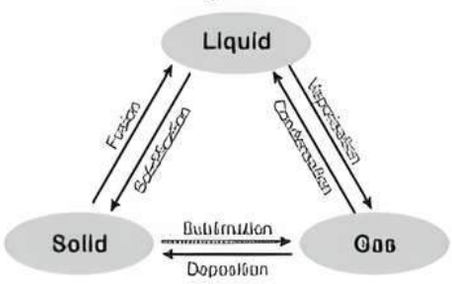
Answers

1. (b) (i) and (ii)
   Evaporation is a surface phenomenon and is a slow process.
2. (d) (ii), (iii) and (iv)
   Rate of evaporation increases with increase in surface area, temperature and wind speed.
3. (b) china dish
   China dish has the maximum surface area available for evaporation.
4. (b) below its boiling point
   Evaporation is conversion of a liquid into vapours below its boiling point.
5. (c) Spreading of virus on sneezing.

Case Study 6

Changes of state are physical changes in matter. They are reversible changes that do not involve changes in matter's chemical properties. We can change the physical state of matter in two ways: (i) by changing temperature (heating or cooling) or (ii) by changing pressure (increasing or decreasing).

Latent heat is the heat energy which has to supplied to change the state of a substance. Latent heat does not increase the temperature of a substance. It can be of fusion or of vaporisation.



Applying pressure and reducing temperature can liquefy gases. Solid carbon dioxide gets converted directly to gaseous state on decrease of pressure to 1 atmosphere.

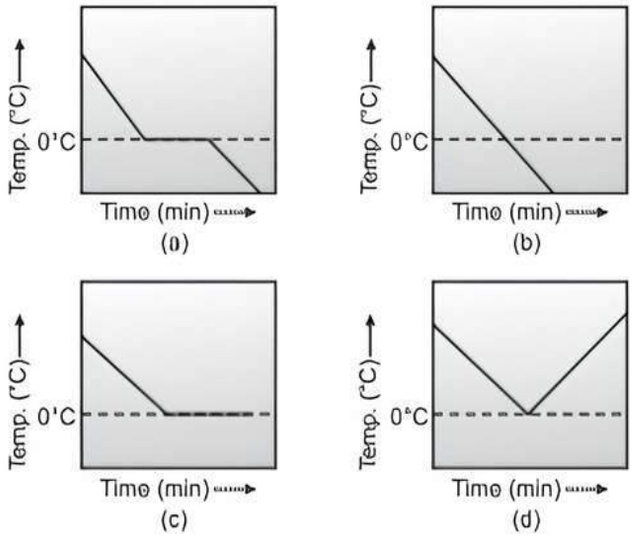
Read the given passage carefully and give the answer of the following questions:

Q 1. What is meant by the word 'latent' in latent heat? Name the two types of latent heat.

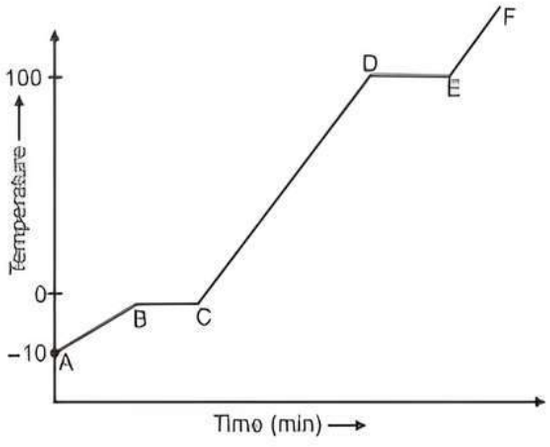
Q 2. Give the temperature at which water exists in two different states.

Q 3. What is the relation between pressure in atmosphere and pressure in pascal.

Q 4. 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 contents of the tumbler, which of the following graphs would correctly represent the change in its temperature as a function of time.



Q 5. Based on the data represented in the graph below, which region shows latent heat of vaporisation?



Answers

1. The word latent means hidden.
   Types: (i) Latent heat of fusion
   (ii) Latent heat of vaporisation.
2. (i) At 0°C, water can be in solid or in liquid state.
   (ii) At 100°C, water can be in liquid or in gaseous state.

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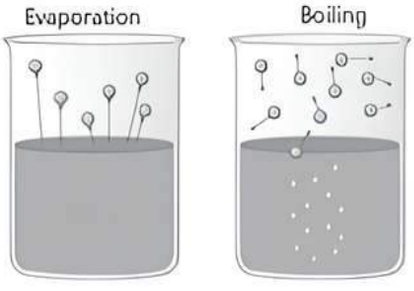
3. 1 atmosphere = 1.01×10^5 Pascal
4. The temperature of hot water decreases to 0°C and remains constant due to latent heat of fusion and then decreases further. So, graph (a) would correctly represent the change in its temperature as a function of time.
5. DE is the region that shows latent heat of vaporisation.

Case Study 7

The phenomenon of change of a liquid into vapours at any given temperature below its boiling point is called evaporation. Evaporation is different from boiling as boiling is a bulk phenomenon *i.e.*, particles from the whole of the liquid change into vapour state whereas evaporation is a surface phenomenon *i.e.*, only the particles from the surface gain enough energy to overcome the forces of attraction present in the liquid and change into vapour state.



The process of evaporation uses the energy of the liquid particles. This results in cooling of the surrounding area. The rate of evaporation depends upon the surface area exposed to the atmosphere, the temperature, the humidity and the wind speed.

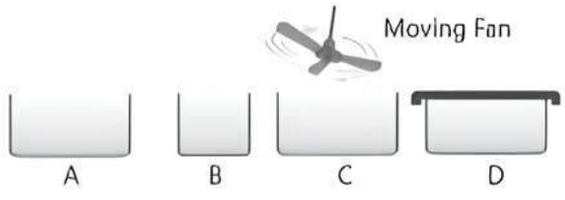
Read the given passage carefully and give the answer of the following questions:

Q 1. Differentiate between evaporation and boiling. Give any two differences.

Q 2. Which one among evaporation or boiling is known as a surface phenomenon. Why?

Q 3. Which one among evaporation or boiling is a slow process?

Q 4. Based on the figure given below, suggest in which of the vessels A, B, C or D, the rate of evaporation be the highest?



Q 5. What is the effect of humidity on rate of evaporation?

Answers

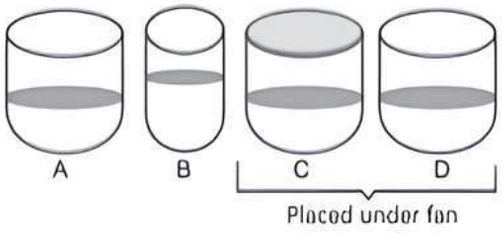
1. Difference between evaporation and boiling is as follows:

Basis of Difference	Evaporation	Boiling
Type	It is a surface phenomenon.	It is a bulk phenomenon.
Cause	It causes cooling.	It does not cause cooling.

2. In evaporation, the particles from the surface gain enough energy to overcome the forces of attraction present in the liquid and change into the vapour state, therefore it is called surface phenomenon.
3. Evaporation
4. Greater the surface area and more the wind speed, higher will be the rate of evaporation. So, the rate of evaporation will be highest in the vessel C.
5. Lesser is the humidity in air, more is the rate of evaporation.

Case Study 8

100 mL of water was placed in four vessels A, B, C and D. Vessel A, C and D are of same size, B is smaller. Vessel C is covered and C and D are placed under the fan.



Read the given passage carefully and give the answer of the following questions:

Q 1. In how many beakers, water will escape into atmosphere as vapours?

Q 2. What name is given to the process of escaping of water from liquid to vapour state?

Q 3. After one hour from the beginning of the experiment, the water level will fall to the maximum in which beaker?

Q 4. What happens in beaker C?

Answers

1. In three beakers, *i.e.*, A, B and D, water will escape into atmosphere as vapours.
2. Evaporation
3. D, because it is placed under fan and has large surface area.
4. Evaporation will not occur and water level remains the same.

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Very Short Answer Type Questions

Q 1. Why are light and sound not considered as matter?

Ans. Light and sound are not considered as matter because they have no mass and do not occupy space.

Q 2. What is diffusion?

Ans. The intermixing of particles of two different types of matter on their own is called diffusion.

Q 3. Give two properties of solid.

Ans. (i) Solids have fixed shape and are rigid.
(ii) Solids cannot be compressed.

Q 4. Sponge is solid but still it can be compressed. Why?

Ans. Sponge has minute holes in which air is trapped. When the sponge is pressed, the air present in the pores comes out and the sponge is compressed.

Knowledge BOOSTER

Sponge is a porous solid that comes back to its original shape after compression.

Q 5. Why do solids generally lack the property of diffusion?

Ans. This is because of the absence of kinetic energy in the particles of solid state where the particles are very closely packed.

Knowledge BOOSTER

Particles of matter move from a region of high concentration to a region of low concentration in diffusion.

Q 6. The melting points of three solids *X*, *Y* and *Z* are 298 K, 314 K and 398 K, respectively. Arrange these in increasing order to their interparticle force of attraction.

Ans. $X < Y < Z$ is the order of increasing interparticle force of attraction. Higher the force of attraction, higher will be melting point.

Q 7. Name the property of gases due to which large volume of CNG can be filled in small cylinders easily.

Ans. Gases can be easily compressed.

Q 8. What happens to the particle motion if the temperature of the gas is increased?

Ans. With the increase in temperature, the average kinetic energy of the particles increases. As a result, the particle motion increases.

Q 9. Mention two ways to liquefy atmospheric gases.

Ans. Atmospheric gases can be liquefied by increasing pressure and decreasing temperature.

Q 10. Arrange the three states of matter in the increasing order of:
(i) rate of diffusion (ii) particle motion.

Ans. **(i) Rate of diffusion:** Solid < Liquid < Gas
(ii) Particle motion: Solid < Liquid < Gas

Q 11. Convert (i) 300 K, (ii) 573 K into celsius scale.

Ans. (i) $300 - 273 = 27°C$ (ii) $573 - 273 = 300°C$

Q 12. Define melting point.

Ans. The minimum temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point.

Q 13. Define boiling point.

Ans. The temperature at which a liquid starts boiling at the atmospheric pressure is known as its boiling point.

Q 14. Define latent heat of vaporisation.

Ans. Latent heat of vaporisation is the heat energy required to change 1 kg of a liquid to gas at atmospheric pressure at its boiling point.

Q 15. Define latent heat of fusion.

Ans. Latent heat of fusion is the amount of heat energy required to change 1 kg of solid into liquid at atmospheric pressure at its melting point.

Q 16. Define sublimation.

Ans. Sublimation is the change of solid state directly to gaseous state without going through liquid state.

Q 17. Name any three substances that show sublimation.

Ans. Ammonium chloride, camphor and naphthalene balls.

Q 18. What is the physical state of water at: (i) 250°C (ii) 100°C?

Ans. (i) At 250°C, water exist in gaseous state.
(ii) At 100°C, it exist in both liquid state as well as in gaseous state.

Q 19. For any substance, why does the temperature remain constant during the change of state?

Ans. It is because heat given to the substance is being used in change of states, *i.e.* overcoming force of attraction between particles.

Q 20. Why is ice at 273 K more effective in cooling than water at the same temperature?

Ans. Ice will take latent heat of fusion from the material in contact and will cause more cooling.

Q 21. What is normal atmospheric pressure?

Ans. The atmospheric pressure at sea level is 1 atm and is taken as the normal atmospheric pressure.

Q 22. Does the evaporation of a liquid occur only at a fixed temperature?

Ans. No, evaporation of a liquid occurs at any temperature below its boiling point.

Q 23. What is humidity?

Ans. The amount of water vapour present in air is called humidity.

Q 24. 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, *i.e.* they are easily vapourised. They gain energy from our palm and evaporate causing the palm to feel cool.

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Short Answer Type-I Questions

Q 1. (i) When 45 g of sugar is dissolved in 100 mL of water, there is no increase in volume. Which characteristic of matter is represented by this observation?

(ii) Name the process which occurs when a drop of dettol is added to water.

Ans. (i) Particles of matter have spaces between them.

(ii) Diffusion.

Q 2. Give reasons for the following observations:

(i) The smell of hot sizzling food reaches you several metres away, but to get the smell from cold food you have to go closer.

(ii) A diver is able to cut through water in a swimming pool. Which property of matter does this observation show? *(NCERT INTEXT)*

Ans. (i) It is because particles of hot sizzling food possess large kinetic energy and diffuse in air rapidly whereas particles of cold food possess less kinetic energy and are not able to reach several metres apart.

(ii) This shows that the particles of matter have spaces between them. Also, the intermolecular forces of attraction are not very strong, hence the diver's force is enough to overcome these forces of attraction.

Q 3. Liquids and gases can be compressed but it is difficult to compress solids. Why?

Ans. Liquids and gases have intermolecular space. On applying pressure externally on them the molecules can come closer thereby minimising the space between them. But, the particles in a solid are very close to each other. So, they cannot be compressed.

Q 4. (i) A gas exerts pressure on the walls of the container, why?

(ii) A gas fills completely the vessel in which it is kept, why?

Ans. (i) Gases have high kinetic energy and weak intermolecular forces and the particles are in continuous random motion. These particles collide with each other as well as the walls of the container and therefore exert pressure on the walls of the container.

(ii) There is negligible intermolecular force of attraction between the particles of gas. Thus, gas particles move freely in all directions. Therefore, gas completely fills the vessel in which it is kept.

Q 5. Which phenomenon occurs during the following changes?

(i) Formation of clouds

(ii) Drying of wet clothes

(iii) Wax melts in the sun

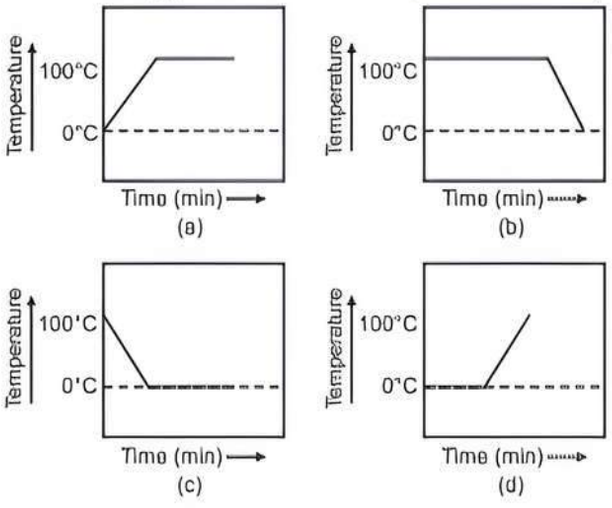
(iv) Size of naphthalene balls decreases

Ans. (i) Condensation, (ii) Evaporation, (iii) Melting (fusion), (iv) Sublimation.

Q 6. A sample of water under study was found to boil at 102°C at normal temperature and pressure. Is the water pure? Will this water freeze at 0°C? Comment. *(NCERT EXEMPLAR)*

Ans. Water is not pure because soluble impurities increase the boiling point of liquid. It will not freeze at 0°C as it is impure and will freeze below 0°C.

Q 7. 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 (figure) would correctly represent the result? Justify your choice. *(NCERT EXEMPLAR)*



Ans. Ice and water both are present at 0°C. The temperature will remain constant till whole ice changes into water because ice will melt by taking latent heat of fusion. On further heating, temperature of water will increase. So, the correct option is (d).

Q 8. You are given the following substances with their melting and boiling points.

Substances	Melting point (°C)	Boiling point (°C)
P	–20	–184
Q	110	450
R	16	80

Identify the physical states of *P*, *Q* and *R* at room temperature (30°C).

Ans. '*P*' is gas at room temperature.
'*Q*' is solid at room temperature.
'*R*' is liquid at room temperature.

Q 9. The melting and boiling points of three substances are given in the table below.

Substances	Melting point (°C)	Boiling point (°C)
A	25	115
B	–46	59
C	107	249

Based on the above information, answer the following questions:

(i) At room temperature, which substances(s) will be in the (a) solid state, (b) liquid state?

(ii) If all three substances are heated from 0°C to 100°C, which substance will (a) change from solid to liquid, (b) change from liquid to gas?

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Ans. (i) (a) C (b) A and B
(ii) (a) A (b) B

Q 10. (i) What do you understand by the term 'latent heat of fusion'? How much is the latent heat of fusion of ice?
(ii) What is meant by saying that latent heat of vaporisation of water is 22.5×10^5 J/kg?

Ans. (i) Latent heat of fusion is the amount of heat energy required to change 1 kg of solid into liquid at its melting point. The latent heat of fusion of ice is 3.36×10^5 J/kg.
(ii) It means that 22.5×10^5 J heat is required to change 1 kg of water (at its boiling point) into steam.

Q 11. Name the factors that affect evaporation.

Ans. The rate of evaporation will increase with:
(i) an increase of surface area.
(ii) an increase of temperature.
(iii) a decrease in humidity.
(iv) an increase in wind speed.

Q 12. Identify and explain the factor responsible for changed rate of evaporation in the following situations:
(i) While putting clothes for drying, we spread them out.
(ii) Water coolers are not effective on a rainy day.

Ans. (i) The rate of evaporation increases because surface area increases by spreading clothes.
(ii) It is because humidity is more in air on a rainy day, therefore rate of evaporation will decrease.

Q 13. (i) How does evaporation cause cooling?
(ii) Why do we see water droplets on the outer surface of a glass containing ice-cold water?

Ans. (i) During evaporation, the particles of liquid absorb energy from the surroundings to regain the energy lost during evaporation. This absorption of energy from the surroundings make the surroundings cold.
(ii) The water vapour present in air, on coming in contact with the cold glass of water, loses energy and gets converted to liquid state (droplets of water).

Q 14. It is a hot summer day. Priyanshi and Ali are wearing cotton and nylon clothes, respectively. Who do you think would be more comfortable and why? *(NCERT EXEMPLAR)*

Ans. Priyanshi would be more comfortable. The reason is that cotton absorbs sweat from the body and provides a larger surface area for evaporation which causes more cooling effect.

Q 15. Why does a desert cooler cool better on a hot dry day? *(NCERT INTEXT)*

Ans. On a hot dry day, the temperature is high and humidity is low. The rate of evaporation increases with increase in temperature and decrease in humidity. So, on a hot dry day, evaporation is more. Thus, water present inside the desert cooler evaporates more, thereby cooling the surroundings more. That is why a desert cooler cools better on a hot dry day.

Q 16. How does the water kept in an earthen pot (*matka*) become cool during summer? *(NCERT INTEXT)*

Ans. Earthen pots contain tiny pores. During summer, when water is poured into an earthen pot, some of the water seeps through pores to the outer surface. The water molecules on evaporation escape from the tiny pores of the earthen pot, thereby causing cooling effect. This makes the pot as well as the water inside the pot cool in summer.

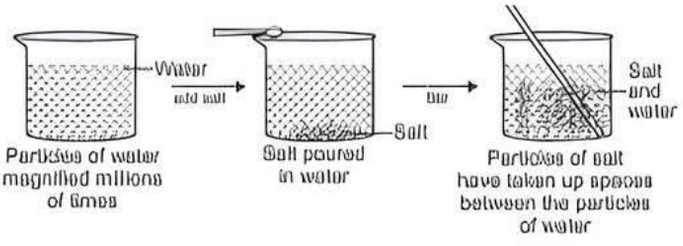
Short Answer Type-II Questions

Q 1. What are the characteristics of the particles of matter?

Ans. The characteristics of the particles of matter are:
(i) Particles of matter have space between them.
(ii) Particles of matter are in continuous motion.
(iii) Particles of matter attract each other.

Q 2. Describe an activity to show that particles of matter have spaces among them.

Ans. To show that particles of matter have space between them.
Materials Required: 100 mL beaker, water, salt, glass rod.
Procedure:
(i) Take a 100 mL beaker and fill it with water and mark the level of water.
(ii) Dissolve the given salt with the help of glass rod.
(iii) Observe the change in the water level and record your observations.



Observations: The salt gets dissolved in water. The particles of salt have entered the space between water molecules, therefore the level of water does not change.
Conclusion: The particles of matter have spaces among them.

Q 3. With the help of an activity, show that diffusion become faster with the increase in temperature.

Ans. To study the variation of rate of diffusion with temperature.
Materials Required: Copper sulphate, two beakers, cold water and hot water.
Procedure:
(i) Take 50 mL of cold water in a beaker.
(ii) Take 50 mL of hot water in another beaker.
(iii) Add a crystal of copper sulphate into the beaker containing 50 mL of cold water.
(iv) Add a crystal of copper sulphate into the beaker containing 50 mL of hot water.
(v) Leave them undisturbed.
(vi) Record the observations.

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Observations: The colour of solution in first beaker becomes blue slowly whereas the colour becomes blue faster in second beaker.

Conclusion: The rate of diffusion increases with increase in temperature because kinetic energy of molecules increases.

Q 4. (i) Define matter and write its three states.
(ii) Explain how these states of matter arise due to variation in the characteristics of the particles?

Ans. (i) Matter is substance which has mass and occupy space. Solid, liquid and gas are the three states of matter.

(ii) Solids have definite shape and volume due to strong forces of attraction between particles and very less intermolecular space.

Liquids have fixed volume but do not have definite shape due to less force of attraction between particles and large intermolecular space.

Gases do not have definite shape and volume due to least force of attraction between particles and very large intermolecular space.

Q 5. Distinguish between solids, liquids and gases in tabular form under the following characteristics:
(i) Interparticle force of attraction
(ii) Diffusion
(iii) Fluidity

Ans.

	Characteristics	Solid	Liquid	Gas
(i)	Interparticle force of attraction	Maximum	Moderate	Least
(ii)	Diffusion	Cannot diffuse	Can diffuse to some extent	Can easily diffuse
(iii)	Fluidity	No fluidity	Can flow from one region to other (less than gases)	Can easily flow in all directions (maximum fluidity)

Q 6. How do you differentiate between solids, liquids and gases on the basis of their melting and boiling points?

Ans. Solids have melting and boiling points above room temperature.

Liquids have melting point below room temperature and boiling point above room temperature.

Gases have melting and boiling points below room temperature.

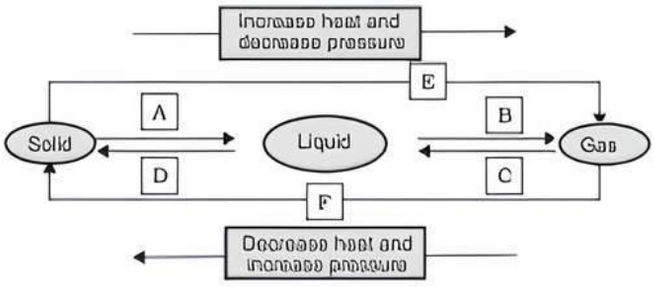
Q 7. We can easily move our hand in air but to do the same through a solid block of wood, we would need a 'Karate expert'. Explain.

Ans. In air, the interparticle space is more and the interparticle forces are quite weak which can be easily overcome. That is why, our hand can easily move in air. But in a solid block, the constituent particles are quite closer and the interparticle forces are very strong. Therefore, it is very difficult to move our hand through a solid.

Q 8. Arrange the following in the increasing order of:
Copper wire, Vinegar, Hydrogen gas
(i) Force of attraction (ii) Intermolecular space
(iii) Rigidity (iv) Diffusion
(v) Compressibility (vi) Density

Ans. (i) Hydrogen gas < Vinegar < Copper wire
(ii) Copper wire < Vinegar < Hydrogen gas
(iii) Hydrogen gas < Vinegar < Copper wire
(iv) Copper wire < Vinegar < Hydrogen gas
(v) Copper wire < Vinegar < Hydrogen gas
(vi) Hydrogen gas < Vinegar < Copper wire

Q 9. Name A, B, C, D, E and F in the following diagram showing change in its state: *(NCERT EXERCISE)*



Ans. A = Melting or fusion, here the solid changes into liquid.

B = Evaporation or vaporisation, here the liquid changes into gas.

C = Condensation, here the gas changes into liquid.

D = Solidification, here the liquid changes into solid.

E = Sublimation, here the solid directly changes into gas without going through liquid state.

F = Deposition, here the gaseous state directly changes into solid without going through liquid state.

Q 10. Give reasons for the following:
(i) A liquid generally flows easily.
(ii) Ice at 0°C appears colder when kept in the mouth than water at 0°C.
(iii) Doctors advise to put strips of wet cloth on the forehead of a person having high fever.

Ans. (i) A liquid generally flows easily because the intermolecular spaces between the liquid particles are more.

Moreover, these particles are loosely packed due to the presence of little force of attraction between them.

(ii) The latent heat of fusion of ice is very high. When kept in the mouth, ice absorbs this latent heat from the mouth and cools it effectively. On the other hand, water doesn't take any heat from the mouth at the same temperature. That's why ice at 0°C gives a sensation of more cooling in the mouth than water kept at the same temperature.

(iii) As water evaporates from the strips of wet cloth placed on the forehead of a person, it absorbs heat from the body. As a result of it, the body temperature gets lowered down and the person gets some relief from fever.

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Q 11. (i) Enumerate the changes that take place inside the matter during the change of states.
(ii) When a solid melts, its temperature remains the same. Give reason.

Ans. (i) When solid changes into liquid, the intermolecular force of attraction decreases and the distance between molecules increases. Kinetic energy of molecules also increases. When liquid changes into gas, the force of attraction between molecules becomes very less. This increases intermolecular space as well as the kinetic energy.

(ii) When a solid melts, the heat energy supplied is used up as latent heat of fusion due to which the temperature remains constant till all the solid melts.

Q 12. Why do we feel chilling cold, when we hold a piece of ice in our hand?

Ans. Melting of ice is an endothermic change of state requiring the absorption of energy. The piece of ice in our hand melts slowly by taking the latent heat from our hand, for melting. Since our hand loses energy to ice, this gives cooling effect to our hand.

Knowledge BOOSTER

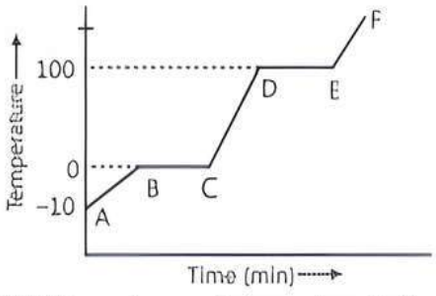
Endothermic change describes a reaction in which system absorbs energy from its surroundings, usually but not always, in the form of heat.

Q 13. Water as ice has a cooling effect, whereas water as steam may cause severe burns. Explain these observations.

Ans. In case of ice, the water molecules possess low energy while in the case of steam, the water molecules possess high energy. The high energy of water molecules in steam is transformed as heat and may cause severe burns.

On the other hand, in case of ice, the water molecules take energy from the body and thus give a cooling effect.

Q 14. From the graph given below:



(i) Which region contains only solid?
(ii) Which region contains all liquids?
(iii) Which region shows latent heat of vaporisation?

Ans. (i) $\overline{AB}$ is the region which contains only solid.
(ii) $\overline{CD}$ is the region which contains all liquids.
(iii) $\overline{DE}$ is the region which shows latent heat of vaporisation.

Q 15. Answer the following questions:
(i) Why is ice at 273 K more effective in cooling than water at the same temperature?
(ii) Name the two gases which are supplied in compressed form in houses and hospitals.
(iii) What is dry ice?

Ans. (i) Ice (solid state) at 273 K carries extra energy in the form of latent heat of fusion (335 k J/kg) as compared to water. When ice starts melting, it gains energy from the surroundings to overcome this latent heat. The temperature of the surroundings gets lowered. Since, water is already present in liquid state, it hardly takes any energy from its surroundings. Ice at 273 K is therefore more effective in cooling than water at the same temperature.

(ii) LPG (Liquefied Petroleum Gas) is supplied in houses while oxygen gas is supplied in hospital.

(iii) Solid carbon dioxide (CO_2) is known as dry ice.

Knowledge BOOSTER

Dry Ice is formed when CO_2 gas is compressed and stored under high pressure.

Q 16. Carbon dioxide was taken in an enclosed cylinder and compressed by applying pressure.
(i) Which state of matter will we obtain after completion of the process?
(ii) Name and define this process.
(iii) What is the common name of the product obtained in the above process?

Ans. (i) Solid state of matter is obtained.

(ii) The process is deposition. It is the process where a gas directly changes to solid without changing into liquid state.

(iii) The common name of the product obtained is dry ice.

Q 17. What determines the physical state of a substance? Suggest a method to liquefy gases. Water droplets are observed on the outer surface of a glass tumbler containing ice cold water. Give reason.

Ans. The physical state of a substance is determined by the temperature and pressure. For example, water exists as solid below 0°C, as liquid above 0°C till 100°C but above 100°C, it exists as gas.

Gases can be liquefied by bringing its particles closer so atmospheric gases can be liquefied either by decreasing temperature or by increasing pressure. For example, LPG is present in cylinder in the form of liquid at high pressure but changes into gas at atmospheric pressure and room temperature.

Water droplets are observed on the outer surface of a glass tumbler containing ice cold water because the water vapour present in air on coming in contact with ice cold glass tumbler, loses energy and gets converted into the liquid state, which we see as water droplets.

Q 18. Draw a well-labelled diagram showing sublimation of ammonium chloride.

Ans. Take some ammonium chloride in a China dish and place the China dish on a tripod stand. Cover the China dish with an inverted glass funnel.

Put a loose cotton plug on the stem of the funnel to prevent the ammonium chloride vapour from escaping into the atmosphere.

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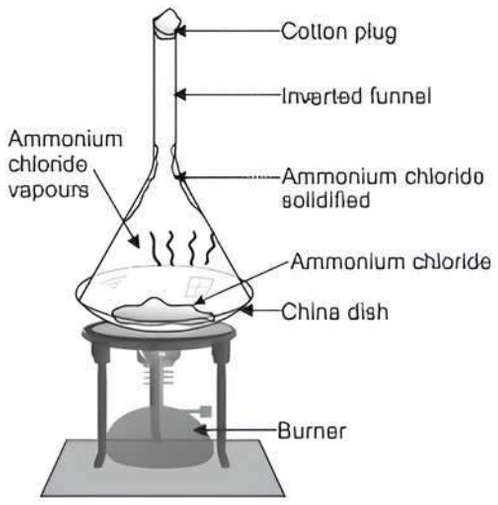


The china dish is heated by using a burner. On heating, ammonium chloride changes into white vapours. These vapours rise up and get converted into solid ammonium chloride on coming in contact with the cold, inner walls of the funnel.

Q 19. Give reasons for the following:

(i) Camphor disappears if kept in open air for a few days.

(ii) Wet clothes do not dry easily on rainy days.

(iii) A gas cylinder cannot be half filled, why?

Ans. (i) It is because camphor has weak interparticle forces of attraction which can be overcome by keeping it at room temperature. Thus, it directly converts into vapour and disappears.

Knowledge BOOSTER

Camphor has the property to sublimate i.e., it directly changes from solid to gas.

(ii) On a rainy day, air already contains so much water vapour that it cannot absorb more. Hence, wet clothes do not dry easily on rainy days.

(iii) The particles of gas have high kinetic energy and negligible forces of attraction. Thus, they move randomly at a very high speed in all directions and hence occupy all the space available to them. Since a gas occupies all its volume, so a gas cylinder cannot be half filled.

Q 20. Comment on the following statements:

(i) Evaporation produces cooling.

(ii) Rate of evaporation of an aqueous solution decreases with increase in humidity.

(iii) The temperature remains constant during sublimation.

Ans. (i) It is because the particles present at the surface of liquid take energy from their surroundings and get converted into vapours, which produces a cooling effect.

(ii) Humidity refers to the amount of water vapour present in air. Air contains a definite amount of water vapour at a given temperature. Therefore, if air is already rich in water vapour, it will not take up more water and so, the rate of evaporation of water will decrease.

(iii) During sublimation, heat of vaporisation and fusion overcome the force of attraction between the particles, thus maintaining the temperature constant.

Q 21. Why should we wear cotton clothes in summer?

Ans. During summer, we perspire more because of the mechanism of our body which tries to keeps us cool. When evaporation takes place, sweat particles gain energy from the body surface and change into vapour. The heat energy equal to the latent heat of vaporisation is absorbed from the body thus, leaving the body cool. Cotton, being a good absorber of water, helps in absorbing the sweat and exposing it to the atmosphere for easy evaporation.

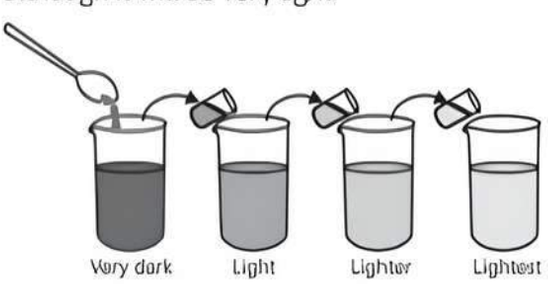
Q 22. On a hot sunny day, why do people sprinkle water on the roof or open ground?

Ans. During hot sunny day, the surface of roof or ground absorbs large amount of heat and remains hot. On sprinkling water on these surfaces, the water absorbs large amount of heat from the surface due to its large latent heat of vaporisation and evaporates thereby allowing the hot surface to cool.

Long Answer Type Questions

Q 1. Describe an activity to show that matter is made up of small particles.

Ans. Activity: Take distilled water in four glass beakers marked as 1, 2, 3 and 4. Fill about half of each beaker. With the help of a spatula, add a few crystals of potassium permanganate to the beaker 1, stir with the spatula and observe the colour of the solution. It will become dark purple. Now transfer a small volume of the solution in a test tube and add this solution to the beaker 2. The solution still remains purple but the colour goes lighter as compared to the solution in beaker 1. Repeat the experiment in beaker 3 as well as in beaker 4. The purple colour of the solution will not disappear even in beaker 4 although it will be very light.



Conclusion: This activity indicates that matter is made up of small particles, which keep on dividing themselves into smaller and smaller particles on each dilution.

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Q 2. What are the differences between solid, liquid and gaseous states?

Ans. Difference between solid, liquid and gaseous states are as follows:

Basis of Difference	Solid State	Liquid State	Gaseous State
Shape and volume	Solids have definite shape and volume.	Liquids have definite volume, but indefinite shape.	Gases neither have a definite shape nor definite volume.
Compressibility	Solids are rigid and non-compressible.	Liquids are non-rigid as well as non-compressible.	Gases are not rigid, but they are compressible.
Density	Solids have high density (except ice).	Liquids have less density than solid.	Gases have least density.
Diffusion	Solids do not diffuse easily.	Liquids diffuse very slowly.	Diffusion of gases is very fast.
Fluidity	Solids do not tend to flow.	Liquids tend to flow.	Gases also tend to flow.
Interparticle space and intermolecular force	Interparticle spaces are small and intermolecular forces of attraction are maximum.	Interparticle space is more than solids, while intermolecular force of attraction is less than solids.	Interparticle space is maximum, while intermolecular force of attraction is minimum.

(Any five)

Q 3. Account for the following:

(i) When sugar crystals dissolve in water, the level of water does not rise appreciably.

(ii) A wooden table should be called a solid.

(iii) Dogs generally hang out their tongue in summer.

(iv) Iron almirah is a solid at room temperature.

(v) Oxygen is called a gas.

Ans. (i) This is because the particles of matter have spaces between them and hence the crystals of sugar dissolve in the spaces making the water level constant.

(ii) A wooden table should be called a solid because:

(a) It is very hard and rigid.

(b) It has a definite shape and volume.

(iii) Dogs hang out their tongue from mouth in summer to regulate body temperature. Dogs have fewer sweat glands, tongue of dogs is coated with saliva and when saliva evaporates from tongue of dog, it provides a cooling effect. Thus, due to evaporation of saliva from tongue of dogs, its cooling effect help in regulation of their body temperature.

Knowledge BOOSTER

Unlike humans, dogs lack the ability to sweat when they overheat.

(iv) Iron almirah has a fixed shape and volume, so it is solid at room temperature.

(v) Oxygen has neither fixed volume nor fixed shape. It exerts pressure due to collision of the molecules on the walls of containing vessel and among themselves. So, it is called a gas.

Q 4. (i) Explain the term density. Arrange different states of matter in increasing order of density.

(ii) Explain how ice floats on water?

Ans. (i) Density can be defined as mass per unit volume. Its CGS unit is g cm^{-3}.

In solids, the molecules are tightly packed. Hence, the number of molecules per unit volume is more and density is highest. In gases, the molecules are very loosely packed, thus the density is the least.

Hence, increasing order of density:

Gases < Liquids < Solids.

(ii) Due to a specific structure, ice has larger interparticle space therefore its volume will be more than water and density will be less. This is the reason that ice floats on the surface of water.

Q 5. (i) What is meant by the word 'Latent heat'?

(ii) Explain with example of water:

(a) Latent heat of fusion, and

(b) Latent heat of vaporisation.

Ans. (i) The meaning of latent is hidden as it is stored in case of solids or liquids. Latent heat is the amount of heat that changes the state of a material without raising its temperature any further.

(ii) (a) When ice is melted at 0°C, it converts into water completely but the temperature remains constant. The heat energy which is needed to convert one kilogram of ice into water at its melting point (0°C) is known as latent heat of fusion.

(b) When water is heated, it changes into vapour. When temperature of water reaches up to 100°C, it converts into steam completely but the temperature remains constant. The heat energy required to convert 1 kg of liquid into vapour completely at its boiling point (100°C) is known as latent heat of vaporisation.

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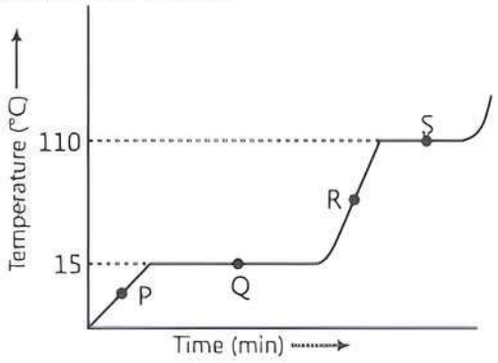
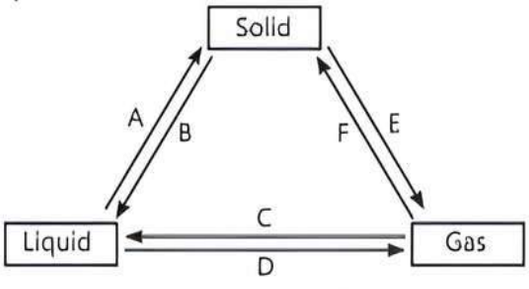
Q 6. The graph shows the heating curve for a pure substance. The temperature rises with time as the substance is heated.



(i) What is the physical state of the substance at the points *P*, *Q*, *R* and *S*?
(ii) What is the melting point of the substance?
(iii) What is its boiling point?
(iv) What happens to the temperature while the substance is changing state?
(v) The substance is not water. How can you judge from the graph?

Ans. (i) **At point *P*:** The substance is in the solid state.
At point *Q*: The substance has started melting. It exists both in the solid and liquid states.
At point *R*: The substance is in the liquid state.
At point *S*: The substance has started boiling. It exists both in the liquid and gaseous states.
(ii) The melting point of the substance is 15°C.
(iii) The boiling point of the substance is 110°C.
(iv) The temperature remains the same during the change of state.
(v) Had the substance been water, its melting point should have been 0°C and boiling point 100°C. It is therefore, not water.

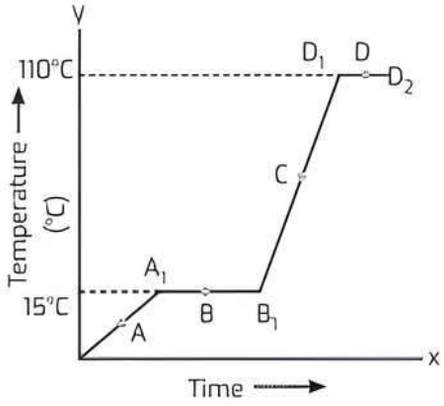
Q 7. Consider the following figure and answer the questions that follow:



(i) Name the changes A to F.
(ii) Name a substance which will undergo change E.
(iii) Name a substance which will undergo changes from solid to liquid to gas from 0°C to 100°C.
(iv) Which of the changes A to F will involve:
(a) an input of heat energy?
(b) an output of heat energy?

Ans. (i) A: Solidification, B: Fusion, C: Condensation, D: Vaporisation E: Sublimation, F: Deposition.
(ii) Naphthalene
(iii) Water
(iv) (a) B, D, E (b) A, C, F

Q 8. The temperature-time graph given below shows the heating curve for pure wax.



From the graph, answer the following:
(i) What is the physical state of the substance at the points *A*, *B*, *C* and *D*?
(ii) What is the melting point of the wax?
(iii) What is its boiling point?
(iv) Which portions of the graph indicate that change of state is taking place?
(v) Name the terms used for heat absorbed during change of states involved in the above processes.

Ans. (i) At point *A* = Solid wax
At point *B* = Solid as well as liquid wax (Melting continues)
At point *C* = Liquid wax
At point *D* = Liquid as well as vapour state (Boiling continues)
(ii) Melting point of wax = 15°C
(iii) Boiling point of wax = 110°C
(iv) Straight lines in the curve parallel to time-axis (*X*-axis) indicates the change of state. These portions are A_1 to B_1 (solid to liquid) and D_1 to D_2 (liquid to vapour state).
(v) During melting, at melting point, the heat absorbed is called latent heat of fusion. During boiling, at boiling point, the heat absorbed is called latent heat of vaporisation.

Q 9. Define evaporation. List the factors on which the rate of evaporation depends and explain how it depends on each of them?

Ans. The phenomenon of change of a liquid into vapours at any temperature below its boiling point is called evaporation.
Factors on which rate of evaporation depends are as follows:
(I) **Surface area:** Greater the surface area, more will be the rate of evaporation e.g., tea becomes cold faster in a saucer than a cup.
(II) **Temperature:** Higher the temperature, more will be the rate of evaporation. Humidity is more in summer than in winters due to faster rate of evaporation of water during summer.
(III) **Wind speed:** Higher the wind speed, more will be the rate of evaporation e.g., clothes dry up faster on windy day.
(IV) **Humidity:** Greater the humidity, lesser will be the rate of evaporation e.g., clothes dry up slowly on a rainy day because humidity in air is more.

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Chapter Test

Multiple Choice Questions

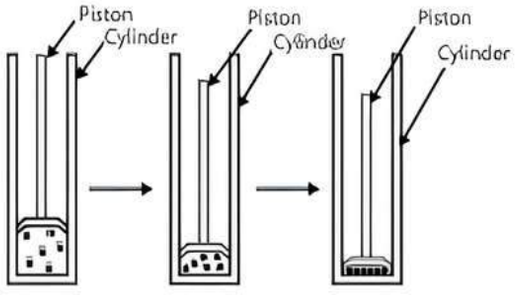
Q 1. The similarity between a liquid and a gas is:

a. both do not show definite shape.
b. both have definite volume.
c. both have same boiling point.
d. both have same nature.

Q 2. A diver is able to cut through water in a swimming pool. The property shown by the matter is:

a. the particles are of very small size.
b. the matter have space between them.
c. the particles are in solid state.
d. the particles are running here and there, have no space between them

Q 3. Observe the given experimental set-up.



Select the correct statements.

(i) The interparticle distances are the largest and interparticle forces of attraction are the weakest in gases.
(ii) The interparticle distances are somewhat shorter and interparticle forces of attraction are somewhat stronger in liquids.
(iii) In solids, the interparticle distances are the shortest and the interparticle forces of attraction are the strongest.
(iv) To convert a gas into a liquid or to convert a liquid into a solid, the interparticle distances must be decreased and the interparticle forces of attraction must be made stronger.

a. (i) and (iii) b. (ii) and (iii)
c. (i) and (ii) d. All of these

Q 4. Which word describes the following change?

$$I_2(s) \longrightarrow I_2(g)$$

a. Boiling b. Condensation
c. Sublimation d. Evaporation

Assertion and Reason Type Questions

Directions (Q. Nos. 5-6): *Each of the following questions consists of two statements, one is* ***Assertion*** *(A) and the other is* ***Reason*** *(R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:*

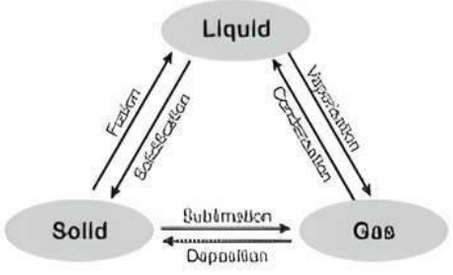
a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
b. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
c. Assertion (A) is true but Reason (R) is false.
d. Assertion (A) is false but Reason (R) is true.

Q 5. Assertion (A): Smell of burning incense stick spreads all around due to the diffusion of its fumes into air.
Reason (R): Increased temperature results in increased kinetic energy of the molecules.

Q 6. Assertion (A): Camphor disappears if kept in open air for a few days.
Reason (R): Camphor has strong interparticle forces of attraction which can't be overcome by keeping it at room temperature.

Case Study Based Question

Q 7. Changes of state are physical changes in matter. They are reversible changes that do not involve changes in matter's chemical properties. We can change the physical state of matter in two ways: (i) by changing temperature (heating or cooling) or (ii) by changing pressure (increasing or decreasing). Latent heat is the heat energy which has to supplied to change the state of a substance. Latent heat does not increase the temperature of a substance. It can be of fusion or of vaporisation.



Applying pressure and reducing temperature can liquefy gases. Solid carbon dioxide gets converted directly to gaseous state on decrease of pressure to 1 atmosphere.

Read the given passage carefully and give the answer of the following questions:

(i) What is meant by the word 'Latent' in latent heat? Name the two types of latent heat.
(ii) Give the temperature at which water exists in two different states.
(iii) What is the relation between pressure in atmosphere and pressure in Pascal?
(iv) 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 contents of the tumbler, which of the following graphs would correctly represent the change in its temperature as a function of time.

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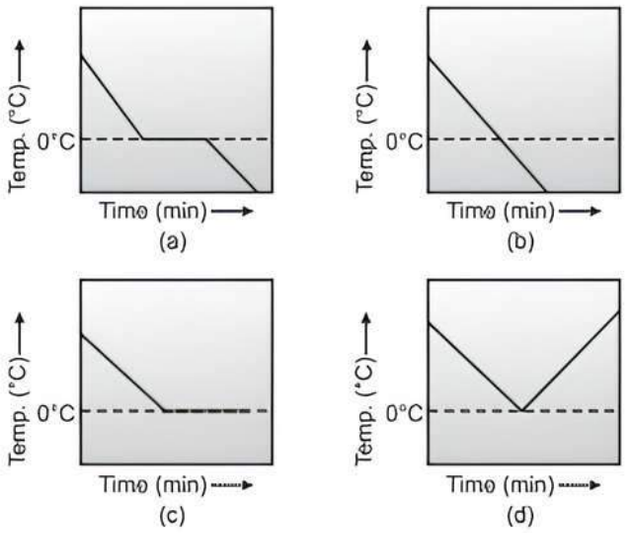

Very Short Answer Type Questions

Q 8. A given substance *X* has definite volume, but no definite shape and can diffuse easily. What is the physical state of substance *X*?

Q 9. Why are we able to sip hot tea or milk faster from a saucer rather than a cup?

Short Answer Type-I Questions

Q 10. How temperature in the Celsius and the Kelvin scales are related to each other? Convert 385K to Celsius scale?

Q 11. Give two differences between boiling and evaporation.

Q 12. Explain each of the following observations:

(i) A solid mothball disappears without leaving any liquid.

(ii) Your skin feels cold when a little alcohol is rubbed on it.

Short Answer Type-II Questions

Q 13. Give two characteristic properties of each.
(i) Solid (ii) Liquid (iii) Gas

Q 14. The substance *X* normally exists in a physical state which can flow easily but does not fill its vessel completely. When substance *X* is cooled excessively, it changes into a substance *Y* which has a fixed shape as well as a fixed volume. If however, the substance *X* is heated strongly, it changes into a substance *Z* which has neither a fixed shape nor a fixed volume.

(i) Name the substance *X*.

(ii) What is the process of conversion of *X* into *Y* known as ?

(iii) At which temperature *X* gets converted into *Y*?

(iv) Name the substance *Z*.

(v) What is the process of conversion of *X* into *Z* known as ?

(v) At which temperature *X* gets converted into *Z*?

Q 15. Classify the following into osmosis/diffusion.

(i) Swelling up of a raisin on keeping in water.

(ii) Spreading of virus on sneezing.

(iii) Earthworm dying on coming in contact with common salt.

(iv) Shrinking of grapes kept in thick sugar syrup.

(v) Preserving pickles in salt.

(vi) Spreading of smell of cake being baked throughout the house.

(vii) Aquatic animals use oxygen dissolved in water during respiration.

Long Answer Type Questions

Q 16. Define the following terms:
(i) Compressibility (ii) Rigidity (iii) Fluidity
(iv) Fusion (v) Melting point

Q 17. Account for the following:

(i) We wear cotton clothes in summer.

(ii) A wet handkerchief is placed on the forehead of a person suffering from high fever.

(iii) Wet clothes dry slowly during rainy season.

(iv) We see droplets of water on the outer surface of a glass containing ice cold water.

(v) People sprinkle water on the roof after a hot sunny day.

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