

Student Learning Outcomes

After studying this chapter, students will be able to:

- Explain changes of state and internal energy with change in temperature (melting, boiling, freezing, condensation, sublimation and deposition) in terms of kinetic particle theory.
- Distinguish between evaporation and boiling.
- Interpret heating and cooling curves in terms of kinetic theory
- Interpret in terms of kinetic particle theory the effects of changing pressure, temperature and volume of a gas on the other two with regards to Boyle's law, Charles's Law, and Avogadro's Law.
- Explain qualitatively the effect of external pressure on rate of boiling and evaporation
- Explain diffusion of gases in terms of kinetic particle theory
- Examine qualitatively the effect of molecular mass and temperature on the rate of diffusion
- Discuss applications of sublimation around us.
- {Examples may include: solid air fresheners and 3D printing}
- Explain, with the help of kinetic particle theory, the importance of rates of diffusion of medicines in the body

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

14.1

Internal Energy

14.2

Interconversion of Physical States

Q.1: Explain how the kinetic particle Theory describes the behaviour, arrangement and movement of particles in the three primary states of Matter.

Ans. States of Matter:

Matter in this world exists in four physical states namely:

- Gas ● Liquid ● Solid ● Plasma

Formulation of kinetic particle Theory:

Out of these four states the properties of gases were studied first. It was suggested that physical properties of gases such as their ability to compress or expand, or diffuse

could be understood by assuming that these gases consist of particles which are continuously moving randomly. This idea then led to formulation of kinetic particle theory for gases.

Scope of Kinetic Particle Theory:

Kinetic particle theory not only explains all the laws which govern the behaviour of gases, it also explains:

- The composition of liquid and solid states of matter
- The interconversion of all three states.

This is natural because all the three physical states are distinct in their physical properties only while their chemical nature remains the same.

For Example: Water in all its three physical states remains chemically the same compound.

Postulates of Kinetic Theory for Gases Random Motion:

According to Kinetic particle theory, gases are composed of particles which are in a continuous state of random motion in all the possible directions.

The pressure exerted by a gas is due to the collisions of its particles with the walls of the container. Since the pressure of a gas in a container does not change with time at constant temperature, it is assumed that the collisions between its particles do not involve any loss or gain of energy due to friction.

The attractive forces between the particles of a gas are assumed as negligible since the particles are widely apart at low pressure.

The average kinetic energy of the particles is directly proportional to the temperature measured on Kelvin scale for all gases at the same temperature.

Postulates of Kinetic Particle Theory For Liquids:

Arrangement of Particles: According to kinetic theory, the particles in a liquid are quite close to one another. They are also moving in all possible directions.

Movements of Particles: In a liquid, the particles show all the three types of movements such as:

- Translational movement
- Rotational movement
- Vibration movement

Owing to the presence of inter-particle forces, however, a liquid has a fixed volume and it keeps its level as well

Postulates of Kinetic particle Theory For Solids:

Fixed Position of Particles: Solid substances consist of ions, atoms and molecules.

According to kinetic particle theory the inter particle forces in the solid substances are so strong that they keep their particles arranged in a fixed position.

Vibrational Motion: The particles of a solid possess vibrational motion.

Fixed shape and Fixed volume: These restricted movements force solid substances to have a fixed shape and a fixed volume.

Q.2: Discuss conversion of a Solid into a liquid.

Ans. Heating:

The physical state of a solid substance can be changed by simple heating.

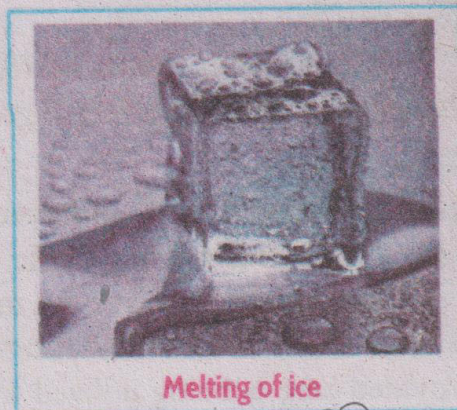
Heat increases the kinetic energy of the particles and they start vibrating at a higher frequency

Melting point: At particular temperature their vibrational motion becomes so fast that it overcomes the cohesive forces. As a result they start melting and this temperature is called the melting point of the solid.

Changing a Solid into a liquid:

At the melting point, the particles of solid not only lose their mean positions but the arrangement as well. The solid collapses and turns to a liquid. Heating a solid below its melting point increases its kinetic energy and temperature that weakens the force of attraction between its particles.

Further heating does not increase the temperature because the heat provided here is being utilized to melt all the solid substance.



Melting of ice

Q.3: How does boiling convert a liquid into a gas?

Ans. Evaporation:

The molecules of a liquid keep on coming out from the surface of a liquid at all temperatures and such an escape of molecules from surface is called evaporation.

Heating the Liquid: Heating a liquid increases the kinetic energy of its molecules and so does the process of evaporation.

Heating the liquid further, increases the kinetic energy so much that the inter particle forces are weakened to a large extent. At this point the bubbles start coming out of the liquid at a rapid pace.

At this stage if the vapour pressure of the liquid becomes equal to the external pressure, the liquid starts boiling.

Boiling point: The temperature of a liquid at which its vapour pressure becomes equal to the atmospheric or external pressure is called its boiling point.

Conversion of a liquid into a gas: At the boiling point, the heat provided to the liquid is used to convert it into gaseous form and during this its temperature remains constant.

In other words, the heat provided is used only to break the forces of attraction between its particles.

Q.4: Explain conversion of a gas into its liquid.

Ans. Cooling of a Gas:

When a gas is cooled the kinetic energy of its molecules decreases, as a result the molecules come closer with a significant force of attraction between them.

Condensation: At a suitable lower temperature the increased attractions bring the molecules so close that they are changed into a liquid form. This is called condensation.

During this transition the temperature of the gas remains constant until all the gas is changed into its liquid.

14.3

Heating and Cooling Curves

14.4

Evaporation and Boiling

Q.5: Define heating and cooling curves. Explain the various stages of heating and cooling curves for a solid substance with the help of a graph.

Ans. Heating or Cooling curve:

It is a graph drawn between the internal energy and the temperature of a system showing the temperature changes as a substance is heated through its different states.

Explanation:

Point A: When a solid substance at a point A is heated, its temperature increases.

Point B: On attaining a specific temperature, it melts as shown by the point B.

This point represents the melting point of the given solid.

Line B to C: Further heating does not increase the temperature because the heat provided here is being utilized to melt all the solid substance as represented by the line B to C.

Point C to D: When all the solid converts into the liquid the temperature starts rising again as shown in the graph for the points C to D.

Point D: At the temperature corresponding to point D the liquid starts boiling. This represents the boiling point of the liquid.

Line D to E: Again further heating does not increase the temperature till the whole liquid is converted into gas.

A line D to E in figure shows no further rise in the temperature.

Point E: The temperature again starts rising after the point E.

Steps A to F: The curve represented by the steps A to F is called a heating curve.

Cooling Curve:

It is a graph drawn between the internal energy and the temperature of a system, showing the temperature changes as a substance is cooled through its different states in reverse (e.g. from a gas to a liquid or a liquid to a solid).

Explanation

Point F: When the gas present at the point F is cooled its temperature starts decreasing.

Point E: At the point E it starts converting into a liquid.

This is called the condensation point or liquefaction point and it represents the same temperature as the boiling point.

The temperature will however remain constant during this process of condensation or liquefaction.

Point C: Further cooling will convert the liquid into solid at the point C which is called the freezing point and it represents the same temperature as the melting point.

The line C to B shows that the process of cooling is converting all the liquid into solid state at constant temperature.

Lines B to C and D to E: Lines B to C and D to E show that here the given energy is being utilized to change the phase from solid to liquid and from liquid to gas respectively.

Q.6: Draw heating curve for the physical changes water undergoes with change in temperature.

Ans. Heating Curve for water at 0°C (Melting Point):

For water a heating curve will show the rise of temperature of ice until it reaches 0°C (melting point) then it remains constant while the ice melts into liquid water.

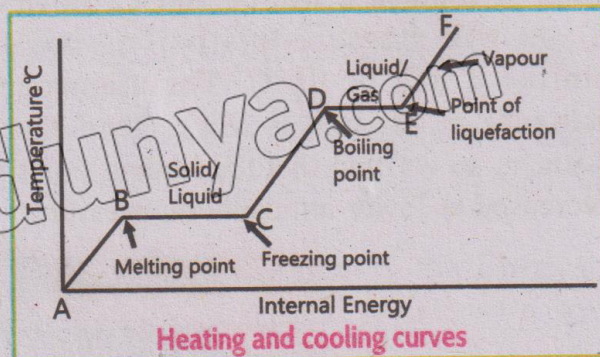
100°C (Boiling Point):

Further heating will increase the temperature again until it reaches 100°C (boiling Point). At this point it remains constant while the liquid water is converted into steam.

Cooling Curve for water:

100°C (Condensation): A cooling curve for a water will show the temperature of the steam decreasing until it reaches 100°C, it then remain constant while the steam condenses into liquid water.

0°C (Freezing): The temperature decreases again until it reaches 0°C. Finally it remains constant while the liquid water changes to ice.



Q.7: Differentiate between evaporation and boiling.

Ans.

Evaporation	Boiling
(i) It is a surface phenomenon. It occurs slowly and only at the surface of the liquid.	(i) A phase change when a liquid turns into a gas throughout the entire liquid forming bubbles, at a definite external atmospheric pressure.
(ii) It occurs at all temperatures but below the boiling point. It increases with increase in temperature and vice versa.	(ii) It occurs at a specific temperature at normal pressure and called the boiling point.
(iii) It produces cooling.	(iii) It does not result in cooling.
(iv) It requires a smaller amount of energy which is provided from inside the liquid.	(iv) It requires an external energy source.

Q.8: Describe effect of external pressure on the rates of evaporation and boiling.

Ans. Effect of External pressure on the Rate of Evaporation and boiling:

Rate of evaporation tends to increase by the decrease in external pressure and vice versa.

Explanation: If a liquid is in an open container, most of the molecules that escape into the vapour phase will not return to the liquid phase. Instead, they will diffuse through the atmosphere away from the container.

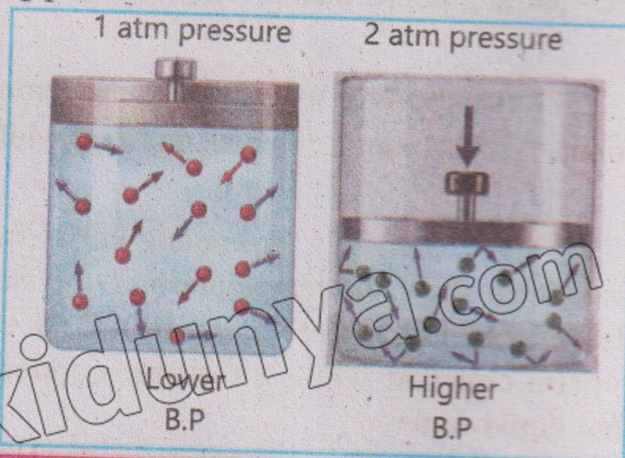
Increasing the External pressure: Increasing the external pressure will force these molecules to return back to the liquid surface making evaporation difficult.

Boiling: When a liquid boils, bubbles are formed inside the container, which then rise to the surface. At this stage, the temperature of the liquid remains constant till all the liquid boils over. This temperature is called the boiling point.

At lower Atmospheric pressure:

The boiling point decreases at lower atmospheric pressure and vice versa.

Example: If we measure the boiling point of water at Karachi it will be 100°C . However, if you will measure this boiling point at Murree it will be 98°C . The atmospheric pressure at Murree is lower than that in Karachi, so we find that the boiling point has decreased at lower atmospheric pressure.



14.5

Sublimation

14.6

Applications of Sublimation

Q.9: Write a note on sublimation and deposition.

Ans. Sublimation:

The direct conversion of a solid to vapours without melting is called sublimation.

Explanation: Just like evaporation, the energy needed for sublimation also comes from within the substance which then absorbs energy from the surrounding. This energy is sufficient to overcome the attractive forces of the neighbouring molecules which then escape into the vapour phase.

Examples:

- Solid carbon dioxide which is also called dry ice, changes directly to gaseous carbon dioxide at room temperature without first melting to liquid state.
- Disappearance of naphthalene balls which are used to keep the insects away from the woolen clothes.

Deposition: The process reverse to sublimation is called deposition, where a gas changes directly to a solid without going into the liquid state.

Example: Formation of frost in winter season is an example of deposition.

Q.10: How does the process of sublimation helpful in printing and in the usage of air freshner?

Ans. Solid Air Freshner:

The process of sublimation is used in the working of air fresheners. Solid air fresheners contain a scented substance which may evaporate with or without heating. The scented substance undergoes sublimation and disperse scented vapours throughout the room and mask unpleasant odours.

Explanation: When a solid air freshener is exposed to the atmosphere or heated in the air, its solid particles gain enough energy to overcome the attractive forces holding them together in the solid state. These particles then spread in the nearby atmosphere in the form of sweet smelling vapours.

Sublimation Printing: When the process of sublimation is used to print a design into a material or fabric, it is called sublimation printing.

Explanation: Essentially the process involves printing that transfers a design into a fabric using ink and heat.

In sublimation printing the first step is to print a design onto a special paper using sublimation inks.

The printed paper is then placed onto a fabric and heat and pressure are applied. The inks used are converted into vapours.

The printing is permanent which does not fade away with time because the ink is embedded in the fabric rather than simply attaching with the top of the fabric in a normal printing.

The heat supplied during the process opens up the pores present in the fabric, the ink enters into these pores under applied pressure, cools down and returns to a solid form.

Importance of Sublimation Printing:

The method is popular for print on demand t-shirts and it is also available on ceramic, wood and metal that have a special coating on to receive the inks which are sublimed.

14.7

Kinetic Theory and the Gas Laws

14.8

Diffusion

14.9

Importance of Rates of Diffusion of Medicines in Human Body

Q.11: State Boyle's law and explain the relationship between the pressure and volume of a gas on the basis of "Kinetic Molecular Theory".

Ans. Boyle's Law:

The law states that the volume of a given mass of a gas is inversely proportional to its pressure at constant temperature

Mathematical Expression:

Mathematically Boyle's law is written as:

$$V \propto \frac{1}{P}$$

Where

V is the volume of given mass of gas P is its absolute pressure.

Explanation: According to kinetic theory, the pressure exerted by the gas in a container is caused by the collisions of its molecules with the walls of the container.

The pressure changes directly with the number of molecules colliding with the wall per unit of time.

Increased Pressure: When the pressure on the given mass of a gas is increased at constant temperature it will decrease the distance between its molecules and the volume of gas will also decrease.

Reducing Volume: If the volume of the gas will be reduced to one half of its original volume, it will double the number of molecules per unit of volume. Hence the number of collisions per unit of time on the same area of the surface will also be doubled. As a consequence of these collisions, the pressure of the gas will also be doubled.

Q.12: Describe an experimental verification of Boyle's law.

Ans. Experimental verification of Boyle's Law:

Robert Boyle proved the pressure-volume relationship by performing a simple experiment.

Robert Boyle used a simple J-shaped tube and sealed its shorter limb. He then poured a small amount of mercury through its open end until it just trapped the air in the sealed end.

Since he used a small amount of mercury it did not squeeze the air inside the limb and it was now at atmospheric pressure (760 mm Hg).

Boyle then added more mercury until the difference in the height of the two columns of mercury was close to 760 mm.

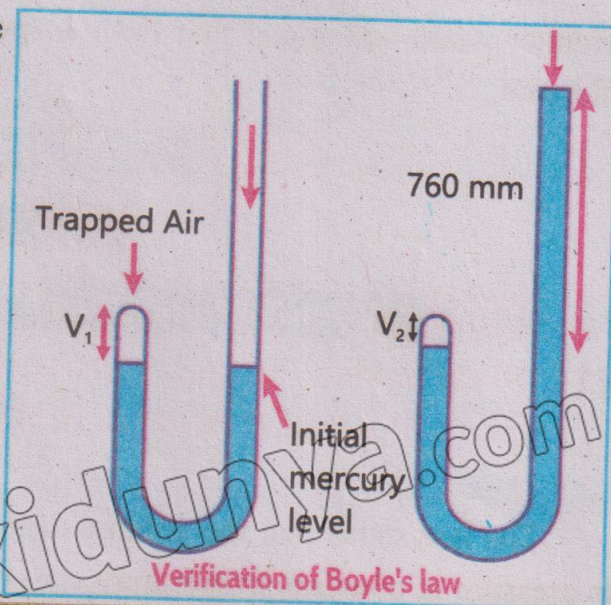
This mercury exerted the extra pressure on the entrapped air which was now about 2 atmosphere (2×760 mm).

When he read the new volume of the entrapped air it was one half of the initial volume.

Conclusion:

During the experiment the mass of the gas remained fixed and the temperature also did not change.

By doubling the pressure, Boyle had reduced the volume by one half.



Q.13: State Charles's Law and explain, using kinetic theory, why the volume of a gas increases when it is heated at constant pressure?

Ans. Charles's Law:

The law states that the volume of a given mass of a gas varies directly with temperature when pressure is kept constant. The temperature must, however, be measured on absolute or Kelvin scale.

Mathematical Expression:

Mathematically Charles's law is written as:

$V \propto T$ (P and mass of gas are kept constant).

Explanation: According to kinetic theory, if temperature of a gas increases, it increases the average speed and kinetic energy of its molecules.

An increase in average speed results in more frequent and harder collisions with the walls of the container and hence its pressure increases.

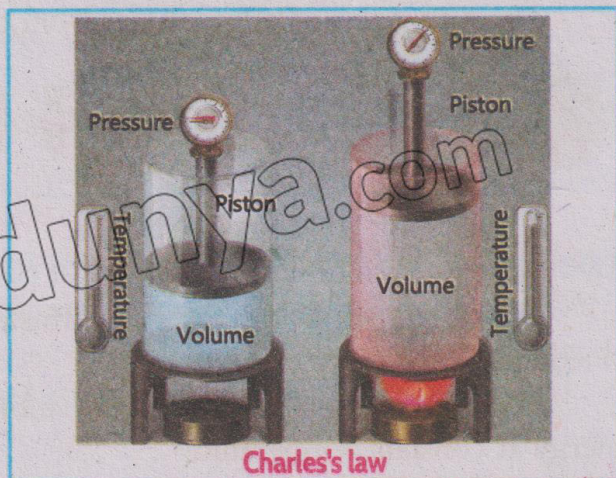
If the pressure of the gas is kept constant, the increase in the temperature must increase the volume of the gas.

Experimental verification (The Piston Experiment):

Charles's law may be visualized easily if a gas is taken in a cylinder to which a piston is attached.

Heating a Gas:

When the gas is heated the piston must move up to increase the volume if the pressure is to remain constant.



Q.14: State Avogadro's law. Explain the relationship between the number of gas particles and the pressure they exert.

Ans. Avogadro's Law:

The law states that equal volumes of different gases must contain an equal number of molecules if the temperature and pressure are kept constant.

Mathematical Expression:

Mathematically Avogadro's law is written as:

$V \propto n$ (at constant temperature and pressure)

Explanation: According to kinetic theory, the pressure exerted by a gas is due to the number of collisions of its particles per unit area. This in turn, depends upon the number of particles and their speed.

If you have two containers containing the same amount of a gas at the same temperature and pressure, and you increase the amount of gas in one container. Naturally the pressure of the gas in this container will increase.

To keep the pressure constant the volume of the gas must increase. This larger

volume compensates for the increased number of particles, ensuring the pressure remains the same.

Conclusion: Therefore, at constant temperature and pressure, a greater number of molecules simply requires a larger volume to maintain the same pressure.

Q.15: Explain the difference in the rates of diffusion of two gases based on kinetic theory.

Ans. Molecules present in gases are in a constant state of random motion. Due to this molecular motion the gas particles spread out and intermix from an area of high concentration to an area of low concentration. This property of gases is called diffusion.

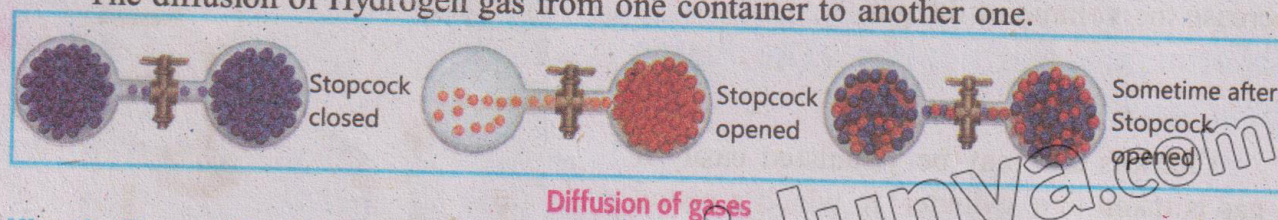
Example: When a bottle of body perfume is opened in one corner of a room its sweet smell slowly spreads throughout the room after sometime due to the process of diffusion.

Spontaneous Process:

Diffusion is a spontaneous process during which gas particles spread out.

Diffusion of Hydrogen Gas:

The diffusion of Hydrogen gas from one container to another one.



Kinetic Theory Explaining Diffusion of Gases:

The difference in the rates of diffusion of gases can be explained with the help of kinetic particle theory of gases.

According to the kinetic theory molecules of all the gases possess some kinetic energy at constant temperature.

Since Hydrogen is lighter than Oxygen its molecules will move faster than Oxygen at a given temperature. The rate at which Hydrogen gas will diffuse is thus much faster than that of Oxygen.

Increase in Rate of Diffusion: Rate of diffusion increases with the increase in temperature as the particles have more kinetic energy and hence they move faster. This eventually leads to rapid mixing and spreading.

Q.16: Prove with an experiment that different gases diffuse at different rates.

Ans. Apparatus:

- Two cotton plugs
- A glass long tube
- chloride gas
- Ammonia Solutions

Procedure: Two cotton plugs soaked in hydrogen chloride gas and ammonia solutions are introduced in the open ends of a 100cm long glass tube simultaneously.

Observation: The two gases produce white dense fumes of ammonium chloride at the point at which they meet in the tube. HCl molecules travel a distance of 40.5 cm while ammonia molecules cover 59.5 cm in the same duration.

Conclusion: Thus ammonia diffuses faster than hydrogen chloride gas because it is lighter than hydrogen chloride gas.



Rates of diffusion of gases

Q.17: Discuss importance of rates of diffusion of medicines in human body.

Ans. Diffusion:

The tendency of the molecules contained in a medicine to move from a region of higher concentration to one of lower concentration is called diffusion.

Diffusion Rates of Medicines: The diffusion rates of medicines control how rapidly and effectively they can be absorbed, distributed and eliminated from the body.

When the medicines are taken orally, the rates of their diffusion between the stomach and intestine control how quickly they are absorbed in the blood.

A faster diffusion rate means early absorption and hence a faster onset of action.

Effectiveness of Drug: Once the drug molecules are absorbed by the blood, they start diffusing into various tissues and organs. The rate of diffusion into various tissues and organs. The rate of diffusion here determines how quickly the drug becomes effective.

Example: Lipid soluble drugs diffuse more easily through cell membranes, making them more effective in shorter time.

More Effective Response:

Generally, a faster rate of diffusion leads to higher drug concentration at its target organ which means a more effective response.

Importance of Rates of Diffusion of Medicines in Human Body:

- Rates of diffusion play a crucial role in the delivery and movement of drugs throughout the body.
- Diffusion ensures that essential substances reach their target locations quickly which eventually helps in the treatment of diseases.

14.1 Quick Check!

1. What is translational motion?

Ans. Translational Motion:

It is a kind of motion in which molecules can move from one place to another in the same or different direction but always remains on the same axis.

2. Is the average kinetic energy possessed by the particles of a gas and a liquid same at the same temperature?

Ans. Yes, the average kinetic energy possessed by the particles of a gas and a liquid are same at the same temperature.

14.2 Quick Check!

1. Why do water vapour at 100°C cause more severe burns as compared to liquid water at the same temperature?

Ans. When you boil water, the temperature stays at 100°C even though you keep heating. That extra heat (energy) is used to pull the water particles apart so they can become water vapour (gas). When water vapour hits your skin, it turns back into liquid and dumps all that extra heat (energy) onto you instantly.

2. Why do we feel comfortable wearing cotton clothes in summer?

Ans. Cotton is a natural fiber. It absorbs sweat from your body very easily. It is because it has tiny pores that let air reach the sweat. When the sweat evaporates (turns into gas) off the cotton, it carries the heat away from your skin, keeping your skin dry and cool. So you feel comfortable wearing cotton clothes in summer.

14.3 Quick Check!

1. Does the change in temperature occur during the process of evaporation?

Ans. No. During the process of evaporation, the temperature of the substance stays the same because the heat is being used to change the state (from liquid to gas) rather than raising the temperature.

2. Does ice sublime?

Ans. Yes. In very cold and dry conditions, ice can turn directly into water vapour without melting into a liquid first.

3. Give one example each for sublimation and deposition other than mentioned in the text.

Ans. Example of sublimation.

Dry Ice:

This is solid carbon dioxide. When it is left out at room temperature, it turns directly into a smoky gas without ever becoming a liquid.

Dry Ice (Solid CO_2):

When carbon dioxide gas is cooled very quickly under pressure, it turns directly into solid blocks or snow.

14.4 Quick Check!

1. With the help of kinetic particle theory explain:

- (i) How does a gas exert pressure?

Ans. Gas particles are in constant, random motion. The pressure exerted by a gas is due to the collisions of its particles with the walls of the container.

- (ii) How does the volume of a gas change when its temperature is decreased? (Pressure and mass constant)

Ans. When the temperature is decreased, the particles lose energy and move slower. They stay closer together, which makes the volume of a gas smaller.

14.5 Quick Check!

1. Which gas among the following will diffuse at the fastest speed and which will diffuse at the slowest speed under similar conditions of temperature and pressure?

NO_2 , SO_2 , H_2S

Ans. Among the gases listed (NO_2 , SO_2 , H_2S), here is how they diffuse:

- H_2S will diffuse at the fastest speed
- SO_2 will diffuse at the slowest speed.

Reason

It is because, lighter gas particles move and spread out (diffuse) much faster than heavier ones. H_2S is the lightest of the three, while SO_2 is the heaviest

- (ii) Explain with the help of kinetic particle theory why does ammonia gas diffuse faster than hydrogen chloride gas?

Ans. Ammonia gas molecules are much lighter than hydrogen chloride gas.

According to the kinetic particle theory, at the same temperature, lighter particles move at higher average speed than heavier particles.

Because ammonia particles are moving faster, they spread through the air more quickly than the heavier, slower hydrogen chloride particles.

DO YOU KNOW?

Interconversion of physical states of matter may not be brought about by changing the temperature only. Sometimes their interconversion may be affected more conveniently by changing both the temperature and pressure at the same time or by varying the pressure only at constant temperature. For example, ice melts from pressure in the hands of a snowball maker. Ammonia gas can be liquefied at atmospheric pressure and at a temperature of -34°C . Alternatively, it can also be liquified by exerting a pressure 1 MPa and at room temperature (25°C).

INTERESTING INFORMATION

Phase change materials are used in thermal regulation, such as in clothing or building insulation, to store and release thermal energy.

THINGS TO KNOW

Molecules present in a gas and a liquid show all the three types of movements simultaneously namely, translational, rotational and vibrational.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

14.1

Internal Energy

14.2

Interconversion of Physical States

- According to the kinetic particle theory, what is the state of motion for particles in all matter?
 - Moving only when heated
 - Continuous and random
 - Stationary and fixed
 - Moving in a circular pattern
- Which type of motion is possessed by particles in a solid?
 - Random motion
 - Vibrational motion

- (c) Rotational motion (d) Translational motion
3. What happens to the average kinetic energy of gas particles if the temperature increases?
 (a) It decreases (b) It stays the same (c) It increases (d) It becomes zero
 4. Internal energy of a substance is the sum of which two types of energy?
 (a) Heat energy and light energy (b) Kinetic energy and potential energy
 (c) Nuclear energy and solar energy (d) vibrational energy and sound energy
 5. At the melting point:
 (a) The solid turns to a liquid (b) The liquid turns to a gas
 (c) The gas turns to a solid (d) The gas turns to a liquid
 6. What is the process called when a gas turns back into a liquid?
 (a) Boiling (b) Melting (c) Condensation (d) Evaporation
 7. At the boiling point the vapour pressure of the liquid is equal to:
 (a) zero (b) The internal energy
 (c) The melting (d) The atmospheric pressure
 8. Which state of matter has a fixed volume but no fixed shape?
 (a) Solid (b) Liquid (c) Gas (d) Plasma
 9. What happens to the movement of particles when a gas is cooled?
 (a) They repel each other more (b) They disappear
 (c) They move faster (d) Their kinetic energy decreases
 10. Which of these substances exists in three Physical states while its chemical nature remains exactly the same?
 (a) Oxygen (b) Iron (c) Carbon dioxide (d) water
 11. Which states of matter show all three types of movement simultaneously?
 (a) Solids and liquids (b) Only gases
 (c) Gases and liquids (d) Only solids
 12. Which state of the matter keeps its level and have a fixed volume?
 (a) Solid (b) Liquid (c) Gas (d) Plasma
 13. Which of the following movements do molecules of a gas and a liquid show?
 (a) Translational (b) Rotational (c) vibrational (d) All of these
 14. What is the name for the escape of molecules from the surface of a liquid at any temperature?
 (a) Condensation (b) Evaporation (c) Boiling (d) Melting
 15. When a gas is cooled and molecules come closer together, what is the result?
 (a) Condensation (b) Evaporation (c) Boiling (d) Melting

14.3

Heating and Cooling Curves

14.4

Evaporation and Boiling

16. When a solid substance is heated, its temperature
 (a) Increases (b) Decreases (c) Remains same (d) Becomes Zero
17. The condensation point is also called the
 (a) Melting point (b) Liquefaction point
 (c) Boiling point (d) Freezing point

18. During the process of condensation, the temperature
 - (a) Will increase
 - (b) Will decrease
 - (c) Remains constant
 - (d) Becomes zero
19. Which of the following represents the same temperature as the melting point?
 - (a) Boiling point
 - (b) Freezing point
 - (c) Condensation point
 - (d) None of these
20. Ammonia gas can be liquefied at atmospheric pressure and at a temperature of:
 - (a) -31°C
 - (b) -32°C
 - (c) -33°C
 - (d) 34°C
21. What is the boiling point of water in Murree as compared to Karachi?
 - (a) 102°C
 - (b) 100°C
 - (c) 98°C
 - (d) 75°C
22. If the external pressure is increased, the rate of evaporation.
 - (a) Also increases
 - (b) Decreases
 - (c) Remains constant
 - (d) Remains same
23. The process of a gas turning directly into a liquid is called.
 - (a) Sublimation
 - (b) Condensation
 - (c) Melting
 - (d) Boiling
24. At what temperature does the heating curve for water stay constant while a ice melts?
 - (a) 0°C
 - (b) 100°C
 - (c) 25°C
 - (d) 34°C
25. Which of the following is "Dry Ice"?
 - (a) Frozen ammonia gas
 - (b) Solid carbon dioxide
 - (c) Liquid nitrogen
 - (d) Frozen oxygen
26. Which of these factors increases the rate of evaporation?
 - (a) Increasing the surface area
 - (b) Decreasing the temperature
 - (c) Increasing external pressure
 - (d) Keeping the container closed
27. In Karachi the boiling point of water is:
 - (a) 25°C
 - (b) 50°C
 - (c) 75°C
 - (d) 100°C
28. When a gas is cooled the kinetic energy of its molecules.
 - (a) Decreases
 - (b) Increases
 - (c) Remains constant
 - (d) Becomes zero
29. The temperature of a liquid at which the vapour pressure of liquid becomes equal to the atmospheric pressure is called its:
 - (a) Melting point
 - (b) Boiling point
 - (c) condensation point
 - (d) Evaporation

14.5

Sublimation

14.6

Applications of Sublimation

30. The direct conversion of a solid to vapours without melting is called.
 - (a) Boiling
 - (b) Freezing
 - (c) Sublimation
 - (d) Condensation
31. What is the reverse process of sublimation called?
 - (a) Melting
 - (b) Deposition
 - (c) Freezing
 - (d) Boiling

32. Which substance is used to keep insects away from woollen clothes through sublimation?
 (a) Salt crystals (b) Naphthalene balls (c) sugar cubes (d) Dry ice
33. The formation of frost in winter is an example of which process?
 (a) Sublimation (b) Evaporation (c) Deposition (d) Condensation
34. Which process is used in the working of air fresheners?
 (a) Evaporation (b) Condensation (c) Deposition (d) Sublimation
35. Which two factors are applied to convert sublimation inks into vapour?
 (a) cold and light (b) Heat and pressure
 (c) water and air (d) light and heat
36. Sublimation printing can be done on fabric and.
 (a) Ceramic (b) Wood (c) Metal (d) All of these
37. What is the process called when a gas changes directly into a solid?
 (a) Deposition (b) Condensation (c) sublimation (d) Melting
38. Which of the following describes the formation of frost?
 (a) Evaporation (b) Melting (c) Sublimation (d) Deposition

14.7

Kinetic Theory and The Gas Laws

14.8

Diffusion

14.9

Importance of Rates of Diffusion of Medicines In Human Body

39. Mathematically Boyle's law is written as:
 (a) $V \propto T$ (b) $V \propto \frac{1}{P}$ (c) $V \propto T$ (d) $V \propto n$
40. How is Charles' law mathematically written?
 (a) $V \propto T$ (b) $V \propto n$ (c) $V \propto \frac{1}{P}$ (d) $V \propto P$
41. Which of the following is mathematically representation of Avogadro's law?
 (a) $V \propto \frac{1}{P}$ (b) $V \propto P$ (c) $V \propto n$ (d) $V \propto T$
42. The basis of pressure volume relationship first observed by.
 (a) Robert Boyle (b) Alexander Charles (c) Avogadro (d) Newton
43. According to Boyle's Law what happens to the volume of a gas when the pressure is doubled at a constant temperature?
 (a) The volume is doubled (b) The volume is reduced one third
 (c) The volume remains the same (d) The volume is reduced to one half
44. Charles' law states that at constant pressure, the volume of a gas is directly proportional to its.
 (a) Atmospheric pressure (b) Absolute (Kelvin) temperature
 (c) Number of moles (d) Celsius temperature
45. What happens to the rate of diffusion when the temperature is increased?
 (a) It remains constant (b) It decreases

- (c) It increases (d) It stops completely
46. In the human body medicines move from the stomach into the blood primarily through.
 (a) Compression (b) Active pumping (c) Diffusion (d) Evaporation
47. Diffusion occurs most rapidly in which state of matter?
 (a) Gas (b) Liquid (c) Solid (d) Plasma
48. If two containers have the same volume, temperature and pressure, Avogadro's Law says they must have.
 (a) Same number of molecules (b) Different speeds
 (c) Same mass of gas (d) Same chemical properties
49. Why does a scent (like perfume) spread across a room even if there is no wind?
 (a) Due to evaporation (b) Due to diffusion
 (c) Due to sublimation (d) Due to deposition
50. Which law explains why a football becomes flat or small in very cold weather?
 (a) Charle's law (b) Avagadro's law (c) Boyle's law (d) None of these
51. If you squeeze a balloon (decreasing its volume) at constant temperature, the pressure inside will.
 (a) Becomes Zero (b) Increases (c) Decreases (d) Remains constant
52. What happens to the pressure of a gas if the number of collisions with the walls increases?
 (a) The gas turns into a liquid (b) The pressure increases
 (c) The pressure stays the same (d) The pressure decrease
53. If you double the number of gas particles in a container while keeping T and P constant, what happens to the volume?
 (a) The volume is halved (b) The volume doubles
 (c) The volume triples (d) The volume stays the same
54. Lipid soluble drugs are often more effective because they call membrane they.
 (a) Diffuse more easily (b) Diffuse slowly
 (c) Evaporate quickly (d) Do not diffuse
55. In Boyle's experiment what was used to trap the air and apply pressure?
 (a) A piston (b) Mercury (c) Oil (d) Water

Answers

- | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (b) | 3. (c) | 4. (b) | 5. (a) | 6. (c) | 7. (d) |
| 8. (b) | 9. (d) | 10. (d) | 11. (c) | 12. (b) | 13. (d) | 14. (b) |
| 15. (a) | 16. (a) | 17. (b) | 18. (c) | 19. (b) | 20. (d) | 21. (c) |
| 22. (b) | 23. (b) | 24. (a) | 25. (b) | 26. (a) | 27. (d) | 28. (a) |
| 29. (b) | 30. (c) | 31. (b) | 32. (b) | 33. (c) | 34. (d) | 35. (b) |
| 36. (d) | 37. (a) | 38. (d) | 39. (b) | 40. (a) | 41. (c) | 42. (a) |
| 43. (d) | 44. (b) | 45. (c) | 46. (c) | 47. (a) | 48. (a) | 49. (b) |
| 50. (a) | 51. (b) | 52. (b) | 53. (b) | 54. (a) | 55. (b) | |

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

14.1

Internal Energy

14.2

Interconversion of Physical States

1. In which four physical states does matter exist in this world?

Ans. Matter in this world exists in four physical states namely gas, liquid, solid and plasma.

2. Properties of which state of matter were studied first?

Ans. Properties of gases were studied first.

3. What idea did lead to formulation of kinetic particle theory for gases?

Ans. It was suggested that physical properties of gases such as their ability to compress or expand, or diffuse could be understood by assuming that the gases consist of particles which are continuously moving randomly. This idea then led to formulation of kinetic particle theory of gases.

4. What does kinetic particle theory explain?

Ans. Kinetic particle theory explains:

- All the laws which govern the behaviour of gases.
- The composition of liquid and solid states of matter
- Interconversion of all three states.

5. What is the main idea of kinetic particle theory?

Ans. The main idea of kinetic particle theory is the all matter is made of particles that are always moving randomly.

6. What is kinetic particle theory?

Ans. Kinetic Particle Theory: It is a theory suggesting that all matter consists of particles that are in continuous random motion. It explain the properties of gases, liquids and solids, as well as their interconversion.

7. What is the main idea of kinetic particle theory?

Ans. The main idea of kinetic particle theory is that all matter is made of particles that are always moving randomly.

8. Give an example to support that all the three physical states are distinct in their physical properties only while their chemical nature remains the same.

Ans. All the three physical states are distinct in their physical properties only while their chemical nature remains the same.

Example: Water in all its three physical states remains chemically the same compound.

9. How does kinetic particle theory explain gas pressure?

Ans. According to kinetic particle theory the pressure exerted by a gas is due to the collisions of its particles with the walls of the container.

- 10. Why are attractive forces between gas particles assumed as negligible?**
Ans. Attractive forces between gas particles are assumed as negligible since the particles are widely apart at low pressure.
- 11. Why do the particles of liquid have not any fixed position and shape?**
Ans. The particles in a liquid are quite close to one another. They are also moving in all directions. As a result, the particles of liquid do not have any fixed position and shape.
- 12. Why does a liquid have a fixed volume?**
Ans. Owing to the presence of interparticle forces, a liquid has a fixed volume and it keeps its level as well.
- 13. What kind of movement do the particles in a liquid show?**
Ans. In a liquid, the particles show all the three types of movements namely.
● Translational ● Rotational ● Vibrational
- 14. Why is it assumed that the collisions between gas particles do not involve any loss or gain of energy due to friction?**
Ans. Since the pressure of a gas in a container does not change with time at constant temperature, it is assumed that the collisions between its particles do not involve any loss or gain of energy due to friction.
- 15. What is the relationship between temperature and kinetic energy in gases?**
Ans. The average kinetic energy of the particles is directly proportional to the temperature measured on kelvin scale.
- 16. Compare the movement of particles in solids and liquids.**
Ans. In solids, particles only possess vibrational motion in fixed positions.
Liquids: In liquids, particles move in all directions and show three types of movement namely, translational, rotational and vibrational.
- 17. Is the average kinetic energy the same for all gases at the same temperature?**
Ans. Yes, the average kinetic energy is the same for all gases at the same temperature.
- 18. At what scale is the temperature of a gas measured to find its kinetic energy?**
Ans. According to kinetic particle theory, the particles in the solid substances are so strong that they keep their particles arranged in a fixed position.
- 19. What solids may consist of?**
Ans. Solids may consist of ion, atoms and molecules.
- 20. What is the only type of motion particles have in a solid?**
Ans. The particles of solid possess vibrational motion only.
- 21. Name the three types of movements shown by gas and liquid particles.**
Ans. Gas and liquid particles show three types of movements namely translational, rotational and vibrational.
- 22. What is internal energy of a substance?**
Ans. The internal energy of a substance is the total energy it contains. It includes the kinetic energy of its particles and the potential energy due to bonding between them.
- 23. What two types of energy make up internal energy?**
Ans. Kinetic energy of particles of a substance and the potential energy due to bonding

between them make up internal energy.

24. What is the impact of heat on the internal energy of a system?

Ans. Heat increases the internal energy of a system.

25. How can the physical state of a solid substance be changed?

Ans. The physical state of a solid substance can be changed by simple heating.

26. Define melting point.

Ans. Melting point: At a particular temperature the vibrational motion of solid particles becomes so fast that it overcomes the cohesive forces. As a result the solid starts melting and this temperature is called the melting point of the solid.

27. Why does solid turn into a liquid at the melting point?

Ans. At the melting point, the particles of a solid not only lose their mean positions but the arrangement as well. The solid collapses and turns to a liquid.

28. Define evaporation.

Ans. Evaporation:

The molecules of a liquid keep on coming out from the surface of a liquid at all temperatures and such an escape of molecules from surface is called evaporation.

29. What is the difference between boiling and evaporation?

Ans. Boiling occurs throughout the liquid at a specific temperature (boiling point), while evaporation occurs only at the surface and at any temperature.

30. Define boiling point.

Ans. Boiling point: The temperature of a liquid at which its vapour pressure becomes equal to the atmospheric or external pressure is called its boiling point.

31. What is condensation?

Ans. Condensation: At a suitable lower temperature the increased attractions bring the molecules so close that they are changed into a liquid form. This is called condensation.

32. Why does a temperature remain constant during condensation?

Ans. During condensation, as particles come together and form bonds/attractions energy is released, which keeps the temperature constant until the entire gas has turned into a liquid.

33. What does heat do to the kinetic energy of the particles?

Ans. Heat increases the kinetic energy of the particles and they start vibrating at a higher frequency.

34. Why doesn't the temperature rise while a solid is melting?

Ans. The temperature doesn't rise while a solid is melting because the heat energy is being used to weaken the force of attraction between the particles instead of raising the temperature.

35. What is the difference between vapour pressure and atmospheric pressure at the boiling point?

Ans. At the boiling point vapour pressure and atmospheric pressure are equal to each other.

36. What is a heating curve?

Ans. Heating curve: It is a graph drawn between the internal energy and the temperature of a system, showing how the temperature changes as a substance is heated through its different states.

37. What is a cooling curve?

Ans. Cooling curve: It is a graph drawn between the internal energy and the temperature of a system, showing how the temperature changes as a substance is cooled through its different states in reverse (e.g, from a gas to a liquid, or a liquid to a solid)

38. Define condensation point or liquefaction point.

Ans. Condensation point or liquefaction point:

It is the specific temperature at which a gas starts converting into a liquid during the cooling process for a pure substance, this is the same temperature as its boiling point.

39. Why does the temperature remain constant during the melting process?

Ans. The temperature remains constant during the melting process because the heat energy being provided is used to break the bonds between solid particles to convert them into a liquid, rather than increasing the kinetic energy of the particles.

40. How does external pressure affect the rate of evaporation?

Ans. Increasing the external pressure makes evaporation more difficult because it force gas molecules back towards the liquid surface. Conversely, a decrease in external pressure increases the rate of evaporation.

41. How are the rates of both evaporation and boiling affected?

Ans. Rates of both evaporation and boiling are affected by the variation in the external pressure to which the liquid is subjected.

42. What does happen to rate of evaporation by the decrease in external pressure?

Ans. Rate of evaporation tends to increase by the decrease in external pressure and vice versa.

43. Why is the boiling point of water lower in Murree (98°C) than in karachi (100°C)?

Ans. Boiling occurs when vapour pressure equals external pressure. The atmospheric pressure at Murree is lower than that in Karachi, So we find that the boiling point has dreceared at lower atmospheric pressure

44. Can a phase change occur without changing temperature?

Ans. Yes, by varying the pressure, a substance can change states at a constant temperature.

For Example:

1. Ice melts from pressure in the hands of a snowball maker.
2. Ammonia gas can be liquefied by exerting a pressure 1 MPa and at room temperature (25°C)

14.5

Sublimation

14.6

Applications of Sublimation

45. What is sublimation?

Ans. Sublimation:

The direct conversion of a solid to vapours without melting is called sublimation.

For example: Solid carbon dioxide which is also called dry ice, changes directly to gaseous carbon dioxide at room temperature without first melting to liquid state.

46. From where does the energy needed for sublimation come?

Ans. The energy needed for sublimation also comes from within the substance which then absorbs energy from the surroundings

47. Define deposition.

Ans. Deposition: The process reverse to sublimation is called deposition where a gas changes directly to a solid without going into the liquid state.

Example: Formation of frost in winter season.

48. Which process is used in the working of air fresheners?

Ans. The process of sublimation is used in the working of air fresheners

49. What is sublimation printing?

Ans. Sublimation printing: When the process of sublimation is used to print a design into a material or fabric, it is called sublimation printing.

50. What does sublimation printing involve?

Ans. The process of sublimation printing involves printing that transfers a design into a fabric using ink and heat.

51. From where does a substance absorb energy for sublimation?

Ans. A substance absorbs energy from its surrounding for sublimation.

52. Does sublimation printing stay on the top of the fabric?

Ans. No, the ink becomes embedded inside the pores present in the fabric.

53. Why does printing in sublimation printing not fade away with time?

Ans. In sublimation printing the printing is permanent which does not fade away with time because the ink is embedded in the fabric rather than simply attaching with the top of the fabric in a normal printing.

54. On what materials can sublimation printing be used?

Ans. Sublimation printing is commonly used for T-shirts, ceramics, wood, and metals that have a special coating to receive the inks which are sublimed.

55. Name two common substances that undergo sublimation.

Ans. Two common substances that undergo

• Dry ice

• Naphthalene balls.

56. What is used to protect woolen clothes from insects?

Ans. Naphthalene balls are used to protect woolen clothes from insects.

57. How do solid air fresheners work?

Ans. Solid air fresheners contain a scented substance which may evaporate with or without heating. The scented substance undergoes sublimation and disperse scented vapours throughout the room and mask unpleasant odours.

58. Why is sublimation printing considered permanent?

Ans. Unlike normal printing where ink sits on top, sublimation printing uses heat to open the pores of the fabric. The ink turns into vapours, enters the pores, and the solidifies inside the fiber as it cools.

59. What is "Dry ice"?

Ans. Dry ice is the common name for the solid carbon dioxide (CO_2).

60. What happens to naphthalene balls over time?

Ans. Naphthalene balls disappear over time because they sublime directly from a solid into a gas.

61. Does dry ice melt into a liquid at room temperature?

Ans. No, it changes directly into gaseous carbon dioxide.

62. What is a natural example of gas turning directly into a solid?

Ans. The formation of frost in winter is a natural example of gas turning directly into a solid.

63. What is needed to turn sublimation ink into vapour during printing?

Ans. Both heat and pressure are applied to turn sublimation ink into vapour during printing.

64. Can you use sublimation printing on metal?

Ans. Yes, as long as the metal has a special coating to receive the metal

14.7

Kinetic Theory and The Gas Laws

14.8

Diffusion

14.9

Importance of Rates of Diffusion of Medicines in Human Body

65. Define Boyle's law

Ans. Boyle's law: The law states that the volume of a given mass of a gas is inversely proportional to its pressure at constant temperature.

66. How is Boyle's law written mathematically?

Ans. Mathematically Boyle's law is written as:

$$V \propto \frac{1}{P}$$

V = The Volume of given mass of gas

P = Absolute pressure of gas.

67. According to kinetic theory what causes the pressure of a gas in a container?

Ans. According to kinetic theory, the pressure exerted by the gas in a container is caused

by the collisions of its molecules with the walls of the container.

68. What did Robert Boyle use to prove the pressure volume relationship?

Ans. Robert Boyle used a simple J shaped tube to prove the pressure volume relationship.

69. What did Robert Boyle use to pour the J shaped tube?

Ans. Robert Boyle poured a small amount of mercury in J shaped tube.

70. What is the relationship between temperature and molecular speed?

Ans. As temperature increases, the average speed and kinetic energy of the molecules also increases.

71. How does the pressure of the gas in a container change?

Ans. The pressure of the gas in a container changes directly with the number of molecules colliding with the wall per unit of time.

72. Who did observe the basis of pressure volume relationship first?

Ans. The basis of pressure volume relationship was first observed by an Irish chemist Robert Boyle.

73. State Charle's law

Ans. Charle's law: The law states that the volume of a given mass of a gas varies directly with temperature when pressure is kept constant.

74. How is Charle's law written mathematically?

Ans. Mathematically charle's law is written as

$$V \propto T$$

P and mass of gas are kept constant

75. Who did give the charle's law?

Ans. French scientist Jacques Alexander Charles gave the charle's law.

76. What is Avogadro's Law?

Ans. Avogadro's Law: The law states that equal volumes of different gases must contain an equal number of molecules if the temperature and pressure are kept constant.

77. How is Avogadro's law written mathematically?

Ans. Mathematically Avogadro's law is written as $V \propto n$ (at constant temperature and pressure).

78. Explain the relationship between the number of molecules and volume.

Ans. At constant temperature and pressure, adding more gas molecules increases the number of collisions. To maintain the same pressure, the volume must increase to provide more space for the additional particles.

79. Define diffusion

Ans. Diffusion: Molecules present in gases are in a constant state of random motion. Due to this molecular Motion the gas particles spread out and intermix from an area of high concentration to an area of low concentration. This property of gases is called diffusion

80. How does the temperature affect the rate of diffusion?

Ans. Rate of diffusion increases with the increase in temperature as the particles have

more kinetic energy and hence they move faster. This eventually leads to rapid mixing and spreading.

81. Why does Ammonia (NH_3) diffuse faster than Hydrogen chloride (HCl)?

Ans. According to kinetic theory at the same temperature lighter molecules move faster than heavier ones.

Since Ammonia is lighter than Hydrogen chloride, it diffuses faster.

82. How does a gas exert pressure?

Ans. Gas pressure is caused by the continuous collisions as gas molecules with the walls of their container.

83. Why is diffusion important for medicines in the human body?

Ans. Diffusion is important for medicines in the human body because the process of diffusion ensures that essential substances reach their target locations quickly which eventually helps in the treatment of diseases.

84. What is spontaneous process in diffusion?

Ans. It means the gases mix on their own naturally without aid of any external force or energy to be applied.

85. How do medicines move from the stomach to the blood?

Ans. Medicines move through the process of diffusion traveling from an area of high concentration (stomach) to low concentration (blood)

86. What do the diffusion rates of medicine control?

Ans. The diffusion rates of medicine control how rapidly and effectively they can be absorbed, distributed and eliminated from the body.

87. What does make lipid soluble drugs more effective?

Ans. Lipid soluble drugs diffuse more easily through cell membranes, making them more effective in shorter time.

88. What does happen once the drug molecules are absorbed by the blood?

Ans. Once the drug molecules are absorbed by the blood, they start diffusing into various tissues and organs.

89. Why the rate at which hydrogen gas diffuses is much faster than oxygen?"

Ans. Since hydrogen is lighter than oxygen its molecules will move faster than oxygen at a given temperature, the rate at which hydrogen gas will diffuse is thus much faster than that of oxygen.

Exercise Questions (Solved)

A. Multiple Choice Questions

☆ Choose and tick the correct answer from the given choices.

1. According to kinetic theory, the basic difference between solid, liquid and gas is due to:

- (a) the difference in the movements of the particles.
- (b) the chemical properties of the particles.
- (c) the size of the particles.
- (d) the shape of the particles.

- Upon heating the rate of evaporation:
- (a) decreases (b) increases (c) remains the same (d) initially decreases and then increases upon further heating
 3. The inter-particle attractions are the strongest in:
 - (a) Solids (b) Liquids (c) Plasma (d) Gas
 4. Cooling the vapours of some gases change them directly into solid state. This phenomenon is called:
 - (a) evaporation (b) condensation (c) sublimation (d) deposition
 5. Physical state in which the particles possess the maximum energy:
 - (a) Solid (b) Liquid (c) Gaseous (d) Vapour
 6. How does the process of evaporation depend on the force of attraction present among the molecules of a liquid?
 - (a) It decreases with the increasing strength of attraction.
 - (b) It increases with the increasing strength of attraction.
 - (c) It is independent of the strength of the force of attraction.
 - (d) It first increases and then decreases with the increasing strength of the force of attraction.
 7. Which gas will diffuse at the fastest rate?
 - (a) HCl (b) SO₂ (c) H₂S (d) CO₂
 8. The phase changes A and B in gas $\xrightarrow{A}$ liquid $\xrightarrow{B}$ solid are:
 - (a) Melting, evaporating (b) Condensation, melting
 - (c) Condensation, freezing (d) Boiling, freezing
 9. A student noticed frost falling on the ground at 6.30 am and disappearing by 8.30 am. Which phase change was responsible for changing the frost into water vapours?
 - (a) Melting (b) Evaporation (c) Sublimation (d) Sublimation

Answers

1. (a) 2. (b) 3. (a) 4. (d) 5. (c) 6. (a) 7. (c)
8. (c) 9. (c)

B. Short Answer Questions

14.1 From where does the energy come when a liquid evaporates?

Ans. When a liquid evaporates, the energy comes from the surroundings and the liquid itself. During evaporation, the surface molecules absorb heat energy from the rest of the liquid and the surroundings to overcome the atmospheric pressure and the attractive forces of other molecules and escape into the air.

14.2 Is condensation an endothermic process?

Ans. No. Condensation is an exothermic process. In condensation, gas molecules lose heat energy to their surroundings as they slow down and move closer together to form a liquid.

14.3 Why naphthalene balls (used to repel insects) disappear after sometime?

Ans. Naphthalene balls disappear after sometime due to a process called sublimation.

This is a process where a solid changes directly into a gas without passing through the liquid state. The solid naphthalene molecules gain enough energy from the air to escape directly as vapours and disappear.

14.4 Why does the temperature remain constant during a phase change?

Ans. The temperature remains constant during a phase change because during a phase change the heat energy supplied is used to break the intermolecular bonds (overcoming the forces of attraction) better than increasing the kinetic energy of the particles (which would raise the temperature)

14.5 Is it possible to compress a liquid like a gas?

Ans. No. Liquids are considered incompressible. In a gas, there are large empty spaces between particles, but in a liquid, particles are already packed very closely together with almost no space to be pushed further.

14.6 Can you change the temperature at which water boils in an experiment in your lab?

Ans. Yes, The boiling point of water depends on atmospheric pressure.

- If you decrease the pressure (using a vacuum pump), water will boil at a temperature lower than 100°C
- If you increase the pressure (like in a pressure cooker), the boiling point increase.

14.7 In which season the wet clothes get dry after a relatively longer time?

Ans. Wet clothes take longer time to dry in Monsoon (Rainy) season. This is because the air is already saturated with moisture (high humidity), which slows down the rate of evaporation from the clothes.

14.8 When a solid is heated, what happens to its particles which are vibrating?

Ans. When heated, the particles gain kinetic energy and their vibrations become more rapid and vigorous. Eventually, the vibrations become strong enough to overcome the rigid bonds of the solid, leading to melting.

14.9 Do solids and liquids also diffuse just like gases?

Ans. Yes Solids and liquids also diffuse just like gases but much more slowly.

Example:

If you write on a chalkboard and leave it unclean for months, it becomes difficult to erase. This is because some particles of the chalk have diffused into the surface of the board.

14.10 Why dew is formed in the early hours of the morning?

Ans. At night, the ground and objects cool down. In the early morning, the air near these cold surfaces cools to its dew point (the temperature at which it is saturated with water vapour). The air can no longer hold all its water vapor, so the excess vapour condenses into water droplets on cold surfaces like grass or leaves

C. Constructed Response Questions

14.1 Differentiate between evaporation and boiling.

Ans. For answer see Q7.

14.2 Describe how boiling is related to the external pressure?

Ans. Boiling occurs when the vapor pressure of the liquid equals the external pressure

Lower External pressure:

When external pressure is lower, the boiling point decreases.

For Example: Water boils at a lower temperature on a mountains because the atmospheric pressure there is lower.

Higher External pressure:

When external pressure is higher, the boiling point increases.

For example: In a pressure cooker, by increasing internal pressure, water boils at a higher temperature, cooking food faster.

14.3 Why the process of evaporation does not need the input of energy?

Ans. Evaporation does not need the input of energy (heat) because it relies on the energy from its surroundings or on the kinetic energy that water molecules already possess at room temperature.

14.4 Why the heating and cooling curves for the phase changes adopt the same path?

Ans. The heating and cooling curves for the phase changes adopt the same path because.

- The heat required to break molecular bonds during heating is exactly equal to the energy released when those bonds reform during cooling.
- Under the same pressure conditions, a substance will melt and freeze at the same temperature (and boil and condense at the same temperature).

14.5 Why ice melts when the pressure is exerted on it?

Ans. Water is denser as a liquid than it is as solid ice.

When you exert pressure on ice, you force the molecules closer together, to collapse into a liquid.

14.6 Why do phase changes occur?

Ans. Phase changes happen because of changes in heat energy. This energy affects how particles behave.

D. Descriptive Questions**14.1 Explain the difference in the rates of diffusion of two gases based on kinetic theory.**

Ans. For answer see Q 15.

14.2 How does the process of sublimation helpful in printing and in the usage of air freshner?

Ans. For answer see Q 10.

14.3 Draw heating curve for the physical changes water undergoes with change in temperature.

Ans. For answer see Q 6.