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UNIQUE NOTES

CHEMISTRY 10

Prepared for the Session 2026-27
According to the New Curriculum of PECTAA 2025-26

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Letter from the Research & Development (R&D) Department

Dear Respected Educators,

- It gives us great pleasure to present the sample chapter of our newly developed notes for the academic session 2026–27.
- These notes have been prepared with dedication and careful planning by our Research & Development team in line with the latest curriculum requirements.
- Designed to meet modern educational standards and student needs, these notes include accurate textbook solutions, additional questions, exam-focused practice material, and clear explanations to support excellent results.
- We believe that quality guidance and smart preparation lead to student success. Therefore, these notes aim to help students excel academically and compete for top positions.
- We are pleased to share this first chapter so your institution may begin planning and preparation while the complete books are being finalized.
- We sincerely hope these notes will prove valuable for your teachers and students. Your trust continues to inspire us to maintain the highest standards of educational excellence.

With best regards,

Ziyad Khan
Principal
Research & Development Department

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Chapter 14

STATES OF MATTER AND PHASE CHANGES

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DESCRIPTIVE QUESTIONS

Q.1 What are states of matter? How kinetic particles theory explain states of matter? 10214001

Ans. Key points: States of Matter | Motion of Molecules | Kinetic Particle Theory

States of Matter

Matter in this world exists in **four physical states** namely gas, liquid, solid and plasma. Out of these four states the properties of gases were studied first.

Motion of molecules

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.

Kinetic particle theory

- Concept of the continuous movement of particle then led to formulation of **kinetic particle theory** for gases.
- 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 and the **interconversion** of all the 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.

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

Q.2 What does kinetic particles theory explain about gases? 10214002

Ans. Key point: Kinetic Particle Theory about Gases

Kinetic particle theory about gases

According to kinetic particle theory, gas molecules possess the following properties.

(i) Random motion: Gases are composed of particles which are in a continuous state of random motion in all the possible directions.

(ii) Pressure: The pressure exerted by a gas is due to the collisions of its particles with the walls of the container.

(iii) Collision of molecules: 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.

(iv) Forces of attraction: The attractive forces between the particles of a gas are assumed as negligible since the particles are widely apart at low pressure.

(v) Kinetic energy: The average kinetic energy of the particles is directly proportional to the temperature measured on kelvin scale. The average kinetic energy is the same for all gases at the same temperature.

Q.3 What does kinetic particle theory explain about liquids? 10214003

Ans. Key point: Kinetic Particle Theory about Liquids

Kinetic particle theory about liquids

According to kinetic particle theory, liquids exhibit following properties.

(i) Movement: The particles in a liquid are quite close to one another and are moving in all possible directions.

(ii) Shape: They are moving in all possible directions. As a result, the particles of a liquid do not have any fixed position and shape.

(iii) Volume: Owing to the presence of inter-particle forces, however, a liquid has a fixed volume and it keeps its level as well.

Things to Know

Q. Give names of types of motion in liquid and gases? 10214004

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

(iv) Types of movements: In a liquid, the particles show all the three types of movements.

Q.4 Describe kinetic particle theory about solids. 10214005

Ans. Key points: Solids | Kinetic Particle Theory about Solids

Solids

Solid substances may consist of ions, atoms and molecules.

Kinetic particle theory about solids

According to kinetic particle theory, solids exhibit following properties.

(i) Forces of attraction: The inter-particle forces in the solid substances are so strong that they keep their particles arranged in a fixed position.

(ii) Motion: These particles possess vibrational motion only.

(iii) Shape and volume: These restricted movements force solid substances to have a fixed shape and a fixed volume.

INTERNAL ENERGY

Q.5 What is internal energy? How it increases? 10214006

Ans. Key point: Internal Energy

Internal energy

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.

Heat increases the internal energy of a system.

14.1 Quick Check!

1. What is translational motion? 10214007

Ans. The motion of particle from one point to another in a straight line is called translational motion.

2. Is the average kinetic energy possessed by the particles of a gas and a liquid, same at the same temperature? 10214008

Ans. Yes, because average kinetic energy of particles of a gas and a liquid is directly proportional to the temperature measured on Kelvin scale so they possess same kinetic energy at the same temperature.

INTERCONVERSION OF PHYSICAL STATES

Q.6 What is interconversion of physical states of matter? Explain how solids can be converted into liquids? **10214009**

Ans. Key points: Interconversion of Physical States | Conversion of a Solid into a Liquid (Melting)

Interconversion of physical states

Physical states of matter can be interconverted to each other by adding or removing heat. It can also be done by changing both temperature and pressure.
Here we are discussing the change affected by heat only.

Conversion of a solid into a liquid (Melting)

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.
- At a particular temperature their vibrational motion 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.
- **Melting point:** *It is defined as the temperature at which a solid changes its state to become a liquid.*
- 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 figure 14.1.

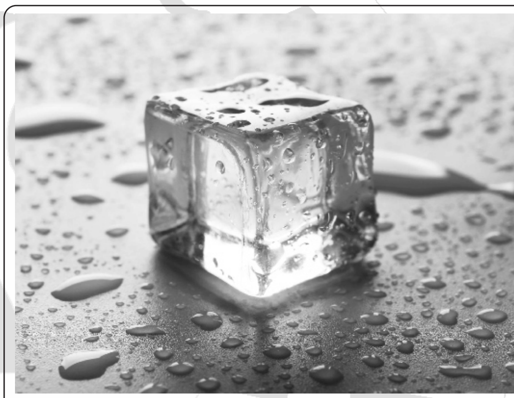

Fig 14.1: Melting of ice

Temperature remains constant at melting point

- Heating a solid below its melting point increases its kinetic energy and temperature that weakens the force of attraction between its particles.
- Further heating the solid after it has **started melting** does not increase its **temperature**. Instead, all the heat energy provided at this moment is utilized to convert the solid into its liquid.

Q.7 Explain how liquid is converted into gas and gas is converted into liquid? **10214010**

Ans. Key points: Conversion of a Liquid into a Gas | Conversion of a Gas into its Liquid

(i) Conversion of a liquid into a gas (Boiling)

When a liquid **boils** it turns into a gas. It may also take place by a phenomenon of evaporation that occurs at all **temperature**. *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**.*

Effect of heat on liquid state

- 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.*

Temperature remains constant after boiling point: 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.

(ii) Conversion of a gas into its liquid (Condensation)

- 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.
- *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.

Example: Rain is the natural example of condensation or liquefaction.

HEATING AND COOLING CURVES

Q.8 What are heating and cooling curves? Write a detailed note on heating curve by explaining its various segments. 10214011

Ans. Key points: Heating and Cooling Curves | Heating Curve

Heating and cooling curves

*Interconversion of physical states can also be understood with the help of a **graph** drawn between the **internal energy** and the temperature of a system. Such a graph is also called a **heating or cooling curve**.*

Figure 14.2 shows such a curve when a substance is heated or cooled.

Heating curve

A heating curve is a graph that shows how the temperature of a substance changes over time as heat is added. The graph is plotted between temperature and internal energy.

It consists of several distinct segments

(i) Segment A to B: When a solid substance at a point A is heated, its temperature increases. On attaining a specific temperature, it melts as shown by the point B in the figure 14.2. This point represents the melting point of the given solid.

(ii) Segment 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.

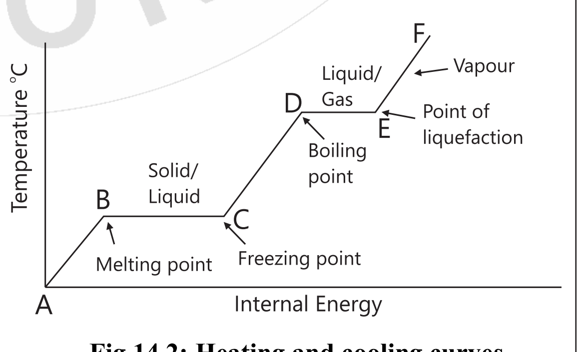

Fig 14.2: Heating and cooling curves

(iii) Segment 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. At the temperature corresponding to point D the liquid starts boiling. This represents the boiling point of the liquid.

(iv) Segment 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 the figure shows no further rise in the temperature.

(v) Segment E to F: The temperature again starts rising after the point E.

This curve represented by the steps from A to F is called a heating curve.

Q.9 Interpret a cooling curve, identifying its various parts. 10214012

Ans. Key point: Cooling Curve

Cooling curve

Cooling curves is the graph that shows how temperature of substance changes over time as heat is removed. The graph is plotted between temperature and internal energy. The same heating curve can be studied in the reverse direction from point F to A is called cooling curve. It has following parts or segment as shown in figure 14.2.

Interesting Information

S.Q Phase change materials are used in which fields? 10214013

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

(i) Segment F to E: When the gas present at the point F is **cooled** its temperature starts decreasing. 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.

(ii) Segment E to D: The temperature will however remain **constant** during this process of condensation or liquefaction.

(iii) Segment D to 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**.

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

(v) Segment B to A and below: The temperature of the solid decreases as it continues to lose heat. The kinetic energy of the particles decreases, causing them to vibrate less.

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? 10214014

Ans. Steam at 100°C causes more severe burns than water at 100°C because it releases additional latent heat of vaporization to the skin as compared to water at 100°C.

2. Why do we feel comfortable wearing cotton clothes in summer? 10214015

Ans. Cotton clothes are comfortable in summer because they absorb sweat and allow it to evaporate easily, removing heat from the body and producing a cooling effect.

Q.10 Draw heating curve for the physical changes water undergoes with change in temperature. **10214016**

Ans. Key point: Heating Curve for Water

<u>Heating curve for water</u>

A heating curve is a graph that shows how the temperature of water changes when heat is supplied to it.

It consists of several distinct segments or parts.

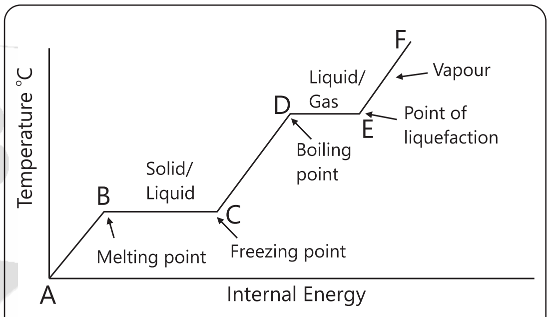

Fig 14.2: Heating and cooling curve of water

(i) Segment A to B – Heating of ice (Solid)

For water, a heating curve will show the rise of temperature of ice until it reaches 0°C (melting point).

(ii) Segment B to C – Melting (Solid $\rightarrow$Liquid)

It remains constant while the ice melts into liquid water.

(iii) Segment C to D – Heating of water (Liquid)

Further heating will increase the temperature again until it reaches 100°C (boiling point).

(iv) Segment D to E – Boiling (Liquid $\rightarrow$Gas)

At this point it remains constant while the liquid water is converted into steam.

(v) Segment E to F – heating of steam (Gas)

Temperature rises again. Gas particles move even faster, far apart with high kinetic energy.

Did you know?

S.Q How interconversion of physical states of matter is affected by changing temperature and pressure? **10214017**

Ans. 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.

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 liquefied by exerting a pressure **1MPa** and at room temperature (25°C).

Q.11 Explain cooling curve for water. **10214018**

Ans. Key point: Cooling Curve for Water

<u>Cooling curve for water</u>

The same graph of heating curve of water is studied in reverse order to show cooling curve.

It consists of several distinct segment or parts.

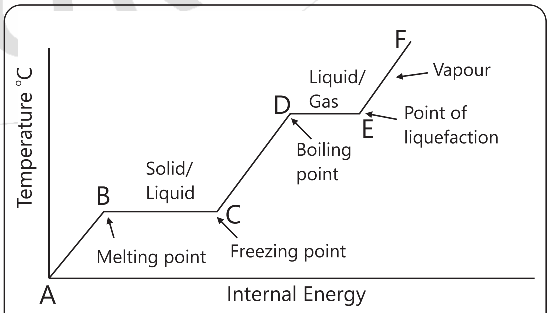

Fig 14.2: Heating and cooling curve of water

(i) Segment F to E: A cooling curve for water will show the temperature of the steam decreasing until it reaches 100°C.

(ii) Segment E to D: It then remains constant while the steam condenses into liquid water.

(iii) Segment D to C: The temperature decreases again until it reaches 0°C.

(iv) Segment C to B: Finally, it remains constant while the liquid water changes to ice.
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.

EVAPORATION AND BOILING

Q.12 What is evaporation? Give relationship between evaporation and boiling. 10214019

Ans. Key points: Evaporation | Relationship between Evaporation and Boiling

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**.

Explanation: When water is taken in an open container at normal **external pressure**, vapours start coming out of its surface silently and steadily. It is shown by the decrease in the level of water surface in the open container. It is called **evaporation** and it is known to occur at all **temperatures**.

Factors affecting: Temperature, intermolecular forces and surface area **affect** the rate of evaporation.

Relationship between evaporation and boiling

- Increasing the temperature of water increases the rate of evaporation because the number of water molecules **escaping** the surface also increases.
- The temperature will keep on increasing until a stage will come at which the water molecules acquire the **maximum** value of **kinetic energy** while in a liquid state.
- *The heat which is provided at this stage will be utilized to change the **liquid water** into **gaseous water** while keeping the temperature of water constant. This stage is called **boiling**.*
- The whole process is being carried out at constant atmospheric pressure.

Q.13 Differentiate between evaporation and boiling. 10214020

Ans. Key point: Difference of Evaporation and Boiling

Evaporation	Boiling
(i) It is a surface phenomenon. It occurs slowly and only at the **surface** of the liquid. **(ii)** It occurs at all temperatures but below the boiling point. It **increases** with increase in temperature and vice versa.	**(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 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.14 Describe the effect of external pressure on the rates of evaporation and boiling. **10214021**

Ans. Key point: Effect of External Pressure on the Rates of Evaporation and Boiling

Effect of external pressure on the rates of evaporation and boiling

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

Effect of external pressure on evaporation

- Rate of evaporation tends to **increase** by the **decrease** in external pressure and vice versa.
- 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 will force these molecules to return back to the **liquid surface** making evaporation difficult.

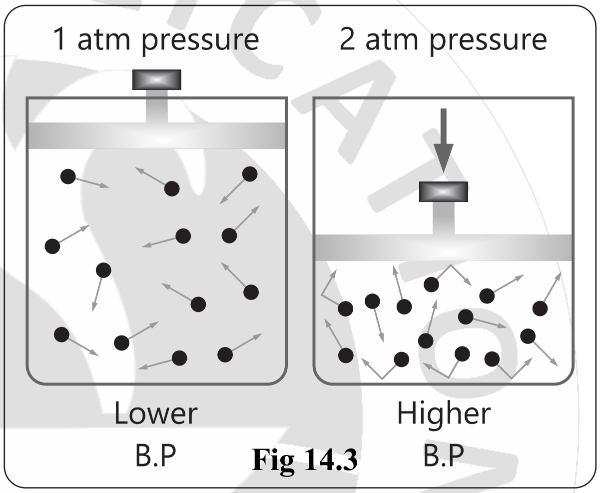

Fig 14.3

Effect of external pressure on boiling

External pressure effect directly on boiling of a liquid. 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**.

Example: If you 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 it is found that the boiling point has **decreased** at lower atmospheric pressure.

SUBLIMATION

Q.15 What is sublimation? Give examples. How is it related to deposition? **10214022**

Ans. Key points: Sublimation | Deposition

Sublimation

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

Conversion of solid into gaseous state without passing through a liquid phase is sublimation.

Examples: The examples of sublimation are:

(i) Dry Ice: Solid carbon dioxide which is also called dry ice, changes directly to gaseous carbon dioxide at room temperature without first melting to liquid state.

(ii) Naphthalene balls: Another common example of sublimation is the disappearance of **naphthalene balls** which are used to keep the insects away from the **woolen clothes**.

Energy for sublimation: 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.

Deposition (Gas to solid)

*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.

Relation of sublimation and deposition: Sublimation and deposition are **inversely related** to each other. Sublimation is the conversion of solid into gas and deposition is the conversion of gas into solid.

14.3 Quick Check!

1. Does the change in temperature occur during the process of evaporation? **10214023**

Ans. Yes, during evaporation the temperature of the liquid decreases because high – energy molecules escape reducing the **average kinetic energy** of the remaining molecules and thus decreasing the temperature.

2. Does ice sublime? **10214024**

Ans. Ice usually **melts** at normal condition. But it can also sublime by changing directly into water vapour especially in **dry air** and at low temperature.

3. Give one example each for sublimation and deposition other than mentioned in the text. **10214025**

Ans. Sublimation: Camphor disappearing when left in open air.

Disposition: Iodine vapours turning back into solid iodine on cooling.

APPLICATIONS OF SUBLIMATION

Q.16 How does the process of sublimation helpful in the usage of solid air freshener and in printing? 10214026

Ans. Key points: Solid Air Fresheners | Sublimation Printing

Solid air fresheners

- 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.

Kinetic Particle theory and sublimation of solid air fresheners

- 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.

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

Steps involved in sublimation printing

- 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 **vapour**.

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

Role of heat and applied pressure: 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.

Application 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.

KINETIC THEORY AND THE GAS LAWS

Q.17 How kinetic theory explains the pressure – volume relationship (Boyle's law)? **10214027**

Ans. Key points: Pressure – Volume Relationship (Boyle's law) | Observations

Pressure – Volume relationship (Boyle's law)

- 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.

Observations

- 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**.
- 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**.
- These observations form the basis of a pressure-volume relationship was first observed by an Irish chemist, Robert Boyle, in 1662 and is called **Boyle's law**.

Boyle's law

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

Mathematical form: Mathematically Boyle's law is written as:

$$V \propto \frac{1}{P} \left(\text{V is the volume of gas and P is its absolute pressure}\right)$$

$$V = k\frac{1}{P}$$

$$PV = k = \text{constant}$$

$$P_1V_1 = P_2V_2$$

Q.18 Describe experimental verification of Boyle's law. 10214028

Ans. Key point: Experimental verification of Boyle's law

Experimental verification of Boyle's law

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

Steps

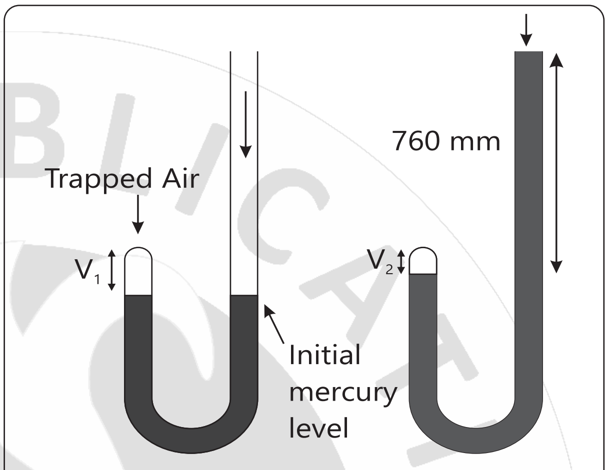

Fig 14.4: Verification of Boyle's law

- He used a simple J shaped tube and sealed its **shorter limb** as shown in the figure 14.4.
- 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 **760mm**.
- This mercury exerted the **extra pressure** on the entrapped air which was now about 2 atmosphere (2 x 760 mm).
- When he read the new volume of the entrapped air it was one half of the initial volume.
- During the experiment the **mass** of the gas **remained fixed** and the temperature also did not change.

Result: By **doubling** the **pressure**, Boyle had reduced the **volume** by **one half**. So, he found an inverse relationship between pressure and volume of a gas.

Q.19 How kinetic theory explains the temperature – volume relationship (Charles' law)? 10214029

Ans. Key points: Temperature – Volume Relationship (Charles' law) | Observations

Temperature – volume relationship (Charles' law)

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

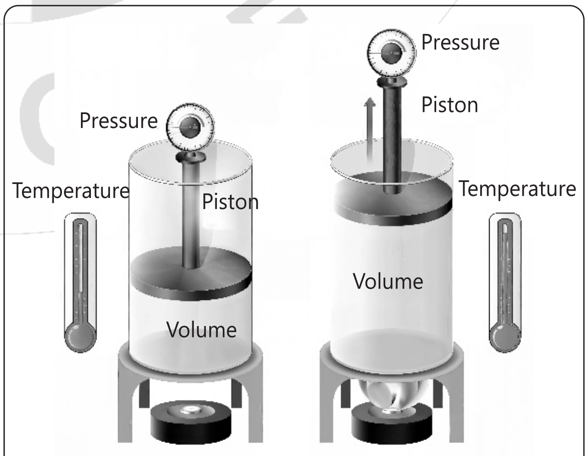

Fig 14.5: Charles' law

Observations

- **Collision:** An increase in average speed results in more frequent and harder collisions with the walls of the container and hence its pressure increases.
- **Increase in volume at constant pressure:** If the pressure of the gas is kept constant, the increase in the temperature must increase the **volume** of the gas.

- **Use of moveable piston:** This may be visualized easily if a gas is taken in a cylinder to which a **piston** is attached. When the gas is **heated** the piston must move up to increase the **volume** if the pressure is to remain constant figure 14.5.

French scientist Jacques Alexander **Charles** in 1780 formulated a law which is called Charles' law.

Charles' law

Statement: *This 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 form

$$V \propto T \left(\text{P and mass of gas are kept constant}\right)$$
$$V = kT$$
$$\frac{V}{T} = k = \text{Constant}$$
$$\frac{V_1}{T_1} = \frac{V_2}{T_2} = \text{Constant}$$

Q.20 How kinetic theory explains the Avogadro's law? 10214030

Ans. Key points: Avogadro's law | Observations

Avogadro's law

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.

Observations

- 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.
- At constant temperature and pressure, a **greater number** of molecules simply requires a larger volume to maintain the same pressure.
- These observations led Avogadro to formulate a law called Avogadros' law.

Avogadros' law

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

Mathematical form: Avogadro's law is written as:

$$V \propto n \ \text{(at constant temperature and pressure)}$$
$$V = kn$$
$$\frac{V}{n} = k = \text{constant}$$

For two different conditions

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

14.4 Quick Check!

With the help of kinetic particle theory explain: **10214031**
(i) How does a gas exert pressure?
(ii) How does the volume of a gas change when its temperature is decreased? (Pressure and mass constant)

Ans. (i) According to kinetic particle theory, the pressure exerted by the gas in a container is caused by the collision of its molecules with the walls of the container. The more frequent and forceful the collisions, the higher the pressure.

(ii) According to Charles' law volume of a gas and temperature are directly proportional to each other. Therefore if temperature drops the volume of a gas is also decreased, if pressure and mass is maintained constant.

DIFFUSION

Q.21 Define diffusion. Explain the difference in the rates of diffusion of two gases based on kinetic theory. **10214032**

Ans. Key points: Diffusion | Factors Affecting the Rate of Diffusion

Diffusion

*It is a process by which particles (molecules) move from origin of **higher concentration** to **lower concentration** until they are equally spread.*

Explanation: 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.

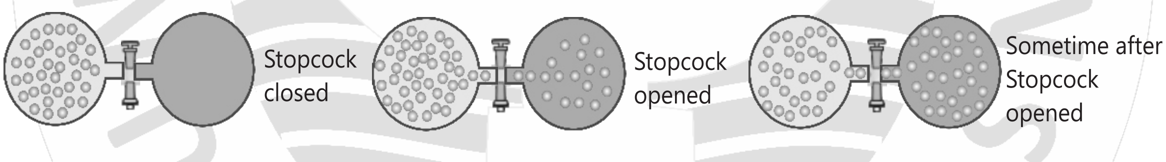

Fig 14.6: Diffusion of gases

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. Figure14.6. shows the diffusion of hydrogen gas from one container to another one.

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

Factors affecting the rate of diffusion

1. **Kinetic energy:** 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 same **average kinetic energy** at constant temperature.

Example: 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.

2. **Temperature:** 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.22 Different gases diffuse at different rates. Prove it experimentally. 10214033

Ans. Key point: Different Gases Diffuse at Different Rates

Different gases diffuse at different rates

- Two cotton plugs soaked in **hydrogen chloride** gas and **ammonia** solutions are introduced in the open ends of a 100 cm long glass tube simultaneously as shown in figure 14.7.
- The two gases produce white dense fumes of ammonium chloride at the point at which they meet in the tube.

$$NH_3 + HC\ell \longrightarrow NH_4C\ell$$

- $HC\ell$ molecules travel a distance of 40.5 cm while ammonia molecules cover 59.5 cm in the same duration.

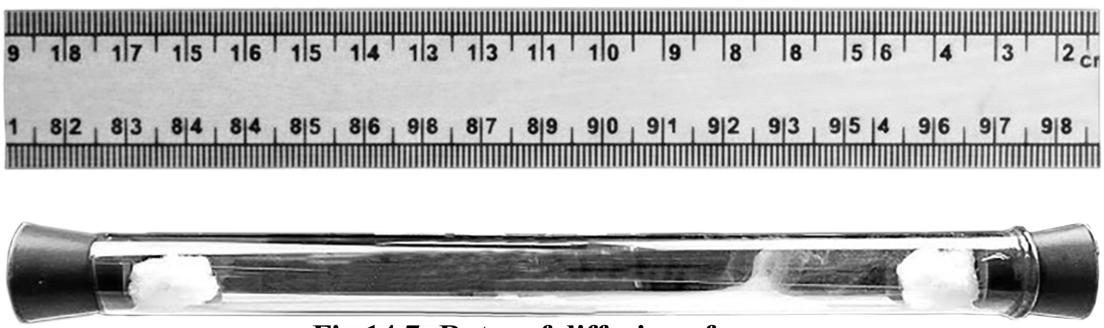

Fig 14.7: Rates of diffusion of gases

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

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? 10214034

NO_2, SO_2, H_2S

Ans. Molecular mass of $NO_2 = 14 + 32 = 46g/mol$

Molar mass of $SO_2 = 32 + 32 = 64g/mol$ Molar mass of $H_2S = 2 + 32 = 34g/mol$

So H_2S will diffuse fastest and SO_2 will diffuse slowest under similar condition of temperature and pressure.

Gas with lower molecular mass will show faster diffusion.

2. Explain with the help of kinetic particle theory why does ammonia gas diffuse faster than hydrogen chloride gas? 10214035

Ans. According to kinetic theory, molecules of all the gases possess same average kinetic energy at same temperature since $(NH_3 = 14 + 3 = 17g/mol)$ is lighter than hydrogen chloride gas $(HC\ell = 1 + 35.5 = 36.5g/mol)$ so it diffuse faster than hydrogen chloride.

IMPORTANCE OF RATES OF DIFFUSION OF MEDICINES IN HUMAN BODY

Q.23 Define rate of diffusion of medicines. Explain how does the rate of diffusion play a crucial role in delivery and movements of drugs in human body. 10214036

Ans. Key point: Importance of Rate of Diffusion of Medicines in Human Body

Importance of rate of diffusion of medicines in human body

*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.*

Rate of diffusion of medicine in human body

- 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.
- Once the drug molecules are absorbed by the blood, they start diffusing 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.
- Generally, a faster rate of diffusion leads to higher drug concentration at its **target organ** which means a more effective response.

Benefits of rate of diffusion of medicines in human body

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

MULTIPLE CHOICE QUESTIONS (EXERCISE)

A. 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: 10214037

(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.

2. Upon heating the rate of evaporation: 10214038

(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: 10214039

(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: 10214040

(a) evaporation (b) condensation
(c) sublimation (d) deposition

5. Physical state in which the particles possess the maximum energy: 10214041

(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?** **10214042**
(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?** **10214043**
(a) HCℓ (b) SO_2
(c) H_2S (d) CO_2

8. **The phase changes A and B in gas $\xrightarrow{A}$ liquid $\xrightarrow{B}$ solid are:** **10214044**
(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?** **10214045**
(a) Melting (b) Evaporation
(c) Sublimation (d) Deposition

SLO BASED MULTIPLE CHOICE QUESTIONS

10. **On how many states do matter exist in the world:** **10214046**
(a) One (b) Two
(c) Three (d) Four

11. **What are physical states of matter in which it exists in the world?** **10214047**
(a) Solid (b) Liquid
(c) Gas and Plasma (d) All of these

12. **The properties of which state were firstly studied:** **10214048**
(a) Solid (b) Liquid
(c) Gas (d) Plasma

13. **Encircle the physical property of a gas.** **10214049**
(a) Compress (b) Expand
(c) Diffuse (d) All of these

14. **Water in all its three physical states remains___the same compound.** **10214050**
(a) Kinetically (b) Physically
(c) Potentially (d) Chemically

15. **Which theory was formulated on the basis of random movement of molecules of gases?** **10214051**
(a) Vital force theory
(b) Ionic theory
(c) Kinetic particle theory
(d) None of these

16. **Which behaviour is similar for a compound showing different physical states?** **10214052**
(a) Diffusion
(b) Movement of molecules
(c) Pressure
(d) Chemical nature

17. **Which property of the gas molecules is responsible for the pressure exerted by a gas?** **10214053**
(a) Random movement
(b) Diffusion
(c) Collision
(d) Expansion

18. **At low pressure, the nature of attractive forces between the particles of a gas:** **10214054**
(a) Very low (b) High
(c) Moderate (d) Negligible

19. **What is the relation between average kinetic energy and temperature of a gas?** **10214055**
(a) Direct (b) Inverse
(c) Equal (d) All of these

20. Which scale is used to measure the temperature of the gas directly related to kinetic energy? **10214056**
(a) Fahrenheit (b) Centigrade
(c) Kelvin (d) Calorie

21. Which physical property is characteristics of all gases? **10214057**
(a) fixed volume
(b) fixed shape
(c) both (a) and (b)
(d) no fixed volume and no fixed shape

22. Which type of movement is exhibited by liquid and gas molecules? **10214058**
(a) Translational (b) Rotational
(c) Vibrational (d) All of these

23. Which type of movement is exhibited by solid molecules only? **10214059**
(a) Translational (b) Rotational
(c) Vibrational (d) None of these

24. Solids have fixed volume and fixed shape due to: **10214060**
(a) Vibrational motion of molecules
(b) Random movement of molecules
(c) Strong inter-particle forces
(d) Rotational movement of molecules

Internal Energy

25. Internal energy of a substance is due to its: **10214061**
(a) Pressure
(b) Kinetic and potential energy of particles
(c) Movements of its molecules
(d) Rotational energy of molecules

26. When heat is added, the internal energy of a system: **10214062**
(a) Increases
(b) Decreases
(c) Remains same
(d) Firstly increases then decreases

Interconversion of Physical States

27. Physical state of a solid substance can be changed by: **10214063**
(a) Simple heating (b) Compressing
(c) Evaporating (d) Condensing

28. The temperature at which a solid starts melting is called: **10214064**
(a) Fusion point
(b) Melting point
(c) Boiling point
(d) Transition temperature

29. How does temperature change after melting point has reached? **10214065**
(a) It remains constant
(b) It increases
(c) It decreases
(d) Firstly increases then decreases

30. At melting point what changes occur in parts of a solid: **10214066**
(a) Loss of mean position
(b) Loss of arrangement
(c) Collapse of molecules
(d) All of these

31. The heat provided after phase change is utilized in: **10214067**
(a) Increasing its temperature
(b) Increasing its potential energy
(c) Both (a) and (b)
(d) None of these

32. The escape of surface molecules of a liquid at all temperatures is called: **10214068**
(a) Condensation (b) Rotation
(c) Evaporation (d) Deposition

33. Evaporation is a surface phenomenon which occurs at: **10214069**
(a) High temperature
(b) Low temperature
(c) Room temperature
(d) All temperatures

34. The temperature at which vapour pressure of a liquid becomes equal to external pressure called its: **10214070**
(a) Boiling point
(b) Freezing point
(c) transition point
(d) All of these

35. Temperature remains constant after heating a substance during: **10214071**
(a) Melting (b) Boiling
(c) Condensation (d) All of these

36. When a gas is cooled it is converted to liquid, this process is called: **10214072**
(a) Evaporation (b) Sublimation
(c) Condensation (d) Deposition

37. A graph which shows relation between internal energy and the temperature: **10214073**
(a) Heating curves
(b) Cooling curves
(c) Heating and cooling curves
(d) None

38. Flat lines in heating and cooling curves show: **10214074**
(a) Melting point
(b) Freezing point
(c) Liquefaction point
(d) Transition state

39. Phase change materials are utilized in fields of: **10214075**
(a) Thermal regulation
(b) Clothing insulation
(c) Building insulations
(d) All of these

40. Heating and cooling curves can be studied equally but differ in: **10214076**
(a) Size (b) Shape
(c) Direction (d) None of these

41. Boiling of a liquid is indicated when: **10214077**
(a) Vapours are formed
(b) Bubbles starts coming
(c) Volume is changed
(d) Drops are found on outer of container

42. Interconversion of physical state is affected by changing: **10214078**
(a) Heat (b) Pressure
(c) Both a and b (d) Evaporation

43. Ice melts in the hands of a snowball maker due to increase in: **10214079**
(a) Temperature (b) Pressure
(c) Height (d) Vapour pressure

44. From where the energy comes for evaporation: **10214080**
(a) Heat (b) Pressure
(c) Inside the liquid (d) Sun

45. Which process produces cooling? **10214081**
(a) Evaporation (b) Boiling
(c) Condensation (d) Deposition

46. In Murree the boiling point of water is: **10214082**
(a) 100° (b) 98°C
(c) 110°C (d) 118°C

47. The compounds which show sublimation: **10214083**
(a) Naphthalene (b) Dry ice
(c) Iodine (d) All of these

48. Which physical state is skipped in deposition? **10214084**
(a) Solid (b) Liquid
(c) Gas (d) All of these

49. Solid air fresheners, when exposed to atmosphere disappears due to: **10214085**
(a) Evaporation (b) Deposition
(c) Sublimation (d) Condensation

Kinetic Theory and The Gas Laws

50. Pressure — volume relationship at constant temperature was first observed by a scientist named: **10214086**
(a) Robert Boyles
(b) Alexander Charles
(c) Amaedo Avogadro
(d) James Chadwick

51. By doubling the pressure, Boyle's found the volume of a given mass of gas is: **10214087**
(a) Doubled
(b) Reduced to half
(c) Increased rapidly
(d) Remains constant

52. A French scientists Jacques Alexander Charles observed a law which deals between two variables. **10214088**
(a) Volume and Pressure
(b) Volume and Temperature
(c) Pressure and Temperature
(d) Density and mass

53. Which one is a mathematical form of Avogadro's law: 10214089

(a) $v \propto \frac{1}{P}$ (b) $V \propto T$

(c) $V \propto n$ (d) $V \propto P$

54. The temperature scale selected to explain Charles' law: 10214090

(a) Fahrenheit (b) Celsius

(c) Kelvin (d) All of these

Diffusion

55. Which gas will diffuse faster under similar conditions of temperature and pressure? 10214091

(a) N_2 (b) SO_3

(c) H_2S (d) $HC\ell$

56. When Ammonia and Hydrogen Chloride react together Ammonium Chloride is formed having color of fumes: 10214092

(a) Black (b) White

(c) Yellow (d) Purple

57. The spontaneous intermingling of gas molecules to form a homogenous mixture: 10214093

(a) Diffusion (b) Deposition

(c) Evaporation (d) Condensation

Importance of rates of diffusion of medicine in human body

58. Once drug molecules are absorbed by blood, they start _______ into various tissues and organs: 10214094

(a) Evaporating (b) Freezing

(c) Depositing (d) Diffusing

59. Which kind of drugs can easily diffuse through cell membrane: 10214095

(a) Water soluble (b) Water insoluble

(c) Lipid soluble (d) Ethanol soluble

ANSWER KEY

1.	a	2.	b	3.	a	4.	d	5.	d	6.	a	7.	c
8.	c	9.	c	10.	d	11.	d	12.	c	13.	d	14.	d
15.	c	16.	d	17.	c	18.	d	19.	a	20.	c	21.	d
22.	d	23.	c	24.	c	25.	b	26.	a	27.	a	28.	b
29.	a	30.	d	31.	b	32.	c	33.	d	34.	a	35.	d
36.	c	37.	c	38.	d	39.	d	40.	c	41.	b	42.	c
43.	b	44.	c	45.	a	46.	b	47.	d	48.	b	49.	c
50.	a	51.	b	52.	b	53.	c	54.	c	55.	c	56.	b
57.	a	58.	d	59.	c								

SHORT ANSWER QUESTIONS (EXERCISE)

B. Write Short Answers.

1. From where does the energy come when a liquid evaporates? 10214096

Ans. When a liquid evaporates the energy is primarily come from the surrounding environment and the remaining from the liquid itself. Energy is provided from outside in the form of heat which increases rate of evaporation.

2. Is condensation an endothermic process? 10214097

Ans. Condensation is not an endothermic process but it is an exothermic process. According to the kinetic particle theory, in a gas, particles move away rapidly and are far apart. As gas loses energy, particle motion slows down, and attractive forces pull the particles closer together, forming a liquid, during condensation.

3. Why naphthalene balls (used to repel insects) disappear after sometime? 10214098

Ans. Naphthalene is an organic aromatic compound having a harsh smell. Naphthalene balls are placed among silky clothes which disappear after sometimes due to process of sublimation. This means they change directly from solid to gas (naphthalene vapour) without turning into liquid.

4. Why does the temperature remain constant during a phase change? 10214099

Ans. Temperature remains constant during a phase change like melting or boiling, because the heat energy added is used to overcome the attractive forces between the particles, not to increase the kinetic energy. Since temperature is a measure of kinetic energy so the temperature remains constant. The heat provided is called latent heat.

5. Is it possible to compress a liquid like a gas? 10214100

Ans. Gases can be compressed easily but liquids cannot be compressed. According to kinetic theory, the particles in a liquid are quite close to one another. They are also moving in all possible directions. So in general, liquid cannot be compressed and are generally incompressible.

6. Can you change the temperature at which water boils in an experiment in your lab? 10214101

Ans. Boiling point of a liquid is affected by changing external pressure. So boiling point of water can be changed in laboratory by applying change in external pressure. If external pressure is increased on the liquid, it boils at higher temperature.

Example: Use of pressure cooker boils the water at higher temperature. Low external pressure makes the water to boil at low temperature.

7. In which season the wet clothes get dry after a relatively longer time? 10214102

Ans. Wet clothes take longer time to dry during winter. This is because, the air is cooler and is more humid. Therefore, rate of evaporation is decreased and clothes require relatively longer time to dry.

8. When a solid is heated, what happens to its particles which are vibrating? 10214103

Ans. 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 at a particular temperature. Their vibrational motion becomes so fast that it overcomes the cohesive forces. As a result, the solid starts melting and particles lose their mean position, solid collapses and turn into liquid.

9. Do solids and liquids also diffuse just like gases? 10214104

Ans. Diffusion is a process of movement of molecules from an area of higher concentration to lower concentration. It is most commonly associated to gases because gas molecules are free to move easily. But diffusion is not just limited to gases. Solids and liquids can also diffuse. In solids, diffusion is very much low due to restricted motion of its molecules. Liquids diffuse faster than solids but slower than gases.

10. Why dew is formed in the early hours of the morning? 10214105

Ans. During night, the temperature of earth becomes very low. It causes the air near the surface of earth to get cool. When the air's temperature drops to its dew point, the water vapour in the air condenses into tiny droplets on the surface forming dew in the early morning.

SLO BASED SHORT ANSWER QUESTIONS

Introduction

11. Which idea lead to the formation of kinetic particle theory for gases? 10214106

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 these gases consist of particles which are continuously moving randomly. This idea then led to formulation of kinetic particle theory for gases.

12. What are the outcomes of kinetic particle theory? 10214107

Ans. The outcomes of kinetic particle theory are:

- Kinetic particle theory explains all the laws which govern the behaviour of gases.
- It explains the composition of liquid and solid states of matter.
- This theory also explains the interconversion of all the three states.

13. Write two postulates of kinetic particle theory for gases. 10214108

Ans. Postulates of kinetic particle theory of gases:

- 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.

14. Why liquids have a fixed volume but no fixed shape? 10214109

Ans. According to kinetic theory, the particles of a liquid do not have any fixed position and shape. Owing to the presence of inter particle forces, however, a liquid has a fixed volume and it keeps its level as well.

15. Why solids have a fixed volume as well as fixed shape? 10214110

Ans. 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. These particles possess vibrational motion only. These restricted movements force solid substances to have a fixed shape and a fixed volume.

16. Define internal energy of a substance. 10214111

Ans. Internal energy

Definition: 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.

Heat increases the internal energy of a system.

Interconversion of Physical States

17. Define melting point. 10214112

Ans. Melting Point: The temperature at which a solid changes its state to become a liquid is called its melting point.

Example: Ice melts at 100°C.

18. What is the effect of heat after melting of a solid? 10214113

Ans. Effect of heat after melting: Further heating the solid after it has started melting does not increase its temperature. Instead, all the heat energy provided at this moment is utilized to convert the solid into its liquid.

19. Define evaporation. Why it is called a surface phenomenon. 10214114

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.

It is a surface phenomenon because the molecules of surface escape out of the liquid.

20. Define boiling point of a liquid. 10214115

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

Example: Boiling point of water is 100°C.

21. Why does temperature remain constant after boiling point has reached? 10214116

Ans. 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. Because the heat provided is used only to break the forces of attraction between its particles.

22. What do you know about condensation? 10214117

Ans. Condensation (Conversion of a gas into its liquid): 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.

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**.

Heating and Cooling Curves

23. What are heating or cooling curves? 10214118

Ans. Heating and cooling curves
Interconversion of physical states can also be understood with the help of a graph drawn between the internal energy and the temperature of a system. Such a graph is also called a heating or cooling curve.

24. What is the state of kinetic energy of molecules when a liquid boils? 10214119

Ans. At boiling point, the kinetic energy (temperature) remains constant. While the potential energy increases as molecules move apart to form gas.

25. Explain why does water boil at 100°C in Karachi and at 98°C in Murree? 10214120

Ans. The boiling point of water in Karachi is higher than Murree because the atmospheric pressure at Murree is lower than that in Karachi, so we find that the boiling point has decreased at lower atmospheric pressure.

Sublimation

26. Define sublimation. Give example. 10214121

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

27. From where does energy come for sublimation? 10214122

Ans. The energy needed for sublimation comes from within the substance and the remaining absorbed from the surrounding.This energy is sufficient to overcome the attractive forces of the neighbouring molecules which then escape into the vapour phase.

28. What is deposition. Give examples.10214123

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 is an example of deposition.

29. Why a solid air freshener disappears automatically after some days? 10214124

Ans. 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 and spread in the nearby atmosphere in the form of sweet smelling vapours. So in this way they disappear automatically after some days.

30. What is sublimation printing? 10214125

Ans. Sublimation printing: When the process of sublimation is used to print a design into a material or fabric, it is called sublimation printing.
The process involves printing that transfers a design into a fabric using ink and heat.

31. In what ways sublimation is being used in our daily life? 10214126

Ans. Sublimation is used in daily life in:
- Air fresheners
- Sublimation printing on T-shirts, ceramics, wood or metals.

Kinetic Theory and Gas Laws

32. Explain how pressure is exerted by a gas. 10214127

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

33. What is the relation between volume and pressure of a gas? Derive a relation between them keeping temperature constant? 10214128

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

Mathematically

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

$(V \text{ is the volume of gas and P is its absolute pressure})$

$$V = k\frac{1}{P}$$

$$PV = k = \text{constant}$$

$$P_1V_1 = P_2V_2$$

34. State Charles' law. Give its mathematical form. **10214129**

Ans. Charles' law

Statement: The law states that, the volume of a given mass of a gas varies directly with temperature when pressure is kept constant.

Mathematical form

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

$$V \propto T$$

$$V = kT$$

$$\frac{V}{T} = k = \text{constant}$$

35. State Avogadro's law. Write its mathematical form. **10214130**

Ans. Avogadro's law

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

Mathematical form

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

$$V = kn$$

$$\frac{V}{n} = k = \text{constant}$$

36. Define diffusion. Give example. **10214131**

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.

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.

37. What is the effect of temperature on diffusion? **10214132**

Ans. Effect of temperature on 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

38. What are the effects of rate of diffusion of medicine in human body? **10214133**

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

CONSTRUCTED RESPONSE QUESTIONS

1. Differentiate between evaporation and boiling. **10214134**

Ans. See Q.13 from theory.

2. Describe how boiling is related to the external pressure? **10214135**

Ans. See Q.14 from theory.

3. Why the process of evaporation does not need the input of energy? **10214136**

Ans. Evaporation is a continuous process which occurs at all temperature. Evaporation does not need input of energy from outside because it required a smaller amount of energy which is produced from inside of the liquid due to continuous collisions of molecules.

4. Why the heating and cooling curves for the phase changes adopt the same path? **10214137**

Ans. A heating curve is a graph that shows the temperature of a substance changes with time. The same graph when studied in reverse order show cooling curve. This occurs because of same phase changes of a substance occur in heating and cooling.

5. Why ice melts when the pressure is exerted on it? **10214138**

Ans. Ice melts from pressure in the hands of snowball because 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.

6. Why do phase changes occur? **10214139**

Ans. Phase change are related to changes in temperature and intermolecular forces. When we add or remove heat, it affects the movement and intermolecular forces of molecules. So, phase change occurs.

Example: When we heat a pure substance in solid state, heating overcomes its intermolecular forces causing solids to melt or liquid to vapourize. Similarly, when cool a pure substance, molecules slow down and arrange their pattern of arrangements like gas to liquid or liquid to solid (condensation, freezing).

DESCRIPTIVE QUESTIONS (EXERCISE)

1. Explain the difference in the rates of diffusion of two gases based on kinetic theory. **10214140**

Ans. See Q.21 from theory.

2. How does the process of sublimation helpful in printing and in the usage of air freshener? **10214141**

Ans. See Q.16 from theory.

3. Draw heating curve for the physical changes water undergoes with change in temperature. **10214142**

Ans. See Q.10 from theory