1st YEAR CHAPTER 4

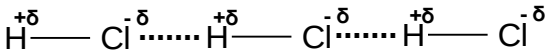
LIQUIDS AND SOLIDS

Intermolecular Forces

1. **What are dipole - dipole forces. How they affect thermodynamic properties of substances.**

Dipole-Dipole Forces:

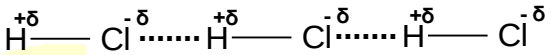
The positive end of one molecule attracts the negative end of other molecule and these electrostatic forces of attration are called dipole-dipole forces. For example:



2. **Define (a)Dipole-dipole forces (b) Hydrogen bonding**

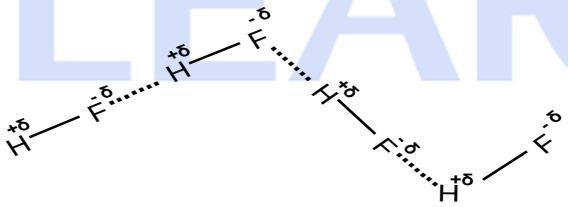
Dipole-dipole forces:

The positive end of one molecule attracts the negative end of other molecule and these electrostatic forces of attraction are called dipole-dipole forces. For example:



Hydrogen bonding:

The electrostatic force of attraction between partial positively charged hydrogen atom and highly electronegative atom (F, O, N) ids called hydrogen bonding.



3. **The vapour pressure of diethyl ether is higher than that of water at same temperature. Give reason.**

The vapour pressure of diethyl ether is higher than that of water at same temperature because diethyl ether has weak intermolecular forces, due to which molecules of diethyl ether evaporate at higher rate than molecules of water so more vapours of diethyl ether exerts more pressure.

London Dispersion Forces

4. **Why the value of boiling point of noble gases increases from top to bottom within a group?**

The dispersion of electronic cloud is known as polarizability of an atom. When we move from top to bottom in a group, the atomic size increases in noble gases so polarizability increases as a result London forces become stronger and hence boiling point increases down the group.

Hydrogen Bonding

5. Water is liquid at room temperature while H_2S is a gas. Explain?

In water strong hydrogen bonding is present which make it liquid. But H_2S has weak intermolecular forces, due to which H_2S is a gas at room temperature.

6. Give reason that ice floats on water.

OR

Ice occupies more space then water. give reason.

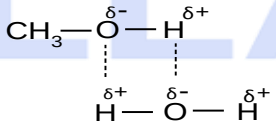
When the temperature of liquid water decreases the arrangement of molecules also changes. In case of ice, hexagonal arrangement of water molecules is formed with large empty spaces than liquid. About 9% expansions in volume take place. Due to lesser density of ice, it floats over water.

7. Why the boiling point of water is higher than HF?

In each water molecule, oxygen atom forms hydrogen bonds with hydrogen atoms of two neighboring water molecules. Whereas in case of HF molecule, only one partial positive hydrogen is available which can make only one hydrogen bond so in water, no. of hydrogen bonds are double as compared to HF. That's why water has high boiling point than HF.

8. Water and ethanol can mix is all proportions. Give reason.

Water and ethanol can mix easily in all proportions because hydrogen bonding is formed between oxygen atom of OH group of ethanol and hydrogen atom of water molecule and vice versa.



9. Describe cleaning action of soaps and detergents on the basis of H-bonding.

Soaps and detergents perform their cleansing action due to hydrogen bonding between polar part of their molecules and water molecules. The polar part of molecules are water soluble and non-polar part are water insoluble. Non-polar part of molecules are either alkyl or aryl groups which remains outside the water.

10. Why HF has less acidic strength than HI?

OR

Why HF is the weakest acid than other halogen halides?

Strength of acid depends upon the ionization of an acid. HF molecule has very strong hydrogen bonding in them. Its ionization constant is low on other hand HI has high ionization constant, that's why HF is less acidic than HI.

Evaporation

11. Evaporation causes cooling. Explain.

When high energy molecules leave the liquid and low energy molecules are left behind, the temperature of the liquid falls. Now the heat from the surrounding move to the liquid and then the temperature of surrounding also falls. Hence cooling takes place.

12. Explain why evaporation takes place at all temperatures.

At low temperature, there are always some molecules whose kinetic energy is greater than average kinetic energy of molecules. These molecules can overcome the intermolecular forces and escape from the surface in the form of vapors. At high temperature, the rate of evaporation increases so evaporation continues at all temperatures but rate of evaporation will be different at different temperatures.

13. Why earthenware vessels keep water cool?

Earthenware vessels are porous. Water in these vessels evaporates through these pores, high energy molecules escape these pores and low energy molecules left behind. Heat from the atmosphere cannot enter in to liquid. So, temperature of water in earthenware vessels keeps water cool.

14. Why one feels sense of cooling under the fan after bath?

After taking bath, water droplets are present all over the body. These molecules absorb heat energy from the body and evaporate. The rate of evaporation increases under the fan due to circulation of air. As a result, the body temperature decreases and one feel dense of cooling.

15. Why different liquids evaporate at different rates even at the same temperature?

The molecules of the liquids having weaker intermolecular forces have greater chance to escape from the surface of liquid. As a result, rate of evaporation is greater e.g gasoline evaporates much faster than water due to weak London forces of attraction between its molecules.

Vapour Pressure

16. Define vapour pressure. Name the factors which affect vapour pressure of a liquid.

Vapour pressure:

The pressure exerted by vapours in equilibrium with its pure liquid at given temperature is called vapour pressure.

Following factors affects the vapour pressure:

- Intermolecular forces
- Temperature

17. What is effect of intermolecular forces on vapour pressure?

OR

How vapour pressure is related to intermolecular forces of attraction.?

Intermolecular forces:

Vapour pressure increases with decreases of strength of intermolecular forces and vice versa. Strong intermolecular forces hold the molecules tightly and chances of liquid molecules to leave the surface decreases. As a result, vapour pressure also decreases.

18. Explain that vapour pressure of solid state far less than those of liquids?

Solids have strong attractive forces among their particles and hence cannot be vaporized at ordinary temperature and pressure. Whereas evaporation of liquid can take place even at room temperature, because they have weak intermolecular forces. That's why vapor pressure of solids is far less than those of liquids.

Boiling Point

19. Why water boils at low pressure at mountains?

OR

Why boiling point of water varies from sea-level to higher places?

Boiling point is not a constant property. It depends upon the external pressure. If external pressure is high, then boiling point is also high and vice versa.

- Boiling point of water in plain areas is **100°C** at external pressure of **760** torr.
- Boiling point of water in Murree is **98°C** at external pressure of **700** torr.
- Boiling point of water at Mount Everest is **69°C** at external pressure of **323** torr.

20. Write two advantages of vacuum distillation?

Advantages of vacuum distillation:

Vacuum distillation has following advantages:

- It decreases the time of distillation.
- It is economical as it is consumes less energy.
- The decomposition of many liquids can be avoided.

21. Vacuum distillation can be used to avoid decomposition of a sensitive liquid. Explain with reason.

Sensitive liquids decompose at their boiling points. By vacuum distillation, a liquid can be made to boil at low temperature by decreasing external pressure and hence decomposition can be avoidede.g glycerin decomposes at its boiling point (290 °C) but can be distilled easily at 210°C by decreasing the external pressure to 50 torr.

22. Why the temperature of a liquid does not rise even if heat is continuously supplied to it?

Before boiling point, heat supplied increases the kinetic energy of molecules so temperature increases. At boiling point, the kinetic energy of molecules become maximum, so the temperature

also becomes constant. Now the heat supplied is only used to break intermolecular forces and convert liquid into vapours. So boiling needs constant heat supply.

Energetics of Phase Change

23. Why molar heat of vaporization (ΔH_v) is greater than molar heat of fussion (ΔH_f)?

When a solid substance melts, then atoms, molecules and ions undergo relatively lesser increase in intermolecular distance and potential energy. So, less amount of energy is required to overcome attraction for lesser increase in intermolecular distance.

When a liquid evaporates, then greater increase in intermolecular distance and potential energy takes place. So, more amount of energy is required to overcome attraction for greater increase in intermolecular distance.

24. Describe that heat of sublimation is greater than heat of vaporization.

When a solid changes directly into vapours, then relatively greater increase in intermolecular distance and potential energy against the strong forces take place. So, large amount of energy is required to do so.

When a liquid changes into vapours, then relatively lesser increase in intermolecular distance and potential energy against the relatively weak forces take place. So, less amount of energy is required to do so.

So heat of sublimation is greater than heat of vaporization

25. Define molar heat of fusion and molar heat of vaporization.

Molar heat of fusion:

The amount of heat required to convert one mole of a solid into liquid at 1 atm at its melting point is called molar heat of fusion. It is represented by **ΔH_f.**

Example: molar heat of fusion of water is 6.02 KJ/mol

Molar heat of Vaporization:

The amount of heat required to convert one mole of a liquid into vapours at 1 atm at its boiling point is called molar heat of vaporization. It is represented by **ΔH_v.**

Example: molar heat of fusion of water is 40.6 KJ/mol

Liquid Crystals

26. Liquid crystals can be used in diagnosis of Cancer. Explain.

Diagnosis of Cancer:

When liquid crystals are applied to the surface of breast, a tumor shows up blue colour because it is hot.

27. Give two uses of liquid crystals. OR Write down two applications of liquid crystals.

Uses of liquid crystals:

i. Liquid crystals are used as solvent in chromatographic separations.

ii. Oscillographic and TV displays also use liquid crystal screens.

28. Define liquid crystal with one example.

Liquid Crystals: The turbid liquid phase of a solid that exists in between the melting and clearing temperature with properties intermediate between liquid and crystal is called liquid crystal. For example: Cholesteryl benzoate

29. How the liquid crystals help in the detection of the blockage in veins and arteries?

In order to locate arteries and veins, specialists use the technique of skin therapy to detect the blockages in arteries and veins. When liquid crystals are applied on the skin, the areas of arteries and veins show different colours because these are warmer areas. Similarly infections can be diagnosed.

Properties of Crystalline Solids

30. Define Anisotropy and Allotropy?

Anisotropy:

Some of the crystals show variation in physical properties depends on direction. Such properties are called anisotropic properties and the phenomenon is called anisotropy.

For example: the following properties are anisotropic.

- Refractive index
- Coefficient of thermal expansion
- Electrical conductivity etc

Allotropy:

The existence of an element in more than one crystalline form is known as allotropy. Such crystalline forms are called allotropic forms.

For example: Carbon has three crystalline forms i.e diamond, graphite.

31. Define transition temperature with two examples?

Transition Temperature:

The temperature at which two crystalline forms of a substance co-exist in equilibrium with each other is called transition temperature.

For Example:

$$\text{Rhombic Sulphur} \underset{}{\overset{95.5^{o}C}{\rightleftharpoons}} \text{Monoclinic Sulphur}$$

$$\text{Grey Tin (Cubic)} \overset{13.2^{o}C}{\rightleftharpoons} \text{White Tin (Tetragonal)}$$

32. Explain cleavage of crystals and cleavage plane.

Cleavage plane.

The direction through which a crystal can be broken by applying pressure is called cleavage plane.

Cleavage of Crystal:

The process of breaking down a bigger crystal structure into smaller similar ones by applying external pressure is called cleavage of crystal.

33. Transition temperature is exhibited by both elements and compounds. Explain.

Elements existing in different crystalline forms are called allotropes and compounds existing in different crystalline forms are called polymorphs. The temperature at which different crystalline forms of the same substance co-exist in equilibrium is called transition temperature. So, only allotropic elements and polymorphic compounds exhibits transition temperature.

e.g

$$\text{Rhombic Sulphur} \underset{}{\overset{95.5^{o}C}{\rightleftharpoons}} \text{Monoclinic Sulphur}$$

$$\underset{\text{(Orthorhombic)}}{KNO_3} \overset{128^{o}C}{\rightleftharpoons} \underset{\text{(Rhombohedral)}}{KNO_3}$$

34. Cleavage is an anisotropic behavior. Explain it.

Whenever a crystalline solid is broken, they do so along definite planes. These planes are called cleavage planes and they are inclined to one another at a particular angle. Due to this reason, cleavage of crystals is known as anisotropic property.

35. Define isomorphism and polymorphism with example.

Isomorphism: The existence of two or more substances in the same crystalline form is called isomorphism. These different substances are called isomorphs.

Example:

$NaNO_3$ and KNO_3 Rhombohedral

Polymorphism: The existence of a substance in more than one crystalline form under different conditions of temperature and pressure is called polymorphism.

Example:

$$CaCO_3 \begin{cases} \text{Rhombohedral (Calcite)} \\ \text{Orthorhombic (Aragonite)} \end{cases}$$

36. What is the relationship between polymorphism and allotropy?

	Polymorphism		Allotropy
1	The existence of compound in more than one crystalline form is known as polymorphism.	1	The existence of an element in more than one crystalline form is known as allotropy.
2	These different crystalline forms of a compound are called polymorphic forms.	2	These crystalline forms are known as allotropic forms.
3	**$CaCO_3$** has trigonal and orhtoehombic forms.	3	Diamond, graphite and Bucky balls are allotropes of carbon.

Crystals and their classification

37. Explain the term unit cell dimension.

There are six unit cell dimensions or crystallographic elements.

- Three are unit cell lengths i.e **a, b** and **c.**
- Three are unit cell angles i.e **α, β** and **γ.**

The unit cell lengths a, b and c may be assigned along x, y and z axis resoectively but angles **α, β** and γ have to be decided accordingly.

Ionic Solids

38. Ionic solids do not conduct electricity in solid state?

Ionic crystals do not conduct electricity in the solid state due to strong electrostatic forces, the cations and anions remain tightly held together and are not free to move to conduct electricity. Ionic solids conduct electricity only in aqueous solution or in molten state because now ions become free and electricity is conducted.

39. Table salt is an insulator in solid state. Justify.

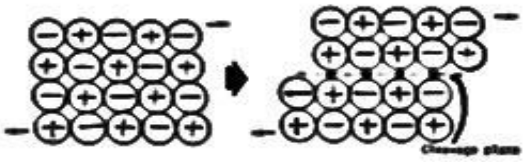
Table salt does not conduct electricity in the solid state due to strong electrostatic forces, the cations (Na^+) and anions(Cl^-) remain tightly held together and are not free to move to conduct electricity. Table salt conducts electricity only in aqueous solution or in molten state because now ions become free and electricity is conducted.

40. Why ionic crystals do not conduct electricity in the solid state?

Ionic crystals do not conduct electricity in the solid state due to strong electrostatic forces, the cations and anions remain tightly held together and are not free to move to conduct electricity. Ionic solids conduct electricity only in aqueous solution or in molten state because now ions become free and electricity is conducted.

41. Describe that ionic crystals are highly brittle?

Ionic solids are composed of parallel layers which contain cations and anions in alternate positions, so that opposite ions in various layers lie over each other. When an external force is applied, one layer slides over the other layer along a plane. In this way, the like ions come in front of each other and hence begin to repel that is why ionic crystals are said to be high brittle.



42. Why NaF has higher lattice energy than NaCl?

With the increasing size of either cation or anion the packing of oppositely charged ions becomes less tight. In NaCl, size of Cl is larger than F in NaF which results in weak electrostatic interaction and less lattice energy.

43. Define lattice energy with an example

Lattice energy:

The amount of energy released when one mole of crystalline solid is formed from the gaseous ions is called lattice energy.

Example: $Na^{+}_{(g)}\ Cl^{-}_{(g)} \longrightarrow NaCl_{(s)}$

Covalent Solids

44. Why diamond is hard and electrically neutral?

In diamond, each carbon has utilized its four electrons and bonded with four other carbon atoms through covalent bond in crystal lattice. This covalent bonding extended through the diamond crystal and compact and tight arrangement of unit cells make diamond very hard.

Diamond is electrical insulator due to absence of free electrons in its crystal lattice because every carbon has utilizes its four electrons in the formation of four covalent bonds.

45. Graphite has slippery touch. Give reason.

Graphite contains layers of carbon atoms. The layers slide over each other easily because there are only weak forces between them, making graphite slippery.

Molecular Solids

46. Why heat of sublimation of iodine is very high?

Heat of sublimation of iodine is very high because iodine molecule is very large in size and has high polarizability. Therefore, strong London dispersion forces are present in iodine which is responsible for its high heat of sublimation.

47. Iodine dissolves readily in carbon tetrachloride. Why?

A polar solute dissolve in polar solvent and non-polar solute dissolves in non-polar solvent, so iodine being non-polar dissolves readily in carbon tetrachloride which is non-polar.

48. Write four properties of molecular solids.

Properties of molecular solids:

i. **Arrangement of atoms:** X-rays analysis shows that there are regular arrangement of atoms in molecules of these solids and molecules have exact position.

ii. **Intermolecular forces:**The forces of attraction between the molecules are very weak. So, they are soft a nd easily compressible.

iii. **Physical properties:** They are mostly volatile and have low melting and boiling points. They have low densities and sometimes transparent to light.

iv. **Conductivity:** They are bad conductor of electricity.

v. **Solubility:**

- Polar molecular solids are mostly soluble in polar solvents.
- Non-Polar molecular solids are usually soluble in non-polar solvents.

Metallic Solids

49. Write four properties of Metallic crystals.

Properties of Metallic crystals:

i. Electrical conductivity:

Metals are good conductor of electricity. When electric field is applied between two ends of a metal, then mobile electrons begin to move positive poles and new electrons from the negative pole take their place.

ii. Effect of temperature on conductivity:

Electrical conductivity of metals decreases with increase in temperature. Because with the increase in temperature, the metal ions begin to vibrate with greater amplitude and hence they offer more hindrance to the free movement of electrons between their layers. This hindrance decreases the electrical conductivity.

iii. Thermal conductivity:

When a piece of metal is heated at one end, the mobile electrons at this end absorb heat energy and move very rapidly through the metallic lattice towards the cooler end. Thus metals conduct electricity.

iv. Malleable and Ductility:

Metals are malleable and ductile whenever stress is applied on them. Their layers slip pass over each other. The structure of metals changes without breaking.

EXPECTED QUESRTIONS

Intermolecular Forces

1. **What is difference between**

   (i) Intermolecular forces

   (ii) intermolecular forces

   (iii) Polar molecules and

   (iv) Non–polar molecules

   (v) Dipole

   (vi) Induced Dipole

   (vii) Instantaneous Dipole

Ans. (i) Intermolecular Forces:

The forces of attraction between two different atoms ions and molecules are **called intermolecular** forces.

For example H—Cl……H—Cl…….H—Cl

(ii) Intramolecular Forces:

The forces of attraction between two atoms or group of atoms present with in the same molecule, **are called intermolecular forces**.e.g covalent bond ,ionic bond etc

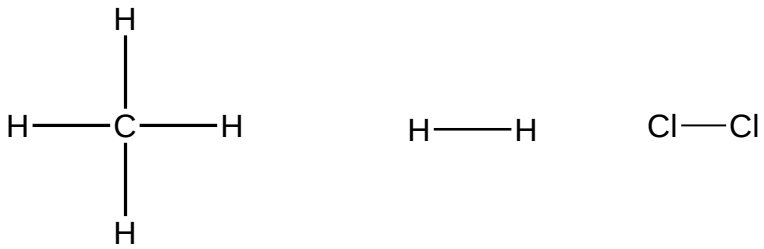
(iii) Polar molecules:

A molecule which has partial +ve and partial –ve charges on it due to difference of electro negativity between bonded atoms **is called polar molecules.** For example $H^{\delta+} – Cl^{\delta-}$

(iv) Non–polar molecules:

A molecule in which bonded atoms have zero or negligible electro negativity difference **is called non–polar molecules.**

For example



Important point: All molecules having same atoms (Homoatomic) are non polar.

(v) Induced Dipole:

A molecule in which polarity is created due to other polar molecule is **called induced dipole**.

(vi) Instantaneous Dipole:

The temporary dipole (polarity) produced in a non–polar molecule at a certain instant is **called instantaneous dipole.**

(vii) Dipole

A molecule which has two poles i.e. two charges partial +ve and partial –ve **is known as dipole**.e.g

$H^{\delta+} – Cl^{\delta-}$

2. Define intermolecular forces, and the types of intermolecular forces?

Ans. Intermolecular Forces:

The forces of attraction that exist between all kinds of atoms, molecules, when they are sufficiently close to each other **are called** intermolecular forces.

Types of intermolecular forces:

There are four types of intermolecular forces.

(a) Dipole–dipole forces

(b) Ion–dipole forces

(c) Dipole–induced dipole forces (Debye forces)

(d) Instantaneous dipole–induced dipole forces or (London dispersion forces).

(a) Dipole–dipole forces:

The forces of attraction between the positive end of one polar molecule and the negative end of other polar molecule **are known as dipole–dipole forces.**

Example

$$\mathbf{H^{\delta+} – Cl^{\delta-} \ldots\ldots H^{\delta+} – Cl^{\delta-} \ldots\ldots H^{\delta+} – Cl^{\delta-}}$$

(b) Ion–Dipole forces:

The forces of attraction in which the negative ends of polar molecules are attracted towards the cation (+ve ion) and positive ends towards anion (– ion) are called ion–dipole forces. Ionic compounds like MX are normally soluble in polar solvent like water. Water molecules break the crystal lattice and the ions are set free. These positive and negative ions are then surrounded by water molecules. The negative ends of the dipole of the water are attracted towards the cation (M+) while the positive ends are attracted towards the anion (X–). The dissolution of most of the ionic compounds in water is due to this reason. The forces of attraction between ions and water molecules **are known as Ion–dipole forces.**

- The forces of attraction that exist between already polar molecules and the molecule having induced dipole forces. The forces are **also called Debye forces.**

(c) Instantaneous Dipole–Induced Dipole forces. (London dispersion forces).

The momentary forces of attraction that exist between instantaneous dipole and the induced dipole **are called instantaneous dipole–induced dipole forces.**

The momentary force of attraction between instantaneous dipole and the induced dipole **is known as instantaneous–induced dipole forces**.

London Dispersion Forces

3. Explain the factors affecting the London forces.

Ans. The strength of these forces depends upon the following two factors.

1. **Size of electronic cloud:**

As the size of electronic cloud of atoms or molecules increases, dispersion becomes easier and these forces are more permanent.

The elements of zero group are monoatomic gases due to their complete outermost shells, they do not form covalent bonds. Their boiling points increase from top to bottom in a group.

2. **Polarizability:**

The quantitative measurement of the extent to which the electronic cloud can be polarized or distorted is called Polarizability.

The boiling points of halogens increase from top to bottom i.e. from fluorine to iodine.

3. **Number of atoms:**

As the number of atoms in non–polar molecule increases polarizability of the molecule increases and London forces become stronger.

The boiling points of saturated hydrocarbons increase as the number of atoms increases. For example Boiling point of C_6H_{14} is higher than C_2H_6 because of greater no. of atoms.

Hydrogen Bonding

4. Define and explain hydrogen bonding. What is the origin of intermolecular forces in water?

Ans. **Hydrogen bonding:**

"The electrostatic force of attraction between highly electronegative atom and partial positive hydrogen atom is called hydrogen bonding."

OR

"The electrostatic force of attraction between highly partial positive hydrogen atom of one molecule and highly electronegative atom of other molecule is called hydrogen bonding."

Explanation:

Consider water molecules to understand hydrogen bonding oxygen is more electronegative than hydrogen. So water is polar molecule. There will be dipole–dipole forces of attraction between water molecules. The electrostatic force of attraction between electronegative oxygen of one molecule and partial positive hydrogen of other molecule is called hydrogen bonding.

Strength of H–Bonding:

Hydrogen bonding is stronger than simple dipole–dipole forces.

This is due to the following reasons.

1. There are lone pairs on highly electronegative atom.
2. There is sufficient partial positive charge on hydrogen. Both positively charged hydrogen of water molecules produce strong attraction due to their small size.

Hydrogen bonding in water molecules acts like a bridge between two electronegative oxygen atoms.

Generally, the strength of H–bonding is twenty times less than that of covalent bond.

5. Give the properties of compounds containing hydrogen bonding.

Ans. 1. There are dynamic properties of covalent compounds.

2. Solubility of Hydrogen bonded molecules.
3. Cleansing action.
4. Application of hydrogen bonding in biological compounds.
5. Surface tension.
6. Effect of hydrogen bonding on viscosity.
7. Hydrogen bonding in paints and dyes.
8. Clothing.
9. Food material.
10. Structure of ice.

6. **Explain the following with reason.**

In the hydrogen bonded structure of H–F, which is stronger bond, the shorter covalent bond or the longer hydrogen between different molecules?

Ans. There is sufficient hydrogen bonding in H–F molecules and it gives zig zag structure. Fluorine atom is present at the end while H atoms are entrapped between two strong electronegative atoms. The covalent bond between H and F is stronger because it is produced by the overlapping of orbital's and two electrons have been shared to give sigma bond.

The bond which is shown by the dotted line is the hydrogen bond due to electrostatic forces of attraction so, it is a weaker bond.

7. **Why H_2S is a gas while H_2O is liquid at room temperature?**

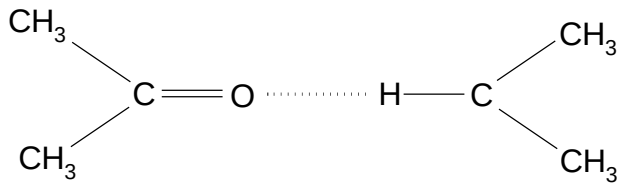
Ans: This is due to high electro negativity of oxygen as compared to sulphur. Water has hydrogen bonding, but H_2S does not have. Due to absence of hydrogen bonding in H_2S at room temperature, it is a gas.

8. **Why the heat of vapourization of water is greater than that of CH_4?**

Ans: Water is a polar liquid and due to strong hydrogen bonding high energy is required to separate the molecules from each other at its boiling point. CH_4 is a non-polar and has weak London dispersion forces. So the heat of vapourization of water is greater than that of CH_4.

9. **H-bonding is present in chloroform and acetone-justify it?**

Ans: Chloroform is a polar compound. Acetone is also a polar compound. When chloroform and acetone are mixed with each other, then they create the forces of attractions due to hydrogen bonding.



10. **In a very cold winter the fish in garden ponds owe their lives to hydrogen bonding. Justify it.**

Ice floats on the surface of water due to its less density. When a thick layer of ice is formed on the surface of water, it serves as an insulator and prevent the further heat loss from water below it. As a result, water below ice remain in liquid state so we can say that in very cold winter, fish in garden ponds owe their lives to hydrogen bonding.

Evaporation

11. **What are the factors that affect the rate of evaporation?**

Ans.1. **Surface Area:**

Evaporation takes place from liquid surface. If area of the surface of liquid increases the rate of evaporation will also increase.

2. **Temperature:**

Temperature also affects rate of evaporation Higher the temperature faster will be the rate of evaporation.

3. **Intermolecular forces**:

Stronger the intermolecular attractive forces slower is the value of evaporation and vice versa.

Vapour Pressure

12. Define and explain the vapour pressure.

Ans. Vapour Pressure:

The pressure exerted by the vapours on the surface of liquid at equilibrium state at a given temperature is called vapour pressure.

Explanation:

Consider a liquid closed in container at a certain temperature. High energy molecules leave the surface of liquid and gather above the surface in the empty space in the form of vapours. These molecules collide with the walls of container as well as with the surface of liquid. In this way they lose some their kinetic energy and there is a chance that these molecules are recaptured by the liquid surface. This process is known as condensation. Both the process i.e. condensation and evaporation continue, till rates of both processes become equal. This state is called dynamic equilibrium, and the pressure exerted by the vapours at this state on the liquid surface at particular temperature is called vapour pressure. Vapour pressure does not depend upon amount or volume of liquid and surface area.

13. What are the factors affecting vapour pressure.

Ans. 1. Nature of liquid

2. Strength of intermolecular forces

3. Size of molecules

4. Temperature.

14. Give variation of vapour pressure and boiling point.

Ans. Vapour pressure is closely related to boiling point. Variation in vapour pressure depends upon the following factors.

1. **Temperature:**

Vapour pressure of a liquid increases by increasing temperature. Higher the temperature more will be the vapour pressure and vice versa. Liquids boil at that temperature when their vapour pressures are equal to 760 torr at sea level. By increasing external pressure boiling point can be increased.

. **Strength of intermolecular forces:**

Stronger the intermolecular forces lower will be vapour pressure and higher will be the boiling point.

15. **Dynamic equilibrium is the ultimate goal of all the reversible chemical and physical changes.**

Whenever a change of state is occurs, the system moves towards the condition of dynamic equilibrium. Dynamic equilibrium the ultimate goal of all the reversible chemical reactions and all physical changes occur at equal rates. Being a chemist we should know that the concept of dynamic equilibrium is the ultimate goal of all the reversible reactions and all the physical changes.

Boiling Point

16. **Define boiling point.**

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

17. **What is the effect of external pressure on boiling point?**

Ans. A liquid boils when its internal pressure becomes equal to external atmospheric pressure so, by changing external pressure, a liquid can be boiled at any temperature. If external pressure is greater, the liquid needs more heat to equalize the internal pressure to external atmospheric pressure. Similarly if external pressure is lower, liquid needs less amount of heat to equalize its vapour pressure, the external pressure. under 700 torr (at Murree hills) water boils at 98oC.

18. **Why the boiling points of the hydrides of second period in group IV-A,V-A,VI-A and VII-A are greater than the Boiling Point of hydrides of third period?**

Ans: The elements of second period are more electronegative than the respective element third period. So,the polarities of the bonds with hydrogen are greater than the third period elements.

$H_2O > H_2S$; $NH_3 > PH_3$; $HF > HCl$; $CH_4 < SiH_4$

19. **What is vacuum distillation? Explain.**

Ans. Definition:

The process in which liquid is heated under reduced pressure, to convert it into its vapours at low temperature and then to condense these vapours into liquid is known as vacuum distillation.

Explanation:

In vacuum distillation boiling point of liquid decreases by reducing the pressure. This is done by connecting the distillation apparatus to the vacuum pump. In this way liquids with high boiling points can be boiled at low temperature.

Energetics of Phase Change

20. Define enthalpy change.

Ans. If physical or chemical change occurs at constant pressure then it is known as enthalpy change.

Liquid Crystals

21. What are liquid crystals? Give their types.

Ans. The molecules which are large somewhat rigid and linear having some of structures of solids showing optical properties and some of the freedom of motion of liquids are called liquid crystals.

Types of liquid crystals:

(a) Smectic liquid crystals.

(b) Nematic liquid crystals.

(c) Cholesteric liquid crystals.

Solids

22. What are solids?

Ans. Solids are those substances which are rigid, hard, have definite shape and definite volume. The atoms, ions, and molecules, that make up a solid are close packed. They are held together by strong cohesive forces.

23. Justify that solids are rigid?

Ans: The solids are very rigid. This rigidity is due to the fixed positions of the particles. The presence of strong cohesive forces makes particles unable to change their positions. This rigidity of solids can be changed under stress

24. Give types of solids?

Ans.There are two types of solids:

(i) Crystalline solids

(ii) Amorphous solids

(i) Crystalline solids:

Those solids in which atoms, ions or molecules are arranged to a definite three dimensional pattern,are called crystalline solids.

(ii) Amorphous solids:

Those solids whose constituent atoms, ions or molecules do not possess a regular orderly arrangement are called amorphous solids.The best examples are glass, plaster and rubber, glue, etc.

25. Describe the types of crystalline solids.

Ans. There are four types of crystalline solids, depending upon the type of bond present in them.

i. Ionic solids.
ii. Covalent solids.
iii. Metallic solids.
iv. Molecular solids

i. **Ionic Solids:**

Crystalline solids in which the particles forming the crystals are positively and negatively charged ions are called ionic solids.These ions are held together by strong electrostatic forces of attraction. These attractive forces are also called i**onic bonds**. The crystals of NaCl, KBr etc. are ionic solids.

ii. Covalent solids:

The crystalline solids in which atoms of similar or different elements are held together by covalent bonds are known as **covalent solids**. They are also called atomic solids.

There are two types of covalent solids.

Type 1: When covalent bonds give joint molecules like diamond, silicon carbide or Aluminum nitride.

Type 2: When atoms join to form the covalent bonds and separate layers are produced like that of graphite, cadmium, iodide and boron nitride.

iii. **Molecular solids:**

The solid substance in which the particles forming the crystals are polar or non–polar molecules or atoms, are called molecular solids. In solidified noble gases, there are non–polar atoms. Two types of intermolecular forces hold them together.

a) Dipole–dipole interactions
b) Vander Waal's forces

These intermolecular forces are much weaker then the forces of attraction between the cations and the anions in ionic crystals and between the atoms in the covalent crystals. Ice and the sugar are the best example of crystals having polar molecules, whereas iodine sulphur and carbon dioxide form crystals containing non–polar molecules.

iv. Metallic solids:

The crystalline solids in which the metal atoms are held together by metallic bonds are known as metallic solids.

Metallic Bond:

The force of attraction that binds positive metal ion to the number of electrons with in its sphere of influence is called **metallic bond.**

Theories of metallic bond:

1. Electron gas theory
2. Valence bond theory
3. Molecular orbital theory

26. What is crystallite?

Ans: The small regions in amorphous solids where particles have a regular arrangement are called crystallites**.**

Properties of Crystalline Solids

27. Crystals have their own habits justify it?

Ans: The shape of a crystal in which it usually grows called habit of a crystal. The shape of the crystal remains same if its conditions remain same. For example When 10%urea is added in NaCl then needle like crystals are formed instead of cubic crystals.

28. Define the following:

(i) Cleavage planes.

(ii) Anisotropy

(iii) Symmetry

(iv) Habit of a crystal

Ans.

(i) **Cleavage planes:** Whenever the crystalline solids are broken they do so along definite planes. These planes are called the cleavage planes.

(ii) **Anisotropy**: Some of the crystals show variation in physical properties depending upon the direction; such properties are called anisotrophic properties and the phenomenon is called anisotropy.

(iii) **Symmetry:** The repetition of faces angles or edges when a crystal is rotated by 360o along its axis is called symmetry.

(v) **Habit of a crystal**: The shape of a crystal in which it usually grows is called habit of crystal.

Crystals and their classification

29. Define the following:

(i) Crystal lattice

(ii) Unit cell

Ans. (i) **Crystal lattice:**

A crystal lattice is defined as an array of points representing atoms, ions or molecules of a crystal arranged at different sites in three dimensional space.

(ii) **Unit cell:**

The smallest part of crystal lattice has all the characteristic features of the entire crystal is called unit cell. The simplest unit cell is a cubic unit cell.

30. Name the crystal systems.

Ans. Trick: (Cu T Or T He Mo Tri)

1. Cubic system
2. Tetragonal system
3. Orthorhombic or Rhombic system
4. Trigonal system
5. Hexagonal system
6. Monoclinic system
7. Triclinic system

Ionic Solids

31. Define lattice energy.

Ans. The energy released when one mole of the ionic crystal is formed from the gaseous ions.It is also defined as the energy required to break one mole of solid into isolated ions in the gas phase. It is expressed in kJ mol^{-1}.

$$Na^{+}_{(g)} + Cl^{-}_{(g)} \longrightarrow NaCl_{(s)} \quad \Delta H \ -792 \text{ kJ mol}^{-1}$$

OR

$$NaCl_{(s)} \longrightarrow Na^{+}_{(g)} + Cl^{-}_{(g)} \quad \Delta H \ +792 \text{ kJ mol}^{-1}$$

32. . What is coordination no. of an ion? What is the coordination no of the cation in

(a)NaCl (b)CsCl?

Ans: The no. of positive ions which surround the anion called coordination no. of anion

(a) Coordination no. Na in NaCl is 6

(b) Coordination no of Cs in CsCl is 8 (due to the greater size of Cs)

Covalent Solids

33. Why diamond is bad conductor of electricity?

Ans: In diamond each carbon is SP^3 hybridized there is no free electron to conduct electricity therefore it is bad conductor.

Molecular Solids

34. . Iodine dissolves readily in tetrachloro methane. Give reason.

Ans. We know that "like dissolve like". Iodine is a non–polar substance. So it becomes solvable in non–polar solvent CCl_4.

35. Justify molecular solids are soft and compressible?

Ans: The forces which hold the molecules together in molecular structure are weak so, they are soft and compressible

Metallic Solids

36. Why metals have shiny surface?

Ans: When light falls on the surface of metals then the electrons are excited after de-exictation they emit energy in the form of light therefore they show shiny surface.

37. Why Na is soft while Cu is hard?

Ans: In sodium only one mobile electron is present while in copper two mobile electrons are present due to strong metallic bond in copper it is hard.

LONG QUESTION

1. **Define Vapour Pressure. How vapour pressure is measured by Manometeric method?**
2. **What are ionic solids? Write four properties of ionic solids?**
3. **What are metallic crystals? Discuss the electron gas theory of metallic bond.**
4. **Define covalent solids with example. Write four properties of covalent solids.**
5. **What are liquid crystals? Write down any three uses of liquid crystals.**
6. **What are molecular solids? Give examples and explain their properties.**
7. **What is the effect of external pressure on the boiling point of a substance? Give example.**
8. **What is H-Bonding? Discuss H-Bonding in biological compounds,**

9. **What is boiling point? What is the effect of external pressure on boiling point? Why the temperature of a liquid remains constant at boiling point although heat is continuously supplied?**

10. **Explain the following properties of crystalline solids. Give two examples in each case.**

(i) Anisotropy **(ii) Polymorphism**