CHAP: 5

States of matter II:

LIQUIDS:-

★ **Liquid:-**

State of matter having constant volume but not constant shape is called liquid.

★ **Properties of Liquids:- (Kinetic Molecular Theory)**

★ **Indefinite Shape:-**

They have indefinite shapes because their molecules can move from their positions. They possess Translational K.E.

★ **Definite volume:-**

Liquids have definite volume because spaces between the molecules is less as compared to gases. The molecules forming the liquid are fairly close to each other. There is very little space between them. As a result the number of collisions among the molecules are moderate.

* Diffusion :-

They have high rate of diffusion as compared to Solids. The rate of diffusion depends on Temperature. According to Kinetic Molecular Theory;

$E_K \propto T$.

Diffusion is more when K.E is more.

* Density :-

Liquids have high density as compared to gases.

$$d = \frac{m}{V}$$

Liquids have less volume unlike gases so their density is more.

* Incompressibility :-

There is no effect of pressure on volume of the liquid. This property is called incompressibility.

* Intermolecular forces :-

They have strong intermolecular forces as compared to gases.

* Freezing :-

When temperature is decreased, liquid is changed into solid, this property is called freezing and solidification.

★ Vaporization :-

Change of liquid into vapours is called vaporization

★ Expansion (effect of temperature) :-

Liquids expand on heating because the intermolecular forces between them decreases.

INTRA-MOLECULAR FORCES :-

Intra means = within

"Forces of attraction within a molecule"

Intramolecular forces are the forces within the molecules. They are strong forces and are also called chemical bonds.

Eg; Covalent bond, Coordinate covalent bond, Ionic bond.

$H-Cl$, Na^+ , Cl^-

↳ Intra molecular forces → intramolecular forces.

★ INTERMOLECULAR FORCES :-

Inter "means" between

"Force of attraction between two different molecules are called intermolecular forces."

Eg; $H^{+\delta}-Cl^{-\delta} \cdots H^{+\delta}-Cl^{-\delta}$ They are also called

Vander Waal's forces.

⟹ Types of intermolecular forces :-

There are five types

1. Dipole - dipole forces
2. Ion - dipole forces
3. Dipole - induced dipole forces (Debye forces)
4. London dispersion forces or Instantaneous dipole induced dipole forces.
5. Hydrogen bonding.

★ ① Dipole - dipole forces :-

These forces are present between polar molecules. In polar molecules, there are two poles, positive pole and negative pole. Therefore, it is called a dipole.

"Force of attraction between the positive pole of one molecule and negative pole of the other are called dipole-dipole forces."

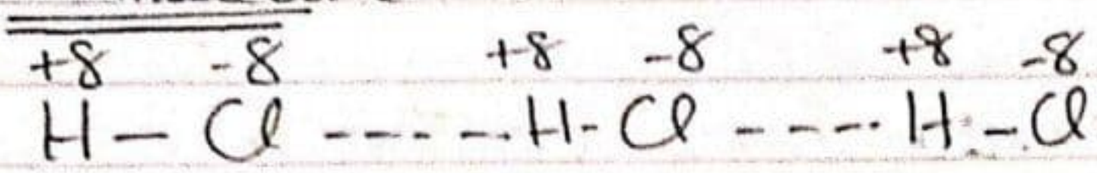
These forces are 1% effective as the covalent bond. Strength of dipole-dipole forces depends on;

a) Electronegativity difference between two bonded atoms

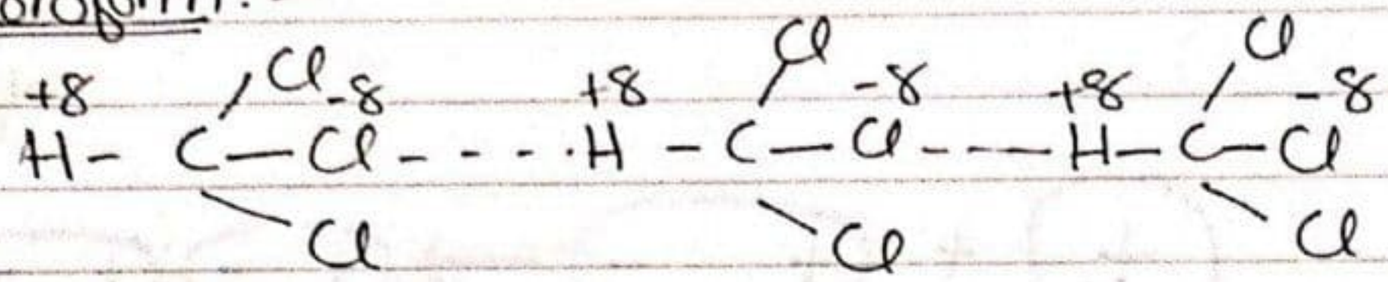
b) Distance between two molecules.

★ Example :-

HCl molecule :-



Chloroform :-

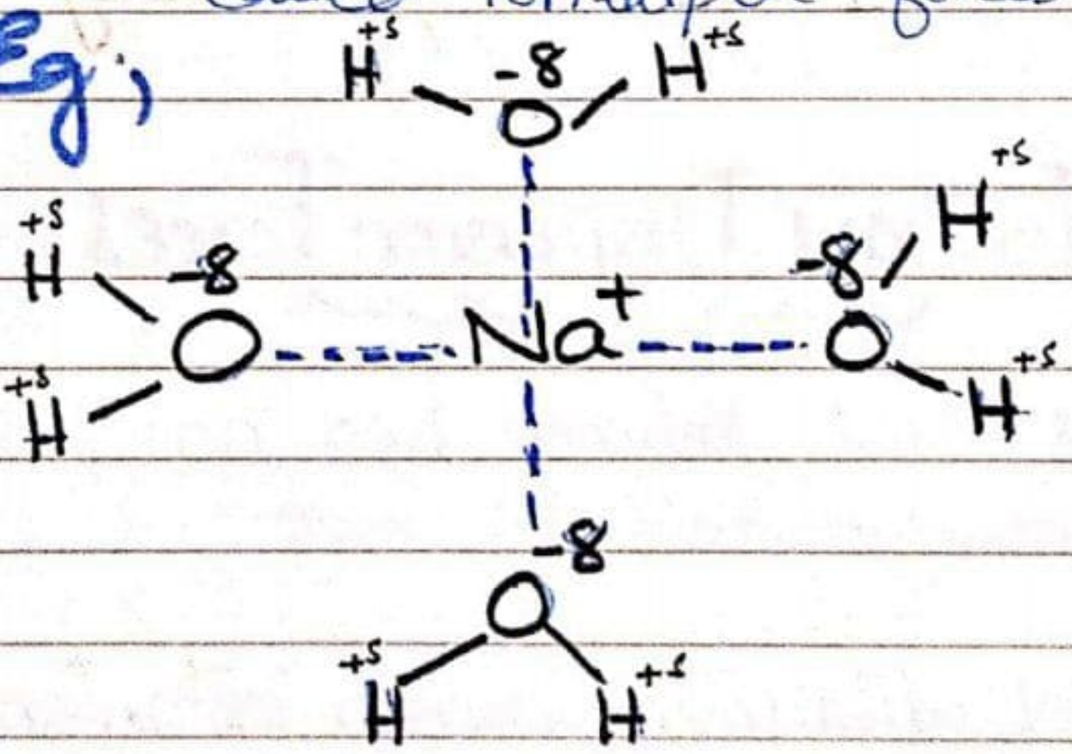


② Ion-dipole forces

These forces are present when ionic compound is dissolved in polar solvent.

" Force of attraction between ion and opposite pole of polar solvent are called ion-dipole forces. "

* Eg;

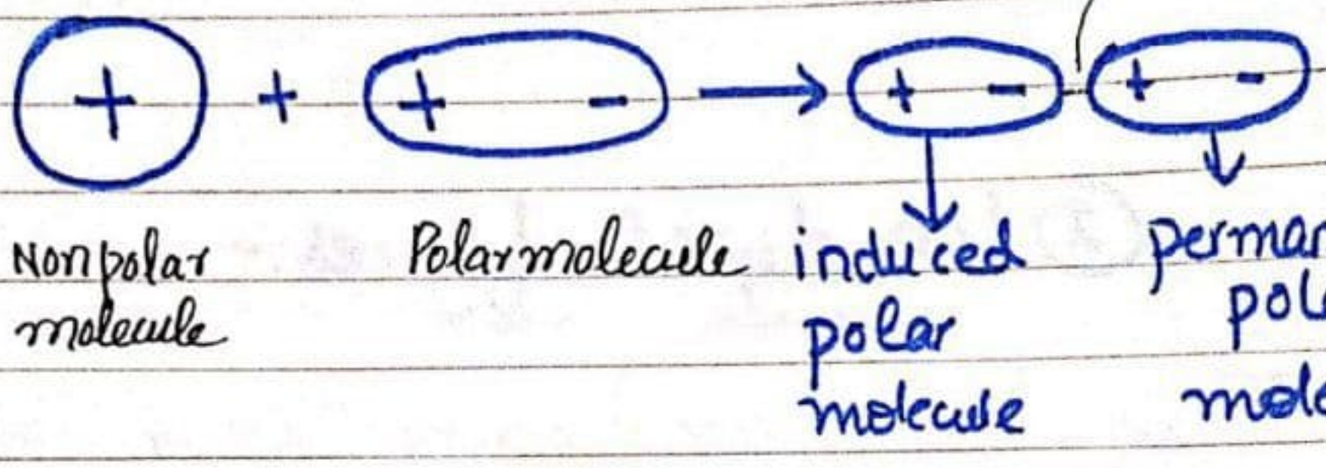


③ Dipole induced dipole forces :-
(Debye forces)

These forces exist between polar molecules and non-polar molecules.

"

Forces of attraction between Permanent Polar molecule and Induce Polar molecules are called dipole induced dipole forces. "



* Example :-

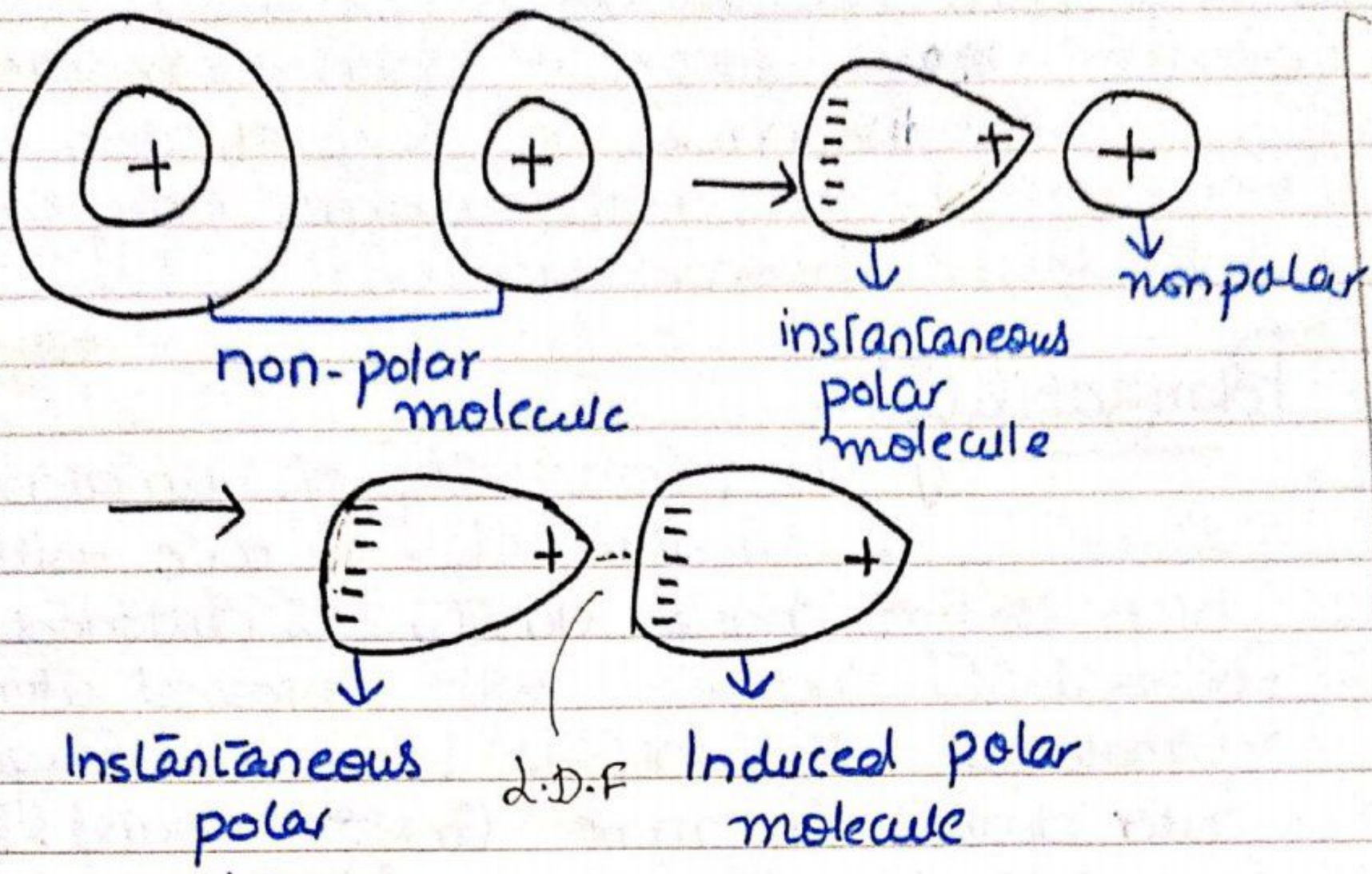
Ether is 5% soluble in water And 95% insoluble. It is soluble because of Debye forces.

④ London Dispersion Forces :-

These forces exist between two non-polar molecules.

" Force of attraction between instantaneous polar molecule and induced polar molecule are called London dispesion forces. "

These forces are also called Short-lived forces. or Temporary forces



★ FACTORS :-

Strength of london dispersion forces depends on;

(1) Size of atom or molecule OR Atomic or Molecular size
OR
Size of electronic cloud.

(2) Polarizability

(3) Number of atoms in a molecule.

Size of atom or molecule OR size of electronic cloud OR Atomic OR Molecular size :- Size of electronic cloud is directly proportional to london dispersion forces.

Eg; In noble gases, melting and

boiling point increases down the group. This is because noble gases are non-polar molecules. With the increase in size of atom or molecule, the dispersion becomes easy and these forces become prominent.

2- Polarizability :-

The polarizability of an atom or molecule is a measure of the ease with which electron charge density is distorted. Polarizability increases with increased atomic or molecular size. This is because in large atoms, outer electrons are more loosly bound. They can shift towards another atom more readily.

3- Number of atoms in a molecule :-

Elongated molecules make contact with neighbouring molecules over a greater surface than do small molecules. Greater the number of atoms in a molecule, greater is the polarizability of the molecule.

Eg; C_2H_6 has boiling point ; -88.6°C
and C_6H_{14} has boiling point ; 67.7°C

This shows that molecules with large chain length expeiences stronger attractive forces

boiling point increases down the group. This is because noble gases are non-polar molecules. With the increase in size of atom or molecule, the dispersion becomes easy and these forces become prominent.

2- Polarizability :-

The polarizability of an atom or molecule is a measure of the ease with which electron charge density is distorted. Polarizability increases with increased atomic or molecular size. This is because in large atoms, outer electrons are more loosely bound. They can shift towards another atom more readily.

3- Number of atoms in a molecule :-

Elongated molecules make contact with neighbouring molecules over a greater surface than do small molecules. Greater the number of atoms in a molecule, greater is the polarizability of the molecule.

Eg; C_2H_6 has boiling point ; -88.6°C
and C_6H_{14} has boiling point ; 67.7°C

This shows that molecules with large chain length expeiences stronger attractive forces

⑤ Hydrogen Bonding:-

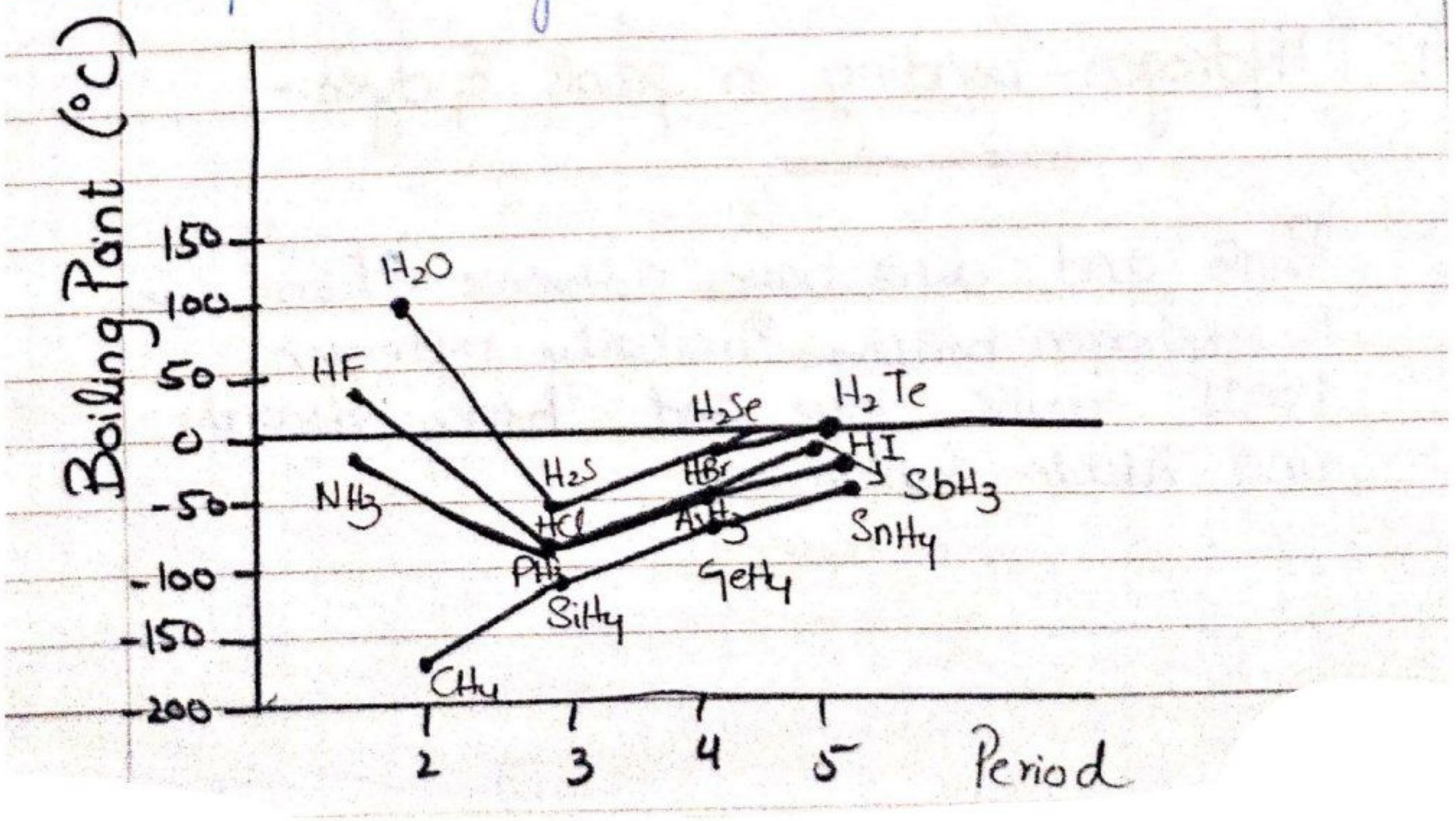
"A hydrogen bond is the attraction between the lone pair of an electronegative atom and a hydrogen atom that is either bonded to N, O, or F."

A hydrogen bond is weaker than covalent bond but stronger than dipole-dipole interactions. These forces are 20% as compared to covalent bond

* Applications of H-Bonding:-

1- Thermodynamic Properties:-

The molecules or compounds having H-bond have high thermodynamic Properties. e.g; melting points, boiling points, are high.



The hydrides of group IV-A have lower boiling points. The reason is that these hydrides are non-polar and have only London dispersion forces.

Hydrides of group V-A, VI-A and VII-A have polar molecules. NH_3, H_2O & HF show maximum boiling points. This is due to H-bonding in their molecules.

2- Solubility of Hydrogen bonded molecules:-

The compounds that have hydrogen bonds are soluble in each other.

Eg; Alcohol and water.

Carboxylic acid and water

3- Cleansing Action:-

Soaps and detergents perform cleansing action. Their molecules contain polar and non-polar ends. The polar parts are water soluble due to hydrogen bonding and non-polar part dissolve oil or grease.

4- Hydrogen-bonding in paints & dyes:-

Paints and dyes have adhesive action due to Hydrogen bonding. Similarly hydrogen bonds make glue and honey viscous and stickle substances.

5- Clothing:-

We use cotton, silk or synthetic fibres for clothing. Hydrogen bonding is of great importance in thread making materials. This hydrogen bonding is responsible in their rigidity and tensile strength.

6- Food Materials:-

Food materials like Carbohydrates consist of glucose, fructose, sucrose, each of them contains -OH groups which is responsible for H-bonding in them.

7- H-bonding in biological molecules:-

The structure of protins is determined partly by H-bonding. The action of enzymes depends on the forming and breaking of hydrogen bonds. The heridatory information is carried in nucleic acids which are joined by H-bonds.

Questions Related To H-Bonding:-

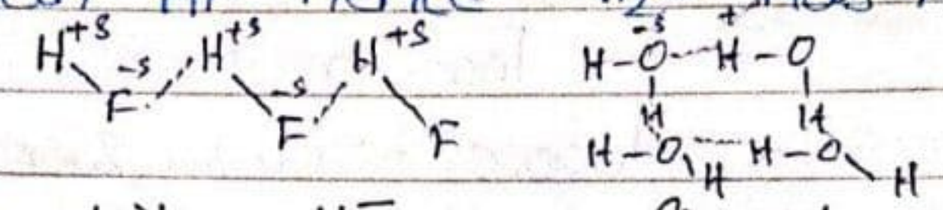
Question 1: Boiling Point of water (H_2O) is greater than H_2S. Explain:-

Answer:

In H_2O, there is H-bonding whereas in H_2S there are dipole-dipole forces which are weaker than H-bonding. H_2O has high thermodynamic properties due to H-bond.

Question 2:- Why Boiling point of H_2O is greater than HF? Although Flourine is more electronegative than Oxygen.?

In case of HF, only one hydrogen bond can be formed. while H_2O can form two Hydrogenbonds. So, in H_2O H-bonding is stronger than HF hence H_2O has higher Boiling Point.



Question 3:- Why HF is a liquid and NH_3 is a gas?

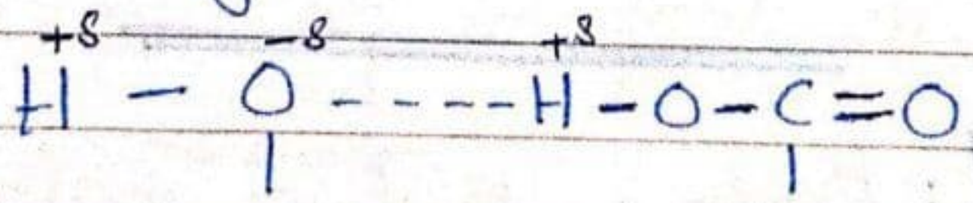
NH_3 has Nitrogen having electronegativity less than Flourine in HF bond.

Therefore due to strong forces in HF bond, it is a liquid rather than gas.

Question 4:- Why small aliphatic carboxylic acids are soluble in water?

They are soluble in water due to Hydrogen bond.

Eg;



Question 5:- Why ice floats on water?

Ice floats on water due to low density. After 4°C, water behaves abnormally. Its volume increases and density decreases. When arranged properly, there are spaces among H_2O molecules. Volume increases by 9% in case of ice

✱ Properties Of Liquids :- (Physical)

There are 3 kinds of physical properties of liquids.

(1 Additive properties :-

Such properties which depend upon number and kind of atoms present in a molecule are called additive properties.

Eg; molar mass.

(2 Constitutive properties :-

Properties which depend upon arrangement of particles in a molecule are called constitutive properties.

Eg; optical activity.

(3 Colligative Property :-

Properties which depend upon number of particles and not on nature of particles are called colligative properties.

Eg; molar volume, lowering of vapour pressure, osmotic pressure.

✱ EVAPORATION :-

" Spontaneous change of liquid into vapours is called evaporation. "

✱ It takes place at all temperatures.

✱ It is a spontaneous process.

✱ It is a cooling process.

⇒ Explanation :-

Evaporation is the process in which liquid molecules escape from the surface and enter gas phase. Surface molecules whose kinetic energies are higher than average kinetic energies, overcome the intermolecular forces that bind them to liquid phase. After their escape, the average kinetic energy of the liquid molecules decreases and temperature decreases. So, evaporation is a cooling process.

⇒ Factors :-

It depends on the following factors;

a) Temperature :-

Temperature is directly proportional to rate of evaporation.

When temperature is increased, the number of molecules having kinetic energy sufficient to overcome intermolecular forces increases. They escape more readily from the liquid surface.

Thus, rate of evaporation increases with increasing temperature.

* Example;
Cloths dry more redily in Summer due to high temperature.

b) Surface Area:-
The rate of evaporation increases with increasing surface area. This is because large surface area allows more molecules to evaporate.

* Example;
Tea in a saucer gets cooled more quickly than tea in a cup because of more surface area of a saucer.

c) Intermolecular forces:-
The escaping Tendency of molecules depend upon attractive forces between the molecules, the liquids with strong intermolecular forces & have less evaporation.

* Example;
Water has H-bonding while petrol

has weak dispersion forces. Therefore water has less rate of evaporation and petrol is volatile.

★ VAPOUR PRESSURE :-

"Pressure exerted by vapours on the surface of the liquid when rate of evaporation is equal to rate of condensation is called vapour pressure it is measured in close container Manometer is used to measured V.P. of liquid"

⇒ Factors :-

Vapour pressure is independent of amount of liquid, therefore, it is called intensive property of a liquid. It depends on the following factors -

a) Intermolecular forces :-

Intermolecular forces is inversely proportional to vapour pressure. Liquids having stronger intermolecular forces possess low vapour pressure. Eg; water has low V.P than petrol.

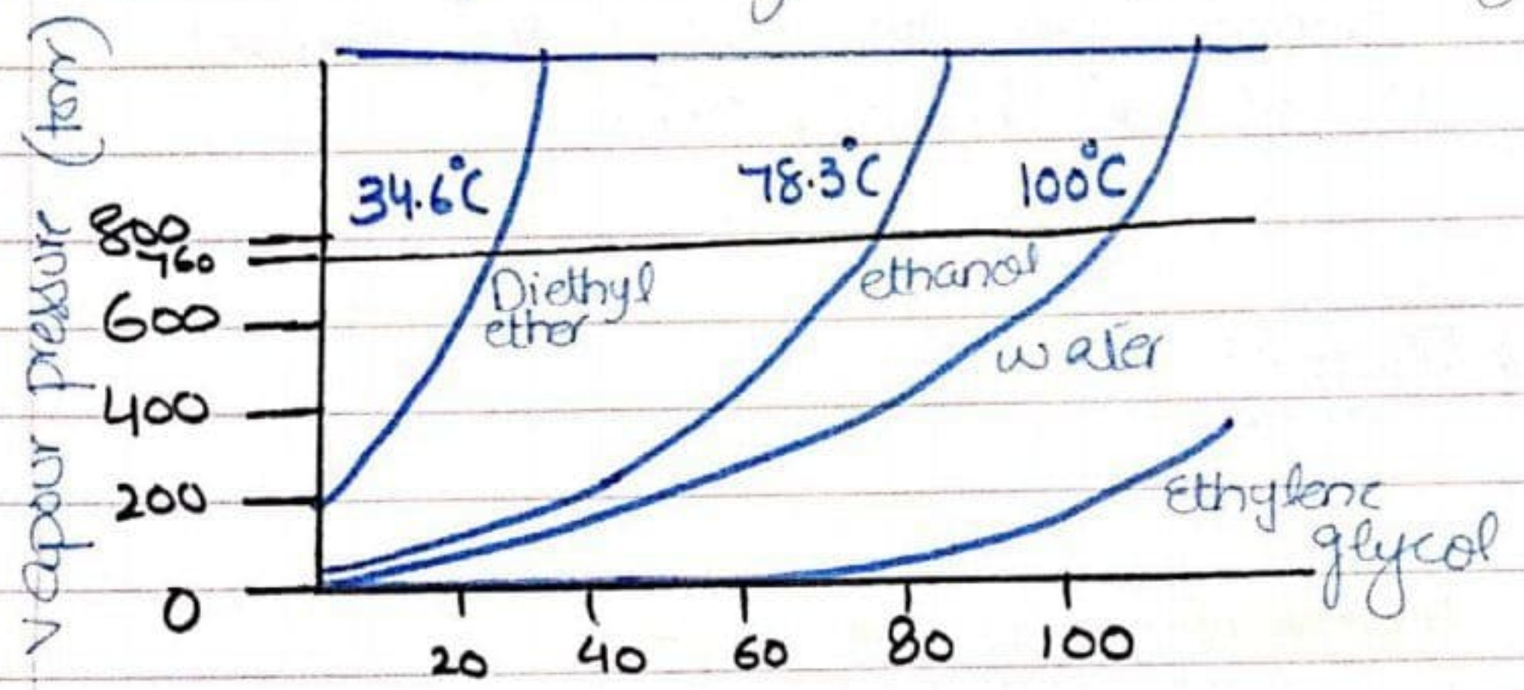
b) Temperature :-

As the temperature increases, the vapor pressure increases. This is because increase in temperature increases the average K.E of the

molecules, which in turn decreases the intermolecular forces.

* Example;

Vapour pressure of water at 0°C is 4.6mm of Hg. And vapour pressure of diethyl ether (185mm Hg) at 0°C



is much greater than that of ethanol (12mm) or water (4.6mm of Hg). Ether is non-polar in nature. Therefore, its high vapour pressore is due to weak dispersion forces. Similarly, in ethanol H-bonding is not as strong as water so ethanol has high vapour pressure than H_2O.

Ethyleneglycol < H_2O < C_2H_5OH < diethylether

⇒ Factors on which vapour pressure doesn't depends;

① Surface Area ② Amount of liquid.

✳ Boiling Point :-

"Temperature at which vapour pressure of a liquid become equal to external pressure above the liquid is called boiling point."

⇒ Factors :

a) Intermolecular forces :-

Strength of intermolecular forces is directly proportional to boiling point of a liquid.
Liquid having strong intermolecular forces has high boiling point.

b) External pressure :-

External pressure is directly proportional to boiling point. Higher the external pressure, greater will be the boiling point of a liquid.

⇒ Elevation of Boiling Point :-

When external pressure is increased, B.P of a liquid is also increased. This is called elevation of Boiling point.

⟹ Depression of Boiling Point:-

When external pressure decreases, boiling point also decreases. This is caued depression of boiling point.

⟹ Examples;

(i) Boiling of H_2O is 100°C at 760 torr

(ii) B.P of H_2O is 25°C at 23.7 torr

(iii) B.P of H_2O is 69°C at 323 torr

(iv) B.P of H_2O is 120°C at 1489 torr

⟹ Applications of Boiling Point:-

① Pressure Cooker:-

Pressure cooker is a closed container. The external pressure is high so the boiling point of water is also increased so any food material in pressure cooker is easily cooked due to high temperature.

② Vacuum Distillation:-

Distillation under reduced pressure is called vacuum distillation.

For example; glycerine.

Boiling point = 290°C at 760 torr.

when pressure is reduced to 50 torr, it boils at 210°C without decomposing because boiling point depends on external pressure and decomposition temperature remains the same i.e 290°C.

In this way, liquids can be purified.

✱ VISCOSITY :- (η)

"Internal resistance in the flow of liquid is called viscosity."

⟹ Reason / Cause :-

The resistance to flow is due to internal friction between the layers of the molecules. The layes adjacent to the walls have the lowest velocity. Each layer exerts a drag on one another and thus causes resistance to flow

⟹ Example :-

It is easy to pour water from one container to another because it is less viscous than honey or glycerine. Honey & glycerine are more viscous.

$$\eta = \frac{F}{6\pi r v} = \frac{N}{m \cdot ms^{-1}} = \frac{Kgms^{-2}}{m^{-1}s^{-1}} = \boxed{Kgm^{-1}s^{-1}}$$

$\boxed{Nm^{-2}s}$ ↑

⇒ UNITS:

SI unit of viscosity is $Kgm^{-1}s^{-1}$ or $Nm^{-2}s$.

Non SI unit of viscosity is Poise.

1 Poise = $gm^{-1}s^{-1}$ or $0.1\ Kgm^{-1}s^{-1}$

⇒ Factors affecting viscosity :-

Viscosity depends upon the following factors;

i) Shape & Size of molecules:-

If molecules have small size and regular shape then viscosity will be less. Eg; water, alcohol, Acetone etc.

If size of molecules is large and shape is irregular then, viscosity will be more.

Eg; glycerine, honey.

Muhammad Javed Iqbal
HOD Chemistry
Askaria Colleges Rwp.

ii) Temperature :-

When temperature increases, the K.E of molecules of liquid increases and their resistance to flow decreases thus decreasing viscosity.

Therefore, temperature is inversely related to viscosity.

Eg; Honey can be poured easily when heated.

iii) Intermolecular forces:-

Intermolecular forces are directly proportional to viscosity. If intermolecular forces are strong, viscosity will be more and vice versa.

Eg; H_2O has more viscosity than CH_3OH because intermolecular forces are strong in H_2O i.e Hydrogen bonding.

---

* SURFACE TENSION (γ)

"

Amount of energy required to expand the surface of liquid by a unit area is called Surface Tension.

"

It is denoted by gamma (γ).

⇒ Explanation :-

Surface tension is the property of the surface of the liquids to act as if there is a membrane stretched across it. All molecules below the surface of the liquid are surrounded in all directions

by other molecules. However, the molecules on the surface of the liquid have an unbalanced force pulling the surface molecules inward.

⟹ Unit:-

SI unit of surface tension is Nm^{-1} or Jm^{-2}. $\boxed{\gamma = \frac{F}{L} = \frac{N}{m} = Nm^{-1}}$

$\gamma = \frac{N}{m} \times \frac{m}{m} = \frac{Nm}{m^2} = Jm^{-2}$ $\quad \because Nm = J$

⟹ Factors:-

i) Temperature:-

Temperature is inversely proportional to surface tension. If temperature is increased, surface tension decreases, because intermolecular forces decrease.

ii) Intermolecular forces:-

Stronger the intermolecular forces, greater will be the surface tension.

For eg; Surface tension of water is higher than many liquids such as alcohol.

iii) Surface Area:-

If surface area is decreased, surface tension increases.

For eg; surface tension of a water droplet is more than water in a lake.

✱ Anomalous Behaviour of Water :-

Water has the most unusual behaviour, on heating and freezing.

In ice at 0°C, hydrogen bonds hold water molecules in a rigid but open hexagonal structure. As ice melts, some of the hydrogen bonds are overcome, and water molecules move into the holes that were present in ice structure. When ice melts, there is an about 9% decrease in volume and density increases. That's why ice floats on water.

When heat is continously provided, water reaches to a maximum density at 3.98°C.

⟹ Survival of Aquatic life :-

In cold regions, when temperature falls below 4°C, the more dense water sinks to the bottom of the lake. The colder surface water freezes, first, and remains at top to cover the lake. This layer of ice acts as an insulator. So, aquatic life survives in cold weather as well.

★ Concept Of H-Bonding To Explain Properties Of Water :-

i) High Surface Tension :-

A stretched membrane is formed on the surface of water. The force on the surface acting downwards is due to strong hydrogen bond in water. Therefore, a high surface tension is observed.

The surface tension of water is highest, i.e ;

$7.275\ Nm^{-1}$

ii) High Specific heat :-

Specific heat is the quantity of heat required to raise the temperature of 1g of a substance by 1°C.

The specific heat of water is 4.180J/g/°C.
It is much higher than those of metals.
It takes a large amount of heat to

increase water's temperature. Conversely, much heat is given off by water even for a small drop in temperature.

⟹ Application in practical life:-

a) The vast amounts of water on the surface of Earth acts as a giant heat reservoir to moderate daily temperature variations.

iii) High heat of Vaporization :-

water has high heat of vaporization due to excessive hydrogen bonding. A large amount of heat is required to evaporate even a small amount of water.

⟹ Application:

a) Large amount of body heat can be dissipated by the evaporation of small amounts of water, from skin. (perspiration)

b) It is also responsible for climate-modifying property of lakes & oceans

iv) High Boiling Points :-

Water has high B.P due to strong H-bonding.

The boiling point of water is 100°C at 760 torr while that of alcohol is 78°C due to weak forces. And ether has 45°C

* ENERGETICS OF PHASE CHANGES :-

When a substance undergoes a phase change its temperature remains constant even though heat is being added.

A - MOLAR HEAT OF FUSION (ΔH_f) :-

Amount of heat required to convert one mole of solid into liquid is called molar heat of fusion.

For eg;

$$H_2O_{(s)} \longrightarrow H_2O_{(l)} \qquad \Delta H_f = 6.02 KJmol^{-1}$$

B- MOLAR HEAT OF VAPORIZATION:-

Amount to convert one mole of liquid into vapours is called molar heat of vaporization

Eg;

$$H_2O(l) \rightarrow H_2O(g)$$

$$\Delta H_v = 40.7 KJmol^{-1}$$

C- MOLAR HEAT OF SUBLIMATION:-

Amount of heat required to convert one mole of solid into vapour without going through liquid state is called molar heat of sublimation.

$$I_{2(s)} \rightleftharpoons I_{2(g)}$$

$$\Delta H_s = 41.8 JKmol^{-1}$$

★ ENERGY CHANGES AND INTERMOLECULAR FORCES :-

As a result of melting of a solid, a small change in intermolecular distance and potential energy takes place in atoms, molecules or ions.

On the other hand on evaporation of a liquid, atoms, molecules or ions undergo large changes in their intermolecular distance and potential energy.

Thaefore, heat of vaporization is much greater than heat of fusion.

⟹ Particular examples :-

i) H_v for H_2O is $40.6\ KJ\ mol^{-1}$ at 100°C.
Because of polar nature nature and strong intermolecular forces, Hv is high :
Heat of fusion will be :
$H_2O = 6.02\ KJ\ mol^{-1}$ at 0°C.
Hf is less than Hv.

ii) I_2 is a volatile solid. It has the highest value of heat of sublimation i.e $41.80\ KJ\ mol^{-1}$ at 185.4°C.

* DYNAMIC EQUILIBRIUM:-

The state at which change of two physical states occurs simultaneously at the same rate is called dynamic equilibrium.

AT dynamic equilibrium, rate of evaporation is equal to rate of condensation In evaporation, liquid is converted to vapours. And in condensation, vapours are converted to liquid.

$$\text{Liquid} \underset{\text{condensation}}{\overset{\text{evaporation}}{\rightleftharpoons}} \text{Gas}$$

Eg;

$$Ice_{solid} \rightleftharpoons Water_{liq}$$

---

* v.v.v.g.

LIQUID CRYSTALS:-

Definition:-

"Turbid liquid having property of liquid as well as crystal (solid) is called liquid crystal."

For example;

Viscosity, surface Tension are the properties of liquid. Optical activity and

isomerphism are properties of solid.

⟹ Example of liquid crystal :-

Cholesteryl benzoate is the example of liquid crystal.

Mercury and honey are liquid crystals.

⟹ Temperature :-

It exists between melting and clearing temperature.

Solid crystal ⟷ liquid crystal ⟷ Clear liquid.

⟹ Properties of liquid crystals :-

1. They are temperature sensors.
2. They are viscous and have surface tension.
3. They are isotropic.

⟹ Uses of liquid crystals, in daily life

1. They are used to monitor temperature changes. Eg; In thermometers for measuring skin temperature of infants.

② They're used to find point of potential failure in micro-electronic circuits.

③ They are used to locate veins, arteries and tumors. it changes colour with temperature change.

④ They are used in display of numbers and letters.

⑤ They are used in LCD screens and oscillographs.

⟹ Difference between liquid crystals From pure liquids & crystalline solids :-

① Liquid crystals are isotropic while crystalline solids are anisotropic and isotropic. Pure liquids remain as such

② Liquid crystal exists between liquid and solid state i.e.
Crystalline solid ⟺ Liquid crystal ⟺ Pure liquid

③ liquid crystal has optical properties while liquids donot have them.

④ Liquid crystal is intermediate in b/w pure liquid and crystallin Phase

EXERSICE

Q¹:- MCQs

i) c
ii) d
iii) c
iv) d
v) c
vi) a
vii) b
viii) a
ix) a
x) b
xi) b
xii) d
xiii) d
xiv) a
xv) d
xvi) a
xvii) a

Q²: part(i) Give general properties of liquids as to

(a) Diffusion:-

The diffusion in liquids takes place because the molecules move from one place to another due to K.E. The diffusion between closely packed molecules of liquid is slow due to less collision between them.

Eg; a drop of ink when added to water diffuses slowly due to relatively small empty spaces between the molecules.

b) Compression (effect of pressure) :-

A liquid cannot be compressed significantly by increasing pressure because the molecules are already in close contact with one another. There is negligible compression in liquids.

Q²: part (ii), (iii), (iv), (v) — See Theory [pg# 2-6] (intermolecular forces)

Q²: part (vi) — See theory [pg# 7]

Q²: part (vii) — See theory [pg# 8]

Q²: part (viii) — See theory [pg# 11, 12]

Q²: part (ix) — See theory [pg# 14]

Q²: part (x): How will you differentiate liquid crystals from pure liquids?

NS:	Liquid crystal	Pure liquid
(1)	Liquid crystal is a state existing between liquid and solid. It exists at clearing temperature	Pure liquids can exist at room temperature.

2) Liquid crystals are always Isotropic	Pure liquids can be isotropic or anisotropic
3) Liquid crystals are long chain molecules that spontaneously line up into crystal arrangements.	Normal or Pure liquids dont. They are not long chain molecule.
4) They have properties of solid crystals and pure liquids. Eg; optical properties, viscosity.	Pure liquids dont have properties of solid crystals.

Q²: part(xi) :- Why distillation under reduced pressure is often used in purification of chemicals?

ANS: Vacuum Distillation :-

Distillation under reduced pressure is called vacuum distillation.

Chemicals can be purified by vacuum distillation because it decreases the boiling point of a chemical without decomposing it hence purifying the chemical.

Q2: part (xii) : You wish to have a "five minute" boiled egg for breakfast. For each of the following locations, would you cook your egg less than or more than 5 minutes to produce your "five minute" boiled egg. Explain your answers of the following.

a) You are at the top of Whittler Mountain in British Columbia.

At more height or altitude, the external temperature decreases thus decreasing the boiling point of water. So, more time will be taken at low temperature. Therefore, the egg will boil in more than 5 minutes.

b) You have breakfast 2000m underground in a gold mine, Ontario.

Underground, external pressure increases and so does the boiling point. So, the egg will boil in less than 5 minutes in less time.

c) You have breakfast on a sunny day at sea level.

The egg will boil at 100°C at 760 mm of Hg in 5 minutes at sea level.

Q²: part (xiii) :- Explain

a) What happens to the particles of solid at its melting point?

At melting point, the particles of solid start vibrating about their mean positions more energetically and leave their fixed positions hence converting into liquid state.

b) What happens during evaporation in a liquid?

During evaporation, the molecules on liquid surface having high K.E ~~too~~ escape into gaseous state. Only molecules with low energy are left in liquid state and absorb energy from the surroundings thus causing cooling.

c) Why a given gas occupies all available space?

A given gas occupies all availabe space because in gas, molecular space is very large and the motion is random. So gas molecules occupy all available space due to weak intermolecular forces.

d) The latent heat of fusion?

"The amount of heat released or absorbed from a substance at constant temperature as you change liquid to solid or solid to liquid is called latent heat of fusion."

Q²: part(xiv):- Explain

a) How liquids mix?

Liquids mix by slow diffusion. The intermolecular forces in liquids is stronger than gases therefore, the diffusion is slow and mixing is also slow.

Eg; Drop of ink added to water.

b) Why temperature of a boiling liquid doesnot reise at its boiling point?

At boiling point, the temperature of a liquid doesnot raise eventhough heat is continously supplied to it because at boiling point, heat provided is used up in overcoming intermolecular forces of liquid, among its molecules.

Q³ (a), (b) — See Theory [pg# 1, 2] part (c) — (xiv)

Q4 a,b - See theory [pg# 2-6]

Q5 a,b,c - See theory [pg# 7,8]

Q6, a,b,c - See theory [pg# 8,9]

Q7 a,b,c - See theory [pg# 9,10]

Q8 a,b - See theory [pg# 10,11]

Q9 (a) - See theory [pg# 11,12]
(b) - See theory [pg# 13]

Q10 a,b - See theory [pg# 11,12]
c - See theory [pg# 15]
d - See theory [pg# 14]

Q12 a) How will you relate enegy changes with changes in intermolecular forces?

There are forces of attraction or repulsion that exist between molecules of all substances.

All phase changes involve either an increase or decrease of intermolecular forces.

When enegy is provided to any substance, intermolecular forces among the molecules decreases. Eg; Solid → Liquid.

When energy is given out by an any substance, intermolecular forces inaeas. eg; Liquid - Solid.

Q13:- a, b, c — See theory [pg 15, 16]

Q14:- —— See theory

Q15:- Same as Q4.

Q16:- pg#14

Q17 a) pg# 1 , b) pg# 15

Q18:- Same as Q7

Q19:- pg#12

Q20:- pg # 15

THE END