EXERCISE

MULTIPLE CHOICE QUESTIONS

1. Choose the correct answer (MCQs).

i. Van Der Waal's forces are effective.

a) At long distance
b) Both at long as well as short distance
c) Only at short distance
d) Independent of distance

ii. Which one of the following forces are also called London forces?

a) Ion-dipole forces
b) Dipole-induced dipole forces
c) Dipole-dipole forces
d) Dispersion forces

iii. Which of the following two halogens are gases at room temperature.

a) Fluorine and Iodine
b) Chlorin and Bromine
c) Fluorine and Chlorine
d) Iodine and Bromine

iv. The intermolecular forces are of

a) Two types
b) Three types

v. Thermostat is an instrument which

a) Increases the temperature
b) Decreases the temperature
c) Maintains the temperature
d) Fluctuate the temperature

vi. The scientist who discussed the phenomenon of viscosity are

a) Poisentille
b) Newton
c) Fritz
d) Vander Wall

vii. The distillation under reduced pressure is called

a) Fractional distillation
b) Vacuum distillation
c) Steam distillation
d) Pressure distillation

viii. The unit of surface tension is

a) Newton per meter
b) Newton per meter square
c) 760mm of Hg
d) Newton square per meter

ix. The flow of the liquid where the velocity of layers is not too large is called

a) Streamlined flow

d) None of these

x. The intermediate phase lying between the solid phase and the norm.al liquid phase is called

a) Crystalline solid
b) Liquid crystals
c) Mesogens
d) Crystal lattice

xi. In which of the following are the particles the most disordered?

a) Water at100°C
b) Steam at 100°C
c) Impure water at 102 °C
d) Water at 10°C

xii. Which of these statements best supports the rife that matter is made up of particles?

a) Liquids always fill the space available to them
b) liquids are easy to compressible
c) 1 cm^3 of water procures nearly 1700 cm^3 of steam
d) If a bottle of perfume is opened. the smell spread quickly

xiii. Which of these processes involve a weakening of the attraction between particles?

(a)Condensation

(b)Freezing

(c)Crystallization

(d) Evaporation

a) Measure its BP
b) React it with ethanol
c) Burn it completely in oxygen
d) Dehydrate it with concentrated H_2SO_4

xv. A flask contains the liquid chloroform and water. They are separated using a separating funnel, which conclusion can · be from this observation alone.

a) Chloroform and water have different relative molecular masses
b) Chloroform and water have different boiling points
c) Chloroform has a higher density than water
d) Chloroform and water do not mix

xvi. Which of the following is the best method of obtaining water from ink?

a) Distillation
b) Filtration
c) freezing
d) Chromatography

xvii. To help diagnose illness, doctors often need to know which amino acids are present in blood or urine. Which method is common by used to separate and identify amino acids?

a) Chromatography
b) Distillation
c) Re-crystallization
d) Filtration
e) Sublimation

Answers:

i c	ii d	iii c	iv d	v c	vi a

vii. b	viii. a	ix. a	x. b	xi. b	xii. c
xiii. d	xiv. a	xv. d	xvi. d	xvii. a	

2: Write brief answer to the following.

i. Give the general properties of liquids as to

(a) Diffusion (b)Compression

Ans.(a) Diffusion of liquids:

The diffusion in liquids takes place because the molecules place to another due to K.E. The restricted movement of the molecule reduces the rate of diffusion

Example:

A drop of ink when added to water diffuses slowly due to relatively small empty spaces between the molecules. The diffusion between closely packed molecules of liquids slow due to less collision between them.

Compression of liquid (effect of pressure):

A liquid cannot be compressed significantly by increasing the pressure because the molecules are already in close contact with one another

Example:

An increase of pressure from one to two atmospheres reduces the volume of water to 0.0045 percent which is negligible. However, the same pressure reduces the volume of a gas up to 50 percent.

ii. What are Intermolecular forces?

Ans. Inter molecular forces:

The forces of attractions among the molecules of a substance are called

inter-molecular forces.

Water exists as a liquid due to inter-molecular attractions called Hydrogen bonds. The forces of attraction existing between the molecules of a non-polar substance is also known as Van Der-Waal's forces.

iii. What are the types of intermolecular forces give examples?

Ans. Intermolecular Forces (Van Der-Waal's forces):

The forces of attractions among the molecules of a substance are called inter molecular forces.

Types:

The intermolecular forces are of five types·

Dipole-Dipole forces:

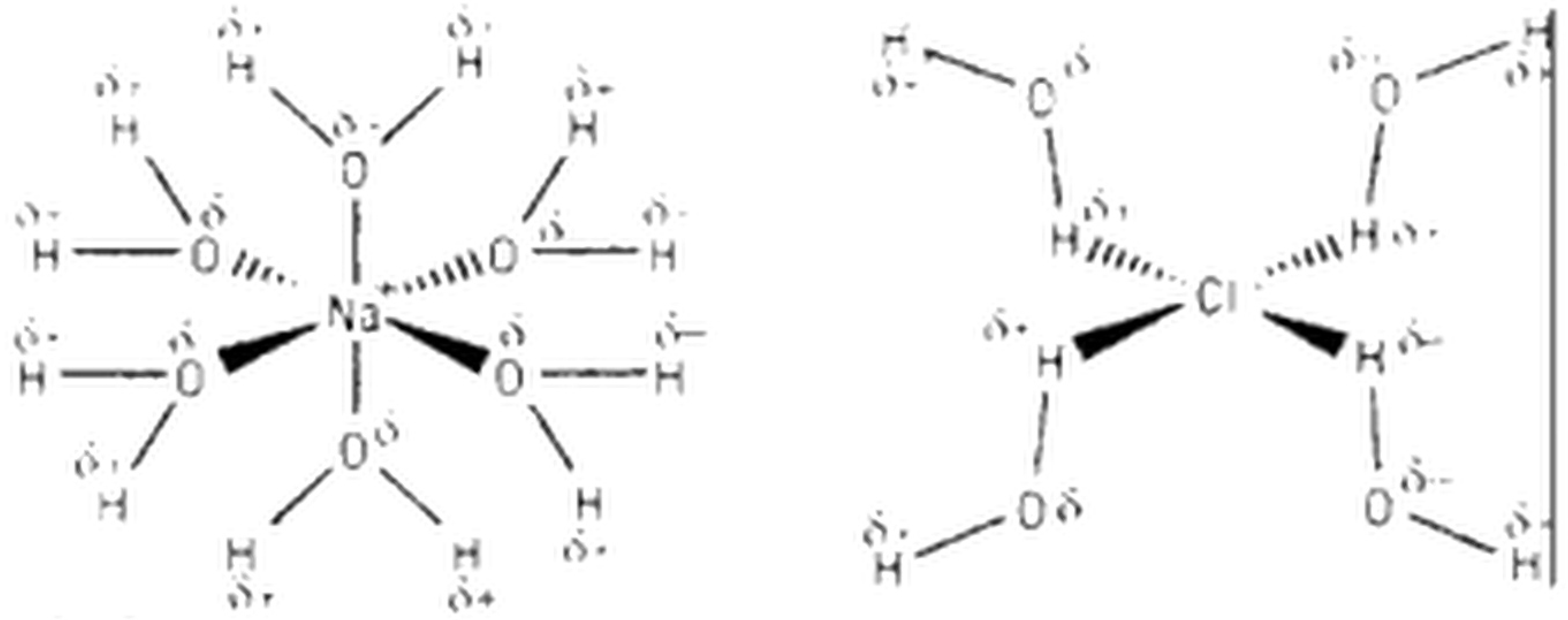
Examples:

Hydrogen chloride (HCl) chloroform ($CHCl_3$). Acetone $(CH_3)_2CO$ etc.

Ion-Dipole forces

Examples:

Forces between ions and water molecules.



Dipole-induced dipole forces:

Examples:

Forces between HCl (polar) and He(non-polar)

London Dispersion forces: Examples:

etc.

Hydrogen bonding:

Examples: NH3, H2O and HF

iv. What is hydrogen bonding give particular examples?

Ans. Hydrogen Bonding

A hydrogen bond is the attraction between the lone pair of an electronegative atom and a hydrogen atom that is bonded to either N, 0 or F.

This limits hydrogen bonding mainly to the participation of nitrogen, oxygen and fluorine atoms. Hydrogen bonds are weaker than covalent bonds but stronger than dipole-dipole interactions, which are stronger than London dispersion forces.

Examples: H_2O. HF and NH_3 have hydrogen bonding.

v. What are the applications of H bonding?

Ans. Applications of Hydrogen Bonding:

(i) Thermodynamic properties:

The boiling points of hydrides of group IVA. VA, VIA and VIIA plotted against period number of the periodic table is shown in figure.

The boiling point of hydrides:

Note that hydrides of group IVA have lower boiling points

The reason is that these hydrides are non-polar and have only London dispersion forces among their molecules.

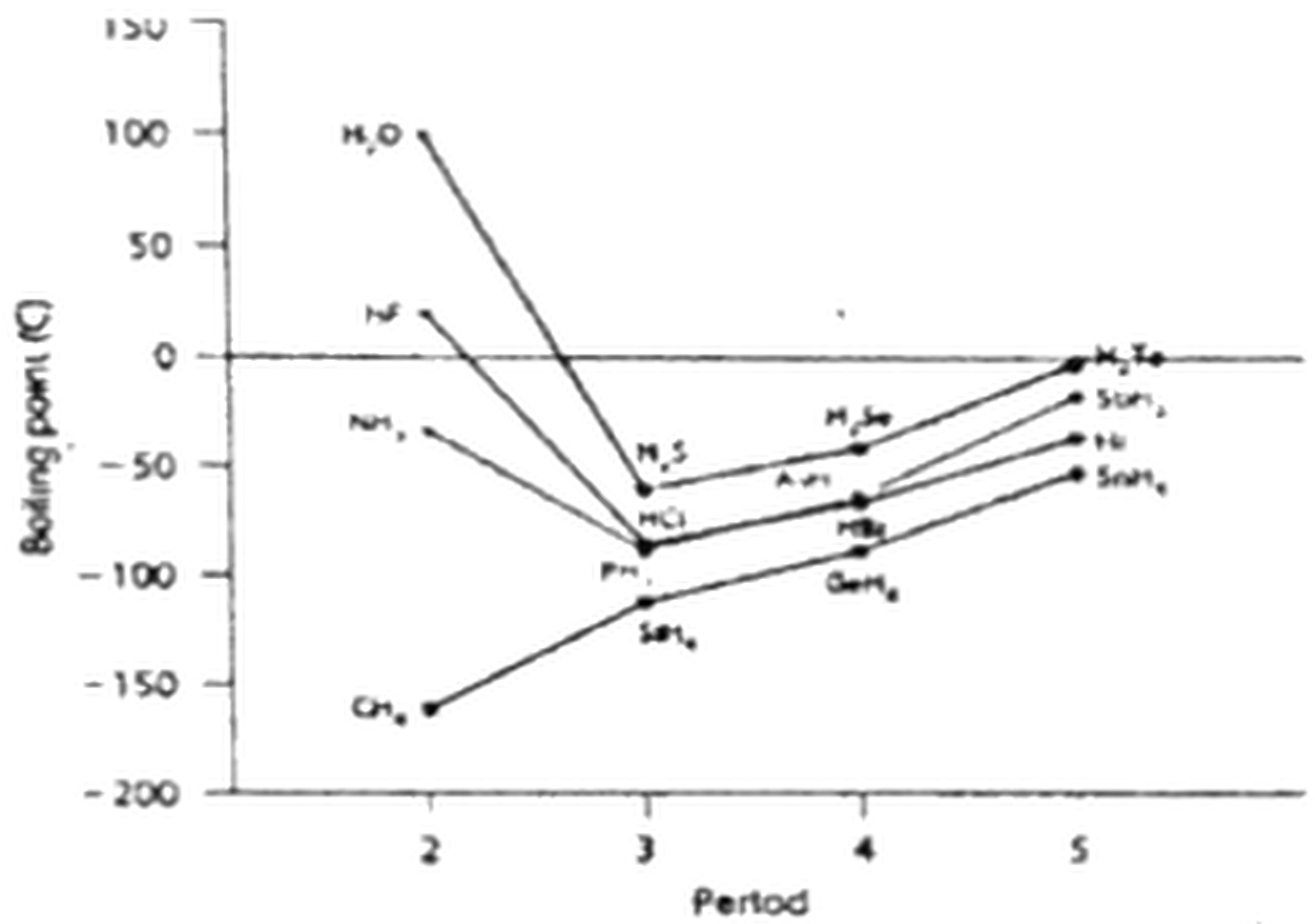
Hydrides of group VA, VIA and VII-A have polar molecules.

NH3, H_20 and HF show maximum boiling points in their respective series. This is due to hydrogen bonding in their molecules.

One should expect H-bonding to be stronger in HF than H_20 but boiling point of H_20 is higher than that of HF. The reason is that fluorine can make only one hydrogen bond with hydrogen of the neighboring molecule.

On the other hand, oxygen atom can form two hydrogen bonds with the neighboring molecules

NH3 can also form only one hydrogen bond per molecule as it has only one lone pair.



A graph between period number and the boiling points of hydrides.

(ii) Solubility of Hydrogen Bonded Molecules

The compounds that have hydrogen bonds are soluble m each other Ethyl

alcohol can dissolve in water because both can form hydrogen bonds with each other Similarly carboxylic acids are also soluble m water, if their molecular sizes are small

(iii) Cleansing Action:

Soaps and detergents perform the cleaning action. Their molecules contain

both polar and. non-polar ends. Their polar parts are water soluble due to hydrogen bonding and non-polar part dissolve oil or grease Attraction between.

(iv) Hydrogen Bonding in Paints and Dyes:

Paints and dyes have adhesive action due to hydrogen bonding. Similarly, hydrogen bonding also makes glue and honey stickle substances.

(v) Clothing:

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

(vi) 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

(vii) Hydrogen Bonding in Biological Molecules:

The structure of proteins substances essential to life, is determined partly by hydrogen bonding the action of enzymes. the protein molecules that catalyze thier actions that sustain The, depends in part on the funning and breaking of hydrogen bonds the hereditary information passed from one generation to the next is carried in nucleic acid molecules joined by hydrogen bonds into an elegant structure.

vi. What are the different types of physical properties of liquids?

Ans. Physical Properties of Liquids:

Following are the physical properties of liquids

1. Additive properties:

Such properties depend upon the number and kind of atoms present in the molecule.

Example:

Molecular weight.

Such properties depend upon the arrangement of atoms in the molecules and

not their number.

Example:

Optical activity.

3. Colligative properties:

Such properties depend on the number of ions and molecules present but do not depend upon the structure of molecules.

Example: Osmotic pressure, molar volume etc.

vii. Define vapor pressure. What are the factors affecting the V.P?

Ans. Vapor Pressure (V.P):

"The pressure exerted by vapors in equilibrium with its liquid state is called

the liquid's vapor pressure at the given temperature"

Factors affecting Vapor Pressure:

Vapor pressure as measured in the same units used for gas pressure Two factors affect liquid's vapor pressure

- Intermolecular forces
- Temperature

viii. What is (a)Viscosity.(b) Surface tension.

Ans. (a) Viscosity:

A liquid's resistance to flow is called its viscosity. The larger the viscosity, the more slowly the liquid flows Viscosity measures, how easily molecules slide by one another.

Examples:

Liquids such as water, acetone, benzene and methanol, whose molecules are

Whereas liquids having large and irregular shaped molecules like honey, glycerin tends to get tangled up with each other. This inhibits the flow of molecules and leads to high viscosity.

(b) Surface tension:

"The force in dynes acting at right angle on a unit length of surface of a liquid is called surface tension".

Surface tension can also be defined as the amount of energy required to expand the surface of a liquid by a unit area.

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

Ans. Molar Heat of Fusion, Molar Heat of Vaporization and Molar Heat of Sublimation:

Molar heat of fusion (ΔH_f):

Molar heat of fusion (ΔH_f) is the amount of heat required to convert one mole of a solid into its liquid state at its melting point is called molar heat of fusion

Example:

Molar heat of fusion for ice is +6.02 KJ mole^{-1}

$H_2O_{(s)} \rightarrow H_2O_{(l)}$ $\Delta H_f = +6.02$ KJ mole^{-1}

Molar heat of vaporization (ΔH_v):

The amount of heat required to convert one mole of a liquid into its vapors at its boiling point is called molar heat of vaporization.

Example:

$H_2O_{(s)} \rightarrow H_2O_{(l)}$ $\Delta H_v = +40.7$ KJmole^{-1}

x. How will you differentiate liquid crystals from pure liquids?

Ans. Differentiate Liquid Crystals from Pure liquids and Crystalline Solids:

and crystalline solid

i e crystalline solid=liquid crystals=pure liquid

A liquid crystal resembles the crystalline solid in certain respects e.g. optical properties. However pure liquids remain as such

A crystalline sold may be isotropic (A substance showing same properties in all directions) and an a:11sotrop1c (A substance showing different properties in different direction) but liquid crystals are always isotropic. Pure liquids remain as such liquid crystal is intermediate in between pure liquid and crystalline phase

xi. Why distillationunderreduced pressure is often used in the purification of chemicals?

Ans. Distillation is a process in which liquid are separated from each other on the basis of their boiling points. In this process liquids are heated under reduced pressure condition. This process is known as vacuum distillation.

Explanation:

The liquids which decompose at their BP can be obtained in the pure form under reduced pressure by Vacuum distillation

Example:

Glycerin has a B P of 290°C at 760mm but it decomposes at its B.P Now in

Order to get it in the pure form the V.P is decreased to 50mm by Vacuum

pump.

The B.P decreases to 120°C without decomposition in this way the liquids

Can be purified.

xii. You wish to have a "five minute" boiled egg for breakfast. For each of the following location or situations, would you cook your egg less than or more than five

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

(b) You have breakfast just before you start work 2000 meter underground in a gold mine in Timmons, Ontario.

(c) You have breakfast on a very clear and bright sunny day at sea level.

Ans. As we know that boiling point is directly proportional to external pressure

$$\text{Boiling point} \propto \text{External pressure}$$

a. At the top of the Whittler Mountain in British Columbia the external pressure is less than the normal pressure. Due to which the bottling point of the water decreases and water boils below 100 °C and that is why cooking of egg will require more than five minutes.

b. In underground gold mine the external pressure is greater than the normal pressure. Due to which the boiling point of the water increases and water boils above 100 °C. So, the cooking of egg will require less than five minutes.

c. At sea level external pressure is equal to the normal pressure. Therefore, cooking of food requires 5 minutes because at normal conditions the water boils at 100 °C.

xiii. Explain:

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

(b) What happens during evaporation in a liquid?

(c) Why a given gas occupies all the available space?

(d) The latent heat of fusion?

Ans.

(a) When a solid is heated the particles gain energy and start to vibrate faster and faster Initially the structure becomes weakened due to the expansion the solid. Further heating provides more energy and the solid begin to melt. At melting point the solid particles acquire more kinetic energy, vibrate more. violently and the high

(b) Evaporation is the process in which liquid molecules escape from the surface and enter the gas phase.

Explanation:

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

(c) Gas molecules have large empty spaces between them due to weak intermolecular forces and they possess high kinetic energy.

That is why the gases occupies all the available space.

(d) Latent heat of fusion:

The amount. of heat require to convert a unit mass of a solid at its melting point into a liquid without an increase in temperature is called latent of heat of fusion

Example:

For example, the latent heat of fusion for water (ice) is about 334 kJ/mol

xiv. Explain:

(a) How liquids mix?

(b) Why temperature of a boiling liquid does not raise at its boiling point?

Ans. (a) Liquids mixes in one another because of the process of diffusion.

Explanation:

The diffusion in liquids takes place because the molecules move from one place to another due to KE the restricted movement of the molecule reduces the rate of diffusion

Example:

A drop of ink when added to water diffuses slowly due to relatively small empty spaces between the molecules. The diffusion between closely packed molecules of liquids is slow due to less collision between them

(b) The increase in temperature increase the kinetic energy of the liquid molecules due to which the intermolecular forces decrease. Heat supplied at boiling point is used in breaking intermolecular forces and to convert the liquid into its vapors That is why the temperature of a boiling liquid does not raise at its boiling pint.

3. (a) Define a liquid and give a particular example.

(b) Give the simple properties of liquids with special reference to the following:

- **Diffusion**
- **Compression**
- **Expansion**
- **Inter molecular forces**
- **Kinetic energy**

(c) Explain on the basis of Kinetic Molecular Theory: Why the B.P of a liquid remains constant although heat is continuously supplied to the liquid?

Ans.(a) Define a liquid and give a particular example.

Liquid:

A simple- definition of a liquid 1s that "it is- a material that assumes the shape of a container without filer it completely"

Examples:

Liquids may be of three types. The types of liquids, their physical properties with examples are shown below

Sr.#	Types of liquids	properties	examples
01	Ionic liquids	High boiling point	Molten salts e.g

02	Molecular liquids	Low boiling point	$H_2O.C_2H_5OH$
03	Metallic liquids	Moderate to high BP	Molten metals e.g. Hg

(b) Give the simple properties of liquids with special reference to the following:

- **Diffusion**
- **Compression**
- **Expansion**
- **Inter molecular forces**
- **Kinetic energy**

i. Diffusion:

The diffusion in liquids takes place because the molecules move from one place to another due to K E. The restricted movement of the molecule reduces the rate of diffusion e g. a drop of ink when added to water diffuses slowly due to relatively small empty spaces between the molecules the diffusion between closely packed molecules of liquids is slow due to less collision between them.

ii. Compression (effect of pressure):

A liquid cannot be compressed significantly by increasing the pressure because the molecule cs are already in close contact with one another e g. an increase of pressure from one to two atmospheres reduces the volume of water to 0.0045 percent which is negligible. However, the same pressure reduces the volume of a gas up to 50 percent.

iii. Expansion (effect of temp erature):

The liquids expand on heating because the intermolecular forces between them decrease. Moreover, the increase of temperature increases the effective collisions between the molecules If the temperature is decreased. Contraction of molecules takes place. This property is u feel for making thermometers, e.g. mercury as the volume of capillary is much less than the volume of use bob containing mercury a small expansion gives a large movement of mercury thread.

iv. Motion of molecules:

The molecules move with lesser speed due to larger forces of attraction among them. As a result, they have lesser kinetic energy However the Kinetic Energy increases with the increase of Temperature.

v. Spaces between them:

The molecules forming the ground states are fairly close to each other There is very little space between them. As a result the numbers of collisions among the molecules are moderate the average Kinetic Energy is also moderate.

vi. Intermolecular forces:

The attractive forces existing between the unindividual particles of a substance, arc called intermolecular forces the physical properties of liquids such as boiling point vapor pressure. surface tension, viscosity and heat of vaporization depend upon the strength of intermolecular attractive forces.

vii. kinetic Energy based on Kinetic Molecular Theory:

According to the K1net1c Molecular Theory. the molecules due to strong intermolecular attractions have minimum movements and minimum collisions. Let us consider the example of water, as the molecules are closer to each other and have strong forces if attractions due to hydrogen bonding so have low kinetic energy.

When a liquid is heated its temperature increases until its boiling point is achieved. The increase in terafeature increase the kinetic ornery of the liquid due to which the intermolecular forces decreases Heat supplied at boiling point is used

in breaking intermolecular forces and to convert the liquid into its vapors. That is

why the temperature of a boiling liquid does not raise at its boiling point.

4. (a) What are the main types of Intermolecular Forces?

(b) Explain the applications of dipole-dipole forces, Hydrogen bonding and London forces.

Ans. (a) Intermolecular Forces (Van Der-Waal's forces):

The forces of attractions among-the molecules of a substance are called inter-molecular forces.

Types:

The intermolecular forces are of five types:

- Dipole-Dipole forces
- Ion-Dipole forces
- Dipole-induced dipole forces
- London Dispersion forces
- Hydrogen bonding

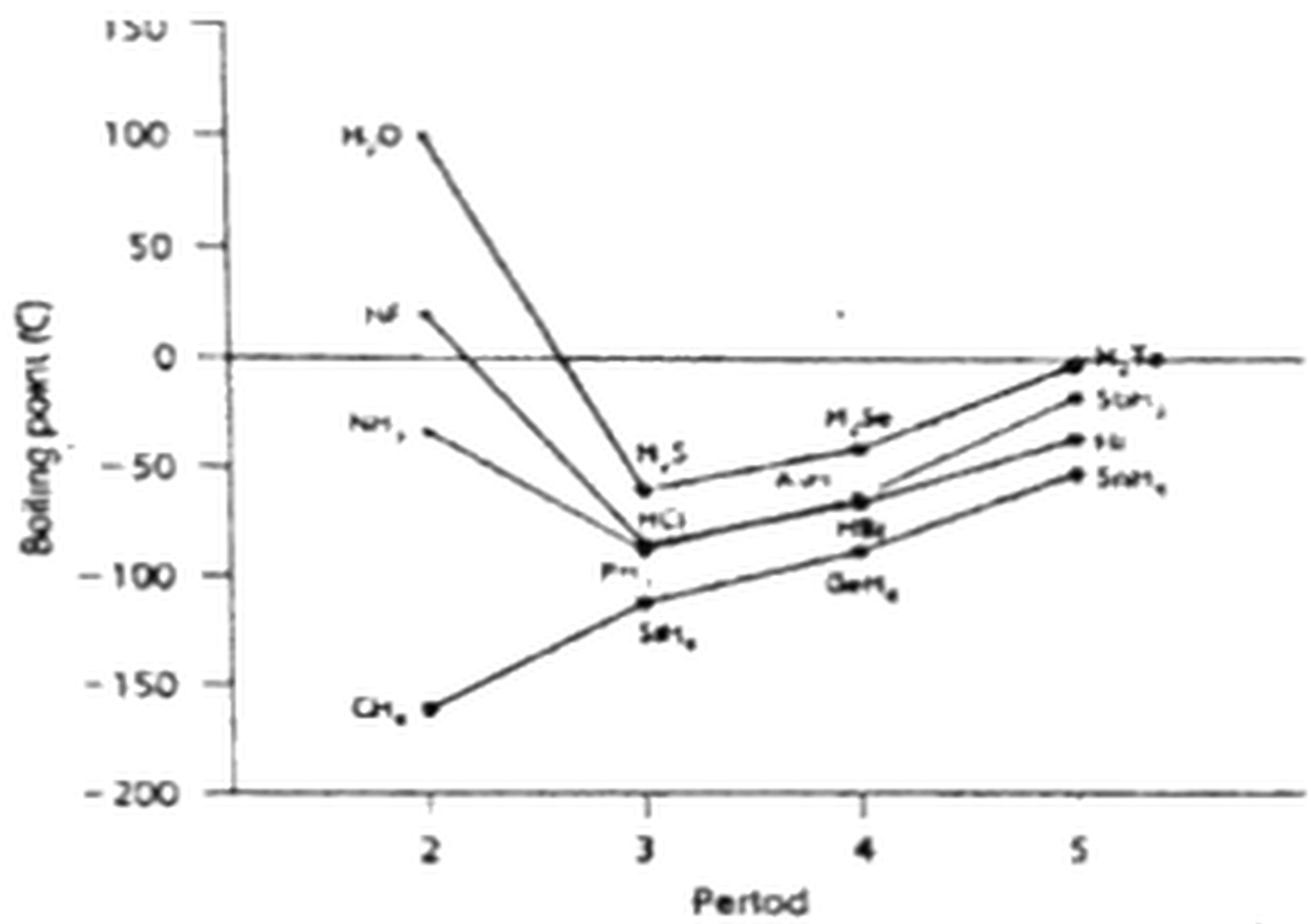
Applications of dipole-dipole forces:

Stronger these dipole-dipole forces, greater -would be the value of thermodynamic parameters like melting point, boiling point, heat of vaporization, heat of subliminal etc.

Applications of hydrogen bonding:

(i) Thermodynamic properties

The boiling points of hydrides of group IVA, VA, VIA and VIIA plotted against period number of the parodic table is shown in figure.



A graph between period number and the boiling points of hydrides.

Explanation:

The boiling point of hydrides:

Note that hydrides of group IVA have lower boiling points. The reason is these hydrides are non-polar and have only London dispersion forces among them molecules. Hydrides of group VA. VIA and VII-A have polar molecules. NH_3, H2O and HF show maximum boiling points in their respective series. This is due to hydrogen bonding in their molecules.

The boiling point of H_20 seems to be more affected than that of HF As F is more electronegative than O One should expect H-bond1ng to be stronger in HF than H_2O But boiling point of H_2O is higher than that of HF The reason is that fluorine can make only one hydrogen bond with hydrogen of the neighboring molecule On the other hand oxygen atom can form two hydrogen bonds with the neighboring molecules NH can form only one hydrogen bond per molecule as it has only one lone pair

Solubility of Hydrogen Bonded Molecules:

The compounds that have hydrogen bonds are soluble in each other. Ethyl alcohol can dissolve water because both can form hydrogen bonds with each other similarly

(i) Cleansing Action:

Soaps and detergents perform the cleaning action Their molecules contain both polar and non-polar ends Their polar parts are water soluble due to hydrogen bonding end non-polar part dissolve oil or grease Attraction between water and polar soap molecule carries the oil or grease droplet into the water.

(ii) Hydrogen Bonding in Paints and Dyes:

Paints and dyes have action due to hydrogen bonding Similarly hydrogen bonding also makes glue and honey stickle substances.

(iii) Clothing:

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

(iv) Food Materials:

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

Hydrogen Bonding in Biological Molecules:

The structure of proteins substances essential to life. 1s determined partly by hydrogen bonding. The action of enzymes the protein molecules that catalyze the reactions that sustain life, depends in part on the forming and breaking of hydrogen bonds the hereditary informatic passed from one generation to the next is earned in nuc1e1c acid molecules joined by hydrogen bonds into an elegant structure.

Applications of London Dispersion Forces:

Factors affecting the London dispersion force are

i. **Atomic or molecule size**
ii. **Polarizability**
iii. **Number of atoms in a molecule**

Number of atoms in a molecule

the strength of London dispersion forces depends upon the size of the electronic cloud of the atom or molecule with the increase in size of atom or molecule. the dispersoid becomes easy and 'hose forces become prominent. Inert gases are all monotonic gases They do not make covalent bonds with other atoms because their valence shells arc complete Their boiling point increase

down the group from He to Rn. This is because of increase in molecular size.

(ii) Polarizability:

The polarizability of an atom or molecule is a measure of the ease with which electron charge density is distorted. Large atoms have more electrons and larger cloud than small atoms

In large atoms. the outer electrons are more loosely bound they can shift towards atom more readily than the more tightly bounded electrons small atoms this means plannability increases w1tn increased atomic ana molecular size

Examples

For example among halogens. the first member, F2 1s a gas at room temperature the second member, Cl_2 is also agas but it is more easily liquefied than F2. Bromine is a liquid and iodine 1s solid at room temperature. Because large intermolecular forces between them are strong enough to form liquids or solids.

(iii) Number of atoms in a molecule:

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

Table: boiling points and physical states of some hydrocarbons

Molecular formula	B.P(°C at 1atm)	Physical state at STP
CH_4	-161.5	gas
C_2H_6	-88.6	gas

C_3H_6	-42.1	gas
C_4H_{10}	-0.5	gas
C_5H_{12}	36.1	liquid
C_6H_{14}	68.7	liquid
$C_{10}H_{22}$	174.1	liquid

Examples:

C_3H_6 and C_6H_{14} have the boiling points as-88.6'JC and 67.7° respectively. This shows that the molecule with a large chain length experiences stronger attractive force.

5. (a) Define and explain evaporation.

(b) What are the factors affecting evaporation?

(c) Differentliquids have different rates of evaporation. Explain with reference to ether and alcohol?

Ans.(a) Evaporation:

Evaporation is the process in which liquid molecules escape from the surface and enter the gas phase

Explanation:

It can be explained in terms of the energy possessed by the molecule on the liquids surface. Surface molecules whose kinetic energies are higher than 0·1 rage kinetic energy. overcome the intermolecular forces that bind entitle to the liquid and enter the gas phase. After their escape, the average kinetic energy of the remaining molecule decreases. Therefore, temperature of the liquid decreases, thus evaporation is a cooling process

(b) Factors affecting evaporation:

The rate of evaporation increases with increasing surface area. This is because large surface area allows more molecules to evaporate

ii. Intermolecular Forces:

The escaping tendency of molecules depends upon attractive forces between the molecules. The liquids with strong intermolecular forces have less evaporation Thus water has less evaporation rate than petrol. This is because Nature has stronger intermolecular forces (H-bonding) than petrol which has weak dispersion force between the molecules. A liquid which can rapidly change into vapors is called volatile e.g. petrol is more volatile than water.

iii. Temperature:

Evaporation takes place at alt temperature. Rate of e /a oration however is affected by the change in temperature increase in temperature increases the number of molecules having kinetic energy sufficient to overcome intermolecular forces and escape more readily from the surface of the liquid. Thus the rate of evaporation increases with increasing temperature. This is why cloths dry more readily in summer.

(c) The rate of the evaporation depends upon the strength of intermolecular forces.

Stronger the intermolecular forces slower will be the rate of evaporation and vice versa.

Example:

Ether and alcohol have London dispersion forces which are weak intermolecular forces that are why they have high rate of evaporation.

6. (a) Define and explain vapor pressure. How equilibrium is established between evaporation and condensation?

(b) What are the factors affecting V.P of a liquid?

Ans. (a) Vapor Pressure (V.P):

Vapor Pressure (V.P):

"The pressure exerted by vapors in equilibrium with its liquid state called the liquids vapor pressure at the given temperature"

Condensation:

In loosed containers. the vapors cannot escape. Therefore, as the vapor concentration increases, some of the vapor molecules lose energy and return to the liquid state. This process is called condensation.

Explanation:

Evaporation involves molecules leaving the liquid and condensation occurs when a vapor changes back to a liquid. While the liquid is placed in a closed container. it begins to evaporate at a constant rate very little condensation takes place. But as the concentration of the vapour increases above the liquid. the rate of condensation increases. After sometime the rate of condensation equals the rate of evaporation. At this stage the number of molecules entering the gas phase equals the number returning to ... phase the system... dynamic equilibrium.

Intensive property:

Vapor pressure is independent of the amount of liquid, so this is called an intensive property of the liquid.

Factors affecting Vapor Pressure:

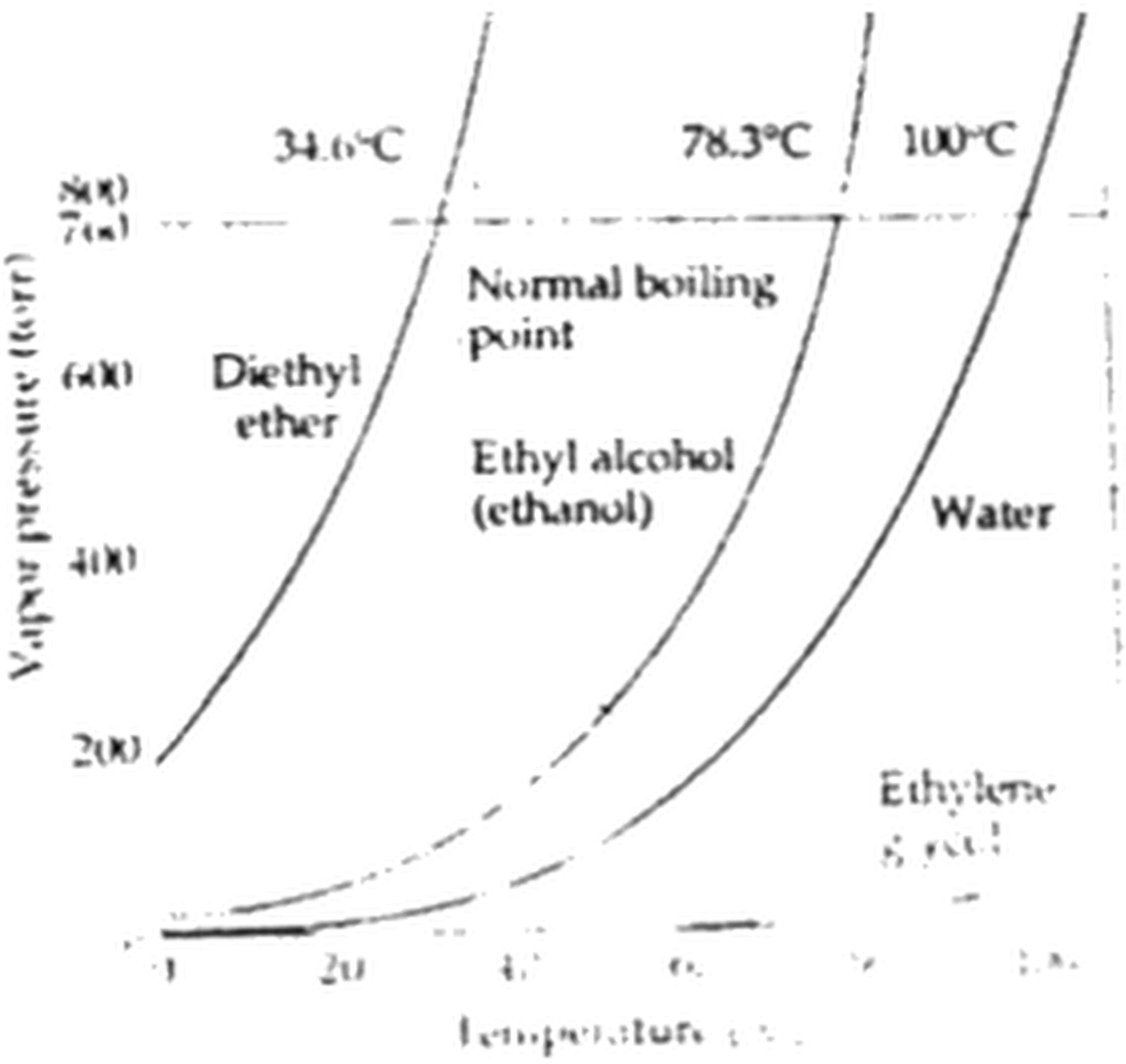
Vapor pressure measured in the same units used for gas pressure. Two factors affect liquid is vapor pressure.

Intermolecular forces

Temperature

Intermolecular forces:

The vapor pressure of a liquid depends on the strength of intermolecular forces Liquids



Temperature:

As the temperature increases, the vapor pressure increases. This is because increase in temperature increase average kinetic energies of the molecules which in turn decreases the intermolecular forces.

Examples:

Vapor pressure of water at 0°C Hg but at 100°C it is 760mm of Hg. The relationship of vapor pressure and temperature is shown by the graph

Notice that the vapor pressure of dienyl ether (185mm Hg) at 0°C is much greater than that of ethanol (12mm Hg water (4 6mm Hg) Ether Is non-polar in nature

Therefore, its high vapor resource s due to its weak intermolecular forces (dispersion forces). Thus, at the surface ether molecules require less energy to break free and change into vapor.

Similarly, external intermolecular forces (H-bonding) are not as strong as

those of water. Consequently, vapor pressure of ethanol is greater than that of water at all temperatures.

It is observed that each of the three vaporia pressure curves cross the line corresponding to one atmosphere at different temperatures. Therefore, they boil at different temperatures.

Ether boils at 36°C ethanol at 78 °C and water at 100°C.

7. (a) Define and explain boiling point of a liquid?

(b) How will you explain the effect of pressure on the B.P of a liquid?

(c) Practically how will you explain the

(i) Effect of increase of pressure on boiling point.

(ii) Effect of decrease of pressure on boiling point.

Ans. The temperature at which the vapor pressures of the liquid equals to atmospheric pressure or some external pressure called pooling point of that liquid.

Explanation:

When a liquid Is heated its V P increases due to the decrease of intermolecular forces with rise in temperature. As a result, more and more vapors escape in the air. A stage reaches at which the liquid begins to boil. So, the temperature at which the vapor pressure of the liquid equals to atmospheric.

pressure or some external pressure is called bling point of that liquid.

Example: Boiling Point of water at 760mrn = 100°C

boiling Point of water at 237mm= 25°C.

(b) Effect of Pressure on boiling point of a Liquid:

There are two practical applications regarding the effect of pressure.

i. **Effect of Increase of Pressure:**

Food can be cooked pressure cookers, which is a closed container the vapors are not allowed to escape out and therefore, develop more pressure This increases the B.P of water Pressure cookers help us in cooking the food quickly even at high attitude e.g. 8.P of water at 2026mm Hg is 130°c

The liquids which decompose at their B.P can be obtained in the Pura form under reduced pressure by Vacuum distillation e.g. Glycerin has a B P of 29Q°C at 760mm but it decomposes at its 8 P Now in order to get it in the pure form, the V.P is decreased to 50mm by Vacuum pump The B P decreases to 120'C without decomposition. In this way the liquids can be purified.

(c) i. Effect of Increase of Pressure:

Food can be cooked easily in pressure cookers. which is a closed container. The vapors are not allowed to escape out and, therefore, develop more pressure. This increases the B P of water. Pressure cookers help us in cooking the food

quickly even at high attitude e.g. B.P of water at 2026mm Hg is 130°C

ii. Effect of decrease of pressure:

The liquids which decompose at their BP can be obtained in the pure form under reduced pressure by Vacuum distillation e.g. Glycerin has a B.P of 290°C at 760mm but it decomposes at its 8.P. Now in order to get it in the pure form, the VP is decreased to 50mm by Vacuum pump. The B.P decreases to 120°C without decomposition. In this way the liquids can be purified.

8 (a) Define and explain the term viscosity of a liquid? How the resistance to the layers causes viscosity?

(b) What are the factors affecting the viscosity of a liquid?

Ans. (a) Viscosity:

A liquid's resistance to flow Is called its viscosity. The larger the viscosity, the more slowly the liquid flows. Viscosity measures, how easily molecules slide by one another.

Explanation:

It is common observation that water can be poured very quickly from one container to another _as compared to honey and glycerin. To understand viscosity, molecules the layers adjacent to the walls have the lowest velocity. Each later exerts drag on one another and thus causes resistance to flow.

(b) Factors Affecting Viscosity:

Viscosity depends on the following factors:

- Molecular shape and size
- Intermolecular forces
- Temperature

Molecular size:

Molecular size and shape strongly influence viscosity. Liquids such as water, acetone, benzene and methanol. whose molecules are small and compact have low viscosity. Whereas liquids having large and irregular shaped molecules like honey, glycerin tends to get tangled up with each other. This inhibits the flow of molecules kind leads to high viscosity.

Intermolecular force:

Stronger the intermolecular · force among the molecules higher is the

viscosity. Liquids whose molecules form hydrogen bonds are more viscous than other without hydrogen bonding. For example, water is more viscous than methanol mainly due to extensive hydrogen bonding.

Temperature:

Molecules move faster as temperature increases. This is because; an increase in temperature decreases the intermolecular forces. This dependence is quite noticeable for highly viscous liquids such as honey and syrup. It is e.-sire to pour these liquids when hot than when cold.

9. (a) What is the S.I unit of viscosity and surface tension?

(b) Use the concept of hydrogen bonding to explain the following properties of water?

(ii) High heat of vaporization

(iii) High B.P

Ans. (a) Units of viscosity:

SI units of viscosity are kilogram per meter per second ($Kgm^{-1}s^{-1}$) or Nm^{-2}

Non--SI unit of viscosity is poise.

1poise = 0.1 Kgm s^{-1} or g m^{-1} s^{-1}

Units surface tension:

SI units of surface tension are joule per square meter. Jm^{-2} or newton per meter or Nm^{-1}

(b) (i) High surface tension

(ii) High heat of vaporization

(iii) High B.P

i. **High surface tension:**

A stretched membrane is from ed 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. This has been proved by the following data.

solvent	**Surface tension (γ)(N m^{-1})**
water	7.275
methanol	2.26
ethanol	2.28
benzene	2.888
hexane	1.84
CCl_4	2.70

Water has a high heat of vaporization due to extensive hydrogen bonding. A

large amount of heat is required to evaporate a small amount of water. This is of enormous importance to us because large amount of body cat can be dissipated by the evaporation of small amounts of water (perspiration) from the skin. This effect also accounts to the climate property of lakes...

iii. High boiling points:

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

It is practically observed that the B P. of water is 100°C at one atmospheric pressure (760mm) at sea level, however, the organic solvents like benzene (8.P50°C). ether (45°C) etc. have lower B.P. due to poor interactions between the molecules.

10 (a) Define and explain the phenomena of surface tension?

(b) What are the factors affecting surface tension?

(c) Define dynamic equilibrium between two physical states?

(d) Define?

i. **Molar Heat of fusion.**
ii. **Molar Heat of vaporization.**
iii. **Ans. (a) Surface Tension:**

Ans: Surface Tension:

"The force in dynes acting at right angle on a unit length of surface of a liquid is called surface tension".

Surface tension is the property of the surface of the liquids to act as if there is

a membrane stretched across it.

Explanation:

All molecules below the surface of the liquid are surrounded in all directions by other molecules. Thus, the force exhibited by such molecules is balanced in all directions whereas a molecule at a liquid surface has molecules beside it and beneath it but no one above it. This results in an unbalanced force pulling the surface molecules inward.

The molecules at the surface therefore feel a net attraction inwards. which create since tension for a molecule to come to the surface it must overcome the attraction directed towards the means work be done to pull it to the surface. Therefore, increases in surface areas of a liquid as input energy.

Surface tension can also be defined as the amount of energy required to

extend the surface of a liquid by a unit area. Small drops of a liquid tend to be spherical:

Molecules at the surface of a liquid are less stable than those middle it, so a liquid is stable when the molecules arc at its surface. This occurs when the liquid has minimum surface area. Spheres have less area per unit volume than and other Therefore small drops of a liquid tend to be spherical

Units:

SI unit of surface tension is Joule per square meter. Jm^{2} or Newton per meter, $N\ m^{-1}$

(b) Factors Affecting Surface Tension:

surface tension of a liquid depends upon the following factors.

(i) Inter molecular forces:

Surface tension of a liquid depends directly on the strength of intermolecular forces

Stronger the intermolecular forces among the molecules of liquid, greater is the surface tension and vice versa.

Example:

The surface tension of water is higher than many liquids such as alcohols, ethers benzene etc. this is due to strong hydrogen bonding between water molecules

(ii) Temperature:

Surface tension of a liquid decreases with the increase of temperature. This is because increased kinetic energy of the molecules decreases strength of little molecular forces

iii. Nature:

It is different for different liquids due to the presence of different types of intermolecular forces.

(C) Dynamic Equilibrium between two Physical States:

Dynamic equilibrium is a situation when two opposite changes occur from solid to liquid when a change of state occurs (solid to liquid or liquid to gas) and vice versa. The system moves towards the condition of dynamic equilibrium.

e.g. At 0 °C, ice exists in dynamic equilibrium with liquid water.

ice → water

(d) Molar Heat of Fusion, Molar Heat of Vaporization and Molar Heat of Sublimation:

(I) Molar heat of fusion

(ii) Molar Heat of vaporization.

Ans. Molar heat of fusion (ΔH_f):

Molar heat of fusion (ΔH_f) is the amount of heat required to convert one mole of a solid into its liquid state at its melting point is called molar heat of fusion

Example:

Molar heat of fusion for ice is +6.02 KJ mole^{-1}

$H_2O_{(s)} \rightarrow H_2O_{(l)}$ $\Delta H_f = +6.02$ KJ mole^{-1}

Molar heat of vaporization (ΔH_v):

The amount of heat required to convert one mole of a liquid into its vapors at its boiling point is called molar heat of vaporization.

Example:

$H_2O_{(l)} \rightarrow H_2O_{(g)}$ $\Delta H_v = +40.7$ KJ mole^{-1}

12. (a) How will you relate energy changes with changes in intermolecular forces?

(b)How will you explain dynamic equilibrium between two physical states?

Ans. (a) 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 Therefore, heat of vaporization is much greater than that heat of fusion.

Particular examples:

ΔH_v (heat of vaporization) for H O (40.6 KJ $mole^{-1}$ at 373 15K, for NH_3 (23.35 KJ $mole^{-1}$ at 239K) and CO_2 (25.23 KJ $mole^{-1}$ at 194 5K) are high due to their polar nature and strong intermolecular forces ΔH_f (Heat of fusion) will be as under:

H_2O = 6.02 KJ $mole^{-1}$ at273.1SK

NH_3 = 6.652 KJ $mole^{-1}$ at 195.4K

CO_2 = 8.33 KJ $mole^{-1}$at217.0K

ii. I_2, a volatile solid has the highest value of Heat of sublimation i.e 41.80 KJ $mole^{-1}$ at 458.4K. The values for other halogens are

...Br_2 = 294 KJ $mole^{-1}$ at 332.4K

Cl_2 = 20.21KJmole $^{-1}$ at 239.1K

F_2 = 3 16 kJ $mole^{-1}$ at 85.0K

This shows that ΔH_v (heat of vaporization) of I_2 is the highest because of strong intermolecular forces than the other halogens.

(b) Dynamic Equilibrium between two Physical States:

Dynamic equilibrium Is a situation when two opposite changes occur i.e. from solid

Example:

At 0°C. ice exists in dynamic equilibrium with liquid water.

Ice $_{solid}$ ⇋ water $_{liq}$

13. Define liquid crystals and give its daily life uses.

(b) what are the uses of Liquid Crystals in Daily Life

(c) How will you differentiate between liquid crystals from pure liquid and crystalline solids?

Ans. (a) liquid crystal:

The substance which can flow like a liquid and also have some of the properties of liquids within a certain temperature range are called liquid crystals.

OR

The intermediate phase lying between the solid phase and the normal liquid phase is called liquid crystal.

(b) Uses in daily life:

i. Liquid crystals are used as temperature sensors. This is because the liquid crystals change their color with change in temperature.

ii. They are used to monitor temperature changes where conventional methods are not feasible. e.g. they are used in thermometer for measuring skin temperature of infants.

iii. Some of the modern room thermometers contain liquid crystals with a suitable temperature range. As temperature changes. the liquid crystal shows up the figure in different contours

iv. They are used to find the pot of potential failure in micro-electronic circuits.

v. They are used to locate the veins, arteries and tumors, e.g. when a layer of liquid crystal is painted on the surface of the breast, a tumor shows up as a hit area which

vi. Liquid crystals are used in the display of numbers and letters of electrical devices such as digital watches. calculators and computes etc.

vii. Liquid crystals are used in LCD screens of oscillographs and TV

(c) How will you differentiate between liquid crystals from pure liquid and crystalline solids:

A liquid crystal is a state of matter which is in between pure liquid (transparent) and crystalline solid.

i.e. crystalline solid = liquid crystals = pure liquid

A liquid crystal resembles the crystalline solid in certain respects, e.g. optical properties. However pure liquids remain as such.

A crystalline solid may be isotropic (A substance showing same properties in all directions) and an anisotropic (A substance showing different properties in different direction) but liquid crystals are always 1sotroplc. Pure liquids remain as such

Liquid crystal is intermediate in between pure liquid and crystalline phase.

14. Define the following?

a. Evaporation b. Vapor pressure c. **Boiling Point**

d. Viscosity e. Surface tension

Ans. a. Evaporation:

Evaporation is the process in which liquid molecules escape from the surface and enter the gas phase.

Explanation:

It can be explained in terms of the energy possessed by the molecules on the liquid's surface. Surface molecules whose kinetic energies are higher than average kinetic energies overcome the intermolecular forces that bind them to the liquid and enter the gas phase. After their escape the average kinetic energy of the

Vapor pressure:

The pressure exerted by the vapors of a liquid in equilibrium with its liquid state at a given temperature is called vapor pressure of a liquid

Boiling Point:

The temperature at which the vapor pressure of the liquid equals to atmospheric pressure or some external pressure is called boiling point of that liquid.

Viscosity:

A liquid's resistance to flow is called its viscosity. The larger the viscosity, the more slowly the liquid flows. Viscosity measures, how easily molecules slide by one another.

Vapor Pressure (V.P):

"The pressure exerted by vapors an equilibrium with its liquid state is called the liquid's vapor pressure at the given temperature"

Condensation:

In closed containers, the vapors cannot escape. Therefore, as the vapor concentration increases. some of the vapor molecules lose energy and return to the liquid state. This process is called condensation.

Explanation:

Evaporation involves molecules leaving the liquid and condensation occurs when a vapor changes back to a liquid. While the liquid is placed in a closed container, it begins to evaporate at a constant rate. very little condensation takes place but as the concentration of the vapor increases above the liquid. the rate of condensation increases

After some time, the rate of condensation equals the rate of evaporation. At this stage, the number of molecules entering the gas phase equals the number returning to the liquid phase. the system is said to be in a dynamic equilibrium.

Intensive property:

Vapor pressure is independent of the amount of liquid. so, this is called an intensive property of the liquid.

Factors affecting Vapor Pressure:

Vapor pressure as measured in the same units used for gas pressure Two factors affect liquid's vapor pressure

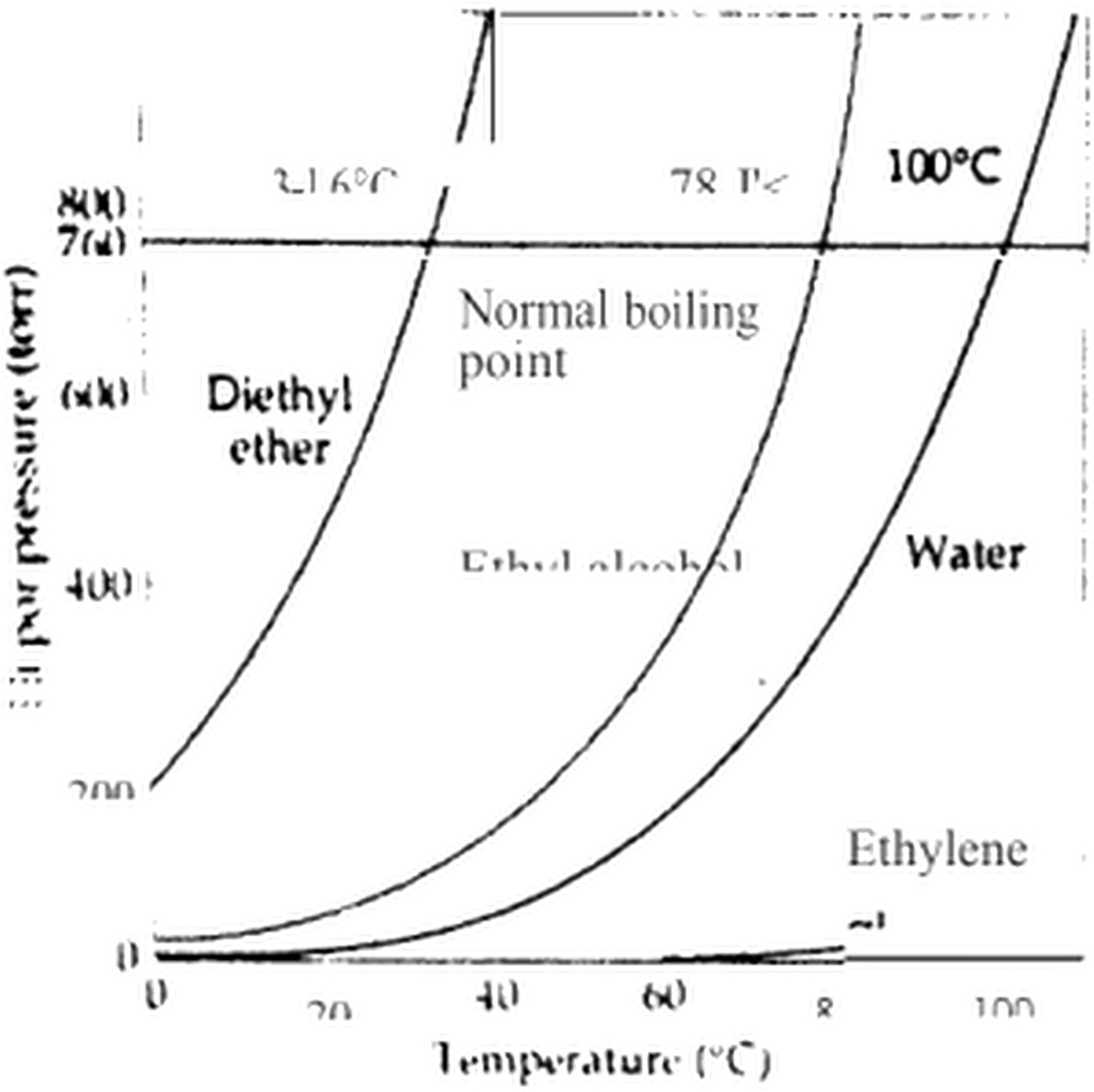
- Intermolecular forces
- Temperature

Intermolecular forces:

The vapor pressure of a liquid depends upon the strength of intermolecular forces Liquids having stronger intermolecular forces possess low vapor pressure and vice versa.

Example:

Water having hydrogen bonding possesses low vapor pressure. On the other hand, ether, petrol etc. have high vapor pressure due to weak dispersion forces.



Temperature:

As the temperature increases, the vapor pressure increases. This is because increase in temperature increases the average kinetic energies of the molecules which in tum decreases the intermolecular forces.

Examples:

Vapor pressure of water at O ^{0}c is 4.6 mm of Hg but at 100 °c it is 760mm of

Hg. The relationship of vapor pressure and temperature is shown by the graph.

Notice that the vapor pressure of diethyl ether (185mm Hg) at 0° C is much greater than that of ethanol {12mm Hg) or water (4.6mm Hg). Ether is non-polar in nature.

Therefore, its high vapor pressure is due to its weak intermolecular forces (dispersion forces). Thus, at the surface ether molecules require less energy to break free and change into vapor.

Similarly, external intermolecular forces (H-bonding) are not as strong as those of water. Consequently, vapor pressure of ethanol is greater than that of water at all temperatures.

It is observed that each of the three vapor pressure curves cross the line

corresponding to one atmosphere at different temperatures. Therefore, they boil at

different temperatures.

Ether boils at 35 °c, ethanol at 78 °c and water at 100°C.

e. Surface tension:

"The force in dynes acting at right angle on a unit length of surface of a liquid is called surface tension".

Surface tension can also be defined as the amount of energy required to expand the surface of a liquid by a unit area

15. (a) Define and explain the intermolecular forces existing between the liquid molecules?

Ans.(a) Intermolecular Forces:

The forces of attractions among the molecules of a Substance are called inter-molecular forces.

Example:

Water exists as a liquid due to inter-molecular attractions called Hydrogen

bonds.

Dipole - Dipole Forces:

The attractive forces between the positive ends of one molecule with the negative end of other molecule are called dipole - dipole forces This means dipole-dipole interactions are electrostatic interactions between permanent dipoles in molecules·

Examples:

Examples of polar molecules include hydrogen chloride (HCl) chloroform ($CHCl_3$) Acetone $CH_3)2CO$ etc.

Note: Stronger these dipole-dipole forces greater would be the value of

Thermodynamic parameters like melting point, boiling point, heat of vaporization, heat of subliminal etc.

London Dispersion Forces:

The forces of attractions between non-polar molecules which become polar for an instant are called London dispersion forces.

Explanation:

Substances like hydrogen, helium. neon, argon, chlorine. fluorine, methane etc. are non-polar in nature. These gases can be liquefied and solidified under appropriate conditions. Some forces must be holding these molecules in contact with one another in the liquid and solid states.

In He gas, on the average, the electron charge density is evenly distributed in a spherical region about the nucleus. However, at any given instant, the actual location of two electrons can influence the distribution of electrons in neighboring helium atoms, producing induced dipoles in those atoms.

London dispersion forces Instantaneous dipole

London Dispersion force:

The forces of attraction between an instantaneous dipole and an induced dipole are known as a dispersion force It is also called as London dispersion force, named for Fritz London who offered a theoretical explanation for these forces in1928.

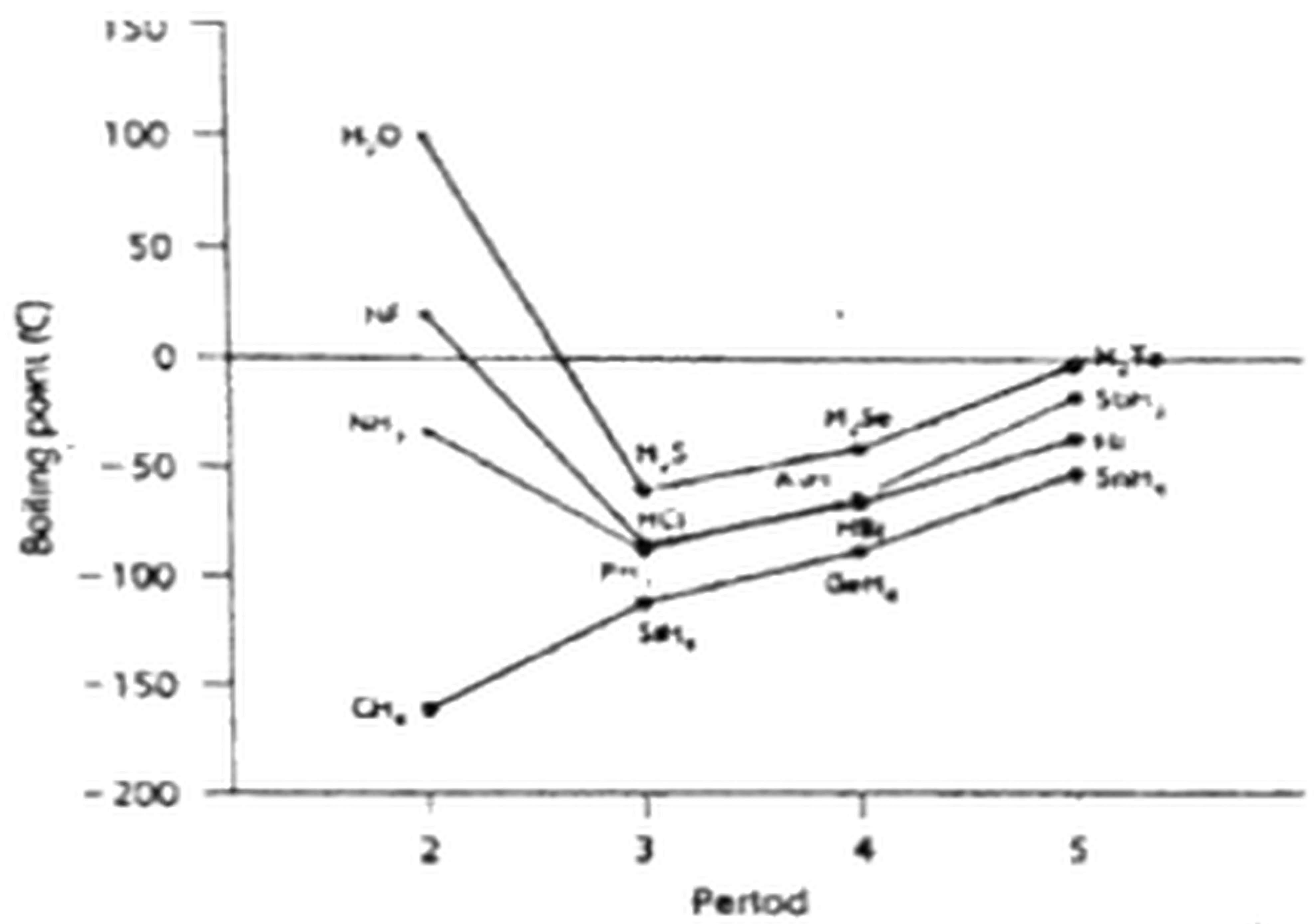
(b) Applications of dipole-dipole forces:

Stronger these dipole-dipole forces, greater would be the value of thermodynamic parameters like melting point, boiling point, heat of vaporization, heat of subliminal etc.

Applications of hydrogen bonding:

(i) **Thermodynamic properties**

The boiling points of hydrides of group IVA, VA, VIA and VIIA plotted against period number of the parodic table is shown in figure.



A graph between period number and the boiling points of hydrides.

Explanation:

The boiling point of hydrides:

Note that hydrides of group IVA have lower boiling points. The reason is these hydrides are non-polar and have only London dispersion forces among them molecules. Hydrides of group VA. VIA and VII-A have polar molecules. NH_3, H2O and HF show maximum boiling points in their respective series. This is due to hydrogen bonding in their molecules.

Solubility of Hydrogen Bonded Molecules:

The compounds that have hydrogen bonds are soluble in each other. Ethyl alcohol can dissolve water because both can form hydrogen bonds with each other similarly carboxylic acids are also soluble in water. if their molecular sizes are… this is ail because of hydrogen bonding

(i) Cleansing Action:

Soaps and detergents perform the cleaning action Their molecules contain both polar and non-polar ends Their polar parts are water soluble due to hydrogen bonding end non-polar part dissolve oil or grease Attraction between water and polar soap molecule carries the oil or grease droplet into the water.

Paints and dyes have action due to hydrogen bonding Similarly hydrogen bonding also makes glue and honey stickle substances.

(iii) Clothing:

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

(iv) Food Materials:

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

Hydrogen Bonding in Biological Molecules:

The structure of proteins substances essential to life. 1s determined partly by hydrogen bonding. The action of enzymes the protein molecules that catalyze the reactions that sustain life, depends in part on the forming and breaking of hydrogen bonds the hereditary informatic passed from one generation to the next is earned in nuc1e1c acid molecules joined by hydrogen bonds into an elegant structure.

Applications of London Dispersion Forces:

Factors affecting the London dispersion force are

i. Atomic or Molecular size
ii. Polarizability
iii. Number of atoms in a molecules

Number of atoms in a molecule

(i) Atomic or Molecular Size:

the strength of London dispersion forces depends upon the size of the electronic cloud of the atom or molecule with the increase in size of atom or molecule. the dispersoid becomes easy and 'hose forces become prominent

Inert gases are all monotonic gases They do not make covalent bonds with other atoms because their valence shells arc complete Their boiling point down the group from He to Rn. This is because of increase in molecular size.

(ii) Polarizability:

The polarizability of an atom or molecule is a measure of the ease with which electron charge density is distorted. Large atoms have more electrons and larger cloud than small atoms

In large atoms. the outer electrons are more loosely bound they can shift towards atom more readily than the more tightly bounded electrons small atoms this means plannability increases w1tn increased atomic ana molecular size

Examples

For example among halogens. the first member, F_2 1s a gas at room temperature the second member, Cl_2 is also agas but it is more easily liquefied than F2. Bromine is a liquid and iodine 1s solid at room temperature. Because large intermolecular forces between them are strong enough to form liquids or solids.

{iii) Number of atoms in a molecule:

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

Examples:

C_3H_6 and C_6H_{14} have the boiling points as-88.6'JC and 67.7° respectively. This shows that the molecule with a large chain length experiences stronger attractive force.

16. What is the energetics of phase changes?

Ans. Energetic of Phase Changes:

i. Physical and chemical changes are accompanied by energy change in the form of heat.

ii. A physical change in energy is the quantitative measurement of the strength of

iii. Energy change at constant pressure is known as enthalpy change denoted by H

iv. It 1s expressed in kg mole

v. When a substance undergoes a phase change (change of state), its temperature remains constant even though heat is being added

17. (a) Describe the Kinetic Molecular of liquids?

(b) Relate energy changes with changes in termolecular forces?

Ans: (a) Kinetic Molecular Interpretation of liquids:

The kinetic molecular theory also ....

i. a liquid is made up of molecules which touch one another.

iii. attractive force among liquid molecules are not sufficient in fixed position the hqu1d molecules can slide each other.

iv. The average Kinetic Energy of liquid molecules 1s directly proportional to the Absolute Temperature

v. At constant temperature, the average KE of the molecules is equal to the K E of the vapors of liquids

(b) 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 Therefore, heat of vaporization is much greater than that heat of fusion.

Particular examples:

ΔH_v (heat of vaporization) for H O (40.6 KJ $mole^{-1}$ at 373 15K, for NH_3

(23.35 KJ $mole^{-1}$ at 239K) and CO_2 (25.23 KJ $mole^{-1}$ at 194 5K) are hiah due to their polar nature and strong intermolecular forces ΔH_f (Heat of fusion) will be as under:

H2O = 6.02 KJ mole^{-1} at273.15K

NH3 = 6.652 KJ mole^{-1} at 195.4K

CO2 = 8.33 KJ mole^{-1}at217.0K

ii. I_2, a volatile solid has the highest value of Heat of sublimation i.e 41.80 KJ mole^{-1} at 458.4K. The values for other halogens are

...Br_2 = 294 KJ mole^{-1} at 332.4K

Cl_2 = 20.21KJmole^{-1} at 239.1K

F_2 = 3 16 kJ mole^{-1} at 85.0K

This shows that ΔH_v (heat of vaporization) of I_2 is the highest because of strong intermolecular forces than the other halogens.

18 (a) Define and explain the Boiling Point of a liquid?

(b) How will you explain the two practical applications regarding the effect of pressure on the Boiling Point of a liquid?

Ans. (a) Boiling Point:

The temperature at which the vapor pressure of the liquid equals to atmospheric pressure or some external pressure is called boiling point of that liquid.

Explanation:

When a liquid is heated, its VP. increases due to · the decrease of intermolecular forces with rise in temperature. As a result, more and more vapors escape in the air. A stage reaches at which the liquid begins to boil. So, the temperature at which the vapor pressure of the liquid equals to atmospheric pressure or some external pressure is called boiling point of that liquid.

Example:

Boiling Point of water at23.7mm= 25°C

There are two practical applications regarding the effect of pressure.

i. Effect of Increase of Pressure:

Food can be cooked easily in pressure cookers, which is a closed container. The vapors are not allowed to escape out and, therefore, develop more pressure. This increases the B.P of water.

Example:

Pressure cookers help us in cooking the food quickly even at high attitude

e.g. B.P of water at 2026mm Hg is 130°C

ii. Effect of decrease of pressure:

The liquids which decompose at their B.P can be obtained in the pure form under reduced pressure by Vacuum dist1llat1on

Example:

Glycerin has a B.P of 290°C at 760mm but 1t decomposes at its B.P. Now in order to get it in the pure form, the V.P is decreased to 50mm oy Vacuum pump. The B.P decreases to 120°C without decomposition. In this way the liquids can be purified.

19. How will you explain the anomalous behavior of water when Its density shows maximum at 4°C?

Ans. Anomalous Behavior of Water:

Anomalous Behavior of Water:

Anomalous Behavior of Water:

i. In hydrogen bonds hold water molecules in a rigid but open hexagonal structure.

ii. As ice melts, some of the hydrogen bonds are overcome. and water into the holes that were present in ice structure.

iv. When ice melts there is about 9% decrease in volume and a corresponding increase in density.

v. So, water is most unusual in this regard, because the liquid state is less dense than the solid for substances

vi. If we continue to heat water just above the melting point more hydrogen bonds are overcome.

vii. The molecules become still mere closely packed and the density of liquid increases to a maximum density at 3.98°C. Above 3.98°C the density of water decreases with temperature, as we expect for a liquid.

viii. These density phenomena explain why a freshwater lake freezes from the top down in winter.

Survival of aquatic life:

When temperature falls below 4°C, the denser water sinks to the bottom of the lake.

The colder surface water freezes first. Since ice is less dense than water, the water that freezes remain at the top to cover the lake with a layer of ice. This layer of ice insulates the water underneath.

Thus, under this thick blanket of ice, fish and plants survive for months.

20. Relate energy changes with changes in intermolecular forces?

Ans. Energy Changes and Intermolecular Forces:

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due to their polar nature and strong intermolecular forces ΔH_f (Heat of fusion) will be as under:

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