EXERCISE

MULTIPLE CHOICE QUESTIONS

1. Choose the correct answer (MCQS).

i. The temperature at which two or more than two types of crystals exist in equilibrium I is called.

a) Melting Point
b) Transition temperature
c) Eutectic temperature
d) Boiling point.

ii. The solids in which atoms, ions or molecules have random non-repetitive three-dimensional arrangements are termed as:

a) Crystals
b) Glasses
c) Alloys
d) Amalgams

iii. The nature of bond in diamond is

a) Ionic
b) Covalent
c) Molecular
d) Metallic

iv. Crystal Lattice is an arrangement of particles in

v. Lattice energy is also called

a) Crystal energy
b) Ionization energy
c) Energy of affinity
d) Bond Energy

vi. When gaseous ions arc allowed to form a crystal energy

a) Is evolved
b) Is absorbed
c) is sometimes absorbed and sometimes released
d) has no effect

vii. Nave and MgO have both atomic ratio 1:1 in their crystals such property is

a) Polymorphism
b) Isomorphism
c) Isotropy
d) Allotropy

viii. Electric current can pass through graphite in **one direction but not through other direction of crystal such a property is called**

a) Allotropy
b) Anisotropy
c) Isomorphism
d) Polymorphism

xi. Iron acts as an electrical conductor due to

a) Electron cloud

x. A crystal of the purple compound Potassium Permanganate placed c:.t the bottom of a beaker of water and the beaker left until there is no further change. What will be observed?

a) A uniformly purple solution
b) A colorless liquid with the purple crystal unchanged.
c) A purple layer below a colorless layer
d) A colorless layer below a purple layer.
e) A deep purple layer below a pale purple layer.

xi. Which of the following method is most suitable for obtaining a pure, dry sample of NaCl from a mixture of NaCl and sand?

a) Shake the mixture with water Filter and dry the substances on the filter paper,
b) Shake the mixture with water, Filter and evaporate the filtrate.
c) Shake the mixture with water and distil off the sand.
d) Heat the mixture gently and collect the substances which boil off.

xii. What method could be used to obtain copper from mixture of pondered copper and sodium chloride?

a) Heating the mixture.
b) Fractional distillation of the mixture.
c) Passing an electric current through the mixture.
d) Adding excess water to the mixture and filtering

xiii. A bottle of copper oxide has been contaminated with some sodium chloride. How can the NaCl be removed from the copper oxide?

a) Place the mixture in a separating funnel.
b) Heat the mixture and allow it to cool.
c) Add water to the mixture and filter.

c) Mass numbers

d) Reactivities.

xv. An insoluble solid was dropped into a measuring cylinder containing 50 cm^3 of water. What will be the effect on volume of water?

a) 15cm^3

b) 17cm^3

c) 50cm^3

d) 65 cm^3

xvi. The results of the accurate weighing of sore crystals are as follows:

Mass of weighing bottle empty = 25.652 gm

Mass of weighing bottle + crystals = 26.541gm

What Is the mass of the crystals?

a) 0.111gm

b) 0.889gm

c) 1.111gm

d) 1.889gm

xvii. The spontaneous mixing of particles is called:

a) Evaporation

b) Sublimation

c) Diffusion

d) Boiling

Answers

i. b	ii. b	iii. b	iv. c	v. a	vi. a	vii. b

2. Write brief and short answers to the following:

i. Indicate the effect of pressure and temperature on solids.

Ans. Compression (Effect of Pressure):

There is practically no effect of pressure on solids the molecules are very closely packed together.

Effect of temperature:

The solids expand when heated i.e. their volume increases. This 1s because the increase of temperature decreases the intermolecular attractive forces. As a result. the volume increases.

ii. Differentiate between amorphous solids and crystalline solids

Ans: Differentiate between Amorphous and Crystalline Solids:

Crystalline Solids	Amorphous Solids
i. In the crystalline state, the crystals possess definite geometrical structure e.g NaCl is cubic in nature	**i.** In the amorphous state the solids do not have definite geometrical structure e.g. glass
ii. There is a complete regularity of arrangement of atoms, ions or molecules in a crystalline solid.	**ii.** The atoms, or molecules are not arranged in a regular manner in amorphous solids
iii. The crystalline substance has a sharp melting point	**iii.** Amorphous solid do not have sharp melting point and gradually soften on heating. They may be called as super-cooled liquids e.g. glass, plastics
iv. In a crystalline substance, water molecules are a part of crystals e.g. $FeSO4.7H_2O$, etc	**iv.** The amorphous substances have no such water of crystallization
v. The crystalline substances do not soften on heating	**v.** The amorphous solid is a solid which soften on heating ultimately. They become mobile over a wide range of temperatures

viii. Examples:	viii. Examples:
NaCl, Sugar, Ice	Rubber, Plastic, Glue

iii. Write a note on Anisotropy.

Ans. Anisotropy:

A substance which shows different intensity of properties in different directions is called anisotropic and this property as anisotropy.

Explanation:

A crystalline substance is a built up of small units all having the same geometrical form. But although a crystal is homogeneous, it possesses different properties in different directions. It is because crystal has different arrangements in different directions.

Examples:

i. Graphite exists in the form of layers, so it is conductor in one direction parallel to layers but insulator across the lay

ii. Refractive index co-efficient of thermal expansion, electrical and thermal conductivities give different intensity of properties in different directions.

iii. Mica can be cut parallel to the layers but difficult to cut in some other plane.

iv. What is symmetry, symmetry operations, planes of symmetry and symmetry elements?

Ans. Symmetry:

The repetition of angles faces and edges when a crystal is rotated about 360° angle along its axis is called symmetry.

Symmetry elements:

The rotational operation which brings the crystals into its original appearance is called

Symmetry operation:

On rotating to 180°, a second identical face and at 360°. four identical faces are observed. An axis containing four identical faces is called four-fold axis of rotation. The process through which the crystal was brought back to its identical position is called symmetry operation.

Plane of symmetry:

An imaginary plane passing through a crystal that divides a crystal into two identical halves is called plane of symmetry.

The symmetry elements that occur in a crystal are plane of symmetry, center of symmetry, axis of symmetry and angle of symmetry.

v. Write a note on transition temperature?

Ans. Transition Temperature:

The temperature at which more than one forms of a given substance can exist in equilibrium is called transition temperature.

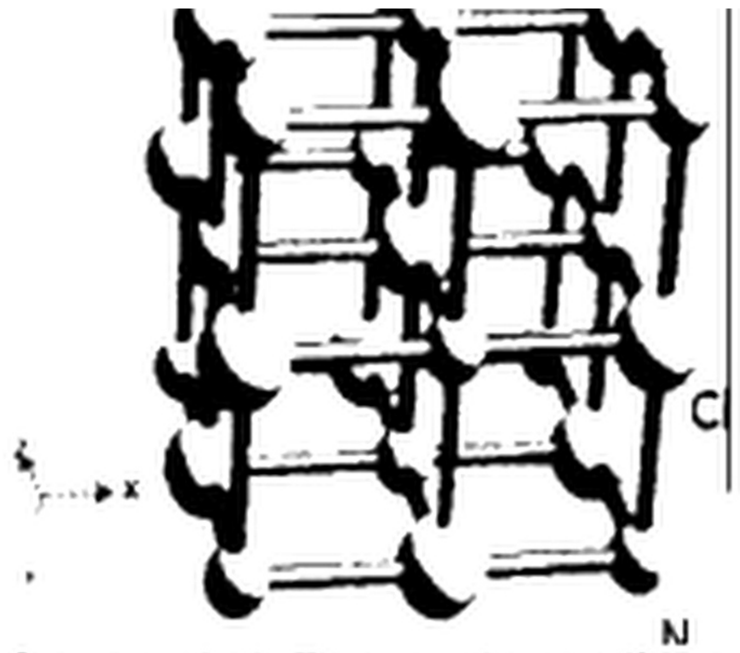
No	Substance	Crystal e form	Transition temperature
1	Tin (grey) Tin (white)	Orthorhombic Tetragonal	18°C
2	Sulphur	Monoclinic Ortho rhombic	95.6 °C
3	KNO_3	Orthorhombic Rhombohedral	128.5 °C

vi. What do you know by a unit cell?

Ans. The smallest unit of volume of a crystal, which shows all the properties of its pattern, is called a unit cell.

We can explain significance of unit cell to the shape of crystal using NaCl as an example.

sodium (I) chloride



This is a basic structural unit of a crystal. The systematic arrangement of atoms in a crystal is called lattice It represents the structure of any substance Primarily a crystal depends upon,

- Shape of the unit cell.
- Contents of the unit cell.

The atoms, molecules or ions in a crystal is repeated in a systematic manner.

vii. What do you know about Hexagonal Closest Packing?

Ans. If tetrahedral holes are covered, the third layer is identical to the bottom layer. This arrangement is called hexagonal close-packing (hep) arrangement. This pattern of arrangement is usually written as ABAB or 1212

viii. What do you know about Lattice Energy?

Ans. Lattice Energy:

1. The amount of heat or energy released when gaseous ions of opposite charges combine to give one mole of a crystalline ionic compound is called lattice energy

Example:

The amount of energy requires a to ordeal one mote crystal lattice into

The lattice energy of the ions depends upon their size and charge of the ions lattice energy decreases with the increase in the size of the ions. (whether cations or anions) the packing of ions become less and less tight Lattice energy increases with reason ionic charge

ix. Write a note on Dispersion Effect.

Ans. Dispersion Effect:

The dispersion effect of electronic cloud can be explained in terms polarizability.

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 electron cloud than small atoms.

In large atoms, the outer electrons are more loosely bound, they can shift towards another atom more readily than the more tightly pounded electrons in small atoms This means polarizability increases with increased atomic and molecular size.

Examples:

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

x. There are some changes in matter.

i. Solids→Liquid
ii. Liquid→Gas
iii. Gas→Liquid
iv. Liquid→Solid

Which of the changes require us to provide energy and which gives out energy?

Ans. Lighter→Denser

Energy is given out. ΔH =Negative

Denser→Lighter

Energy is taken in ΔH =Positive

i. Solids→Liquid

Energy is required to convert a liquid into gas. ΔH is Positive in this case. This energy is called heat of vaporization

Gas→Liquid

Energy is released when a gas is converted into 3 liquid. ΔH is negative in this case this process is called condensation process.

Liquid→Solid

Energy is released when a liquid converts not solid. ΔH is negative in this case This process is called freezing process.

xi. Explain each of the statements below,

(a) You can smell a fish from across the road.

(b) Sugar dissolves faster in hot water than m cold water.

(c) Condensation occurs on the inside of your windows in winter.

Ans.(a) Due to diffusion we can smell of fish from across the road.

Explanation:

According to the kinetic molecular theory of gases, the molecules of the gases are in random motion. They collide with each other and change their directions. That is why you can smell a fish from across the road due to diffusion.

(b) Solubility increase with the increase in temperature

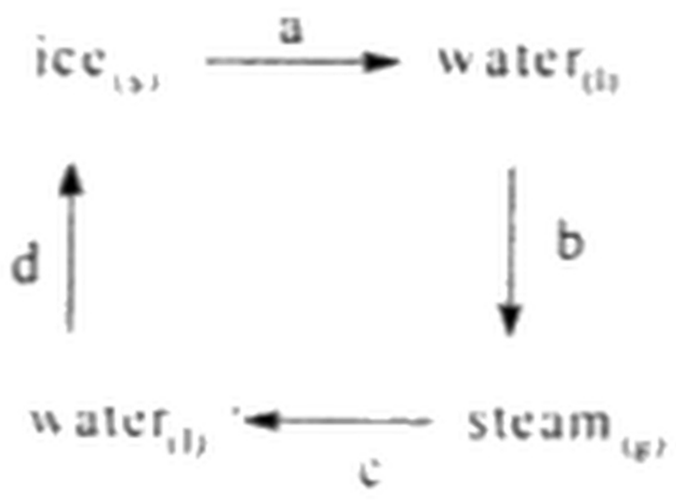
Explanation:

When temperature increases the intermolecular forces among the sugar molecules decreases and therefore the sugar dissolves faster in hot water than in cold water

(c) Condensation is the process in which vapors are converted into liquid.

Condensation occurs on the inside of our windows in winter because the temperature of outside environment is lower than inside. It makes the window cold. Therefore, when the water vapors strike the cold window they condense into liquid.

xii. Use the followina words to label the chanaes "a" to "d" condensation, evaporation,

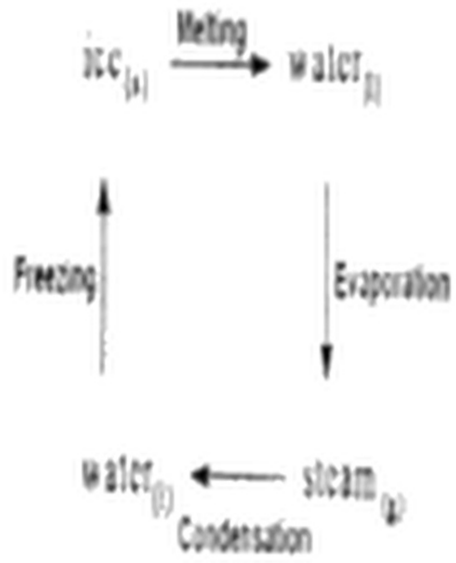


Ans: a =melting

b = evaporation

c =condensation

d =freezing



xiii. look at the densities in the table below:

no	elements	Density(g/Cm^3)
1	oxygen	0.00133 at room temperature and pressure
2	sulphur	8.92
3	potassium	7.14
4	nitrogen	0.00117 at room temperature and pressure.

a. What is the physical state of each element in the above table at 25°C?

b. Give the reason for big differences in the densities of elements shown above?

While Sulphur and potassium are solids at room temperature because their densities are quite high as shown in the table.

b. At room temperature oxygen and nitrogen are gas is lease they have low dens1t1es and have high volume. At room temperature sculpture and potassium are solids because they nave high densities and have small volume.

c. Temperature and pressure important while giving the density of oxygen and nitrogen

As we know that d = PM/RT

From the equation it is concluded that density is directly proportional to pressure and inversely proportional to temperature.

i.e. dα p and dα1/T.

Therefore, pressure and temperature should be mentioned along with the densities.

xiv. Explain why the particles in solid ice stick together and those of steam do not (even when they get very close(collision)?

Ans. Particles in solid ice:

As we know that shows nave strong intermolecular forces due to which they have only vibrational motion that is why the particles in solid ice stick together.

Particles in steam:

As we know that gases have weak intermolecular forces due to which they possess high kinetic energy That 1s why the particles of steam do not stick together even when they get very close collision).

xv. When long bridges are constructed, the roadbed is made in **sections with spaces between the sections. Why must be done so?**

Ans. When long bridges are constructed, the roadbed is made m sections with

xvi. Explain each of the following situations in terms of energy produced or used.

(a) You feel cold immediately after getting out of a swimming pool, but

yow feel comfortably warm when you have dried yourself.

(b) Skin exposed to Just a short tame to steam can suffer severe burns whereas; skin exposed to hot water for the same length of time suffers only a mild bum or none at all.

Ans.{a) Evaporation is a cooling process:

when we come out from swimming pool water molecules ire present on our body these water molecules evaporate by taking heat from the surrounding. Thus due to evaporation of water molecules from our body we feel cold immediately after getting out of a swimming pool as we know that evaporation is a cooling process.

But when we dried our body water evaporates therefore the temperature of our body becomes equal to the temperature of surrounding. That is why we feel comfortably warm when we dried our self.

(b) Gases have high energy:

As we know that gas molecules have high kinetic energy. Thus, steam have high kinetic energy than hot water that 1s why when skin expose for Just a short time period can suffer severe burn.

xvii. Write notes on(i) Amorphous solids (ii)Crystalline solids.

Ans: i. Amorphous Solids:

The solids which have no definite geometric shape are called amorphous solids e g glass. rubber. dust etc.

ii. Crystalline Solids:

The solid, which have a definite regular and three-dimensional geometric shape are called crystalline solids. Some crystalline shows have certain molecules of water of crystallization e g $CuSO_4 5H_2O$. Na $_7SO_4 10H_2O$.

i. Rigidity

ii. Collision

iii. Geometric shape

iv. Attractive forces

Ans. i. Rigidity:

The molecules in solids are closely packed. Therefore, their movement is resented (limited). As a result, they are rigid in nature. The molecules cannot move due to maximum attractive forces between them. However, molecules vibrate about their mean position.

ii. Collision:

As there is no translational movement of particles in a solid. therefore. there are no collisions among the molecules.

iii. Geometric Shape:

The crystalline solids have definite distinctive geometrical shape. It is due to the definite and orderly arrangement of atoms. Ions or molecules in three-dimensional shape.

iv. Attractive Forces:

The attractive forces among the molecules are maximum due to closest packing of the molecules.

4. Define and explain compressibility (β)?

Ans. Compression (Effect of Pressure):

There is practically no effect of pressure on solids as the molecules are very close packed together.

Compressibility factor (β):

The effect of pressure on solids is expressed in terms of compressibility (β). This is defined as. "The decrease in volume per unit volume when the pressure is increased by one atmosphere."

The solids expand when heated i.e. their volume increases. This is because the increase of temperature decreases the intermolecular attractive forces. As a result, the volume increases.

Co-efficient of expansion:

The co-efficient of expansion(α) is defined as "the increase in volume per unit volume when the temperature is increased by 1°C."

6. Describe the following properties of crystalline solids:

1. Cleavage plane
2. Melting point
3. Isomorphism
4. Polymorphism
5. Allotropy
6. Transition temperature

Ans. Properties of crystalline solids:

Some important properties of crystalline solids are described here:

i. Cleavage plane:

The breaking up of larger crystals into smaller one with identical size and shape is called Cleavage.

The plane which contains the direction of cleavage is called cleavage plane.

A crystalline solid contains atoms, ions or molecules closely packed to each other. When some external pressure is applied to it, it changes into small crystals of the same size and shape as that of the original one.

Example:

1) **$NiSO_4.6H_20$ crystal can be cleaved easily provided cleavage is parallel to the surfaces.**
2) The cleavage of NaN03 and $(CH3COO)_2Ca$ is easy. It is parallel to the surface.
3) Mica can be cut easily parallel to the layers.

become so much that they leave their fixed positions simultaneously and become a liquid.

iii. Isomorphism:

There are certain substances which are similar 1r 3hape. Different crystalline substances having the same crystalline stapes are called isomorphs. and this phenomenon is called Isomorphism.

Examples:

i. $ZnSO_4$ and $NiSO_4$ are isomorphism because both have the same crystalline shape i.e. orthorhombic isomorphs have same atomic ratio.

ii. Ag_2SO_4 and Na_2SO_4 are hexagonal. (Atomic ratio=2:1:4)

iii. $CaCO_3$ and $NaN0_3$ are Rhombohedral. (Atomic ratio=1:1:3)

iv. Polymorphism:

The substance existing in more than one crystalline form is called Polymorphous substance and the phenomena as Polymorphism.

Examples:

i. NaCl is found in cubic and octahedral forms.

ii. $CaCO_3$ is trigonal when present as calcite and orthorhombic when present as aragonite.

iii. HgI_2 is orthorhombic (yellow form) and tetragonal in red form.

v. Allotropy (allotrope - Greek-allows (other), tropia (turning): (forms):

An element may exist in different crystalline forms These forms are called Allotropes and this phenomenon is called allotropy.

e.g. **(i) C** (as diamond)_____ in cubic form

(ii) C(as graphite)_____ in hexagonal form

vi. Transition temperature:

The temperature at which more than one for'111:> of a given substance can exist in

1	Tin (grey) Tin (white)	Orthorhombic Tetragonal	18°C
2	Sulphur	Monoclinic Ortho rhombic	95.6 °C
3	**KNO3**	Orthorhombic Rhombohedral	128.5 °C

7. Differentiate between the following pairs:

Crystalline solids and amorphous solids.

Lattice and crystal lattice.

Polymorphism and isomorphism.

(d) Hexagonal closest packing and cubic closest packing.

Ans. (a) Crystalline solids and amorphous solids.

Crystalline solids	Amorphous solids
i. In the crystalline slate, the crystals possess definite geometrical structure. E.g. NaCl is cubic in nature	**i.** In the amorphous state the solids do not have definite geometrical structure. E.g. glass.
ii. There is a complete regularity of arrangement of atoms, ions or molecules in a crystalline solid.	**ii.** The atoms ions or molecules are not arranged in a regular manner molecules in a crystalline solid amorphous solids
iii. The crystalline substance has a sharp Melting Point.	**iii.** Amorphous solid do not have sharp Melting Pant and gradually

iv. in a crystalline substance, water molecules are a part of crystal e.g $FeSO_4$ 7H20 Cuso, 5H, etc	**iv.** The amorphous substances have no such water of crystallization.
v. The crystalline substances do not soften on heating	**v.** The amorphous solid is a solid which soften on heating ultimately, they become mobile over a wide range of temperatures
vi. Three dimensional arrangement of particles	**vi.** No three dimensional arrangement of particles
vii. They have definite heat of fusion	**vii.** They do not have definite heat of fusion
viii. Examples Sugar Ice Diamond etc	**viii. Examples** Rubber Plastic Glue. Glass Paper

(b) Lattice and crystal lattice.

Crystal Lattice:

An array of points representing the arrangement of particles (atoms, ions or molecules) in three dimensional spaces is called crystal lattice.

Lattice:

The position of the particles (atoms, ions or molecules) in a crystalline solid is called Lattice.

Polymorphism	Isomorphism
The substance existing in more than one crystalline form called Polymorphous substance the phenomena as Polymorphism.	Different crystalline substances having the same crystalline shapes are called Isomorphs, and this phenomenon is called isomorphism.
This is compound phenomenon	They may be elements or compounds
They can be convertable from one form to another.	They cannot be inter-converted,
They have some chemical but different physical properties	They have different physical and chemical property.
Examples: NaCl is found in cubic and octahedral forms. $CaCO_3$ is trigonal when present as calcite and orthorhombic have same when present as aragonite	**Examples**: (1) $Znso_4$ and $Niso_4$ are isomorphism because both have the same crystalline shape orthorhombic. Isomorphs have same atomic ratio.
HgI is orthorhombic (yellow form and tetragonal in red form).	(i) Ag_2SO_4 and Na_2SO_4 Are Hexagonal Atomic ratio= 2 1 4) (ii) $CaCO_3$ and $NaNO_3$ are Rhombohedral (Atomic ratio= 1 1 3)

Hexagonal close-packing:

If tetrahedral holes are covered. the third layer is identical to the bottom layer. This arrangement is called hexagonal close-packing (hep) arrangement. This pattern of arrangement is usually written as ABAB or 1212.

Cubic closed packing:

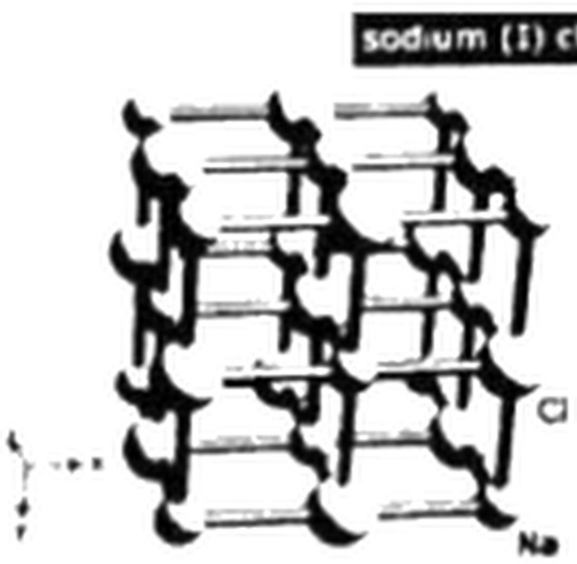
In contrast. if we cover the octahedral holes, the third layer is not identical with the bottom layer. This is called the cubic closed packing(ccp) arrangement. It 1s usually written as ABCABC or 123123.

8. (a) Define a unit cell. List the factors on which a unit cell depends?

(b) Explain the structure of NaCl, keeping in view the unit cell?

Ans. (a) Unit cell:

The smallest unit of volume of a crystal. which shows all the properties of its pattern. is called a unit cell



Structure of **NaCl Crystal**

This is a basic structural unit of a crystal. The systematic arrangement of atoms in a crystal is called lattice. It represents the structure of any substance Primarily a crystal depends upon,

- Shape of the unit cell.
- Contents of the unit cell.

The atoms, molecule or ions in crystal are repeated in a systematic manner. We can explain significance of unit cell to the shape of crystal using NaCl as an example. The unit

example. The unit cell is concerned with the shape of the crystalline substance. Keeping in view. the shape of the crystal. its structure can be identified. Let us take the example of NaCl.

1. Co-ordinate Number:

The number of negative ions which contact a unit positive ion is called its co-ordinate number. In NaCl each Na^{+1} ion contact with 6 Cl^{-1} ions at the corner of a regular octahedron. So, the co-ordination number of Na^{+1} ion is 6 Similarly co-ordination number of Cl^{-1} ion is also 6. The distance between Na^{+1} ion all and Cl^{-1} ion is the same.

2. No. of NaCl in Each Unit Cell:

In NaCl there are 8 Cl ions at each corner of the cube. Each Cl^{-1} ion is shared among eight-unit cells Each face shares with two-unit cells. So, the number of ion in each unit cell can be calculated

Calculation of Na• ions and Cl ions:

a. Calculation of Cl' ions:

i. No of unit cells =8

No of Cl^{-1} ions = 8

Number of Cl^{-1} ions in one-unit cell=1

ii. Total number of Cl^{-1} ions at the corner of a regular octahedron=6

No of unit cells containing each face = 2

No of Cl^{-1} ion in each unit cell= 3

Total number of Cl^{-1} ion in each unit cell=1+3=4 Cl^{-1}

(b) Calculation of Na^{+1} ions:

Na^{+1} ion are present at the edges

No of edges present in the cube = 12

Total number of Na^{+1} ions = 3 + 1 = 4 Na^{+1} ion

So, each unit cell consists of 4 Na^{+1} ions and 4 Cr^{-1} ions.

Hence 4 Na^{+1} + **4** Cl^{-1} = 4 NaCl can be written

9. Explain the three factors that affect the shape of an ionic crystal?

Ans. The Factors that Affect the Shape of an Ionic Solid

Q18. Explain the three factor that affect the shape of an ionic solid.

Ans: The Factors that Affect he Shape of an Ionic Solid:

There are three factors which affect the shape of an ionic crystal.

1. Electrostatic Forces of Attractions:

The ionic solids are composed of cations and anions. They are held together through strong electrostatic forces of attraction forming a well-defined geometric shape e.g. formation of NaCl.

Sodium loses one electron to be converted to Na^{+1} ions.

$$Na - 1e^{-1} \rightarrow Na^{+1} \text{ (A cation is formed)}$$

$$Cl + 1e^{-1} \rightarrow Cl^{-1} \text{ (A anion is formed)}$$

These ions combine together due to strong electrostatic force.

$$Na^{+1} + Cl^{-1} \rightarrow NaCl \quad L\backslash H=-787 kgMole^{-1}$$

It is an exothermic reaction. To form a crystal lattice of NaCl, each Na^{+1} ion is surrounded by 6 Cl^{-1} ions and each Cl^{-1} ion is surrounded by 6 Na^{+1} result a cubic structure of ionic solid of NaCl is formed.

2. Radius Ratio:

The structure and shape of an ionic solid depends upon the radius ratio of cations and anions.

e.g. NaCl and CsF have the different geometry because the radius ratio is different in

The structure and limiting Radius Ratio of certain crystalline substances are given below

No	Shape of ionic solid	Limiting Radius Radio r• ¹ / r· ¹
1	Body centered cubic	0.732 and above
2	Octahedral	0.414 to 0.732
3	Tetrahedral	0.22 to 0.414
4	Triangular	0.15 to 0.22

Thus, knowledge of Radius Ratio consisting of cations and anions can give a good idea of the shape of crystal.

Cubic structure:

And ionic compound with Radius Ratio greater than 0.732 will have cubic structure e.g. NaCl.

Octahedral structure:

The radius ratio of an ionic compound with octahedral structure should be in between 0.414 and 0.732.

Tetrahedral structure:

A tetrahedral structure is formed if the radius ratio is in between 0.22 to 0.414.

The Radius Ratio of the following ionic crystals are:

4. NaCl = 0.522 - Octahedral arrangement or cubic structure.

5. CsCl = 0.93 - Body centred cubic arrangement.

6. ZnS=0.4 Tetrahedral arrangement.

3. Poor Conductivity:

The ionic crystals do not conduct electricity in the solid state. The shape of the crystals remain as such. However, when a solvent (H_2O) is added to the ionic solid.

Example:

Thus, the ions are solvated.

10. (a) Define lattice energy and give a particular example?

(a) Explain the low density and high heat of fusion of ice?

Ans. (a) Lattice Energy:

1. The amount of heat or energy released when gaseous ions of opposite charges combine to give one · mole of a crystalline 1on1c compound is called lattice energy.

Example:

$$NaCl\ (g) + Cl(g) + NaCl(s)\ H = -787\ kg\ mol^{-1}$$

2. The amount of energy required to break one mole crystal lattice into its gaseous ions is called lattice energy

Example:

$$NaCl(s) \rightarrow Na(g) + Cl(g) \qquad H = +787\ kg\ mol^{-1}$$

Dependence:

The lattice energy of the ions depends upon their size and charge of the ions. Lattice energy decreases with the increase in the size of the ions. (whether cations or anions). the packing of oppositely charged ions become less and less tight lattice energy increases with increasing tonic charge.

(b) Low Density and high Heat of Fusion of Ice:

i. Low density of ice:

When the temperature is decreased the molecules come close to each other As a result the intermolecular attractive forces increase However some spaces are developed the ice. As a result about 9% more space than liquid water is produced. As d=m/v that is density is. inversely proportional to volume, the increase in volume decreases the density. That 1s why ice floats overwater.

Application of Low Density in **Real Life:**

Keeping in view the above discussion, we are forced to believe that the pattern of life for plants and animals would have been totally different in the absence of Hydrogen bonding in water.

ii. High Heat of Fusion of Ice:

The quantity of heat required to convert one mole of a solid into liquid is called molar heat of fusion.

e.g. liquid water $6H_f$= 6.02 KJ mole^{-1}

Applications in Real Life:

Ice absorbs 333 Joules of energy for every gram of ice to melt It means, if 33 3 K. Joules of energy from the surrounding is absorbed by each of the drinks, the temperature of the drink without ice would rise from 0°C to 20°C The drink containing the ice would remain at 0°C but 100 grams of ice would melt.

Therefore, it can be said that the aquatic life would be totally different in the absence of hydrogen bonding.

11. Write notes on molecular crystals and metallic crystals.

Ans: Molecular Crystal:

Definition:

The solid substances in which the particles forming the solids are polar or non-polar molecules are called molecular crystals.

Examples:

e.g. In solidified gases. these are non-polar atoms. Two types of intermolecular forces hold them together

(i) Dipole-Dipole interactions.

(ii) Van der Waal's forces

Examples:

i. Crystals with polar molecules e.g. Ice. Suaar

i. X-ray analysis indicates the regular arrangement of atoms. Thus, we get the exact positions of all the atoms.

ii. Polar molecular crystals have high M.P and B.P. as compared to non-polar molecular crystals.

iii. They are soft and easily compressible.

iv. They are volatile in nature.

v. They are bad conductors of electricity.

vi. They have low densities due to weak attractive forces.

vii. They are transparent to light.

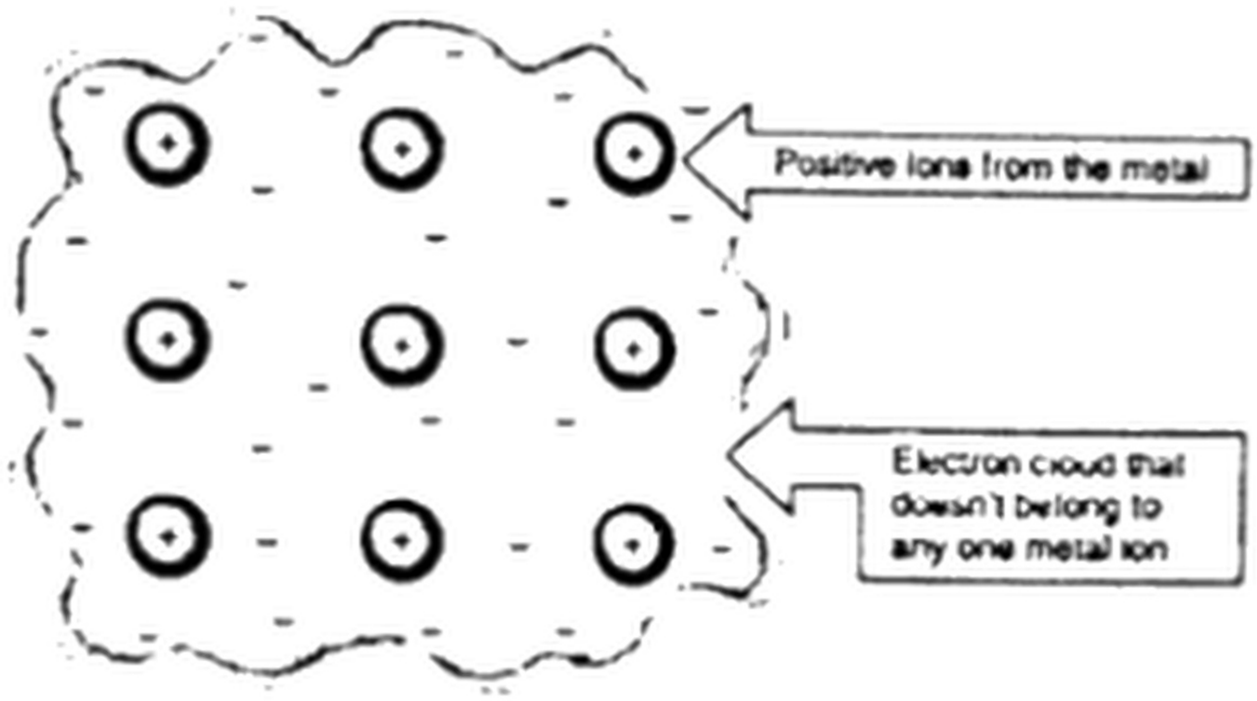
Metallic crystal:

Definition:

The crystalline solids in which metal atoms are held together by metallic bonds are known as metallic solid e g Na, Cu etc.

Explanation (Electron Sea or Electron Gas Theory:

Metals are good conductors because the valence electrons are loosely bound. They move from on atom to the other. Due to this mobility of electrons they are conductors to conduct electricity the positively charged portion of electrons serve. This is shown below



An electron sea surrounding cations

ii. Forces of repulsion between positively charged ions. These forces are equal and opposite. Therefore, they counterbalance each other Thus the metallic atom is neutral as a whole.

Properties:

i. They are best conductors of heat and electricity.

ii. They have lustrous surface.

iii. They are malleable and ductile.

iv. They have high melting points.

12. Explain the conductivity of a metallic crystal using "electron sea theory".

Ans: Metallic Solids:

Definition:

The crystalline solids in which metal atoms are held together by metallic bonds are known as metallic solid e.g. Na, Cu etc

Explanation (Electron Sea or Electron Gas Theory):

Metals are good conductors because the valence electrons are loosely bounds. Therefore, they can move from one atom to the other. Due to this mobility of electrons, they are considered to conduct electricity.

The positively charged portion of the metallic atom is surrounded b electrons in such a way that these electrons serve as an atmosphere of distributed charges. The positively charged particles are immersed in it. Such an atmosphere is called an electron gas or sea.

Properties:

i. They are best conductors of heat the electricity.

ii. They have lustrous surfaces.

iii. They are malleable and ductile.

iv. They have high melting points.

v.

13. Write a detail note on ionic solids.

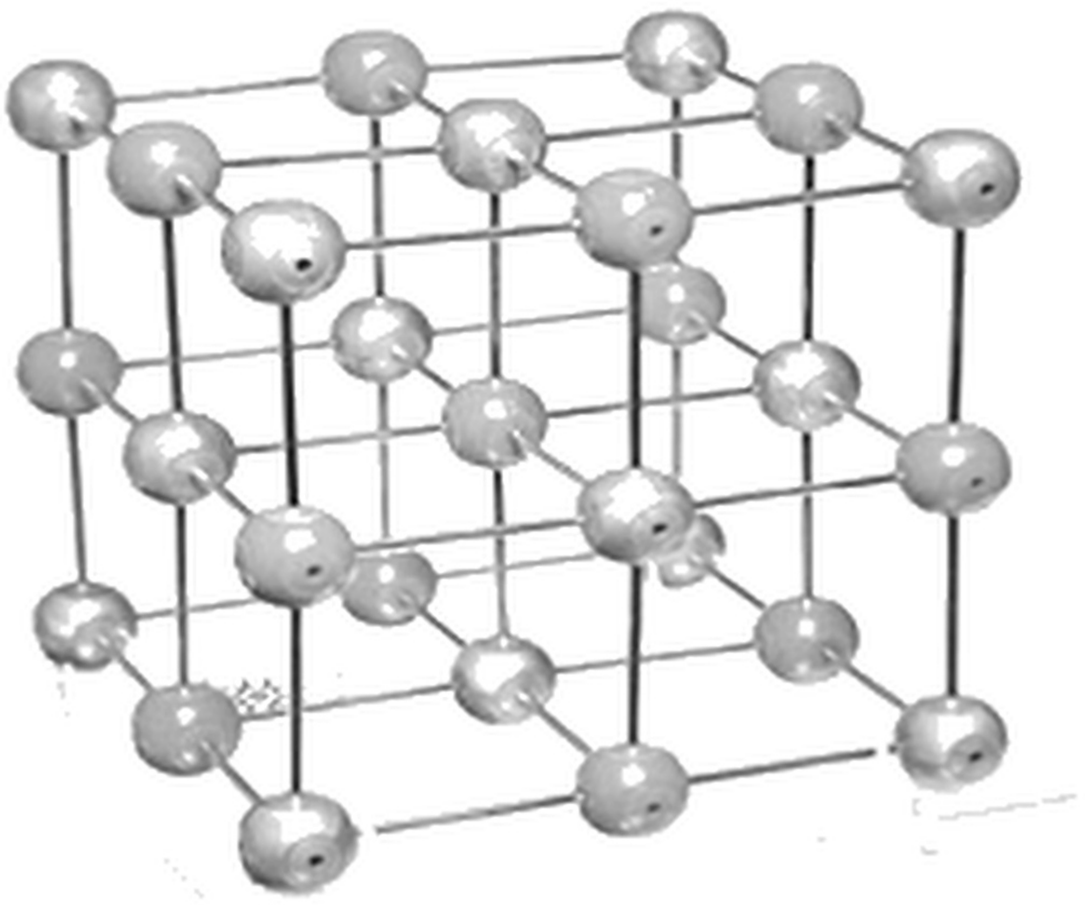
Ans. Ionic Solids:

Formation of NaCl:

$$Na_{(2\,8\,1)} - e^{1} \rightarrow Na^{1}_{(2\,8)} \quad (cation)$$

$$Cl_{(2\,8\,7)} + e^{1} \rightarrow Cl^{1}_{(2\,8\,8)} \quad (anion)$$

$$Na^{+1} + Cl^{1} \rightarrow NaCl$$



Sodium chloride crystal

i. They are non-conductors of electricity in the solid state. However they conduct electricity in the molten or solution form.

ii. They have definite geometric shape.

iii. They are non-directional in nature.

iv. They do not exist in the form of molecules due to their ionic nature.

14.(a) Define covalent crystals and give their properties?

(b) How will you explain the covalent solids?

i. When the atoms are jointly held together like diamond.

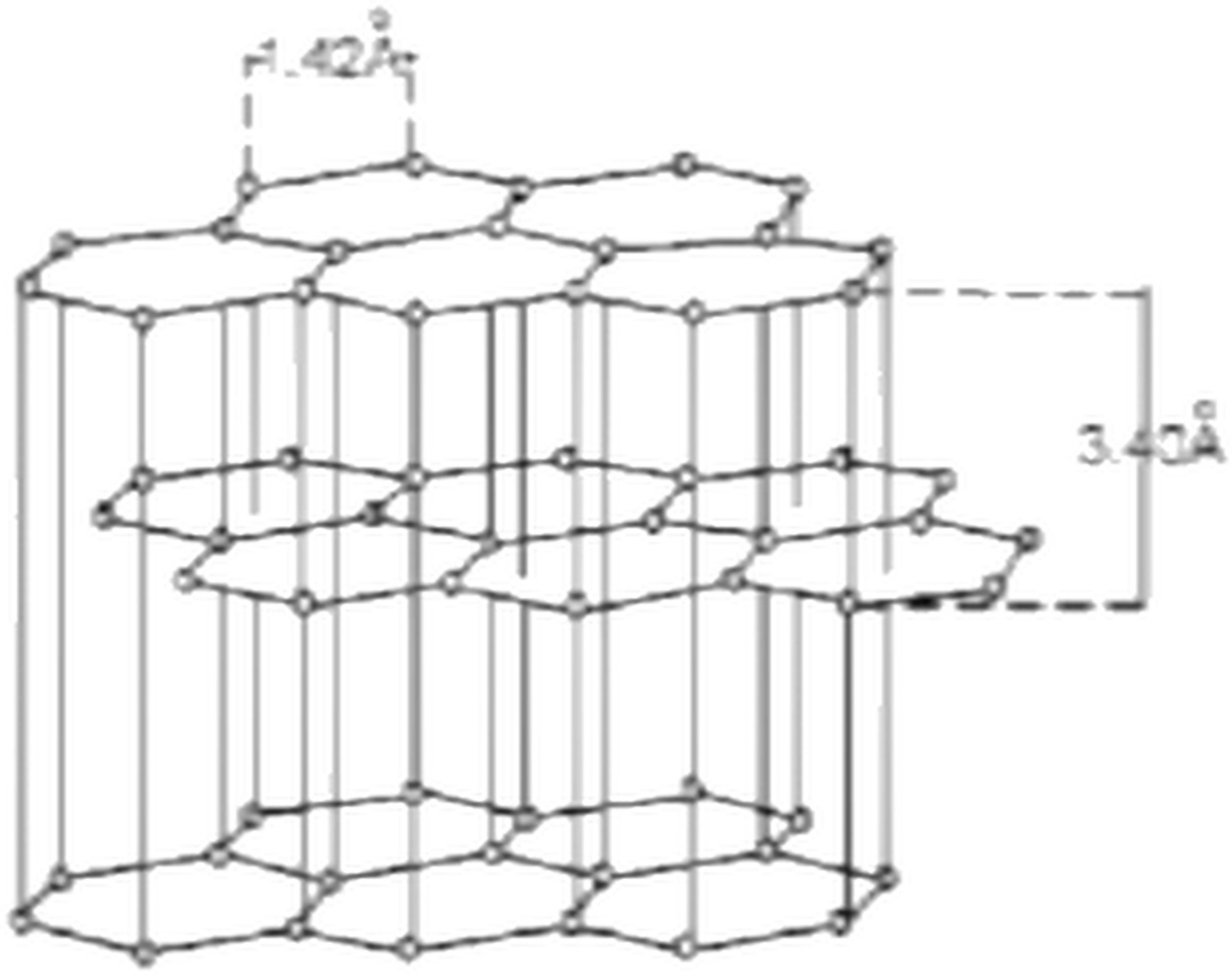
ii. When the atoms have separate layers like graphite.

Ans. (a) Covalent crystal (solid):

The crystalline solids in which atoms of similar or dissimilar elements are held together in a network of single bond are known as covalent crystals e.g. diamond etc.

ii. When atoms join together by sharing of electrons. As a result separate layers are formed e.g. graphite.

(Graphite crystal)



iii. They are bad conductors of electricity with the exception of graphite.

iv. They have definite shape and oriented in three direction with a network structure.

v. They have open structure due to the valence of atoms directed in definite direction.

vi. They may be called as molecules due to the valence of atoms directed in definite direction.

(b) i. when the atoms are jointly held together like diamond.

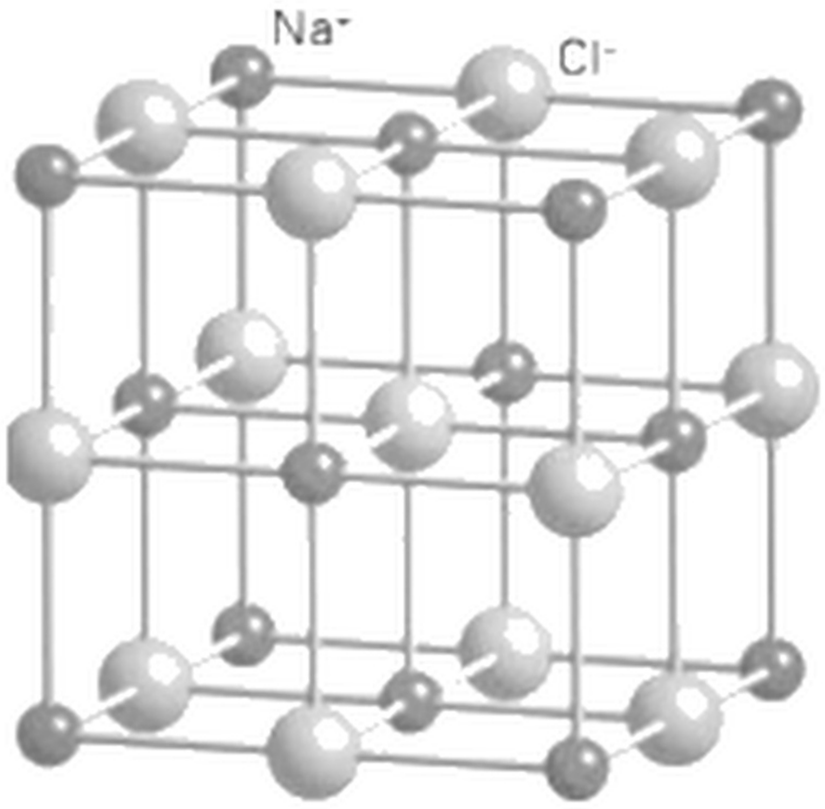
When the atoms are jointly held together like diamond then covalent bonds give giant molecules. It is non-conductors of electricity due to complete sharing of electrons.

ii. When the atoms have separate layers like graphite.

When atoms join together by sharing of electrons. As a result separate layers are formed e.g. graphite. Graphite is good conductors of electricity due to free electrons.

Note: Network covalent solids vary from insulating to semiconducting in their behavior, depending on the band gap of the material.

Ans. The smallest unit of volume of a crystal, which shows all the properties of its pattern, is called a unit cell.



(Structure of NaCl Crystal)

This is a basic structure unit of a crystal. The systematic arrangement of atoms in a crystal is called lattice. Is represents the structure of any substance Primarily a crystal depends upon,

- Shape of the unit cell.
- Contents of the unit cell.

The atoms molecules or ions in a crystal are repeated in a somatic manner.

We can explain significance of unit cell to the shape of crystal using NaCl as an example

Unit Cell and Shape of NaCl:

We can explain significance of unit cell to the shape of crystal using NaCl as an example. The unit cell is primary concerned with the shape of the crystalline substance. Keeping in view the shape of the crystal, its structure can be identified.

Let us take the example of NaCl

Location of ions:

In NaCl, each Na^{+1} ion contacts with 6 Cl^{-1} ions and vice versa. The size of Cl^{-1} ion is bigger than Na^{+1} ion because Cl^{-1} ion has 18 electrons and Na^{-1} ion has 10 electrons.

Co-ordinate Number:

No. of NaCl in each unit cell:

In NaCl there are 8 Cl ions at each corner of the cube. Each Cl ion is shared among eight unit cells. Each face shares with two unit cells. So the number of Cl ion in each unit cell can be calculated.

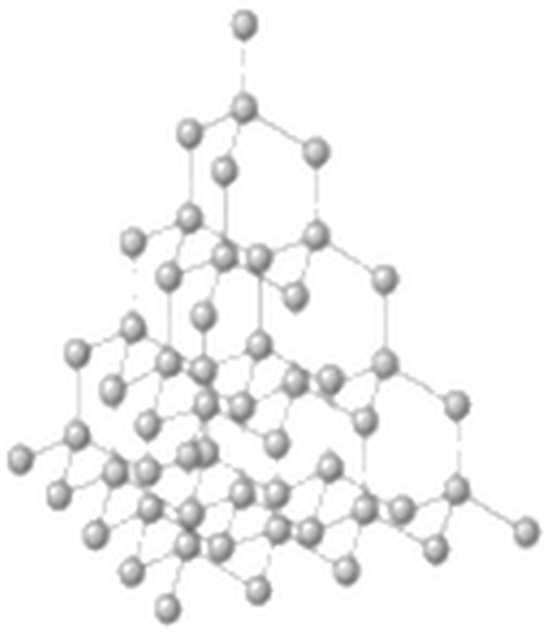
16. How will you explain that diamond is non-conductor while graphite is conductor in nature?

Ans. Diamond is non-conductor:

In diamond free electrons are not present therefore it is non-conductor in nature.

Explanation:

In diamond each carbon atom is covalently bonded with four other carbon atoms and have a network structure as shown in the figure.



Fragment of the diamond giant structure
Each carbon atom is linked to four others

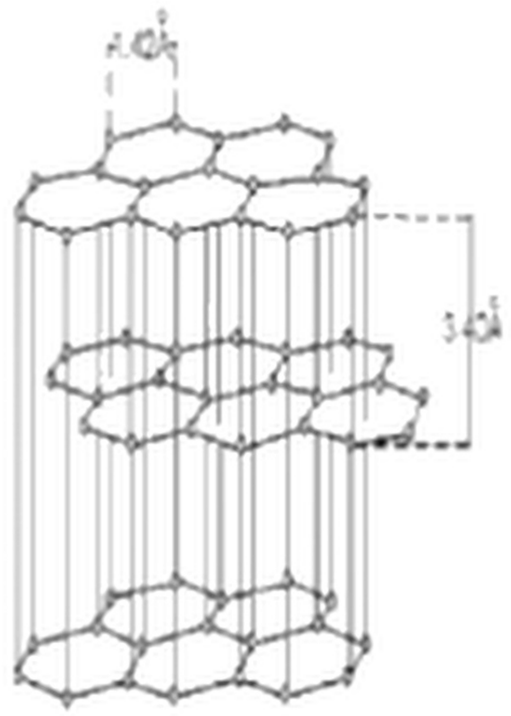
Therefore it has no free electron for the conduction of electricity hence it is non-conductor.

Graphite is a conductor:

In graphite free electrons are present therefore it is a conductor in nature.

Explanation:

In graphite each carbon atom is covalently bonded with three other carbon atoms and has a layered structure as shown in the figure.



Therefore the fourth outermost electron of carbon is free which can be used for the conduction of electricity.

But according to Anisotropy graphite exist in the form of layers so it is conductor in one direction, parallel to layers but insulator across the layers.

17. Explain the kinetic energy of solids, based upon the kinetic molecular theory?

Ans. Kinetic Energy Based Upon Kinetic Molecular Theory:

According to the Kinetic molecular Theory, the attractive forces between the solid particles are maximum. This is due to minimum distance between them and, therefore, molecules do not possess translation and vibration kinetic energies. However, they can vibrate about their mean positions. So they possess vibrational kinetic energy.

18. How will you explain the use of oxygen and sulphur to define allotropes?

Ans. Allotropy:

It is the ability of an element to exist in more than one from in the same crystalline state.

Allotropes of Oxygen:

Dioxide (O_2) and Trioxide (O_3 or Ozone) are considered to be the two forms of oxygen obtained by the absorption of certain amount of heat from atmosphere.

$$3O_2 \rightarrow 2O_3 \qquad \triangle H = 142kg - mole^{-1} of - O_3$$

therefore, it is called monotropic (moving in one direction). It has been found that the maximum concentration of ozone is (about 10 pm) (parts per million), occurs 24-30 Km from the surface of the earth. Thus oxygen has two allotropic forms which are irreversible.

Structures

Oxygen molecule O=O has a sigma (o) bond and a Pi-bond (π) between the two atoms. In ozone molecule, there is an angle of 117° between the bonds as indicated.

The allotropes of oxygen are of two types:

i. **Oxygen (O_2)**
ii. **Ozone (O_3)**

Ozone has a characteristic smell, in concentration above 1000 ppm, it is damaging the health.

Allotropes of sulphur

Allotropes of sulphur are of four types

- Rhombic Sulphur
- Monoclinic Sulphur
- Amorphous Sulphur
- Plastic Sulphur

Rhombic Sulphur (α -Sulphur):

It is bright yellow in colour and stable below 96°. It is crystalline I nature and made up of S_8 molecules.

Monoclinic Sulphur (β-Sulphur):

It is a crystalline solid and stable between 96° and 119°.It is not found in the free state. It is converted to Rhombic Sulphur at room temperature.

Amorphous Sulphur (δ -Sulphur):

It has irregular crystalline shape which may be called as Amorphous. It is not found in the free state. It may be prepared by passing H_2S gas through water for a long time. The saturated

Plastic Sulphur:

It is a super cooled form of sulphur. If the yellow sulphur is heated to boiling and poured into liquid water, it will roll up and produce yellow ribbons resembling plastic like material. It is not considered to be a true allotrope of sulphur because it is soft and elastic in nature and insoluble in H_2S.

19. Explain, why a compound like $CaCl_2$ (calcium chloride) fluctuate in mass from day to day because of humidity?

Ans. Hygroscopic Salts:

Some salts absorb moisture from atmosphere. Such salts are called hygroscopic salts. Calcium chloride has the atmosphere. Such salts are called hygroscopic.

The absorption of moisture becomes maximum when there is humidity in air.

The water molecules absorbed will become part of crystal of $CaCl_2$ may be called as water of crystallization such substances are called Hydrates. $CaCl_2$ can absorb a maximum of 2H,0 Therefore $CaCl_2$, becomes $CaCl_2.2H_2O$. The water of crystallization attached will increase the mass of calcium chloride.

That is why compound like $CaCl_2$. (calcium chloride) fluctuate in mass from day to day because of humidity.

20. How will you purify saline water by repeated freezing method?

Ans. Sodium chloride salt from saline solution:

Saline water (NaCl solution) contains water along with certain impurities. If saline water is allowed to freeze freezing mixture of water the impurities come up to the surface in the form of ice at 4°C leaving behind NaCl.

Ice and impurities are removed from the surface leaving behind pure NaCl.