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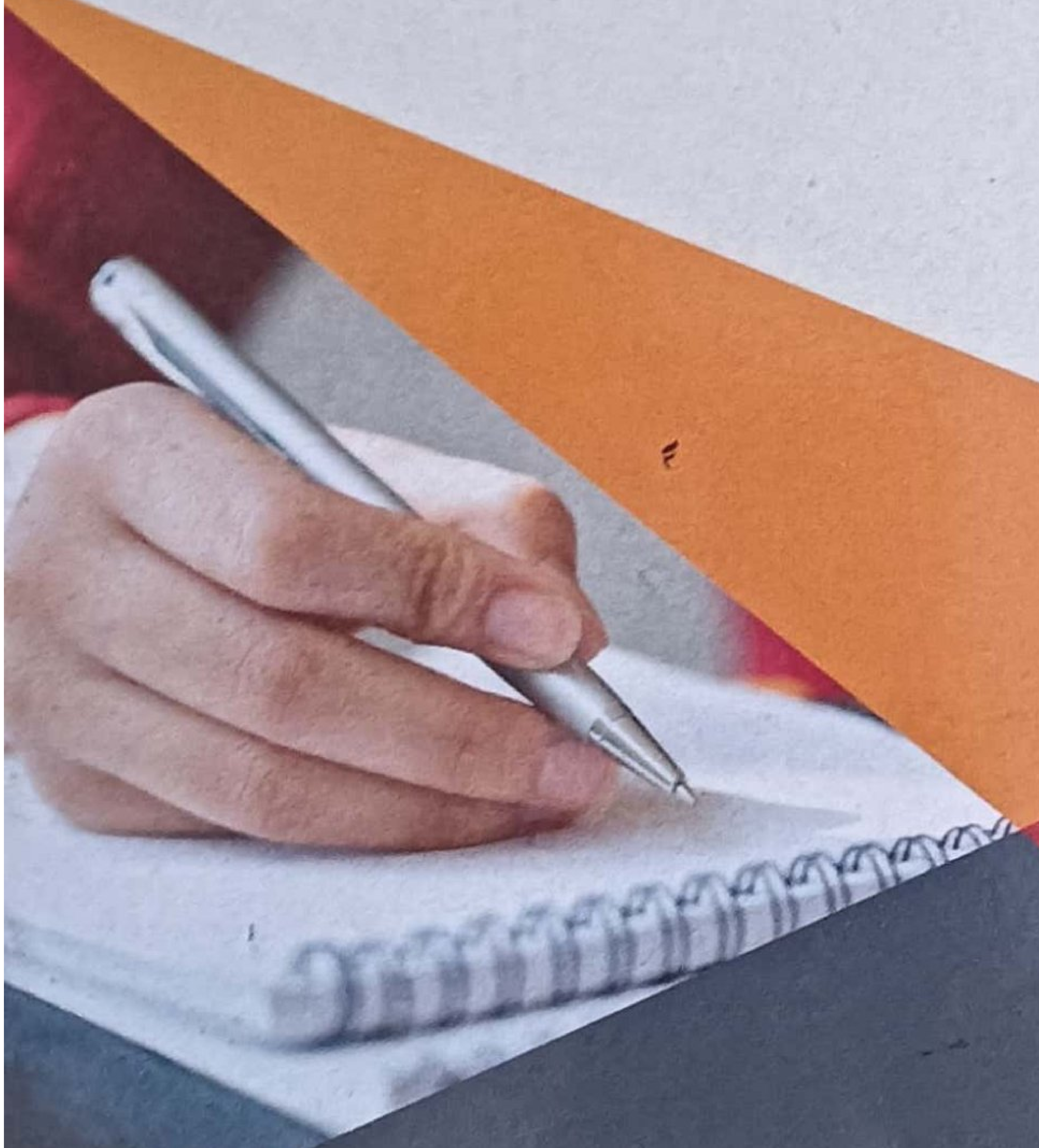

ASSIGNMENT

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B.A. / B.Sc. / B.Com.

ASSIGNMENT WORK / MIDTERM TEST

Session 20 .... - 20 ....

Semester ....

Name of Student Manisha Choudhary **Father's Name** Mr. Sohan lal Choudhary

Roll No. .... **Enrollment No.** ....

Year .... **Semester** ....

Question-1 (a) Explain the solubility of ionic compound ?
Question-1 (b) Explain the factor affecting solubility of ionic compounds ?

Question 2 (a) On the basis of VSPER theory explain the hybridisation of SF_4 and ICl_2 ?
(b) What is VSPER theory and explain the postulate of the VSPER theory ?

Question (3) (a) Explain the seven crystal system.
(b) Explain the difference b/w crystalline and non - crystalline solid
(c) Define the law of Rational Indices.

Question (4) (a) What happens when an electrolyte is added to the gold sol. ?
(b) what happens when the solution of salt turns milky on adding alcohol ?
(c) Why is $FeCl_3$ solution applied to stop bleeding from a cut ?

Question - 1.(a)

Answer

Fajon 's' rule. ⇒ Fajon explained the polarizing power of cation and polarization of anion and deduced many rules such as.

Factors related to cation ÷

(i) Size of cation ÷ The polarising power of a cation decreases with the increase in its size. When the radii of the cations bearing similar charge increase the electron density decreases.

example $Be^{+2} < Mg^{+2} < Ca^{+2} < Sr^{+2} < Ba^{+2}$

increasing order of
Size of cation

$$\text{Polarizing power of cation} \propto \frac{1}{\text{Size of cation}}$$

(ii) Charge on cation ÷ As the charge on cation increases then the polarizing power of cation to polarize anion increases

Polarizing power of cation $\propto$ Charge on cation

example $Na^{+} < Mg^{+2} < Al^{+3}$

→ increase in polarising power.

→ increase in covalent nature

→ decrease in melting point

→ factors related to Anions ÷

(1) Size of anion ÷ More is the size of anion less is the attraction force of nucleus on its etc. e^-.

→ Because of this anion is easily polarized by cation

★ Polarizing power of anion ∝ Size of anion

Example

(1) $F^{\ominus} < Cl^{\ominus} < Br^{\ominus} < I^{\ominus}$

(•) increase in polarizing power, size, cov. nature

(•) mealting point decreases. sol. in water decreases

(2) $CaF_2 < CaCl_2 < CaBr_2 < CaI_2$

(2) Charge on anion ÷

→ when charge (-ve) on anion increases then size of anion also increases. Therefore polarizing power also increases.

Example

(1) $F^{\ominus} < Cl^{\ominus} < Br^{\ominus} < I^{\ominus}$

(ii) $LiF < Li_2O < Li_3N$

increase in size, polarization, covalent nature

Question 1 (b)

Answer (b)

factors affecting solubility of ionic compound.

(i) Ionic Size

→ The solubility of any compound depends upon its lattice energy and soluation energy.

→ Value of lattice energy (u) is inversly proportional to the sum of radius of cation and anion present in crystal lattice.

$$U \propto \frac{1}{r+r}$$

radius of cation ← r+r → radius of anion

→ That's why if there's any change in the radius of cation and anion then solubility of ionic compound is affected.

→ Soluation energy of any ionic compound is equal to the sum of soluation energy of cation and anion

formula

$$\Delta H_S = \Delta H_S^{\oplus} + \Delta H_S^{\ominus}$$

Soluation energy / enthalpy.

(ii) Ionic charge :

When ionic charge increases then due to the internal reactions of ionic solvents, the increase in soluation energy is not as much as that in Lattice energy

Due to this most crystal having more ionic charge are insoluable.

That's why most of the multivalent anions like phosphate and sulphate are less soluable in water.

Compound	charge on cation	charge on anion
LiF	+1	−1
MgF_2	+2	−2
MgO	+2	−2
Al_2O_3	+3	−3

↓

charge (−) ↑ses

Solubility − ↓ses

(iii) dielectric constant of Solvent

→ Ionic compound are more soluable in polarized solvents. When the solvent is more polarized then its dielectric value also increases, increasing the solvation energy.

→ Therefore those solvents having more dielectric value are more soluable.

→ Dielectric value is represented by ε(Abs

Relation between dielectric constant and solvation energy of an ion can be calculated as :-

$$\underset{\downarrow}{H_s} = \frac{Z^2 e^2}{2r}\left(1 - \frac{1}{\underset{\downarrow}{\varepsilon}}\right)$$

Soluantion energy   dielectric constant

(iv) Temperature

When a solute is mixed in a solvent then the process of formation of solution can be exothermic or endothermic.

(a) Solute + Solvent ⟶ Solution + energy
(exothermic reaction)
$\Delta H = -ve$

(b) Solute + Solvent + energy ⟶ Solution
(endothermic reaction)
$\Delta H = +ve$.

→ for exothermic reaction value of ΔH is $-ve$. Hence on increasing temperature its solubility ↓ses.

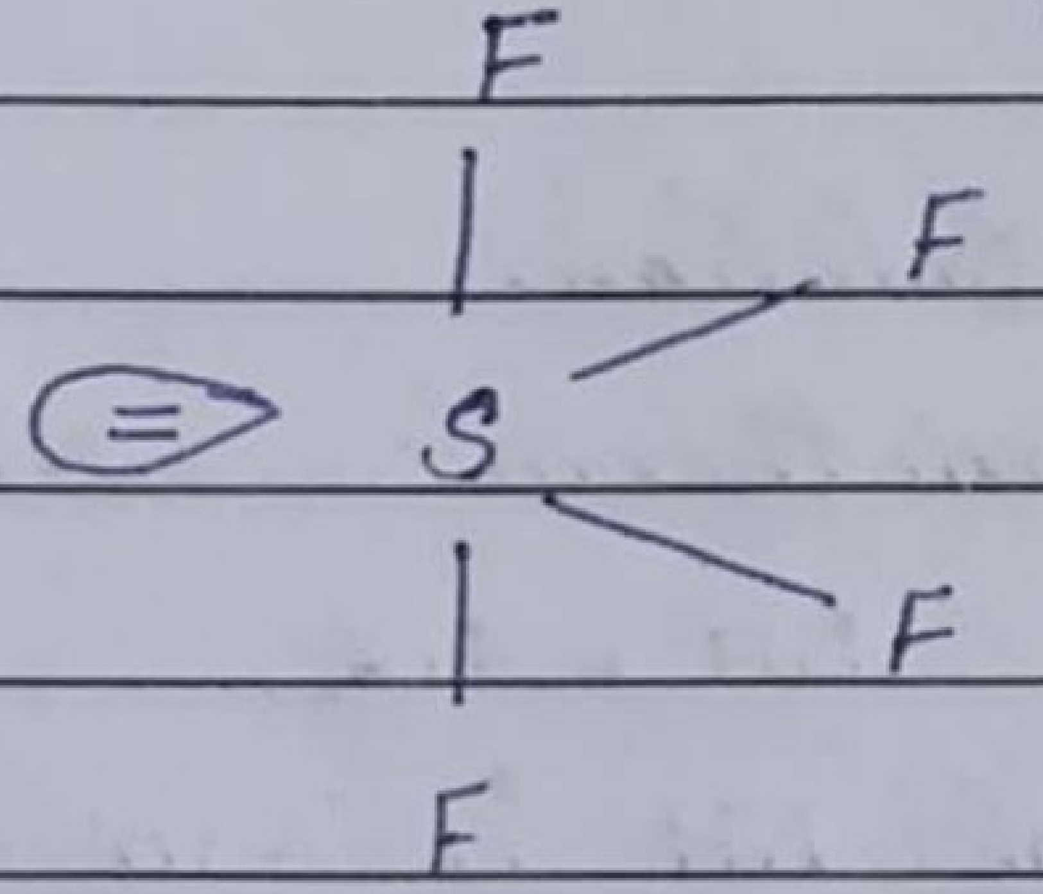
→ whereas for endothermic reactions value of ΔH is $+ve$. Hence on ↑sing temperature its solubility also ↑ses.

Question (2) (a)

Answer

(i) SF_4 : The central atom present in SF_4 is sulphur which has 6 electrons in its valence shell. Four e^- in σ - bond and one lone pair remains free in SF_4

Its structure is following :-



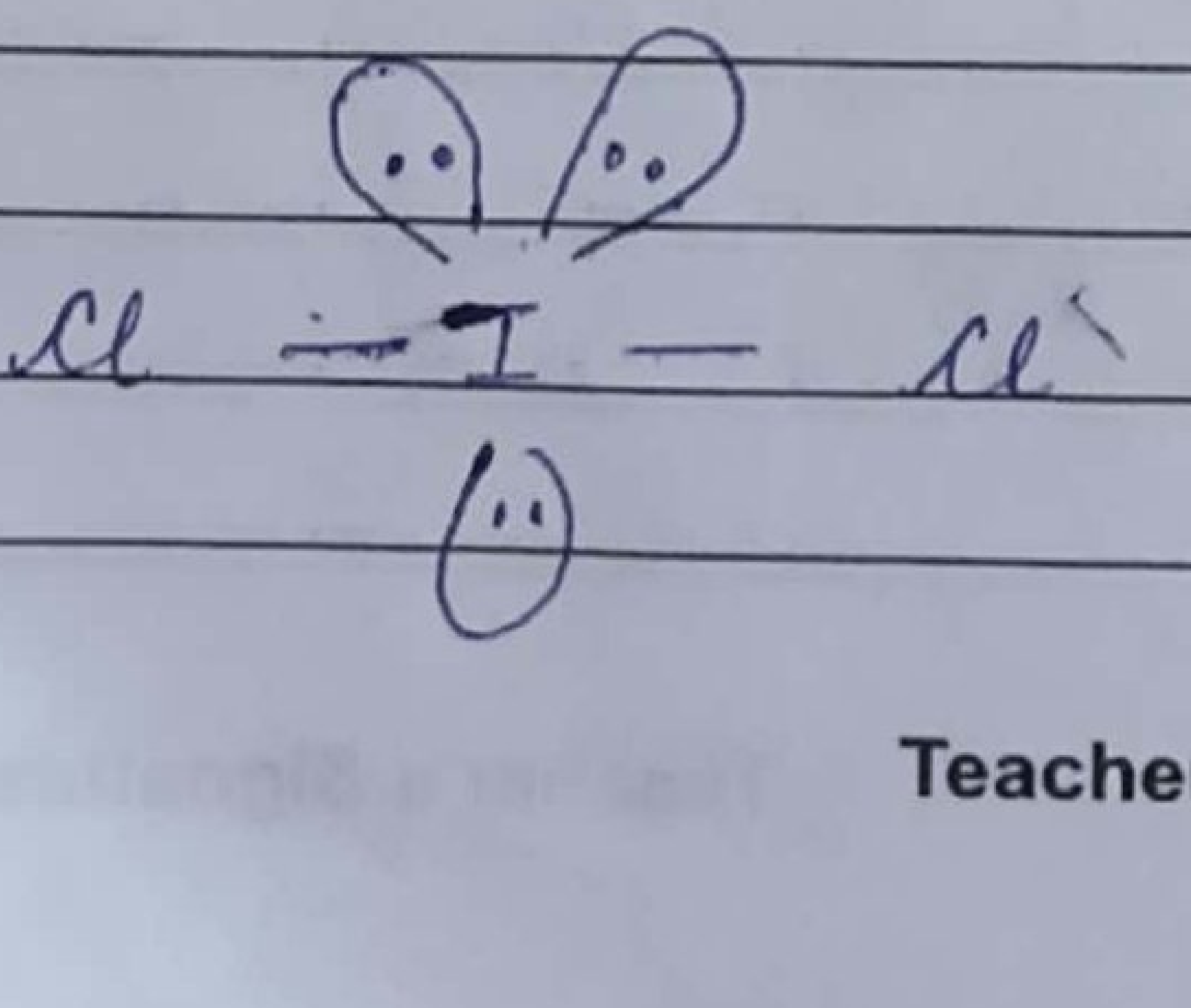
hybridisation = Sp^3d
Structure = distorted tetrahedral

(ii) ICl_2^- :-

The central atom in ICl_2 is Iodine (I), which has 7 electrons in its outermost shell. Two Cl atmos are connected to I by two σ bonds.

I atoms carries a -ve charge on it and it has 8 electrons.

That's how ICl_2^- has 3 lone pairs and 2 bond pair



hybridisation = Sp^3d
Structure = linear
Angle = 180°

→ Its hybridisation is sp^3d.
→ Its structure is linear.
→ Bond pair and lone pairs are. 2+3 = 5

Question (2) (b)

Answer.

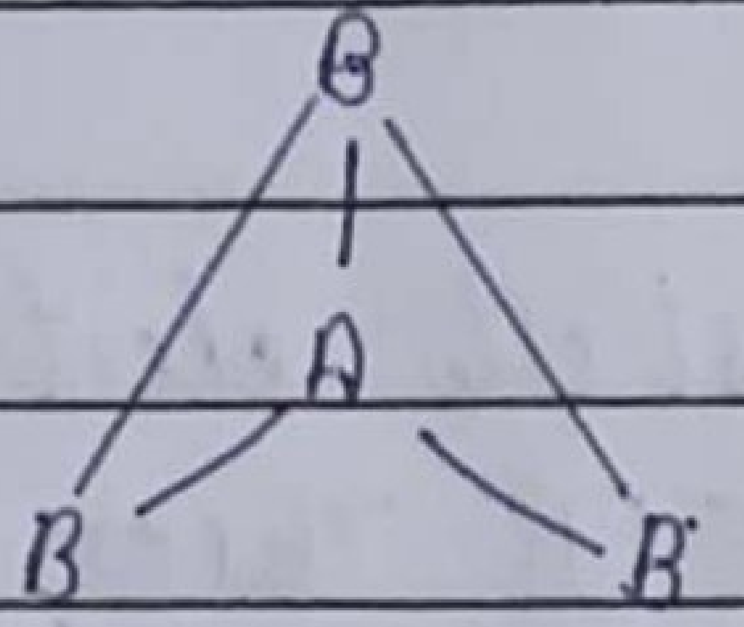
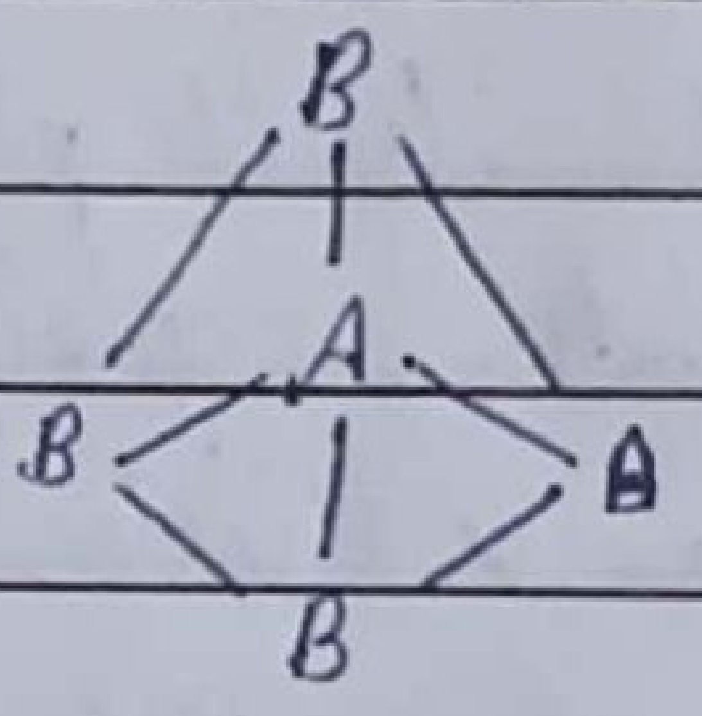
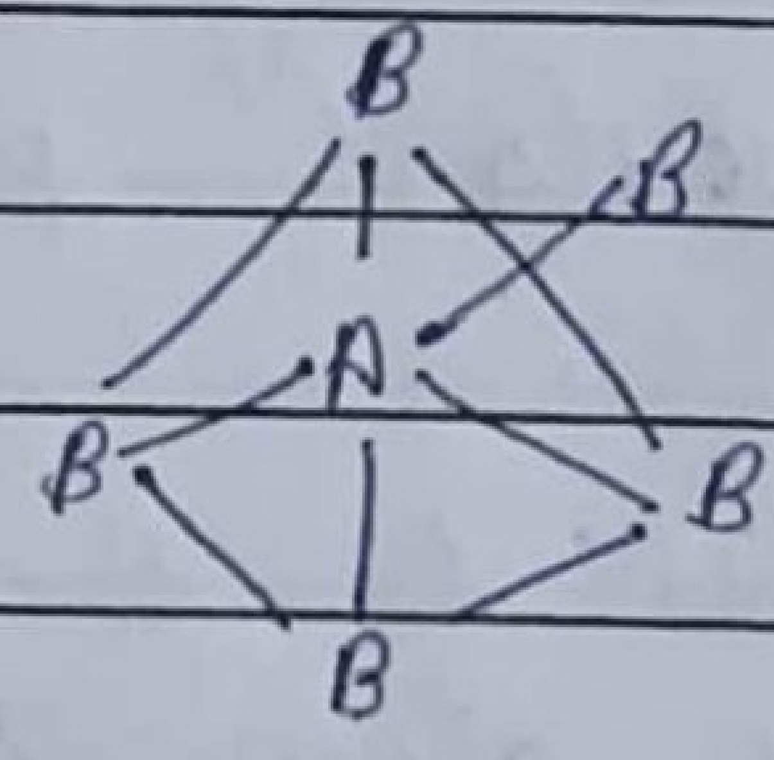
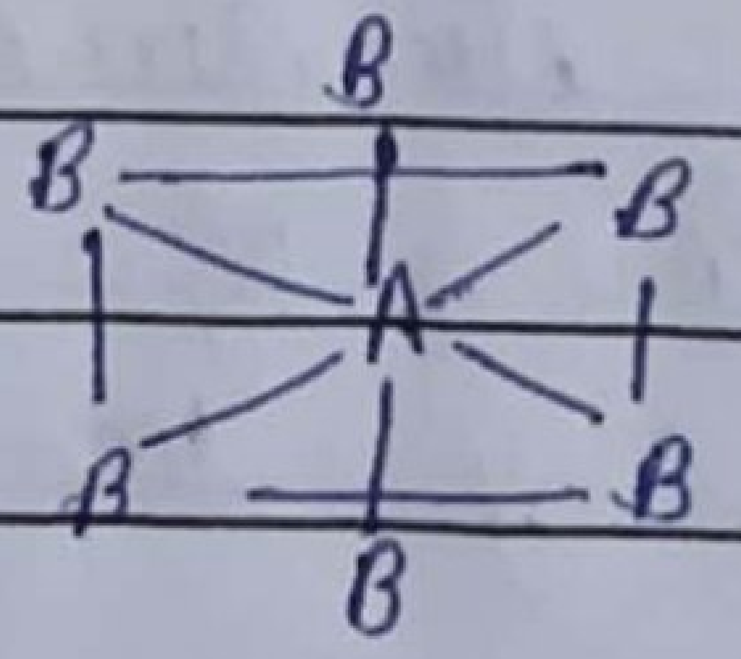
Valence shell electron pair repulsion theory.
(VSEPR Theory)

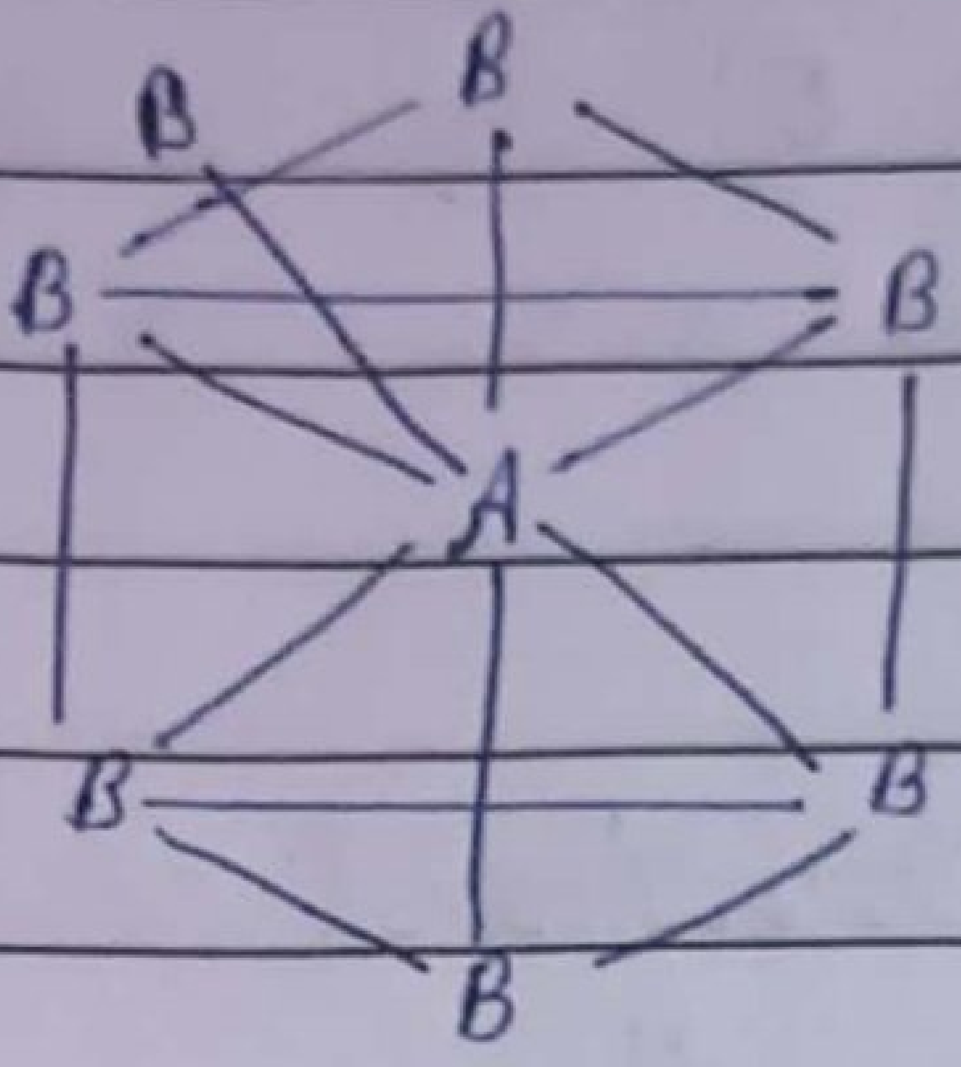
→ This Theory was given by Sidgwick and Powell in 1940 to explain the structure of molecules.
→ In 1957 Gillespie and Nyholm proposed a new theory to explain the stereochemistry of inorganic compounds, which can be taken as an extension of the Sidgwick theory. This theory is known as the valence shell electron pair repulsion theory (VSEPR Theory).
→ Some important points are following →

(1) Rule →

If there is not any lone pair present in an atom / molecule then the structure will be continuous or regular.

Hence the structure will be according to the Hybridisation of that molecules, as there will not be any repulsion between Bond pairs.

Serial Number	Number of B.P on C.A	Hybridisation	Bond angle	Structure	Example
1.	2	Sp	180°	B – A – B linear	$BeCl_2$ $ZnCl_2$ etc
2.	3	Sp^2	120°	 linear pyramidal	BF_3, BH_3 etc.
3.	4	Sp^3	190° 28'	 Octahedral	CH_4, $SnCl_2$ etc.
4.	5	Sp^3d	90° & 120°	 Trigonal bipyramidal	PCl_5, PF_5 etc.
5.	6	Sp^3d^2	90°		SF_6 etc

6.	7	Sp^3d^3	180°, 90°, 70°	 Pentagonal bi-pyro-midel	IF_7 etc.

Rule (II) →

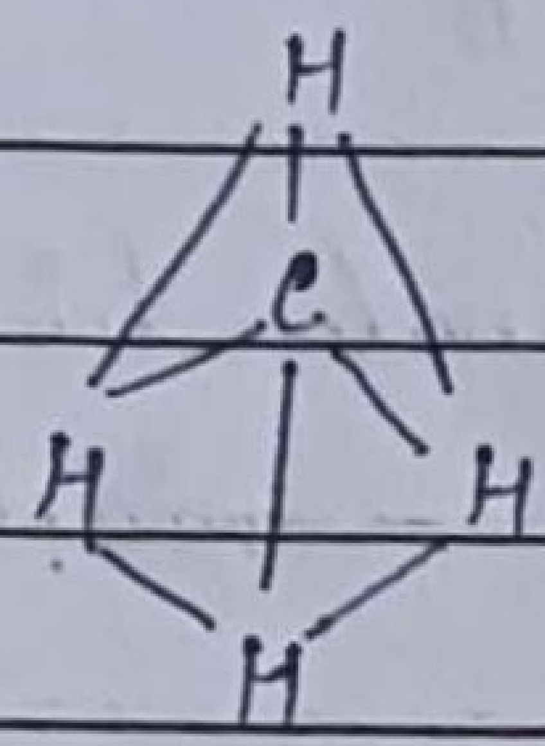
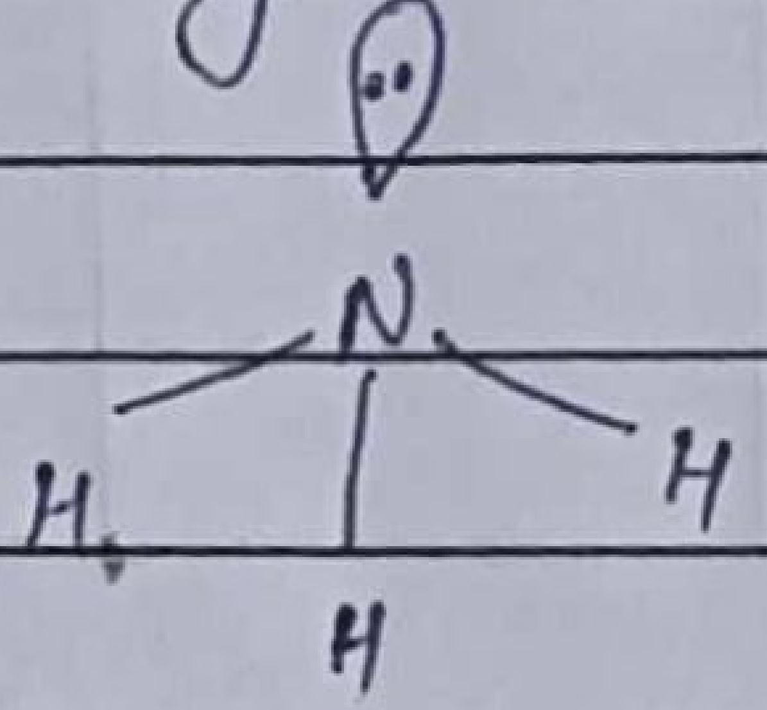
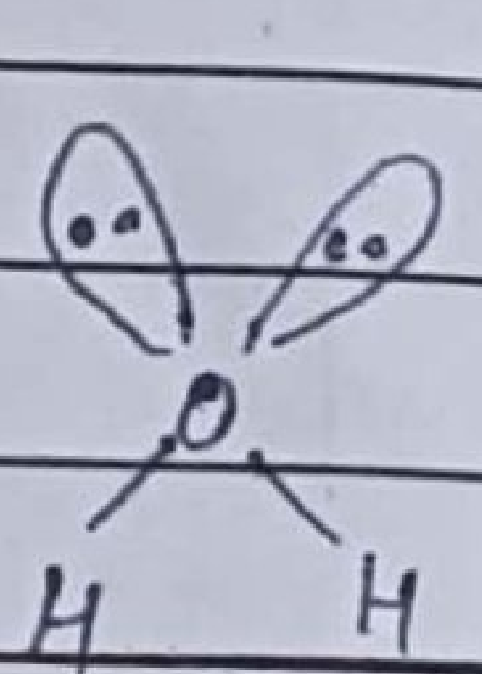
→ If there is lone pair along with bond pair then due to repulsion between bolin bond pair and lone pair the structure of molecule gets disturbed and is not formed the way it should be.

→ Order of repulsion between bond pair and lone pair.

Lone pair - Lone pair > lone pair - Bond pair > Bond pair - bond pair

Example.

	CH_4	NH_4	H_2O
Hybridisation	Sp^3	Sp^3	Sp^3
Bond angle	109°28'	107°	104°

Number of lone pair.	0	1	2
Structure	Tetrahedral 	Pyramidal 	V-Shaped 

Rule = (III) →

When the electronegativity of the atoms joined to C.A. increases, then bond angle decreases.

Example

(i) $H_2O > F_2O$

104° 103.2°

(ii) $NH_3 > NF_3$

107° 102°

order of electronegativity

$F > Cl > Br > I$

(iii) $PI_3 > PBr_3$

120° 101.5°

Rule (IV) →

The electro pairs present in double bonds or triple bond occupy more space than single bond, hence apply more force on electrons of valence shell which repulsion them and which decreases the value of bond angle.

Example

molecule	bond angle b/w atoms (X-Y-Z)	expected value
$O=CF_2$	108°	120°
$O=PCl_3$	103°. 6°	109.5°
$O=SF_4$	115°	120°
$S=C(NH_4)_2$	116°	120°

Rule (IV) →

The repulsion between electronic pair of second period elements is more than that in elements of third and first period. Due to this the value of Bond angle decreases.

Example

(i) NH_3 (107°) > PH_3 (93.3°) > AsH_3 (91.8°) > SbH_3 (91.3°)

(ii) H_2O (104.5°) > H_2S (92.2°) > H_2Se (91.0°) > H_2Te (90°)

Question (3) (a)

Answer

Seven Crystal System.

S. No.	Crystal System	Axial Characteristic	Interfacial Angle	Point group	Number of Space lattices or Bravias lattices	Example
1.	Cubic	$a = b = c$	$\alpha = \beta = \gamma = 90^\circ$	5	3	$NaCl$, KCl, CaF_2, Pb, diamond, ZnS, Hg, Ag, Au
2.	Tetragonal	$a = b \neq c$	$\alpha = \beta = \gamma = 90^\circ$	7	2	TiO_2, Sn, SnO_2, Crea
3.	Orthorhombic	$a \neq b \neq c$	$\alpha = \beta = \gamma = 90^\circ$	3	4	$BaSO_4$, $PbCO_3$, KNO_3, K_2SO_4, $CuSO_4$, I_2, α-Sulphur, Ortharhombic
4.	Monoclinic	$a \neq b \neq c$	$\alpha = \gamma = 90^\circ$ $\beta \neq 90^\circ$	3	2	$CaSO_4$, $2H_2O$, β-Sulphur, Sulphur monoclinic

5.	Triclinic	$a \neq b \neq c$	$\alpha \neq \beta \neq \gamma \neq 90°$	2	1	$CuSO_4 \, 5H_2O$, H_3BO_3, $K_2Cr_2O_7$
6	Hexagonal	$a = b \neq c$	$\alpha \neq \beta \neq \gamma$ $\gamma \neq 120°$ $\alpha = \beta = 90°$	7	1	Graphite, HgS, AgI, SiC, PbI_2, Zn, Cd, ZnO, CdS, Mg.
7.	Trigonal/ Rhombohedral	$a = b = c$	$\alpha = \beta = \gamma \neq 90°$	5	1	Quartz, Calcite ($CaCO_3$), $NaNO_3$, HgS
		Total		32	14	

Question (3) (b).

Answer

Crystalline Solids.

The solids that have their atoms, ions, or molecules which are arranged in a definite three dimensional pattern are called as crystalline solids.

They have the following characteristics

- Crystalline solids have a characteristics geometrical shape.
- Crystalline solids have sharp melting points, indicating the presence of a long range order arrangement in them

→ Some of the example of crystalline solids are. Sodium chloride, Cesium chloride and etc.

→ Non crystalline Solids (Amorphus solids)
Substance whose constituent's atoms, ions, or molecules do not possess a regular orderly arrangement are called non-crystalline solids. They are different from crystalline solids in many respects.

→ They have the following characteristics.
- These solids do not have a definite geometrical shape.
- Non-crystalline do not break at a fixed cleavage planes.

→ The common examples of non-crystalline solids are :
Glass, Rubber, Cotton candy, fused silica, Ceramic, Plastics, Glue.

→ The above properties suggest that the properties of the solids not only depends upon the nature of the constituents, but also on their arrangements.

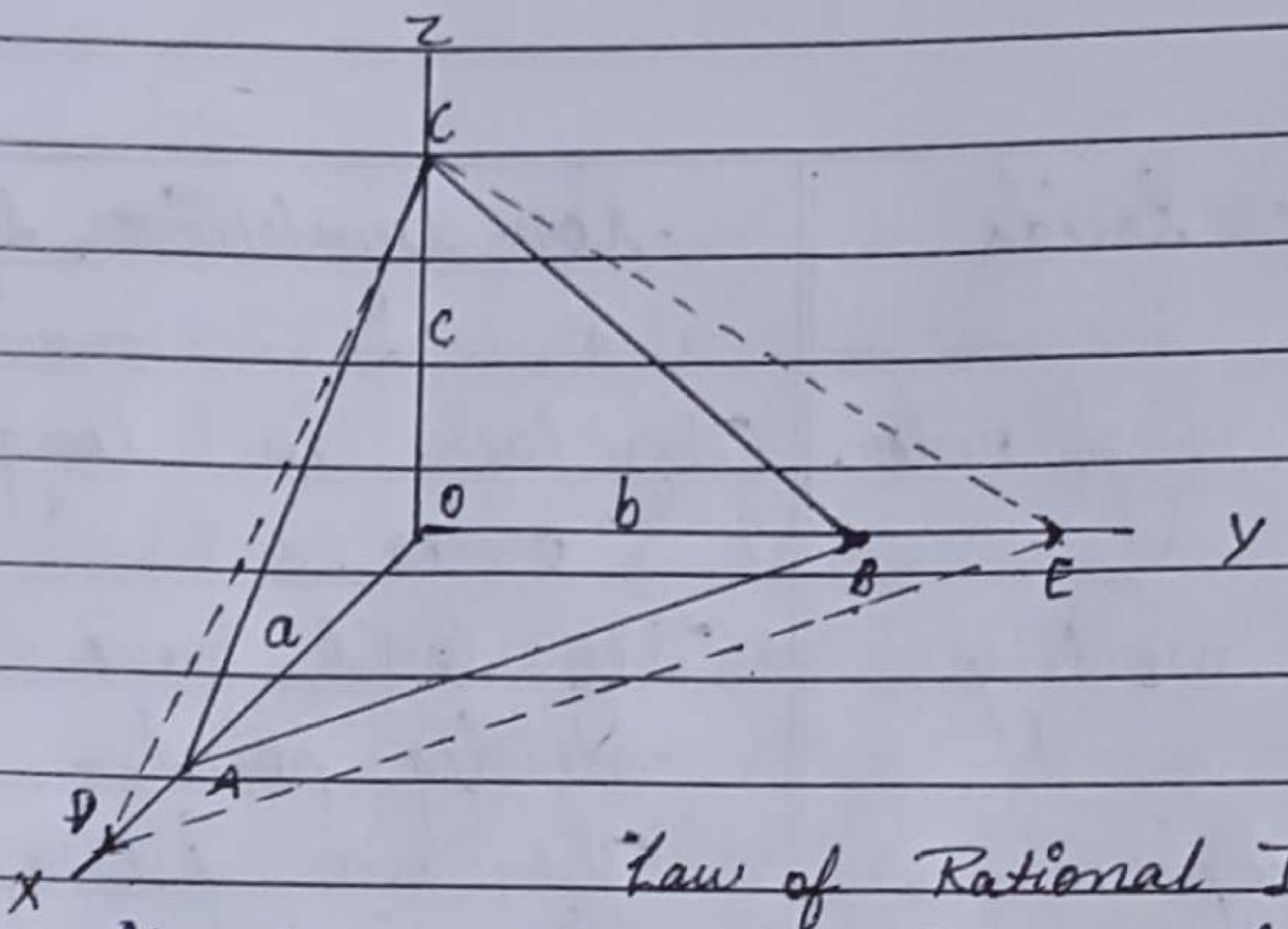
Difference between crystalline and non-crystalline solids :

Crystalline Solids	Non-Crystalline Solids
The have long range order.	They lack in long range order.
The have sharp melting point.	They don't have sharp melting point.
They are anisotropic	They are isotrophic
Cleavage of crystal occurs along certain planes	They give a rough surface on cutting along any direction.

Question 3 (c)

Answer.

Law of Rational Indices. :- Hauy in 1874 studied the position of different crystals in space and gave a law. According to it, " The intercepts, cut by different faces of a crystal, on the crystallographic axes are either infinite or equal to or in the rational multiples of the intercepts, cut by a unit face. This law is known as law of rational indices. This law helps in determining the arrangement of the source atoms or molecules in a crystal.



Law of Rational Indices

If a unit face ABC is intercepting the crystallographic axes at a, b and c respectively. (fig. 8) than the other face of this unit cell will intercept at la, mb and nc respectively. where l, m and n are either, infinite, whole or fractional integers suppores another face DEC cuts the crystallographic axes as follows.

$$OD = 2OA = 2a$$

$$OE = 2OB = 2b$$

$$OC = OC = c.$$

As, it is clear form the fig 8 that the intercepts made by DEC are, 2a, 2b and c respectively on X, Y and Z axes are intergal multiles of a, b and c.

If a face if parallel to any axis, than it is assumed that is intercepts the axes at infinity and the sign ∞ is used before the notations a, b, or c. for example, a face, cut Y and Z axes at b and 2c but parallel to X-axis,

than the weiss parameters (explained in the next point) of this face will be $(\infty a : b : 2c)$.
The geometry of a crystal, can be studied very well by its position in space and by the intercepts on the crystallographic axes, cut by that crystal. The faces can be designated in tems of the crystallographic indicators or ratios.

Question 4 (a)

Answer.

When an electrolyte is added to a gold sol, the gold sol coagulates and forms a blue-colored solution. This is because the electrolyte's ions are preferentially adsorbed to the colloidal particles, causing them to aggregate and form an insoluble precipitate.

Coagulation occurs when a higher concentration of electrolyte is added, and the particles aggregate into larger particles that precipitate. Flocculation occurs at lower concentrations of electrolyte, and the particles aggregate but can be reversed by shaking.

Question 4 (b)

Answer

When alcohol is added to NaCl (Salt) solution, it can cause the solution to become milky due to a phenomenon called precipitation. This is caused by the disruption of the crystal lattice structure of NaCl and the interference with the solvation process. This is caused by the disruption of the crystal lattice structure of NaCl and the interference with the solvation process. This happens because the alcohol disrupts the formation of the crystal lattice structure of the NaCl, resulting in the formation of tiny particles that scatter light, creating a milky appearance.

Question 4 (c)

Answer

→ferric chloride ($FeCl_3$) is applied to stop bleeding from a cut because it coagulates blood.

→ Blood is negatively charged: Blood is a negatively charged colloidal solution.

→ $FeCl_3$ neutralizes the charge: The Fe^{3+} ions in ferric chloride neutralize the charge on the colloidal impurities in blood.

Coagulation occurs : The coagulation process forms a negatively charged sol with Cl^- ions .

Proteins coagulate : The ferric and chloride ions in ferric chloride react with blood proteins , causing them to coagulate.

Capillaries close : The coagulated proteins close the openings of small capillaries , stopping bleeding. ferric chloride is a strong coagulant and is preferred over potassium chloride for stopping bleeding.