The Law of Corresponding states :-

Vanderwaal showed that if the values of pressure volume and temperature be expressed as fraction of the corresponding critical values we have

$$\frac{P}{P_c} = \pi, \quad \frac{V}{V_c} = \phi \text{ and } \frac{T}{T_c} = \theta$$

where π, ϕ and θ are known as reduced pressure, reduced volume and reduced temperature respectively.

$$\therefore P = \pi P_c, \quad V = \phi V_c, \quad T = \theta T_c$$

Putting these values in the vanderwaal equat

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT \text{ for 1 mole gas} \quad \text{—(I)}$$

we have $\left(\pi P_c + \frac{a}{\phi^2 V_c^2}\right)(\phi V_c - b) = R\theta T_c$ —(II)

Substituting the value of $P_c = \frac{a}{27b^2}$, $V_c = 3b$

and $T_c = \frac{8a}{27Rb}$ in the above equation (II) we h

$$\text{or } \left(\pi \cdot \frac{a}{27b^2} + \frac{a}{\phi^2 \cdot 9b^2}\right)(\phi 3b - b) = R\theta \cdot \frac{8a}{27Rb}$$

$$\text{or } \left(\pi a + \frac{3a}{\phi^2}\right)(3b\phi - b) = 8ab\theta$$

$$\text{or } \left(\pi + \frac{3}{\phi^2}\right)(3\phi - 1) = 8\theta$$

The above equation neither involves R nor the vanderwaal's constant a and b.

Teacher's Signature : L.K. Mishra
Chemistry, J.N. College

Expt. No. Page No. B

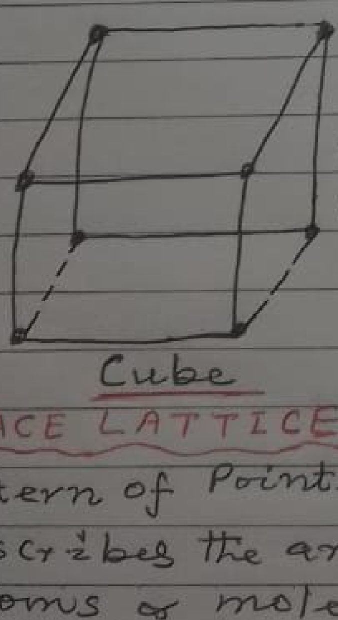
Hence it is a general equation applicable to all substances.

It is evident that if two substances have the same reduced temperature (θ) and same reduced Pressure (π) they will have the same reduced volume (φ). This is known as the "Law of corresponding states"

Two or more stances having the same reduced temperature and Pressure and thus having the same reduced volume are said to be in the corresponding states.

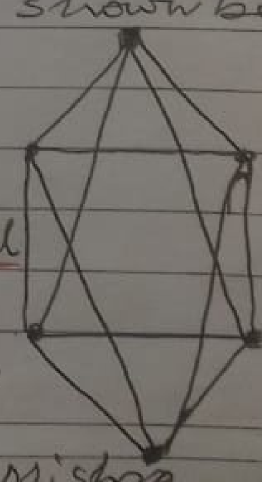
CRYSTAL SYSTEM :- Deg I Chem (H) Paper I

When molecules or atoms have orderly arrangement such that it is repeated in all the three direction the arrangement is called a crystal. Crystal of a substance is bounded by plane surfaces called "faces". NaCl for example crystallises as a cube with faces inserting at 90°.



Cube

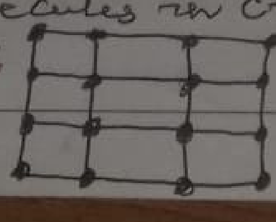
Some substances under different conditions crystallise in different crystal form. NaCl crystallises as cube shown above and as octahedral shown below.



Octahedral

SPACE LATTICE :-

Pattern of Points which describes the arrangement of ions atoms or molecules in crystal is called space lattice.



Teacher's Signature :

L.K. Mishra
Chemistry, J.N. College

CRYSTAL DEFECTS :-

They are two types of crystal defects as shown below :-

+ − + − + −	+ − + − + −	+ − + − + −
− + − + − +	− + − + − +	− + − □ − +
+ − + − + −	+ − + − + −	+ − + − + −
− + − + − +	− + □ + − +	− + − + − + (⊕ displaced)
+ − + − + −	+ − + − □ −	+ − + − + −
Perfect	Schottkey defect	Frankel defect

The defects are intrinsic defects since the stoichio-metry does not alter. In schottkey defects, both cations and anions escape the lattice site, whereas in Frenkel defect the cation or anion is displaced from the lattice point and trapped in the interstices.

When KCl is heated with K, it turns blue. The blue colour is due to excess of K^+ in the lattice. K enters the lattice as K^+ and e and thus there is excess of K^+ in KCl. The formula becomes K^+ and e Cl and the compound is non-stoichiometric

+ − + − + −
(e)
− + − + − +
⊕
+ − + − + −

The electron is free to move in the whole lattice and imparts colour.

ZnO when heated become yellow and on cooling becomes colourless. When ZnO is heated, some of the O^{--} escape as O_2 leaving behind electrons (excess) in ZnO lat[tice]. Thus there is excess of metal ion and deficie[ncy] of O^{--}. The electron movement imparts colour.

Teacher's Signature : L.K. Mishra
Chemistry, J.N. College

Expt. No. ____________ Page No. (F) Date ______

CONDUCTOR & SEMI CONDUCTOR

Ques:- Though Fe and Na both have metallic structure, Na ~~are~~ is soft but Fe is hard. Why?

Ans:- Na is present as Na^+ and e. With small force Na^+ can move from the lattice site and hence it is soft. In case of Fe, in addition to Fe^{+2}, 2e attraction there is covalent bonding due to unfilled d-orbital in Fe^{+2} and hence Fe^{+2} cannot move from the lattice site and it is hard.

Ques:- What do you mean by (a) n-type (b) p-type semiconductor?

Ans:-

(Normal)	(p-type)	(n-type)
+ − + − +	+ − + − +	+ − + − +
− + − + −	− ≠ − + −	− + = + −
+ − + − +	+ − + − +	+ − + − +
− + − + −	− + − + −	− + − + −

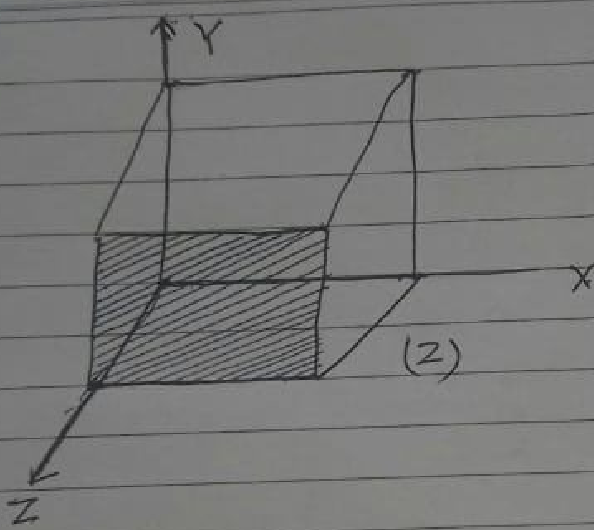
(≠ indicates +2 charge) = indicates −2 charge

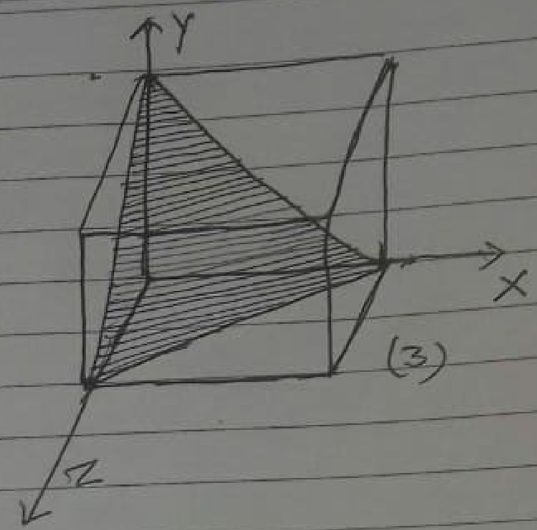
In p-type there is ⊕ hole and in case of n-type there is ⊖ hole. Due to the holes these conduct electricity.

Ques:- Germanium (32) is non conductor but Gallium (31) or Arsenic (33) is present as impurity, Germanium conducts electricity. Why?

Ans:- Ge(32) has 4 valence electrons, Ga(31) has 3 valence electrons and As(33) has 5 valence electrons. If Ga substitutes for Ge then 1 electron short in the lattice i.e. there is positive hole and so Ge behaves as p-type semiconductor and conducts electricity since electron from other site moves towards the positive h[ole]. If As substitutes Ge there is an extra electron and there negative hole. So electron from ~~positive site~~ move to other and conduct electricity. In this case Ge behaves as n-type semiconductor.

Teacher's Signature: L.K. Mishra
Chemistry, J.N College





OA, OB and OC are intercepts, If a, b and c are the unit length then $\frac{a}{OA} = h$, $\frac{b}{OB} = K$ and $\frac{c}{OC} = l$
h, K and l are thus reciprocal of intercepts and are called "Miller indices".

Thus if $OA = 2a$, $OB = 2b$ and $OC = c$ then miller indices are $\frac{a}{2a}, \frac{b}{2b}, \frac{c}{2c} = \frac{1}{2}, \frac{1}{2}$ and 1

ie h, K, l are $\frac{1}{2}, \frac{1}{2}, 1$

Similarly in fig (2) the Plane is ∥ to X and Y axes and cuts the Z-axis at say unit length, hence h, K, l = $\frac{1}{\infty}, \frac{1}{\infty}, \frac{1}{1}$ ie 0, 0, 1 Plane. In the Same way, when the Plane cuts the X, Y and Z axes at unit length the miller indices are 1, 1, 1 and hence the Plane is (1, 1, 1) as shown in fig (3)

Teacher's Signature: L. K. Mishra
Chemistry, J. N. College