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Chapter 5 tuvw

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Semiconductor :- A semiconductor is a substance which has resistivity (10^{-4} to 0.5 Ωm) in between conductor and insulator : For example germenium, silicon, carbon.

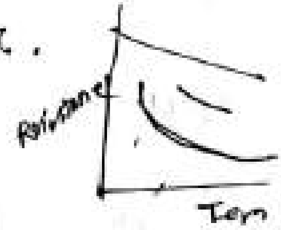
$s[i] -= 1$

7/2 3

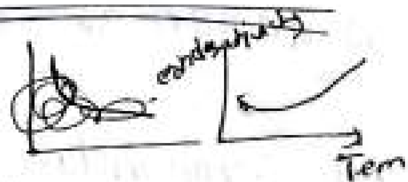
$s[i] = s[i] - 1$

Properties of semiconductor:

i. The resistivity of semiconductor is less than an an insulator but more than a conductor.



ii. Semiconductors have negative temparature co-efficient of resistance.

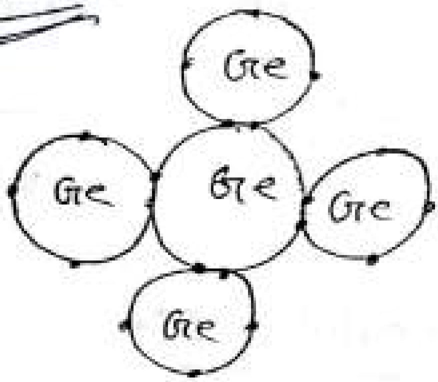


The resistance of a semiconductor decreas with the increase in temperature and vice-versa

iii. When a suitable metallic impurity (arsenic, gallium) is added to a semiconductor. its current conducting properties change appreciably

Bonds in Semiconductor :-

In semiconductors bonds are formed by sharing of valence electrons. Such bonds are called co-valent bonds.



covalent bond

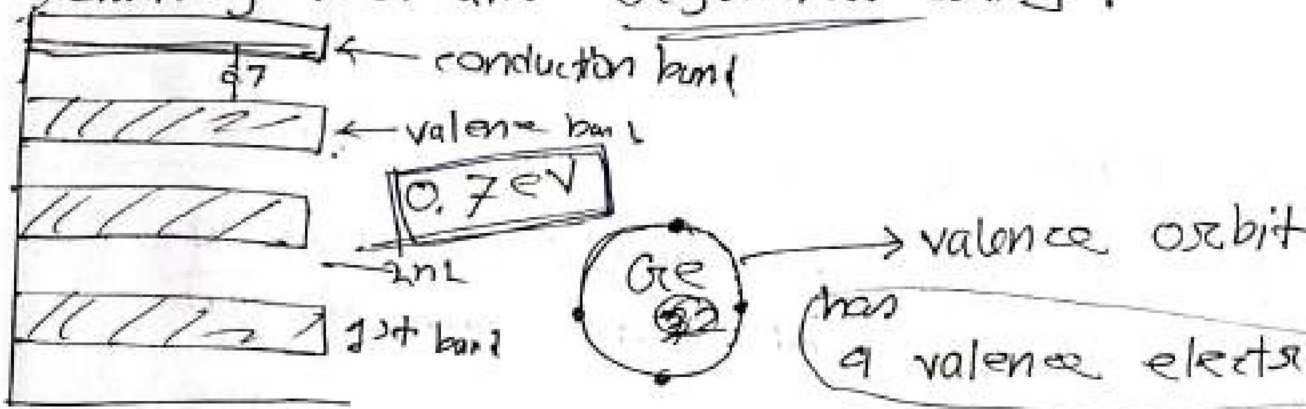
crystals :- is A substance in which the atoms or molecules are arranged in an orderly pattern is known as a crystal.

All semiconductors have crystalline structure.

The crystalline structure leads to well defined energy bands and predictable electrical behavior.

Germanium

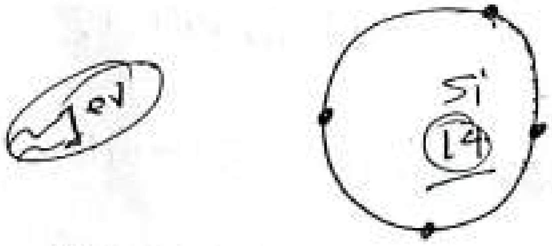
The main reason being that it can be purified relatively well and crystallized easily.



has 4 valence electron

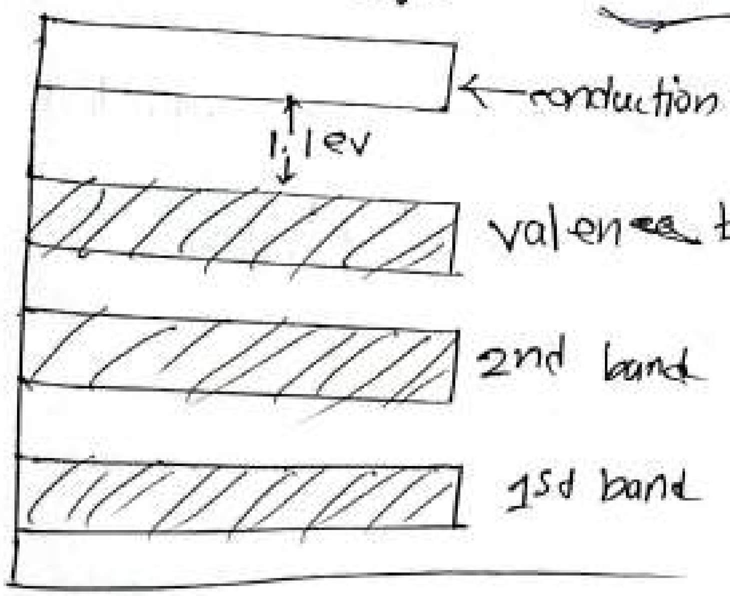
Silicon

The silicon compounds are chemically reduced to silicon which is 100% pure for use as a semiconductor



4 valence electron

1.1eV energy

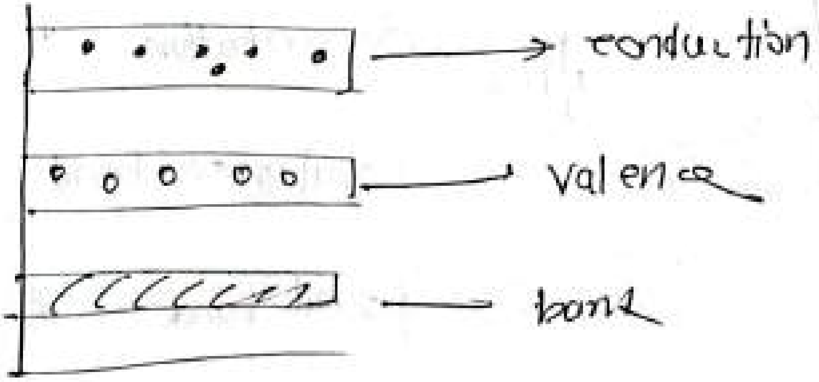


Silicon

Effect of temperature on semiconductor:-

(i) At absolute zero insulator temperature the semicondu
behaves the crystal as a perfect insulators.
At this temperature, the co-valent bond are very
strong and have not any free electrons.
valance bond complete conduction band empty

(ii) Above absolute zero temperature: when the
temperature raised increased some od the covalent bond
break due to thermal energy, This result few
free electrons exist in the semiconductor.
These free electron supplied the current

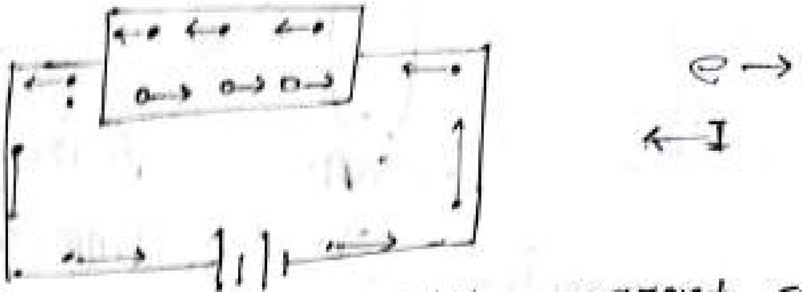


Hole current :- Hole current is a movement of positive charge carriers (holes) in a semiconductor, which occurs when electron shift to fill empty position in the valence band, creating the effect of a positive charge flo

Intrinsic semiconductor

A semiconductor in an extremely pure form is known as an intrinsic semiconductor.

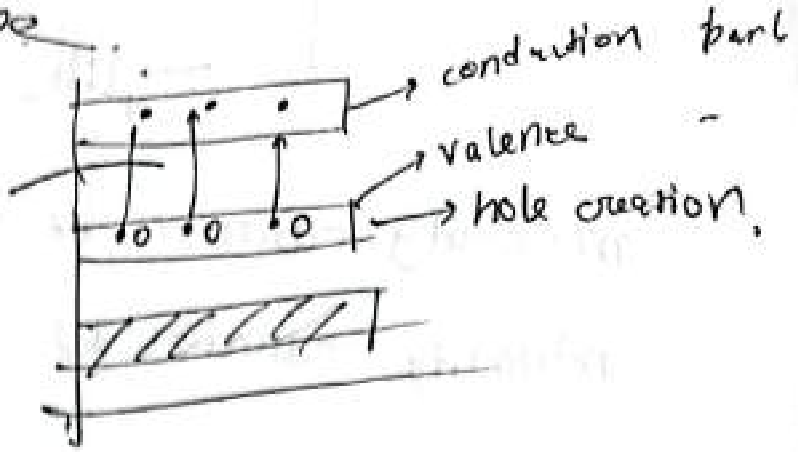
Ex : Ge, Si, Sn.



The intrinsic semiconductor has little current conduction capability in room temperature.

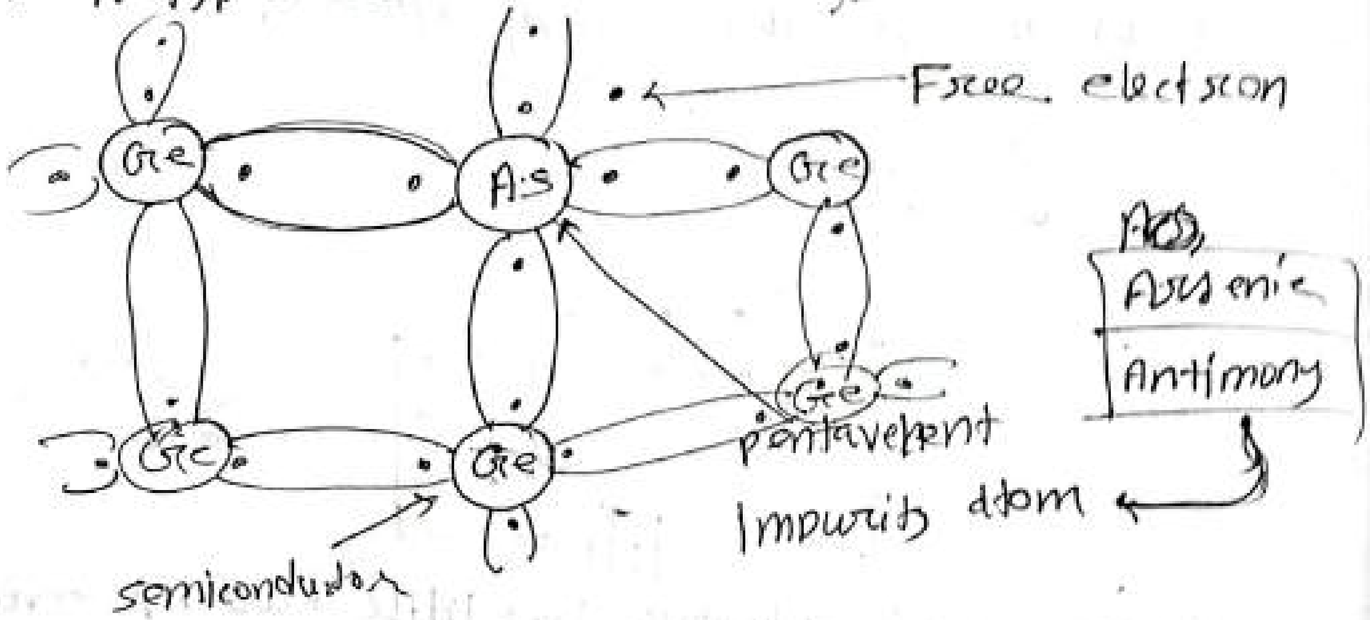
Extrinsic semiconductors are semiconductors that are doped with specific impurities.

p type and n type.

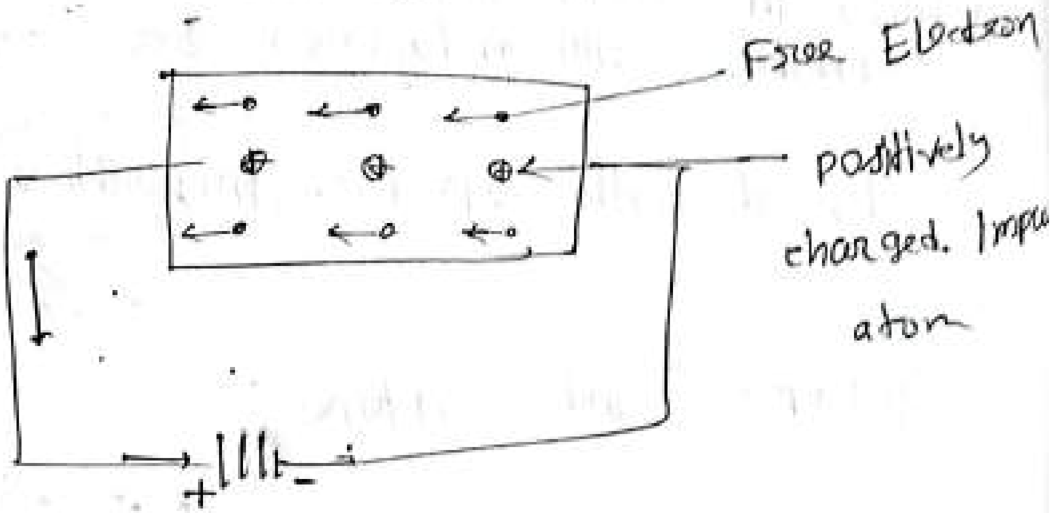


n-type semiconductor

When a small ammount of pentavalent impuri is added to a pure semiconductor, it is known as n-type semiconductor $\{Ge + As\}$



Purity
2
impurity

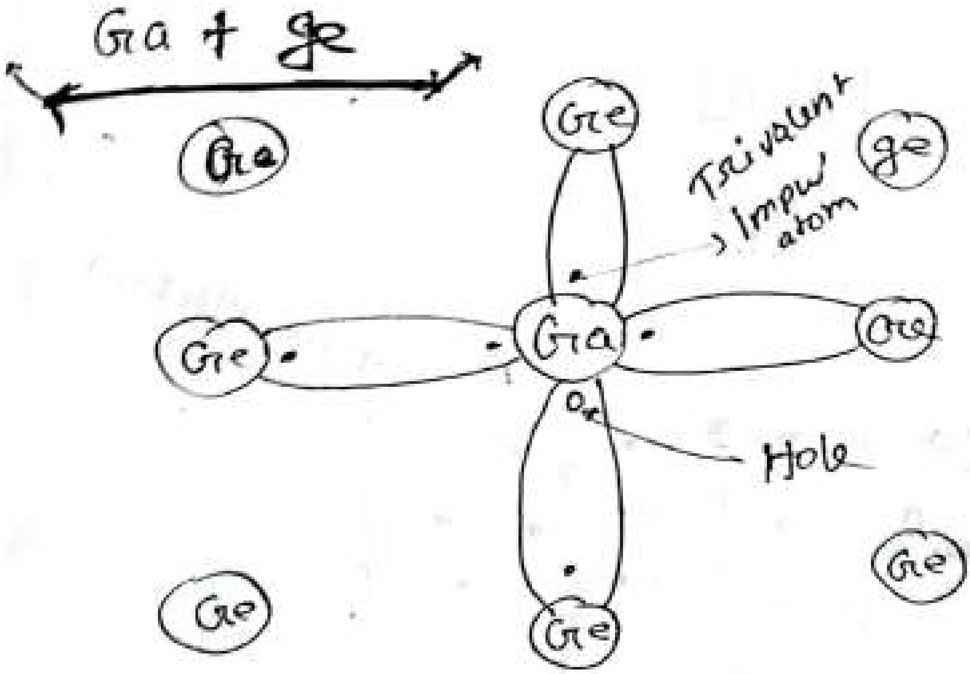


majority carrier is electron

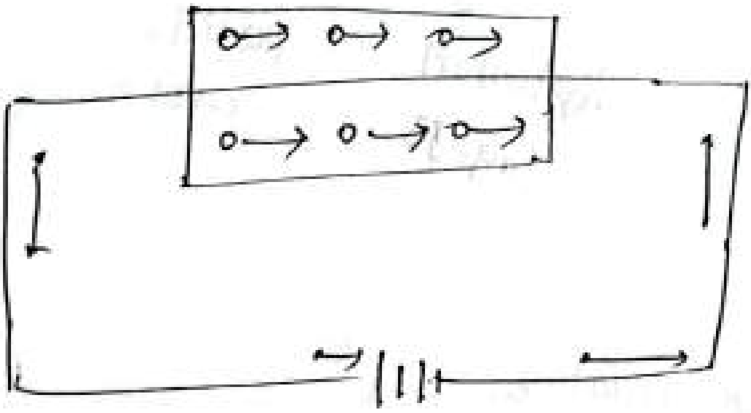
minority carrier is hole

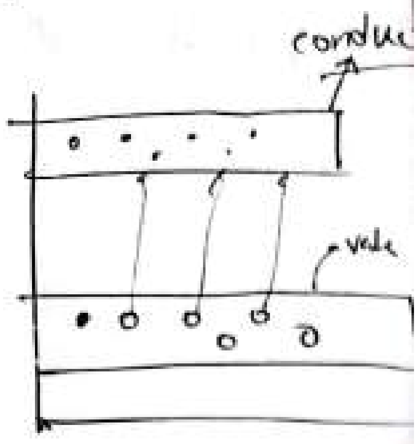
P-type semiconductor

When a small ammount of trivalent impurity is added to a pure semiconductor it is called p-type semicondu...



gallium, indium → Acceptor impurities



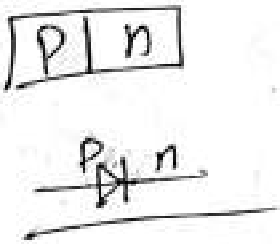


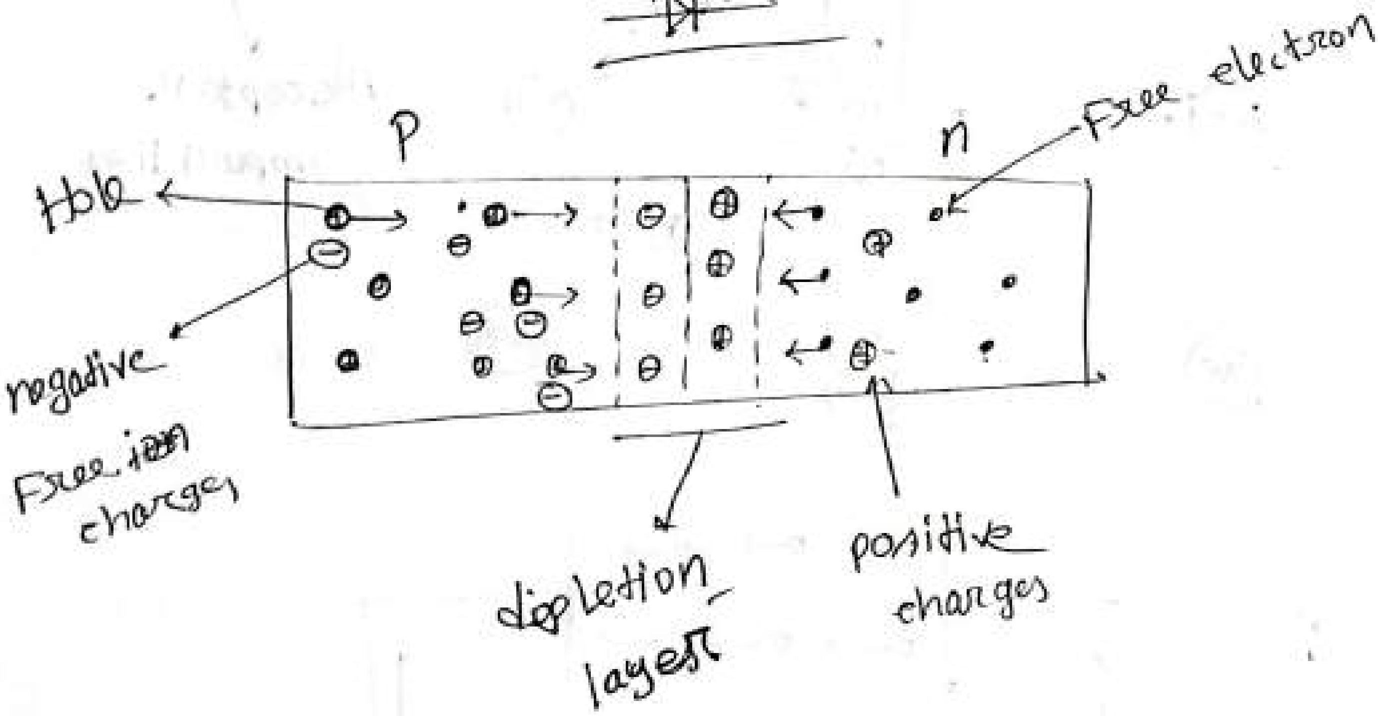
majority carrier is hole

minority " is electron

p-n junction

when a p-type semiconductor is suitably join to n-type semiconductor, the contact surface is called pn junction





barrier potential V_0

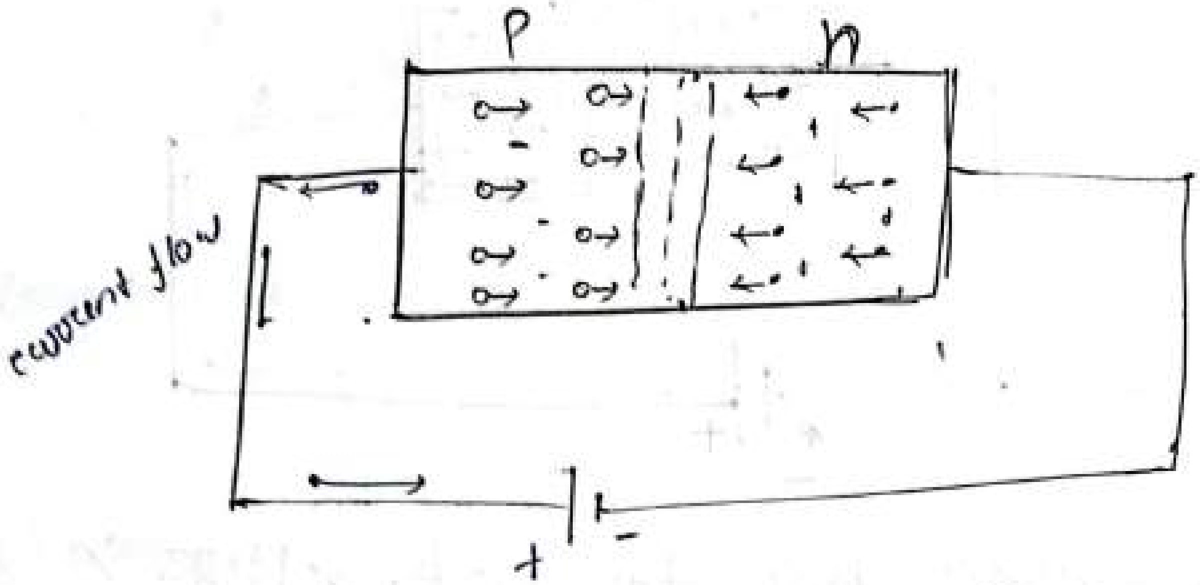
for silicon $V_0 = 0.7$ V

for germ $V_0 = 0.3$ V

Forward biasing

- Forward bias meaning is that the current flows in the forward direction due to the voltage applied in the forward direction.

- In forward bias, the p-type (anode) of the semiconductor is connected to the positive end, and the n type (cathod) is connected to the negative end of the battery.



properties

1. The anode voltage is greater than the cathod voltage

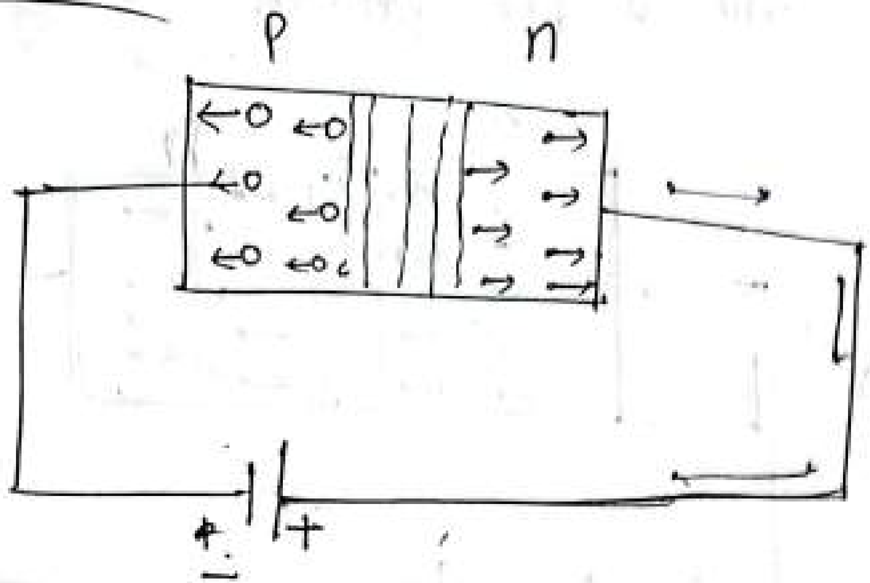
ii. The current level depends on the forward voltage

iii. depletion ~~les~~ layer is thinner

iv. in forward biyas layer can be decrease instan

v. Forward voltage (0.1 to 0.3 v)

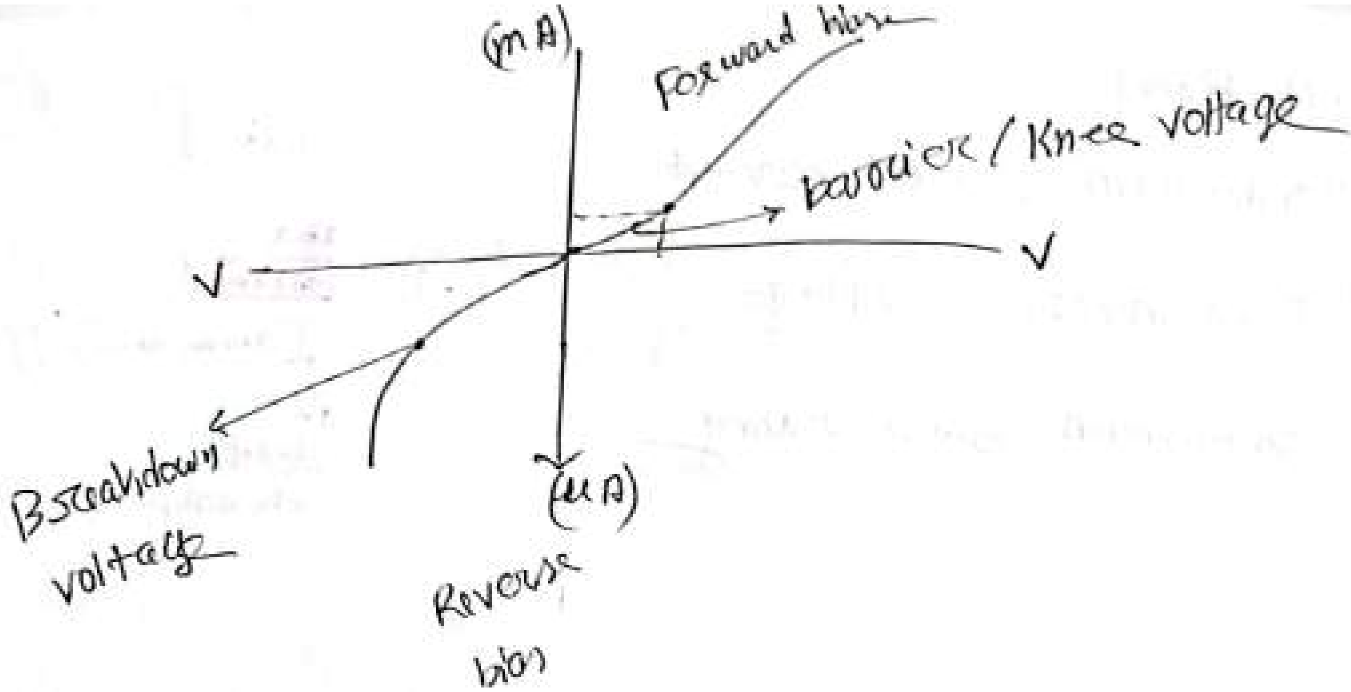
Reverse bias



1. In reverse bias, the anode voltage is less than its cathod

ii. passing the current is minimal

iii. diode's ~~increase~~ resistance increase instan



barrier / knee voltage :-

It is the forward voltage at which the current through the junction starts to increase rapidly.

si = 0.7V
Ge = 0.3V
→ knee voltage.

Breakdown voltage :- It is the minimum reverse voltage at which pn junction breaks down with sudden rise in reverse current

Lim.
(i)
(ii)
(iii)

Properties of pn junction.

1. Depletion Region; Forms as electrons diffus from the n-region to the P region, creating positive and negative charge layers

2. The depletion layers prevents the movement of charge carriers

3. The barrier potential of Ge is 0.3 and Si

4. The depletion layer is thin compared to the P and n regions.

Limitations of pn Junction:

1. maximum forward current :- The highest current the junction can conduct without damage. Exceeding this can cause overheating and destruction.

ii. peak inverse voltage :- The highest reverse voltage the junction can handle without damage

iii. ~~The hi~~ maximum power rating :- The highest power the junction can dissipate without overheating damage