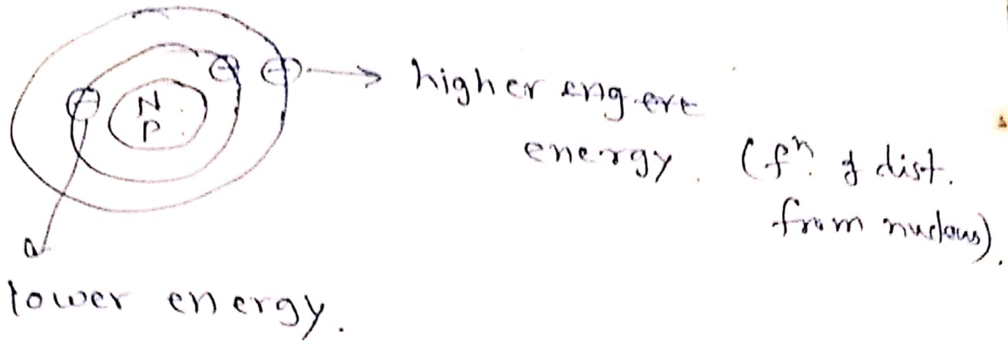
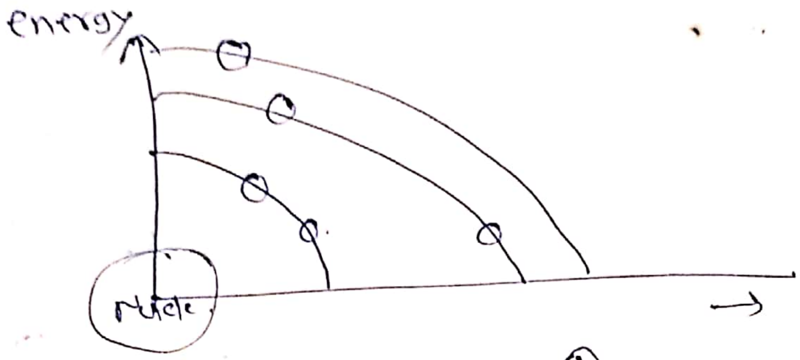
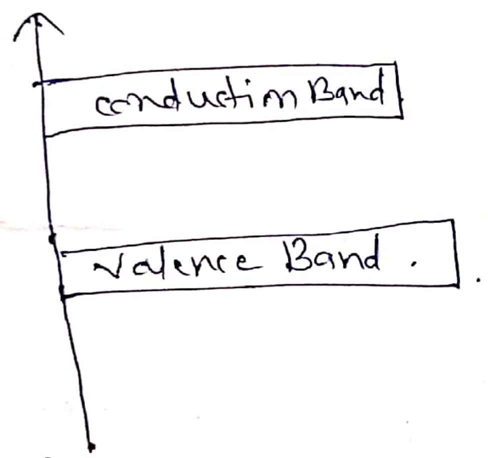
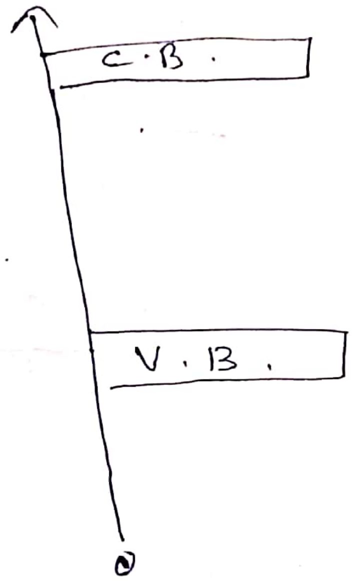
Atom





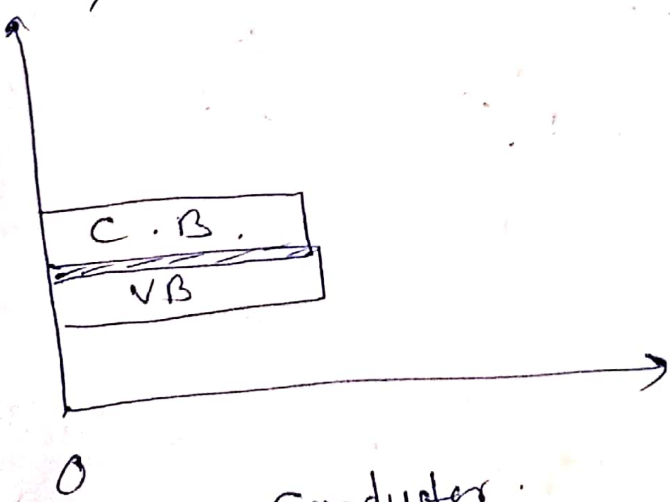
Energy





Semicon- (Si, Ge). Insulator.

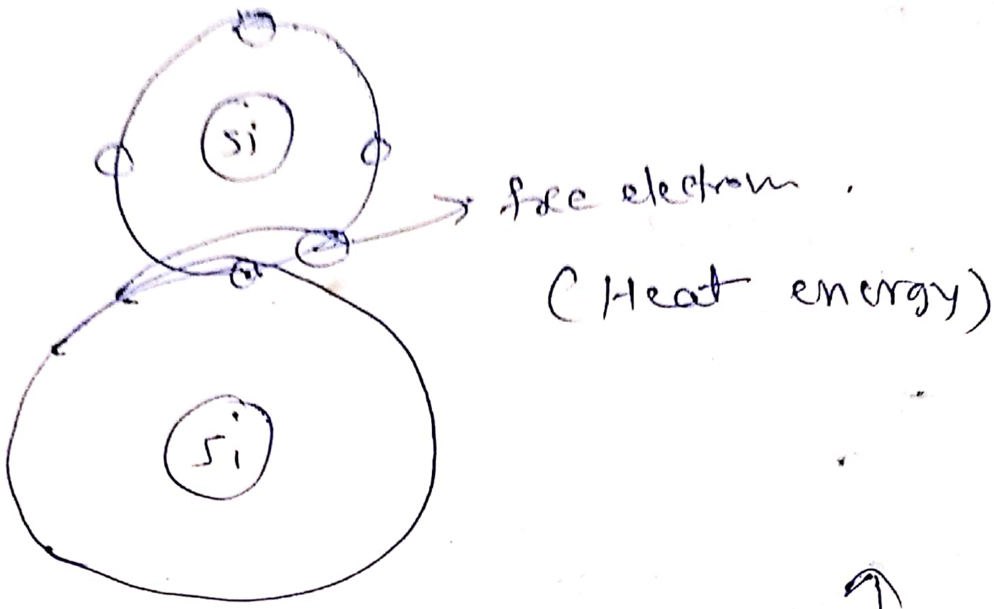
energy

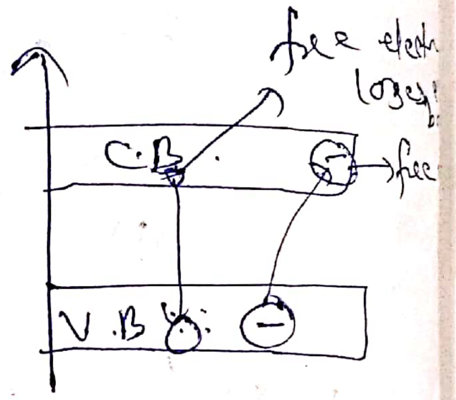


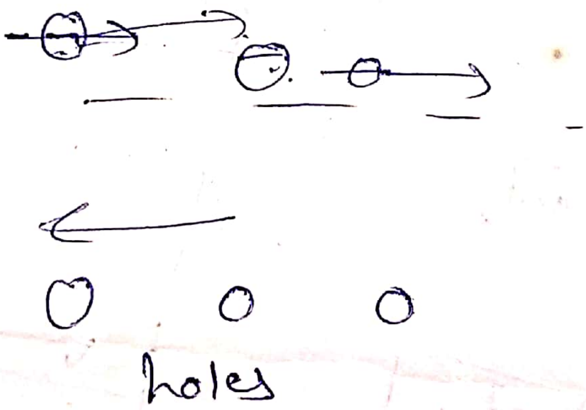
Conductor.

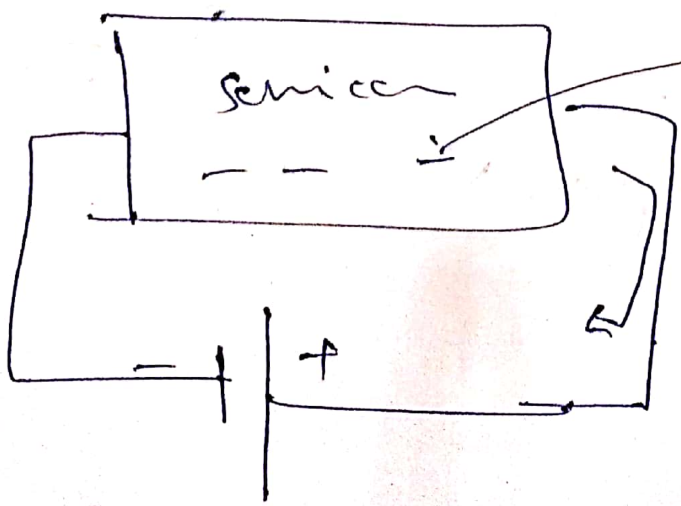
Copper

Formation of E-H pairs



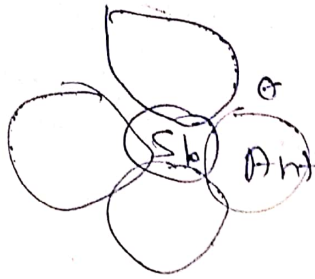






free. electrons.
conduction band
& hole current in
valence band.

N- type semi . (Pentavalent Impur)



o free elect — majority carriers
Antimony
no holes generated.

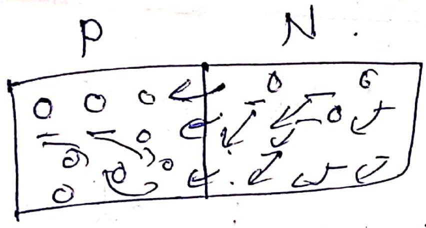
Holes are gen by thermal action.

minority carriers.

P-type . — Trivalent . holes majority.

(Thin)

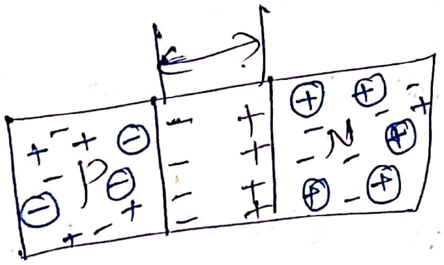
P-N j^n Depletion Region . (Depleted of charge carriers)



Electrons

1. Diffuse ~~P~~ thro' j^n.
2. combine with holes
3. ∴ positive charges in N region near j^n. (Pentavalent ions)
4. p region loses holes near j^n. ∴ trivalent ions . negative charge.
5. Equilibrium is reached. No. further diffusion is allowed. very . fast .
6. Force betn. two charges by columb's law .

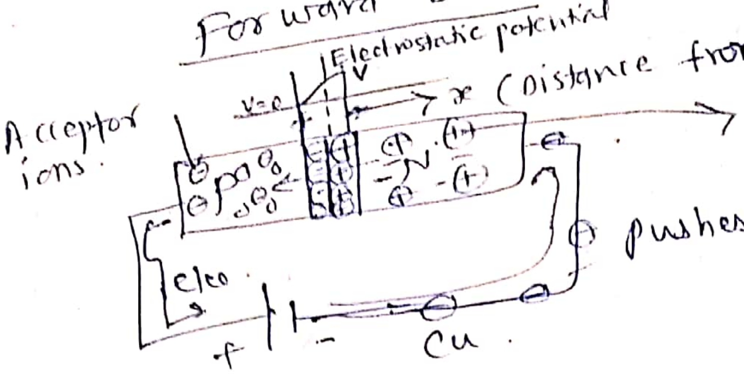
Barrier .



∴ External energy is required to move electrons thro' barrier potential .

Barrier potential - Force acting ...
Coulomb's law. (In volts).

Forward bias. Effect on depletion region



✓

① In P, in conduction band free electron from N-type loses energy & comes into valence band in p-type.

② +ve term of bias volt. attracts e. The holes, electrons move toward +ve terminal

Diffusion current

holes

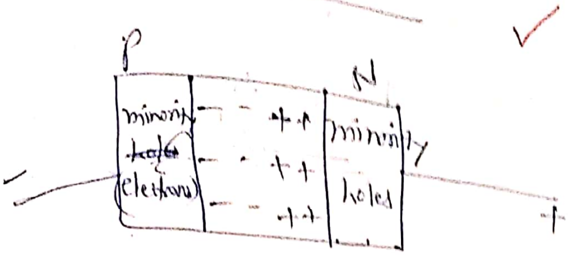
electrons.

③ Effectively holes move towards ... When ~~they~~ electrons come in external ... they ~~require~~ less energy to be in conduction band.

Forward current.

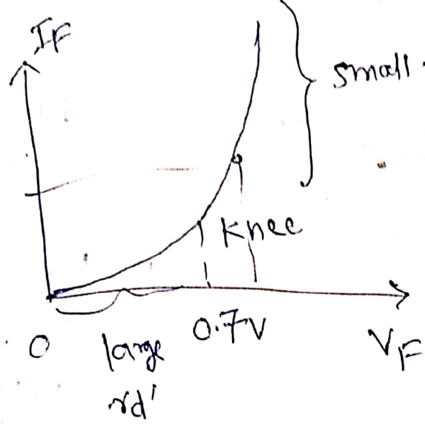
④ As more electrons move ~~f~~ ... Depletion region, No. of +ve ions is reduced toward N, Also holes move ... $V_{Barrier}$ reduced.

Reverse Bias



Reverse saturation current

F.B. chara.



✲ Voltage drop across diode above knee voltage (0.7V) is due to drop across internal resistance of semiconductor material.

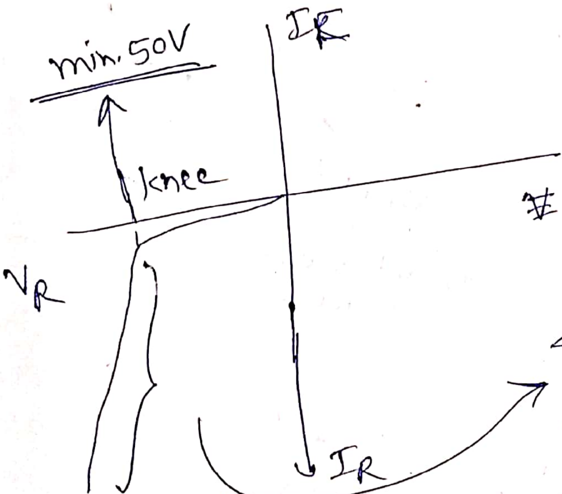
dynamic resistance r_d not constant over entire curve.

Static resistance (d.c.)

dynamic resistance (a.c.)

(resistance changes & not constant)

R.B. chara.

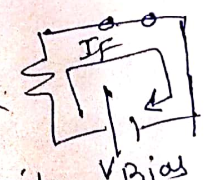


✲ Not normal mode of operation for many pn jn.

Models for cct. analysis.

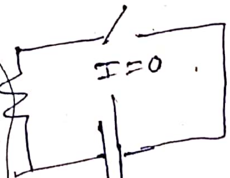
Ideal diode model. (FB) (RB)

Switch

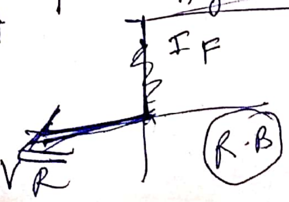


R ← to limit current in cct.

$V_{barrier}$ & Internal dynamic resistance are neglected.

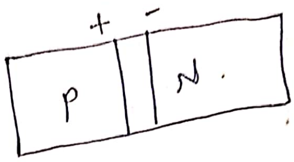


$I_F = \frac{V_{Bias}}{R}$.



Effect of Forward bias on Depletion Region. -

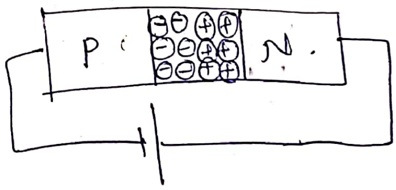
As more electrons flow into depletion region, No. of positive ions is reduced. As No. of holes effectively flow into depletion region, No. of -ve ions is reduced. ∴ depletion region becomes narrow.



Effect of barrier potential during forward bias.

Free electrons (with enough energy) require energy to cross barrier potential. When electrons give up energy equal to barrier potential when cross depletion region. ① Energy loss is equivalent to voltage drop across pn j^n. (0.7V) ② Additional small voltage drop across p & n regions due to internal resistance of material. (dynamic resistance)

Reverse Bias



Electrons are attracted towards +ve side of battery ~~holes~~ Additional +ve ions are created. Electrons from -ve side of battery enter in holes ∴ -ve ions will be increased ∴ widening of depletion region. Flow of valence electrons can be viewed as holes pulled towards -ve side of battery.

The initial flow of carriers is transitional & only for a short time after bias is applied.

As depletion region widens, electric field ...