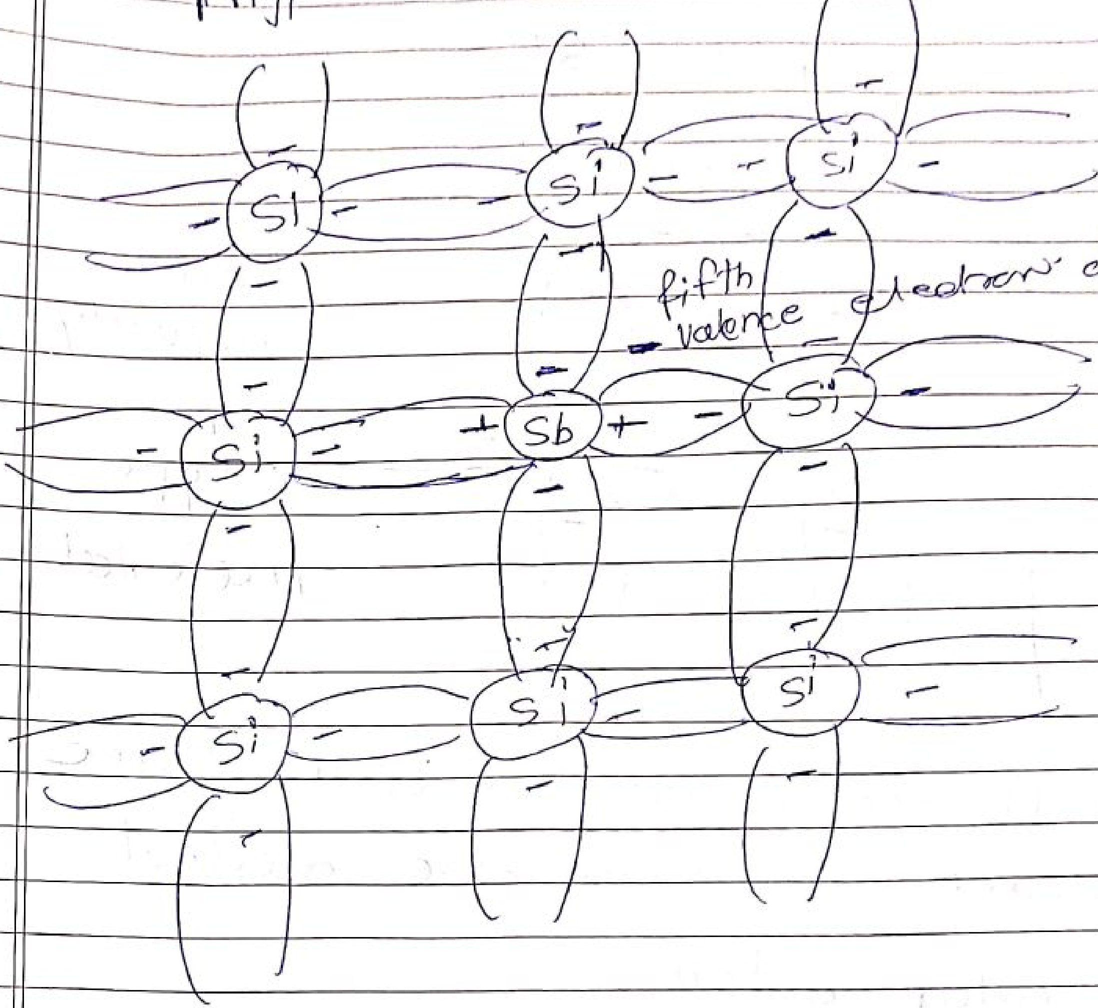
N type Semiconductor

impurity
antimony
arsenic
phosphorus

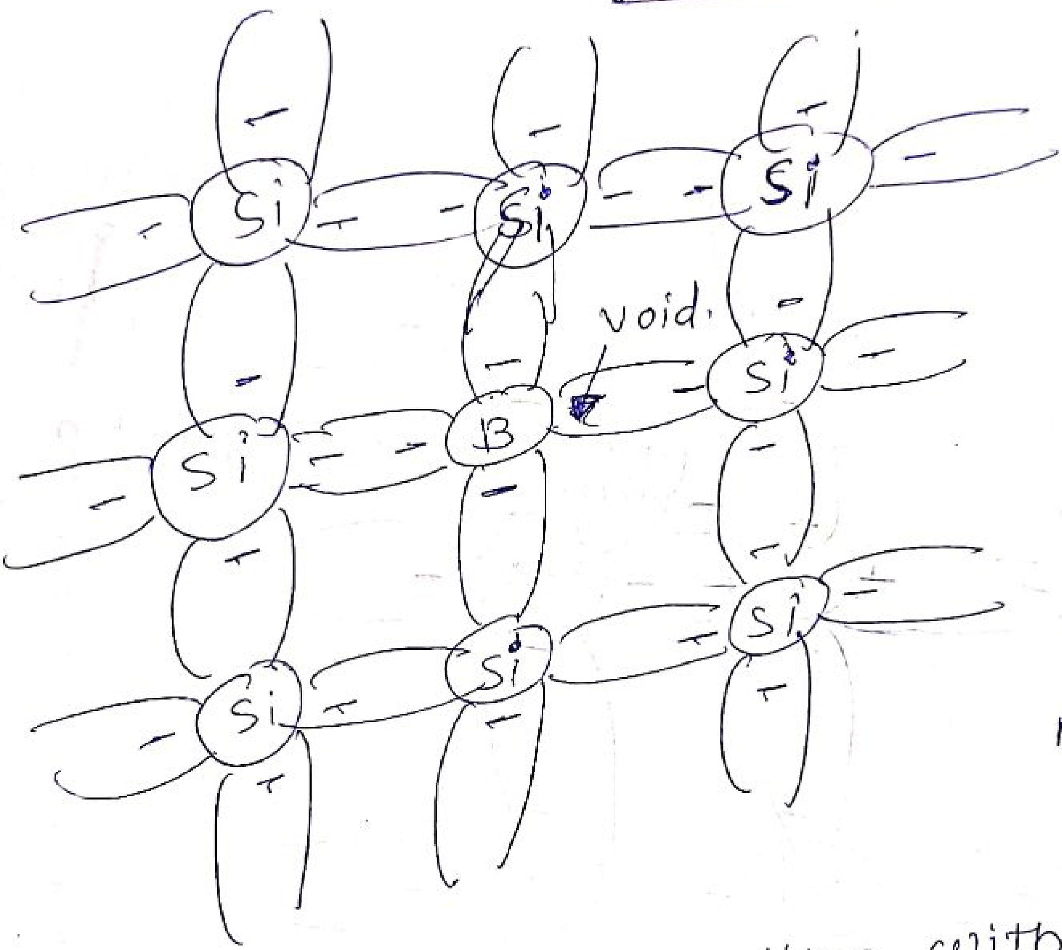


n+ 1

diffused impurities with five valence electrons are called donar atoms.

Donar impurity contributes free electron

p type material Impurity boron
gallium and indium



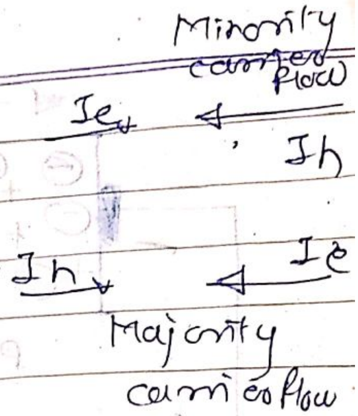
Boron Impurity in p type material.

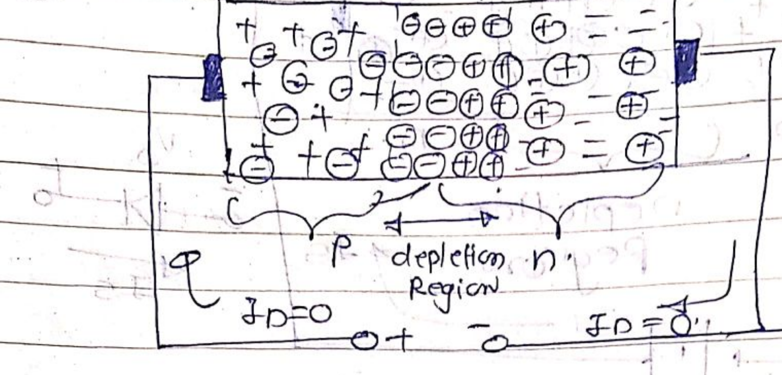
Diffused impurities with three valence electrons are called acceptor atoms.

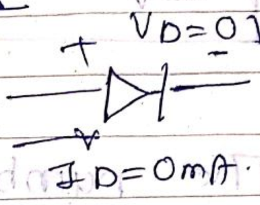
Acceptor impurity creates hole

Semiconductor diode

(a) No applied bias.







$V_D = 0$

(no bias)

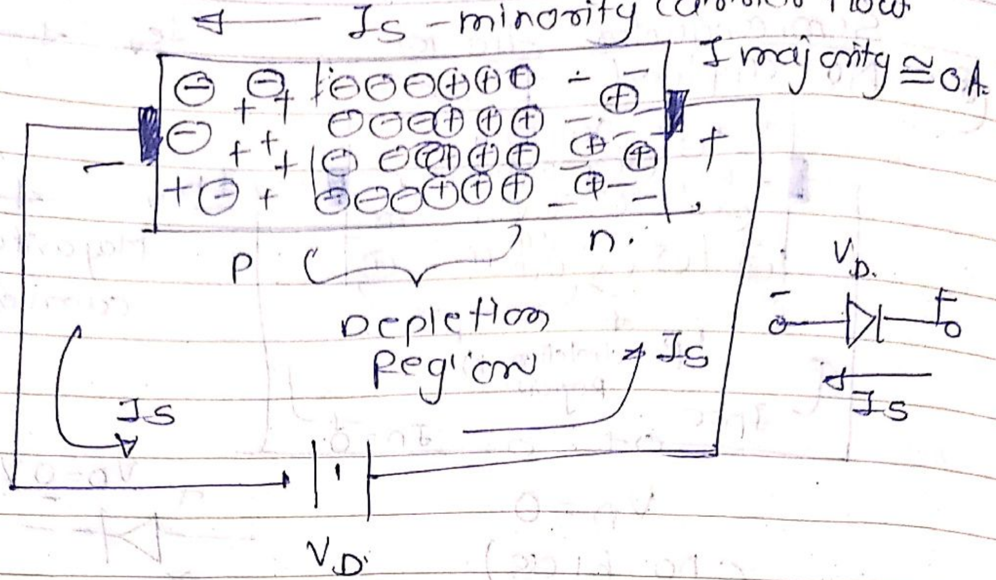
When two material p type & N type are "joined" the $\bar{e}$ & holes in the region of the junction will combine, resulting in a lack of free carriers near the junction.

The region of uncovered +ve & −ve ions is called depletion region due to the "depletion" of free carriers in the region (reduction).

~~Reverse Bias.~~ Here applied voltage is zero volts and the resulting current is 0 A, much like a isolated resistor.

Reverse bias Condition ($V_D < 0V$)

Positive terminal is connected to the n type material & negative terminal is connected to p-type material as shown.



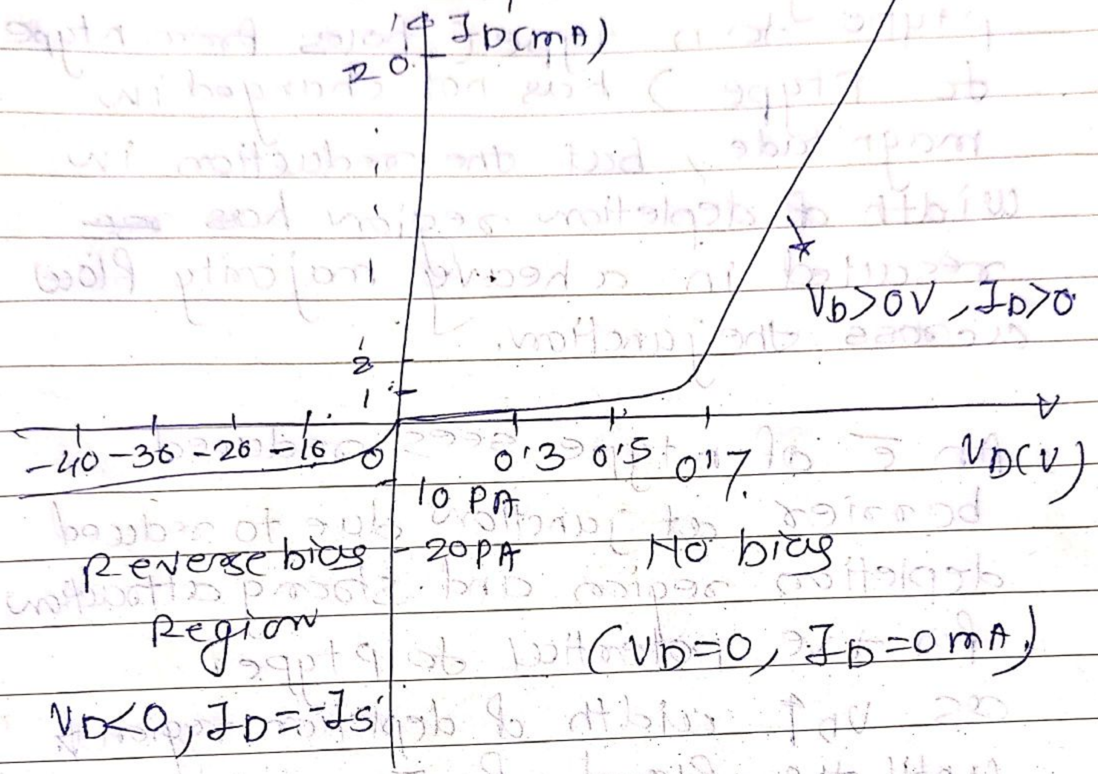
The number of uncovered positive ions in the depletion region of the n-type material will increase due to the large number of free electrons drawn to the positive potential of the applied voltage.

For similar reasons, the number of uncovered negative ions will increase the increase in p-type material. The net effect, therefore is widening of the depletion region.

This widening of depletion region will establish too great a barrier for the majority carriers to overcome, effectively reducing the majority carrier flow to zero, as shown

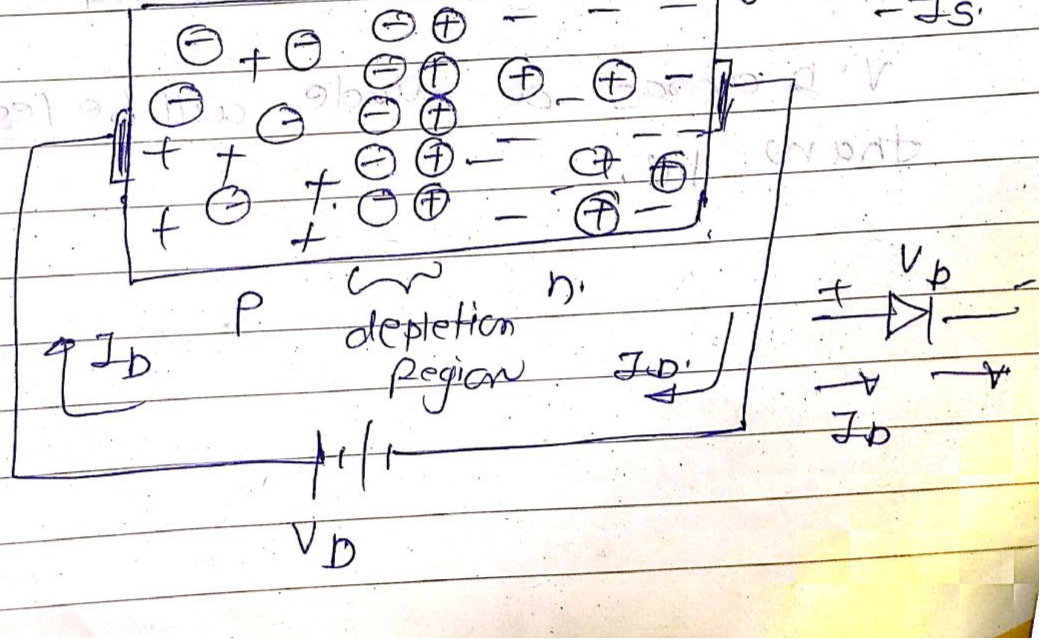
The number of minority carriers however entering the depletion region will not change, resulting in minority carrier flow vectors of the same magnitude as indicated in case 1

The current exists under reverse bias condition is called reverse saturation current I_s, in μA.
Saturation means it reaches its max^m level quickly and does not change significantly with cha ↑ in reverse bias potential.



Forward bias ($V_D > 0V$)

I_s ← → $I_{majority}$ } $I_D = I_{majority} - I_s$



p type - positive potential
n type - negative potential
forward bias potential VD will
pressure electrons in n type &
holes in p type material to
recombine with ions near the
boundary and reduce the width of
depletion region. The resulting
minority carrier flow of ē from
ptype to n type (holes from ntype
to ptype) has not changed in
magnitude, but the reduction in
width of depletion region has ~~rso~~
resulted in a heavy majority flow
across the junction.

An ē of ntype sees reduced
barrier at junction due to reduced
depletion region and strong attraction
for +ve potential to ptype.
as VD ↑ width of depletion region ↓
until the flood of ē can pass
through junction resulting an
exponential rise in current.

V.D across a diode will be less
than 1V.