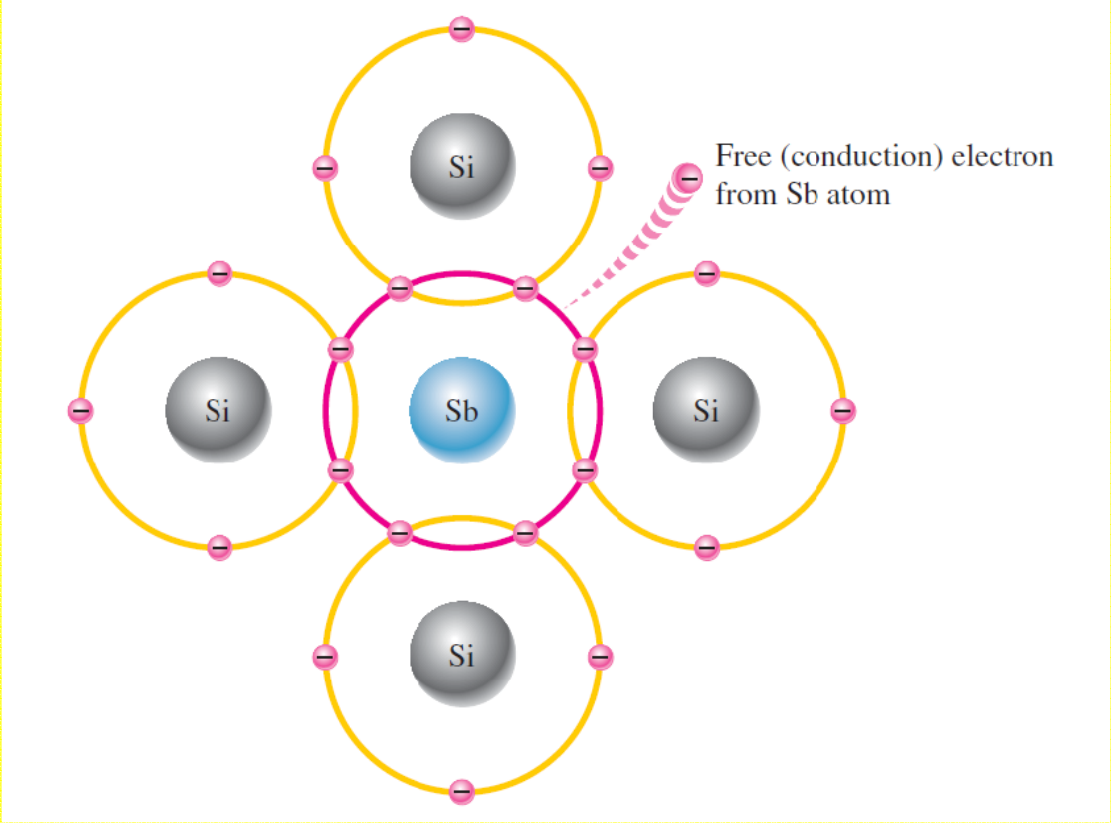
# Doping

- A manufacturing process that adds free charge carriers (free electronic or hole) into a pure semiconductor material to increase its conductivity .

- Doping → n-type or p-type material

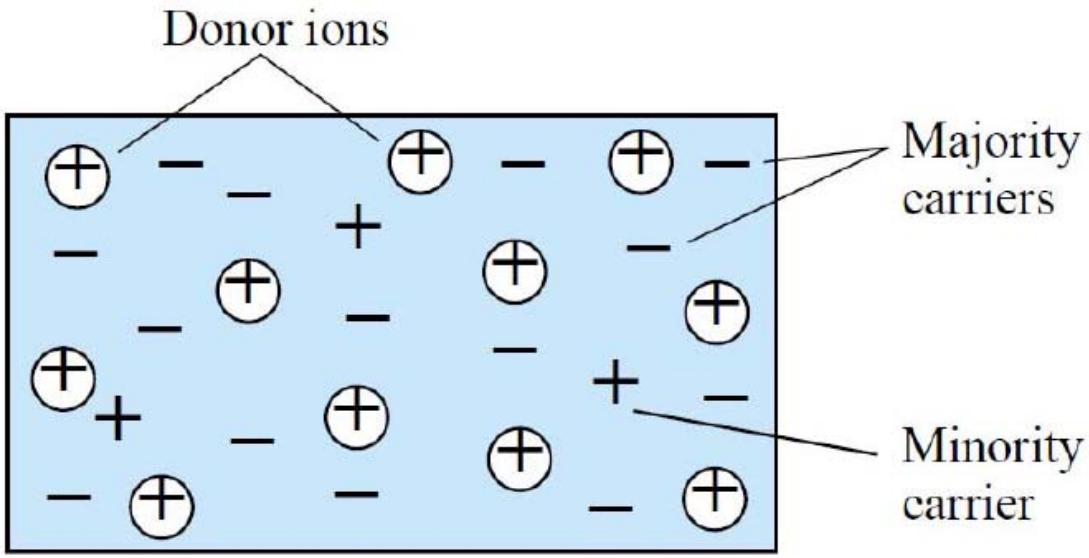
## N - type semiconductor

Sb (antimony) has five valence electrons and it is called a donor atom.



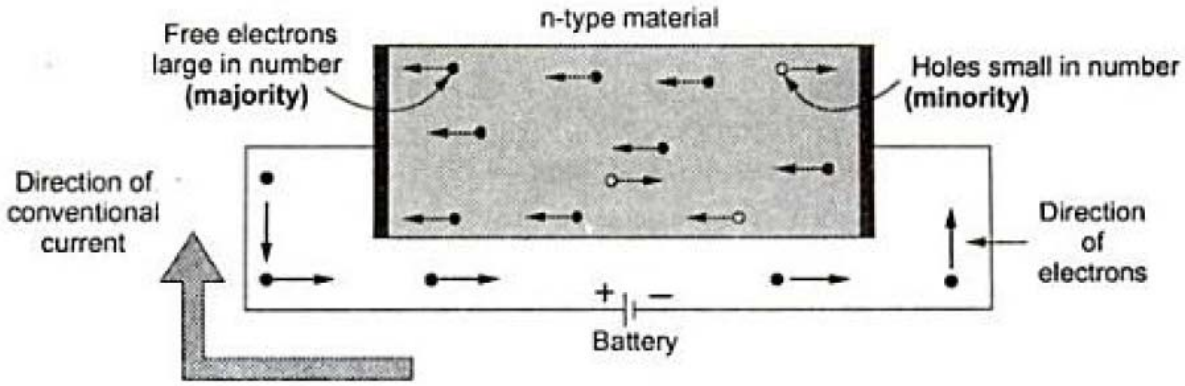
►Sb (antimony) has five valence electrons and it is called a donor atom.

In the n-type material the free electrons are the majority and the holes are the minority.




*n*-type

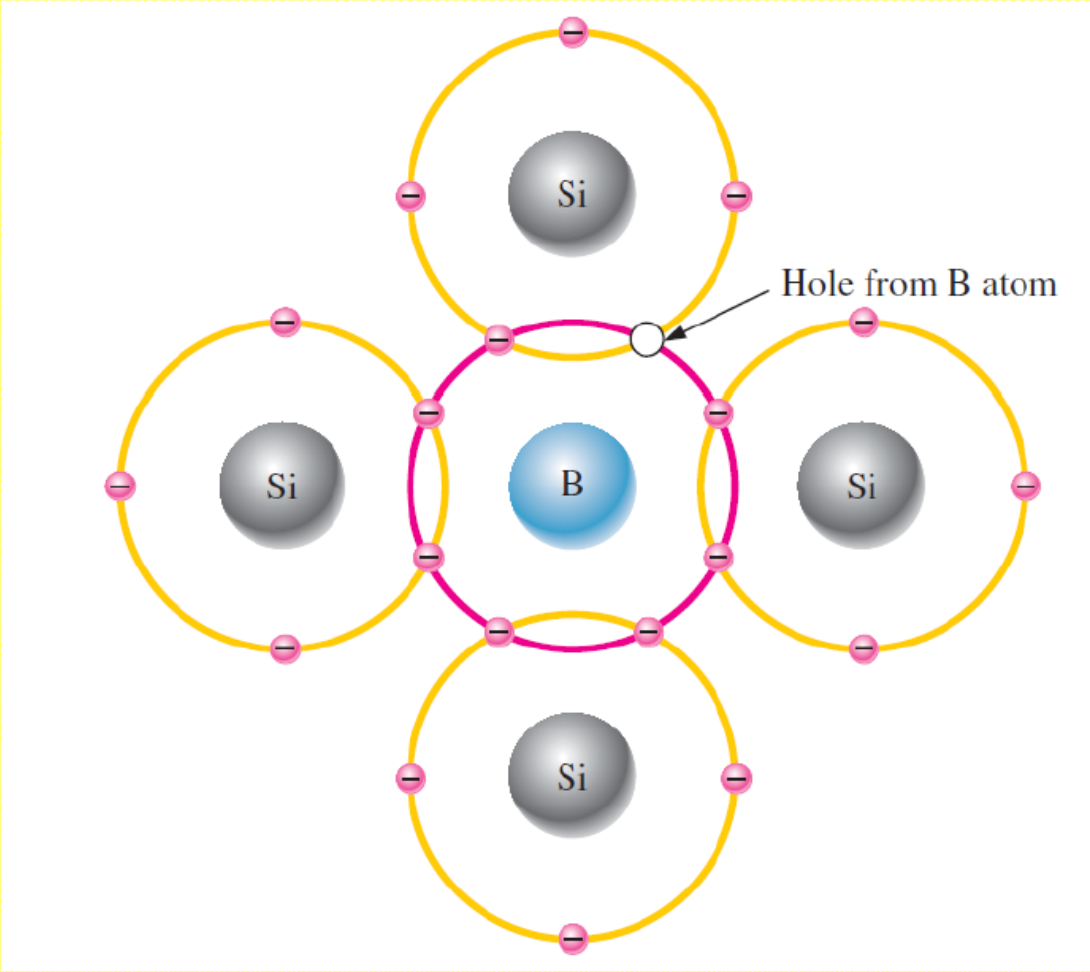
# Conduction in n-type material



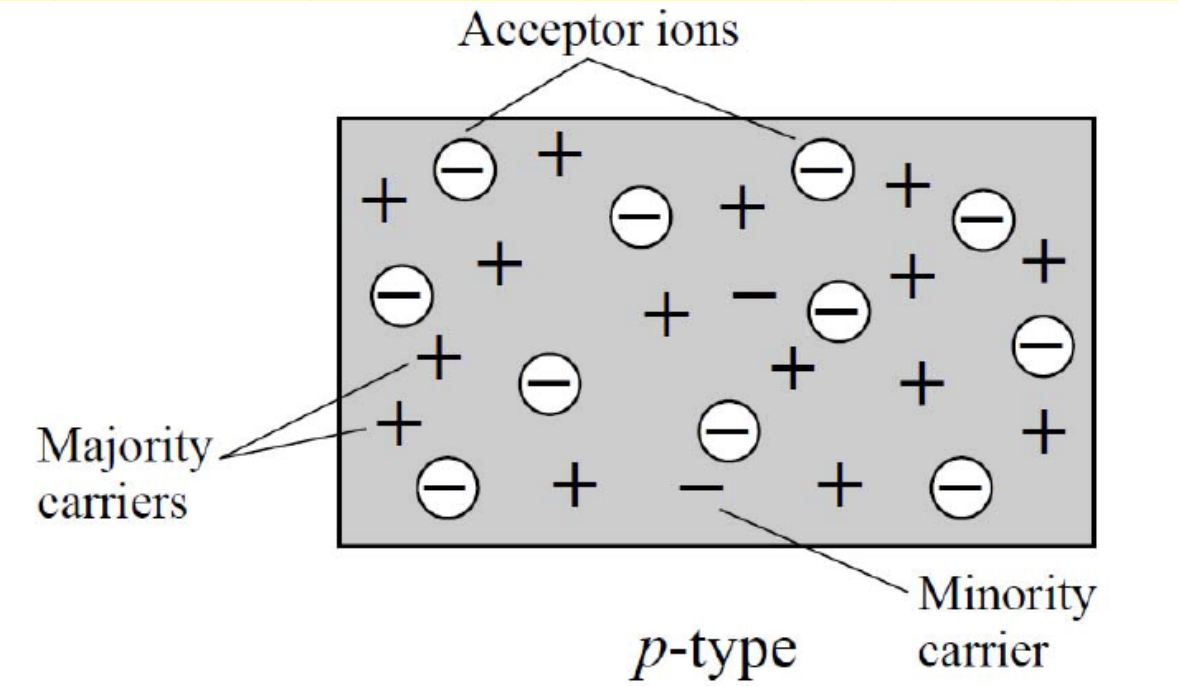

**Conduction in n-type material**

## P - type semiconductor

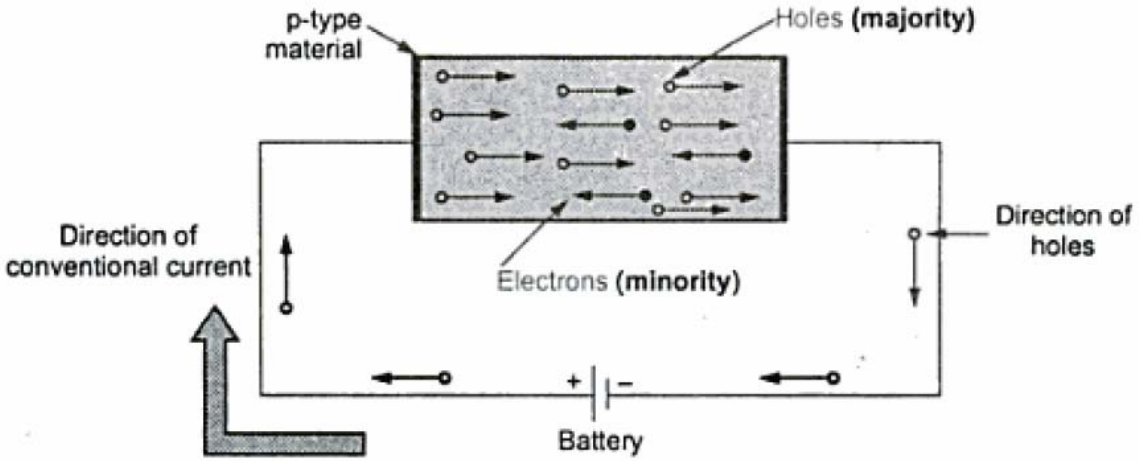
B (Boron ) has three valence electrons (acceptor atom)



►B (Boron ) has three valence electrons (acceptor atom)
In the p-type material the holes are the majority and the free electrons are the minority .



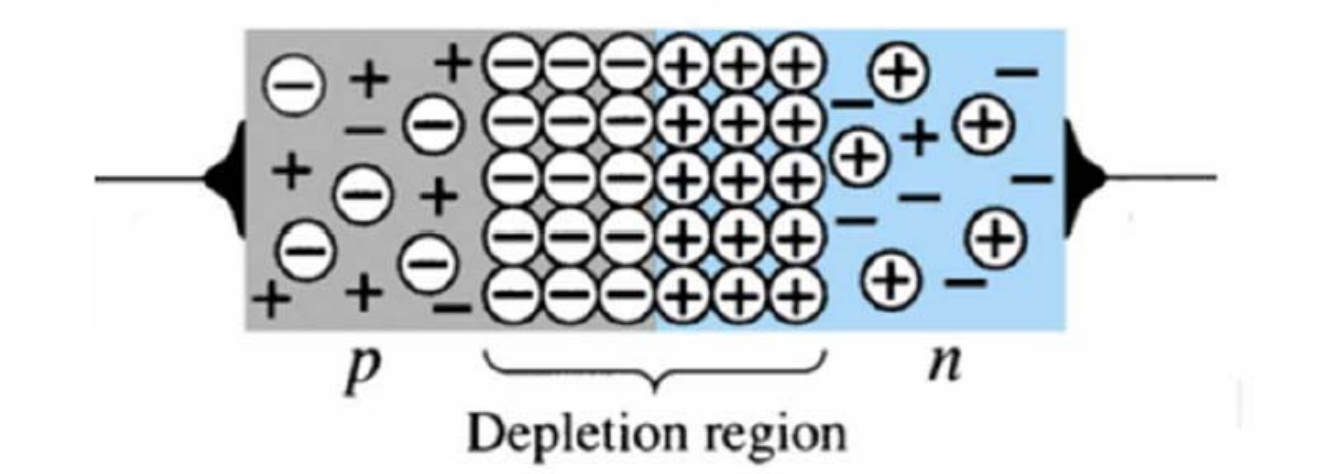
# Conduction in p-type material




**Conduction in p-type material**

# Pn junction

- The p-n junction is the basis for diodes, certain transistors ,and other devices.



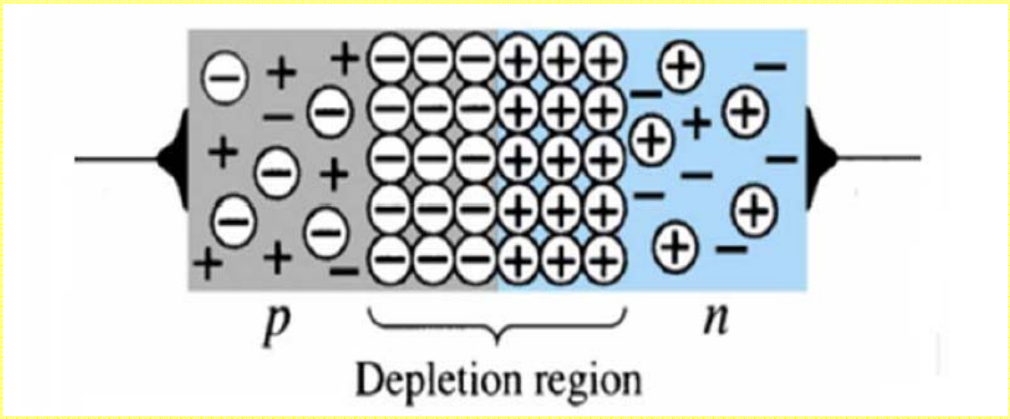
1 ) Electrons from the n-type material near the junction diffuse a cross the junction.

2) These electrons fill the holes in the p-type material adjacent to the junction.

3) As a result of electrons leaving the n-type material , donor ions are created on the n side of the junction .

4) When these electrons fill holes in the p side of the junction ,accepter ions are produced.

5) A wall of stationary positive ions is aligned with a wall of negative ions a long the n and p sides of the junction .

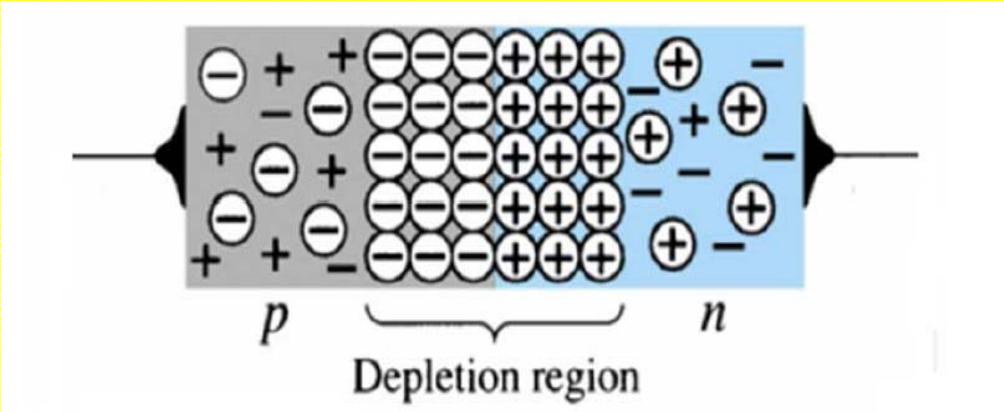


6 ) The space occupied between the ion walls is called depletion region.

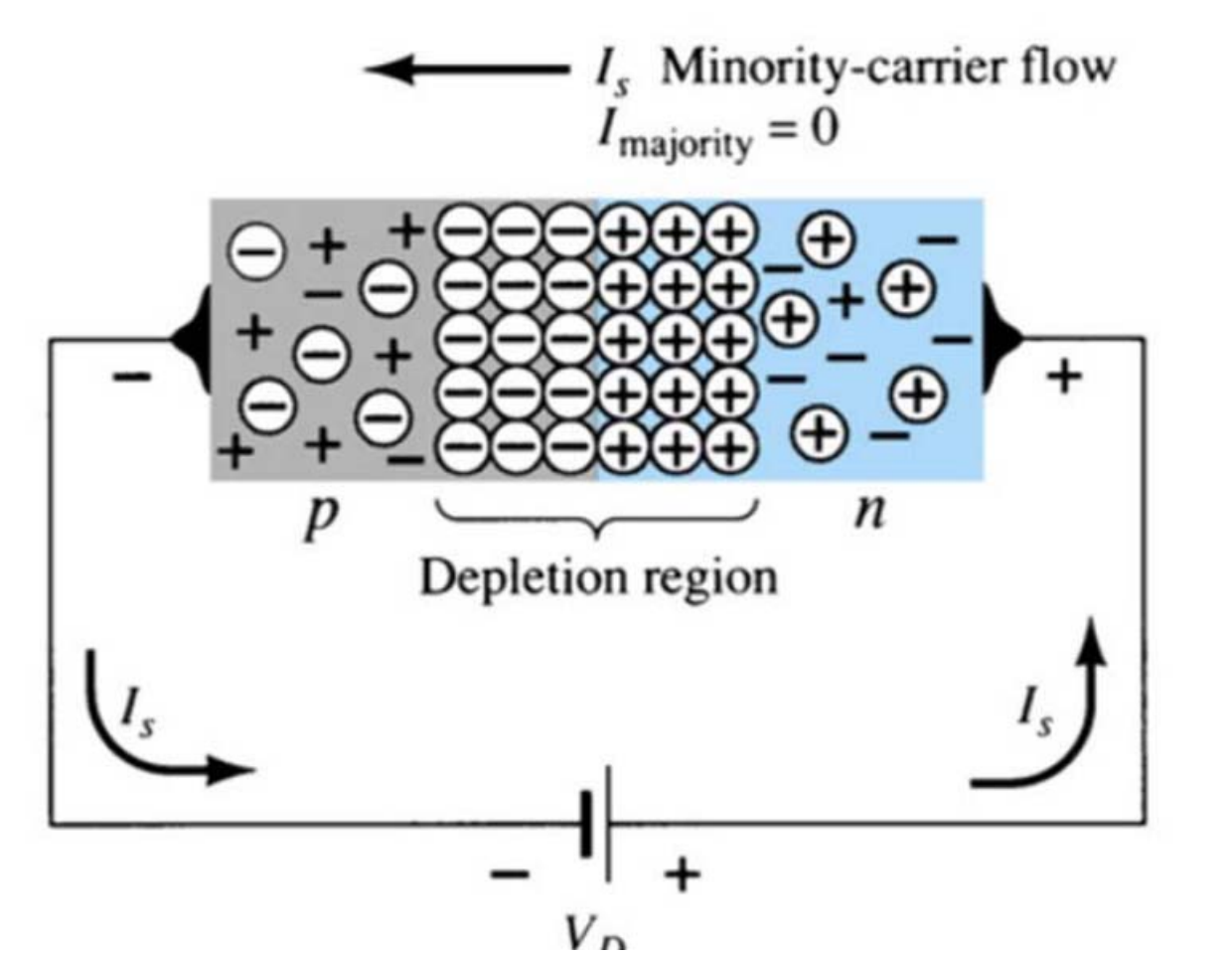
7 )Whenever there exists a positive charge with respect to a negative charge , a voltage difference is set between charges ;(Junction potential, Junction barrier).

8 ) The junction potential acts as potential barrier that tend to prevent majority carriers from crossing the junction.

9 ) Minority carriers are aided by the junction potential .



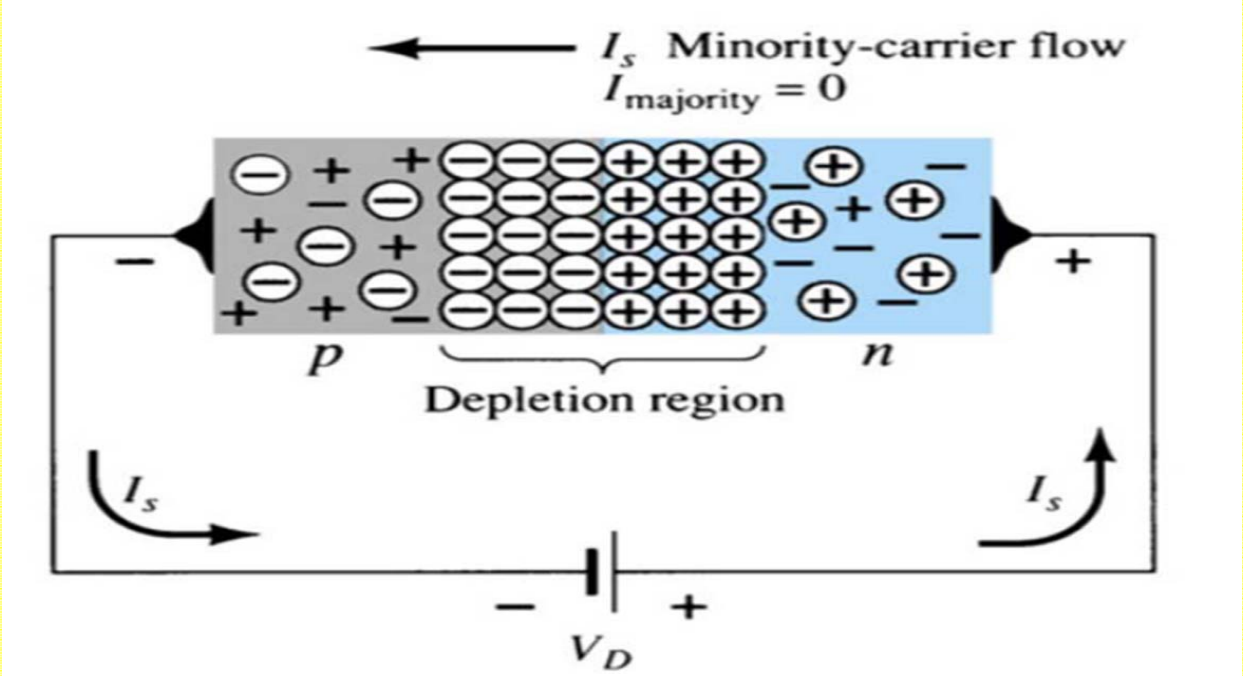
# Reverse bias of a pn junction



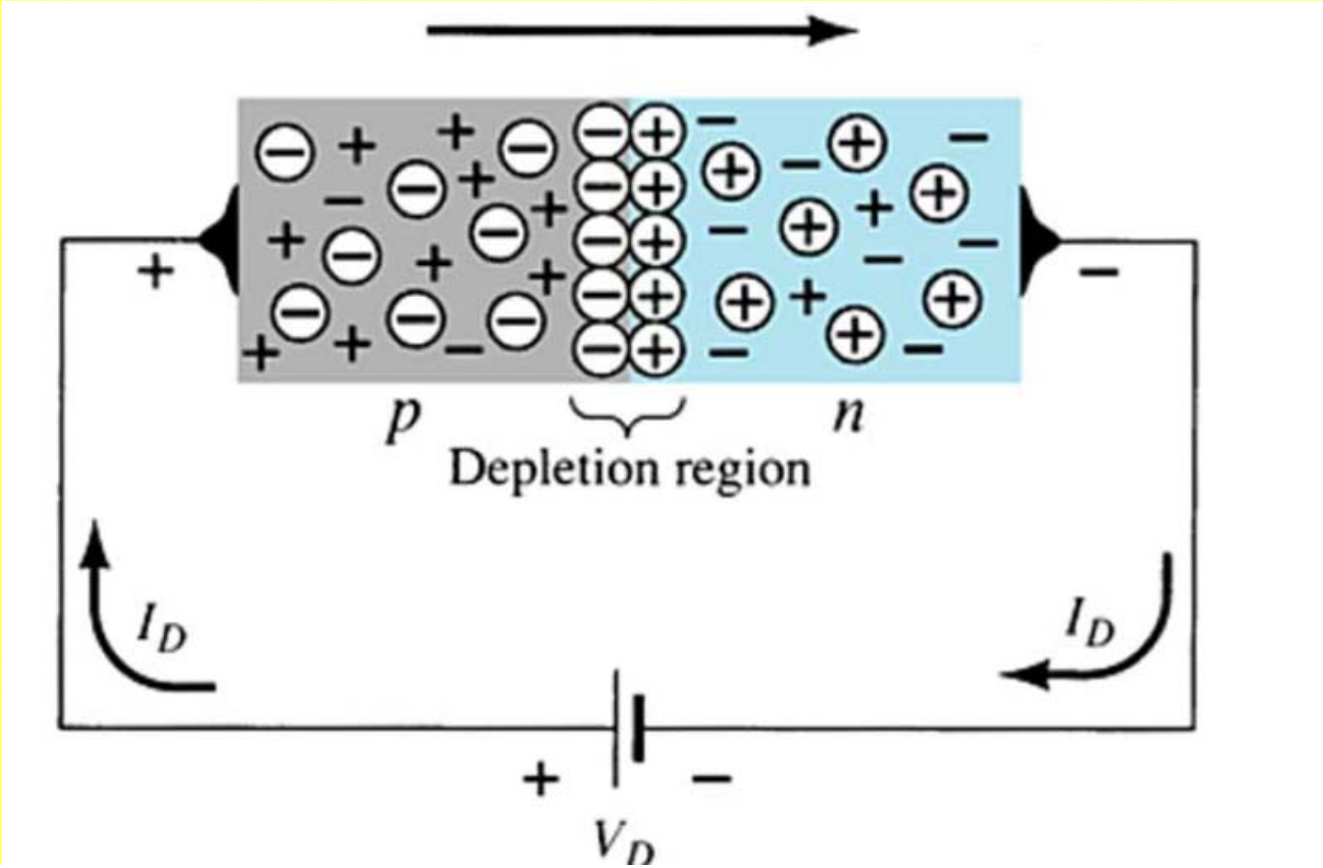
- The reverse voltage causes the depletion region to widen .

- The electrons in the n-type material are attracted toward the positive terminal of the voltage source .

- The holes in the p-type material are attracted toward the negative terminal of the voltage source .



# Forward bias of a pn junction



►The forward voltage causes the depletion region to narrow

►The electrons and holes are pushed toward the p-n junction

►The electrons and holes have sufficient energy to cross the p-n junction