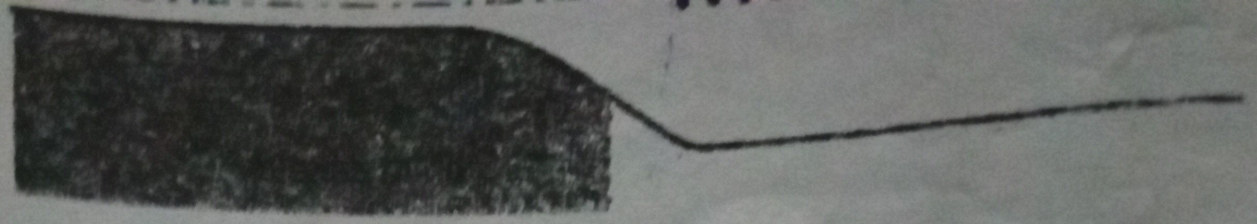


p-n junction

The upward direction in the diagram represents increasing electron energy. This means energy must be supplied to get an electron to go up on the diagram, and energy must be supplied to get a hole to go down.

Q.10 What is forward biased and reverse biased of a diode? How they affect the width of a depletion region? *(Pu.2004)*

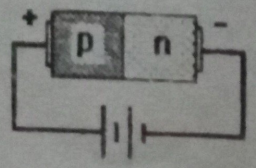
WORKING OF P-N JUNCTION

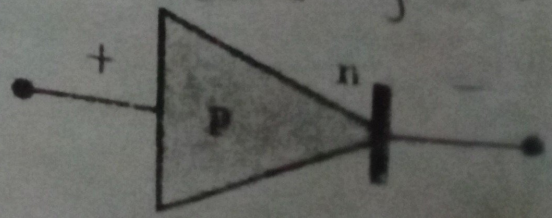
The semiconductor p–n junction is called diode. The diode has depletion region at junction boundary. The depletion region has positive and negative ions. It stops the flow of free electrons across the junction by diffusion process because electrons face opposite polarity. The p–n junction comes in working conditions when potential difference is applied. The application of potential difference across p–n junction has two types. These types are called forward biased and reverse biased.

FORWARD BIASED

The p–n junction is called forward biased when negative terminal of a battery is connected to n–type and positive terminal of a battery is connected to p–type material.

Process of appling external voltage is called biasing.

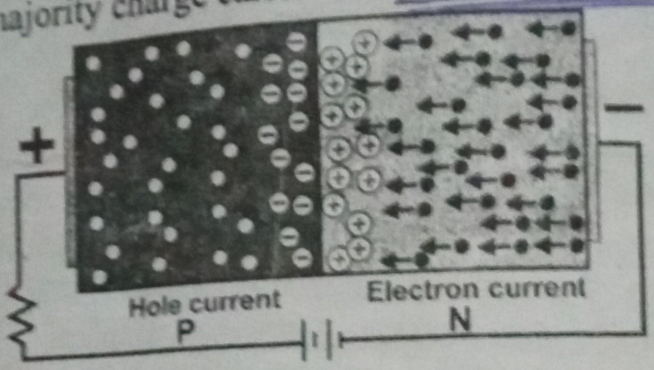




The applied potential of battery establishes an electric field. This electric field acts t the electric field generated at junction boundary due to ions presents inside on region. The resultant field is weakened up and barrier height is reduced. The e which completely remove the barrier is **called biasing voltage**. The biasing e for silicon diode is 0.7 V and 0.3 V for germanium diode.

WARD CURRENT

The resistance of p–n junction during forward biased becomes almost zero because moval of barrier height. The flow of current after removal of barrier height across the unction due to majority charge carriers is **called forward current.**



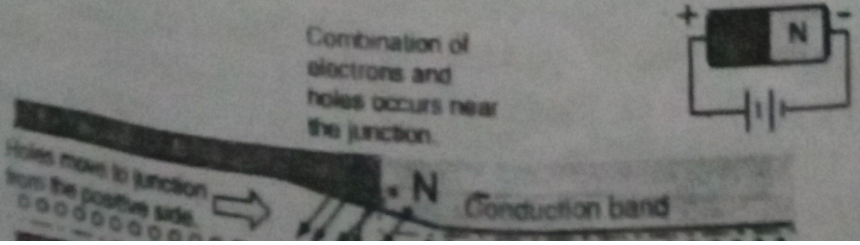
● Electron ○ Hole ⊖ Negative ion from filling of p-type vacancy ⊕ Positive ion from removal of electron from n-type impuirty

RWARD CURRENT

Then negative terminal of a battery repels free electrons of n–type region towards ype region. The positive terminal of a battery repels holes of p–type region towards ype region. These electrons and holes recombine at junction boundary and establish ward current. The free electrons of n–type material move towards positive terminal of battery across the junction to establish forward current.

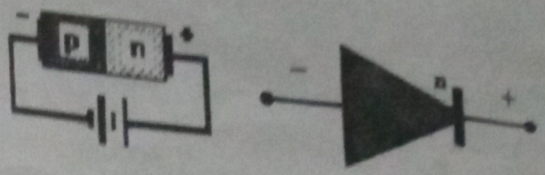
N JUNCTION ENERGY BAND

The energy band diagram of p–n junction during forward biased is shown below. p–side is made more positive for forward biasing the p-n junction. It is **"downhill"** electron motion across the junction. The electron fills a hole near the junction and ve across the junction. Then it move from vacancy to vacancy leftward toward the itive terminal and could be described as the hole moving right. The conduction ection for electrons in the diagram is right to left, and the upward direction represents reasing electron energy.

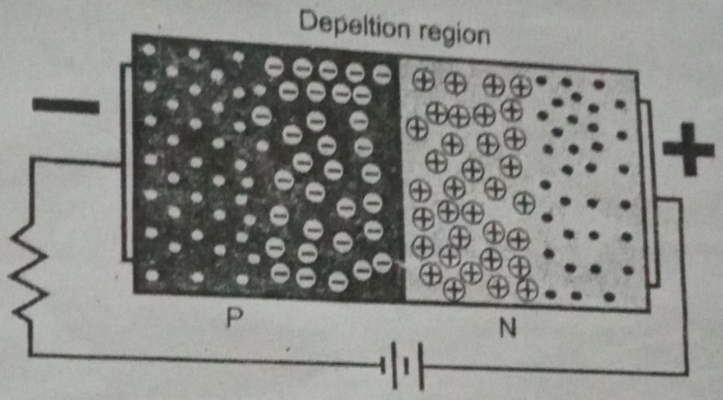


REVERSE BIASED

The p–n junction is **called reverse biased** when negative terminal of a battery is connected with p–type and positive terminal of a battery is connected with n–type material.



The applied voltage establishes an electric field. This electric fieldacts in the same direction as the electric field generated due positive ions and negative ions(present inside depletion region). The resultant electric field gets stronger. It increases the barrier height and strength of potential barrier. The increased potential barrier prevents the flow of charge carriers across the junction.



The barrier height at junction increases because positive terminal of battery attracts free electrons from the n–type region and leaves behind positive ions at the junction boundary. Similarly holes of P–type region attract electrons from negative terminal of battery and create negative ions at junction boundary in p–side. It means current does not flow due to majority charge carriers during reverse biasing of p–n junction. The resistance of p–n junction during reverse bias becomes high.

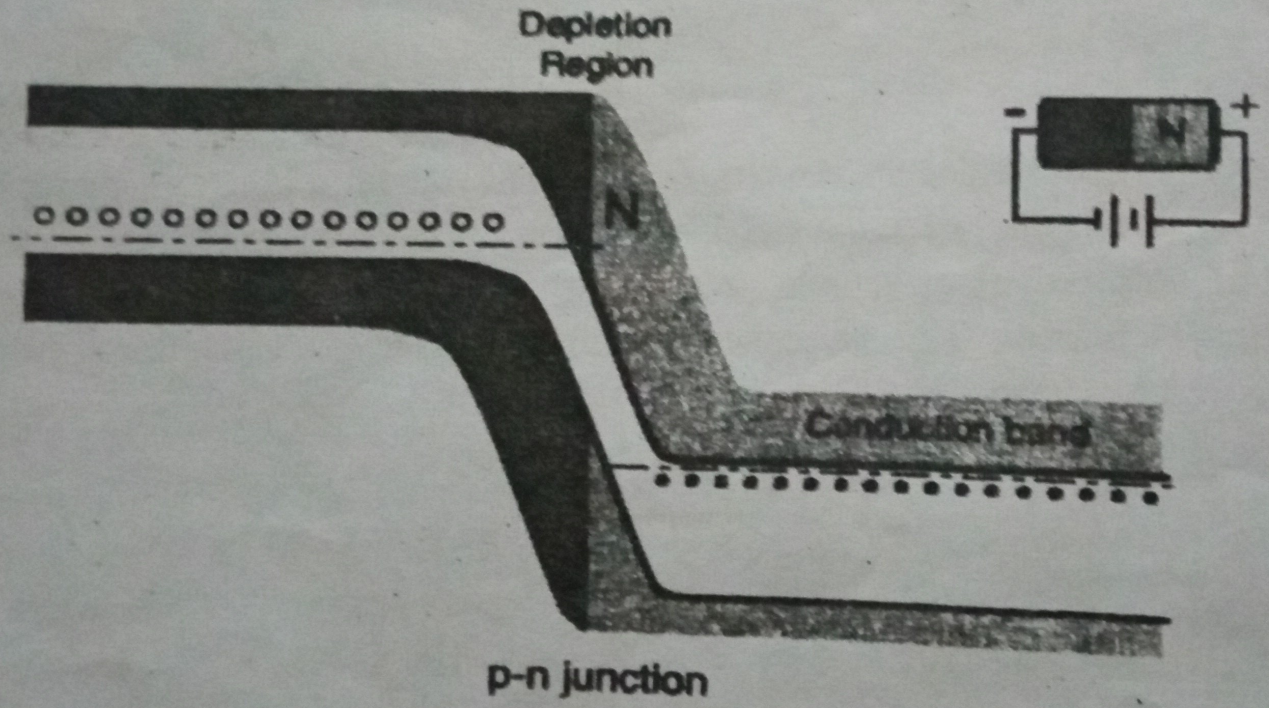
The depletion region acts as insulator between n–type and p–type regions. The layer of positive ions and negative ions behaves as capacitor. The capacitance is inversely proportional to revere applied voltage. Therefore diodes can be used to tune capacitors in high frequency and TV receiving systems.

REVERSE LEAKAGE CURRENT

The majority current carriers can not establish current in diode when it is reverse biased. The p–type region has free electrons and n–type has holes as minority charge carriers. These charge carriers are created when covalent bonds breaks due to thermal agitation. The hole–electron pairs called minority carriers are also produced in depletion layer. The minority free electrons move towards the positive terminal of battery and minority holes move towards negative terminal of battery when diode is reverse biased. The small amount of current established in diode during reverse bias due to minority charge carriers is **called reverse leakage current**. The battery polarity is accurate to support the movement of these minority charge carriers across the junction.

P–N ENERGY BAND

The energy band diagram of p–n junction for reverse biased is shown in diagram below. The p–side is made more negative for reverse biasing. It makes "**uphill**" for electrons moving across the junction.



The conduction direction for electrons in the diagram is right to left and the upward ection represents increasing electron energy.

11 Why silicon p–n junction is better for power supply?