Now equation (2.34) becomes

$$\sigma = en_i(\mu_e + \mu_h) \quad (2.$$

We know that from equation (2.13)

$$n_i = 2\left(\frac{2\pi kT}{h^2}\right)^{\frac{3}{2}} (m_e^* m_h^*)^{\frac{3}{4}} \exp\left(-\frac{E_g}{2kT}\right)$$

Substitute the value of n_i in equation (2.35), we get

$$\sigma = 2e(\mu_e + \mu_h)\left(\frac{2\pi kT}{h^2}\right)(m_e^* m_h^*)^{3/4} \exp\left(-\frac{E_g}{2kT}\right)$$

Here μ_e and μ_h are not strongly dependent on temperature in comparison to density of elec and holes. Here, s depends upon temperature.

(b) Electrical conductivity of extrinsic semiconductor

The extrinsic semiconductors can be divided into two classes.

1. *n*-type semiconductor
2. *p*-type semiconductor

1. ***n-type semiconductor***

   In *n*-type semiconductor, the electrical conductivity is primarily due to electrons in the co tion band and can be written as

$$\sigma = N_d \mu_e e$$

2. ***p-type semiconductor***

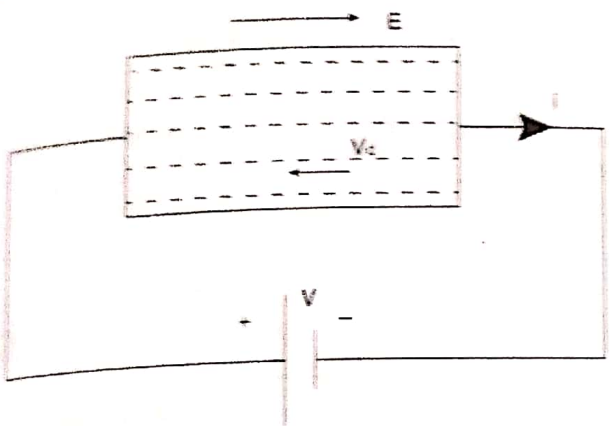
   In *p*-type semiconductor, the electrical conductivity is primarily due to the holes in the va band and can be written as

$$\sigma = N_a \mu_h e$$

2.9 DRIFT AND DIFFUSION

Drift

Let us consider a semiconductor with electrons and holes and apply a potential difference as shown in the diagram.



Def:

"The motion of charge carries under the influence of electric field" is known as drift.

We know,

$$i = \frac{V}{R}$$

$$i = \frac{V}{\rho l / A} = \frac{1}{\rho}\left(\frac{V}{l}\right) A$$

$$\Rightarrow i = \sigma E A$$

$$\frac{i}{A} = \sigma E$$

$$\Rightarrow \vec{J} = \sigma \vec{E} \quad \left[\because \frac{i}{A} = J = \text{current density}\right]$$

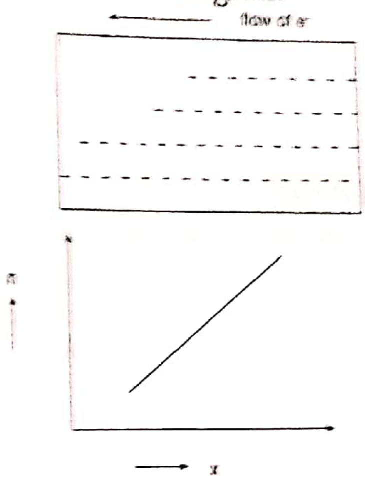
In particular direction,

$$J_x = \sigma E_x \quad [\because \sigma = ne\mu]$$

$$J_x = (ne\mu_e + Pe\mu_n) E_x$$

Diffusion

Let us consider a semiconductor with charge carries as shown in the diagram



Def:

"The motion of charge carries due to concentration variation" is known as diffusion.

The motion of charge carries per unit length per unit time is directly proportional to

$$\left[-\left(\frac{dn}{dx}\right)\right]$$

[negative sign indicates opp.direction].

The current per unit length

$$J \alpha - e\left(\frac{dn}{dx}\right)$$

$$J = -De\left(\frac{dn}{dx}\right)$$

for electrons $J_n = -D_n e\left(\frac{dn}{dx}\right)$

for holes $J_p = -D_p e\left(\frac{dn}{dx}\right)$

Since the current direction is opp to flow of electrons

$$J_n = D_n e\left(\frac{dn}{dx}\right)$$