Assignment No. 1

Q1: How many free electrons will flow to Contribute charge of 1 Coulomb.

Q2: If potential difference V applied across a Conductor is increased to 2V, how will the drift velocity of the electrons change?

Q3: 10^5 electrons pass from a point P towards another point Q in a Conductor in 10^{-4} sec. Find the magnitude and direction of Current.

Q4: What are the factors on which mobility of charge Carriers will depend?

Q5: What will be change in relaxation time with decrease in temperature of Conductor.

Q6: What will be change in drift velocity with increase in temperature of Conductor.

Solutions Assignment No. 1

Ans 1: As charge is due to flow of free electrons.

$\therefore \quad q = ne$

$n \rightarrow$ Total No. of free electrons and e is charge on one electron

$e = 1.6 \times 10^{-19}\ C$

$\therefore \quad n = \frac{q}{e}$

$q = 1$ Coulomb (given)

$$\Rightarrow n = \frac{1}{1.6 \times 10^{-19}} = \frac{10^{19}}{1.6} = \frac{100}{16} \times 10^{18} = 6.25 \times 10^{18}$$

$\Rightarrow$ **No. of free electrons $= 6.25 \times 10^{18}$**

Ans 2: We know that

$$v_d = \frac{eV}{ml}\tau$$

By keeping, all factors other than V to be Constant

$v_d \propto V$

$$\Rightarrow \frac{v_{d_2}}{v_{d_1}} = \frac{V_2}{V_1} \longrightarrow (1)$$

Now $V_1 = V \rightarrow V_2 = 2V$ (given)

$$\therefore \frac{v_{d_2}}{v_{d_1}} = \frac{2V}{V} = 2 \Rightarrow v_{d_2} = 2 v_{d_1}$$

$\Rightarrow$ **Hence, drift velocity of electrons is also doubled**

Ans 3: Given $n = 10^5$ time $t = 10^{-4}$ sec.

Total charge flowing through Conductor $q = ne$

where $e = 1.6 \times 10^{-19}$ Coulomb

Current $I = \frac{q}{t} = \frac{ne}{t}$

$$\Rightarrow I = \frac{10^5 \times 1.6 \times 10^{-19}}{10^{-4}} = 1.6 \times 10^{-19} \times 10^{9} = 1.6 \times 10^{-10}\ \text{Amp.}$$

$\Rightarrow$ **1.6×10^{-10} Amp. Current will flow from Q to P**

Direction of Conventional current is opposite to direction of flow of e^-.

Ans 4: As Mobility $\mu = \frac{e\tau}{m}$

Hence mobility is directly proportional to relaxation time
mobility is inversely proportional to mass of Current Carrier.

Ans 5: When temperature of Conductor decreases then chances of Collision Suffered by free electron also reduces. Hence, relaxation time between two successive Collisions increases.

⟹ Relaxation time increases with decrease of temperature of Conductor.

Ans 6: As $v_d = \frac{eE}{m}\tau$

With increase in temperature of Conductor, thermal motion will increases which will increase the chances of Collision Suffered by free electron. So, relaxation time will decrease which will Cause decrease in drift velocity.

⟹ Drift velocity decreases with increase of temperature of Conductor.