Sol: Quiz – I

Q1. (a) $np = n_i^2$ — 1.5

$n = p + N_D$ — 1.5

$n = \frac{n_i^2}{n} + N_D \Rightarrow n = \frac{N_D + \sqrt{N_D^2 + 4n_i^2}}{2}$ — 3

(b) $\mu_n >> \mu_p$

$\mu \propto T^{-3/2}$

$T = 300K$ $\quad$ $T = 500K$

$\mu_{n1} \cdot n_1 \cdot q = \mu_{n2} \cdot n_2 q$ — 2

$\frac{N_D}{n_2} = \frac{n_1}{n_2}$;

$\frac{\mu_{n2}}{\mu_{n1}} = \left(\frac{5}{3}\right)^{-3/2}$ — 2

$$\frac{N_D}{\frac{N_D + \sqrt{N_D^2 + 4n_i^2}}{2}} = \left(\frac{5}{3}\right)^{-3/2} \quad (2)$$

$n_i = 5 \times 10^{16}/cm^3$

$$N_D = 3.17 \times 10^{16}/cm^3 \quad (2)$$

Q2. (1) $\frac{1}{\mu} = \frac{1}{\mu_1} + \frac{1}{\mu_2} = \frac{1}{800} + \frac{1}{200}$

$$\mu_2 \quad \frac{800 \times 200}{800 + 200} = 160\ cm^2/V\text{-}s$$

(1) (1)

Q3.

$A \rightarrow n \Rightarrow \sigma_n = n e / \mu_n$

$B \rightarrow p \Rightarrow \sigma_p = p e / \mu_p$

$\mu_p < \mu_n \Rightarrow \sigma_p < \sigma_n$

(1)

$\rho_p > \rho_n$

$\rho_B > \rho_A$

(1)

Q4. $T = 300\ K$ Si $n_i = 1.5 \times 10^{10}/cm^3$

$p = 2.25 \times 10^5/cm^3$

$n = \frac{n_i^2}{p} = 10^{15}/cm^3$ — (1), (2)

$N_A = 5 \times 10^{15}/cm^3$ — (2)

(a) n-type — (1)

(b) $p + N_D = n + N_A = 10^{15} + 5 \times 10^{15}$

$N_D \simeq 6 \times 10^{15}/cm^3$ — (1), (2)