

# Homework #. 7. solution.

$$1. \mu_{ion} = \frac{D \cdot 2e}{k_B T} = \frac{10^{-13} \cdot 2 \times 1.6 \times 10^{-19}}{1.38 \times 10^{-23} \times 300}$$

$$= 3.32 \times 10^{-12} \text{ cm}^2 / \text{V} \cdot \text{s}$$

Appendix 4에서 electron과 hole의 mobility는

$10^{-2} \sim 10^{-1}$  order로 이는  $\mu_{ion}$ 에 비해 훨씬 큰값이다.

$\therefore$  Ion의 mobility가 electron / hole 보다 훨씬 작음을 알 수 있다.

$$2. D = D_0 \exp\left(-\frac{Q}{k_B T}\right)$$

$$T = 300 \text{ K}$$

$$D = 10^{-19} \text{ m}^2 / \text{s}$$

$$D_0 = 10^{-3} \text{ m}^2 / \text{s}$$

$$Q = k_B T \ln\left(\frac{D_0}{D}\right)$$

$$= 0.83 \text{ eV}$$

$$3. \rho_{ion} = \frac{N_{ion} e^2 D_0}{k_B T} \exp\left(-\frac{Q}{k_B T}\right)$$

$$= \frac{6 \times 10^{20} \times (1.6 \times 10^{-19})^2 \times 10^{-3}}{1.38 \times 10^{-23} \times 300} \exp\left(-\frac{0.8 \times 1.6 \times 10^{-9}}{1.38 \times 10^{-23} \times 300}\right)$$

$$= 1.35 \times 10^{-13} (\Omega \cdot \text{m})^{-1}$$

$$4. (9.3) E = \frac{V}{L}$$

$$(9.9) C = \frac{q}{V}$$

$$(9.11) \epsilon = \frac{C}{C_{vac}}$$

$$\left. \begin{array}{l} V = E \cdot L \\ q = C \cdot V = C \cdot E \cdot L \end{array} \right\} \rightarrow$$

전체 net charge = const.

$$C_{vac} \cdot E_{vac} \cdot L = C \cdot E \cdot L$$

$$\therefore E = \frac{C_{vac}}{C} \cdot E_{vac} = \frac{E_{vac}}{\epsilon}$$

$$6. \quad p = qx$$

$$D = \epsilon \epsilon_0 E = \frac{q}{A}$$

$$= \epsilon_0 E + p = \epsilon \epsilon_0 E$$

$$\therefore p = (\epsilon - 1) \epsilon_0 E$$

$$\therefore \text{vacuum} \quad \epsilon = 1, \quad p = 0, \quad D = \epsilon_0 E$$

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$$7. \quad C = \epsilon \cdot \epsilon_0 \frac{A}{L} = \frac{q}{V}$$

$$\epsilon \epsilon_0 \frac{V}{L} = \frac{q}{A}$$

$$\therefore \epsilon \epsilon_0 E = \frac{q}{A}$$