Fundamentals of Nanoelectronics, Basic Concepts Unit 3
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L3.2 Quiz
Answers

3.2. A New Boundary Condition

Diffusive transport is commonly described through the diffusion equation

$$I = -\frac{\sigma_0 A}{q}\frac{d\mu}{dz} \qquad \textbf{(A)}$$

with boundary conditions at the contacts given by

$$\mu(z=0) = \mu_1 \quad \text{and} \quad \mu(z=L) = \mu_2 \qquad \textbf{(B)}$$

3.2a Solution of (A) using (B) gives for the current

(a) $I = \frac{1}{q}\frac{\sigma_0 L}{A}\left(\mu_1 - \mu_2\right)$

(b) $I = \frac{1}{q}\frac{\sigma_0 (L+\lambda)}{A}\left(\mu_1 - \mu_2\right)$

(c) $I = \frac{1}{q}\frac{\sigma_0 A}{L+\lambda}\left(\mu_1 - \mu_2\right)$

(d) $I = \frac{1}{q}\frac{\sigma_0 A}{L}\left(\mu_1 - \mu_2\right)$

(e) None of the above

3.2b To describe ballistic transport we need to

(a) replace (A) with a different equation

(b) use (A) but change (B) to

$$\mu(z=0) = \mu_1 - \frac{qIR_B}{2} \quad \textit{and} \quad \mu(z=L) = \mu_2 + \frac{qIR_B}{2}$$

(c) use (A) but change (B) to

$$\mu(z=0) = \mu_1 - \frac{kT}{2q} \quad \textit{and} \quad \mu(z=L) = \mu_2 + \frac{kT}{2q}$$

(d) use (A) but change (B) to

$$\mu(z=0) = \mu_1 - qIR_B \quad \textit{and} \quad \mu(z=L) = \mu_2 + qIR_B$$

(e) do nothing. (A) and (B) describe ballistic transport as well.