Week 8 Lecture 18 Quiz:
Thermoelectric Effects: Charge flow

ECE 656: Electronic Conduction In Semiconductors
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Purdue University, Fall 2013

Student’s name: ____________________________

Answer the **multiple choice questions** below by choosing the **one, best answer**. Then **ask a question** about the lecture.

1) What is the proper, near-equilibrium current equation when the temperature varies slowly with position?
   
   a) \( J_{nx} = \sigma_n \frac{d(F_n/q)}{dx} \)
   
   b) \( J_{nx} = \sigma_n \frac{d(F_n/q)}{dx} - S_n \frac{dT}{dx} \)
   
   c) \( J_{nx} = \sigma_n \frac{d(F_n/q)}{dx} - S_n \frac{d\sigma_n}{dx} \)
   
   d) \( J_{nx} = \sigma_n \frac{d(F_n/q)}{dx} - \pi_n \frac{d\sigma_n}{dx} \)
   
   e) \( J_{nx} = \sigma_n \frac{d(F_n/q)}{dx} - \kappa_n \sigma_n \frac{dT}{dx} \).

2) What is the strongest factor that determines the magnitude of the Seebeck coefficient?
   
   a) The location of the Fermi level with respect to the band edge.
   
   b) The shape of the density of states.
   
   c) The energy dependence of the mean-free-path for backscattering.
   
   d) The dimensionality of the semiconductor.
   
   e) All of the above-listed factors are equally important.

3) What are the two, most general driving forces for current?
   
   a) Gradients in the electrostatic potential and temperature.
   
   b) Gradients in the carrier concentration and temperature.
   
   c) Gradients in the electrochemical potential and temperature.
   
   d) Gradients in the electrostatic potential and carrier concentration.
   
   e) Gradients in the electron density and electrostatic potential.
   
   **continued on next page**
4) For a non-degenerate, n-type semiconductor, the current typically flows at an energy, \( \Delta_n \), above the bottom of the conduction band. What is a typical value for \( \Delta_n \)?

a) Much less than \( k_B T \).
b) Much greater than \( k_B T \).
c) On the order of \( k_B T \).
d) Approximately \( E_F - E_C \).
e) Approximately \( E_C - E_F \).

5) For a degenerate, n-type semiconductor, the current typically flows at an energy, \( \Delta_n \), above the bottom of the conduction band. What is a typical value for \( \Delta_n \)?

a) Much less than \( k_B T \).
b) Much greater than \( k_B T \).
c) On the order of \( k_B T \).
d) Approximately \( E_F - E_C \).
e) Approximately \( E_C - E_F \).

6) **What question do you have about this lecture?**

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Turn in to Prof. Lundstrom in class on Friday.