Week 9 Lecture 21 Quiz:
Scattering and Transmission

ECE 656: Electronic Conduction In Semiconductors

Mark Lundstrom
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) Under what conditions does $\mathcal{T}_{12}(E) = \mathcal{T}_{21}(E)$?

   a) Isotropic scattering
   b) Near-equilibrium
   c) Elastic scattering
   d) Inelastic scattering
   e) Weak scattering

2) In our derivation of the transmission and its relation to the mean-free-path, $\mathcal{T}(E) = \dfrac{\lambda(E)}{\lambda(E) + L}$, what assumptions were made?

   a) No recombination-generation
   b) Elastic scattering
   c) No electric field
   d) Position-independent mean-free-path
   e) All of the above

3) In general, how does the Landauer mean-free path (the mean-free=path for backscattering) compare to the commonly used mean-free-path, $\Lambda(E) = \upsilon(E)\tau_m(E)$?

   a) $\lambda(E) = \Lambda(E)$.
   b) $\lambda(E) \approx \Lambda(E)$
   c) $\lambda(E) > \Lambda(E)$
   d) $\lambda(E) < \Lambda(E)$.
   e) $\lambda(E) = \dfrac{\lambda(E)}{L}\Lambda(E)$

4) How is the diffusion coefficient related to the mean-free=path?

a) $D_n(E) = \langle v_x^+(E) \rangle \lambda(E)$.

b) $D_n(E) = \langle v_x^+(E) \rangle \lambda(E)/2$.

c) $D_n(E) = \langle v_x^+(E) \rangle \lambda(E)/3$.

d) $D_n(E) = \langle v_x^+(E) \rangle \lambda(E)/d$ (where *d* is the dimension, 1, 2, or 3)

e) None of the above.

5) When the energy-dependent mean-free-path is written in power law form, $\lambda(E) = \lambda_0 \left(\frac{E - E_c}{k_B T_L} \right)^r$, we find that the <u>average</u> mean-free-path depends on:

a) The dimensionality of the material.

b) The energy dependence of the mean-free-path

c) The degree of carrier degeneracy.

d) All of the above

e) None of the above.

6) What question do you have about this lecture?

Turn in to Prof. Lundstrom in class on Friday.