Quiz Answers: Week 5
ECE 656: Electronic Conduction In Semiconductors

Mark Lundstrom
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Lecture 10 Quiz :

1) Emission is proportional to the number of phonons and absorption to the number plus one. Why?
   a) To account for the zero point energy of the harmonic oscillator.
   b) To ensure that detailed balance is satisfied in equilibrium.
   c) To ensure that energetic carriers relax to the lowest energy states.
   d) Answers (a) and (b) above.
   e) **Answers (b) and (c) above.**

2) The scattering rate and the momentum relaxation rate are equal for which of the following cases?
   a) ADP, II, and ODP scattering.
   b) ADP, ODP, and POP scattering.
   c) POP, IV, ADP and ODP scattering.
   d) ADP, ODP, IV, and POP scattering.
   e) **ADP, ODP, and IV scattering.**

3) Which of the following scattering mechanisms favor small angle scattering?
   a) ADP and II.
   b) ODP and II.
   c) IV and II.
   d) POP and II.
   e) II.

4) Electron-electron scattering is usually ignored when analyzing semiconductor devices. How is this justified?
   a) Because it is typically weak compared to charged impurity and phonon scattering.
   b) Because it conserves the momentum of the electron ensemble.
   c) Because it conserves the energy of the electron ensemble.
   d) Because it conserves the number of electrons.
   e) Because it is just to difficult to compute.

5) Consider the II-VI semiconductor, ZnSe. What do you expect the dominant scattering mechanism to be if it is undoped and at room temperature?
   a) ADP scattering.
   b) ODP scattering.
   c) PZ scattering.
   d) POP scattering.
   e) IV scattering.

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Lecture 11 Quiz:

1) ADP scattering in 3D is proportional to the 3D density of final states. ADP scattering in 2D is proportional to the 2D density of final states, but something else changes. What is it?
   a) We must be careful about momentum conservation in the direction of confinement.
   b) We must be careful about momentum conservation in the plane.
   c) We must be careful about energy conservation in the direction of confinement..
   d) We must be careful about energy conservation in the plane.
   e) All of the above.

2) What is a "form factor"?
   a) Another name for the overlap integral.
   b) Another name for the shape of the confined wavefunction.
   c) An integral that depends on the shape of the confined wavefunction and that modifies momentum conservation for confined carriers.
   d) An integral that depends on the shape of the confined wavefunction and that modifies energy conservation for confined carriers..
   e) The factor used to normalize the wavefunction of the confined carrier to 1.

3) ADP scattering can be expressed in power law form, $\tau(E) = \tau_0 \left(E / k_B T \right)^s$. What is the characteristic exponent, *s*, in 3D, 2D, and 1D for a **parabolic band** semiconductor?

   a) $s_{3D} = 3/2, s_{2D} = 1, s_{1D} = 1/2$.
   b) $s_{3D} = 3, s_{2D} = 2, s_{1D} = 1$.
   c) $s_{3D} = 3/2, s_{2D} = 1/2, s_{1D} = -1/2$.
   d) $s_{3D} = +1/2, s_{2D} = 0, s_{1D} = -1/2$.
   e) $s_{3D} = -1/2, s_{2D} = 0, s_{1D} = +1/2$**.**

4) ADP scattering can be expressed in power law form, $\tau(E) = \tau_0 \left(E / k_B T \right)^s$. What is the characteristic exponent, *s* for **graphene**?

   a) $s = 1/2$.
   b) $s = 0$**.**
   c) $s = -1/2$.
   d) $s = -1$**.**
   e) $s = -3/2$.

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5) The 2D density of states for parabolic energy bands is independent of energy, but for electrons in the 2D quantum well, the scattering rate generally increases with energy. Why?
   a) Because of conduction non-parabolicity.
   b) Because of carrier degeneracy.
   c) Because the electron-phonon coupling parameter is enhanced.
   d) Because overlap integral increase with quantum confinement.
   e) Because inter-subband scattering can occur in addition to intra-subband scattering.