Quiz: Week 3
ECE 656: Electronic Conduction In Semiconductors
Mark Lundstrom
Purdue University, Fall 2017

1) Which of the following is true ionized impurity scattering?
   a) It is elastic and isotropic.
   b) It is elastic and anisotropic**.**
   c) It is inelastic and isotropic.
   d) It is inelastic and anisotropic.
   e) It is inelastic for donors and elastic for acceptors.

2) What is the Debye length?
   a) The average distance an electron diffuses before recombining with a hole.
   b) The average distance between ionized impurity scattering events.
   c) The average distance over which charge perturbations decay to zero.
   d) The length of the depletion region around an ionized impurity.
   e) The length of the accumulation region around an ionized impurity.

3) How does the II momentum relaxation time vary with energy?
   a) As $\left(E - E_C\right)^{1/2}$.
   b) As $\left(E - E_C\right)^{3/2}$.
   c) As $\left(E - E_C\right)^{0}$.
   d) As $\left(E - E_C\right)^{-1/2}$.
   e) As $\left(E - E_C\right)^{-3/2}$.

4) Which of the following statements is true about the characteristics times for II scattering?
   a) The scattering time is greater than the momentum relaxation time, but less than the energy relaxation rate.
   b) The scattering time is less than the momentum relaxation time, and less than the energy relaxation rate.
   c) The scattering time and the momentum relaxation times are equal and less than the energy relaxation time.
   d) The scattering time and the momentum relaxation times are equal and greater than the energy relaxation time.
   e) The scattering time, the momentum relaxation time, and the energy relaxation time are all equal.

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5) Consider a semiconductor that is so heavily doped that degenerate carrier statistics are needed. How does the non-degenerate expression for the screening length compare to the degenerate expression?

a) The non-degenerate expression gives a longer screening length.
b) The non-degenerate expression gives a shorter screening length.
c) The non-degenerate expression gives the same screening length.
d) The answer depends on how heavily doped the semiconductor is.
e) The answer depends on the sign of the charge perturbation.

6) What is the parameter, *b*, the impact factor?
a) Another name for the Debye length.
b) The average spacing of dopants.
c) The minimum distance between the carrier and the ionized impurity in a scattering event.
d) The maximum distance between the carrier and the ionized impurity in a scattering event.
e) The radius of the ionized impurity.

7) What is main difference between the Brooks-Herring (BH) and Conwell-Weisskopf (CW) treatments of II scattering?
a) BH assumes a screened Coulomb potential and CW an unscreened Coulomb potential.
b) BH uses Fermi's Golden Rule to compute the transition rate, and CW does not.
c) CW uses Fermi's Golden Rule to compute the transition rate, and BH does not.
d) BH assumes Fermi-Dirac statistics and CW does not.
e) CW assumes Fermi-Dirac statistics and BH does not.

8) Which of the following is true of the Brooks-Herring approach to ionized impurity scattering but **not true** about the Conwell-Weisskopf approach?
a) It strongly favors small angle scattering.
b) It assumes that the scattering potential is screened.
c) It assumes that scattering from different impurities is phase incoherent.
d) It is elastic.
e) It gets weaker as the energy of the carrier increases

9) How does one decide whether to use the BH approach or the CW approach?
a) Use CW when the maximum impact parameter is greater than the Debye length.
b) Use CW when the maximum impact parameter is less than the Debye length.
c) Use CW for low temperatures and BH for high temperatures.
d) Use CW for high temperatures and BH for low temperatures.
e) Use CW for electrons and BH for holes.

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10) What is (are) limitations for the Fermi's Golden Rule treatment of II scattering?
    a) It assumes parabolic energy bands.
    b) It assumes low temperatures.
    c) It assumes that the scattering rate does not depend on the sign of the II charge.
    d) All of the above.
    e) None of the above.