Quiz: Week 2 Bonus Lecture
Thermoelectric Materials and Devices
Jesse Maassen & Mark Lundstrom, nanoHUB-U Fall 2013

Answer the **five questions** below by choosing the **one, best answer**.

1) Why use a full band description of electron/phonon states?

   a) Extract meaningful and reliable material parameters.

   b) Predict the properties of materials, where little or no experimental data is available.

   c) Using a full band approach is easy and computationally efficient.

   d) All of the above answers.

   e) None of the above answers.

2) The transport distribution $\Sigma(E)$, the central quantity in the Boltzmann approach, is simply proportional to two quantities in the Landauer approach?

   a) Number of modes $M(E)$ times the average velocity $\langle \upsilon(E) \rangle$.

   b) Number of modes $M(E)$ times the average velocity projected along the transport direction $\langle \upsilon_x(E) \rangle$.

   c) Number of modes $M(E)$ times the mean-free-path for backscattering $\lambda(E)$.

   d) Density of states $D(E)$ times the mean-free-path $l(E)$.

   e) Density of states $D(E)$ times the average velocity projected along the transport direction $\langle \upsilon_x(E) \rangle$.

3) The "band counting" method to calculate the number of modes $M(E)$ depends on what?

   a) The degeneracy of the bands.

   b) The sign of the velocity projected along the transport direction.

   c) The bandwidth of a band (i.e. energy range spanned by a band).

   d) The dimensionality of the system.

   e) All of the above answers.

4) What are the units of the distribution of modes $M_{3D}(E)$ (e.g. for a bulk material)?

   a) m^1.

   b) m^0.

   c) m^{-1}.

   d) m^{-2}.

   e) m^{-3}.

5) Typically, electrons are better described by simple dispersion models (e.g. parabolic approximation) compared to phonons (e.g. Debye model), why?

   a) Electron bandwidths are much larger than $k_B T$; phonon bandwidths are much smaller than $k_B T$.

   b) Electron bandwidths are much smaller than $k_B T$; phonon bandwidths are much larger than $k_B T$.

   c) Electronic velocities are much larger than phonon velocities.

   d) Electronic mean-free-paths for backscattering do not vary much, while phonon mean-free-paths for backscattering can vary by orders of magnitude.

   e) Electrons have a much larger number of modes compared to phonons.

End of quiz. This quiz contains 5 questions.