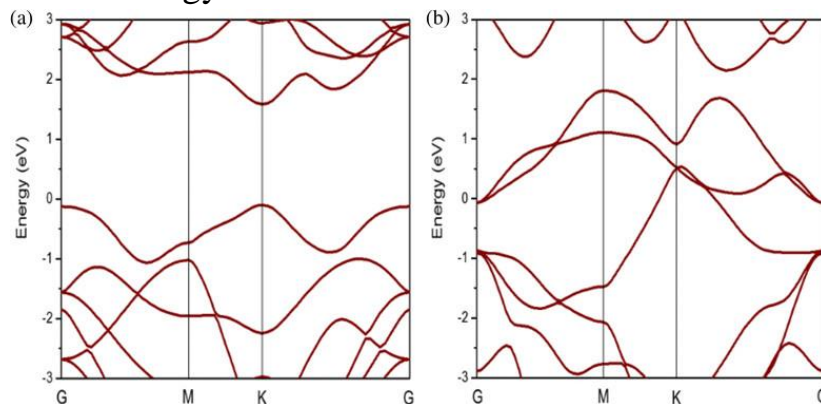


# Solid state physics

## Problems 3

**Deadline: 1. November 2020. 24:00**

- 1) Plot the dispersion relation of a nearly free electron (Eq. 4.13). Due to the Bragg reflection convert every wavenumber into the first Brillouin-zone.
- 2) What determines the width of a band (in energy) in the “approximation with bound electrons” (tight-binding model)?
- 3) Show that the dispersion (Eq. 4.10) for the s-band in the tight-binding model (bound state approximation) can be approximated by a parabolic dispersion in the vicinity of  $k=0$ , as in the nearly free electron model. (b) Calculate the effective mass in this case, and discuss the result.
- 4) Explain how expression (5.3) is related to the more familiar form of Ohm’s law  $I=U/R$ .
- 5) Plot the Fermi-surface for a free electron gas in two dimensions.
- 6) What is the meaning of the  $f$ -function in Eq. (5.10)?
- 7) You can see band structures of two different materials. Are they insulators or metals? The Fermi-energy is at 0 eV.



- 8) Give some examples of devices which operate according to the Peltier or Seebeck effect.