

Exercise 6.1

High-temperature thermal conductivity. At high temperature, the phonon relaxation time in a crystal is

$$\frac{1}{\tau} = \frac{k_B T}{mva}$$

where a is of the order of distance between atoms and m is the atomic weight.

- a) Prove that the high-temperature thermal conductivity is proportional to $1/T$.
- b) The thermal conductivity of silicon at 300 K is $145 \text{ Wm}^{-1}\text{K}^{-1}$. Estimate its thermal conductivity at 400 K.

Exercise 6.2

Landauer formulation for electron thermal conduction. A metallic square nanowire is placed between two thermal reservoirs at temperature T_1 and T_2 . Assume that electron transmissivity is equal to one. Derive an expression for the thermal conductance of the nanowire contributed by the electron.