1. **Hall effect with two carrier types.**

   (a) (Kittel 8.3) Assuming concentrations $n$, $p$; relaxation time $\tau_e$, $\tau_h$; and masses $m_e$, $m_h$; show that the weak field limit ($\omega_c \tau \ll 1$), the Hall coefficient in the drift velocity approximation is

   $$ R_H = \frac{1}{e c} \cdot \frac{p - nb^2}{(p + nb)^2} $$

   in CGS unit, where $b = \mu_e/\mu_h$ is the mobility ratio.

   (b) A silicon sample of resistivity $10^{-3}$ $\Omega$ cm has zero Hall voltage at small magnetic field strengths. Assume $\mu_n = 1300$ cm$^2$/Vs and $\mu_p = 300$ cm$^2$/Vs and determine the carrier concentrations.

2. Ashcroft / Mermin Chapter 13 Problem 2

3. **De Haas-van Alphen period of potassium**

   (a) Calculate the period $\Delta(1/B)$ expected for potassium on the free electron model.

   (b) What is the area in real space of the extremal orbit for $B = 10$ kG?

4. **Open orbits**

   An open orbit in a monovalent tetragonal metal connects opposite faces on the boundaries of a BZ. The faces are separated by $G = 2 \times 10^8$ cm$^{-1}$. A magnetic field $B = 10^3$ gauss is normal to the plane of the orbit.

   (a) What is the order of magnitude of the period of the motion in k-space? Take $v \sim 10^8$ cm/s.

   (b) Describe in real space the motion of an electron on this orbit in the presence of a magnetic field.

5. Ashcroft / Mermin Chapter 14 Problem 1