Condensed Matter Physics 2023
Quiz 2 (Week 9)

1. The Fermi temperature T_F of a metal is 81815 K. Calculate the Fermi energy. Do you recognise which metal this is?

2. For the same metal of Question 1, calculate the density of free electrons. Then, find the drift velocity of a wire when it carries a current (density) of $j = 1.5 \times 10^7$ A/m^2.

3. (a) Using the free electron model, calculate the Fermi velocity for gold given that the Fermi energy is 5.5 eV.

   (b) Using now kinetic theory, calculate the root-mean-square velocity at room temperature (from the average kinetic energy).

   How do the two values compare?

4. The experimental specific heat of potassium metal at low temperature has the form $C = \gamma T + \alpha T^3$. Its Fermi temperature is 37368 K.

   (a) Explain the origin of each of the two terms in this expression.

   (b) Mainstream only. Estimate γ for a mole of potassium from Sommerfeld theory.

   (c) Advanced only. Estimate what fraction of electrons can contribute to the heat capacity of potassium at room temperature.