1. The work function of a metal is the minimum energy required to remove an electron form a metal, and is typically of order 3 eV. find a value for the "penetration depth" of the electron wavefunction outside the metal for electrons at the Fermi energy. *Hint: Use the 1D Schrödinger equation and consider how the wavefunction decays.*

2. Show that the kinetic energy of a free electron gas at absolute zero is

$$E = \frac{3}{5} N \epsilon_F \, .$$

   Derive expressions for the pressure and bulk modulus,

$$p = -\frac{\partial E}{\partial V} \text{ and } B = -V \frac{\partial p}{\partial V}$$

   respectively.

3. Estimate the Fermi energy of

   (a) liquid ^{3}He (density 81 kg m^{-3}), and

   (b) the neutrons in a neutron star (density 10^{17} kg m^{-3}).