J04T.2—Fermionic Gas

Problem

Consider a gas of N nonrelativistic fermions with spin $1/2$ and mass m initially at zero temperature and confined in a volume V_0.

a) Express the kinetic energy of the gas in terms of N and V_0.

b) What is the pressure of the gas? You can assume here that the gas is ideal.

c) Now the gas is allowed to expand to the volume $V_1 \gg V_0$ without any energy exchange with the outside world. Calculate the temperature of the gas after it will reach equilibrium due to weak interactions between the fermions.

d) What is the pressure of the gas in the final state?