FinalW: Ideal Gas

1. Derive the van Vleck formula (52.6) from general thermodynamics formulae (32.5) and (32.6).

2. Consider a collection of non-interacting atoms with the magnetic moment $\vec{\mu} = -g\mu_B \vec{J}$ each. The system is in equilibrium at temperature T and is subject to the magnetic field $\vec{H} = H\hat{z}$. Derive the magnetic part of the energy and entropy and investigate your answer in the limits of high and low temperatures. *Bonus*: The same for the magnetic part of the specific heat.

3. 2 moles of an ideal gas, initially in a state given P_0 and V_0, are contracted adiabatically to a volume of $V_0/8$. This gas is then isothermally expanded to a volume of $V_0/2$ and which point its pressure is $2^{11/5}P_0$.

   (a) Is the gas monatomic, diatomic, or polyatomic?

   (b) What fraction of the initial internal energy of the gas is the final translational kinetic energy?