

Physics 540: Statistical Mechanics I

Read: LL 9, 11-16

Problems to study: K.1 ex 2

“LL 1” means section 1 from Landau and Lifshitz book

“K.1 ex 2” means example 2 from section 1 of Kubo’s book.

Homework 2

Exercise 1

Using the ideal gas expression for entropy (see K.1 ex 2)

$$S(E, V, N) = N \left\{ \log \frac{V}{N} + \frac{3}{2} \log \frac{2E}{3N} + \log \frac{(2\pi m)^{3/2} e^{5/2}}{h^3} \right\}$$

- find $E(S, V, N)$ and derive T, P from it;
- find the free energy $F(T, V, N) = E - TS$ and derive S, P from it;
- What is the equation of state of an ideal gas? What is the condition for an adiabatic process for an ideal gas in terms of variables T and V ?
- find specific heats C_V and C_P for an ideal gas from $C_V(T, V) = T \left(\frac{\partial S}{\partial T} \right)_V$ and $C_P(T, P) = T \left(\frac{\partial S}{\partial T} \right)_P$.

Exercise 2

Derive the following general relation between specific heats C_P and C_V :

$$C_P - C_V = -T \frac{[(\partial P / \partial T)_V]^2}{(\partial P / \partial V)_T}$$

(see LL 16). Check it for the particular case of classical ideal gas.