

Statistical Physics B

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Mateusz Homenda, room 5.26

mateusz.homenda@fuw.edu.pl

1. **Exercise 1:** (Chapter 3.8 Pathria) Derive the formula for free energy and internal energy of a one dimensional system containing N atoms treated as:

- (a) classical harmonic oscillators
- (b) quantum harmonic oscillators

Comment the differences between these models.

2. **Exercise 2:** (Ex 3.7 Pathria) Prove that:

$$C_p - C_V \geq 0$$

3. **Exercise 3:** (Ex 3.13 Pathria) Evaluate the partition function of an ideal gas consisting of two species of molecules with masses: m_1 and m_2 .
4. **Bonus Exercise:** (Ex 3.15 Pathria) Extreme relativistic gas $\epsilon = pc$ in canonical ensemble. Calculate the partition function Q_N , equation of state, internal energy and derive the expression for density of states.