

Physics 540: Statistical Mechanics I

Read: LL 53-58

Problems to study: K.4 pr 3

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

“K.1 pr 2” means problem 2 from section 1 of Kubo’s book.

Homework 9

Exercise 1

Calculate quantum corrections to c_p , $c_p - c_v$, and to isothermal compressibility $\kappa \equiv -\frac{1}{V} \left(\frac{\partial V}{\partial P} \right)_T$ of a Boltzmann gas in the first order in N/V . Consider both Fermi and Bose statistics of elementary particles.

Exercise 2

Liquid He³ has 46.2 \AA^3 volume per atom. Considering it an ideal Fermi gas, calculate its Fermi momentum, Fermi energy, and heat capacity c_v at $T = 0.01 K$. Compare c_v to the classical ideal gas under the same conditions: explain the difference.

Exercise 3

A neutron star has a mass of 0.6 of that of the Sun and the radius of $15 km$. Assuming that neutrons near the surface form an ideal Fermi gas in the field of constant gravity, find

- the height of the atmosphere,
- the density as a function of height from the surface,
- consider the effect of the non-zero temperature $T = 1 keV$ on the atmosphere profile.