

## Exercises in Statistical Mechanics

Based on course by Doron Cohen, has to be proofed  
*Department of Physics, Ben-Gurion University, Beer-Sheva 84105, Israel*

This exercises pool is intended for a graduate course in “statistical mechanics”. Some of the problems are original, while other were assembled from various undocumented sources. In particular some problems originate from exams that were written by B. Horovitz (BGU), S. Fishman (Technion), and D. Cohen (BGU).

### ===== [Exercise 3230]

#### Heat Capacity of He4 system, energy gap

The specific heat of  $He^4$  at low temperatures has the form

$$C_v = A(T) + B(T)e^{-\Delta/T}$$

This is explained by the having a dispersion relation that give rise to long wavelength phonons  $\omega = c|\mathbf{k}|$  and short wavelength rotons  $\omega(k) = \Delta + b(|\mathbf{k}| - k_0)^2$ , where  $k_0 = 1/a$  is comparable to the mean interparticle separation.

- (a) Find explicit expressions for the coefficients  $A(T)$  and  $B(T)$
- (b) What would be the power in the  $T$  dependence of the coefficients if the the system were two dimensional?