

Statistical Mechanics and Thermodynamics

Homework for Week 2

Due Wednesday, 22 January, 2003

Reading: K&K chapter 2; start chapter 3. Fermi touches briefly on the statistical definition of entropy in §13. Much of Mandl chapter 2, including the problems, is relevant this week. These problems and their solutions, worked in an appendix, may help with the problems in K&K.

1. K&K 2.1

2. K&K 2.2

3. K&K 2.3

4. *This draws on the beginning of K&K chapter 3.* Consider the non-interacting two-level system with just four classical spins. Turn on a magnetic field, and suppose the difference in energy for one spin between \uparrow and \downarrow is u , with \downarrow having the lower energy. (a) For a general temperature T , what is the probability that the system has exactly two spins up and exactly two spins down? *At $T = 0$, the answer is zero, since the configuration then is definitely $\downarrow\downarrow\downarrow\downarrow$; at $T = \infty$, all microstates are equally likely, so the answer is $\frac{1}{16} \binom{4}{2} = 3/8$.* (b) Also for general T , what is the thermal average total energy, taking the ground-state energy as zero?