

## Homework Problems

1. Estimate the kinetic energy of the air in our classroom, Phys 240A.
2. Given a partition function

$$Z = \sum_i e^{-\beta E_i} \quad (63)$$

of a system, prove that the entropy  $S$  can be written as

$$S = -k_B \sum_i p_i \log p_i = -\beta^2 k_B \frac{\partial \log Z}{\partial \beta} \frac{1}{\beta}. \quad (64)$$

Here,  $p_i$  is the probability that the system is in the state with energy  $E_i$ .

3. From the partition function given in lecture, calculate the energy and entropy of the 1D Ising Model with  $N$  lattice sites. What is the entropy at  $T = \infty$  ( $\beta = 0$ ), in the limit that  $N \rightarrow \infty$ ? What does this mean for the number of states that contribute at  $T = \infty$ ? What is the entropy at  $T = 0$  ( $\beta = \infty$ )? What states can exist and how many are there?