Problem 1.   Ideal gas in one and two dimensions

- Use methods of partition functions to find the free energy, energy, pressure, and entropy in one and two dimensions. Compare your result to the 3D case.

Problem 2.   Degeneracy

Often there may be more than one quantum mechanical state with the same energy level E_ℓ – this is known as degeneracy. A very common source of degeneracy is the quantum mechanical spin. If the energy is independent of the spin, then there will be two quantum mechanical states with the same energy level E_ℓ (one with spin up and one with spin down), and the degeneracy of the energy level is two, $g_\ell = 2$. In the partition function we sum over *states*, which is clearly related to the sum over energy levels as follows:

$$\sum_{\text{states}} e^{-E_s/k_B T} = \sum_{\text{energy−levels}} g_\ell e^{-E_\ell/k_B T} \tag{1}$$

where g_ℓ is the degeneracy of the ℓ-th energy level.

(a) Do problem Blundell, 21.4

Problem 3.   Blundell 21.6

Hint: Approximate the sum by an integral.