Many Particle Systems – Practice Problem Set 3

These problems are not for assessment. However, it is recommended that you attempt them as practice for the test and exam.

1. A hypothetical system has only four possible energy eigenstates, with energies of $-1, 0, 0$ and $+1$ (in units of 10^{-20} Joule). Determine the probability that the system occupies a state with zero energy when it is in contact with a heat reservoir with temperature $T = 200\text{K}$.

2. A hypothetical particle has only four possible energy eigenstates, with energies of $-a, 0, 0$ and $+a$ (where $a > 0$ is a constant with units of energy).

   (a) If the particle is in contact with a heat reservoir at temperature T, give an expression for the probability that the particle occupies a state with zero energy.

   (b) Now consider two such particles which make up an isolated system (i.e. no energy exchange between the particles and their environment) with a total energy $+a$. Assume the particles are distinguishable, labelled A and B. What is the probability that particle A is in an energy eigenstate with energy $+a$.