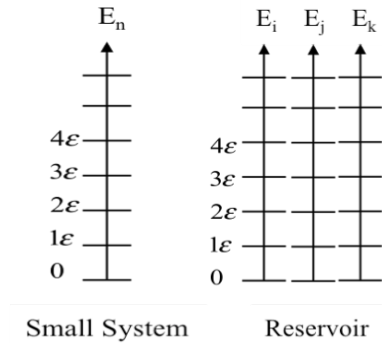


1. Consider a small system containing one oscillator that is brought into thermal contact with a larger system (“Reservoir”) consisting of three oscillators:

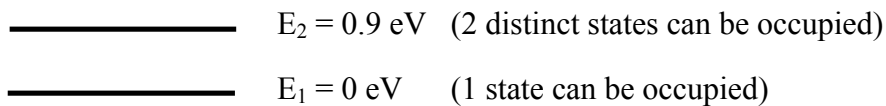


The total energy of the system $U \equiv E_n + E_i + E_j + E_k = 3\epsilon$.

a) [5 points] What is the probability to find the *small system* with 1ϵ of energy?

b) [5 points] What is the total entropy S given this energy for the *small system*?

2) Consider a molecule that has 2 energy levels as shown below:



In this particular molecule, the *excited state* is “doubly-degenerate” (i.e. there are two distinguishable states with energy E_2 , each of which can be occupied)

a) [5 points] What fraction of the molecules will have energy E_2 when $T = 5500 \text{ K}$?

b) [5 points] What is the entropy S of an ensemble of *1 million* of such molecules at very high temperatures (i.e. as $T \rightarrow \text{infinity}$) assuming they are all distinguishable?