1. Consider a molecule with 5 energy levels $\varepsilon_i=\{0,1,2,3,4\}$ and $g_i=\{1,1,3,4,4\}$.
(a) Find all the possible macrostates for the state: N=5, E=10. Find the number of microstates for each macrostate. Assume that only one molecule can occupy a given level (Fermi-Dirac Statistic).
(b) Answer the above problem for N=5, E=20.
(c) Answer the above problem for N=10, E=20.
(d) Note the particular macrostate with maximum number of microstates for each of the states given above in (a), (b), and (c). Assume that they represent the equilibrium distribution of molecules in those energy levels. Explain why the molecules choose to arrange in that manner for the given change in N or E.

2. Solve the problem 1 for a molecule with 5 energy levels $\varepsilon_i=\{0,1,2,3,4\}$ and $g_i=\{2,2,2,2,2\}$. Explain the difference in the equilibrium states based on the changes in degeneracies.

3. Solve Problem 1 for Bosons.

4. Derive the macrostate (N_j's) with the maximum number of microstates, for a Fermion.