Section B. Statistical Mechanics and Thermodynamics

1. **Atomic/Molecular Gas**

   Consider a dilute gas of identical spinless atoms of mass m. They move nonrelativistically at temperature T. There is a very short range attraction between atoms that has only one bound state (a diatomic molecule) with binding energy Δ; no molecules of more than two atoms are bound. The total number density of atoms including those in molecules is n.

   Calculate the equilibrium equation of state for the pressure of this gas, assuming the gas remains dilute enough so that the motion of the atoms and molecules can be treated classically, although the binding of atoms to form molecules is necessarily quantum. Analyze your result in the two limits of: (a) weak, and (b) strong binding to show (and to check) that it agrees with simple arguments in these limits.