

Assignment 8

1. If the excitation energy of a certain molecule is 0.1 eV, at what temperature will 1% of these molecules be in the excited state?
2. The mass of an average air molecule is about 5×10^{-26} kg. Assuming the temperature is a constant 275 K at all altitudes and that the gravitational acceleration is a constant 9.8 m/s^2 , at what altitude would you expect to find the air density to be half that at sea level?
3. A certain liquid at room temperature has Avogadro's number of molecules each having spin 1 (i.e. angular momentum quantum number equals 1) and the magnetic moment of each molecule is one Bohr magneton μ_B . In quantum mechanics it is learned that a spin 1 particle may have only three discrete values for the z component of its magnetic moment: $+\mu_B$, 0 and $-\mu_B$.
 - a) What is the probability that a molecule will be in each of the three possible alignments?
 - b) What will be the average magnetic moment of one molecule when $\mu_B B / k_B T \ll 1$?
 - c) What will be the magnetic moment of the entire liquid?