Physics 390: Homework set #5

Due Friday March 16, 2007

Reading: Tipler & Llewellyn, Chapter 8 (1-5), Chapter 9 (4-6), Chapter 10 (2-8)

Questions:

1. It is generally more convenient whenever possible to use the Maxwell-Boltzmann distribution, rather than quantum statistics. Under what conditions can quantum systems be described by classical statistics?

2. Estimate the mean kinetic energy of the "free" electrons in a metal if they obeyed Maxwell-Boltzmann statistics. How does this compare with the actual result from applying Fermi-Dirac statistics? Why is there such a difference?

3. Three identical, indistinguishable particles are placed into a system consisting of four energy levels with energies 1.0, 2.0, 3.0, and 4.0 eV, respectively. The total energy of the three particles is 6.0 eV. What is the average number of particles occupying each energy level, if those particles are (a) bosons, or (b) fermions?

Problems: Chapter 8:   15, 22, 33[1], 45[2]
Chapter 9:   27, 35, 38
Chapter 10:   12, 17, 22, 26

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[1] Solution in book is incorrect

[2] Print error in book. f_i should read as $f_i = C\, e^{-E_i/kT}$