Physics 410 - 2003

Thermal Physics

Problem Set 3

1. Problem 2, Chapter 2 (4 pt)

2. Consider a harmonic oscillator with mass m and angular frequency ω. (a) Plot the classical trajectory of the oscillator in phase space (p, x) (1 pt); (b) Find the phase volume $\Gamma_0(E)$ for all energies $\leq E$ (3 pt); (c) Find the total number of quantum states with energies $\leq E$ assuming that $E \gg \hbar\omega$. Compare the result with $\Gamma_0(E)/2\pi\hbar$ (2 pt)

3. Solve the previous problem for a 1-dimensional particle in a potential box of size L. (6 pt total)

4. N molecules of an ideal gas are placed in a container of volume V and come to thermal equailibrium. Let a number of these molecules, n, occupy volume v. Assume that $v \ll V$ and $n \ll N$. (a) Find the average $\langle n \rangle \equiv \bar{n}$ for given v (2 pt); (b) Find the probability distribution $P(n)$(4 pt); (c) Analyze the form of this distribution for large N, n (3 pt)

You need to have 20 points out of 25 (5 points are extra credit).