Physics 410 - 2004

Thermal Physics

Problem Set 3

1. Consider a particle of mass m confined in a one-dimensional potential box with walls at $x = 0$ and $x = L$. (a) Plot a classical trajectory of the particle in phase space (p, x); (2 pt) (b) Find the phase volume

$$\Gamma_0(E) = \int_{E(p,x)<E} dp\, dx$$

(here, $E(p, x)$ is the classical energy of a particle with coordinate x and momentum p) (2 pt); (c) Find the total number of quantum states with energies $\leq E$ assuming that $E \gg \hbar^2/2mL^2$. Compare the result with $\Gamma_0(E)/2\pi\hbar$ (3 pt)

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

3. Problem 1, Chapter 2 (5 pt)

4. Problem 5, Chapter 2 (6 pt)

You need to have 25 points