KFUPM
Department of Physics
Phys530

Homework # 2

Due on Sunday, October 29, 2006

Problem 1

Problem 1.8 from your textbook.

Problem 2

Consider a system of N one-dimensional non-interacting identical harmonic oscillators.

(a) Write the density function of the phase space that corresponds to a canonical ensemble in terms of q_i's and p_i's.

(b) Show that this ensemble is stationary by writing ρ and H in terms of the generalized coordinates and evaluating the Poisson bracket [ρ,H].

(c) Show that you can write the Hamiltonian as

$$H = \frac{1}{2}\sum_{i=1}^{N}(q_i \frac{\partial H}{\partial q_1} + p_i \frac{\partial H}{\partial p_1}).$$

By evaluating $< H >$, prove the equipartition theorem which states that each harmonic term in the Hamiltonian makes a contribution of $\frac{kT}{2}$ towards the internal energy of the system ($< H >$).

Problem 3

Problem 2.6 from your textbook (Pathria). Note for a simple pendulum, θ is small.

Problem 4

Problem 2.7 from your textbook (Pathria). (Use classical limit where the energy quantum is much smaller than the mean energy per oscillator)

Problem 5

Problem 2.9 (a) from your textbook. Part (a) only.