

Physics 162a, Fall 2009 – Problem Set 5

Due in class Monday, Nov. 2

1. Compute the partition function, entropy, and average energy for the simple harmonic oscillator in the canonical ensemble.

2. For the Hamiltonian

$$H = \frac{p^2}{2m} + \lambda_n x^n \quad (1)$$

use a scaling argument to find the characteristic length and energy scale for low-lying energy eigenstates.

3. Baym, chapter 5, problem 4. There is a sign error in the definition of D in part (c). Note that for an inhomogeneous differential equation

$$D_t x(t) = F(t) \quad (2)$$

where D_t is a differential operator (such as $\frac{d^2}{dt^2} + f(t)\frac{d}{dt} + g(t)$), the Green function G is a solution to the equation

$$D_t G(t, t') = \delta(t - t') \quad (3)$$

Given G , a solution to the inhomogeneous equation is:

$$x(t) = \int_{-\infty}^{\infty} dt' G(t, t') F(t') \quad (4)$$

One must impose correct boundary conditions on G . In this case, if we want $x(t)$ to depend only on the values of $F(t')$ for $t' < t$ (so that the problem is causal), we require $G(t, t') = 0$ when $t < t'$.

4. Sakurai, problem 2.16.