Physics 448 **HOMEWORK SET 2** **Fall 2008**

Due Wednesday September 17

6) Gasiorowicz Problems 1-3 and 1-4.

7) The table below gives measurements of the specific heat (in J/mole · K) of Be as a function of T (in K). Use these data to estimate the energy spacing, ϵ, between the vibrational states of the atoms. Make a plot comparing the measurements with the prediction obtained from the Einstein theory using your value of ϵ.

T :	50	70	100	150	200	250	300	400	500	600	800	1000
C_v :	0.17	0.50	1.80	5.70	10.1	13.8	16.4	20.0	22.0	23.4	25.4	27.2

8) Gasiorowicz Problem 1-9.

9) Find the binding energy and the orbit radius of the lowest state of "muonic helium" consisting of a $^4\text{He}^{++}$ nucleus ($m = 3727$ MeV/c^2) and a muon ($m = 105.66$ MeV/c^2).

10) Use the methods and assumptions of the Bohr model to predict the energy levels of the circular orbits of a mass m in a 3-dimensional harmonic oscillator potential ($V = \frac{1}{2}kr^2$; $\vec{F} = -k\vec{r}$).

11) Consider a macroscopic "hydrogen atom" consisting of a ball of mass $m = 1$ g orbiting a second ball of infinite mass. The balls carry equal and opposite charges $q = \pm 10^{-4}$ C.

(a) Find the energy of the ground state ($n = 1$) of the system.

(b) Find the approximate value of n for a circular orbit of radius $r = 10$ cm.

(c) According to classical physics this system should emit electromagnetic waves of frequency $\nu = f_{\text{orbit}} = v/2\pi r$. Calculate f_{orbit} and compare your result with the Bohr model prediction for the frequency of the radiation obtained in the transition from state n to state $n-1$.