

PHYSICS 210A, HOMEWORK ASSIGNMENT #3

May 07, 2009

1. Solve Problem 6.3 of the text.
2. Solve Problem 7.2 of the text --- verify the quoted values of only the first three virial coefficients a_1 , a_2 and a_3 !
- 3, 4 & 5. Solve Problems 7.3, 7.6 and 7.11 of the text.
6. Consider a Bose gas consisting of N identical particles trapped in a magnetic field such that they behave like 'simple harmonic oscillators'. The energy of any one of them is given by

$$\epsilon = \frac{p^2}{2m} + \frac{1}{2} m \omega^2 r^2,$$

which means that they all are vibrating with the same angular frequency ω .

- (a) Show that this gas undergoes the phenomenon of Bose-Einstein condensation at a temperature T_c , where

$$T_c = \frac{\hbar \omega}{k} \left(\frac{N}{1.202} \right)^{1/3}.$$

- (b) Next, determine the manner in which the condensate fraction, N_0/N , in this gas varies with T .
- (c) Finally, examine the specific heat C_V of this gas --- both above T_c and below T_c --- and show that, at $T = T_c$, C_V undergoes a *jump discontinuity* of magnitude $6.577 Nk$.