PHYSICS 210A, HOMEWORK ASSIGNMENT #1 April 09, 2009

1. Solve Problem 1.4 of the text and follow it up with Problem 3.23.

2. In continuation of this, consider the following extension:

$$u(r) = \begin{cases} \infty & \text{for } r < \sigma \\ -u_0 (\sigma/r)^6 & \text{for } r \geq \sigma, \end{cases}$$

where $(u_0 / kT) << 1$. Show that the equation of state now takes the form of the van der Waals equation of state

$$\left(P + \frac{a}{v^2}\right)(v - b) = kT,$$

where $v\ (= V/N) >> \sigma^3$, while constants a and b are certain functions of the parameters u_0 and σ.
Evaluate a and b in terms of u_0 and σ.

3. Solve Problem 2.7 of the text.
[Hint: For part (i), you may get some help from pages 70-71 of the text.
For part (ii), you'll have to use for the energy of the oscillator the *classical* expression

$$\varepsilon = \frac{p_x^2}{2m} + \frac{1}{2} K x^2.$$

4. Solve Problem 3.15 of the text.
[In this connection, please do take a glancing look at Problem 6.10 as well --- which I am not asking you to do, but that problem does take care of a case much more general than either a non-relativitic gas or an extreme relativistic one!]

5. Solve Problem 3.29 of the text.
[Once again, take a good look at the next Problem, viz. 3.30, though (for now) I am not asking you to do it --- but one day I might!]