1. Calculate the leading small-T ($O(T^2)$) correction to Pauli's paramagnetism. Sketch the behaviour of $\chi(T)$ when $0 \leq T < \infty$ and show that $\chi(T \to \infty)$ approaches the Curie law.

2. Derive the following expressions for the virial coefficients in terms of cluster integrals b_l:

$$B_2 = -b_2 = \frac{1}{2}\int d\mathbf{r}[1 - e^{-\beta v(r)}] \quad (1)$$

$$B_3 = 4b_2^2 - 2b_3 \quad (2)$$

$$B_4 = -20b_2^3 + 18b_2b_3 - 3b_4 \quad (3)$$

   Calculate the 2nd virial coefficient for a gas of hard spheres ($v(r < d) = \infty$, $v(r \geq d) = 0$) and a gas with a hard core and attractive "box"-potential $v(r < d) = \infty$, $v(d \leq r < R) = -a$, $v(r \geq R) = 0$.

3. Consider 1-dimensional gas of hard "spheres", diameter d. N particles are moving along a line of length L. Determine the equation of state in the thermodynamic limit $N \to \infty$, $L \to \infty$ and $N/L =$ constant. Does the system have phase transitions?

4. (*Extra if you have time:*) Calculate the isothermal compressibility $\kappa_{T,N}$ and and heat expansion coefficient $\alpha_{p,N}$ of low-temperature almost-degenerate fermi gas. What is C_p?