1) A volume $V$ at temperature $T$ contains $N$ spin-0 bosons of mass $m$. 
(a) Compute $N$ and the energy $U$ as functions of the chemical potential $\mu$. Use this result to determine the critical temperature $T_c$ at which a Bose condensate emerges. (b) Find $N$ and $U$ below $T_c$ and approximate $U(N, V, T)$ in the low temperature limit.

2) The partition function and equation of state for the van der Waals gas model are given in the notes. (a) Determine the constants $a$ and $b$ appearing in the equation of state in terms of $T_c$, $P_c$ and $V_c$. (b) Find the energy $U$ and the heat capacity $C_V = \left(\frac{\partial U}{\partial T}\right)_V$, also in terms of $T_c$, $P_c$ and $V_c$.

3) (a) Find the mass density for a white dwarf in terms of fundamental constants (e.g., particle masses, $\hbar$) and the total mass of the star, $M$. Use this result to find a relation between the total mass and the radius. (b) Find the mass density for a neutron star in terms of fundamental constants (e.g., particle masses, $\hbar$) and the total mass of the star, $M$. Use this result to find a relation between the total mass and the radius. (c) Estimate the maximum mass of a white dwarf and the maximum mass of a neutron star.