1. Derive the barometric formula for an extended atmosphere with $\Delta r/R$ not small. Start from the general hydrostatic equation $dP/dr = -\rho(r)g(r)$, $g(r) = GM/r^2$. Assume $(1/\rho)(d\rho/dr) \gg (1/T)(dT/dr)$.

   a) Discuss the solution for $\Delta r/R \ll 1$ and demonstrate how it approaches the plane-parallel solution in this limit.

   b) Discuss the solution for $\Delta r/R \gg 1$. Why is the solution in this limit unreasonable? What is the explanation for this behavior? (4 points)

2. Derive the density stratification for the hydrodynamic case with a spherically symmetric stellar wind outflow velocity field $v(r)$ for radii $r \geq r_1$, where $v(r) >> v_{\text{esc}}(r) >> v_{\text{sound}}$. Assume constant temperature. Discuss the solution relative to the solution in 1b). (3 points)

3. Consider an atmosphere with a pressure scale height $H$ of the order of the stellar radius $R$, i.e. $H/R \sim 1$. Find a simple physical argument, why such an atmosphere can’t be in hydrostatic equilibrium. (3 points)

Please return homework at Tuesday, January 26 lecture.