# Class problems #7

1. Find relativistic and non-relativistic limits for equilibrium number density ($n$), energy density ($\rho$) and pressure ($p$) as a function of temperature for fermions and bosons.

2. Derive an exact expression for the number of relativistic degrees of freedom and reproduce (discuss) qualitatively fig. 1 from the lecture notes #5, in particular show that for $T \gg 100$ MeV ($T \gtrsim 10^6$ MeV) $g_\star = 106\frac{3}{4}$, for $T \ll 1$ MeV ($T \lesssim 10^{-1}$ MeV) $g_\star = 3.36$, while for $10^2$ MeV $\gtrsim T \gtrsim 1$ MeV $g_\star \simeq 10\frac{3}{4}$. Verify tables 1 and 2 from the lecture notes.

3. Derive

$$p_i(T) = g_i \int \frac{|\vec{p}|^2}{3E_i(\vec{p})} f_i(\vec{p}, T) \frac{d^3p}{(2\pi)^3},$$

which is eq.(4) of the lecture notes.