Problem:

Show that the difference between the number densities of electrons and positrons in the relativistic limit $(m_e << T)$ is:

$$n_e - \bar{n}_e = \frac{gT^3}{6\pi^2} \left[\pi^2 \left(\frac{\mu_e}{T} \right) + \left(\frac{\mu_e}{T} \right)^3 \right],$$

where μ_e is the chemical potential (note that antiparticles have opposite chemical potentials).

Hint: You may use that

$$\int_0^\infty dy \frac{y}{e^y + 1} = \frac{\pi^2}{12}$$