This quiz is closed-note, and closed-book.

1. (10 pts) Consider a two-dimensional gas of photons at a temperature T, alongside a two-dimensional gas of massless electrons at the same temperature. For both cases, assume there is zero chemical potential, and note that there are two spin states for each species. DERIVE the ratio of the pressures, $P_{\text{electrons}}/P_\gamma$.

2. (10 pts) It was shown in lecture that the excitation energy for a Fermi gas of fixed particle number behaved at low temperature as

$$\frac{E^*}{V} = \frac{\pi^2 T^2}{6V} D(\epsilon_f) = \kappa T^2.$$

For a gas of electrons, find an expression for κ in terms of the electron mass m and the electron number density ρ.