Tarefa 3: Derive as seguintes passagens:

$$N = \frac{V_{\mathbf{r}}}{2\pi^2}\left(\frac{2m^*}{\hbar^2}\right)^{\frac{3}{2}} \int_0^\infty \frac{\varepsilon^{\frac{1}{2}}}{\left(e^{(\varepsilon-\mu)/k_B T}+1\right)} d\varepsilon \;\xrightarrow{\mu \gg k_B T}\; \boxed{\mu \approx \varepsilon_F\left(1-\frac{\pi^2 (k_B T)^2}{12\mu^2}\right)}$$

- Dicas: use a expansão de Sommerfeld, a definição de ε_F e expansão de polinômio.

$$\int_0^\infty \frac{x^j}{\left(e^{(x-x_0)}+1\right)} dx \approx \frac{x_0^{j+1}}{j+1}\left(1+\frac{\pi^2 j(j+1)}{6x_0^2}+\mathcal{O}(x_0^{-4})\right)$$

$$\varepsilon_F = \left(\frac{\hbar^2 (3\pi^2)^{\frac{2}{3}}}{2m^*}\right) n^{\frac{2}{3}}$$

$$(1+x)^n \approx 1+nx \text{ para } (x \ll 1)$$