

Thermal Physics Exam 2 FORMULAS

$$\begin{aligned}
f(\varepsilon) &= \lambda \exp(-\varepsilon/\tau) & \lambda &= \frac{N}{\sum \exp(-\varepsilon_{\mathbf{n}}/\tau)} & \varepsilon_{\mathbf{n}} &= \frac{\hbar^2}{2M} \left(\frac{\pi n}{V^{1/3}} \right)^2 \\
\sum_{\mathbf{n}} \exp(-\varepsilon_{\mathbf{n}}/\tau) &= \frac{1}{2}\pi \int d\mathbf{n} n^2 \exp(-\varepsilon/\tau) & \lambda &= \frac{N}{n_Q V} & n_Q &= \left(\frac{M\tau}{2\pi\hbar^2} \right)^{3/2} \\
\mu &= \tau \ln(n/n_Q) & F &= \int dN \mu(N, \tau, V) = N\tau[\ln(n/n_Q) - 1] \\
p &= - \left(\frac{\partial F}{\partial V} \right)_{\tau, N} = N\tau/V & \varepsilon_F &= \frac{\hbar^2}{2M} \left(\frac{3\pi^2 N}{V} \right)^{2/3} & U_0 &= \frac{3}{5} N \varepsilon_F \\
\mathcal{D}(\varepsilon_F) &= \frac{3N}{2\varepsilon_F} & C_{el} &= \frac{1}{3}\pi^2 \mathcal{D}(\varepsilon_F)\tau \approx N\tau/\tau_F & N_e/N &= 2.612 n_Q/n \approx (\tau/\tau_E)^{3/2} \\
\tau_E &= \frac{2\pi\hbar^2}{M} \left(\frac{N}{2.612V} \right)^{2/3} & f(\varepsilon) &= \frac{1}{1 + \exp[(\varepsilon - \mu)/\tau]} & n_e - n_h &= \Delta n \\
n_{c,v} &= 2 \left(\frac{m_{e,h}^* \tau}{2\pi\hbar^2} \right)^{3/2} & n_e &= n_c \exp(-[(\varepsilon_c - \mu)/\tau]) & n_e &= n_v \exp(-[(\mu - \varepsilon_v)/\tau]) \\
n_e n_h &= n_i^2 = n_c n_v \exp(-\varepsilon_g/\tau) & \varepsilon_g &= \varepsilon_c - \varepsilon_v \\
E &= \left(\frac{2e}{\epsilon} \frac{n_a n_d}{n_a + n_d} [(|V| + V_{bi}) - 2\tau/e] \right)^{1/2} \\
\mathbf{J}_n &= e\tilde{\mu}_e n_e \mathbf{E} + eD_e \mathbf{grad} n_e & \mathbf{J}_p &= e\tilde{\mu}_h n_h \mathbf{E} + eD_h \mathbf{grad} n_h \\
D_e &= \tilde{\mu}_e \tau / e & D_h &= \tilde{\mu}_h \tau / e \\
\tilde{Q} &= \tau d\sigma & \eta_C &= (\tau_h - \tau_\ell)/\tau_h \geq W/Q_h & \gamma_C &= \tau_\ell/(\tau_h - \tau_\ell) \geq Q_\ell/W \\
F &= U - \tau\sigma & G &= U - \tau\sigma + pV \\
\left(\frac{\partial G}{\partial \tau} \right)_{N,p} &= -\sigma & \left(\frac{\partial G}{\partial p} \right)_{N,\tau} &= V & \left(\frac{\partial G}{\partial N} \right)_{\tau,p} &= \mu \\
G(\tau, p, N) &= N\mu(\tau, p) & \Pi n_j^{\nu_j} &= K(\tau)
\end{aligned}$$