Cheat Sheet

Constants

$$\begin{split} N_A &= 6.02 \times 10^{23} \text{ molecules/mole} \\ k &= 1.38 \times 10^{-23} \text{ J/K} \\ &= 8.62 \times 10^{-5} \text{ ev/K} \\ q &= 1.60 \times 10^{-19} \text{ C} \\ m_0 &= 9.11 \times 10^{-31} \text{ kg} \\ \epsilon_0 &= 8.85 \times 10^{-14} \text{ F/cm} \\ h &= 6.63 \times 10^{-34} \text{ Js} \\ &= 4.14 \times 10^{-15} \text{ eVs} \\ kT &= 0.0259 \text{ eV} \\ c &= 2.998 \times 10^{10} \text{ cm/s} \\ \mathring{\mathbf{A}} &= 10^{-8} \text{ cm} \\ 1 \text{ eV} &= 1.6 \times 10^{-19} \text{ J} \end{split}$$

Formulas

$$egin{aligned} p &= mv = \hbar ec{k} = rac{h}{\lambda} \ E &= hv = \hbar \omega \ E &= rac{1}{2} m v^2 = rac{1}{2} rac{p^2}{m} = rac{\hbar}{2m^*} ec{k}^2 \ m^* &= rac{\hbar^2}{rac{d^2E}{dk^2}} \ E_N &= KE + PE = E_c + E(k) = -rac{mq^4}{K^2 n^2 \hbar^2} \end{aligned}$$

	Classical Mechanics	Quantum Mechanics
Position	x	x
Momentum	p=mv	$\frac{\hbar}{j} \frac{\partial}{\partial x}$
Energy	$E=KE+PE=rac{1}{2}mv^2+PE$	$-rac{\hbar}{j}rac{\partial}{\partial t}$

$$egin{aligned} \langle Q
angle &= \int \limits_{-\infty}^{\infty} \psi^* Q_{op} \psi \ dec{x} \ Eg(x) &= \int \limits_{-\infty}^{\infty} g(x) P(x) dx \end{aligned}$$

n: extra electrons

p :extra holes

$$f(E)=rac{1}{e^{(E-E_F)/kT}+1}pprox e^{(E_F-E)/kT}
onumber \ n_0=N_cf(E_C)$$

$$egin{aligned} N_c &= 2(rac{2\pi m_n^*kT}{h^2})^{3/2} \ N_v &= 2(rac{2\pi m_p^*kT}{h^2})^{3/2} \ p_0 &= N_v f(E_v) \ n_i &= N_c e^{-(E_C-E_i)/kT} = \sqrt{N_c N_v} e^{-E_g/2kT} \ p_i &= N_v e^{-(E_i-E_C)/kT} \ E &= rac{mq^4}{2K^2\hbar^2} \end{aligned}$$

Equilibrium

$$egin{aligned} n_0 &= n_i e^{(E_F-E_i)/kT} \ p_0 &= n_i e^{(E_i-E_F)/kT} \ n_0 p_0 &= n_i^2 \end{aligned}$$

Steady State

$$egin{aligned} n &= N_c e^{-(E_C - F_n)/kT} = n_i e^{(F_n - E_i)/kT} \ p &= N_v e^{-(F_p - E_v)/kT} = n_i e^{(E_i - F_p)/kT} \ np &= n_i^2 e^{(F_n - F_p)/kT} \end{aligned}$$

Potential Well

$$\psi = A \sin K x \ K = rac{\sqrt{2mE}}{\hbar}$$

$$\psi_H = \sqrt{rac{2}{L}} \sin rac{nm}{L} x \ \psi_K(X) = U(k_x,x) e^{jKxX}$$