Equation Sheet

Please tear off this page and keep it with you

Equations and constants that *may* be helpful:

$$h = \frac{na}{A}, k = \frac{na}{B}, l = \frac{na}{C} \qquad E = \frac{\hbar^2 k^2}{2m^*} \qquad v = \frac{1}{\hbar}\frac{dE}{dk} \qquad m^* = \hbar^2 \left(\frac{d^2 E}{dk^2}\right)^{-1}$$

$$g_c(E) = \frac{4\pi}{h^3}\left(2m_n^*\right)^{3/2}\sqrt{E - E_C} \qquad g_v(E) = \frac{4\pi}{h^3}\left(2m_p^*\right)^{3/2}\sqrt{E_V - E} \qquad f(E) = \frac{1}{1 + e^{\left(\frac{E-E_F}{kT}\right)}}$$

$$n_0 = N_C e^{\left(\frac{-(E_C - E_F)}{kT}\right)} \qquad p_0 = N_V e^{\left(\frac{-(E_F - E_V)}{kT}\right)} \qquad N_C = 2\left(\frac{2\pi m_n^* kT}{h^2}\right)^{3/2} \qquad N_V = 2\left(\frac{2\pi m_p^* kT}{h^2}\right)^{3/2}$$

$$n_0 = n_i e^{\left(\frac{(E_F - E_{Fi})}{kT}\right)} \qquad p_0 = n_i e^{\left(\frac{(E_{Fi} - E_F)}{kT}\right)} \qquad n_i^2 = N_C N_V e^{\left(\frac{-E_g}{kT}\right)} = n_0 p_0$$

$$n_0 = \frac{N_d - N_a}{2} + \sqrt{\left(\frac{N_d - N_a}{2}\right)^2 + n_i^2} \qquad p_0 = \frac{N_a - N_d}{2} + \sqrt{\left(\frac{N_a - N_d}{2}\right)^2 + n_i^2}$$

$$E_{Fi} = \frac{E_C + E_V}{2} + \frac{3}{4}kT \ln\left(\frac{m_p^*}{m_n^*}\right) \qquad N_{C,V}(T) = N_{C,V \to 300K}\left(\frac{T}{300K}\right)^{3/2}$$

$$J_{drift} = \sigma E \qquad \sigma = e(\mu_n n + \mu_p p) = \frac{1}{\rho} \qquad \mu = \frac{e\tau_c}{m_c^*} \qquad J_{diff} = eD_n\frac{dn}{dx} - eD_p\frac{dp}{dx}$$

$$J = \frac{I}{A} \qquad V = IR \qquad \rho = \frac{RA}{L} \qquad \frac{D}{\mu} = \frac{kT}{e} \qquad \phi = -\frac{1}{e}\left(E_C - E_{ref}\right) \qquad E = \frac{1}{e}\frac{dE_{Fi}}{dx}$$

$$k = 8.62 x 10^{-5} eV/K = 1.38 x 10^{-23} J/K \qquad h = 4.14 x 10^{-15} eV\cdot s = 6.63 x 10^{-34} J\cdot s \qquad \hbar = \frac{h}{2\pi}$$

$$q = 1.602 x 10^{-19} C$$

Some potentially useful information for Si at T = 300 K: $N_c = 2.8 x 10^{19}$ cm^{-3}, $N_v = 1.04 x 10^{19}$ cm^{-3}, $n_i = 1.5 x 10^{10}$ cm^{-3}, $m_n^* = 1.08 m_0$, $m_p^* = 0.56 m_0$, $E_g = 1.12$ eV