$$m_p = 1.673 \times 10^{-27}\ \text{kg}^2 = 938.272\text{MeV/c}^2$$

$$m_n = 1.675 \times 10^{-27}\ \text{kg} = 939.566\text{MeV/c}^2$$

$$m_e = 9.109 \times 10^{-31}\ \text{kg} = 0.511\text{MeV/c}^2$$

$$\frac{-\hbar^2}{2m}\nabla^2\psi + V\psi = E\psi; \qquad \Delta p\Delta x \geq \hbar; \qquad \Delta E\Delta t \geq \hbar;$$

$$\lambda = \frac{2\pi}{k}; \qquad \lambda = \frac{h}{p};$$

$$T \approx 16\left(\frac{E}{V_0}\right)\left(1 - \frac{E}{V_0}\right)e^{-2k_2 a}$$

$$E = \frac{p^2}{2m} = \frac{k^2\hbar^2}{2m}$$

$$V_k = \left(\frac{\pi}{a}\right)^3$$

$$g_T(k)dk = \frac{k^2 dk}{\pi^2}a^3; \quad g_T(E)dE = \frac{4\pi a^3}{h^3}(2m)^{3/2}\sqrt{E}dE; \quad g(E) = \frac{4\pi(2m)^{3/2}}{h^3}\sqrt{E}$$

$$g_c(E) = \frac{4\pi(2m)^{3/2}}{h^3}\sqrt{E - E_c}; \qquad g_v(E) = \frac{4\pi(2m)^{3/2}}{h^3}\sqrt{E_v - E}$$

$$k_B = 1.381 \times 10^{-23}\ \text{J K}^{-1} = 8.617 \times 10^{-5}\text{eVK}^{-1}$$

$$f_F(E) = \frac{1}{1 + e^{\frac{E-E_F}{k_B T}}} \approx e^{\frac{-(E-E_F)}{k_B T}}\ if\ E - E_F >> k_B T$$

$$n(E) = g_c(E)f_F(E)$$

$$n_0 = \int_{E_c}^{\infty} g_c(E)f_F(E)dE$$

$$(E_c - E_F) >> k_B T \implies n_0 = N_c e^{\frac{-(E_c-E_F)}{k_B T}}; \qquad N_c = 2\left(\frac{2\pi m k_B T}{h^2}\right)^{3/2}$$

$$p(E) = g_v(E)[1 - f_F(E)]$$

$$p_0 = \int_{-\infty}^{E_v} g_v(E)[1 - f_F(E)dE$$

$$(E_F - E_v) >> k_B T \implies p_0 = N_v e^{\frac{-(E_F-E_v)}{k_B T}}; \qquad N_v = 2\left(\frac{2\pi m k_B T}{h^2}\right)^{3/2}$$

$$E_{Fi} - E_{midgap} = 3/4kT\ln(m * p/m * n)$$

$$n_i^2 = N_c N_v e^{-(E_c - E_v)/kT}$$