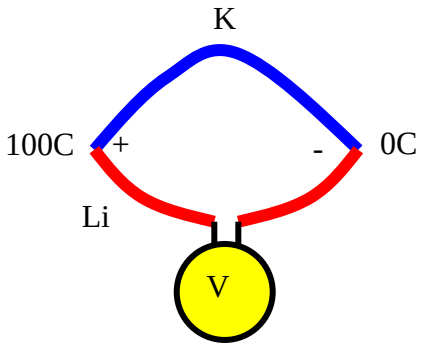
**Problem 1**

Using Eq 114 in the notes potential difference is

$$\Delta V = \int_{T_1}^{T_2} (Q_{Li} - Q_K) dT = -\frac{\pi^2 k_B^2}{3e} \int_{T_1}^{T_2} \left( \frac{x_{Li} T}{E_{F,Li}} - \frac{x_K T}{E_{F,K}} \right) dT =$$

$$-\frac{\pi^2 k_B^2}{6e} (T_2^2 - T_1^2) \left( \frac{x_{Li}}{E_{F,Li}} - \frac{x_K}{E_{F,K}} \right) = 3.6mV - 1.9mV = 1.7mV$$




**Problem 2.**
First find effective densities of states

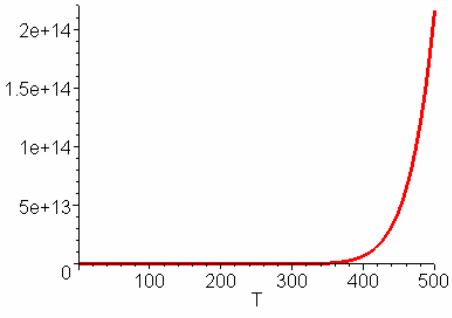
$$N_{c,v} = 2\left( \frac{m_{c,v} k_B T}{2\pi\hbar^2} \right)^{3/2} = 2\left( \frac{m_{c,v}}{m_0} \right)^{3/2} \left( \frac{0.025eV}{2\pi \cdot 7.62eV \cdot A^2} \frac{T}{300K} \right)^{3/2} = 0.253 \times 10^{20} \left( \frac{m_{c,v}}{m_0} \right)^{3/2} \left( \frac{T}{300K} \right)^{3/2} cm^{-3}$$

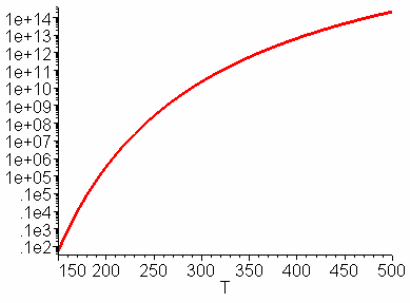
Substituting the density of states effective masses we obtain $N_c(T) = 2.88 \times 10^{19} (T/300K) cm^{-3}$, $N_v(T) = 3.10 \times 10^{19} (T/300K) cm^{-3}$,

The intrinsic carrier concentration is

$$n_i = \sqrt{N_c(T) N_v(T)} e^{\frac{-E_g}{2kT}} = \sqrt{2.88 \times 3.1} e^{-\frac{1.1}{.052}\frac{300K}{T} - 1.1/.052} \times 10^{19} cm^{-3}$$

$$= 3 \times 10^{-19} (T/300)^{3/2} e^{-21(300/T)}$$



Intrisnic Fermi level is at $\mathrm{E}_i - \mathrm{E}_g / 2 = \frac{3}{4} k_B T \ln\left(\frac{m_v}{m_c}\right) \approx 1meV \frac{T}{300K}$