LECTURE 3

Topics to be covered

- Wiedmann –Franz Law
- Comparision with Lorentz Law

The Wiedemann-Franz law

$$\frac{\kappa}{\sigma} = LT$$

$$\frac{\kappa}{\sigma} = constant$$

- Wiedemann and Franz found in 1853 that the ratio of thermal and electrical conductivity for ALL METALS is constant at a given temperature (for room temperature and above). Later it was found by L. Lorenz that this constant is proportional to the temperature.
- Let's try to reproduce the linear behaviour and to calculate L here.

The Wiedemann Franz law

$$\kappa = \frac{1}{3} v_t^2 \tau c_v$$

$$\sigma = \frac{n e^2 \tau}{m_e}$$

$$\frac{\kappa}{\sigma} = \frac{3}{2}\frac{k_B^2}{e^2} T = LT$$

the actual quantum mechanical result is

$$\frac{\kappa}{\sigma} = \frac{\pi^2}{3}\frac{k_B^2}{e^2} T = LT$$

this is 3, more or less....

Comparison of the Lorenz number to experimental data

at 273 K

metal	10^{-8} Watt Ω K^{-2}
Ag	2.31
Au	2.35
Cd	2.42
Cu	2.23
Mo	2.61
Pb	2.47
Pt	2.51
Sn	2.52
W	3.04
Zn	2.31

$$\frac{\kappa}{\sigma} = \frac{\pi^2}{3}\frac{k_B^2}{e^2}T = LT$$

L = 2.45 10^{-8} Watt Ω K^{-2}