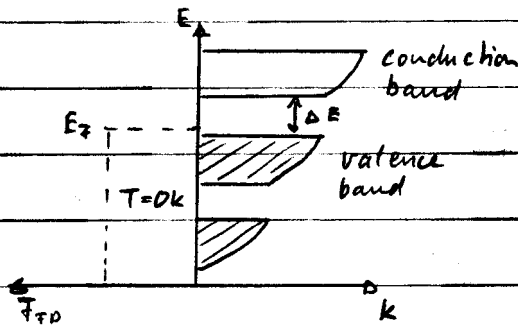


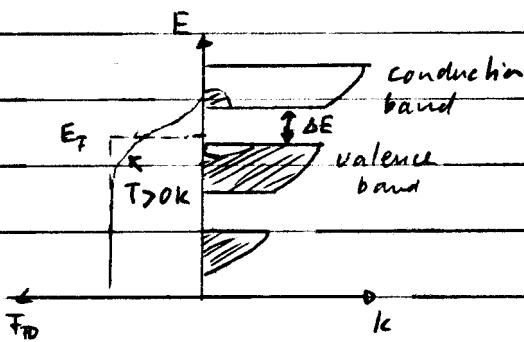
Insulators, Semiconductors, Conductors

Insulators:



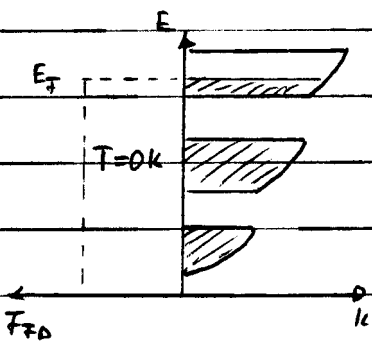
valence band is completely filled. Energy gap ΔE large ($\leq 7 \text{ eV}$) with $\Delta E \gg kT$. At high T , if $kT \approx \Delta E$ get some conductivity

Semiconductors:



no sharp distinction between insulator and semiconductor at $T > 0 \text{ K}$. Except ΔE is smaller with ΔE typically $\leq 1 \text{ eV}$. At high T , some electrons will be excited into valence band

Conductors:



Highest occupied band is only partially filled. At $T > 0 \text{ K}$ electrons can easily get into nearby empty energy levels.

$$\Delta E \ll kT \text{ for } T > 0 \text{ K}$$

Fermi-Dirac distribution:
$$F_{FD}(E) = \frac{1}{e^{(E-E_F)/kT} + 1}$$

and
$$\Delta E = E - E_F$$