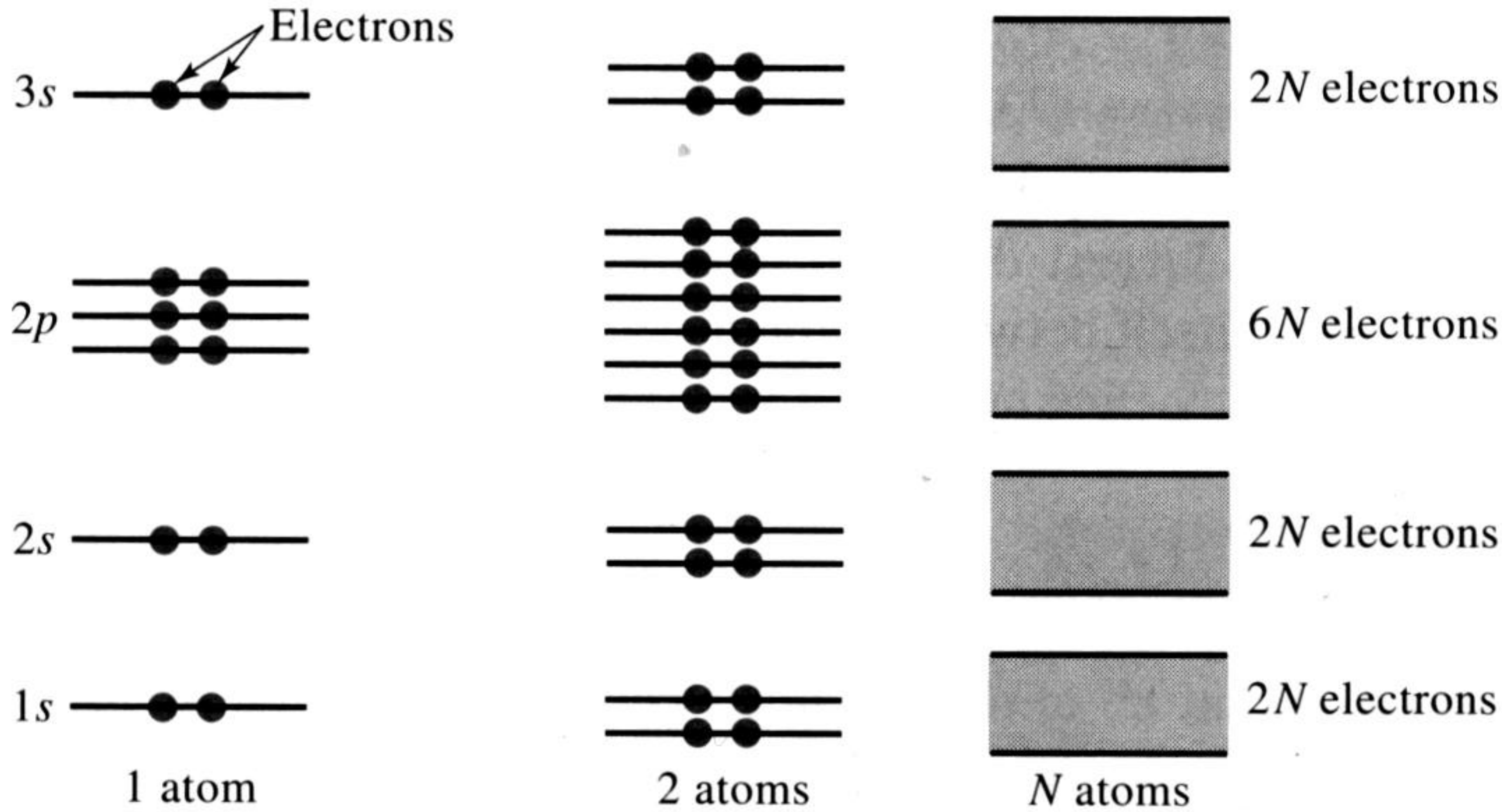
Electrical Conductivity

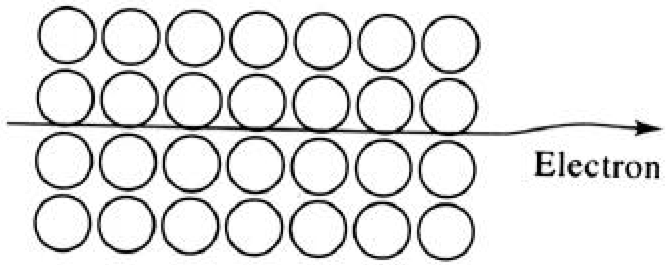
- $V = IR$: (Ohm's Law)
- $R = r\frac{l}{A} = \frac{l}{sA}$: (r = Electrical Resistivity ($\Omega \bullet cm$))
- $P = VI = I^2R$: (P = Elctrical Power Loss)
- $x = \frac{V}{l}$: (Electric Field)

Band Theory

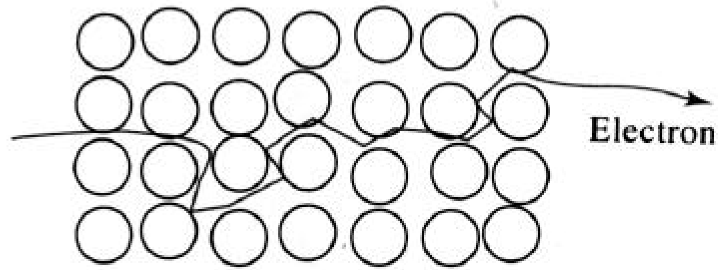

Electrons
3s
2p
2s
1s
1 atom
2 atoms
N atoms
2N electrons
6N electrons
2N electrons
2N electrons

Conductivity of Metals

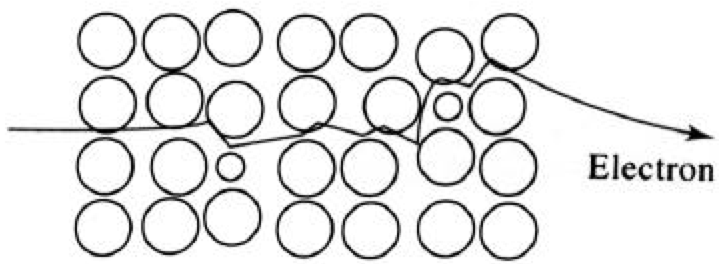
$$r_T = r_r\left(1 + a\Delta T\right)$$



(a)



(b)

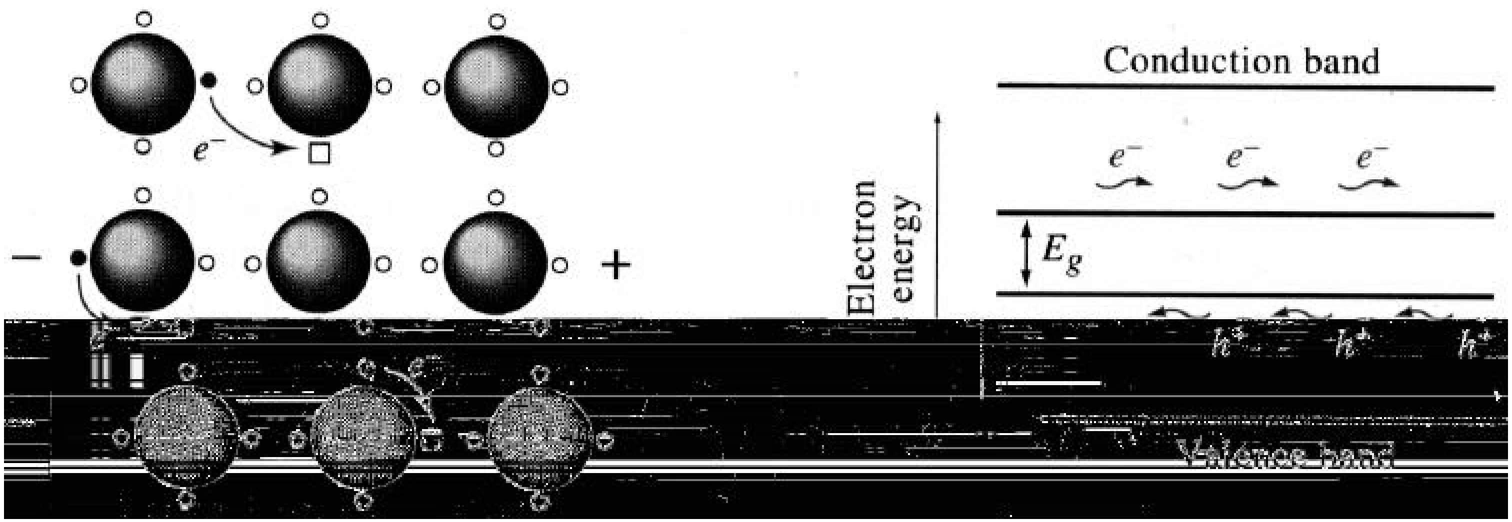


(c)

$$r_d = b\left(1 - x\right)x$$

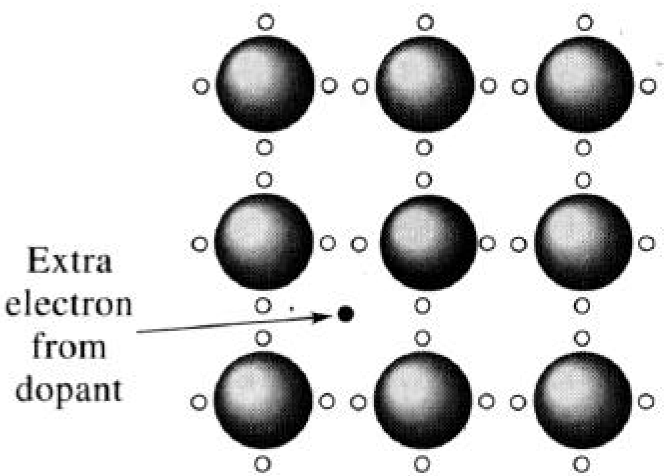
Intrinsic Semiconductors

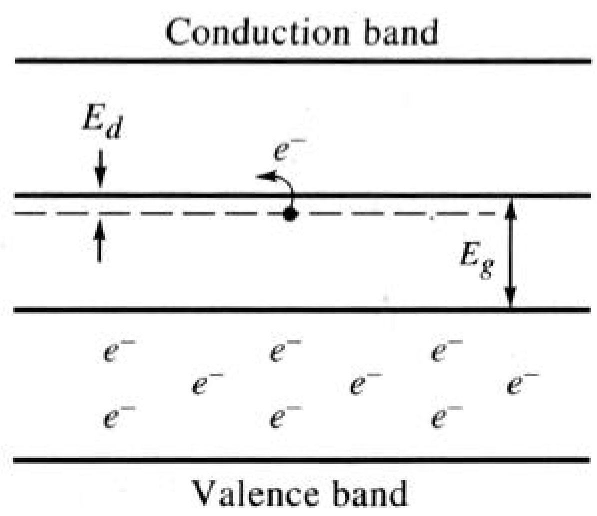
- Pure silicon or germanium; with a small energy gap, thermal energy allows some electrons to jump into the conduction band.



Extrinsic Semiconductors

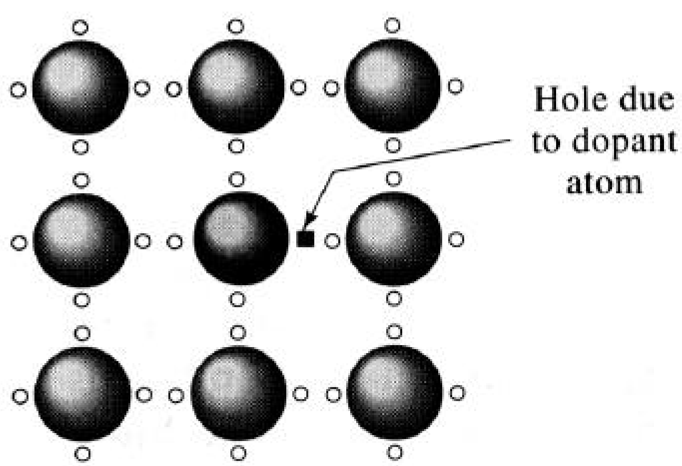
- ***n*** **- Type Semiconductors**: Doped with impurity atoms that have an extra valence electron which become the main charge carriers.

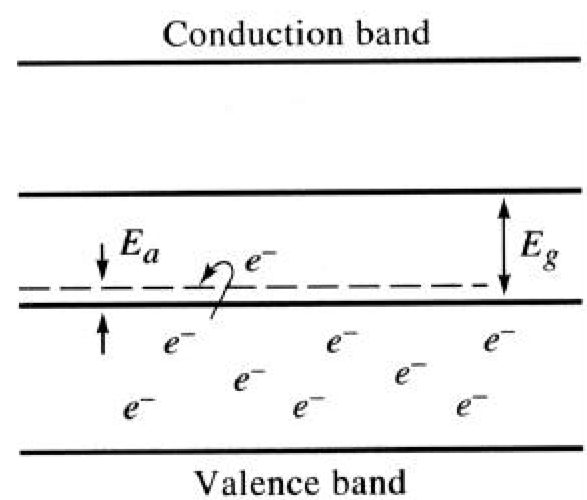




Extrinsic Semiconductors

- ***p* - Type Semiconductors**: Doped with impurity atoms that are lacking a valence electron which leaves an electron "hole" which can be filled by a near by electron in the same energy band.





Superconductors

- When the frequency of the atomic vibration in the lattice synchronizes with the frequency or wavelength of electron pairs, superconductivity is possible.