

this is N-type semiconductor, the valence band is full, and there are more electrons in the conduction band, this decreases the work function by raising the fermi level.

$$\rho = f(T)$$

$$\text{fermi level} = f(T)$$

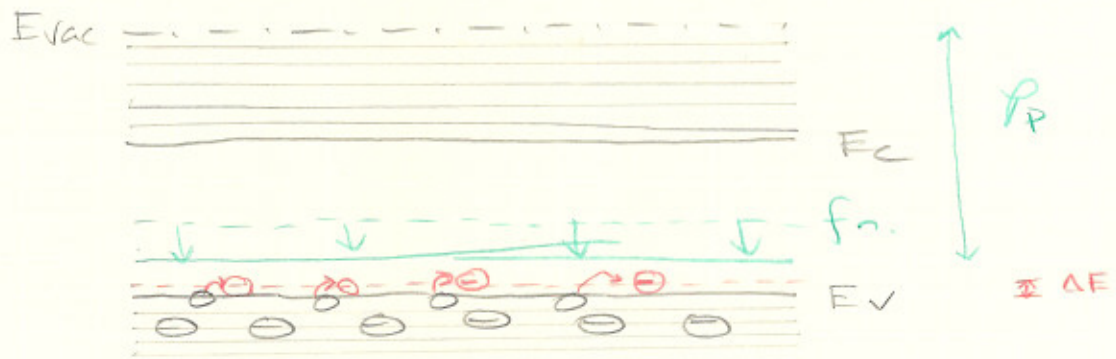
functions of temperature.



\ominus : atom with 3 electrons.

\ominus : atom with 4 electrons.

this is p-type semiconductor.



this has σ_p conductivity.

$$\Delta E = E_c - E_v$$

$$\Delta E > 0$$

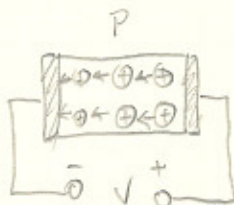
$$\Delta E = 0$$

$$\Delta E < 0$$

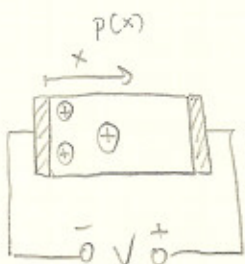
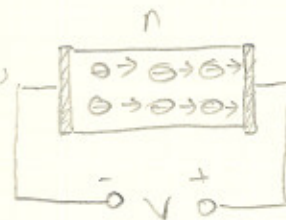
$$j_p^{drift} = \sigma_p E$$

E : electric field strength

$$j_n^{drift} = \sigma_n E$$



this illustrates drift current.

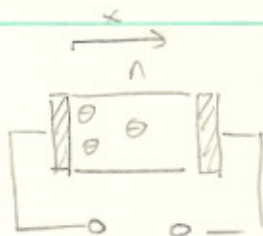


$$\frac{dp(x)}{dx} \neq 0$$

$$j_p^{drift} = q D_p \frac{dp(x)}{dx}$$

note: no longer dependent on field strength.

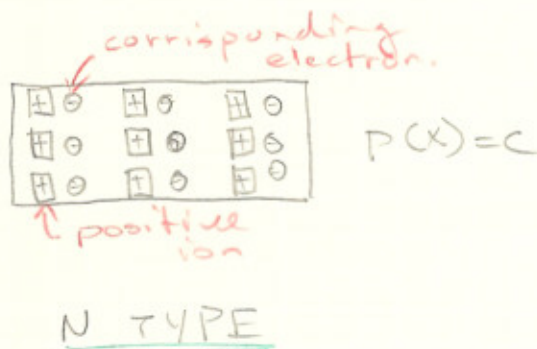
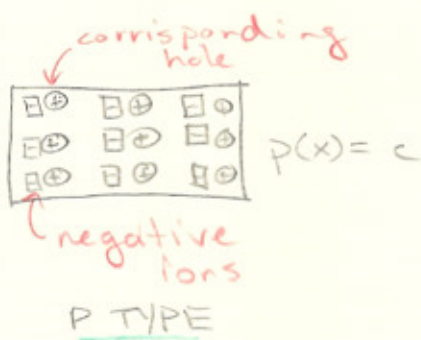
D_p : diffusion coefficient.



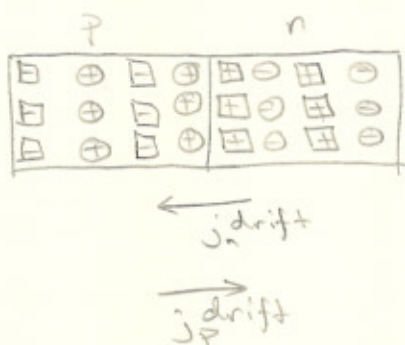
$$\frac{\partial n(x)}{\partial x} \neq 0$$

$$j_{n, \text{drift}} = -q D_n \frac{\partial n(x)}{\partial x}$$

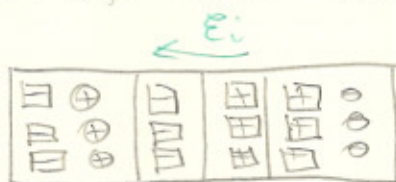
this illustrates diffusion currents.



now we will connect them.



charges cancel out near the middle



E_i : internal electrical field