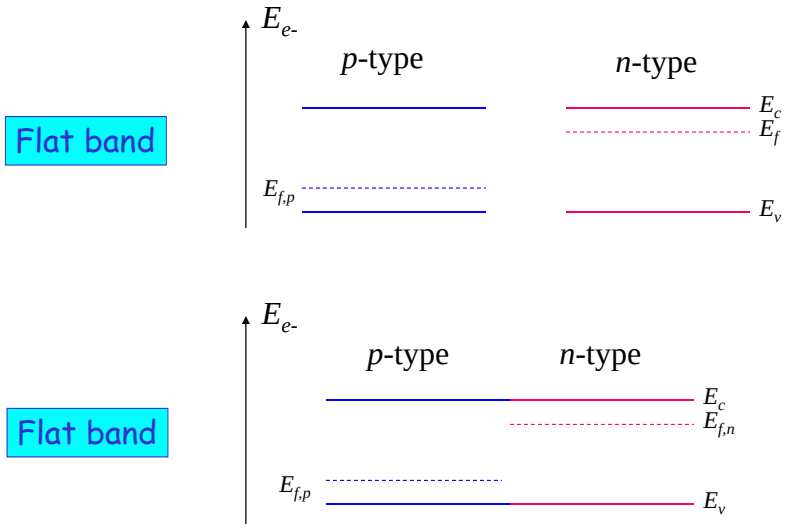
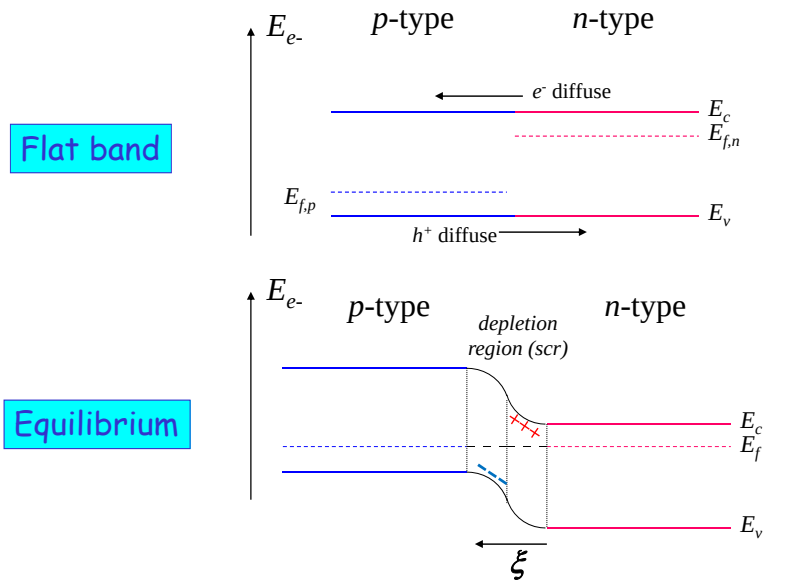
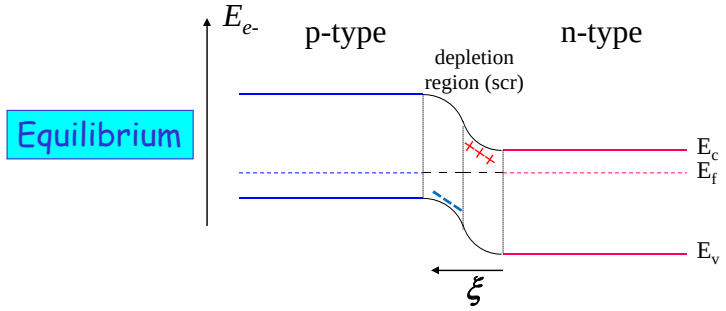
Part 2: *p-n* Junctions



p-n Junctions



p-n Junctions



$$\rho = q\left[\left(p + N_D^+\right) - \left(n + N_A^-\right)\right]$$

$$-\frac{d\xi}{dx} = -\frac{\rho}{\varepsilon}$$

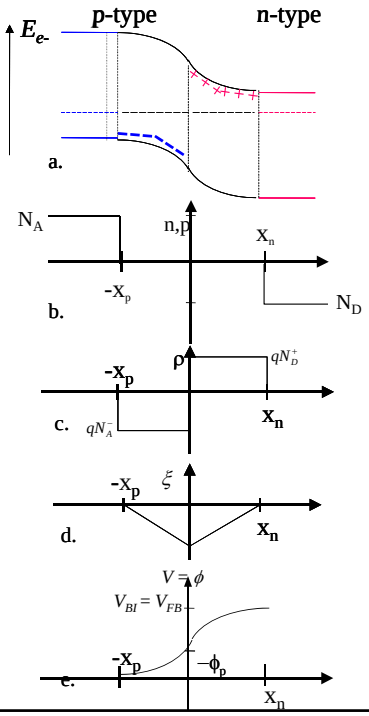
where

$$\varepsilon = \varepsilon_o \varepsilon_R$$

$$\frac{d^2V}{dx^2} = -\frac{d\xi}{dx} = -\frac{\rho}{\varepsilon}$$

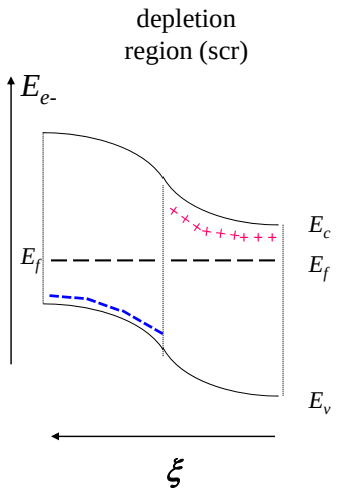
Poisson's Equation

p-n Junctions



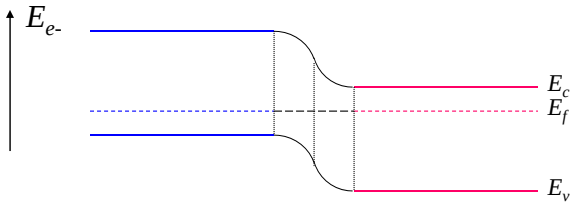
p-n Junctions

- Current Flow in *p-n* junction:
  - ✓ 1st: *diffusion* of e^-'s & h^+'s occur due to the difference in E_f (μ_{chem}).
    - o *Current density* due to diffusion: J_{dif}
  - ✓ 2nd: *Electric field* is induced due to *ionized donors* and *ionized acceptors*.
  - ✓ 3rd: Electric field induces e^-'s & h^+'s to *drift*.
    - o *Current density* due to drift: J_{drift}



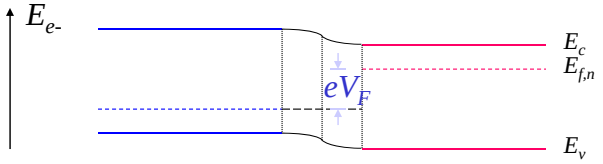
Steady State: $J_{dif} = -J_{drift}$ OR $J_{dif} + J_{drift} = 0$

p-n Junctions

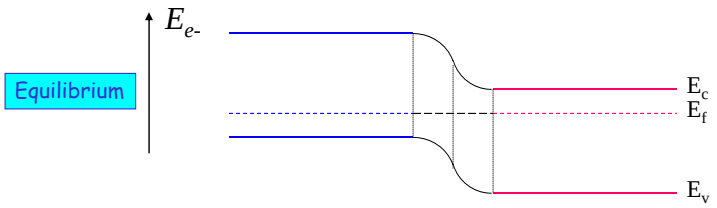


Question: If a forward bias is applied to the junction, what bias do we put on the:
- *n*-type side?
- *p*-type side?

Question: How will the E_f respond on the:
- *n*-type side?
- *p*-type side?

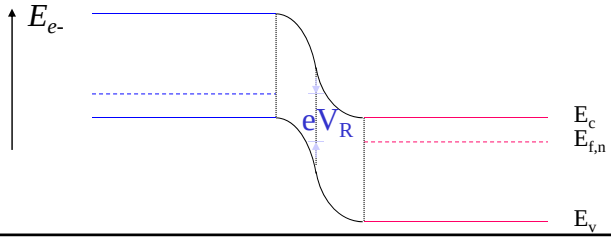


p-n Junctions



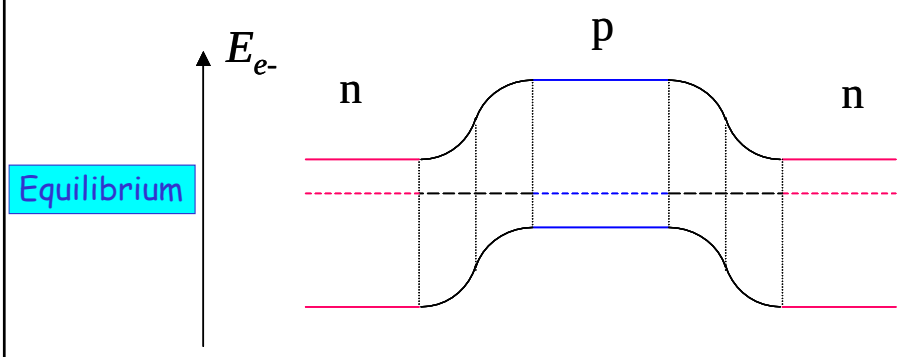
Question: If a *reverse* bias is applied to the junction, what bias do we put on the:
- n-type side?
- p-type side?

Question: How will the E_f respond on the:
- n-type side?
- p-type side?



How can a p-n junction be used as a diode?

n-p-n Junctions



Bipolar Transistor Action