

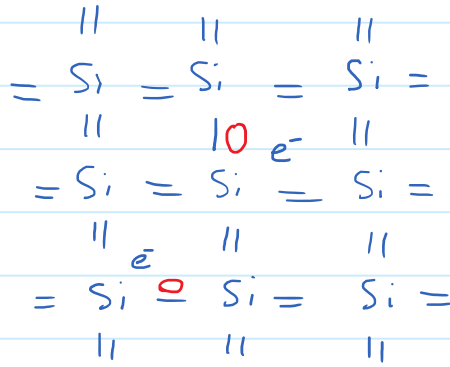
Reading

Adel S. Sedra and Kenneth C. Smith, **Microelectronic Circuits** 7th Edition, *Oxford University Press*, 2014.

- Chapter 3.4-3.6

Review

$$n_p = n_e$$



$$n_p \cdot n_e = n_i^2 \quad \leftarrow$$

T is 10K T \nearrow

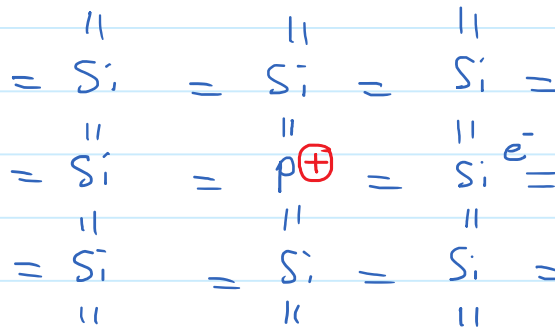
$$n_i = \beta T^{3/2} e^{-\frac{E_g}{2kT}}$$

1.12 eV

$n_i = n_e = n_p$

@ 300 K $\rightarrow n_i = 1.5 \times 10^{10}$ carriers/cm³

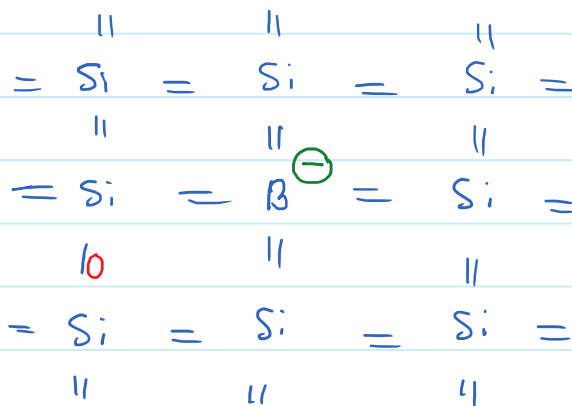
4A 5A
Si \rightarrow P
n-type
semiconductor



$n_e = N_D$ $n_p \cdot n_e = n_i^2$
 $n_p \cdot N_D = n_i^2$

$$n_p = \frac{n_i^2}{N_D}$$

4A 3A
Si \rightarrow B
p-type
semiconductor

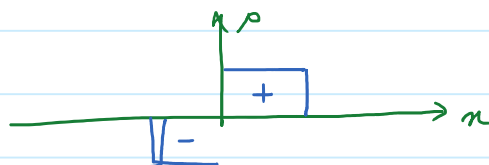
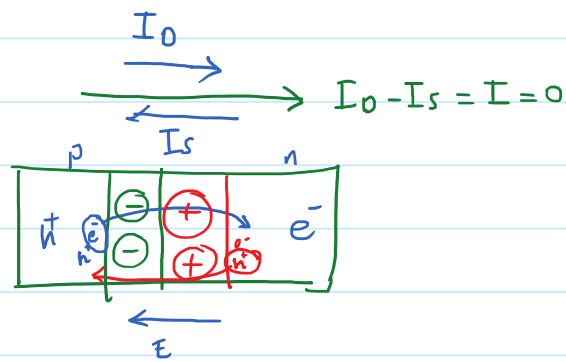
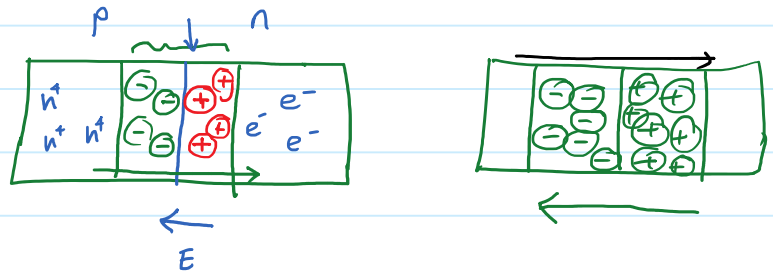
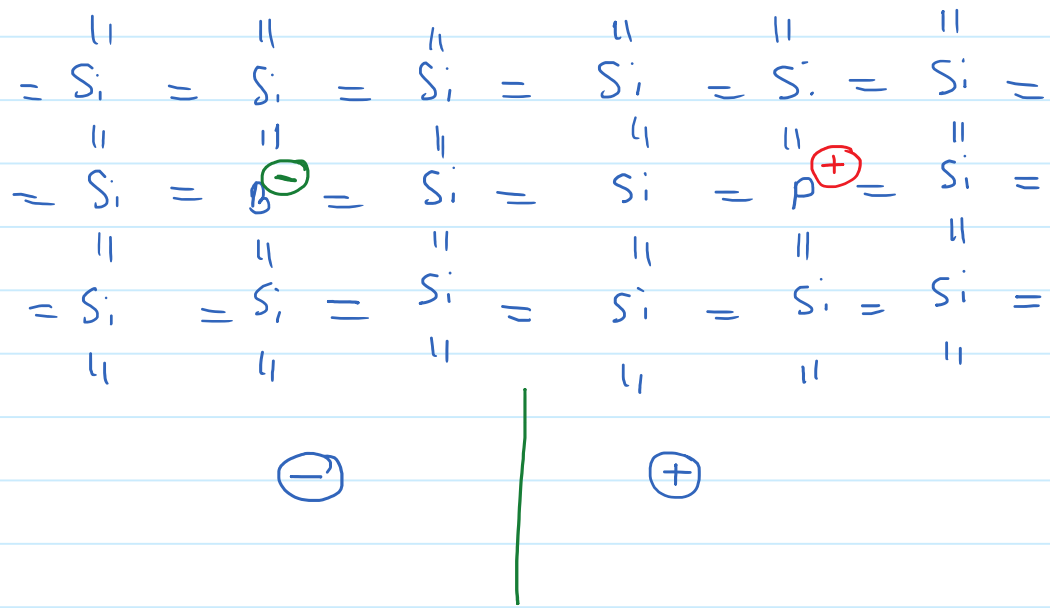


$n_p = N_A$ $n_e = ?$

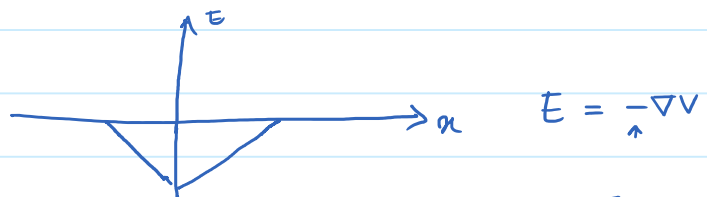
$n_i^2 = n_p n_e = N_A \cdot n_e$

$$n_e = \frac{n_i^2}{N_A}$$

pn Junction



$$\frac{dE}{dx} = \nabla \cdot E = \frac{\rho}{\epsilon}$$



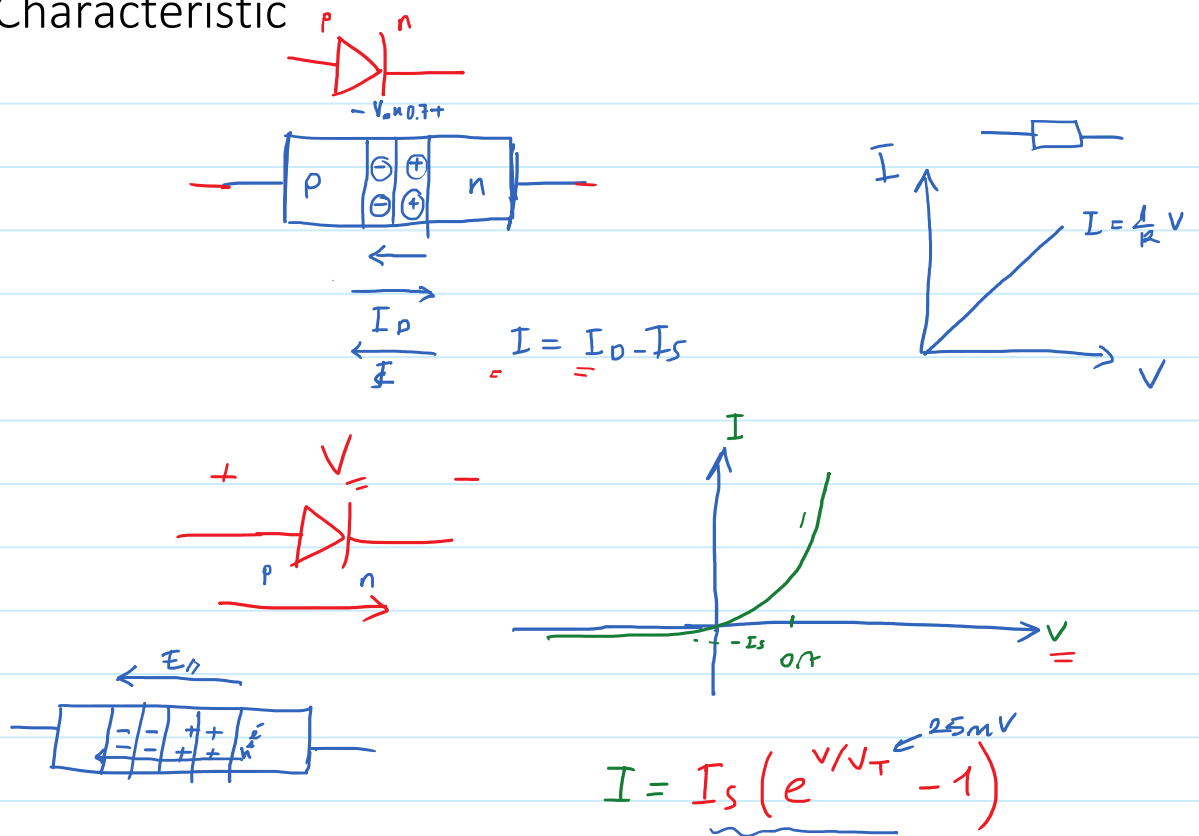
$$E = -\nabla V$$

Graph showing the potential energy (V) across the pn junction. The x-axis represents the position (x) and the y-axis represents the potential energy (V). The potential energy is zero in the bulk regions and has a constant negative value in the depletion region, indicated by a blue box with a '-' sign. The depletion region is centered at x=0.

$$V_0 = V_T \ln \left(\frac{N_A \cdot N_D}{n_i^2} \right)$$

where $\frac{kT}{q} \approx 25\text{mV}$

I-V Characteristic



Reverse Breakdown

$$= S_{ii} = e^-$$

