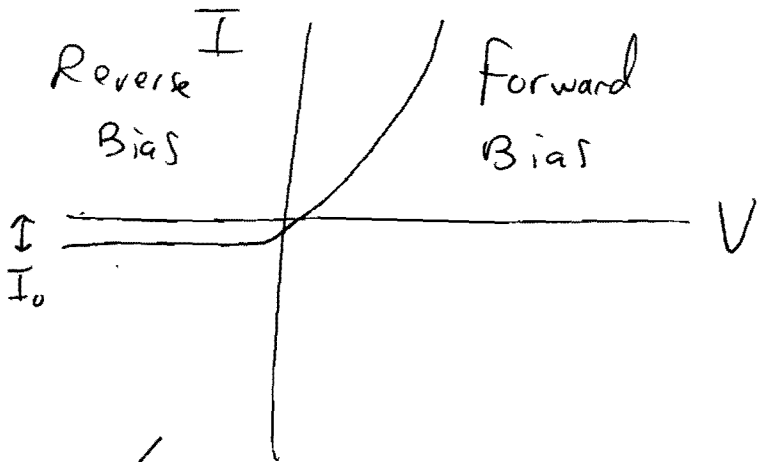


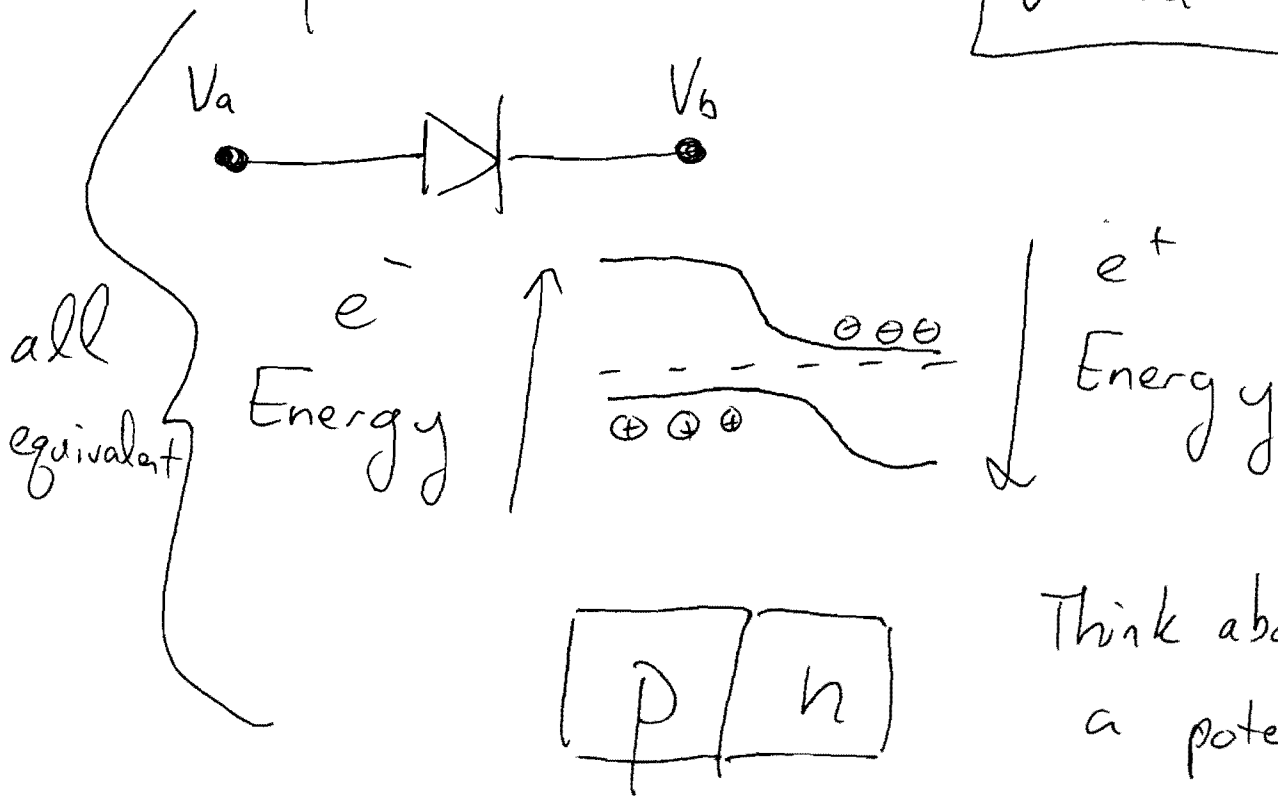
Diodes:

Diodes are pn junctions which are made by doping semiconductor material, and they display non-linear $I(V)$ curves.



$$I(V) = I_0 \left(e^{\frac{eV}{k_B T}} - 1 \right)$$

$$V = V_a - V_b$$

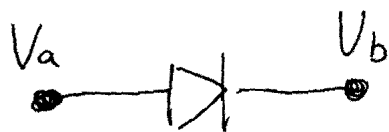


Think about applying a potential.

Think about the built in inner \vec{E} -field.

Diode Impedance :

This is an interesting problem.

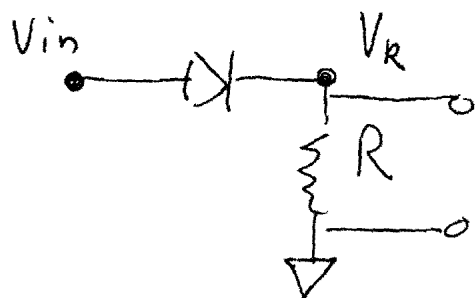


$$\frac{\partial I}{\partial (V_a - V_b)} = \frac{1}{Z_D} \quad (\text{Definition})$$

Recall $I = I_0 (e^{\alpha(V_a - V_b)} - 1)$, where $\alpha = \frac{e}{k_B T}$

$$\text{So } \frac{1}{Z_D} = \alpha I_0 e^{\alpha(V_a - V_b)}$$

ex:



$$V_R = \left(\frac{R}{R + Z_D} \right) V_{in}$$

$$\frac{1}{Z_D} = \alpha I_0 e^{\alpha \left(V_{in} - \left(\frac{R}{R + Z_D} \right) V_{in} \right)}$$

Solve graphically (2)