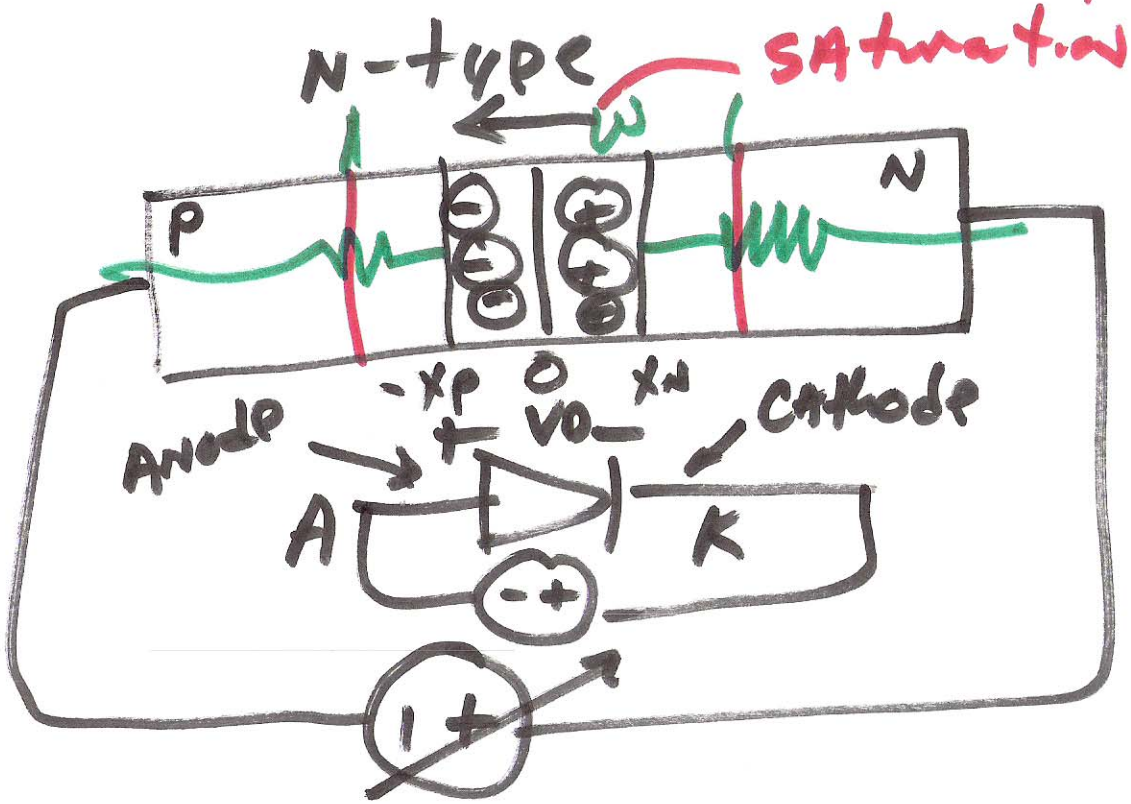
EE 320 Electronics

2/13/13 Lecture 7

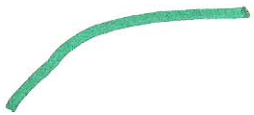
2.26C

$N_0 = 3 \times 10^{17}$ Atoms/cm^3



$W = X_p + X_n$

$\sqrt{V}$



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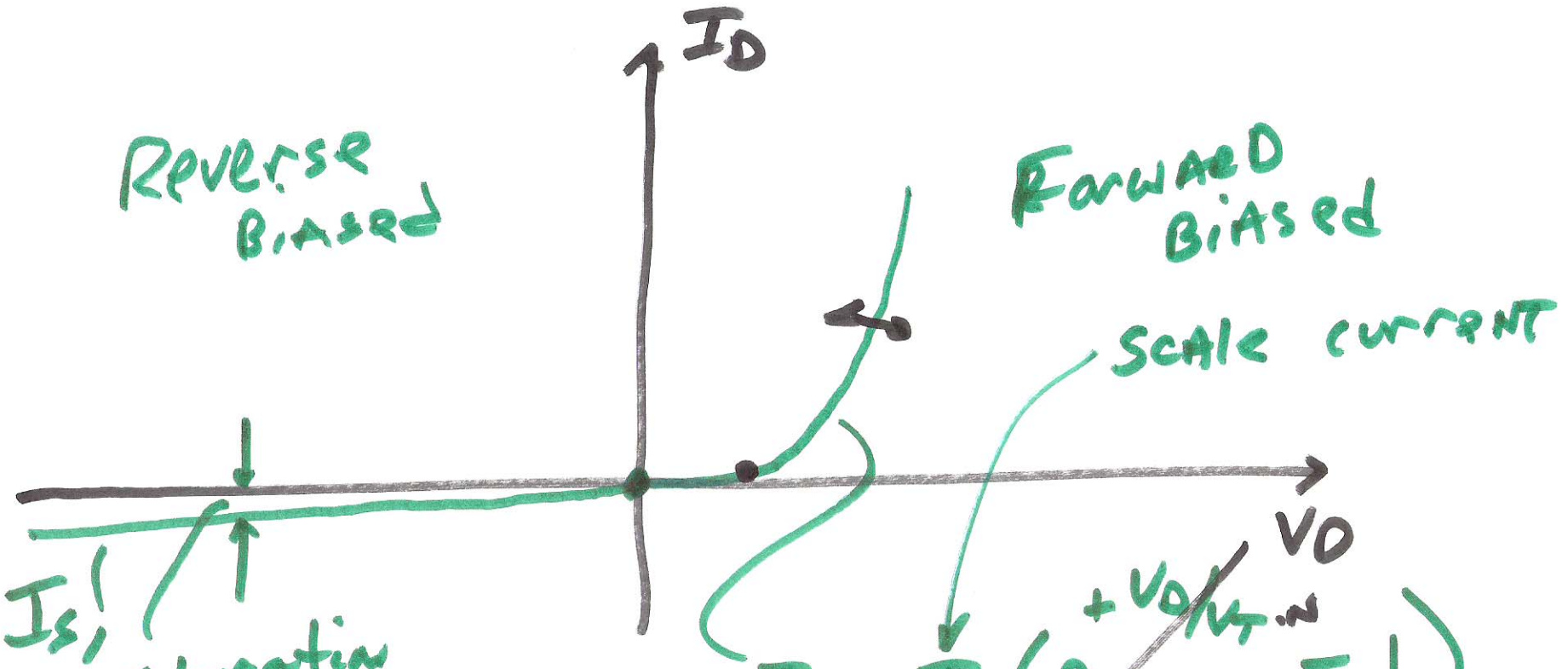


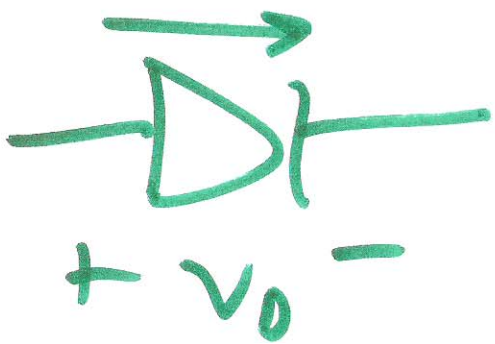
$I_D = I_S\left(e^{+V_D/\eta V_T} - 1\right)$

η - Emission coefficient

$\cong 0$, for rev. BIAS

Thermal voltage $= V_T = \frac{kT}{q}$ (volts)

$\cong 25mV$ @ 300K



Rev. BIAS

$I_D = -I_S$

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Forward Bias

$$I_D = I_S\left(e^{V_D/0.025} - 1\right), \quad I_S = 10^{-15}$$

$\ln\frac{a}{b} = \ln a - \ln b$

$$I_D \simeq I_S e^{V_D/NV_T}, \text{ for forward Bias}$$

$\frac{\ln x}{\ln y}$ 3.21)

$$\frac{I_D}{I_S} = e^{V_D/NV_T}, \quad V_D = NV_T \cdot \ln\frac{I_D}{I_S}$$

$$600mV = N \cdot 0.025 \cdot \ln\frac{100\mu A}{I_S}$$

$$500mV = N \cdot 0.025 \ln\frac{5\mu A}{I_S}$$

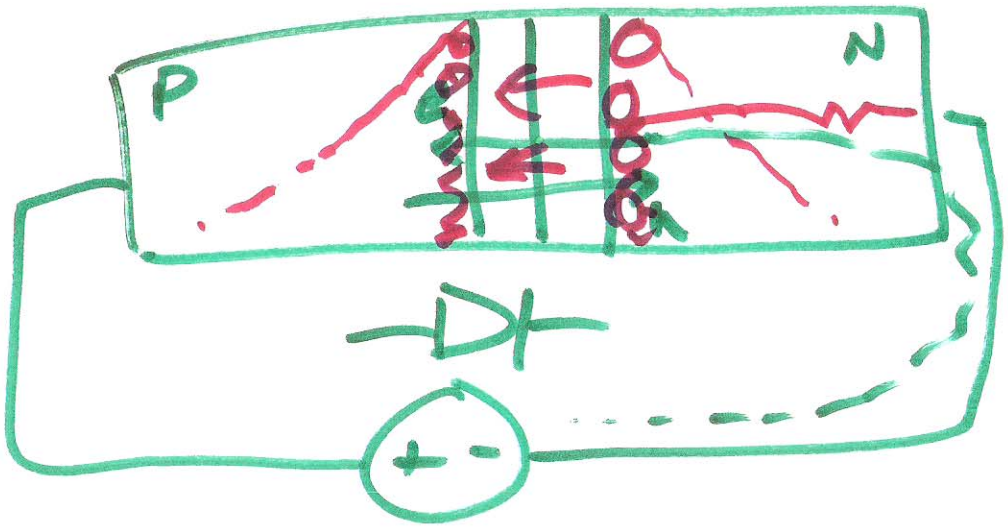
$$600mV - 500mV = N \cdot 0.025\left(\ln\frac{100\mu}{I_S} - \ln\frac{5\mu}{I_S}\right)$$

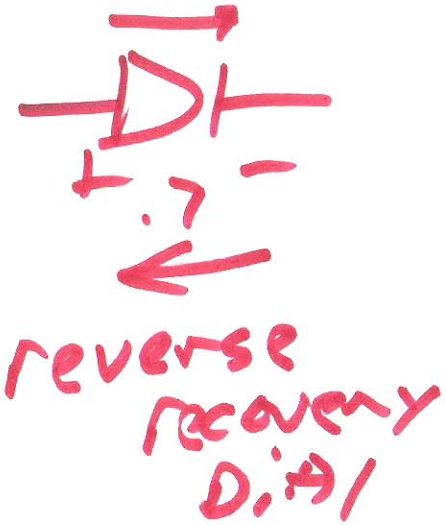
$$100mV = N \cdot 0.025 \cdot \ln 20$$

$$N = \frac{0.1}{0.025} \cdot \frac{1}{\ln 20} = \frac{4}{\ln 20}$$

$$N = 1.33$$

$$I_S = \frac{100\mu}{e^{.6/(1.33 \cdot 0.025)}} = 1.5 \times 10^{-12}$$





$$\frac{\delta V_T}{\delta T} = \frac{\delta}{\delta T}\left(\frac{kT}{q}\right) = \frac{k}{q}$$

$$I_D = I_S\, e^{V_D/nV_T}$$

for forward Bias

$$V_D = \ln\frac{I_D}{I_S} \ln$$

$$-\ln\frac{I_S}{I_D}$$

$$V_D = nV_T \ln\frac{I_D}{I_S}$$

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$0.085\,\frac{mV}{K^\circ}$

$$\frac{\delta V_D}{\delta T} = n\ln\frac{I_D}{I_S}\cdot\frac{\delta V_T}{\delta T} + nV_T\left(-\frac{I_D}{I_S}\right)\frac{\delta I_D}{\delta T}$$

$\frac{\delta V_T}{\delta T} = \frac{k}{q}$