HW2

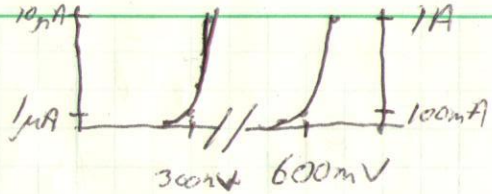
piazza, 3 courses, web page
↳ ask!

Diodes

BJTs

FETs

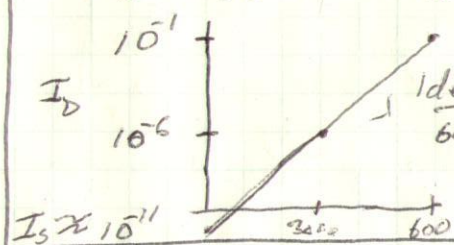
Last time:

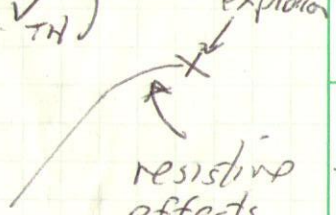


exact same shape.

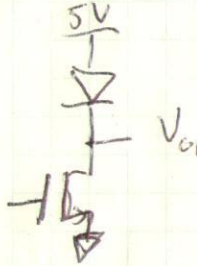
$$I_D \cong I_S e^{V_D/V_{TH}}$$

$$\log_{10} I_D = \log_{10} I_S + \log_{10}(e)\left(\frac{V_D}{V_{TH}}\right)$$

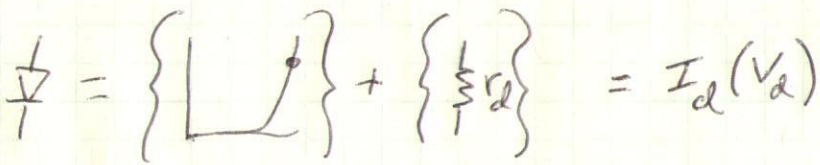




Linearization



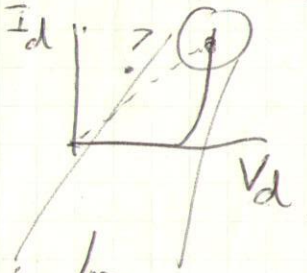
what's the bias point?
voltage?
current?
what's the small signal model?



large signal bias I_D, V_D

ss model i_d, v_d

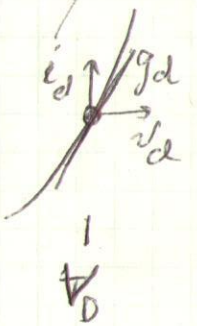
$$r_d = \frac{1}{g_d} \qquad g_d =$$

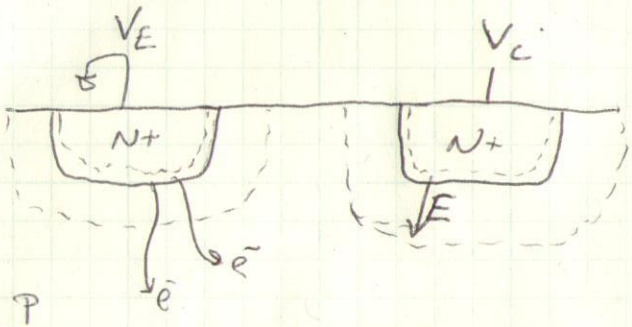


$$g_d = \left.\frac{\partial I_d}{\partial V_d}\right|_{V_D} = \frac{I_D}{V_{TH}}$$

$$r_d = \frac{V_{TH}}{I_D}$$

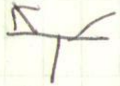
I_D –



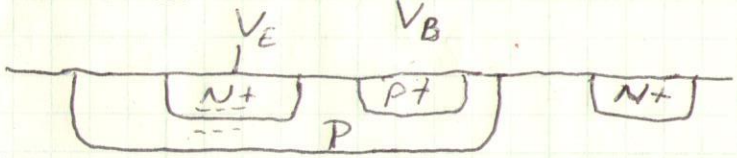


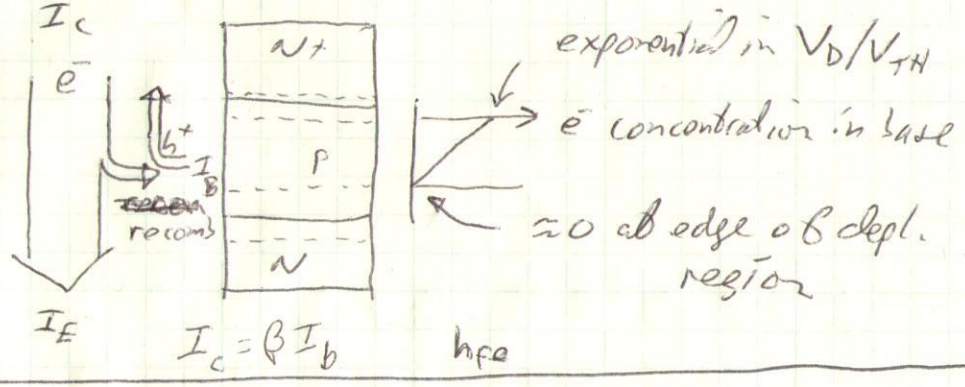
Original

emitter collector



more recent





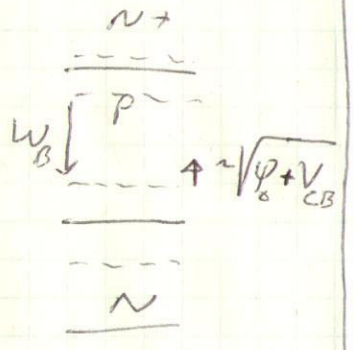
$I_C = \beta I_b$ h_{FE}

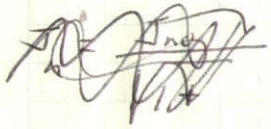
Current flow to emitter depends on gradient

$$J_n = q D_n \frac{d n_p}{dx}$$

$$= q D_n \frac{n_{po} e^{V_D/V_{TH}}}{W_B}$$

W_B depends on V_{CB}.

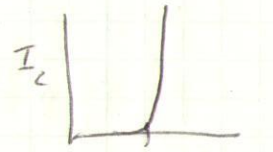




$I_C = \beta I_B$ $\beta = 10 - 400$

$V_A \approx 10 - 100$ V

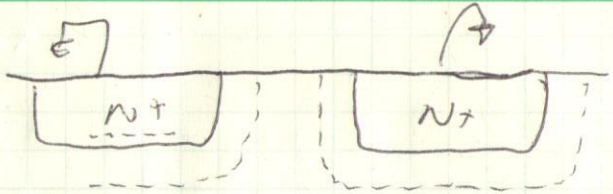
$$I_C = I_S e^{V_{BE}/V_{TH}} \left(1 + \frac{V_{CE}}{V_A}\right)$$

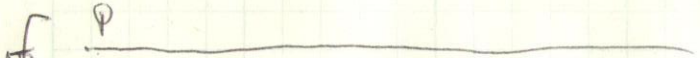


$$g_m = \frac{\partial I_C}{\partial V_{BE}} = \frac{I_C}{V_{TH}}$$

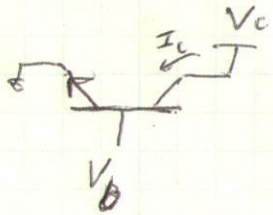
$$g_o = \frac{\partial I_C}{\partial V_{CE}} \approx \frac{I_C}{V_A} \qquad r_o = \frac{1}{g_o} = \frac{V_A}{I_C}$$

$$r_\pi = \left(\frac{\partial I_b}{\partial V_{be}}\right)^{-1} = \left(\frac{1}{\beta} g_m\right)^{-1} = \frac{\beta}{g_m}$$





create an ehp - where does it go?



Intrinsic gain

10-100 V

$$A_V = \frac{g_m}{g_o} = g_m r_o = \frac{I_c}{V_{TH}} \frac{V_A}{I_c} = \frac{V_A}{V_{TH}}$$ ← 25 mV

$$= \quad 400 - 4{,}000 !$$