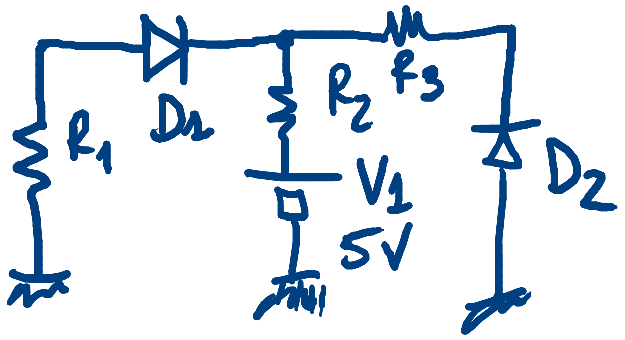
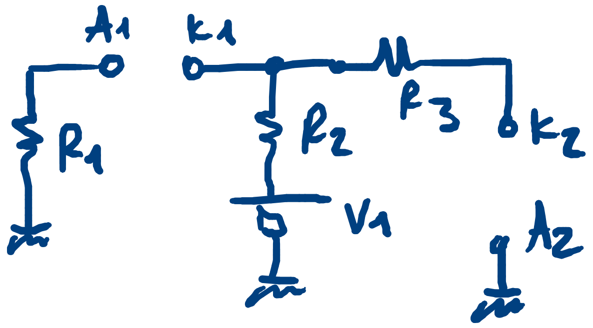


$R_1=R_2=R_3=1k\Omega$

D1 e D2 ideali

Hp.: D1 e D2 siano OFF



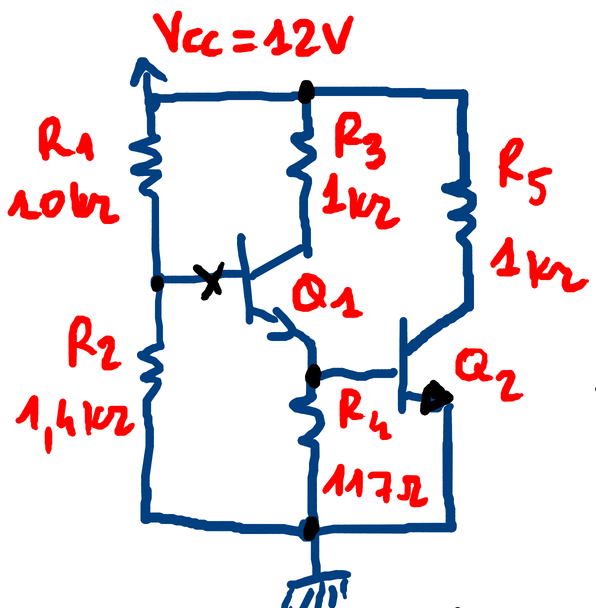
$I_{R2}=I_{R3}=0A$

$V_{K1}=V_{K2}=5V$

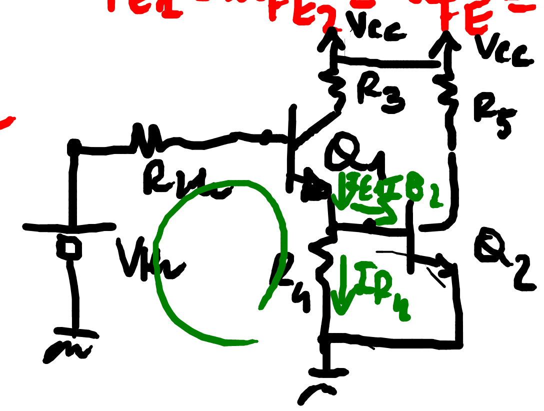
$I_{R1}=0A$

$V_{A1}=V_{A2}=0V$

$$\left.\begin{array}{l} V_{A_1K_1}=V_{A1}-V_{K1}=-5V \\ V_{A_2K_2}=V_{A2}-V_{K2}=-5V \end{array}\right\} \text{OK Hp}$$



$h_{FE1}=h_{FE2}=h_{FE}=100$



Hp: $Q_1 \wedge Q_2$ sono in Zona Attiva Diretta

$R_{th}=R_1\|R_2=1228k\Omega$ $\quad V_{th}=\frac{R_2}{R_1+R_2}V_{cc}=1,4737V$

$V_{th}=R_{th}I_{B1}+V_{BEON1}+V_{BEON2}$

$I_{B1}=\frac{V_{th}-2V_{BEON}}{R_{th}}=60\mu A$

$I_{C1}=h_{FE}I_{B1}=6mA$ $\quad I_{B2}=?$

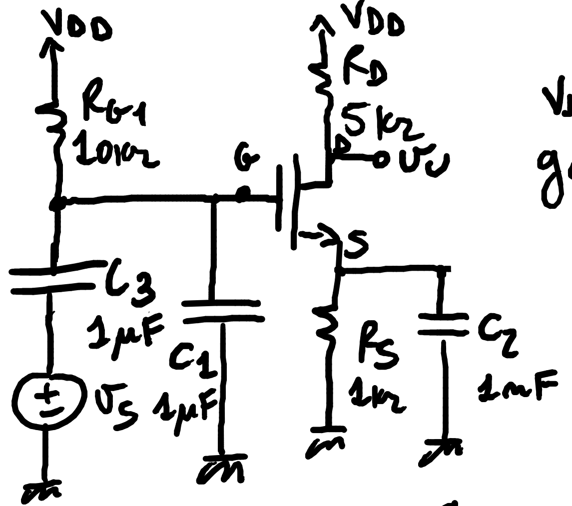
$I_{E1}=(h_{FE}+1)I_{B1}=6,06mA$

$I_{R4}=\frac{V_{BEON2}}{R_4}=5,983mA$ $\quad I_{B2}=I_{E1}-I_{R4}=$
$=77\mu A$

$I_{C2}=h_{FE}I_{B2}=7,7mA$

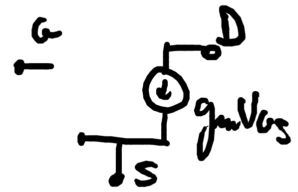
$V_{CE1}=V_{CC}-R_3I_{C1}-V_{BEON2}=$
$=5,3V>V_{CEsat}=0,1V$

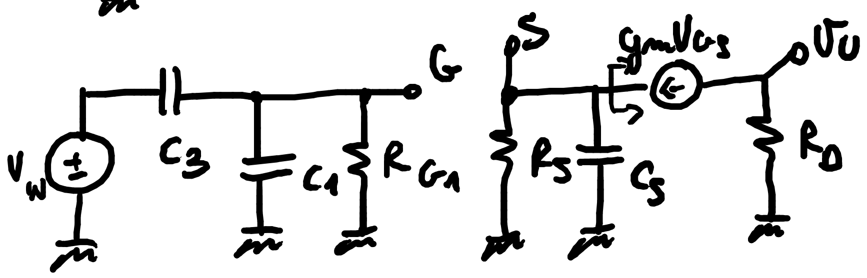
$V_{CE2}=V_{CC}-R_5I_{C2}=$
$=4,3V>V_{CEsat}=0,1V$



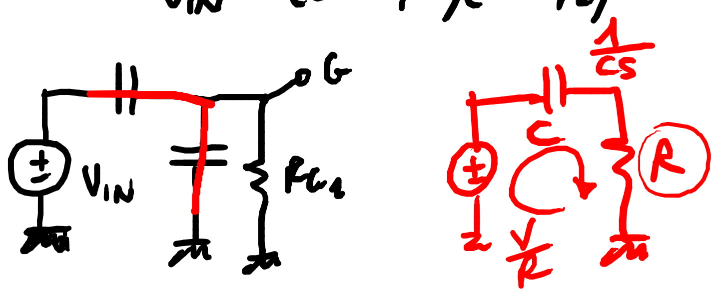
$V_{DD} = 12V$

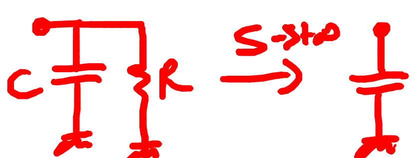
$g_m = 1mS$

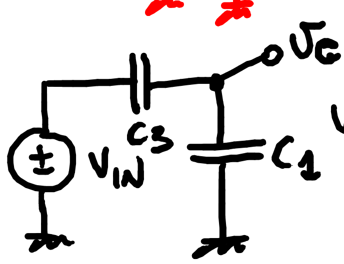




$$A_V(s) = \frac{V_U}{V_{IN}} = \frac{\quad}{(s+\omega_{p1})(s+\omega_{p2})}$$







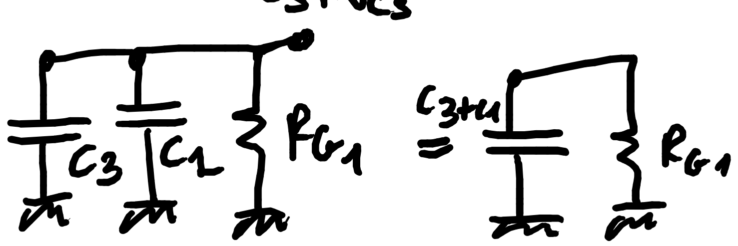
$$V_G = \frac{\frac{1}{C_1 \cancel{s}}}{\frac{1}{C_1 \cancel{s}} + \frac{1}{C_3 \cancel{s}}} V_{IN} = \frac{C_3}{C_1 + C_3} V_{IN}$$

$$A_{V\infty} = -g_m R_D \frac{C_3}{C_1 + C_3}$$

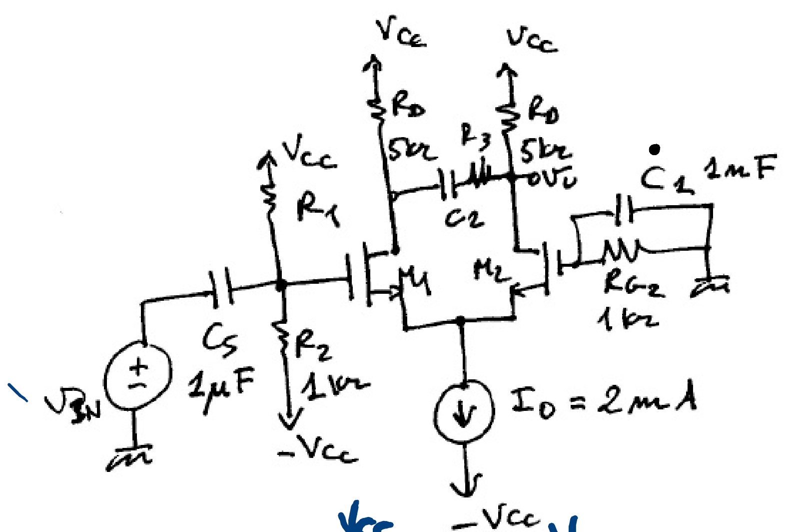
$$A_V(s) = A_{V\infty} \frac{s(s+\omega_0)}{(s+\omega_{p1})(s+\omega_{p2})} \qquad \omega_0 = \frac{1}{R_S C_S} =$$

ω_{p1} = Polo introdotto da C_S

$$\omega_{p1} = \frac{1}{C_S R_{V_{CS}}} \qquad R_{V_{CS}} = ? = R_S \parallel \frac{1}{g_m}$$



$$\omega_{p2} = \frac{1}{(C_3 + C_1) R_{G1}}$$



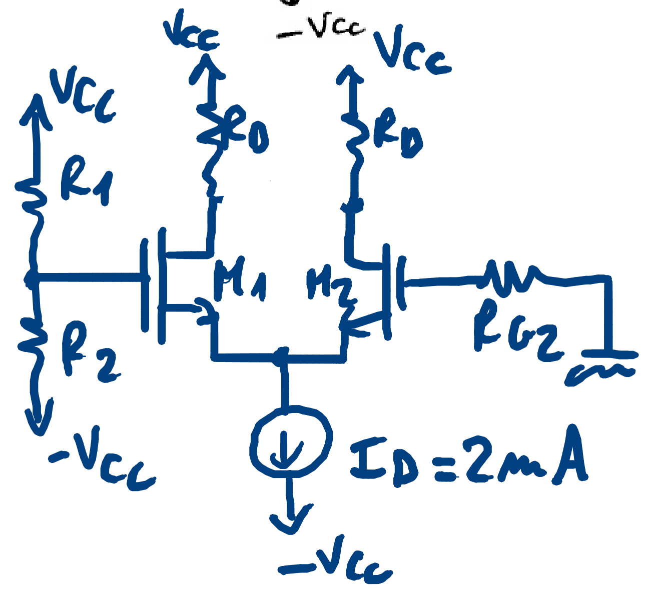
$V_{CC} = 12V$

$\mu_n C_{ox} \frac{W}{L} = 2\, mA/V^2 \Big\} M_1, M_2$

$V_T = 1V$

$C_2 = 1\, mF$

$R_3 = 1k\Omega$



$I_{DS_1} = I_{DS_2} = 1mA$

Ma $V_{G2} = 0V$ Per la simmetria

Anche V_{G1} deve essere uguale a zero

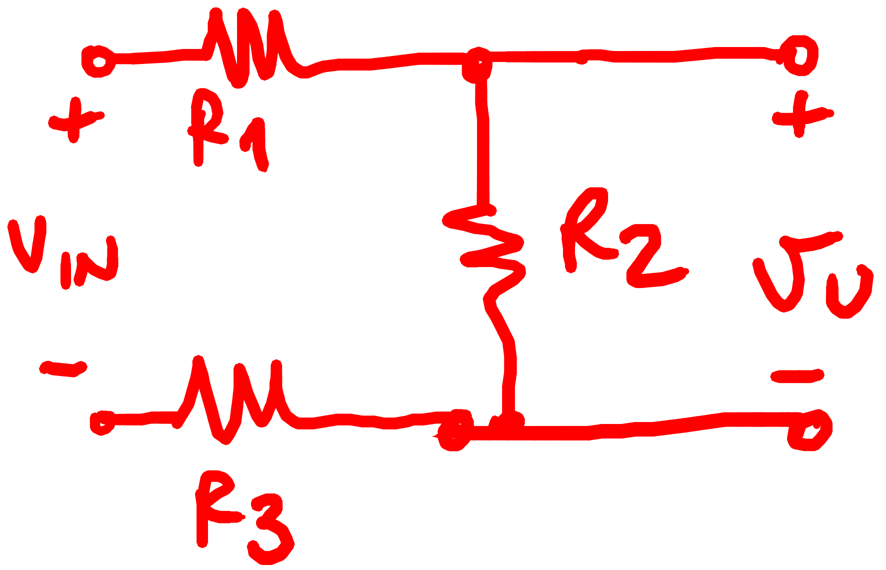
$V_{G1} = \frac{R_2}{R_1+R_2}V_{CC} - \frac{R_1}{R_1+R_2}V_{CC} \Rightarrow \boxed{R_1=R_2}$

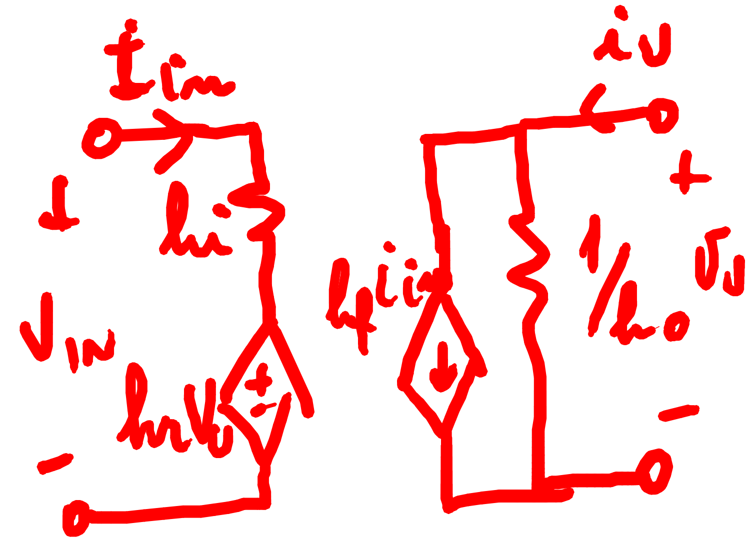
$I_{DS1} = I_{DS2} = 1mA$

$V_{GS} = \sqrt{\frac{I_{DS}}{K}} + V_T \qquad V_{GS1} = V_{GS2} = 2V$

$V_{G2} = 0V \qquad V_{G1} = V_{G2} - \cancel{V_{GS_2}} + \cancel{V_{GS1}} = 0$

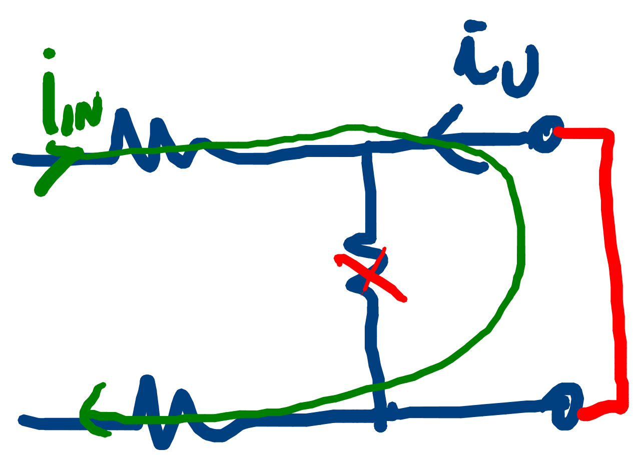
$V_{G1} = 0 = \frac{R_2}{R_1+R_2}V_{CC} - \frac{R_1}{R_1+R_2}V_{CC}$



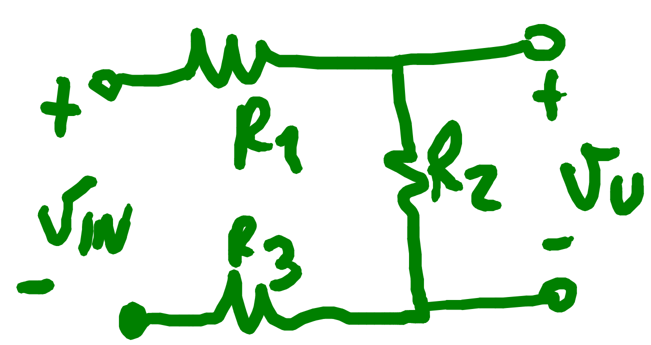


$$\left\{\begin{array}{l} v_{IN} = h_i\, i_{in} + h_r v_U \\ i_U = h_o v_U + h_f\, i_{in} \end{array}\right. \Rightarrow \underline{h_i = R_1 + R_3}$$

$$h_f = \frac{i_U}{i_{in}}\Big|_{v_U=0}$$



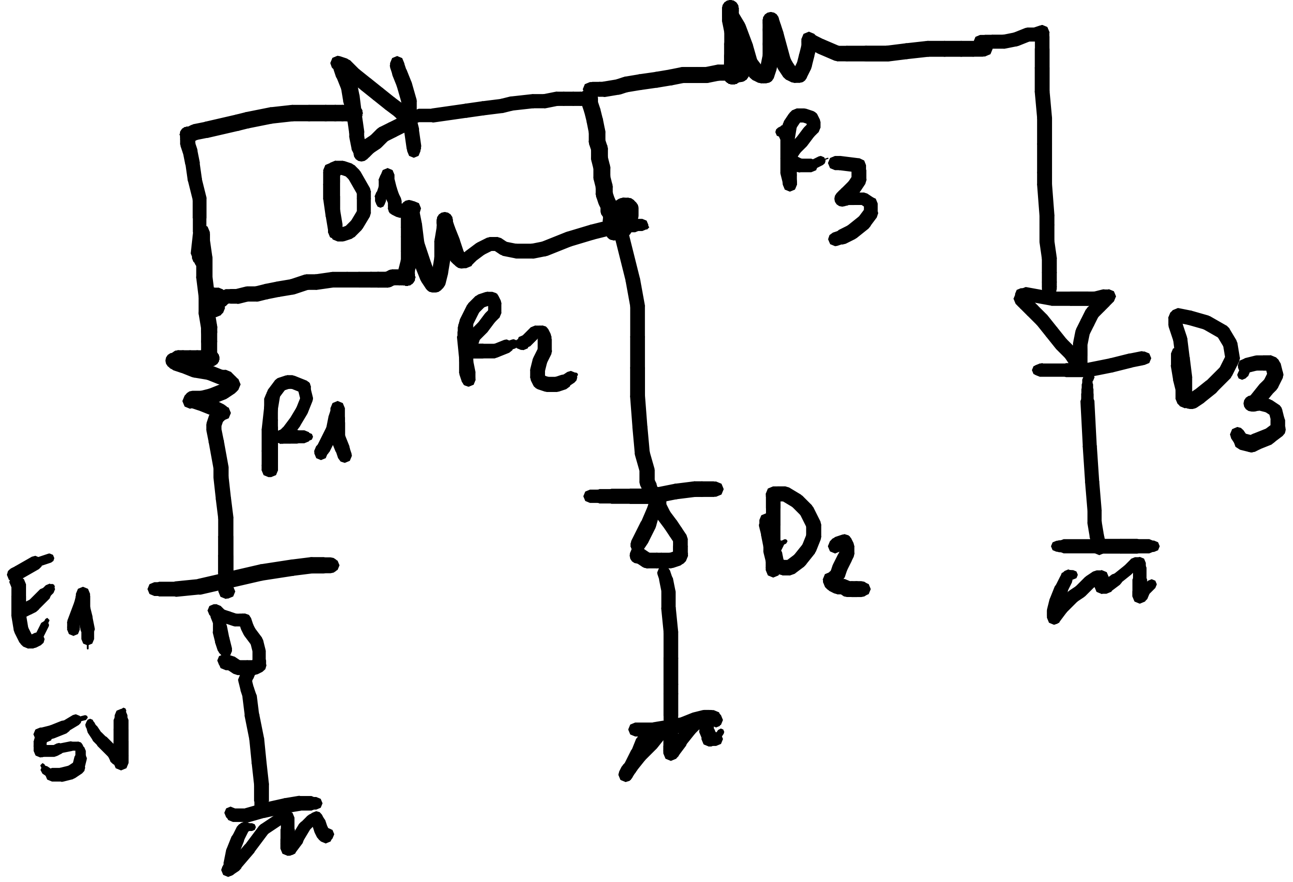
$$i_U = -i_{in}$$



$$h_r = \frac{v_{IN}}{v_U}\Big|_{i_{in}=0}$$

$$v_U = v_{IN} \Rightarrow h_r = 1$$

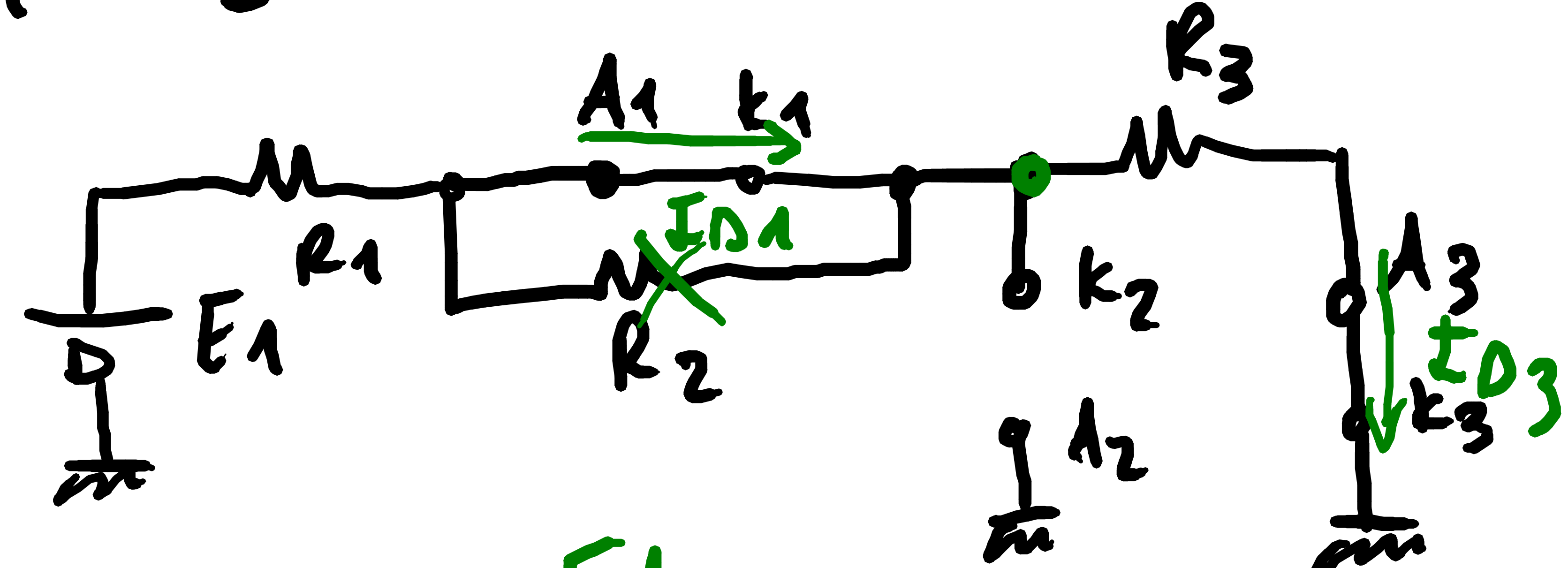
$$h_o = \frac{i_U}{v_U}\Big|_{i_{in}=0A} = \frac{1}{R_2}$$



$R_1 = R_2 = R_3 = 1\,k\Omega$

$V_\gamma = 0V$

$D_1 \wedge D_3$: ON D_2 : OFF



$$I_{D1} = I_{D3} = \frac{E1}{R_1+R_3} = 2{,}5\,mA \Rightarrow D_1 \wedge D_2 \text{ ON}$$

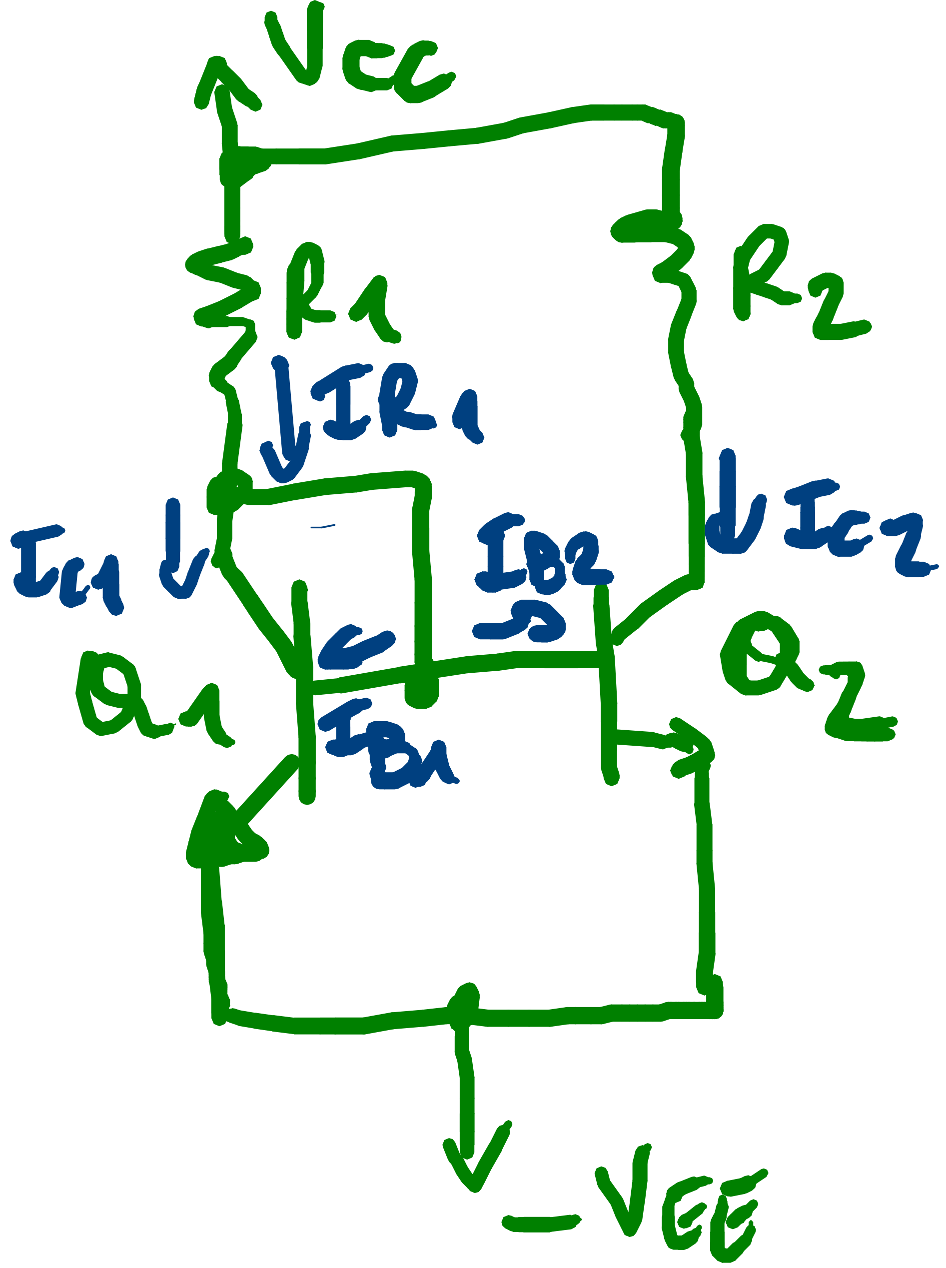
OK

$$V_{K2} = \frac{R_3}{R_1+R_3} E_1 = 2{,}5\,V$$

$$V_{A2} = 0V \Rightarrow V_{A2K2} = -2{,}5V \quad D_3 \text{ OFF}$$

OK

$$\underline{V_{A2K2} = V_{A2} - V_{K2}}$$



$$Q: I_C \simeq I_{CS}\left(e^{\frac{V_{BE}}{V_T}}-1\right)$$

$$I_{C1} = I_{C2} = I_C$$

$$V_{BE1} = V_{BE2}$$

$$I_{R1} = \frac{V_{CC} - V_{BEON} + V_{EE}}{R_1}$$

$$I_{R1} = I_{C1} + I_{B1} + I_{B2}$$

$$\beta = \frac{I_C}{I_B}$$

$$I_{B1} = I_{B2} = I_B = \frac{I_C}{\beta}$$

$$I_{R1} = I_C + 2\frac{I_C}{\beta}$$

$$I_{R1} = \left(1+\frac{2}{\beta}\right)I_C$$

$$I_{C2} = I_{R2} = I_C$$

$$I_{R1} = \left(1+\frac{2}{\beta}\right)I_{R2}$$

$$\frac{I_{R2}}{I_{R1}} = \frac{\beta}{2+\beta}$$