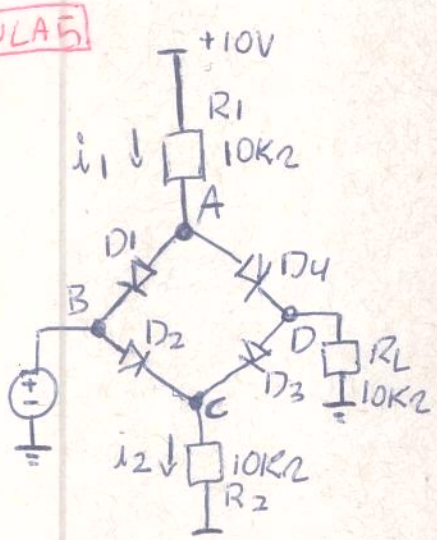
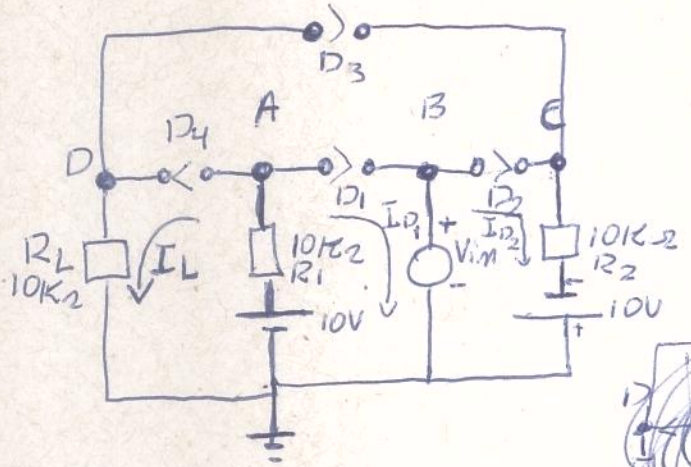
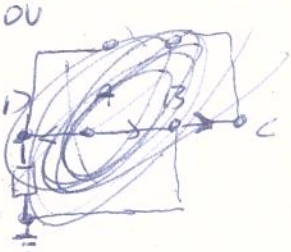
ULA 5

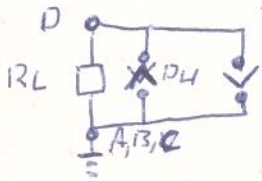


$\Leftrightarrow$





* $V_{in}=0 \Rightarrow D_1: F$; $D_2: F \Rightarrow V_A=V_B=V_C=0V \Rightarrow$



$\Rightarrow D_4$ e D_3: A

* $V_{in}>0 \Rightarrow D_1: F$; $D_2: F \Rightarrow V_A=V_B=V_C=V_{in}$

Como $V_A=V_{in}>0 \Rightarrow D_4: F \Rightarrow V_D=V_C \Rightarrow D_3: A$

- $\boxed{I_L=\frac{V_{in}}{R_L}}>0$ (10K)

- $10.(I_L+I_{D1})=10-V_{in} \Rightarrow 10\left(\frac{V_{in}}{10}+I_{D1}\right)=10-V_{in} \Rightarrow I_{D1}=\frac{10-2V_{in}}{10}$

$\Rightarrow D_1: F \Rightarrow I_{D1}>0 \Rightarrow V_{in}<5V \Rightarrow V_L=V_{in}$ (V_L e V_D)

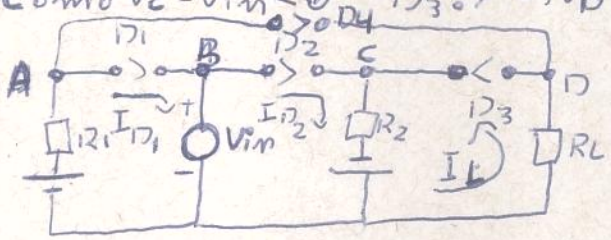
- $10.I_{D2}=10+V_{in} \Rightarrow \boxed{I_{D2}=\frac{10+V_{in}}{10}}>0$

$\Rightarrow V_{in}\geq 5V \Rightarrow D_1: A$; D_2 F ; D_4: F $\Rightarrow \begin{cases} V_C=V_{in} \\ V_D=\frac{10}{10+10}.10=5V \end{cases} \Rightarrow V_C \geq V_D \Rightarrow D_3: A$

$\Rightarrow \boxed{V_L=5V}$

* $V_{in}<0 \Rightarrow D_1: F$; D_2 F $\Rightarrow V_A=V_B=V_C=V_{in}$

Como $V_C=V_{in}<0 \Rightarrow D_3: F \Rightarrow V_D=V_A \Rightarrow D_4: A$



- $\boxed{I_L=\frac{-V_{in}}{10}}>0$

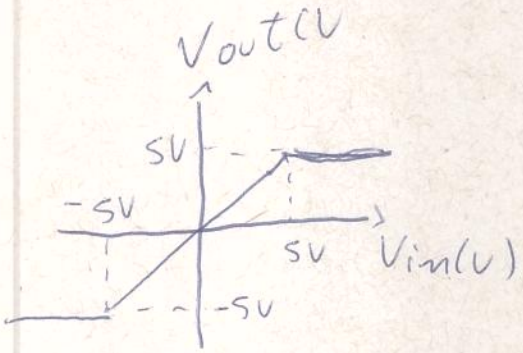
- $\boxed{I_{D1}=\frac{10-V_{in}}{10}}>0$

- $10.(I_{D2}+I_L)=10+V_{in} \Rightarrow I_{D2}=\frac{10+2V_{in}}{10}$ ($-\frac{V_{in}}{10}$)

$\Rightarrow D_2$ F $\Rightarrow I_{D2}>0 \Rightarrow V_{in}>-5V \Rightarrow \boxed{V_L=V_{in}}$

$V_{in}\leq -5V \Rightarrow D_2: A$; $D_1: F$; D_3 ; F $\Rightarrow \begin{cases} V_A=V_{in} \\ V_D=\frac{-10}{10+10}.10=-5V \end{cases} \Rightarrow V_A<V_D \Rightarrow D_4: A$

$\boxed{V_L=-5V}$


Vout(V
5V
-5V
5V
Vin(V)
-5V