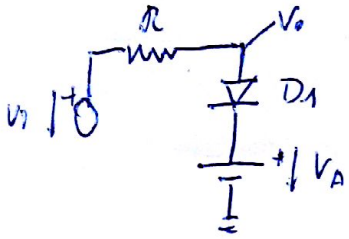


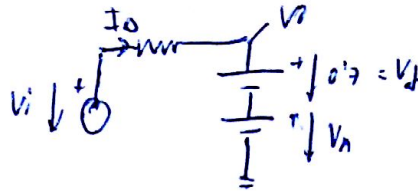
EJERCICIO 03  
ELECTRÓNICA

1

6)  $V_A = 4V$ ,  $I_{max} = 25mA$ ,  $R = 1K\Omega$



a) Suponiendo  $D_1$  on,  $I_0 = 0$

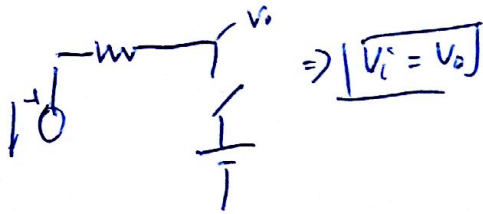


$$V_i - I_0 R - 0.7 - 4 = 0$$

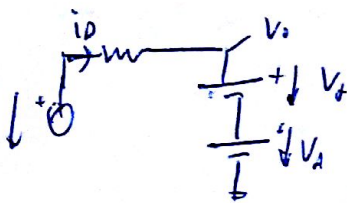
$$V_i = 4.7V$$

Si  $V_i < 4.7 \rightarrow D_1$  off

Si  $V_i > 4.7 \rightarrow D_1$  ON  
Si  $V_i < 4.7 \rightarrow D_1$  off



Si  $V_i > 4.7 \rightarrow D_1$  ON



$$i_D = \frac{V_i - 0.7 - 4}{R}$$

$$V_o = V_i - I \cdot R = V_i - \frac{V_i - 0.7 - 4}{R} R =$$

$$V_o = 4.7$$

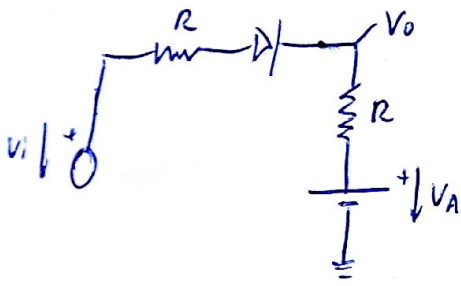
c)  $i_D < 25mA$

$$i_D = \frac{V_i - 0.7 - 4}{R} < 25mA \Rightarrow V_i - 0.7 - 4 < 25mA \cdot 1K$$

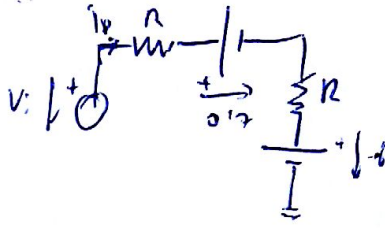
$$V_i < 25 + 4.7 \Rightarrow V_i < 29.7V$$

Si  $V_i > 29.7 \rightarrow D_1$  Arde.

⑦  $V_A = 6V$ ;  $I_{max} = 25mA$ ,  $R = 1k\Omega$



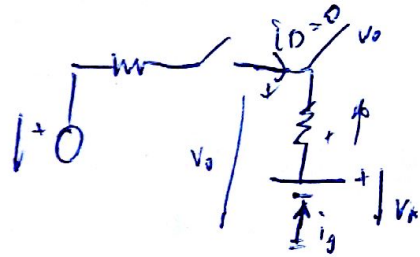
a) Supponiamo  $D_1$  on,  $I_D = 0$



$$V_i - \frac{i_D R}{0} - 0.7 - \frac{i_D R}{0} - 6 = 0$$

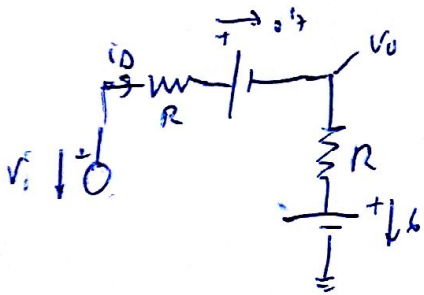
$$V_i = 6.7$$

$$\text{Si } \begin{cases} V_i > 6.7 \rightarrow D_1 \text{ on} \\ V_i < 6.7 \rightarrow D_1 \text{ off} \end{cases}$$



$$\begin{aligned} V_o &= V_A = \\ \boxed{V_o = 6V} \end{aligned}$$

Si  $V_i > 6.7 \rightarrow D_1 \text{ on}$

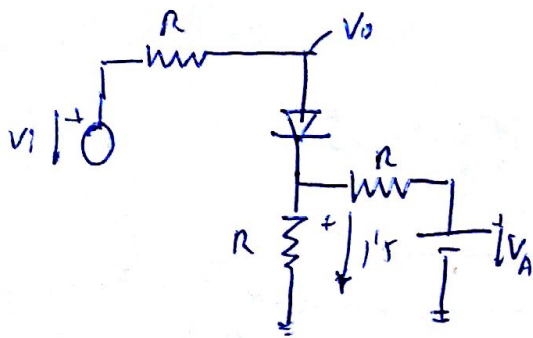


$$i_D = \frac{V_i - 0.7 - 6}{2R} = \frac{V_i - 6.7}{2R}$$

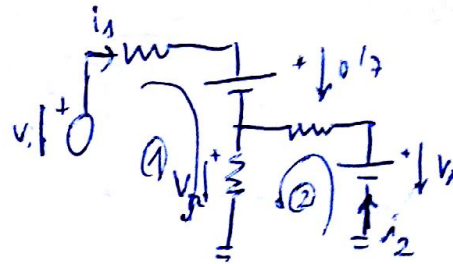
$$V_o = i_D R + 6 = 6 + \frac{V_i - 6.7}{2R} \cdot R \Rightarrow V_o = \frac{V_i + 5.3}{2}$$

$$\boxed{V_o = \frac{V_i + 5.3}{2}}$$

③  $V_A = 3V$



a) Supponemus  $D_1$  on,  $I_{D2} = 0$



$$V_A = V_A \frac{R}{2R} = \frac{V_A}{2} = \frac{3}{2} = 1.5$$

①  $v_i - i_1 R - 0.7 - i_2 R = 0$

$v_i - 0.7 - i_2 R = 0 \Rightarrow v_i - 0.7 - \frac{V_A}{2R} R = 0$

②  $V_A - i_2 R - i_2 R = 0$

$V_A - 2i_2 R = 0$

$i_2 = \frac{V_A}{2R}$

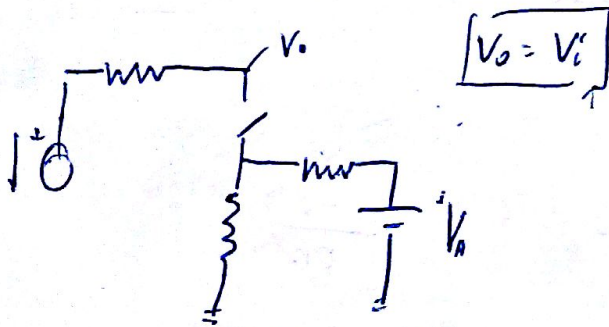
$v_i - 0.7 - \frac{3}{2} = 0$

$v_i = 2.2$

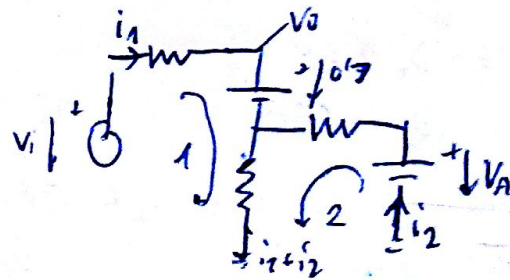
Si  $v_i > 2.2 \rightarrow D_1$  on  
 $v_i < 2.2 \rightarrow D_2$  off

b) Si  $v_i < 2.2 \rightarrow D_1$  off

Si  $v_i > 2.2 \rightarrow D_1$  on



$v_o = v_i - i_1 R$



①  $v_i - i_1 R - 0.7 - (i_1 + i_2) R = 0$

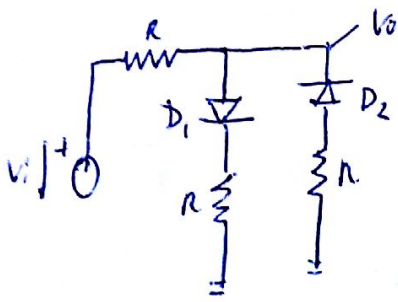
②  $V_A - i_2 R - (i_1 + i_2) R = 0$

$\Rightarrow \begin{cases} 2(v_i - 0.7 - 2i_1 R - i_2 R = 0) \\ (V_A - 2i_2 R - i_1 R = 0) \end{cases} \Rightarrow 2v_i - 1.4 - 3i_1 R + V_A = 0$

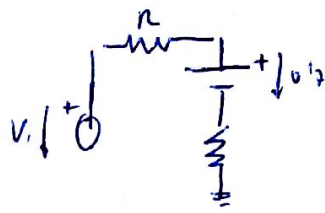
$i_1 = \frac{2v_i + 4.4}{3R}$

$v_o = v_i - \frac{(2v_i - 4.4) R}{3R} \Rightarrow v_o = \frac{v_i + 4.4}{3}$

②



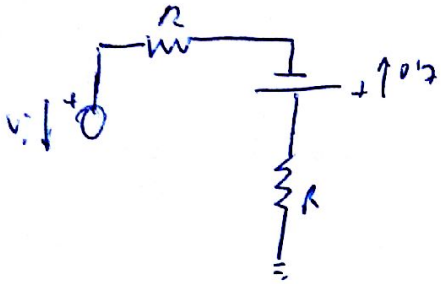
1)  $V_i > 0.7$   $D_1$  ON  $\rightarrow i_D = 0$



$$V_i - i_D R - 0.7 - i_D R = 0$$

$$V_i = 0.7$$

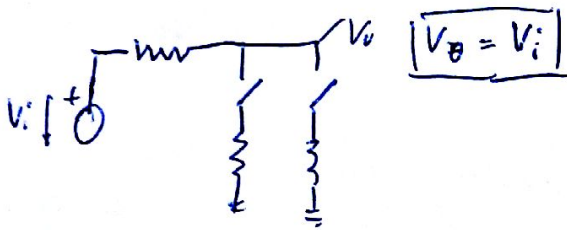
Si  $V_i \geq 0.7 \rightarrow D_1$  ON  
 $V_i < 0.7 \rightarrow D_1$  OFF



$$V_i = i_D R - 0.7 + i_D R$$

Si  $V_i \leq -0.7$   $D_2$  ON  
 $V_i > -0.7$   $D_2$  OFF

4) HYPOTHESIS  $\rightarrow D_1, D_2$  OFF



$$V_0 = V_i$$

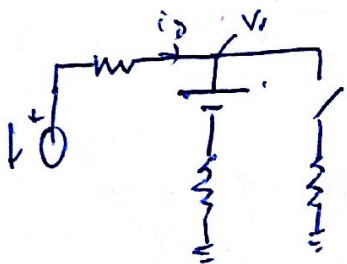
Comprobamos

$D_1$  OFF  $\rightarrow V_i < 0.7 \rightarrow$   ~~$V_0$~~

$D_2$  OFF  $\rightarrow V_i > -0.7$

Si  $-0.7 < V_i < 0.7$   $D_1$  OFF  $D_2$  OFF

Si  $\rightarrow V_i \geq 0.7$   $D_1 \rightarrow$  ON  
 $D_2 \rightarrow$  OFF

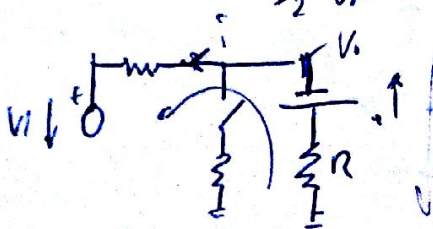


$$V_0 = 0.7 + i_D R \Rightarrow V_0 = 0.7 + \frac{V_i - 0.7}{2R} R =$$

$$i_D = \frac{V_i - 0.7}{2R}$$

$$V_0 = \frac{V_i + 0.7}{2}$$

Si  $V_i \leq -0.7$   $D_1$  OFF  
 $D_2$  ON



$$V_i = -0.7 + i_D R + i_D R = -0.7 + 2i_D R$$

$$i_D = \frac{-V_i - 0.7}{2R}$$

$$V_0 = -0.7 + i_D R = -0.7 + \frac{-V_i - 0.7}{2} R$$

$$V_0 = V_i + IR$$

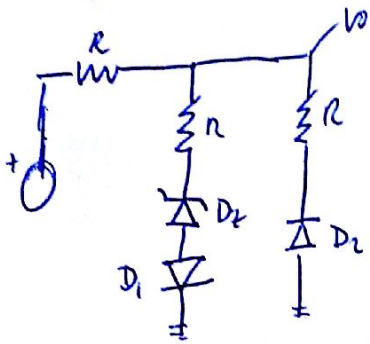
$$V_0 = V_i + \frac{-V_i - 0.7}{2} R$$

$$V_0 = \frac{V_i - 0.7}{2}$$

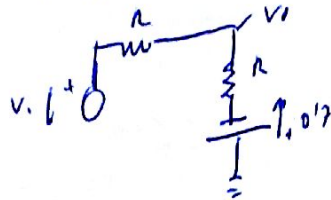
Continuación 2

$V_i$	$D_1$	$D_2$	$V_o$
$V_i \leq -0.7$	OFF	ON	$\frac{V_i - 0.7}{2}$
$-0.7 < V_i < 0.7$	OFF	OFF	$V_i$
$V_i \geq 0.7$	ON	OFF	$\frac{V_i + 0.7}{2}$

8)  $|V_2| = 7.5V, I_{max} = 100mA, P_{2,max} = 600mW, R = 1k\Omega$



a) Suponemos  $D_2$  ON  $I_D = 0$



$$V_i = I_D R - I_{D0} R + 0.7 =$$

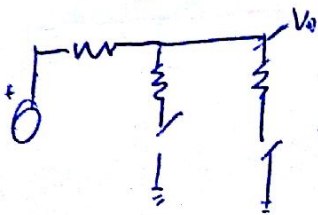
$$V_i = -0.7$$

Si  $V_o \leq -0.7$   $D_1$  ON  
 Si  $V_o > -0.7$   $D_2$  OFF

$$V_i = -0.7 + 0.7 = 0$$

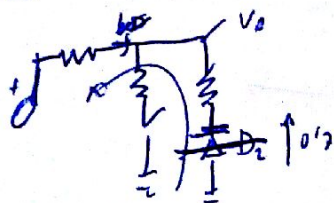
Si  $V_o \geq 7.2$   $D_2$  y  $D_1$  ON  
 Si  $V_o < 7.2$  OFF OFF

HIPO  $D_1$  OFF  
 $D_2$  OFF  
 $D_L$  OFF



Comprobamos  $V_o = V_i$   
 $D_2$  ON, OFF  $\rightarrow V_o < 7.2$   
 $D_2$  OFF  $\rightarrow V_i > -0.7$   $D_2$  OFF  
 $-0.7 < V_i < 7.2$   $D_1, D_2, D_L$  OFF

AIPO Si  $V_i < -0.7$   $D_2$  ON  $D_1$  OFF



$$V_o = V_i + i_D R$$

$$V_o = V_i + \frac{-0.7 - V_i}{2R} R$$

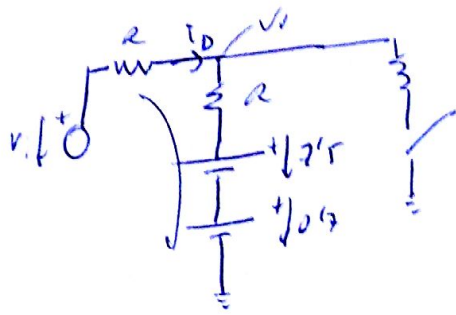
$$V_o = \frac{V_i + 0.7}{2}$$

$$V_i = -2i_D R - 0.7$$

$$i_D = -\frac{V_i - 0.7}{2}$$

Comprobamos

Si  $V_i > 8'2 \rightarrow D_2$  RUPT  $D_1$  ON  
 $D_2$  OFF



$$i_D = \frac{V_i - 0'7 - 0'7}{2R} = \frac{V_i - 1'4}{2R}$$

$$V_o = V_i - i_D R$$

$$V_o = V_i - \left( \frac{V_i - 1'4}{2R} \right) R = \frac{V_i + 1'4}{2}$$

$$\boxed{V_o = \frac{V_i + 1'4}{2}}$$

$V_i$	$D_1$	$D_2$	$D_2$	$V_o$
$V_i < 0'7$	OFF	ON	OFF	$V_o = V_i \rightarrow \frac{V_i - 0'7}{2}$
$0'7 < V_i < 1'4$	OFF	OFF	OFF	$V_i$
$V_i > 1'4$	ON	OFF	RUPT	$\frac{V_i + 1'4}{2}$

b) Limitación Diodes  $\rightarrow I_D < 100 \text{ mA}$

$D_1 \rightarrow i_D = \frac{V_i - 1'4}{2R} < 100 \text{ mA} \Rightarrow V_i - 1'4 < 200$

$$\boxed{V_i < 201'4 \text{ V}}$$

$D_2 \rightarrow i_D = \frac{-0'7 - V_i}{2R} < 100 \text{ mA}$

$$-0'7 - V_i < 200 \Rightarrow \boxed{V_i > -200'7 \text{ V}} \quad \boxed{-200'7 < V_i < 201'4}$$

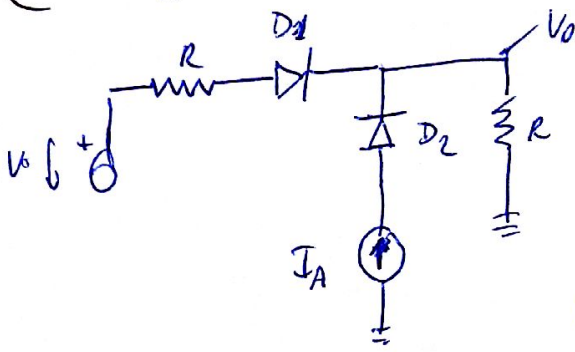
~~$V_i < 200'7 \text{ V}$~~   
 ~~$V_i > -200'7 \text{ V}$~~

$D_2 \rightarrow P_{\text{max}} \rightarrow P = VI \Rightarrow I = \frac{P}{V} = \frac{600 \text{ mW}}{7'5 \text{ V}} = 80 \text{ mA}$

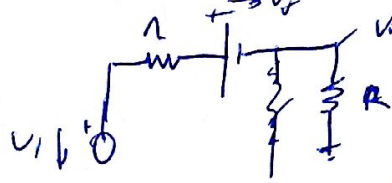
$i_D < 80 \text{ mA} \rightarrow \frac{V_i + 1'4}{2} < 80 \Rightarrow V_i < 160 - 1'4 \Rightarrow \boxed{V_i < 158'6}$

Revisar

(11)  $I_A = 25\text{mA}$   $R = 1\text{k}\Omega$



Supponems  $D_1 \text{ ON}$ ,  $I_D = 0$



~~$V_i - i_D R - 0.7 - i_D R$~~

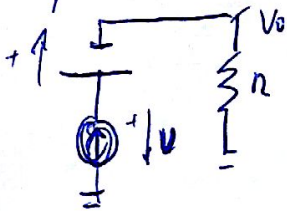
~~$V_i = 0.7$~~

~~$V_i - i_D R - 0.7 - V_o$~~

$V_i - V_o \geq 0.7$

$$\left\{ \begin{array}{l} V_i - V_o \geq 0.7 \text{ } D_1 \text{ ON} \\ V_i - V_o < 0.7 \text{ } D_1 \text{ OFF} \end{array} \right.$$

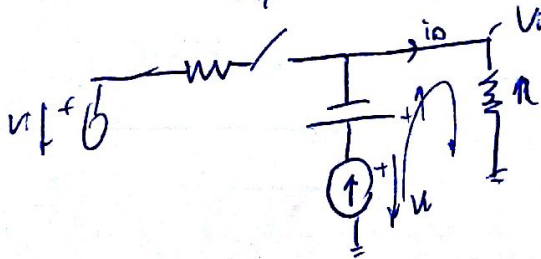
Supponems  $D_2 \text{ ON}$ ,  $I_D = 0$



$U - 0.7 - V_o = 0$

$$\left\{ \begin{array}{l} U - V_o \geq 0.7 \text{ } D_2 \text{ ON} \\ U - V_o < 0.7 \text{ } D_2 \text{ OFF} \end{array} \right.$$

HIP 1.  $D_1 \text{ OFF}$ .  $D_2 \text{ ON}$



$I_D = 2.5\text{mA}$

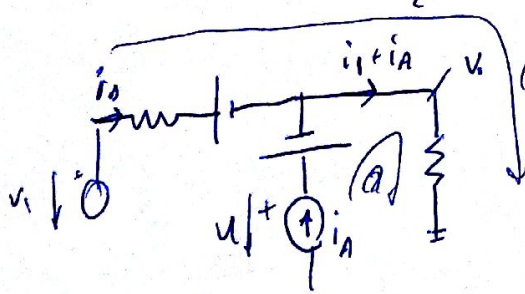
$$i_D = \frac{U - 0.7}{R}$$

$$V_o = 2.5\text{mA} \cdot 1\text{k}\Omega = 2.5\text{V}$$

~~$V_o = i_D R = \frac{U - 0.7}{R} \cdot R$~~

Comparison:  $D_1 \text{ OFF} \rightarrow V_i - V_o < 0.7$   
 $V_i - 2.5 < 0.7$   
 $V_i < 3.2$  ✓

HIP 2  $V_i \geq 3.2 \rightarrow D_1 \text{ ON}$   
 $D_2 \text{ ON}$



①  $V_i - i_D R - 0.7 - (i_1 + i_A) R = 0$

②  $U - 0.7 - (i_1 + i_A) R = 0$

①  $V_i - 2i_D (1\text{k}) - 0.7 - 2.5 = 0$

$$i_1 = \frac{V_i - 0.7 - 2.5}{2} = \frac{V_i - 3.2}{2}$$

$V_o = (i_1 + i_A) R$

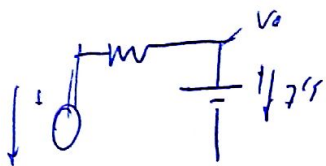
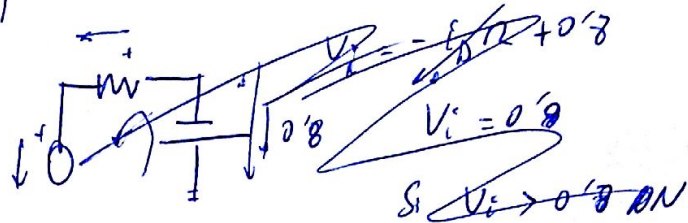
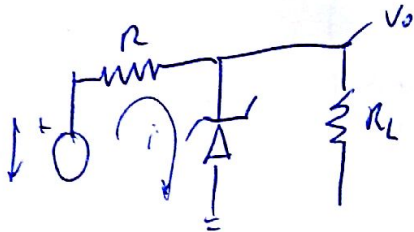
$$V_o = \left( \frac{V_i - 3.2}{2} + 2.5 \right) \cdot 1\text{k}$$

$V_i \geq 3.2 \rightarrow V_o \geq 2.5$   
 $D_2 \text{ ON} \rightarrow V_i - V_o \geq 0.7$   
 $V_i \geq 3.2 \rightarrow \checkmark$

$V_i$	$D_1$	$D_2$	$V_o$
$V_i \leq 3.2$	OFF	ON	2.5
$V_i > 3.2$	ON	ON	$(2.5 + \frac{V_i - 3.2}{2}) 1k$

(9)  $V_2 = 7.5$   $I_{L, min} = 4mA$ ,  $P_{D, max} = 600mW$ ,  $R_L = 3k\Omega$   $R = 1k$

Suponemos  $D_2$  ON,  $I_D = 0$



$$V_i - i_D R - 7.5 = 0$$

$$V_i = 7.5$$

$V_o > 7.5 \rightarrow D_2$  RUPTURA

$$V_o \text{ si } V_i = -\frac{5}{4}R - 0.8$$

$$V_i \leq 0.8 \text{ ON}$$

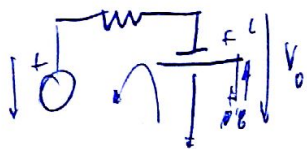
$$V_o \leq -0.8$$

~~$V_o > 7.5$~~

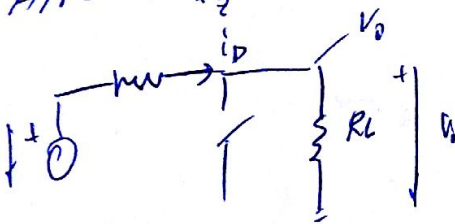
$V_o \leq -0.8$  ON

$-0.8 < V_o < 7.5$  OFF

$V_o > 7.5$  RUPT.



HIPOT  $\rightarrow D_2$  OFF

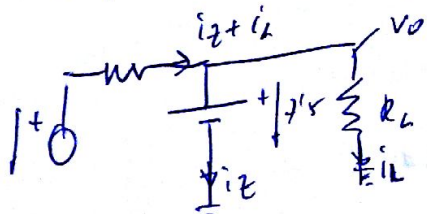


$$V_o = V_i \frac{3}{3+1} = V_i \frac{3}{4} \Rightarrow \boxed{V_o = \frac{3}{4} V_i}$$

$$D_2 \text{ OFF} \rightarrow -0.8 < \frac{3}{4} V_i < 7.5$$

$$\boxed{-1.06 < V_i < 10}$$

Si  $V_i > 10 \rightarrow V_o > 7.5$  Rupt.



$$V_o = i_2 R$$

$$V_i - (i_1 + i_2)R - 7.5 = 0$$

$$V_i = (i_2 + 2.5)R + 7.5$$

$$i_2 = \frac{V_i - 7.5}{R} = 2.5mA$$

$$\boxed{V_o = 7.5}$$

$$7.5 = i_2 R_L \Rightarrow$$

$$i_2 = \frac{7.5}{R_L} = \frac{7.5}{3} = 2.5mA$$

$$\cancel{V_i > 10 \rightarrow V_o > 7.5}$$

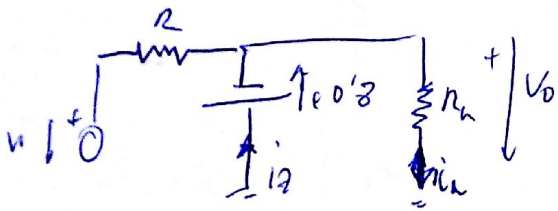
~~$i_2$  a  $i_1$  tiene que ser mayor que  $i_2$~~



Continuación de (9)

(5)

$$\text{Si } V_o \leq -1'06 \rightarrow V_o \leq +0'8 \text{ ON}$$



$$V_o = -0'8 \quad V_o = -i_k \cdot R \rightarrow i_k = -\frac{V_o}{R} = \frac{-0'8}{3} = 0'26$$

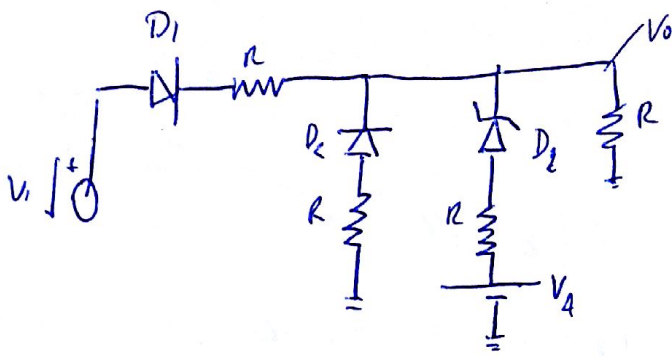
$$i_i \quad 0 - 0'8 - (i_2 + i_k)R = V_i$$

$$i_2 = -V_i - 0'8 - 0'26$$

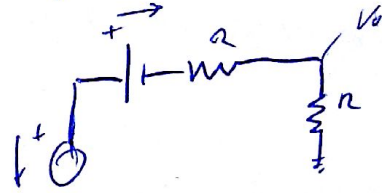
$$i_2 = -V_i - 1'06$$

Mirar en Hojas

(13)  $|V_2| = 5/6$



Suponemos  $D_3$  ON,  $I_D = 0$

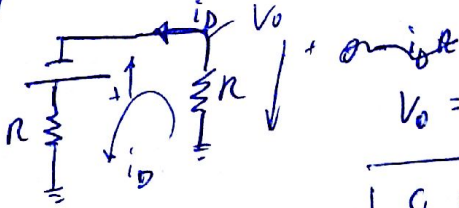


$$V_i - 0.7 - I_D R = \frac{-V_o}{R}$$

$$V_i - 0.7 = 0.7$$

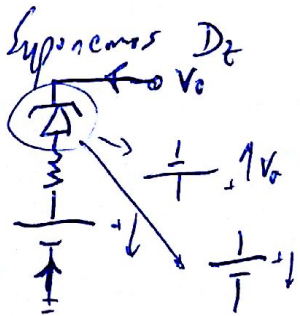
$$D_1 \rightarrow \begin{cases} \text{Si } V_i > 0.7 \text{ ON} \\ \text{Si } V_i < 0.7 \text{ OFF} \end{cases}$$

Suponemos  $D_2$  ON  $I_D = 0$



$$V_o = -0.7 + i_D R$$

$$D_2 \rightarrow \begin{cases} \text{Si } V_o \leq -0.7 \text{ ON} \\ \text{Si } V_o > -0.7 \text{ OFF} \end{cases}$$



$$V_o = -0.8 - \frac{I_D}{2} R + V_A$$

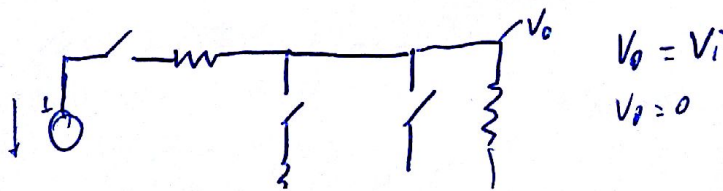
$$V_o - V_A \leq -0.8 \text{ ON}$$

$$V_o = 5/6 + V_A$$

$$V_o - V_A > 5/6 \text{ Ruptura}$$

$$D_3 \rightarrow \begin{cases} \text{Si } V_o - V_A \leq -0.8 \text{ ON} \\ \text{Si } -0.8 < V_o - V_A < 5/6 \text{ OFF} \\ \text{Si } V_o - V_A > 5/6 \text{ RUPTURA} \end{cases}$$

HIPO  $\rightarrow D_1$  OFF  $D_2$  OFF  $D_3$  OFF



$$D_1 \text{ OFF} \rightarrow V_i - V_o < 0.7 \Rightarrow V_i < 0.7 \text{ "}$$

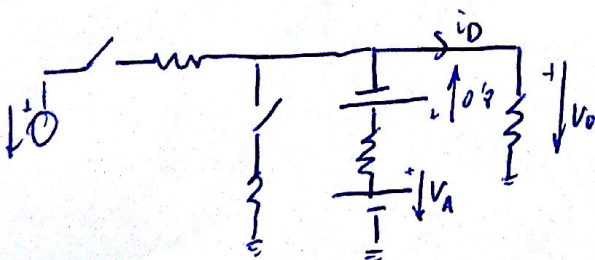
$$D_2 \text{ OFF} \rightarrow V_o > -0.7 \Rightarrow \text{"}$$

$$D_3 \text{ OFF} \rightarrow -0.8 < -4 < 5/6 \Rightarrow \text{"}$$

$$\downarrow$$

$$-4 \leq -0.8 \rightarrow \text{ON}$$

HIPI  $\rightarrow D_1$  OFF  $D_2$  OFF  $D_3$  ON



$$i_D = \frac{V_A - 0.8}{2R}$$

$$V_o = i_D R$$

$$\boxed{V_o = \frac{3.2}{2} = 1.6 \text{ V}}$$

Comprobamos  $\rightarrow D_1$  OFF  $\rightarrow V_i - V_o < 0.7 \Rightarrow V_i < 0.7 + 1.6 \Rightarrow \boxed{V_i < 2.3 \text{ "}}$

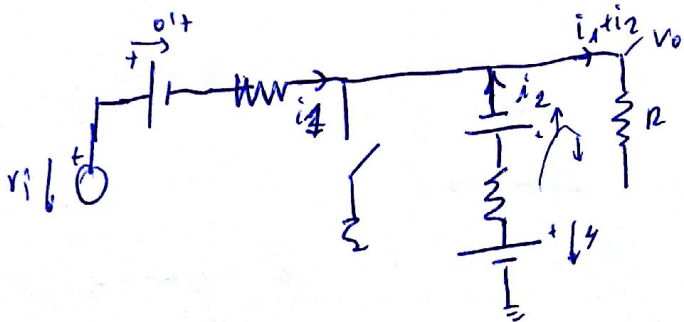
$D_2$  OFF  $\rightarrow V_o > -0.7 \rightarrow 1.6 > -0.7 \text{ "}$

Si  $V_i > 2.3 \rightarrow D_1$  ON

Si  $V_i > 2'3 \rightarrow D_1 \text{ ON}$

(6)

HPP 2  $D_1 \text{ ON } D_2 \text{ OFF } D_3 \text{ ON}$



$$V_o = (i_1 + i_2)R \quad V_o = V_i - 0'7 - i_1 R$$

$$\textcircled{1} V_i - 0'7 - i_1 R - (i_1 + i_2)R = 0$$

$$\textcircled{2} 4 - i_2 R - 0'7 - (i_1 + i_2)R = 0$$

$$\Rightarrow \begin{cases} V_i - 0'7 - 2i_1 R - i_2 R = 0 \\ 3'2 - i_1 R - 2i_2 R = 0 \end{cases}$$

$$\Rightarrow \begin{cases} 2V_i - 1'4 - 3'2 - 3i_1 R = 0 \\ i_1 = \frac{2V_i - 4'6}{3R} \end{cases}$$

$$V_o = V_i - 0'7 - \left( \frac{2V_i - 4'6}{3R} \right) R = \boxed{V_o = \frac{V_i + 2'5}{3}}$$

Comprobamos

$$D_2 \text{ OFF} \rightarrow V_o > -0'7$$

$$\frac{V_i + 2'5}{3} > -0'7 \rightarrow V_i > 2'3$$

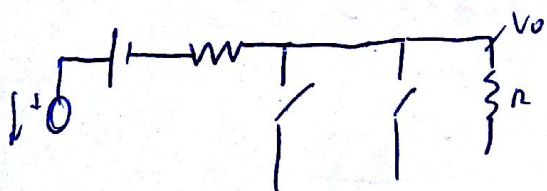
Comprobamos

$$D_3 \text{ ON} \rightarrow V_o - 4 \leq -0'8 \Rightarrow V_o \leq 3'2$$

$$\frac{V_i + 2'5}{3} \leq 3'2 \Rightarrow V_i \leq 7'1$$

Si  $V_i > 7'1 \rightarrow$  Pasa a  $D_2 \text{ OFF}$

HPP 3  $D_1 \text{ ON } D_2 \text{ OFF } D_3 \text{ OFF}$



$$\begin{cases} V_i - 0'7 - i_D R = V_o \\ i_D = \frac{V_i - 0'7}{2R} \\ V_o = i_D R = \frac{V_i - 0'7}{2} \end{cases}$$

Comprobamos

$$D_1 \text{ ON} \rightarrow V_i - V_o > 0'7 \rightarrow V_i - \frac{V_i - 0'7}{2} > 0'7 \Rightarrow \frac{V_i + 0'7}{2} > 0'7 \rightarrow V_i > 0'7$$

$$D_2 \text{ OFF} \rightarrow V_o > -0'7 \rightarrow \frac{V_i - 0'7}{2} > -0'7 \rightarrow 3'2 > -0'7$$

$$D_3 \text{ OFF} \rightarrow -0'8 < \left( \frac{V_i - 0'7}{2} - 4 \right) < 5'6 \quad \text{ERROR}$$

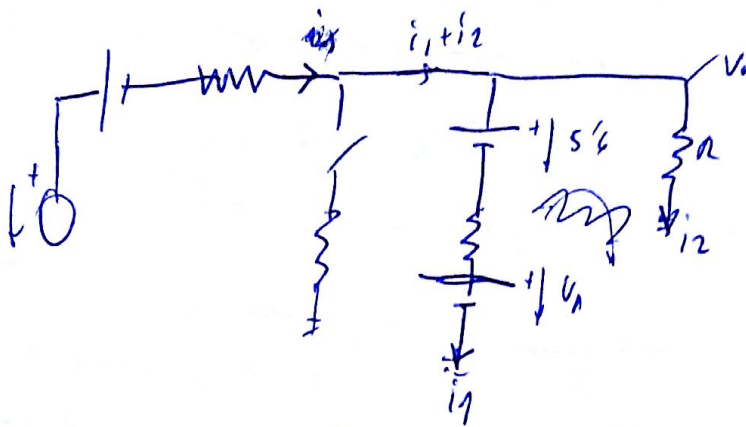
$$\frac{V_i - 0'7}{2} - 4 < 5'6 \Rightarrow \frac{V_i - 0'7}{2} < 9'6 \Rightarrow \boxed{V_i < 19'9 \text{ V}} \rightarrow D_3$$

Si  $V_i > 19'9 \rightarrow D_3 \rightarrow$  RUPTURA

HIP 4 S  $V_i > 19/9 \rightarrow D_2$  Repetido

$D_1$  ON

$D_2$  OFF



$$V_o = i_2 R$$

~~$$V_i - 0.7 =$$~~

$$(1) V_i - 0.7 - (i_1 + i_2)R - i_2 R = 0$$

$$(2) \text{  ~~} V_i - 0.7 - (i_1 + i_2)R - 5.6 - i_1 R - 4 = 0~~$$

~~$$V_i - 0.7 - (i_1 + i_2)R - 5.6 - i_1 R - 4 = 0$$~~

$$\Rightarrow \begin{cases} (V_i - 0.7 - i_1 R - 2i_2 R = 0) \\ (V_i - 10.3 - 2i_1 R - i_2 R = 0) \end{cases} \Rightarrow \begin{cases} V_i + 8.9 - 3i_2 R = 0 \\ V_i - 10.3 - 2i_1 R - i_2 R = 0 \end{cases} \Rightarrow \boxed{i_2 = \frac{V_i + 8.9}{3R}}$$

$$\boxed{V_o = \frac{V_i + 8.9}{3}}$$

Comprobado

$D_1$  ON  $\rightarrow V_i - V_o > 0.7 \rightarrow$  ~~OK~~  $\checkmark$

$D_2$  OFF  $\rightarrow V_o > -0.7 \rightarrow 9.6 > -0.7 \checkmark$

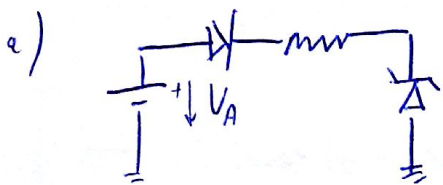
$D_2$  OFF  $\rightarrow V_o - V_A > 5.6 \rightarrow 9.6 - 4 > 5.6 \rightarrow 5.6 > 5.6 \checkmark$

TABLA

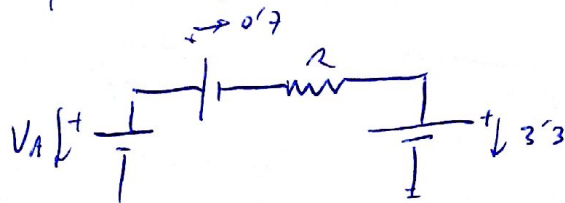
$V_i$	$D_1$	$D_2$	$D_2$	$V_o$
$V_i < 2.3$	OFF	OFF	ON	1.6
$2.3 < V_i < 7.1$	ON	OFF	ON	$\frac{V_i + 2.5}{3}$
$7.1 < V_i < 19/9$	ON	OFF	OFF	$\frac{V_i - 0.7}{2}$
$V_i > 19/9$	ON	OFF	RUPT	$\frac{V_i + 8.9}{3}$

1)  $V_A = 3.3$   $R = 2K$

7



Suponemos  $D_1$  ON  $D_2$  Rupt  $I_D = 0$

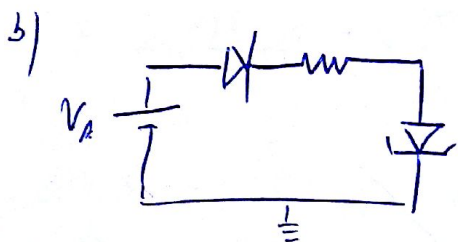


$V_A > 0.7 \rightarrow D_1$  ON

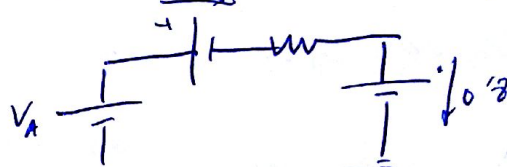
$V_A - 0.7 - I_D R - 3.3 = 0$

$V_A = 10; i_D = \frac{V_A - 0.7 - 3.3}{2} = 3mA$

$V_A = 4$  Si  $V_A > 4 \rightarrow D_1$  ON  $D_2$  Rupt  
 Si  $V_A < 4 \rightarrow D_1$  OFF



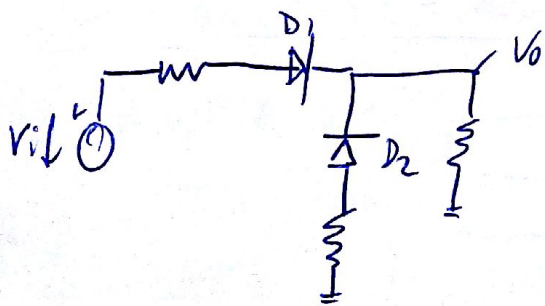
Para que circule  $I > 0 \rightarrow D_1$  ON  $D_2$  ON



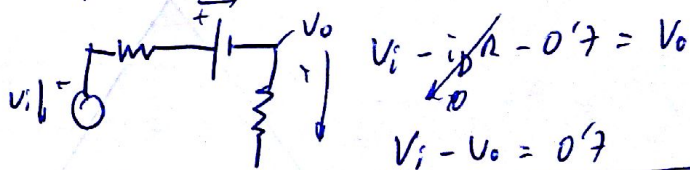
$V_A = 10; i_D = \frac{V_A - 0.7 - 0.7}{2} = 4.25mA$   $V_A - 0.7 - I_D R - 0.7 = 0$

$V_A = 1.5 \rightarrow$  Si  $V_A > 1.5 \rightarrow D_1$  ON  
 Si  $V_A < 1.5 \rightarrow D_2$  OFF

4)  $I_{max} = 5mA, R = 1K\Omega$

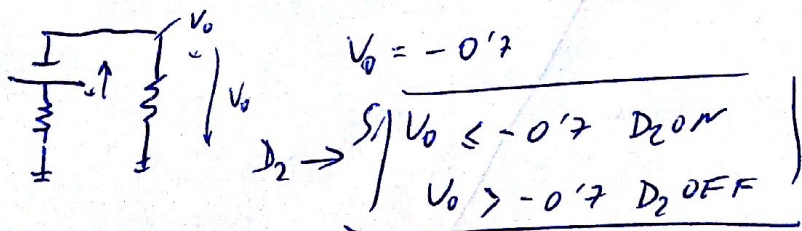


a) Suponemos  $D_1$  ON,  $I_D = 0$



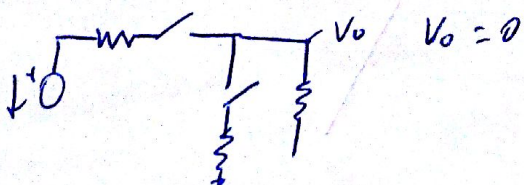
$V_i - \frac{i_D R}{2} - 0.7 = V_o$   
 $V_i - V_o = 0.7$   
 Si  $V_i - V_o > 0.7 \rightarrow D_1$  ON  
 Si  $V_i - V_o < 0.7 \rightarrow D_1$  OFF

b) Suponemos  $D_2$  ON,  $I_D = 0$



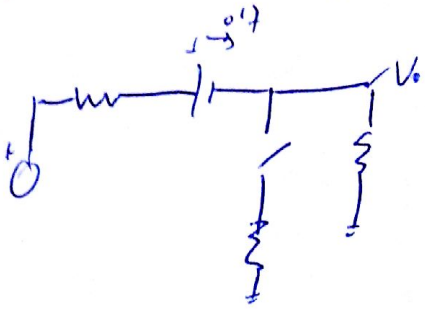
$V_o = -0.7$   
 Si  $V_o \leq -0.7 \rightarrow D_2$  ON  
 Si  $V_o > -0.7 \rightarrow D_2$  OFF

HIPO  $\rightarrow D_1$  OFF,  $D_2$  OFF



Comprobamos  $D_1$  OFF  $\rightarrow V_i - V_o < 0.7 \rightarrow V_i < 0.7$  ✓  
 $D_2$  OFF  $\rightarrow V_o > -0.7 \rightarrow 0 > -0.7$  ✓

• Si  $V_i > 0.7 \rightarrow D_1 \text{ ON } D_2 \text{ OFF}$



$$i_D = \frac{V_i - 0.7}{2R}$$

$$V_o = i_D R = \frac{V_i - 0.7}{2} \Rightarrow \boxed{V_o = \frac{V_i - 0.7}{2}}$$

Comprobamos

$$D_2 \text{ OFF} \rightarrow V_o > -0.7$$

$$\frac{V_i - 0.7}{2} > -0.7$$

$$D_1 \text{ ON} \rightarrow V_i - V_o > 0.7$$

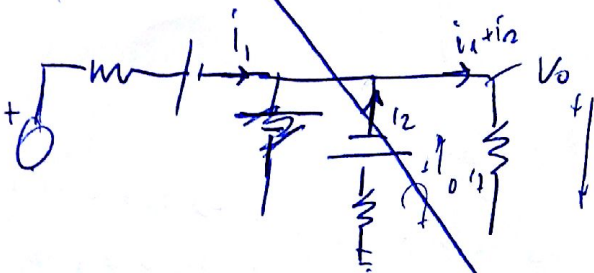
$$\boxed{V_i > -0.7}$$

• Si  $-0.7 < V_i < 0.7 \rightarrow D_1 \text{ OFF } D_2 \text{ OFF}$

$$V_i - \frac{V_i - 0.7}{2} > 0.7$$

$$\frac{V_i + 0.7}{2} > 0.7$$

• Si  $V_i \leq -0.7 \rightarrow D_2 \text{ ON } D_1 \text{ ON}$



$$V_o = V_i - 0.7 - i_1 R \quad V_i > 1.4$$

$$V_i > 2.8$$

$$V_i - i_1 R - 0.7 - (i_1 + i_2) R = 0$$

$$0 - i_2 R - 0.7 - (i_1 + i_2) R = 0$$

$$\Rightarrow \begin{cases} (V_i - 0.7 - 2i_1 R - i_2 R = 0) \\ -(-0.7 - i_1 R - 2i_2 R = 0) \end{cases} \Rightarrow \begin{cases} 2V_i - 1.4 + 0.7 - 3i_1 R = 0 \\ 2V_i - 1.4 + 0.7 - 3i_1 R = 0 \end{cases}$$

$$\boxed{I_1 = \frac{2V_i - 0.7}{3R}}$$

$$V_o = V_i - 0.7 - \left( \frac{2V_i - 0.7}{3R} \right) R = \boxed{V_o = \frac{V_i}{3} - 1.4}$$

$$V_o = -0.7$$

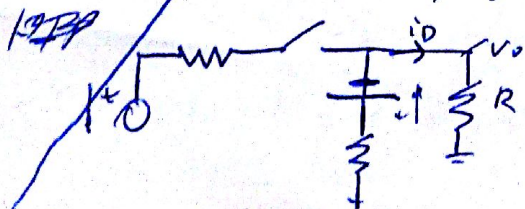
Comprobamos

$$D_1 \text{ ON} \rightarrow V_i - V_o > 0.7 \rightarrow V_i > 1.07 + V_o \Rightarrow \boxed{V_i > 0} \rightarrow D_1 \text{ ON}$$

$$D_2 \text{ ON} \rightarrow V_o \leq -0.7 \rightarrow -0.7 \leq -0.7 \Rightarrow V_i - \left( \frac{V_i}{3} - 1.4 \right) > 0.7$$

$$\frac{2V_i + 1.4}{3} > 0.7 \Rightarrow \boxed{V_i > 0.35}$$

• Si  $V_i < 0.35, D_1 \text{ OFF } D_2 \text{ ON}$



$$V_o = i_D R$$

$$0 - i_D R - 0.7 - i_D R = 0$$

$$-2i_D R - 0.7 = 0$$

$$\boxed{V_i = \frac{0.7}{2} = 0.35}$$

$$i_D = \frac{0.7}{2R}$$

Comprobamos

$$D_1 \text{ OFF} \rightarrow V_i - V_o < 0.7$$

$$V_i < 1.05$$

$$D_2 \text{ ON} \rightarrow$$

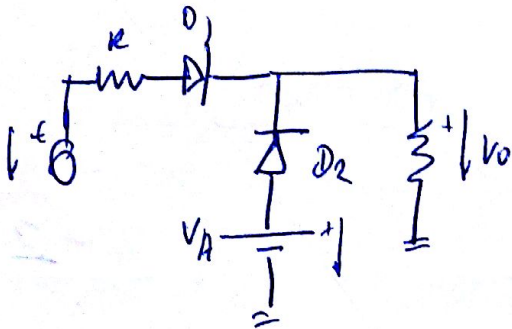
$$V_o \leq -0.7$$

$$0.35 < -0.7$$

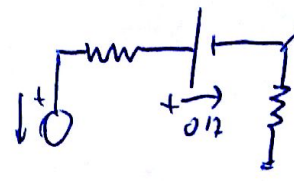
b)  $D_1 \rightarrow \frac{V_i - 0.7}{2R} < 50 \mu A \rightarrow V_i - 0.7 < 100 \Rightarrow \boxed{V_i < 100.7 V}$

~~Diagram~~

5)  $V_A = 2V, I_{max} = 50 \mu A, R = 1K$



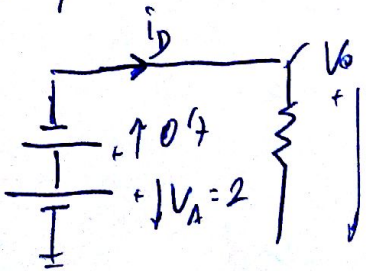
a) Suponemos  $D_1$  ON,  $I_D = 0$



$V_i - i_D R - 0.7 - V_o = 0$   
 $V_i - V_o = 0.7$

$D_1 \rightarrow \begin{cases} V_i - V_o \geq 0.7 \text{ ON} \\ V_i - V_o < 0.7 \text{ OFF} \end{cases}$

b) Suponemos  $D_2$  ON,  $I_D = 0$

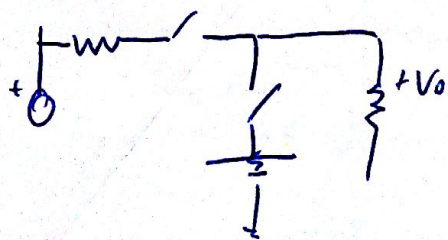


$V_o = -0.7 + 2 = 1.3$

~~$V_A = V_o$~~   
 ~~$V_A = V_o$~~   
 ~~$V_A = V_o$~~

$\begin{cases} V_o \geq 1.3 \text{ ON} \\ V_o < 1.3 \text{ OFF} \end{cases}$

HIPO +  $D_1$  OFF  $D_2$  OFF



$V_o = 0$   
 $V_o = V_i$

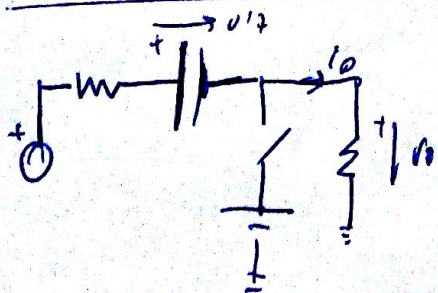
Comprobamos

$D_1$  OFF  $\rightarrow V_i - V_o < 0.7 \rightarrow V_i < 0.7$  ✓

$D_2$  OFF  $\rightarrow V_o < 1.3 \rightarrow 0 < 1.3$  ✓

$\therefore V_i \geq 0.7 \rightarrow D_1$  ON

HIPI  $\rightarrow D_1$  ON,  $D_2$  OFF  $V_i \geq 0.7$



$i_D = \frac{V_i - 0.7}{2R}; V_o = i_D R \Rightarrow \boxed{V_o = \frac{V_i - 0.7}{2}}$

Comprobamos

~~$D_1$  ON  $\rightarrow V_i - V_o \geq 0.7$~~

$D_2$  OFF  $\rightarrow V_o < 1.3 \rightarrow \frac{V_i - 0.7}{2} < 1.3 \rightarrow \boxed{V_i < 3.3}$

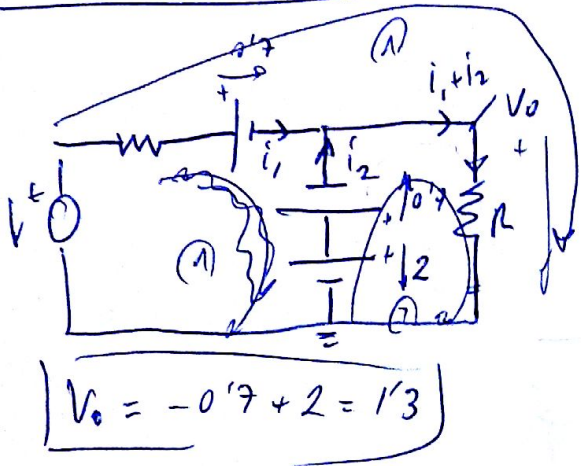
$\therefore V_i \geq 3.3 \rightarrow D_2$  ON

Comprobamos  $D_1 ON \rightarrow V_i - V_o > 0,7 \rightarrow V_i - \left(\frac{V_i - 0,7}{2}\right) > 0,7 \Rightarrow \frac{V_i + 0,7}{2} > 0,7 \Rightarrow$

$\Rightarrow V_i > 0,7 \checkmark$

$V_i > 3,3 \rightarrow D_2 ON$

HIP 2  $D_1 ON$   $D_2 ON$



①  $V_i - i_1 R - 0,7 - (i_1 + i_2)R = 0$

②  $0,2 - 0,7 - (i_1 + i_2)R = 0$   
 $V_o = -0,7 + 2 + (i_1 + i_2)R + 0,7 - 2 = 0$

$\Rightarrow \begin{cases} V_i - 0,7 - 2i_1 R - i_2 R = 0 \\ -(1,3 - i_1 R - i_2 R) = 0 \end{cases}$

$V_i - 0,7 + 1,3 - i_1 R = 0 \Rightarrow i_1 = \frac{V_i + 0,6}{R}$

$V_o = -0,7 - i_1 R + V_i$

Comprobamos

~~$D_1 ON \rightarrow V_i - V_o > 0,7 \Rightarrow V_i > 2$~~

$V_o = V_i - 0,7 - \left(\frac{V_i + 0,6}{R}\right)R \Rightarrow V_o = -0,7 - 0,6 = -1,3 + 1,3$

Comprobamos

$D_1 ON \rightarrow V_i - V_o > 0,7 \rightarrow V_i > 1,0,7 + V_o \Rightarrow V_i > 2 \text{ y } 3,3 > 2 \checkmark$

$D_2 ON \rightarrow V_o > 1,3 \rightarrow 1,3 > 1,3 \checkmark$

TABLA

$V_i$	$D_1$	$D_2$	$V_o$
$V_i < 0,7$	OFF	OFF	0
$0,7 < V_i < 3,3$	ON	OFF	$\frac{V_i - 0,7}{2}$
$V_i > 3,3$	ON	ON	1,3

b) Para no superar  $D_1 \rightarrow$

$i_D = \frac{V_i - 0,7}{2R} < 50 \text{ mA}$

$V_i - 0,7 < 50 \cdot 2 \text{ mA}$

$V_i < 100,7$

~~$V_i < 100,7$~~