$$V_{(\infty^-)} = K_1 \cdot e^{\frac{\infty}{R_C}} + K_2 \Rightarrow 10'66 = K_2$$

$$V_{(0^+)} = K_1 e^{\frac{0}{R_C}} + K_2 = K_1 + K_2 \Rightarrow -1'92 = K_1 + K_2$$

$$\Big\} -12'58 = K_1$$

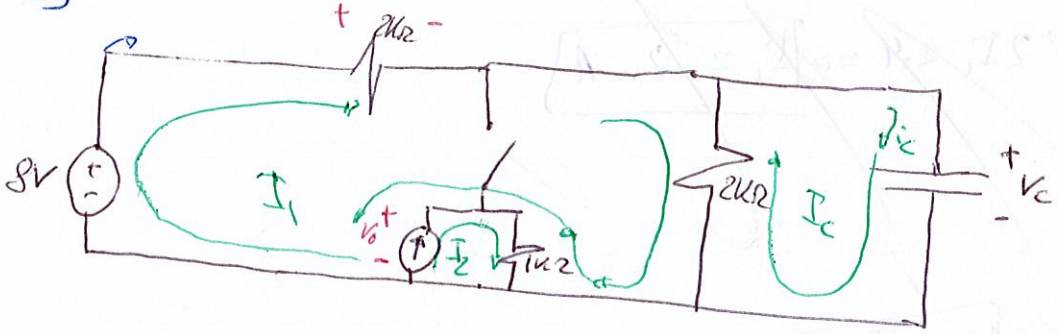
$$V_{(0'0'25)} = -12'58 \cdot e^{\frac{0'25}{2'66}} + 10'66 = -13'82 + 10'66 = -3'16\,V$$

$$\tau \rightarrow \tau = 200\mu F \cdot 2'66 K\Omega = 532\,mS$$

$$4\tau = 2128\,mS = 2'13\,s$$

$$F = \frac{1}{T} = 0'47\,Hz$$

a)



~~$2I_1 + 2I_2 - 2I_c = 8 \Rightarrow 2I_1 + 32 =$~~

~~$I_2 = V_0 \Rightarrow I_2 = 16mA \Rightarrow V_0 = 16V$~~

$I_c = 0\,A$ izango da, kondentsadorea denbora luzez baliogo irekita.

$2I_1 + 2I_1 - 2I_c + I_1 - I_2 + V_0 = 8 \Rightarrow 5I_1 - I_2 + V_0 = 8$

$I_2 - I_1 = V_0 \Rightarrow I_2 - I_1 - V_0 = 0$

$2I_c - 2I_1 + V_c = 0$

$4I_1 = 8 \Rightarrow \boxed{I_1 = 2A}$

$-2I_1 + V_c = 0 \Rightarrow \boxed{V_c = 4V}$

$16m - 2 = V_0 \Rightarrow \boxed{V_0 = 14V}$

$\boxed{I_2 = 16mA}$

b)

~~$I_2 = 16mA$~~ $I_2 - I_1 = 16mA \Rightarrow I_2 = 16 - I_1$

$2I_1 + V_0 = 8$

$I_2 - I_3 = V_0 \Rightarrow I_2 - \frac{1}{3}I_2 = V_0 \Rightarrow \frac{2}{3}I_2 = V_0 \Rightarrow \frac{32 - 2I_1}{3} = V_0 \Rightarrow 32 - 2I_1 = 3V_0$

$2I_3 - 2I_c + I_3 - I_2 = 0 \Rightarrow 3I_3 - I_2 = 0 \Rightarrow I_2 = 3I_3$

$2I_c - 2I_3 + V_c = 0$

$2I_1 + V_0 = 8$

$32 - 2I_1 = 3V_0$

$32 + V_0 = 3V_0 + 8$

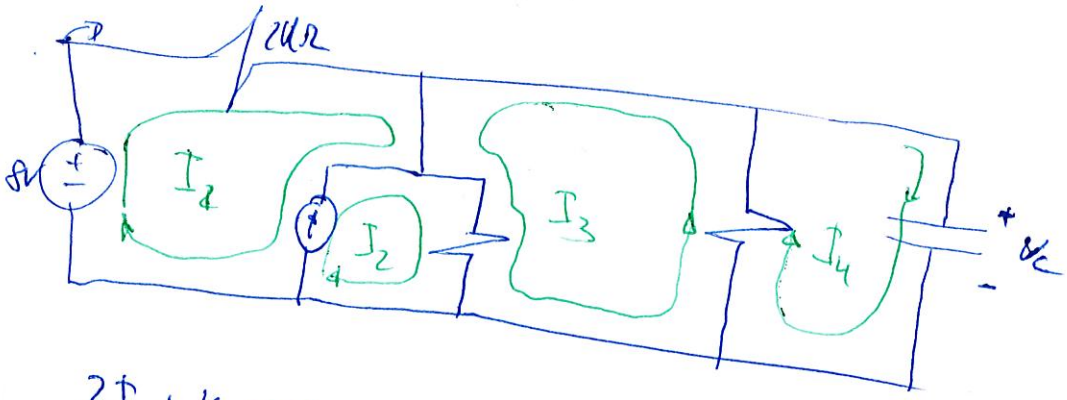
$32 - 8 = 2V_0 \Rightarrow \boxed{V_0 = 12V}$

$2I_1 = 4 \Rightarrow \boxed{I_1 = 2mA}$

$I_2 - I_1 = 16mA \Rightarrow I_2 + 2 = 16 \Rightarrow \boxed{I_2 = 14mA}$

$I_2 = 3I_3 \Rightarrow 14 = 3I_3 \Rightarrow \frac{14}{3} = I_3 \Rightarrow \boxed{I_3 = 4'66mA}$

$-2I_3 = V_C$



$2I_1 + V_0 = 8$

$I_2 + I_3 - V_0 = 0 \Rightarrow I_2 - \frac{I_2}{3} - V_0 = 0 \Rightarrow \frac{2I_2}{3} - V_0 = 0 \Rightarrow 2I_2 = 3V_0 \Rightarrow 32 + 2I_1 = 3V_0$

$2I_3 + 2I_4 + I_3 + I_2 = 0 \Rightarrow 3I_3 + I_2 = 0 \Rightarrow I_3 = -\frac{I_2}{3} \Rightarrow \boxed{I_3 = -5mA}$

$V_C + 2I_4 + 2I_3 = 0 \Rightarrow V_C = -2I_3 \Rightarrow \boxed{V_C = 10V}$

$I_2 - I_1 = 16 \Rightarrow I_2 = 16 + I_1 \Rightarrow I_2 = 15mA$

$2I_1 + V_0 = 8 \quad |\cdot -1$

$32 + 2I_1 = 3V_0$

$32 - V_0 = 3V_0 - 8 \Rightarrow 4V_0 = 40 \Rightarrow \boxed{V_0 = 10V}$

$2I_1 = 2 \Rightarrow \boxed{I_1 = -1mA}$

$V_{(0^+)} = 4V$

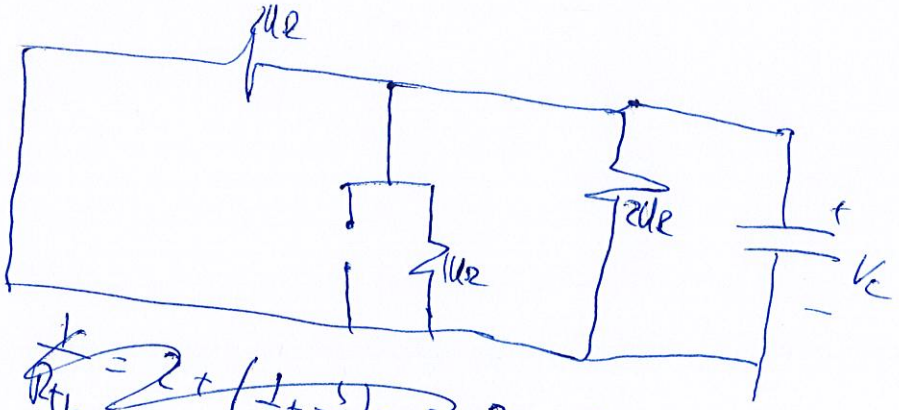
$V_{(0^-)} = 4V$

$V_{(\infty)} = 10V$

$I_C(0^-) = 0A$

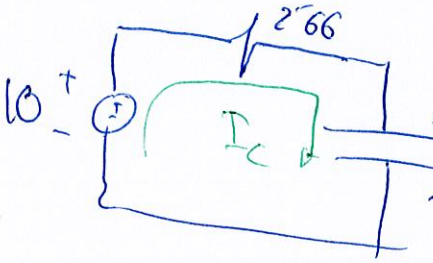
$I_C(0^+) = ?\ 225mA$

Thevenin-en zirkuit baliokidea



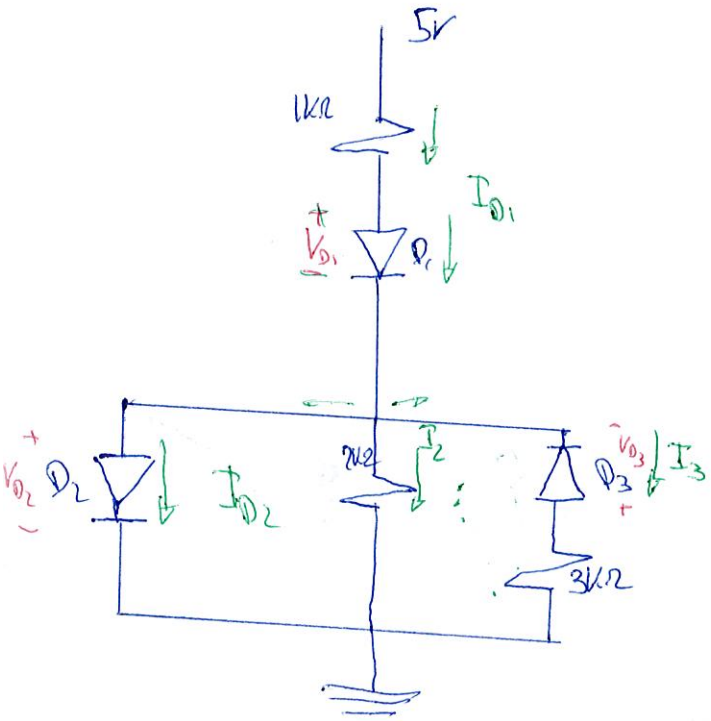
$R_{th} = 2 + \left(\frac{1}{1} + \frac{1}{2}\right) = 2 + \frac{2}{3} = \frac{8}{3}\Omega$

$R_{TH} = \frac{3}{2} + 2 \rightarrow \frac{3}{2} + \frac{2}{3} + 2 = \frac{8}{3}\Omega$



$V_C = 4 \quad 2'66 I_C + 4 = 10 \Rightarrow 2'66 I_C = 6$

$I_C = 2'25mA$



1. Ipotesi (diodoen polarizazioari buruzkoa)

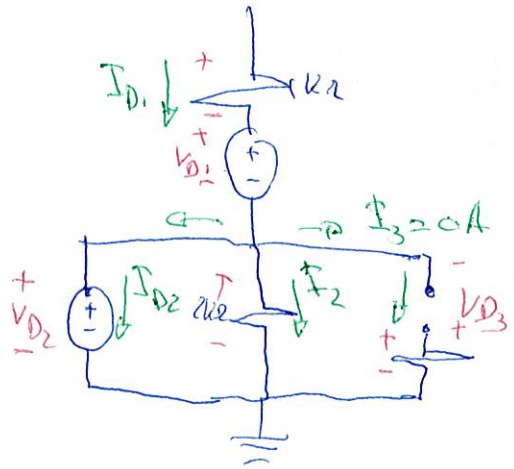
Zehaztu: D_1: ZP; D_2: ZP; D_3: AP:

Ekuazioak: $V_{D_1} = 0'7V$ $V_{D_2} = 0'7V$ $I_3 = 0A$

Baldintzak: $I_{D_1} \geq 0$ $I_{D_2} \geq 0$ $V_{D_3} \leq 0'7V$

Eredua: 

Zirkuitu baliokidea



Zirkuituaren ekuazioak

KKL: $I_{D_1} = I_{D_2} + I_{2k\Omega} + I_3$

KTL: $1I_{D_1} + 0'7 + 0'7 = 5 - 0$

Ezkerreko bidetik: $1I_{D_1} + 0'7 + 2I_2 = 5 - 0$

Eskuinetako bidetik: $I_{D_1} + 0'7 + -V_{D_3} + 3I_3 = 5 - 0$

Soluzioa

(2) → $I_{D_1} = \frac{5 - 0'7 - 0'7}{1} = 3'6\,mA$

(3) → $I_2 = \frac{5 - 0'7 - 3'6m}{2} = 0'35\,mA$

④ → $V_{D3} = \frac{3'6 + 0'2 - 5}{} = -0'2V$

① → $I_{D2} = 3'6 - 0'35 = 3'25mA$

Hipotesiaren egiaztapena:

Baldintzak betetzen dira?

$I_{D1} \geq 0 \Rightarrow I_{D1} = 36mA > 0$

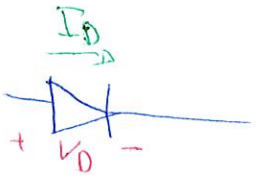
$I_{D2} \geq 0 \Rightarrow I_{D2} = 0'35mA > 0$

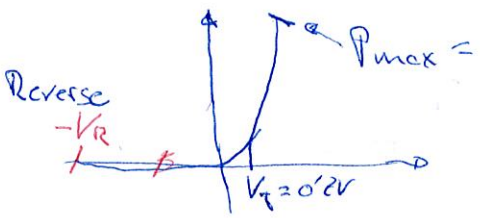
$V_{D3} \leq 0'2V \Rightarrow V_{D3} = -0'2V < 0'2V$

Egindako hipotesia zuzena da.

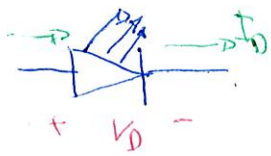
$V_A = V_{A0} = V_{D2} = 2I_2 = -V_{B3} = 0'2V$

Diodo artezleak:





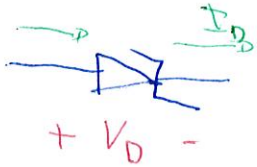
LED diodoa

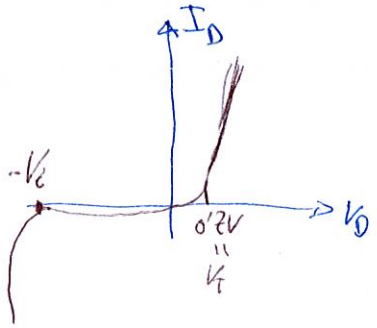


$V_{LED} = 2'2V$ − Gorria

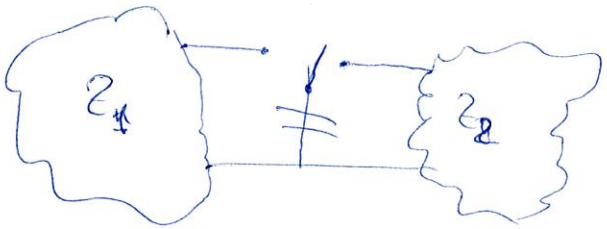
$V_{LED} = 1'7V$ − x

Zener Diodoa

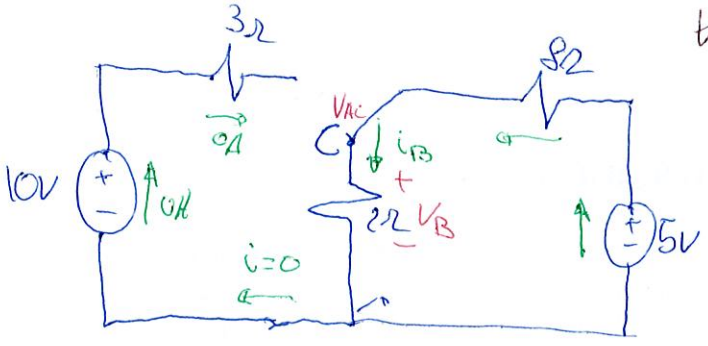




Kommutagailuak



Zirkuitu baten Thevenin-en zirkuituaren baliokide erraz bi zirkuituen zirkuitu baliokide. Lortu ondoren eginiko dugu kommutagailuaren

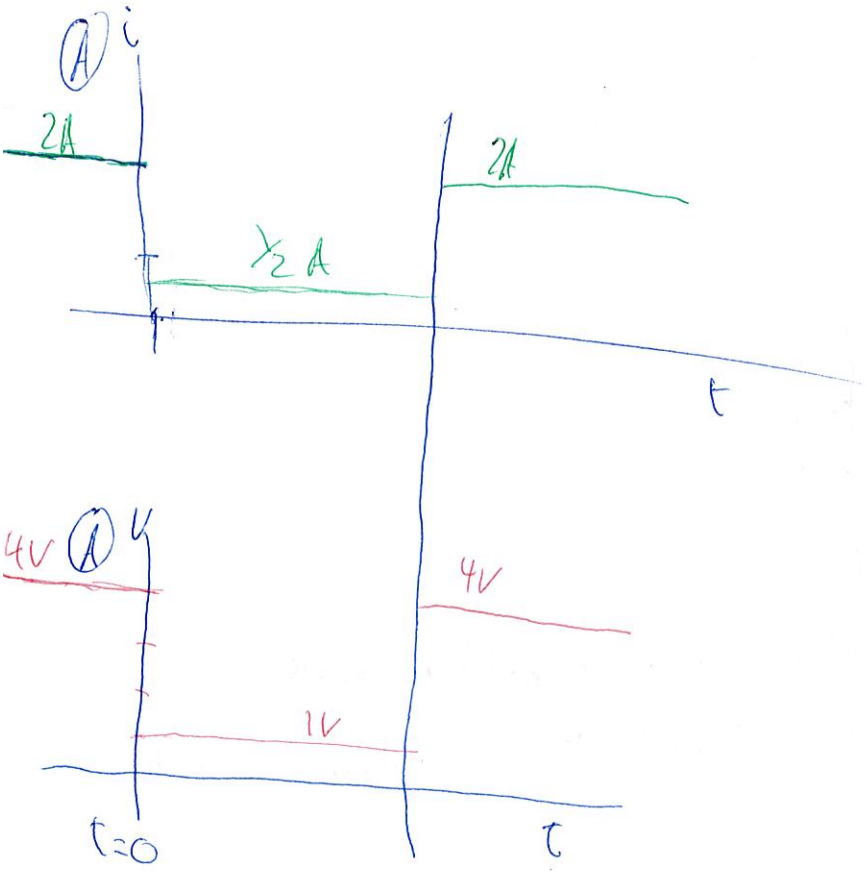


Kurz nach Umlegen in B Position

$V_{AC} = 10V - 1V = 9V$

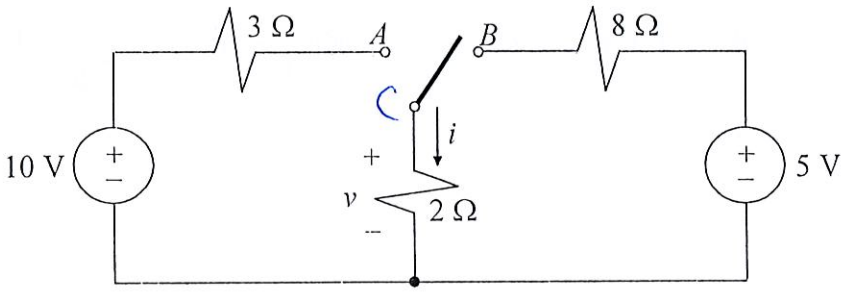
UtL: $-5V + 8i_B + 2i_B = 0 \Rightarrow 10i_B = 5 \Rightarrow i_B = \frac{1}{2}A$

$V_B = 2 \cdot i_B = 1V$

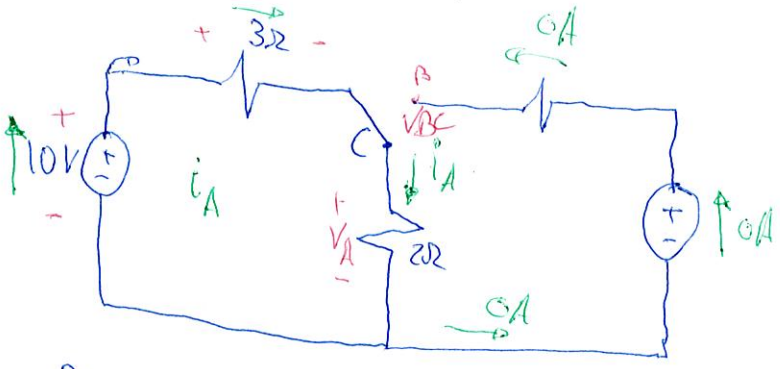


7. gaia: egoera iragankorra

Irudiko zirkuituan, kalkula itzazu v eta i magnitudeen balioak kommutagailuaren bi posizioetarako, A eta B. Zer gertatzen da kommutagailua posizio batetik bestera pasatzean? Irudika itzazu magnitudeen aldaketak denboran zehar kommutagailuaren posizioa aldatzean.



Kommutagailua A posizioan:



$V_{BC} = 0V + 5V - 4V = 1V$

B posizioan zirkuitu irekia bezala geratzen da, beraz, bertatik igarotzen den korrontea 0A-koa izango da. Eta i_A 10V-eko tentsio sorgailuak emandako tentsioa izango da.

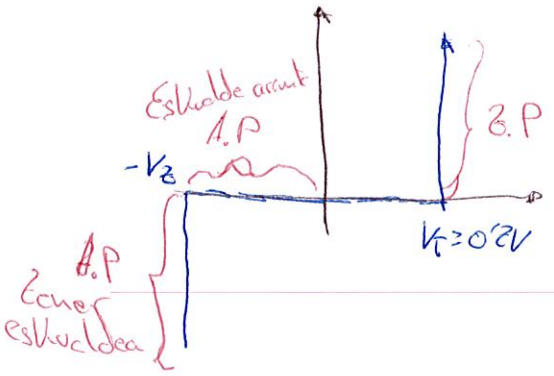
KTL

1. maila: $3i_A + 2i_A - 10 = 0 \Rightarrow 5i_A = 10 \Rightarrow i_A = 2A$

i_A-bera, 2A izango da, eta $V_A = 4V$

$V_A = i_A \cdot 2\Omega = 4V$

Zener diodoetako kurbilketa lineala:



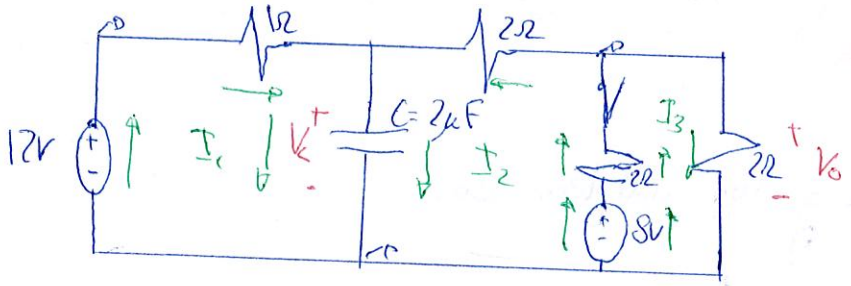
Polarizazio	Z.P	A.P aktiboa	A.P Zener
Eskuzabia	$V_\gamma = 0'2V$	$I_D = 0A$	$V_D = -V_Z$
Beloutza	$I_D \geq 0$	$V_t < V_\gamma = 0'2$	$I_D \leq 0$
Eredua	I_D → 0'2V	$I_D = 0A$ $+V_D-$	I_D V_Z

Erabili Zener diodoak.

9)

Mikel Azkaiti
Aitzol Elu

7



KTL egingo dira maileetan, 3 ekuazio lortuko ditugu.

1. maila: $I_1 + V_c - 12 = 0$.

2. maila: $-8 + 2I_2 + 2I_3 + 2I_2 + V_c = 0 \Rightarrow 4I_2 + 2I_3 + V_c = 8$.

3. maila: $2I_3 - 8 + 2I_3 + 2I_2 = 0 \Rightarrow 4I_3 + 2I_2 = 8 \Rightarrow 2I_3 + I_2 = 4$: -1

$3I_2 + V_c = 4$.

$I_1 + V_c - 12 = 0$.

$3I_2 + V_c = 4$

$I_c = I_1 + I_2 \Rightarrow I_c = 0$ izango da 5 denbora asko baitago itxita.

Beraz, $I_1 = -I_2$

$I_1 + V_c - 12 = 12$

$-3I_1 + V_c = 4$ ..-1

$4I_1 = 8 \Rightarrow I_1 = 2A$.

$I_1 + V_c - 12 = 0$ (I_1 ordezkatu V_c lortuko dugu.)

$V_c - 10 = 0 \Rightarrow V_c = 10V$ $V_c(\infty)$

$V_c = 10V$ izango da kondentsadorean metatuko den tentsioa.

$I_1 = 2A \Rightarrow I_1 = -I_2 \Rightarrow I_2 = -2A$

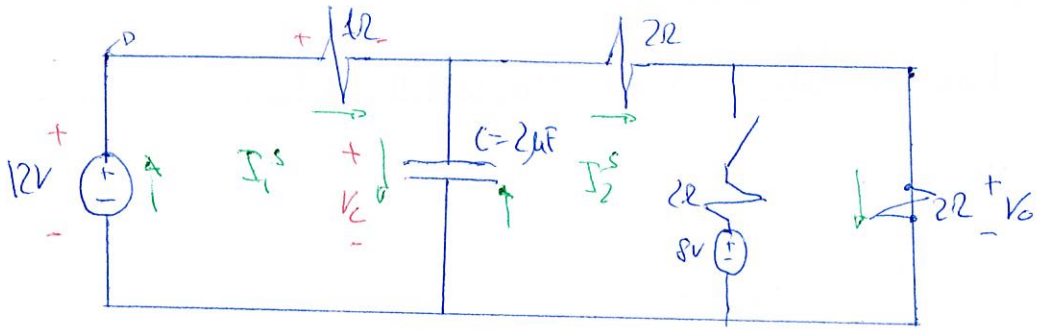
$4I_3 + 2I_2 = 8 \Rightarrow 4I_3 = 12 \Rightarrow I_3 = 3A$

$I_3 = 3A$ bada, $V_o = 2 \cdot I_3 = 6V$ izango da. ✓

$V_o(\infty)$

b)

$t=0$ unean S etengailua irekitzen da.



S denbora luzean badago irekita, $I_c^s = 0A$ izango da.

$I_c^s = 0A \Rightarrow I_1 - I_2 = 0 \Rightarrow I_1 = I_2$ ✓

KTL egin ondoren 2 ekuazio lortuko ditugu bi mailako banaketagu.

1. maila: $I_1^s + V_c = 12 \Rightarrow (I_2^s + V_c = 12) \cdot 1$

2. maila: $2I_c^s + 2I_2^s = V_c \Rightarrow 4I_2^s = V_c$

$3I_2 = 12 \Rightarrow I_2^s = 4A$

$V_c(0^-)$ $V_c = 4I_2^s = 16V$ izango da denbora luze pasa ondoren.

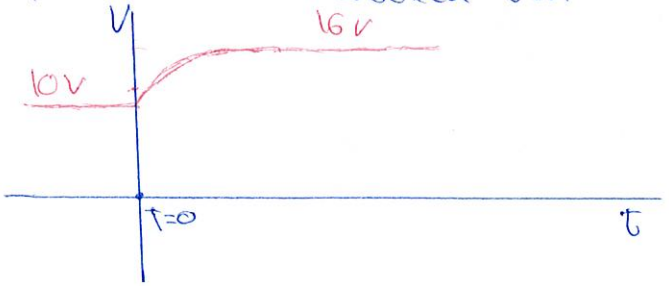
$V_o = 2I_2^s = 8V$ izango da S irekitzen den momentuan.

$V_o(\infty)$ $V_c(0^+)$

$t=0$ unean $V_c = 10V$ izango da kondentsadorean denbora bat behar baita bere tentsioa aldatzen. Ondoa, $V_{c(0^+)} = 16V$ izango da S irekita denbora asko egondakoa.

V_o ordea bi unetan $V_o = 8V$ izango da erresistentziaren boltaia intentsitatea aldatzen den momentuan aldatzen baita.

(hau da kondentsadorearen tentsioaren grafikoa)



c)

Etengailua irekitzean denetik, denbora bat behar du tentsio aldaketa egiten.

Denbora hori honela kalkulatzen da.

$$v_c(0^+) = K_1 e^{-\frac{0}{\tau}} + K_2 \Rightarrow 10V = K_1 + K_2$$

$$v_c(\infty) = K_1 e^{-\frac{\infty}{\tau}} + K_2 \Rightarrow 16 = K_2$$

$$10 = K_1 + 16 \Rightarrow K_1 = -6V$$

$\tau^s = 0{,}8\Omega \cdot 2\mu F = 1{,}6\mu s \Rightarrow 4\tau^s = 6{,}4\mu s$ behar du denbora aldaketa 10V etik 16V era pasatzeko.

$$\frac{1}{R_{Th}} = 1 + \frac{1}{2\Omega} = \frac{5}{4}\Omega$$

$$R_{Th} = \frac{4}{5}\Omega = 0{,}8\Omega$$

Baina, denbora kori Δv_c egitean da, zenbat da $\frac{\Delta v_c^s}{2}$ egitean behar den denbora?

$$\Delta v_c = 16 - 10 = 6V$$

$$\frac{\Delta v_c}{2} = \frac{1}{2} \cdot 6V = 3V$$

$10V = K_1 + K_2 \Rightarrow 10 = K_1 + 13 \Rightarrow -3V = K_1$

$K_2 = 13V$

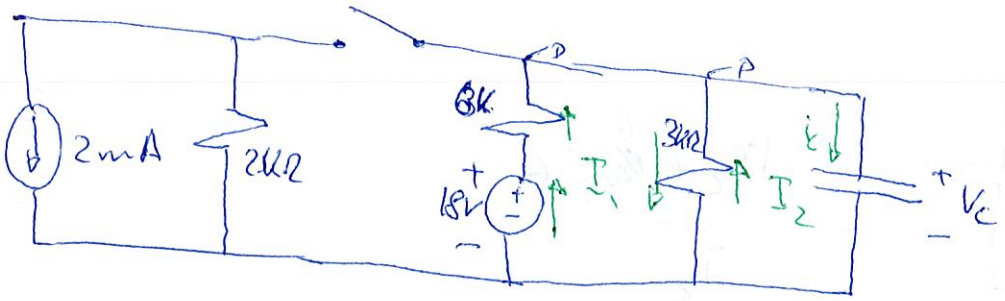
Mikel Azkoiti
Aitzol Elo

$13V = -6 \cdot e^{-\frac{t}{Rc}} + 16 \Rightarrow$ ~~$\ln 3 = \ln 6 \cdot e^{-\frac{t}{Rc}}$~~

$\Rightarrow \frac{3}{6} = e^{-\frac{t}{Rc}} \Rightarrow \ln\frac{1}{2} = \ln e^{-\frac{t}{Rc}} \Rightarrow$

$\Rightarrow \ln\frac{1}{2} = -\frac{t}{Rc} \Rightarrow \ln\frac{1}{2} = -\frac{t}{0'5} \Rightarrow t = 0'55\mu s$

$t = 0'55\mu s$



a)

$$3I_1 - 3I_2 - 18V + 6I_1 = 0 \Rightarrow 9I_1 - 18 = 0 \Rightarrow I_1 = 2A$$

$$V_c + 3I_2 - 3I_1 = 0 \Rightarrow V_c - 3I_1 = 0 \Rightarrow V_c = 6V$$

$I_c = 0A \Rightarrow I_2 = 0A$

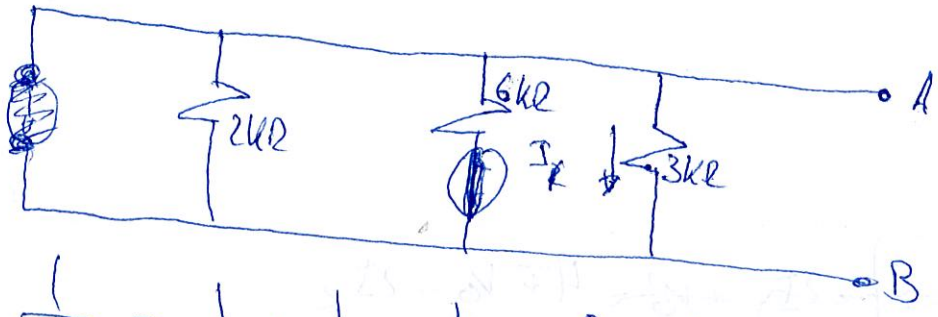
$$\boxed{V_{c(\infty)} = 6V}$$

b)

$V_{c(0^-)} = 6V \quad V_{c(0^+)} = 6V$

$i_{c(0^-)} = 0A \quad V_{c(\infty)} =$

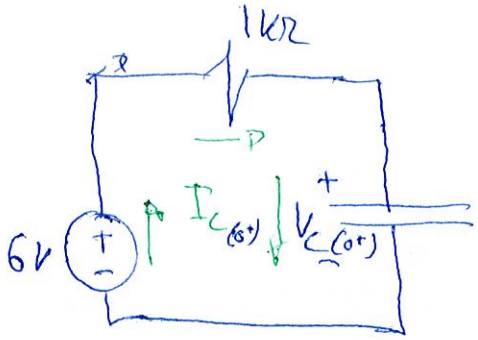
Thevenin-ein zirkuito baliokidea:



$$\frac{1}{R_{Th}} = \frac{1}{2} + \frac{1}{6} + \frac{1}{3} = \frac{3}{6} + \frac{1}{6} + \frac{2}{6} = 1\Omega^{-1}$$

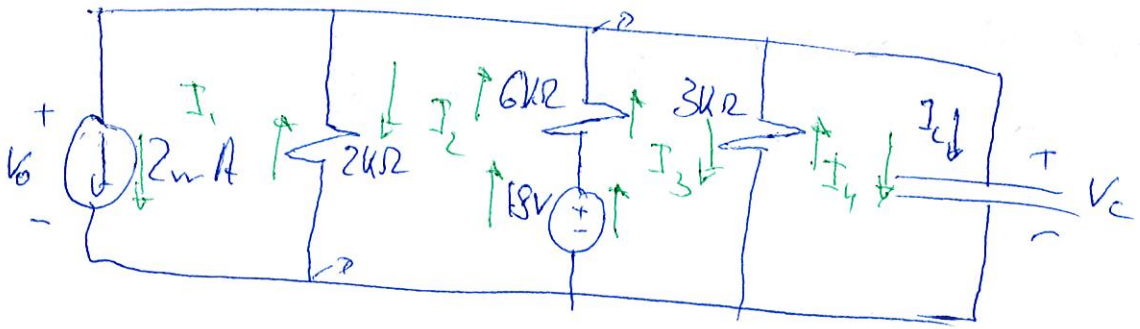
$$\boxed{R_{Th} = 1\Omega}$$

$E_{Th} = V_{AB} = 3k\Omega I_2 = 6V$



$$1I_C + 6 = 6$$

I_C



$2I_1 + V_0 = 0 \Rightarrow 2I_1 - 2I_2 + V_0 = 0$

$6I_2 + 8I_3 + 2I_2 - 2I_1 = 18 \Rightarrow 8I_2 + 6I_3 - 2I_1 = 18$

$8I_3 - 4I_4 + 6I_3 + 4I_2 = 18 \quad 9I_3 + 6I_2 = 18 \Rightarrow (3I_3 + 2I_2 = 6) \cdot -2$

$4I_4 - 3I_3 + V_C = 0$

$4I_2 - 2I_1 = 6$

$4I_2 - 4 = 6$

$I_2 = \frac{10}{4} = \frac{5}{2}$

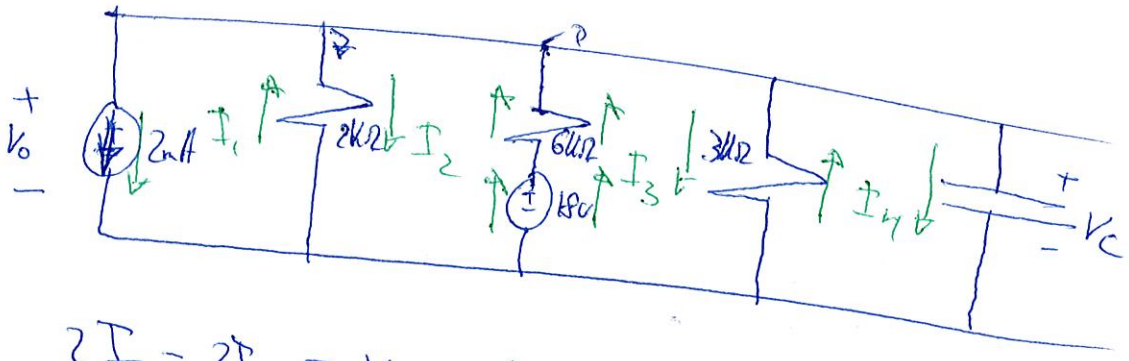
$2I_1 - 2I_2 + V_0 = 0$

$4I_2 - 2I_1 = 6$

$2I_2 + V_0 = 6$

$2I_1 - 2I_2 + V_0 = 0 \Rightarrow -2I_2 + V_0 = 4 + V_0 = 2I_2$

$8I_2 + 6I$



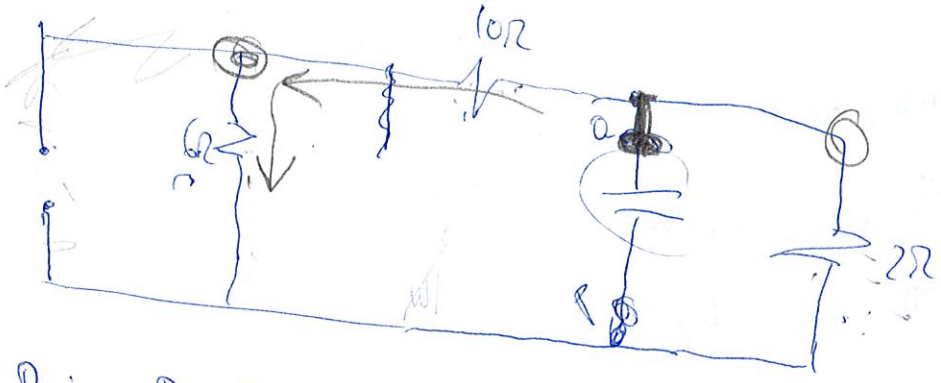
$2I - 2I_2 = V_0 \Rightarrow 4 - 2I_2 = V_0 \Rightarrow 4 + V_0 = 2I_2$

$2I_2 - 2I_1 + 6I_2 + 6I_3 = 18 \Rightarrow 8I_2 + 6I_3 = 22 \Rightarrow 4I_2 + 3I_3 = 11$

$3I_3 + 6I_2 + 6I_3 = 18 \Rightarrow 9I_3 + 6I_2 = 18 \Rightarrow (3I_3 + 2I_2 = 6) \cdot -1$

$V_C - 3I_3 = 0$

$2I_2 = 12$

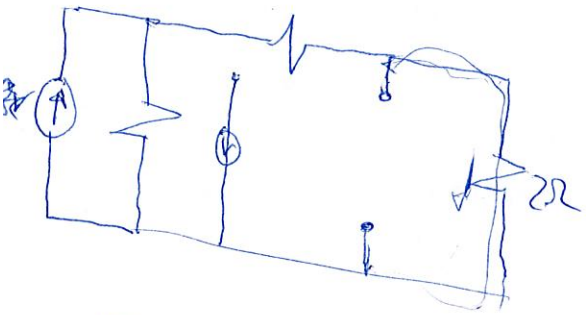


$R_{12} = R_1 + R_2 = 16\,\Omega$

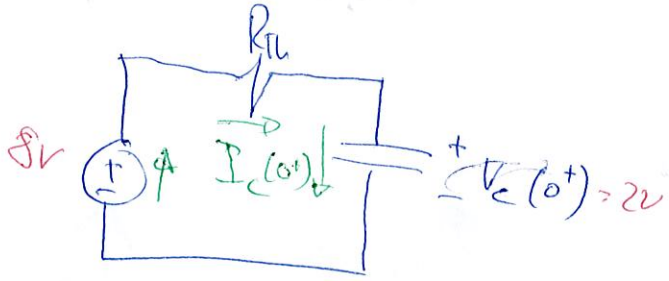
$\frac{1}{R_{Th}} = \frac{1}{R_{12}} + \frac{1}{R_3} = \frac{1}{16} + \frac{1}{2} = \frac{1}{16} + \frac{8}{16} = \frac{9}{16}\,\Omega$

$R_{Th} = 1'77\,\Omega$

E_{Th}

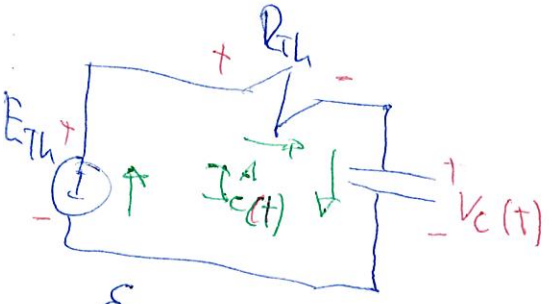


$E_{Th} = I_3 \cdot 2\Omega = 8V$



$1'77\,I_c(0^+) + 2V = 8V$

$I_c(0^+) = \frac{6}{1'77} = 3'375\,A$



Ahora ecuaciones:

LKL: $R_{Th}\,I_c(t) + V_c(t) = E_{Th} \Rightarrow 1'77\,I_c(t) + V_c(t) = 8$

Condensadores: $I_c(t) = C \cdot \frac{dV_c(t)}{dt}$

$R_{Th}\left(C \cdot \frac{dV_c(t)}{dt}\right) + V_c(t) = 8$

$$u_c(t) = K_1 e^{-t/\tau_c} + K_2 \Rightarrow$$

$$8V = u_c^A(0^+) = K_1 e^{-\frac{0}{\tau_c}} + K_2 = K_1 + K_2$$

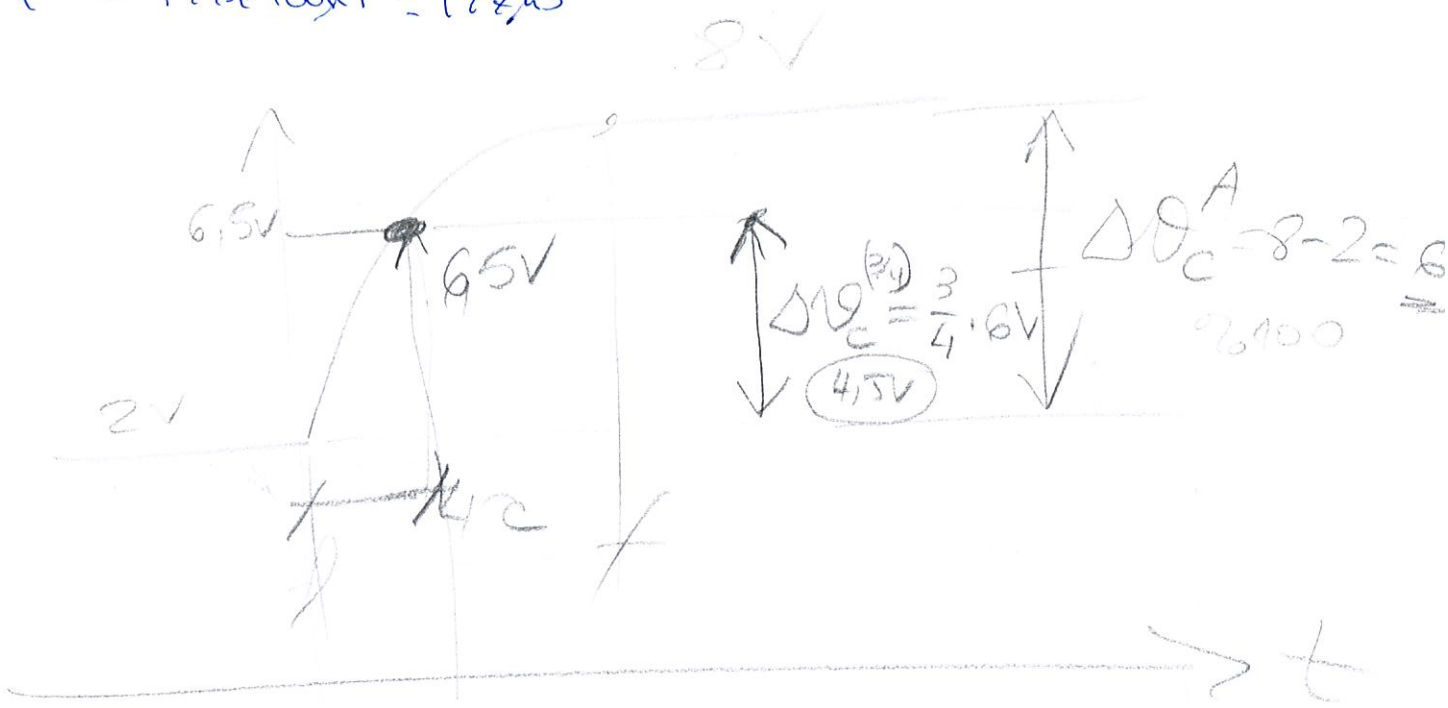
$$8V = u_c^A(\infty) = K_1 e^{-\frac{\infty}{\tau_c}} + K_2 = K_2$$

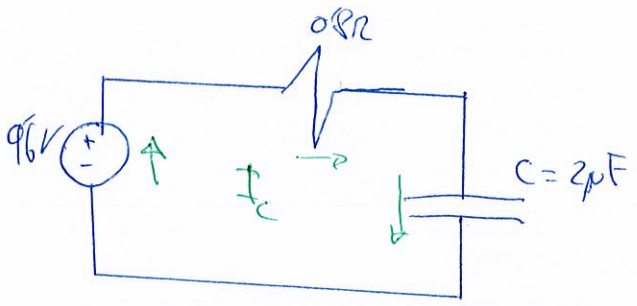
$$\boxed{K_2 = 8V}$$

$$K_1 + K_2 = 2 \Rightarrow K_1 = 2 - K_2 = -6V \Rightarrow \boxed{K_1 = -6V}$$

$$u_c^A(t) = -6e^{-\frac{t}{\tau}} + 8$$

$$\tau^A = 1{,}72k\Omega \cdot 100\mu F = 172\mu s$$





$10'66 = V_c(0') = K_1 e^{-\frac{0}{R_c}} + K_2 = K_1 + K_2$

$9'6 = V_c(\infty) = K_1 e^{\frac{\infty}{R_c}} + K_2 = K_2$

$K_2 = 9'6V$

$K_1 + K_2 = 10'66$ } $K_2 = 9'6V$, $K_1 = 1'06V$

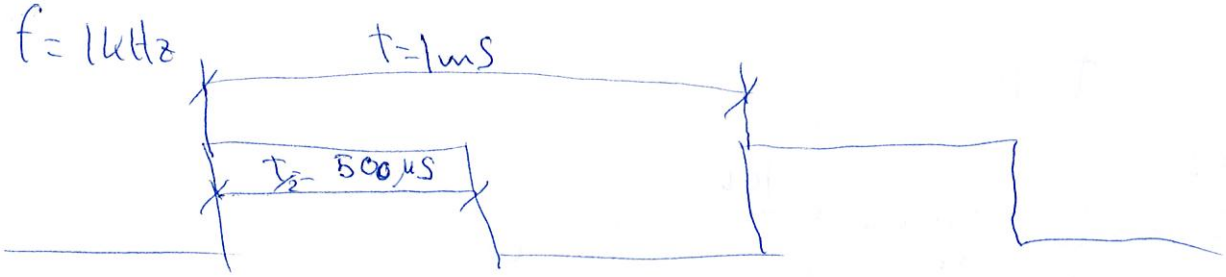
$\tau = 8\Omega \cdot 2\mu F = 16\mu s$

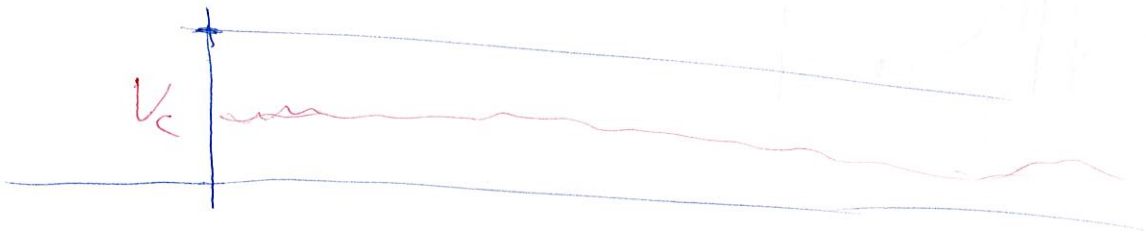
Zeubt denbora beharrko duen kondentsadoreak tentsio-aldaketa erdia egiteko, hori kalkulatzeko,

$\Delta V_c = 9'6 - 10'66 = -1'06V$

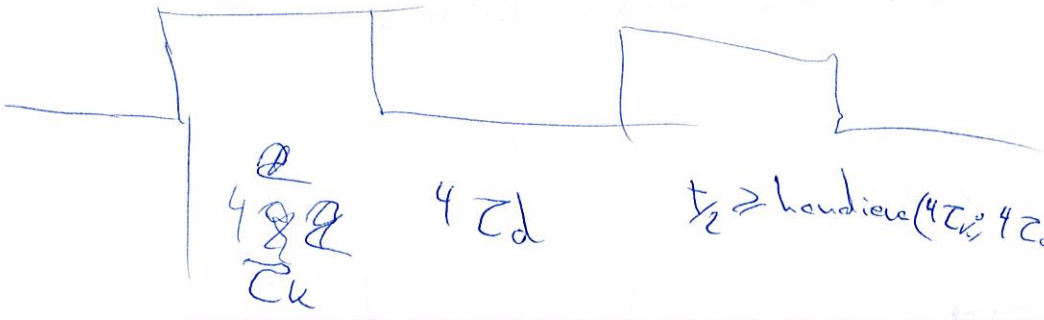
$\Delta V_c^{1/2} = \frac{1}{2} \cdot -1'06 = -0'53V$ aldaketa egin beharko du.

$1'06V$ eko aldaketa egiten 4τ tardetzen du, hau da, $6'4\mu s$ beraz, erdia egiteko $3'2\mu s$ beharko dira

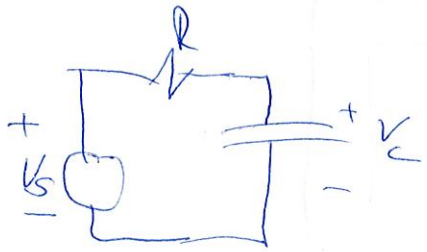


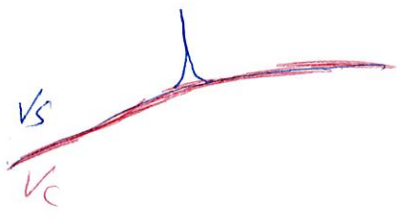


V_c otiene lo cn. justo $\frac{T}{2} \geq 4\tau$, $\Rightarrow t \geq 2(4RC) \Rightarrow f = \frac{1}{2(4\tau)}$



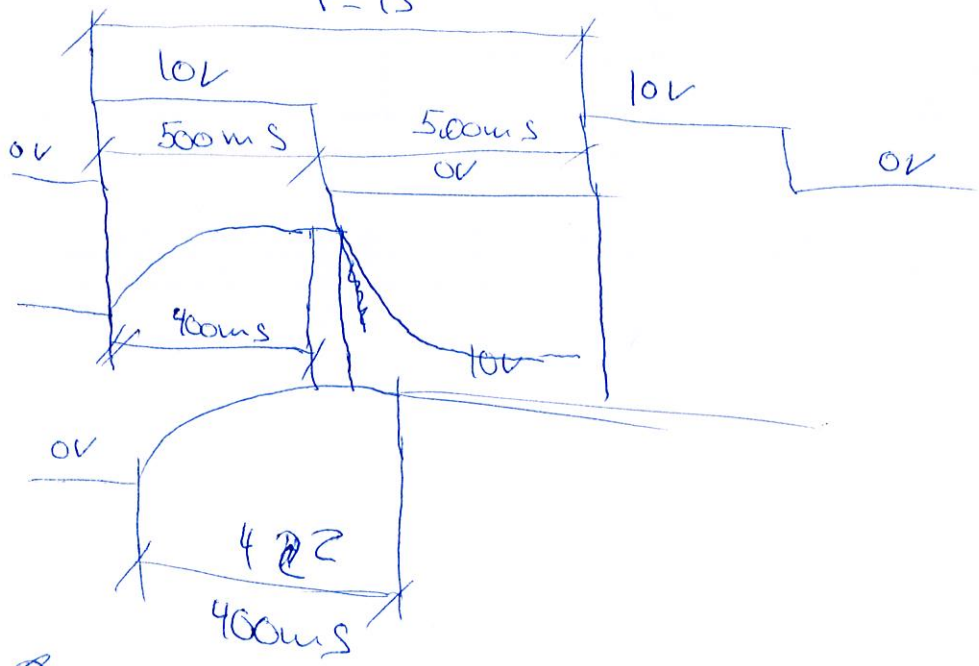
$4\tau_c$



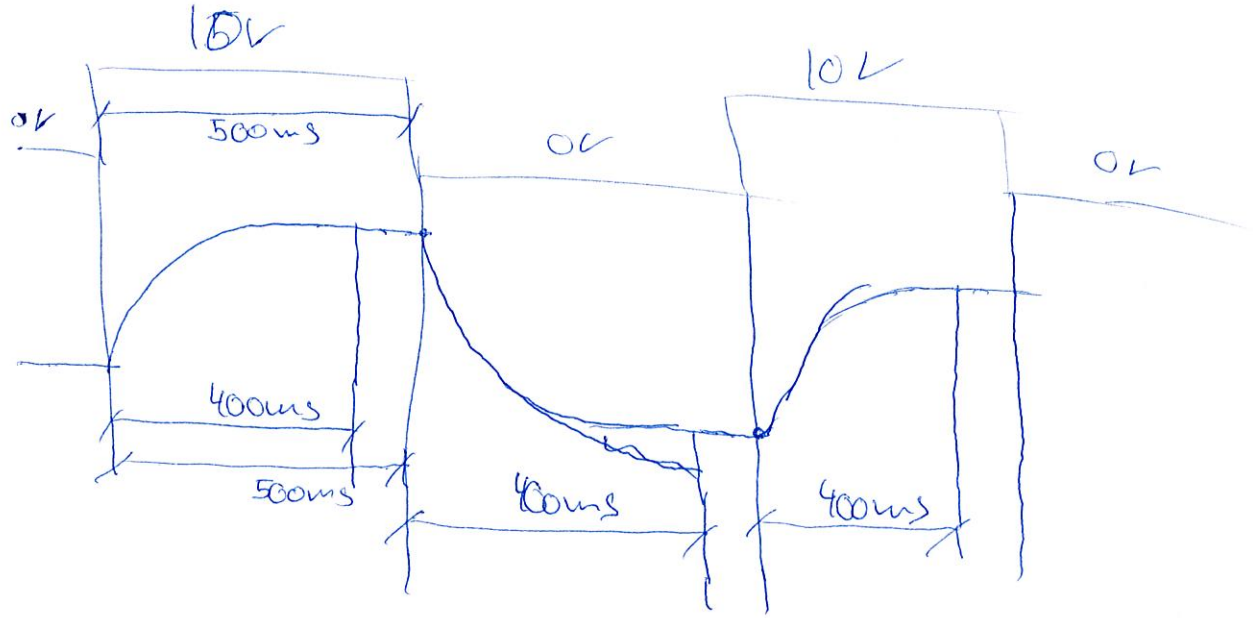


f = 1Hz

T = 1s



$\tau = R \cdot C = 1k\Omega \cdot 100\mu F = 100ms$



4.2

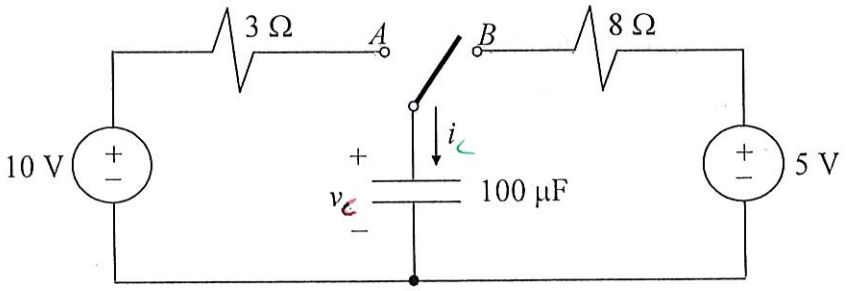
$\bar{Q}_0 + Q_2 = \bar{D}_2$

$Q_2 Q_1 Q_0$	D_2	J_1	K_1	D_0	K_0	$Q_2' Q_1' Q_0'$
0 0 0	0	1	0	0	0	0 1 0
~~0 0 1~~	~~1~~					~~1~~
0 1 0	0	0	1	0	0	0 1 1
0 1 1	1	0	1	1	1	1 0 0
~~1~~ 0 0	0	1	0	0	0	0 1 0
1 0 1						
1 1 0						
1 1 1						

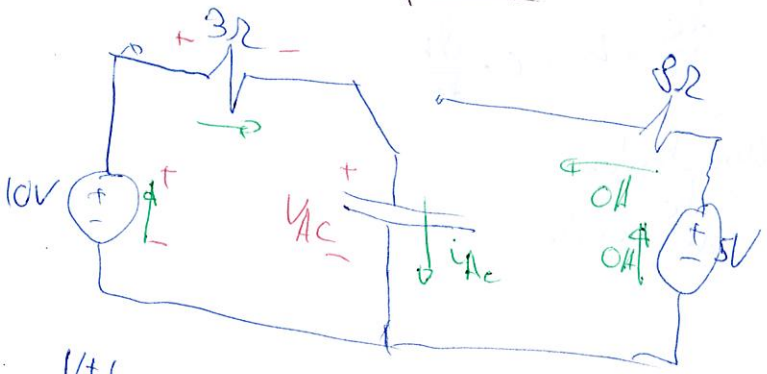
Sekwencja ~~0 2 1 2 2 3 4 2~~ ...

-2--3--4-2-

Irudiko zirkuituan, kalkula itzazu v eta i magnitudeen balioak kommutagailuaren bi posizioetarako, A eta B. Zer gertatzen da kommutagailua posizio batetik bestera pasatzean? Irudika itzazu magnitudeen aldaketak denboran zehar kommutagailuaren posizioa aldatzean.



Kommutagailua A posizioan



$q = C \cdot V$

$i = \frac{dq}{dt}$

$i = \frac{dq}{dt} = \frac{d(C \cdot V)}{dt} = C' \cdot V + V' \cdot C$

$\frac{dC}{dt} \cdot V + C \cdot \frac{dV}{dt}$

KtL:

$3I_c^A + V_c^A - 10V = 0 \Rightarrow 3I_c^A + 5V - 10V = 0 \Rightarrow$ | C: Konstante denez,

$5V = V_{AC} + V_c^A$

$i_C = \frac{dV_c}{dt} \cdot C$

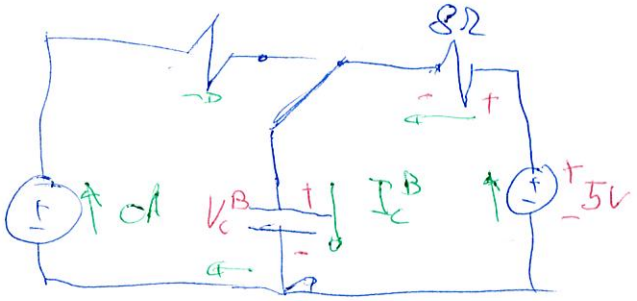
Eguera egonkorrean egongo denez kondentsadorearen tentsio konstatea izango da. Beraz $I_c^A = 0A$ izango da.

$I_c(\infty) = 0A$

Infinito illunabarretik asko nahi du denbora luzea dagoela posizio berean, hau da, eguera egonkorrean dagoela kondentsadorea

$$\left.\begin{aligned} 3I_c^A + V_c^A &= 10 \\ I_c^A &= 0A \end{aligned}\right\} \; V_c^A = 10V$$

Kommutagailua B posizioan: egoera egonkorrean.



LKL

$-5 + 8I_c^B + V_c^B = 0 \Rightarrow 8I_c^B + V_c^B = 5$

$q = C \cdot V \Rightarrow i = \frac{dq}{dt} \Rightarrow i = \frac{dC}{dt} \cdot V + C \cdot \frac{dV}{dt}$

~~$i = C \cdot \frac{dV}{dt}$~~

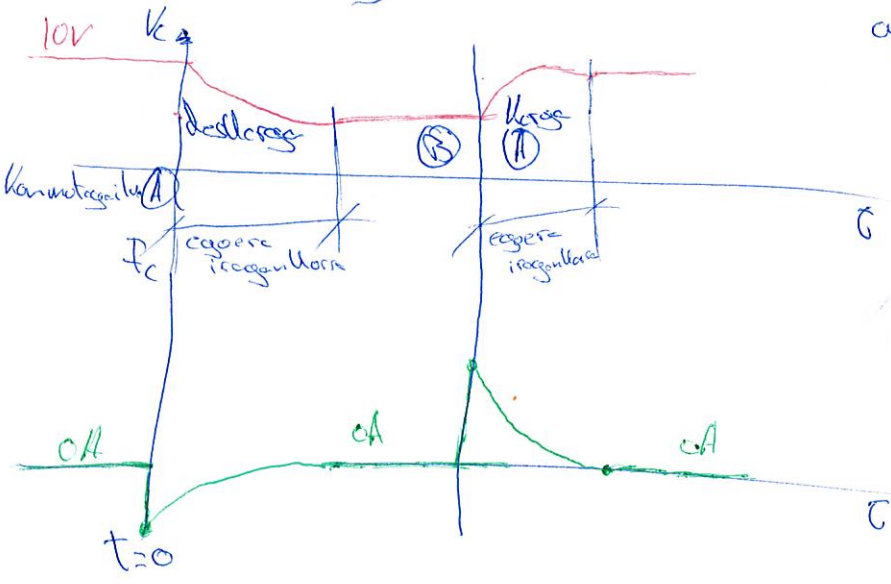
C konstantea denez, $\frac{dC}{dt} = 0$ da.

Beraz, $i_c^B = C \cdot \frac{dV}{dt}$

Denbora luzez dagoenez, egoera egonkorrean dago beraz, $i_c^B = 0A$ izango da.

$i_c^B(\infty) = 0A$

$$\left.\begin{array}{l} 8I_c^B + V_c^B = 5 \\ I_c^B = 0A \end{array}\right\} V_c^B = 5V$$



a) $V_c^A(\infty) = 10V$ (A)

$I_c^A(\infty) = 0A$

b) $t=0$ (A) → (B)

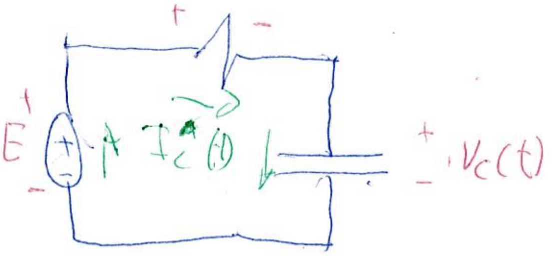
$V_c^B(0^-) = 10V$

$i_c^B(0^-) = 0A$

$V_c^B(0^-) = V_c^B(0^+) = 10V$

$i_{c(0^+)}^B = ?$

$V_c^B(\infty) = 5V \quad i_c^B(\infty) = 0A$



Egoera iraunkorrean:

KTL: $R I_C(t) + V_C(t) = E$ (1)

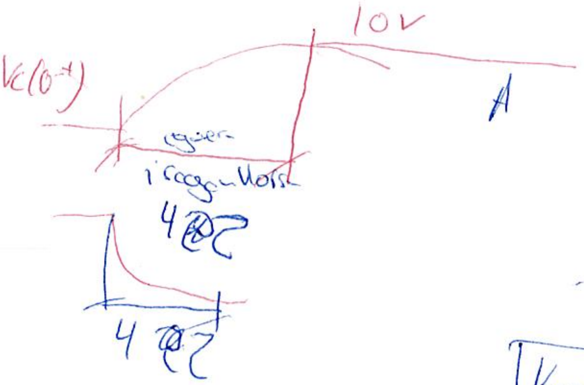
Kondentsadorearen portaeraren ekuazioa:

$$I_C(t) = C \cdot \frac{d\,V_C(t)}{dt}$$

$R I_C = C \cdot \frac{V_C t}{dt}$

Ekuazio diferentziala:

$$V_C(t) = K_1 e^{-\frac{t}{RC}} + K_2$$



Soluzio partikularrak:

$5V = \left[V_C^A(0^+) = K_1 e^{-\frac{0}{RC}} + K_2 = K_1 + K_2 \right]$

$10V = \left[V_C^A(\infty) = K_1 e^{-\frac{\infty}{RC}} + K_2 = K_2 \right]$

$\boxed{K_2 = 10V}$

$K_1 + K_2 = 5V \Rightarrow \boxed{K_1 = -5V}$

$V_C^A(t) = -5e^{-t} + 10 =$

$\tau^A = R_C^A = 3\Omega \cdot 100\mu F = 300\mu s$

denbora-konstantea

$V_C^B(t) = \quad e^{-t} +$

$\tau^B = 8\Omega \cdot 100\mu F = 800\mu s$

(A)

$V_c^A(0^-) = 5V$

$V_c^A(0^+) = 5V$

$V_c^A(\infty) = 10V$

$I_c^A(0^-) = 0A$

$I_c^A(0^+) = \frac{5}{3}A$

$I_c^A(\infty) = 0A$

(B)

$V_c^B(0^-) = 10V$

$V_c^B(0^+) = 10V$

$V_c^B(\infty) = 5V$

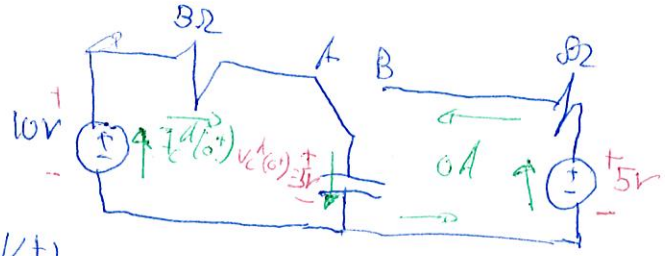
$I_c^B(0^-) = 0A$

$I_c^B(0^+) = -\frac{5}{8}A$

$I_c^B(\infty) = 0A$

$t = 0^+$

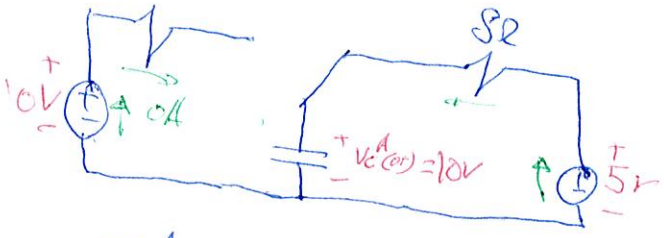
(A)



KVL

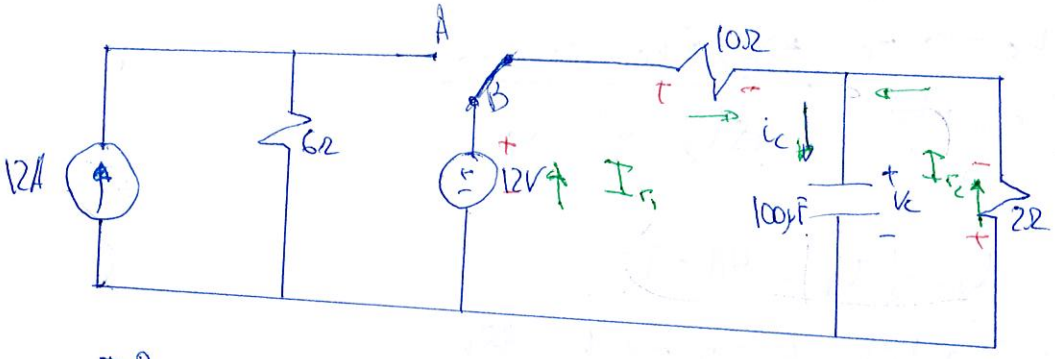
$3I_c^A(0^+) + 5 - 10 = 0 \Rightarrow 3I_c^A(0^+) = 5 \Rightarrow \boxed{I_c^A = \frac{5}{3}A}$

(B)



$8I_c^A(0^+) + 10 - 5 = 0 \Rightarrow \boxed{I_c^A = -\frac{5}{8}A}$

2010 - 11 - 26

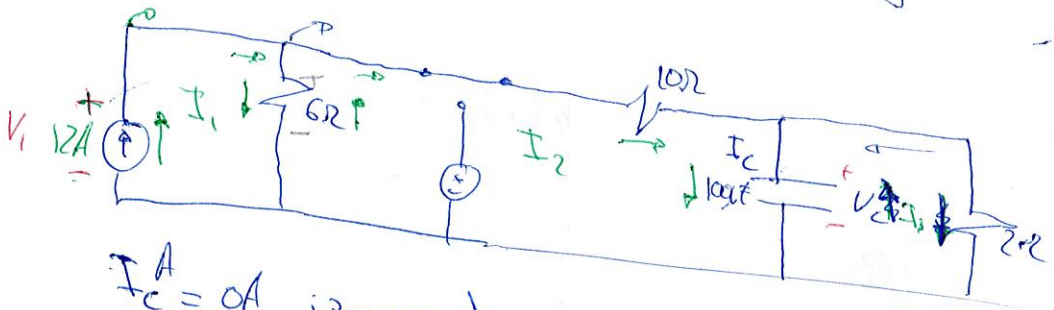


$I_C^B = 0A$ izango da eggera eganllorren baitago.

1. maila: $-12 + 10I_{s_1} + V_C = 0 \Rightarrow -12 + 10I_{s_1} + 2I_{s_1} = 0 \Rightarrow \boxed{I_{s_1} = 1A}$

2. maila: $2I_{s_2} + V_C = 0 \Rightarrow 2I_{s_1} = V_C \Rightarrow \boxed{V_C = 2V}$.

$0 = I_{s_1} + I_{s_2} \Rightarrow I_{s_1} = -I_{s_2} \Rightarrow \boxed{-1A = I_{s_2}}$



$I_C^A = 0A$ izango da eggera eganllorren baitago.

1. maila: $6I_1 - 6I_2 - 12 = 0 \Rightarrow 6I_1 - 6I_2 - 12 = 0$

2. maila: $10I_2 + V_C + 6I_2 - 6I_1 = 0 \Rightarrow 16I_2 - 6I_1 + V_C = 0$

$10I_2 - 12 + V_C = 0$

3. maila: $2I_3 - V_C = 0$

$0 = I_2 + I_3 \Rightarrow I_2 = -I_3 \Rightarrow \boxed{I_2 = -0'55A}$

$2I_3 + V_C = 0$

$20I_3 - 12 + V_C = 0$

$22I_3 = 12$

$\boxed{I_3 = 0'55A}$

$6I_1 - 6I_2 - 12 = 0$

$I_1 = \frac{15'27}{6} = 2'55A$

$\boxed{I_1 = 2'55A}$

1. maila: $6I_1 - 6I_2 + V_1 = 0 \Rightarrow 72 - 6I_2 - 12 = 0 \Rightarrow I_2 = 10A$

2. maila: $10I_2 + V_C + 6I_2 - 6I_1 = 0 \Rightarrow 160 - 72 + V_C = 0 \Rightarrow V_C = -88V$

3. maila: $2I_3 - V_C = 0 \Rightarrow V_C =$

① 1. malha: $6I_1 - 6I_2 - V_1 = 0$

② 2. malha: $16I_2 + V_c + 6I_2 - 6I_1 = 0 \Rightarrow 16I_2 + V_c - 6I_1 = 0$

③ 3. malha: $2I_3 + V_c = 0 \Rightarrow -2I_2 + V_c = 0$

④ ~~$0 = -I_2 + I_3 \Rightarrow I_2 = I_3$~~

$0 = I_2 - I_3 \Rightarrow I_2 = I_3$

$18I_2 - 6I_1 = 0$

~~$I_1 = 3I_2 = 3 \cdot$~~ $I_2 = \frac{1}{3} I_1 = 4A = I_3$

~~$6 \cdot 3I_2 - 6I_2 - V_1 = 0 \Rightarrow 12I_2 - V_1 = 0$~~ $\Rightarrow V_1 = 48V$

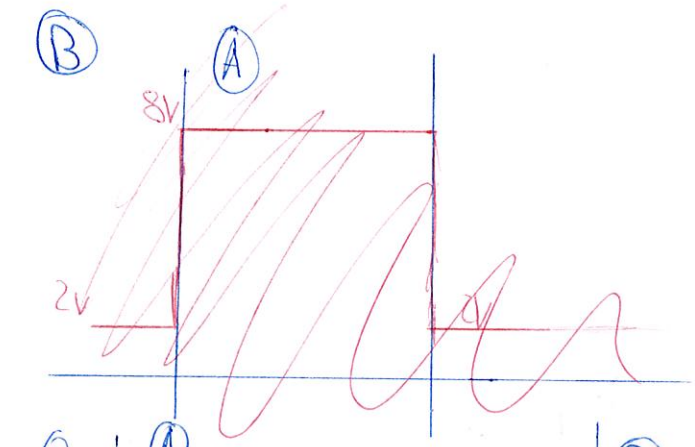
~~$16I_2 + V_c - 18I_2 = 0 \Rightarrow -2I_2 + V_c = 0$~~ $\Rightarrow V_c = 8V$

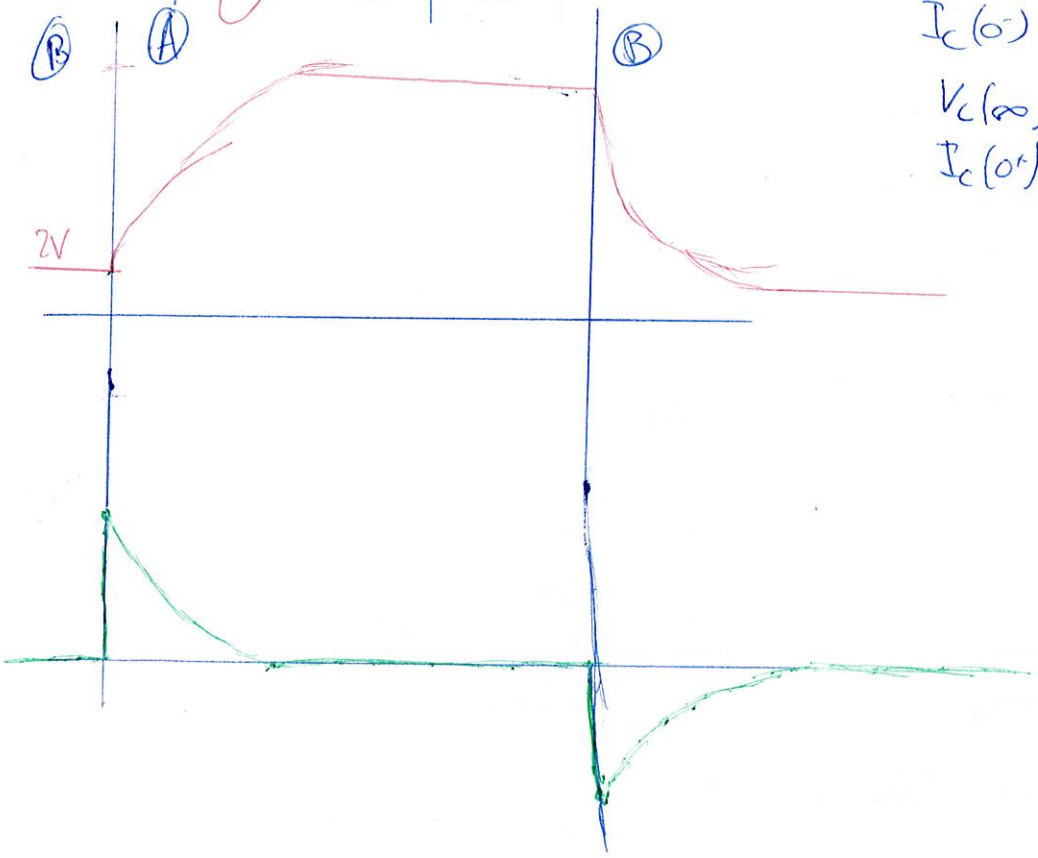
$I_1 = 12A$

$I_2 = \frac{1}{3} 4A$

$I_3 = 4A$

Que letra mais feia!! Comoto ♡





$V_c(0^-) = 2V$

$V_c(0^+) = 2V$

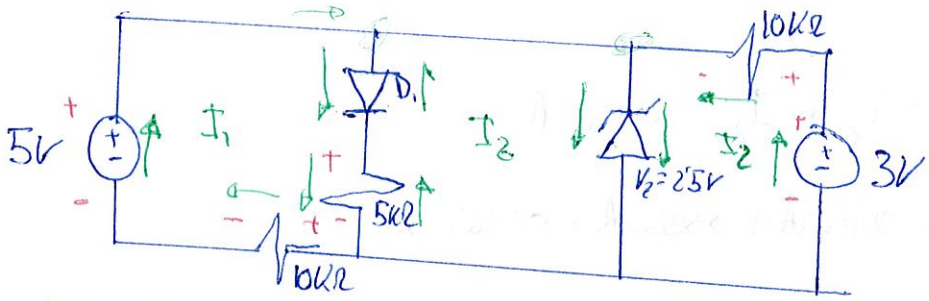
$I_c(0^-) = 0A$

$V_c(\infty) = 8V$

$I_c(0^+) = 10,6A$

③

a)



1. Hipotesia

D_1: Z.P D_2: A.P ~~Zener~~ antzeko

Ekuazioak $V_{D_1} = 0'2V$

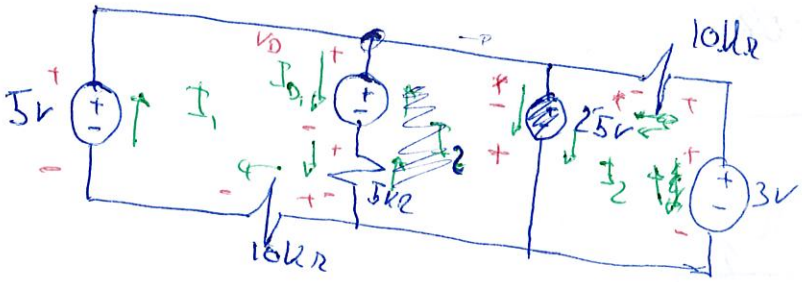
Baldintzak $I_{D_1} \geq 0$

Ebatzi.

~~$I_{D_2} \geq 0$~~ ~~$V_D = V_2$~~ ~~$I_D = 0$~~

~~$I_{D_2} \leq 0$~~ ~~$-V_2 \leq V_D \leq 0'2$~~

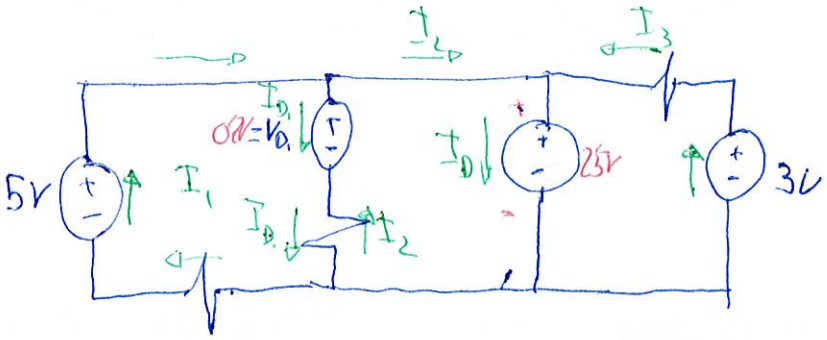
Zirkuitu baliokidea:



~~$10kI_2 + 5kI_1 + 10kI_1$~~

$I_1 - I_2 = I_{D_1}$

~~$I_2 \geq 0$~~ $I_2 = 0$



$I_1 - I_2 = I_{D_1} \Rightarrow I_1 - I_{D_1} = I_2 \Rightarrow I_2 = -0'11\,mA$

$I_2 + I_3 = I_{D_2}$ ~~$I_{D_2} = 0'11mA + 0'25mA = 0'36mA$~~

$0'7 + 5K I_{D_1} + 10K I_1 = 5 \Rightarrow 5K I_{D_1} + 2'5 + 0'7 = 5 \quad I_{D_1} = 0'36mA$

$2'5V + 10K I_1 = 5 \Rightarrow I_1 = 0'25\,mA$

$10K I_3 + 2'5 = 3 \Rightarrow I_3 = 0'05mA$

$I_2 + I_3 = I_{D_2} \Rightarrow -0'06\,mA = I_{D_2}$

~~Lehenengo hipotesia gaizki dago.~~

~~2 hipotesia~~

D_1: Z.P

Ekuazioa $V_{D_1} = 0'7$

B.(Desberdintza) $I_{D_1} \geq 0$

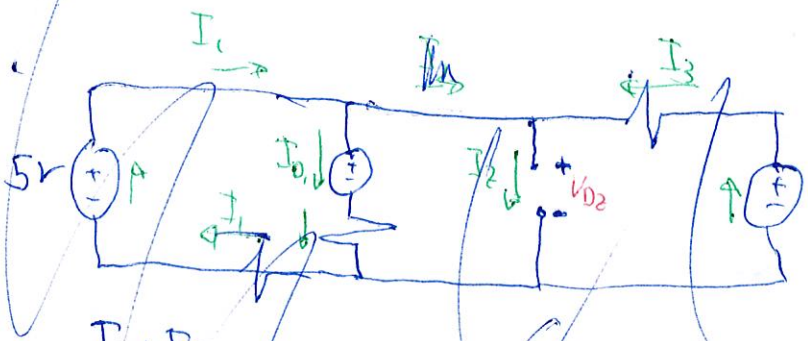
Eredua —(+ −)—

D_2: A.P aurrean

$I_{D_2} = 0A$

$-V_2 \leq V_D \leq 0'7$

Eredua — + −



$I_2 + I_3 = 0$

~~$I_1 - I_2 = I_{D_1}$~~

~~$0'7 + 5I_{D_1} + 10I_{D_1} = 5$~~

$V_{D_2} + 10I_1 = 5$

$10I_3 + V_{D_2} = 3$

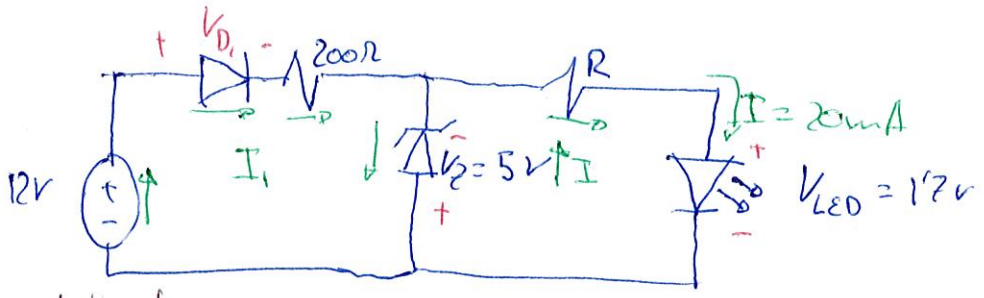
$I_1 + I_3 = 0 \quad I_{D_1} = 0 = I_1 + I_3 - I_{D_1}$

$0'7 + 5I_{D_1} + 10I_1 = 0$

~~$10I_3 + V_{D_2} = 3$~~

$V_{D_2} + 10I_1 = 5$

~~$10I_3$~~



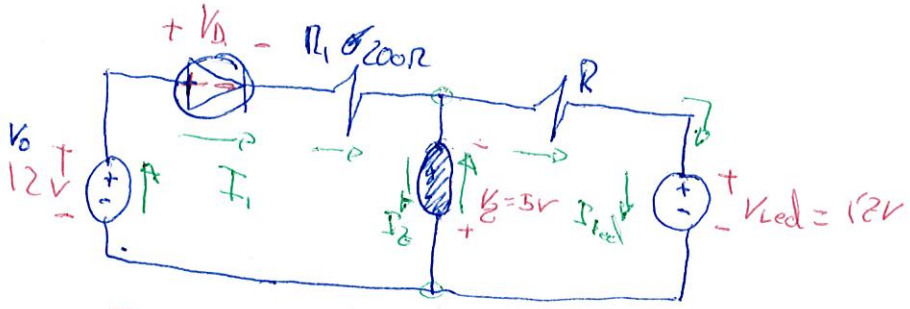
1. Hipotesis: D_1 D_2 D_3

2.P A.P Zener

Ecuaciones $V_{D_1} = 0'7V$ $V_Z = 5V$ $V_{Led} = 1'7V$

Soldintzak $I_{D_1} \geq 0$ $I_Z = 0$ $I_{Led} > 0$

Ezeduak



$I_1 = I_Z + I_{Led}$

$0'7 + 0'2k\Omega I_1 - 5V = 12 - 0 \Rightarrow I_1 = \frac{6'3}{0'2} = 31'5mA$

$0'7 + 0'2k\Omega I_1 + R I_{Led} + 1'7 = 12 \Rightarrow 0'7 + 6'3 + 20mA\,R + 1'7 = 12 \Rightarrow R = \frac{3'3}{20} = 0'165k\Omega$

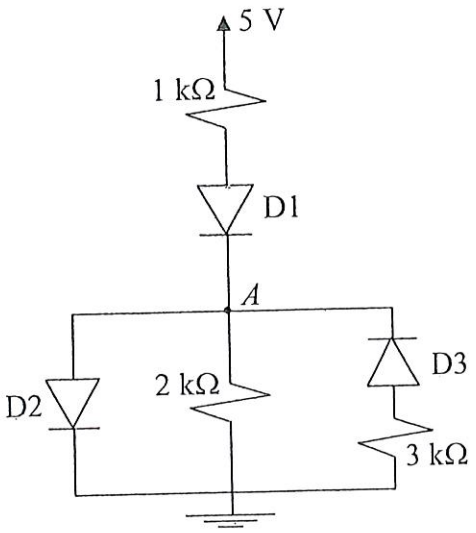
~~$V_R = I \cdot R \Rightarrow$~~

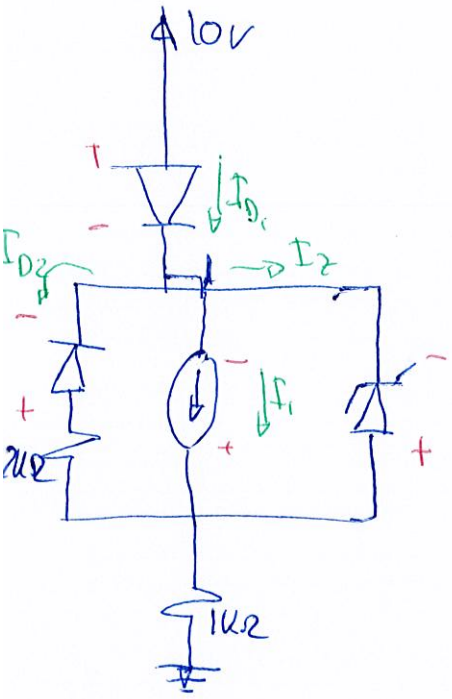
$V_{D_1} = 0'7V$

$V_{R_1} = 31'5mA \cdot 0'2k\Omega = 6'3V$

$V_{R_1} = 20mA \cdot 0'165 = 3'3V$

Analiza ezazu irudiko zirkuitua diodoaren bigarren hurbilketa erabiliz. Zenbatekoa da *A* puntuaren tentsioa?





A-ren tentsio

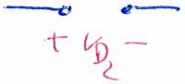
$V_A = -3V + 1I_{D_1} = 6'3 - 3 = \boxed{3'3V}$

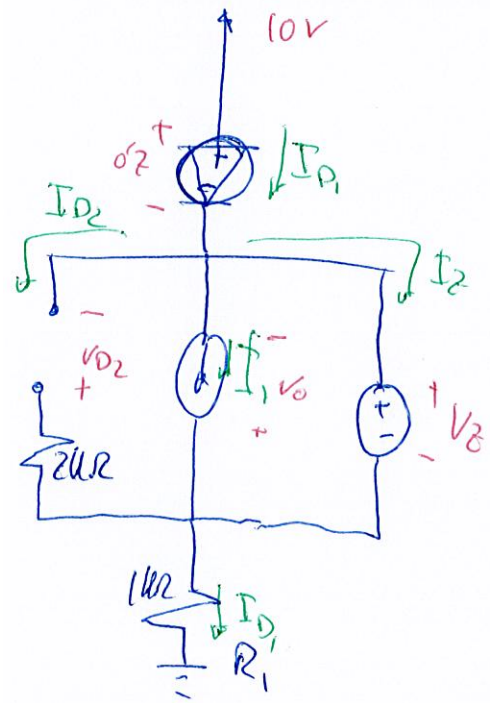
D_1 : Z.P D_2 : A.P D_3 : A.P zener

elkozio $V_{D_1} = 0'7$ $I_{D_2} = 0A$ $-V_Z = V_{D_2}$

Baldintza $I_{D_1} \geq 0$ $V_{D_2} \leq 0'7$ $I_Z \geq 0$

ereduak





$I_{D_1} = I_{D_2} + I_1 + I_Z \Rightarrow I_{D_1} - I_Z = 5mA$

$0'7 - V_{D_2} + 1I_{D_2} = 10 \Rightarrow \boxed{V_{D_2} = +3V}$

$0'7 + V_0 + 1I_{D_1} = 10 \Rightarrow \boxed{V_0 = +3V}$

$0'7 + V_3 + 1I_{D_1} = 10 \Rightarrow 0'7 + 3 + 1I_{D_1} = 0$

$I_{D_1} = 6'3mA$

$I_Z = 6'3 - 5 = 1'3mA$

$D_1 \Rightarrow V_{D_1} = 0'7V,\ I_{D_1} = 6'3mA$

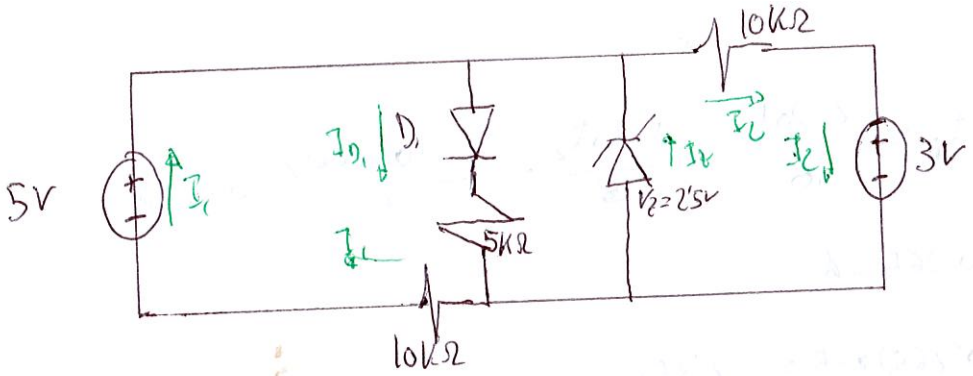
$D_2 \Rightarrow V_Z = 3V,\ I_Z = 1'3mA$

$D_2 \Rightarrow V_{D_2} = +3V,\ I_{D_2} = 0A$

$V_0 = +3V$

$R_1 = 6'3V$

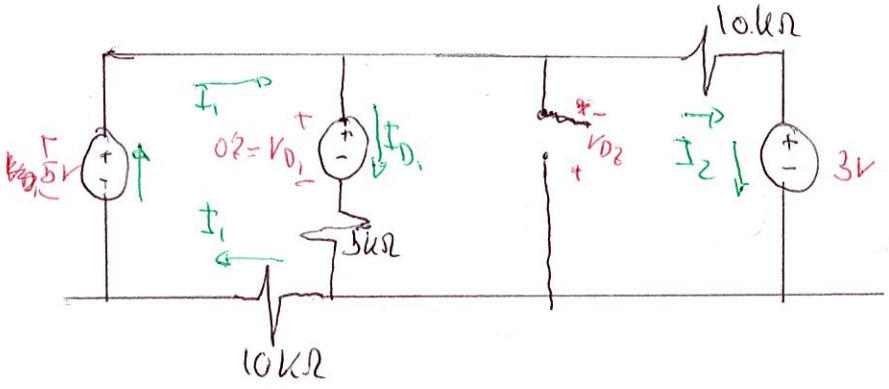
3.



8

1. hipotesia

	D_1: Z.P	D_2: A.P arrunta
Ekuazioak	$V_{D_1} = 0'7V$	$I_{D_2} = 0\ A$
Baldintzak	$I_{D_1} \geq 0$	$-V_{BR} \leq V_{D_2} \leq 0'7$
Eredua	I_{D_1} $+ V_{D_1} -$	$I_D = 0$ $+ V_{D_2} -$



KKL

$I_1 = I_2 + I_{D_1}$ (1)

KtL

$5I_{D_1} + 10I_1 = 5 - 0'7$ (2)

$-V_{D_2} + 10I_1 = 5$ (3)

$10I_2 + 10I_1 = 5 - 3$ (4)

(1) → (2) : $5I_{D_1} + 10(I_2 + I_{D_1}) = 4'3 \Rightarrow 15 \cdot \left(\frac{1 - 10I_2}{5}\right) + 10I_2 = 4'3 \Rightarrow 3 - 30I_2 + 10I_2 = 4'3$

$I_2 = -0'065mA$

① → ④

$10I_2 + 10\cdot(I_2 + I_{D_1}) = 2$

$20I_2 + 10I_{D_1} = 2 \Rightarrow I_{D_1} = \frac{2 - 20I_2}{10} = \frac{1 - 10I_2}{5} = \frac{1 - 10(0'065)}{5} = 0'33\,mA$

$I_1 = -0'065 + 0'33 = 0'265\,mA$

$V_{D2} = 10I_1 - 5 = 10(0'265) - 5 = -2'35V$

$I_{D1} > 0$ ✓

Beraz, hipotesia zuzena da, $-2'5 \leq -2'35 \leq 0'2$, beraz hipotesia zuzena da.

b)

Potentzien balantzea:

$\sum P_x = \sum P_e$

$P_1 = 5\cdot 0'262 = 1'31\,mW$

$P_2 = 0'2\cdot I_{D_1} = 0'331\,mW$

$P_3 = 5\cdot(0'33)^2 = 0'544\,mW$

$P_4 = 10\cdot(-0'065)^2 = 0'042\,mW$

$P_5 = 3\cdot(0'065) = -0'195\,mW$

$P_6 = 10\cdot(0'262)^2 = 0'68\,mW$

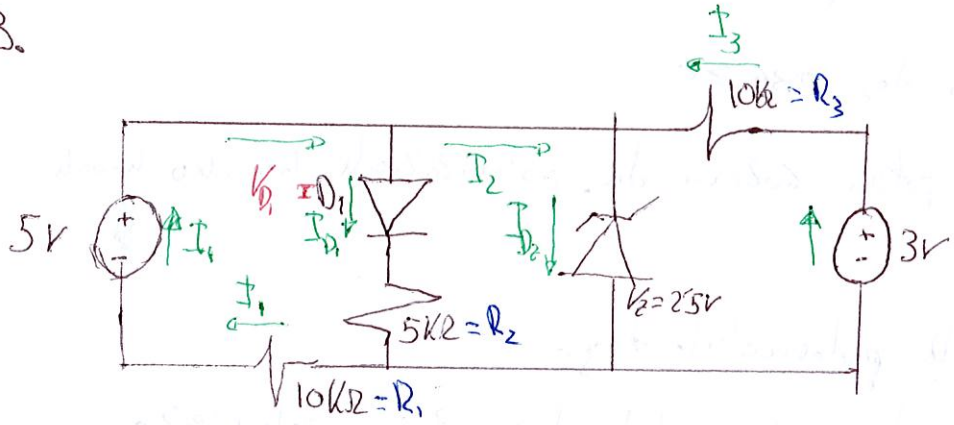
$P_7 = 0\,mW$

$1'31\,mW = 0'231 + 0'544 + 0'042 + 0'68 - 0'195$

$1'31\,mW = 1'31\,mW \Rightarrow \sum P_x = \sum P_e$ betetzen da

Ariketak. Diodoak

3.

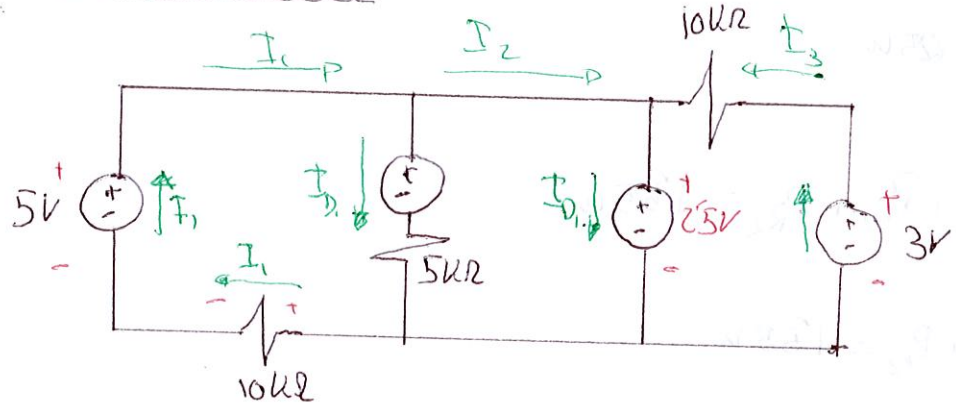


a)

1. Hipotesia:

	D_1: Z. P	D_2: AP Zener
Ekuazioak:	$V_D = 0'2V$	$V_D = -V_Z$
Baldintza:	$I_{D_1} \geq 0$	$I_{D_2} \leq 0$
Eredua:		

Zirkuito baliokidea:



$I_1 - I_2 = I_{D_1} \Rightarrow I_1 - I_{D_1} = I_2 \Rightarrow I_2 = -0'11 mA$

$I_2 + I_3 = I_{D_2} \Rightarrow I_{D_2} = I_2 + I_3 = -0'06 mA$

$0'2 + 5K I_{D_1} + 10K I_1 = 5 \Rightarrow 0'2 + 5K I_{D_1} + 2'5 = 5 \Rightarrow I_{D_1} = 0'36 mA$

$2'5 + 10K I_1 = 5 \Rightarrow I_1 = 0'25 mA$

$10K I_3 + 2'5 = 3 \Rightarrow I_3 = 0'05 mA$

$I_{D_2} \leq 0$ deneż, kev da, $-0'06mA \leq 0$ ✓

$I_{D_1} \geq 0$ deneż, kev da, $0'36 \geq 0$

Beraz, lehenengo hipotesia zuzena da, polarizazioak honako kevak dira:

D_1 diodoa: zuzenki polarizatuta dago

D_2 diodoa: Aldeerantzaiz polarizatuta dago, zener polarizazioa.

$I_1 = 0'25mA$; $I_2 = -0'11mA$; $I_3 = 0'05mA$; $I_{D_1} = 0'36mA$; $I_{D_2} = 0'06mA$

$V_{R_1} = I_1 \cdot 10k\Omega = 2'5V$; $V_{R_2} = I_{D_1} \cdot 5k\Omega = 1'8V$; $V_{R_3} = I_3 \cdot 10k\Omega = 0'5V$

b)

$P_{V_1} = 5 \cdot 0'25mA = 1W$ $P_{V_2} = 0'06 \cdot 2'5 = 0'15W$

$P_{D_1} = 0'36mA \cdot 0'7 = 0'252W$ $P_{R_3} = 0'5 \cdot 0'05 = 0'025W$

$P_{R_2} = 1'8 \cdot 0'36 = 0'648W$ $P_{V_2} = 3 \cdot 0'05 = 0'15W$

$P_{R_1} = 2'5 \cdot 0'25 = 0'625W$

$\sum_{\text{xurgatu}} = P_{D_1} + P_{R_1} + P_{R_2} + P_{R_3} = 1'55W$

$\sum_{\text{emon}} = P_{V_1} + P_{D_2} + P_{V_2} = 1'55W$