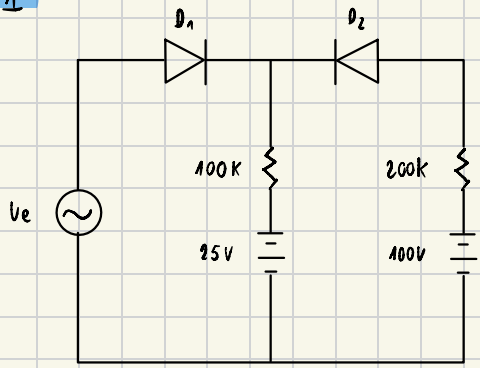
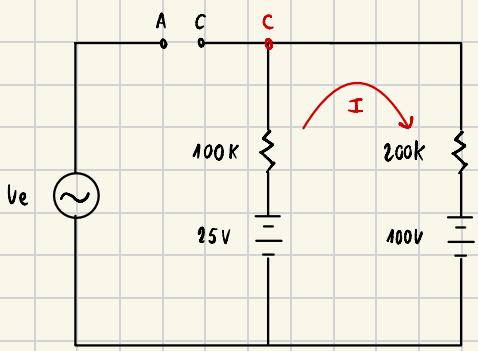
DIODOS

1



D_1 PL D_2 ON:



$V_A = V_e$

$V_C = 100 + 200K\, I_2$

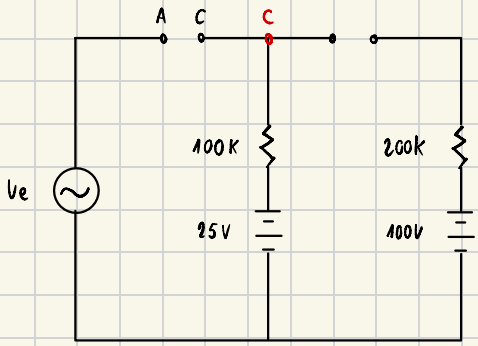
$-75 = 300K\, I_2$; $I_2 = \frac{-75}{300K}$

$V_C = 100 - \frac{150}{3} = 50\ V$

$V_A - V_C = V_e - 50$

$V_e > 50$	D_1 ON	D_2 ON
$V_e < 50$	D_1 off	D_2 ON

D_1 PL D_2 Off:



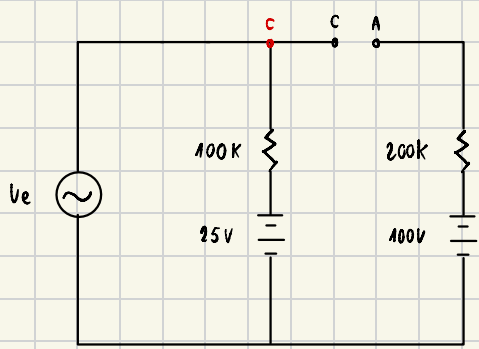
$V_A = V_e$

$V_C = 25 + \cancel{100K I}^{\,0}$

$V_A - V_C = V_e - 25$

$V_e > 25$	D_1 ON	D_2 Off
$V_e < 25$	D_1 Off	D_2 Off

D_1 ON D_2 PL:



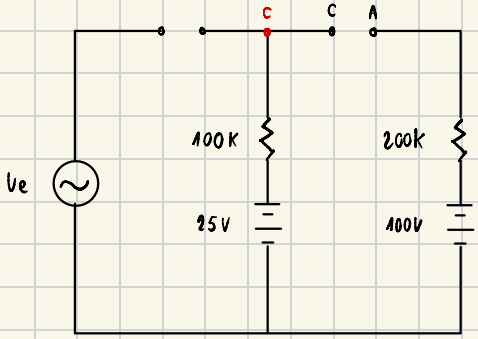
$V_C = V_e$

$V_A = 100 + \cancel{200K I}^{\,0}$

$V_A - V_C = 100 - V_e$ $\qquad 100 > V_e$

$V_e > 100$	D_1 ON	D_2 Off
$V_e < 100$	D_1 ON	D_2 ON

D_1 Off D_2 PL:



$V_C = 25 + 100KI^0$

$V_A = 100 + 200KI^0$

$V_A - V_C = 100 - 25 = 75V$

D_1 Off ⟶ D_2 ON

$V_e > 25$ D_1 ON D_2 Off

$V_e < 25$ D_1 Off D_2 ~~Off~~

$V_e > 50$ D_1 ON D_2 ON

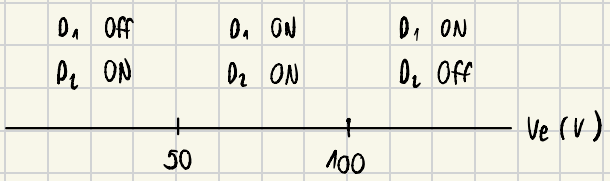
$V_e < 50$ D_1 Off D_2 ON

$V_e > 100$ D_1 ON D_2 Off

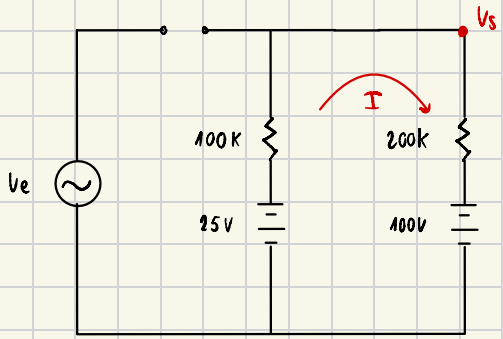
$V_e < 100$ D_1 ON D_2 ON

INCOMPATIBLE

• D_1 Off ⟶ D_2 ON



$V_e < 50\,V$ (D_1 off, D_2 ON)

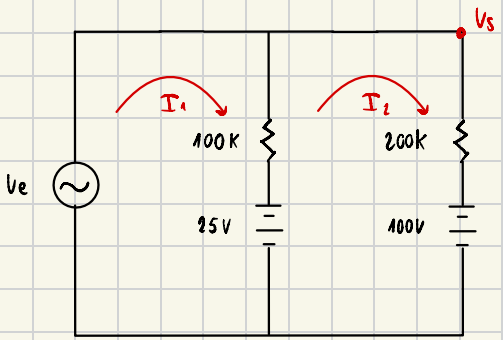


$V_s = 100 + 200K\,I$

$25 - 100 = 300K\,I \;;\; I = \dfrac{-75}{300K}$

$V_s = 100 + 200K\,\dfrac{-75}{300K} = 100 - 50 = 50\,V$

$50 < V_e < 100$ (D_1 ON, D_2 ON)



$V_e - 25 = 100K\,I_1 - 100K\,I_2$

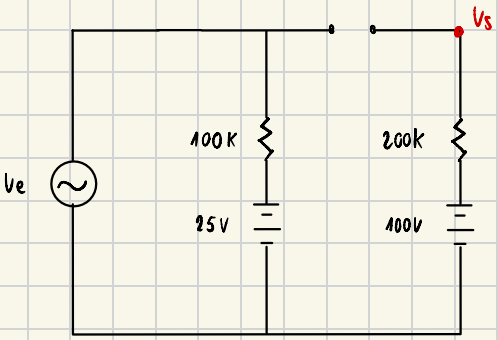
$25 - 100 = 300K\,I_2 - 100K\,I_1$

$V_e - 100 = 200K\,I_2$

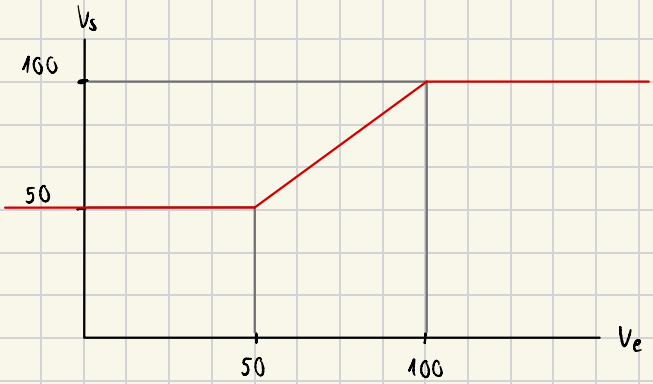
$I_2 = \dfrac{V_e - 100}{200K}$

$V_s = 100 + 200K\,I = 100 + 200K\,\dfrac{V_e - 100}{200K} = V_e$

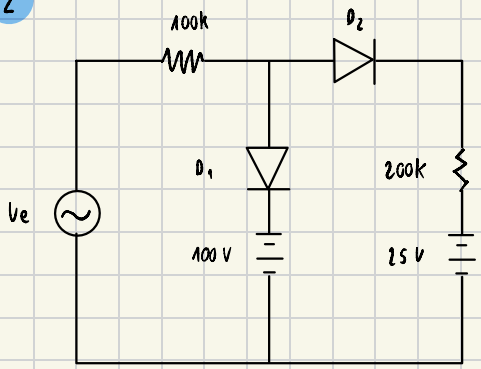
Ve > 100 (D_1 ON, D_2 OFF)



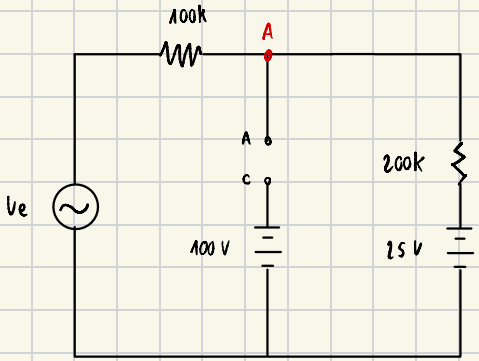
$V_S = 100 + 0$



2



D_1 PL D_2 ON:



$V_A = V_e - 100K\,I$

$V_e - 25 = 300K\,I \;;\; I = \frac{V_e - 25}{300K}$

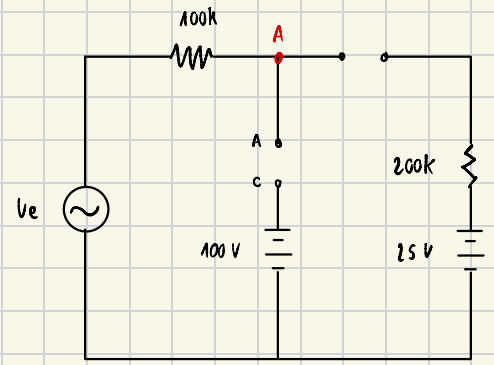
$V_A = V_e - \frac{V_e - 25}{3} = \frac{2V_e + 25}{3}$

$V_C = 100$

$$V_A - V_C = \frac{2V_e + 25}{3} - 100 = \frac{2V_e - 275}{3}$$

$V_e > 137{,}5$ V	D_1 ON	D_2 ON
$V_e < 137{,}5$ V	D_1 Off	D_2 ON

D_1 PL D_2 ON :



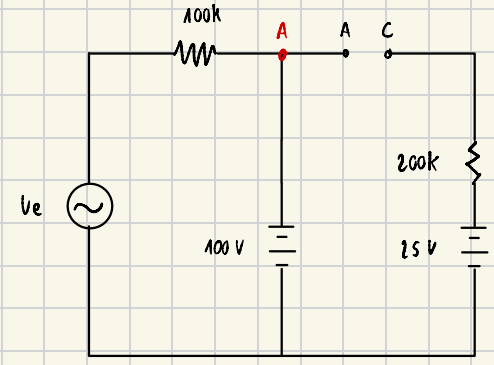
$V_C = 100\ V$

$V_A = V_e - 100K\ I$ → 0

$V_A - V_C = V_e - 100$

$V_e >$	100 V	D_1 ON	D_2 Off
$V_e <$	100 V	D_1 Off	D_2 Off

D_1 ON D_2 PL :



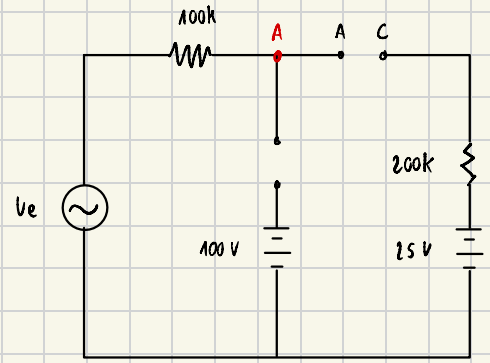
$V_A = 100\ V$

$V_C = 25 + 200K\ I$ → 0

$V_A - V_C = 100 - 25 = 75\ V$

D_1 ON → D_2 ON

D_1 Off D_2 PL:



$V_A = V_e + 100K\,I^0$

$V_C = 25 + 200K\,I^0$

$V_A - V_C = V_e - 25$

$V_e > 25\,V$	D_1 Off	D_2 ON
$V_e < 25\,V$	D_1 Off	D_2 Off

- $V_e > 25\,V$ D_1 Off D_2 ON
- $V_e < 25\,V$ D_1 Off D_2 Off

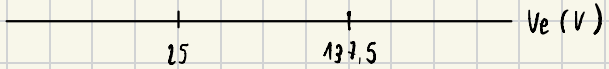
- $V_e > 100\,V$ D_1 ON D_2 ~~Off~~
- $V_e < 100\,V$ D_1 Off D_2 Off

- $V_e > 137{,}5\,V$ D_1 ON D_2 ON
- $V_e < 137{,}5\,V$ D_1 Off D_2 ON

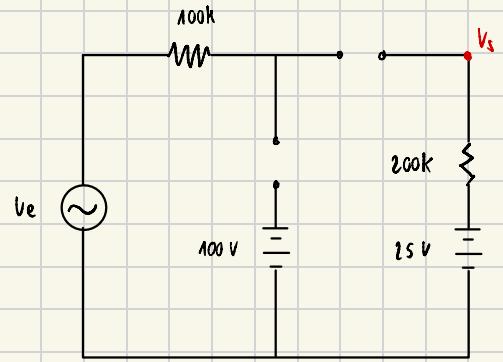
INCOMPATIBLE

- D_1 ON → D_2 ON

D_1 Off	D_1 Off	D_1 ON
D_2 Off	D_2 ON	D_2 ON

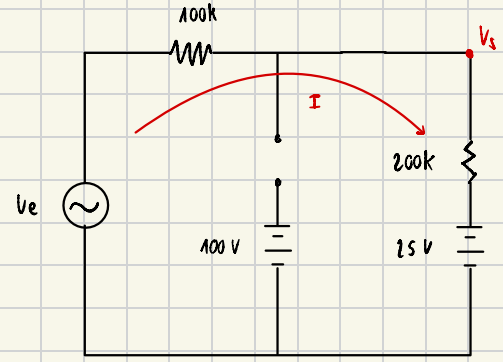


$V_e < 25V$ (D_1 Off, D_2 Off)



$V_s = 25 + \cancel{200K\,I}^{\,0}$

$25 < V_e < 137,5V$ (D_1 Off, D_2 ON)



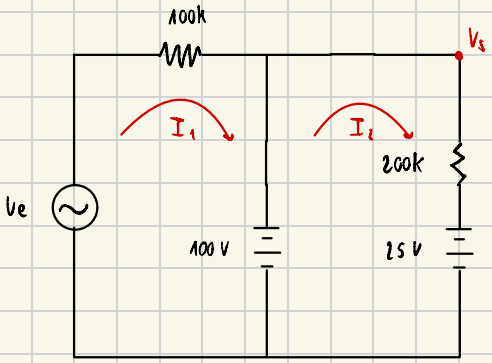
$V_s = 25 + 200K\,I$

$V_e - 25 = 300K\,I \;;\; I = \dfrac{V_e - 25}{300K}$

$V_s = 25 + 200K\,\dfrac{V_e - 25}{300K} = 25 + \dfrac{2V_e - 50}{3}$

$= \dfrac{2V_e + 25}{3}$

$V_e > 137.5\,V$ (D_1 ON, D_2 ON)

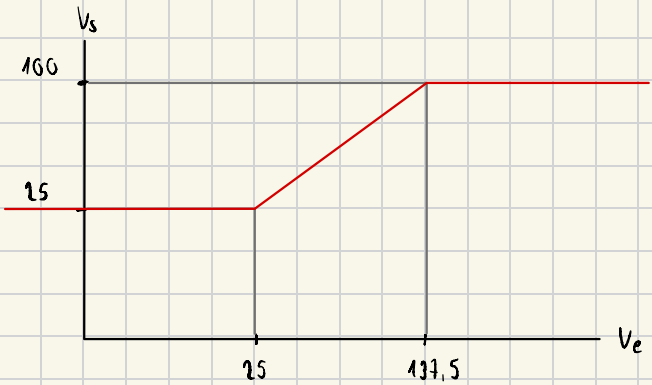


$V_s = 25 + 200K\,I_2$

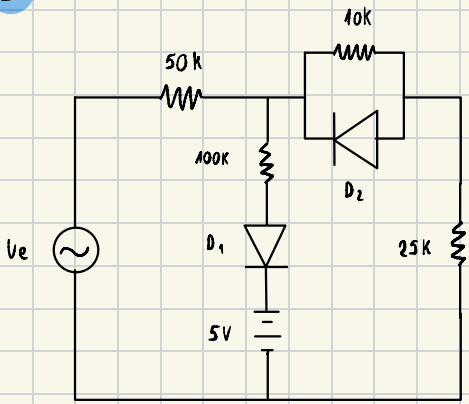
$V_e - 100 = 100K\,I_1$

$100 - 25 = 200K\,I_2 \;;\; I_2 = \frac{75}{200k}$

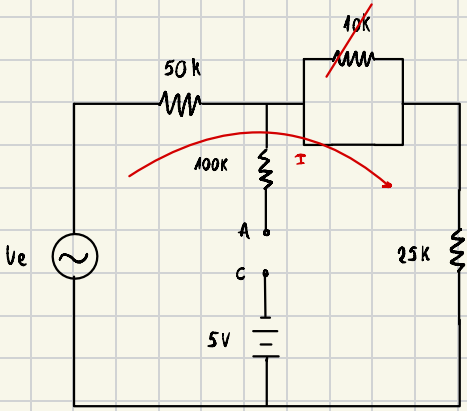
$V_s = 25 + 200K\,\frac{75}{200k} = 100\,V$



3



D1 PL D2 ON



$V_C = -5\,V$

$V_A = V_e - 50KI + \cancel{100KI}^{0}$

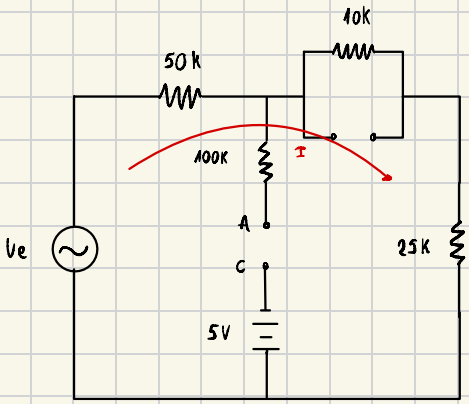
$V_C = 75KI \;;\; I = \frac{V_e}{75K}$

$V_A = V_e - \frac{2V_e}{3} = \frac{V_e}{3}$

$V_A - V_C = \frac{V_e}{3} + 5 = \frac{V_e + 15}{3}$

V_e	$> -15\,V$	D_1	Off	D_2 ON
V_e	$< -15\,V$	D_1	ON	D_2 ON

D1 PL D2 Off



$V_C = -5\,V$

$V_A = V_e - 50KI + \cancel{100KI}^{\,0}$

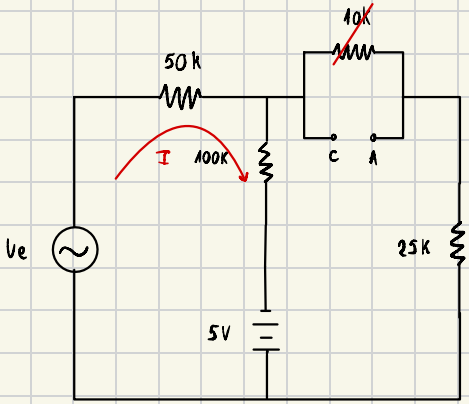
$V_e = 85KI \;;\; I = \frac{V_e}{85K}$

$V_A = V_e - \frac{50}{85} V_e = \frac{7}{17} V_e$

$V_A - V_C = \frac{7}{17} V_e + 5 = \frac{7V_e + 85}{17}$

$V_e > -12,143\,V$	D_1 ON	D_2 Off
$V_e < -12,143\,V$	D_1 Off	D_2 Off

D1 ON D2 PL



$V_e + 5 = 150KI \;;\; I = \frac{V_e + 5}{150K}$

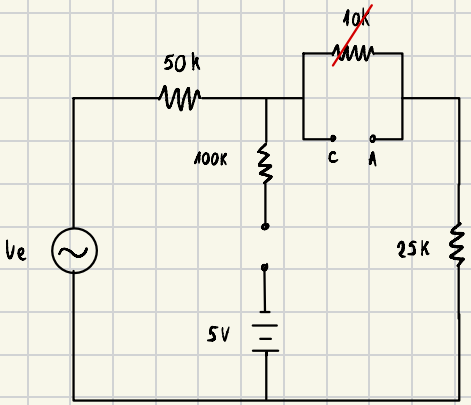
$V_C = 50KI - V_e = \frac{V_e + 5}{3} - V_e = \frac{5 - 2V_e}{3}$

$V_A = \cancel{25KI}^{\,0} = 0$

$V_A - V_C = \frac{2V_e - 5}{3}$

$V_e > 2,5\,V$	D_1 ON	D_2 ON
$V_e < 2,5\,V$	D_1 ON	D_2 Off

D1 off D2 PL



$V_A = \cancel{50kI}^{0} - V_c$

$V_C = \cancel{25kI}^{0} = 0$

$V_A - V_C = -Ve\ V$

$Ve > 0$	D_1 off	D_2 off
$Ve < 0$	D_1 off	D_2 ON

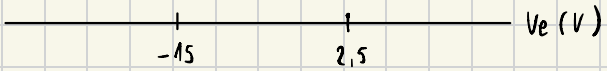
$Ve > -15V$	D_1 off	D_2 ON
$Ve < -15V$	D_1 ON	D_2 ON
$Ve > -12,143V$	D_1 ON	D_2 off
$Ve < -12,143V$	D_1 off	D_2 off
$Ve > 0$	D_1 off	D_2 off
$Ve < 0$	D_1 off	D_2 ON
$Vc > 2,5V$	D_1 ON	D_2 ON
$Vc < 2,5V$	D_1 ON	D_2 off

incompatibles

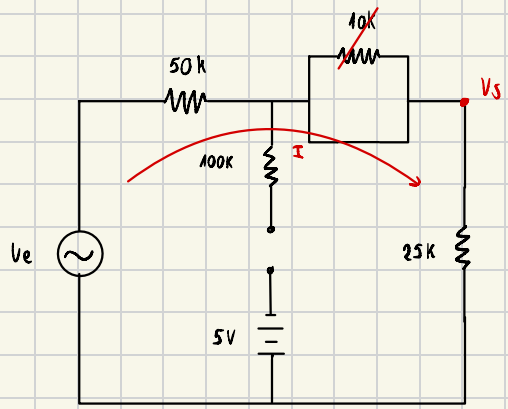
incompatibles

COGEMOS LOS EXTREMOS

D_1 Off	D_1 ON	D_1 ON
D_2 ON	D_2 ON	D_2 OFF



$V_e < -15V$ (D_1 Off, D_2 ON)

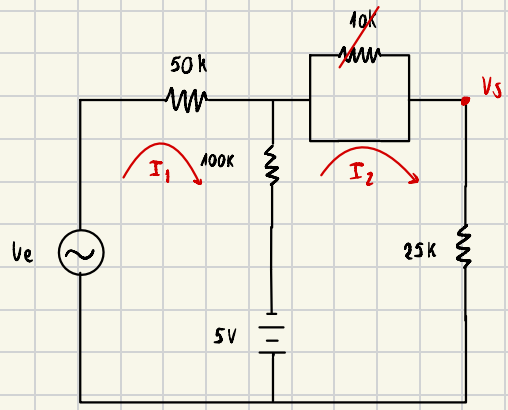


$V_s = 25K\,I$

$V_e = 75K\,I$; $I = \frac{Ve}{75K}$

$V_s = \frac{Ve}{3}$

$-15 < Ve < 2,5V$ (D_1 ON, D_2 ON)



$V_s = 25K\,I_2$

$Ve + 5 = 150K\,I_1 - 100K\,I_2$ ×2

$-5 = 125K\,I_2 - 100K\,I_1$ ×3

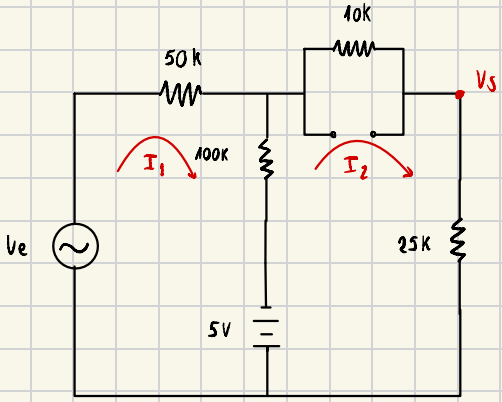
$2Ve + 10 = 300K\,I_1 - 200K\,I_2$

$-15 = 375K\,I_2 - 300K\,I_1$

$2Ve - 5 = 175K\,I_2$; $I_2 = \frac{2Ve - 5}{175K}$

$V_s = 25K\,I_2 = \frac{2Ve - 5}{7}$

$V_e > 2{,}5V$ (D_1 ON, D_2 OFF)



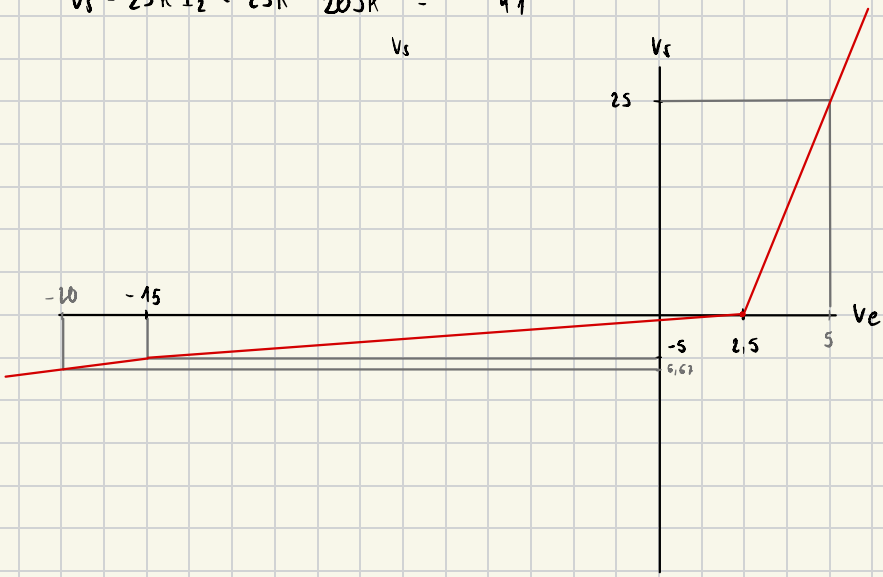
$V_s = 25K\,I_2$

$$\left.\begin{aligned} V_e + 5 &= 150K\,I_1 - 100K\,I_2 \\ 5 &= 135K\,I_2 - 100K\,I_1 \end{aligned}\right\} \begin{matrix} \times 2 \\ \times 3 \end{matrix}$$

$$\left.\begin{aligned} 2V_e + 10 &= 300K\,I_1 - 200K\,I_2 \\ -15 &= 405K\,I_2 - 300K\,I_1 \end{aligned}\right\}$$

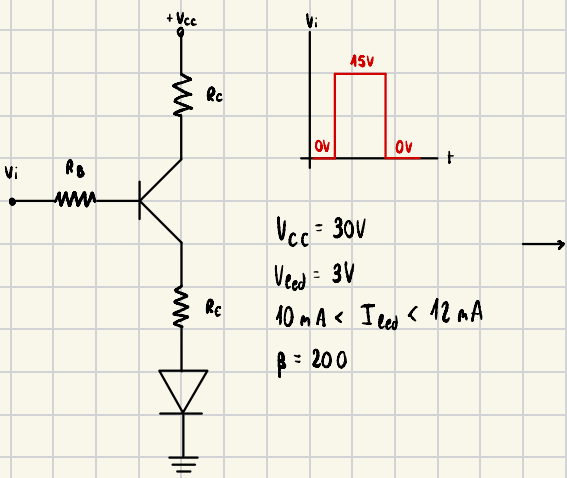
$2V_e - 5 = 205K\,I_1$; $I_2 = \dfrac{2V_e - 5}{205K}$

$V_s = 25K\,I_2 = 25K\,\dfrac{2V_e - 5}{205K} = \dfrac{10V_e - 25}{41}$



BJT

1 **Resistencias ?**

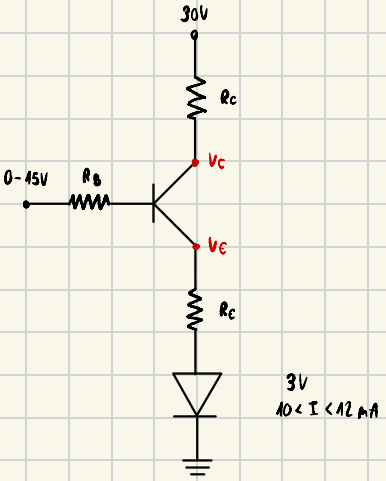


$V_{cc} = 30V$

$V_{eed} = 3V$

$10\,mA < I_{eed} < 12\,mA$

$\beta = 200$



Suponemos $I_e = 10mA$ (SAT)

$$\left.\begin{aligned} V_{cc} &= R_c I_c + V_c \\ V_c &= V_{ce} + V_e + V_{eed} \end{aligned}\right\} \quad V_{cc} = R_c I_c + V_{ce} + V_e + V_{eed}$$

$$\left.\begin{aligned} I_e &= I_c + I_B \\ I_c &= I_B \beta \end{aligned}\right\} \quad I_e = I_B \beta + I_B = I_B(\beta + 1) \; ; \; I_B = \frac{I_e}{\beta + 1} = \frac{10}{201}\ mA$$

$$I_c = \frac{10}{201}\,200 = \frac{2000}{201}\ mA$$

$$V_e = R_e I_e = \frac{R_c}{4} I_e = \frac{R_c}{4}(I_c + I_B) = \frac{R_c}{4}\,\frac{2010}{201} = \frac{10}{4} R_c$$

$$V_{cc} = R_c I_c + V_{ce} + V_e + V_{eed} \; ; \; 30 = \frac{2000}{201} R_c + 0{,}2 + \frac{10 R_c}{4} + 3$$

$$\left(\frac{2000}{201} + \frac{10}{4}\right) R_c = 30 - 0{,}2 - 3 \; ; \; \frac{10010}{804} R_c = 26{,}8 \; ; \; \boxed{R_c = 2{,}0883\ K\Omega}$$

$$\boxed{R_e = \frac{R_c}{4} = 0{,}5221\ K\Omega}$$

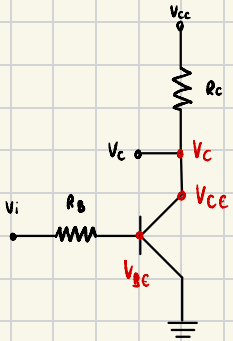
$$\left.\begin{aligned} V_{BB} &= R_B I_B + V_B \\ V_B &= V_{BE} + V_E - V_{LED} \end{aligned}\right\} \quad V_{BB} = R_B I_B + V_{BE} + R_E I_E - V_{LED}$$

$$V_{BB} = R_B I_B + V_{BE} + R_E I_E - V_{LED} \; ; \quad R_B I_B = V_{BB} - V_{BE} - R_E I_E - V_{LED}$$

$$R_B = \frac{V_{BB} - V_{BE} - R_E I_E - V_{LED}}{I_B} = \frac{15 - 0{,}7 - 0{,}5221 \cdot 10 - 3}{\frac{10}{201}}$$

$$R_B = 122{,}1879 \; K\Omega$$

2 V_C vs. V_{BB}



$V_{cc} = 5V$

$R_C = 0{,}82\ K\Omega$

$R_B = 68\ K\Omega$

$h_{FE} = \beta = 125$

$V_{ce} = 0{,}2\ V \longrightarrow SAT$

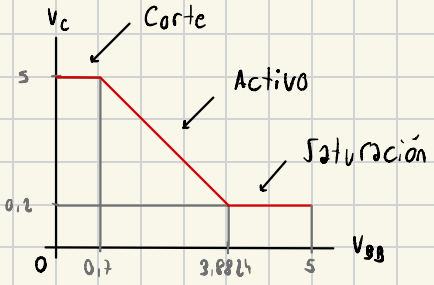
$V_{BE} = 0{,}7\ V \longrightarrow CORTE$

$$\left.\begin{array}{l} V_{cc} = I_C R_C + V_C \\ V_C = V_{CE} + \cancel{V_E} \end{array}\right\} \quad V_{cc} = I_C R_C + V_C \;;\; I_C = \frac{V_{cc} - V_C}{R_C} = \frac{5 - 0{,}2}{0{,}82} = 5{,}8537\ mA$$

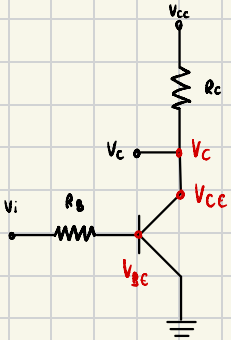
$R_E = 0 \rightarrow V_E = 0$

$$I_C = I_B \beta \;;\; I_B = \frac{I_C}{\beta} = \frac{5{,}8537}{125} = 0{,}0468\ mA$$

$$\left.\begin{array}{l} V_{BB} = I_B R_B + V_B \\ V_B = V_{BE} + \cancel{V_E} \end{array}\right\} \quad V_{BB} = I_B R_B + V_B = 0{,}0468 \cdot 68 + 0{,}7 = 3{,}8824\ V$$



3 V_{CE} vs. V_{BB}



$V_{cc} = 12\,V$ $\quad V_{ce} = 0.2\,V \longrightarrow SAT$

$R_C = 1.2\,K\Omega$ $\quad V_{BE} = 0.7\,V \longrightarrow CORTE$

$R_B = 100\,K\Omega$

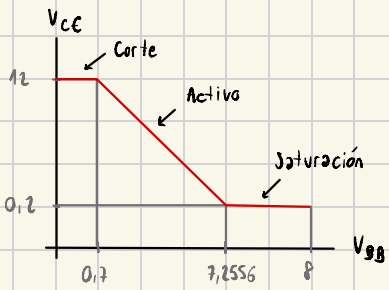
$\beta = 150$

* Gráfica : $V_{BB\,max} = 8V$

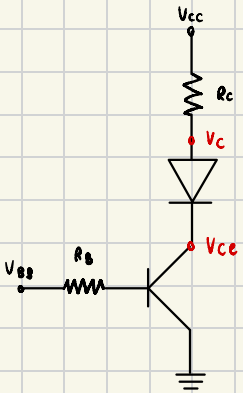
$$\left.\begin{aligned} V_{CC} &= I_C R_C + V_C \\ V_C &= V_{CE} + \cancel{R_E I_E} \end{aligned}\right\} \quad V_{CC} = I_C R_C + V_{CE} \;;\; I_C = \frac{V_{CC} - V_{CE}}{R_C} = \frac{12 - 0.2}{1.2} = 9.8333\,mA$$

$$I_C = I_B \beta \;;\; I_B = \frac{I_C}{\beta} = \frac{9.8333}{150} = 0.6556\,mA$$

$$V_{BB} = I_B R_B + V_{BE} = 0.6556 \cdot 100 + 0.7 = 7.2556\,V$$



4 **Resistencias ?**



$V_{ced} = 2V$

$I_{ced} > 8mA$

$\beta = 250$

$V_{CC} = 12V$

$V_{ce} = 0,2V \longrightarrow SAT$

$V_{BE} = 0,7V \longrightarrow CORTE$

* Gráfico : $V_{BB\,MAX} = 10V$

$$V_{CC} = I_C R_C + V_{ced} + V_{ce} + \cancel{V_e}^{\,0} \;;\; R_C = \frac{V_{cc} - V_{ced} - V_{ce}}{I_C} = \frac{12 - 2 - 0,2}{8}$$

$R_C = 1,225\ K\Omega$

$$I_C = I_B \beta \;;\; I_B = \frac{I_C}{\beta} = \frac{8}{250}$$

$$V_{BB} = I_B R_B + V_{BE} + \cancel{V_e}^{\,0} \;;\; R_B = \frac{V_{BB} - V_{BE}}{I_B} = 250\,\frac{10 - 0,7}{8}$$

$R_B = 290,625\ K\Omega$