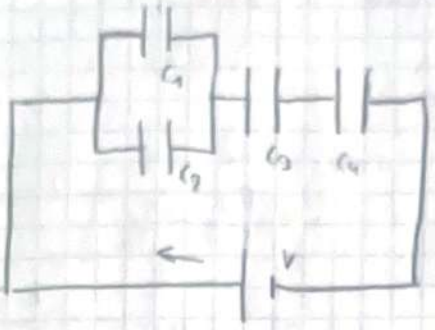
Ejercicios Boletín I

1-



$C_1 = 1\,\mu F$

$C_2 = 5\,\mu F$

$C_3 = C_4 = 12\,\mu F$

$V = 100\,V$

a) Asociación de condensadores

en serie $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots + \frac{1}{C_N}$

en paralelo: $C_{eq} = C_1 + C_2 + \dots + C_N$

$C_{eq_1} = C_1 + C_2 = 1 + 5 = 6\,\mu F$

$\frac{1}{C_{eq_2}} = \frac{1}{6} + \frac{1}{12} + \frac{1}{12} = \frac{1}{3}$

$C_{eq} = 3\,\mu F \rightarrow$ capacidad total equivalente

b) $Q_t = C_t \cdot V = 3\,\mu F \cdot 100\,V = 3 \cdot 10^{-6}\,F \cdot 100\,V$

$1\,F = \frac{1\,C}{1\,V} \qquad V = 1\,\frac{C}{F}$

$Q_t = \frac{1\,C}{3 \cdot 10^{-6}\,V} 100\,V = 3 \cdot 10^{-4}\,C$

c) Condensadores en serie acumulan la misma carga

$C_3 = 12\,\mu F \quad C_4 = 12\,\mu F$

$V_3 = \frac{Q_t}{C_3} \qquad V_4 = \frac{Q_t}{C_4} \qquad V_{12} = \frac{Q_t}{C_{12}} = V_1 = V_2$ les aplica la misma tensión

$Q_1 = C_1 V_{12}$

$Q_2 = C_2 V_{12}$

2- $R = 10\,K\Omega$

I, V

En serie

R_1 R_2

$R = R_1 + R_2$

$I_1 = I_2 = I_3$

En paralelo

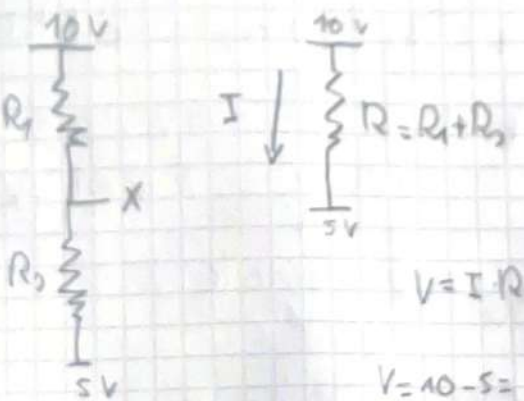
R_p

$R_p = \left[\frac{1}{R_1} + \frac{1}{R_2}\right]^{-1}$

$R_1 = 0{,}5\,R_p$ < R

< R_p

3- $R_1 = 2\,K\Omega$ $R_2 = 3\,K\Omega$

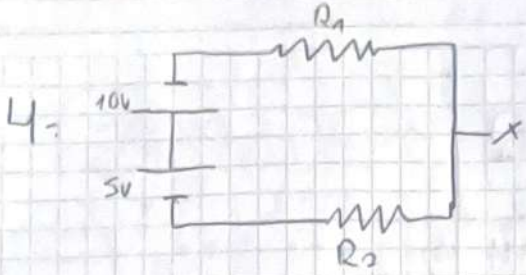


$V = I\,R \Rightarrow I = \frac{V}{R} = \frac{5V}{5K}$

$V = 10 - 5 = 5V$

P.F tensión

4-



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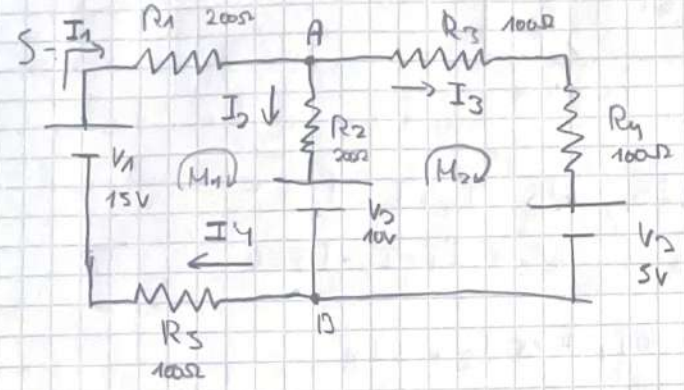


NA: $I_1 - I_2 - I_3 = 0$ NB = $I_2 + I_3 - I_4$

M_1: $15 - 10 = 200 I_1 + 200 I_2 + 100 I_4$

M_2: $10 - 5 = -200 I_2 + 200 I_3$

$I_1 = \frac{3}{160}$ $I_2 = \frac{-1}{320}$ $I_3 = \frac{7}{320}$ $I_4 = \frac{3}{160}$

$\frac{3}{160} \cdot 100 = 1'875$

$V_{R1} = \frac{3}{160} \cdot 200 = 3'75$

$V_{R2} = \frac{-1}{320} \cdot 200 = -0'625$

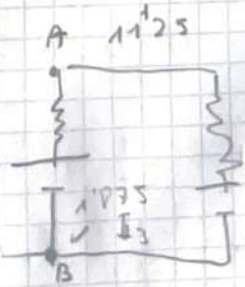
$\frac{7}{320} \cdot 200 = 4'375$

$V_{AB} = V_A - V_B$

$V_A = 15 - 3'75 = 11'25$

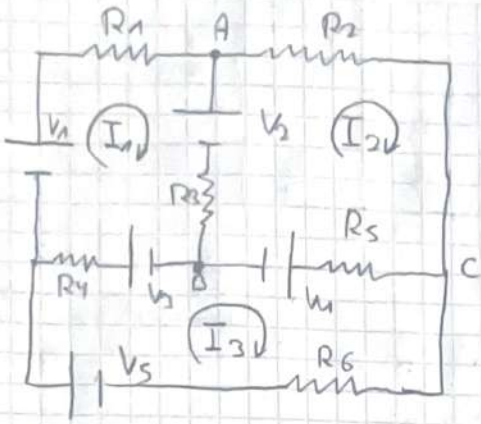
$V_B = 1'875$

$V_{AB} = 11'25 - 1'875 = 9'375$



B

6:



M_1: $V_1 - V_2 + V_3 = I_1 R_1 + R_3 (I_1 - I_2) + R_4 (I_1 - I_3)$

M_2: $V_2 - V_4 = I_2 R_2 + R_5 (I_2 - I_3) + R_3 (I_2 - I_1)$

M_3: $V_5 - V_3 + V_4 = I_3 R_6 + R_4 (I_3 - I_1) + R_5 (I_3 - I_2)$

$I_1 = 1\,A \quad I_2 = \frac{4}{9}\,A \quad I_3 = \frac{7}{9}\,A$

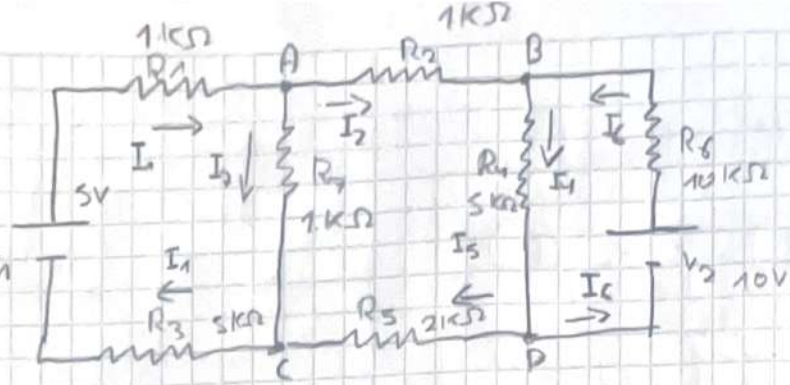
$V_{AB} = V_A - V_B \qquad V_{AB} = -(I_2 - I_3) R_3 + V_2 = 10'5$

$V_A = V_B - (I_2 - I_1) R_3 + V_2$

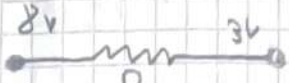
$V_{BC} = V_B - V_C \qquad V_{BC} = (I_2 - I_3) R_5 - V_4 = 8'3$

$V_C = V_B + V_4 - (-I_2 + I_3) R_5$

7-



$V_D = 0$



$I = \frac{V}{R} = \frac{8-3}{R}$

NA: $I_1 - I_7 - I_2 = 0$

$$\frac{V_1 - V_A}{R_1} - \frac{V_A - V_C}{R_7} - \frac{V_A - V_B}{R_2} = 0$$

NB: $I_2 - I_4 + I_6 = 0$

$$\frac{V_A - V_B}{R_2} - \frac{V_B - V_D}{R_4} + \frac{V_2 - V_B}{R_6} = 0$$

NC: $I_5 + I_7 - I_1 = 0$

$$\frac{V_D - V_C}{R_5} + \frac{V_A - V_C}{R_7} - \frac{V_C - V_1}{R_3} = 0$$

$$5 - V_A - V_A + V_C - V_A + V_B = 0$$

$$-3V_A + V_B + V_C = -5$$

$$10V_A - 10V_B - 2V_B + 10 - V_B = 0$$

$$10V_A - 13V_B = -10$$

$$-5V_C + 10V_A - 10V_C - 2V_C + 10 = 0$$

$$10V_A - 17V_C = -10$$

$V_A = \frac{1405}{363}$

$V_B = \frac{1360}{363}$

$V_C = \frac{1040}{363}$

$V_{R2} = I_2 \cdot R_2$

$I_7 = \frac{V_A - V_C}{R_7} = 1'005\ mA$

$V_{R2} = V_A - V_B = 0'123\ V$

8: V_1 3V R_1 12KΩ

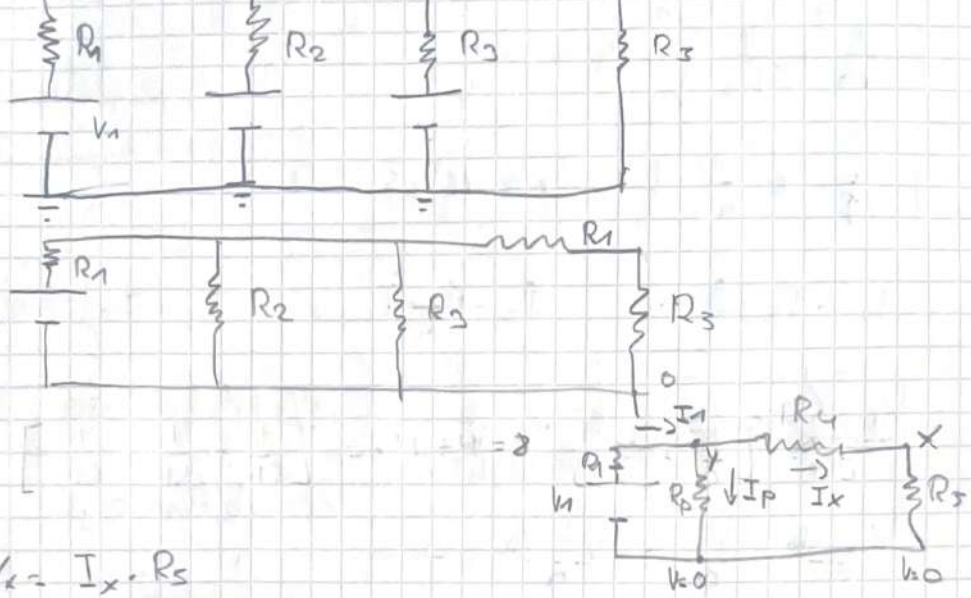
V_2 1'5V R_2 12KΩ

V_3 1'5V R_3 12KΩ

R_4 4KΩ

X

R_5 2KΩ



$V_x = I_x \cdot R_5$

El tipo usa nudos por la cara

$R_p = \left[\frac{1}{12} + \frac{1}{12}\right]^{-1} = 6$

$I_1 - I_p - I_x = 0$

$\frac{V_1 - V_y}{R_1} - \frac{V_y - 0}{R_p} - \frac{V_y}{R_4 + R_5} = 0 \qquad V_y = \frac{3}{5}$

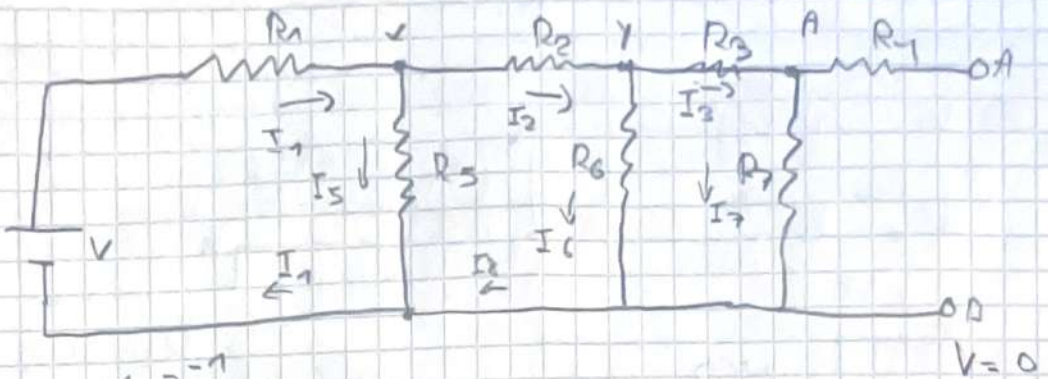
$I_x = \frac{V_y}{R_4 + R_5} = \frac{3}{30} V_1$

$V_x = \frac{V_1}{30} \cdot 2 \; R_5$

aplica superposición

$V_x = \frac{1}{15}(V_1 + V_2 + V_3) = 1\,V$

9-.



$$\left[\frac{1}{R_1}+\frac{1}{R_5}\right]^{-1}+R_2=15$$

$$\left[\frac{1}{15}+\frac{1}{R_6}\right]^{-1}+R_3=16$$

$$Req = 16'15\ K\Omega$$

$$\left[\frac{1}{16}+\frac{1}{R_7}\right]+R_4=16'15\ K\Omega$$

$$I_1 - I_5 - I_2 = 0 \qquad I_2 - I_3 - I_6 = 0 \qquad I_2 - I_7 - I_4$$

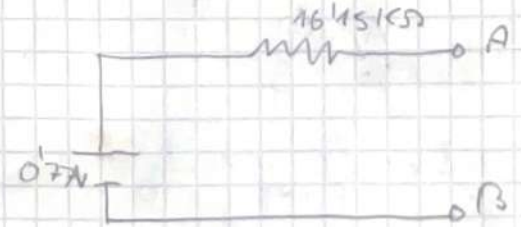
$$\frac{V_1 - V_x}{R_1} - \frac{V_x}{R_5} - \frac{V_x - V_y}{R_2} = 0 \qquad 10 - 3V_x + V_y = 0$$

$$\frac{V_x - V_y}{R_2} - \frac{V_y}{R_6} - \frac{V_y - V_A}{R_3} = 0 \qquad V_x - 3V_y + V_A = 0$$

$$\frac{V_y - V_A}{R_3} - \frac{V_A}{R_7} = 0 \qquad V_y - 3V_A = 0$$

$$V_A = 0'77$$

$$V_{TH} = V_A - V_B = 0'77\ V$$



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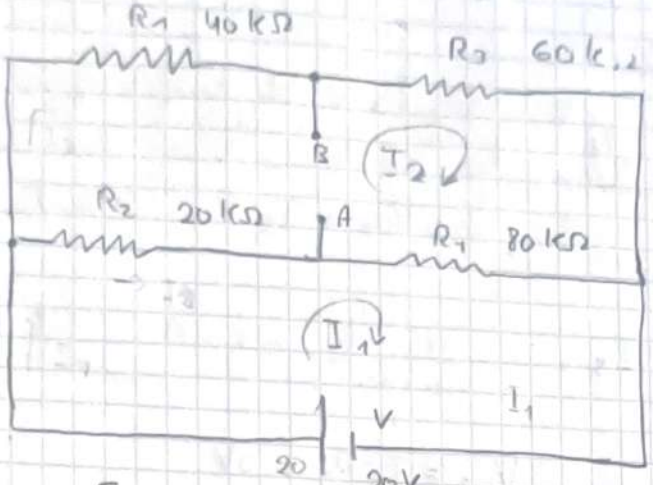


$$Req = \left[\frac{1}{20} + \frac{1}{80} \right]^{-1} + \left[\frac{1}{40} + \frac{1}{60} \right]^{-1} = 40\ k\Omega$$

M_1: $20 = R_2(I_1 - I_2) + R_4(I_1 - I_2)$

M_2: $0 = R_2(I_2 - I_1) + R_4(I_2 - I_1) + R_3 I_2 + R_1 I_2$

$20 = 100\, I_2 - 100\, I_1$

$0 = 200\, I_2 - 100\, I_1$

$I_1 = -\frac{2}{5} \qquad I_2 = -\frac{1}{5}$

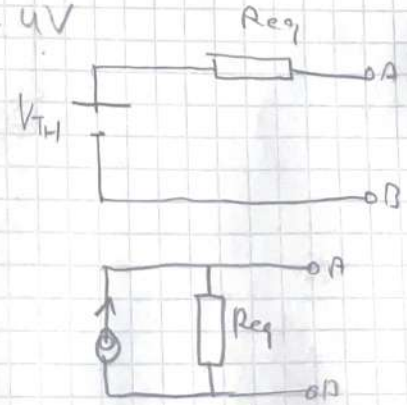
$V_{TH} = V_A - V_B =$

$V_B = \ldots + I_2 R_3 + R_4(I_2 - I_1) + V_A$

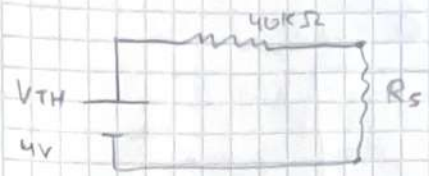
$V_{TH} = -I_2 R_3 + R_4(I_2 - I_1) = 4V$

$V_{TH} = I_N \cdot Req$

$I_N = 1\ mA$



11- $R_S = 20\,k\Omega$ I_S? V_S?



$$I_S = \frac{4}{60000} = 66'67\ \mu A$$

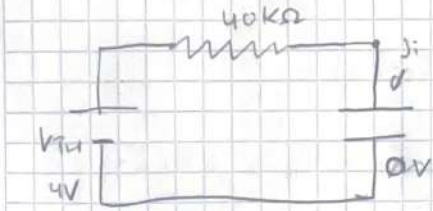
$$V_{RS} = I_S \cdot R_S = 1'3\ V$$

$R_S = 0k\Omega$

$$I_S = \frac{4}{40\,000} = 0'1\ mA$$

$$V_{RS} = I_S R_S = 0V$$

12- $C = 1\mu F$ $1F = 1\frac{V}{C}$ $V = 0V$



si está cargado $\Delta V = 0$ no le entra más carga

$$V_C = V_0 \cdot e^{-\frac{t}{RC}}$$

$$0'4 = 4 \cdot e^{-\frac{t}{RC}} \rightarrow (t - t_0)$$

$t_0 = 0$

$$\ln(0'4) = \ln\left(4 \cdot e^{-\frac{t}{RC}}\right)$$

$$\ln(0'4) = \ln(4) + \ln\left(e^{-\frac{t}{RC}}\right)$$

$$\ln(0'4) - \ln(4) = -\frac{t}{RC} \ln(e) = 0 \quad -\ln(0'1) \cdot RC = t$$

$$\ln\left(\frac{0'4}{4}\right)$$

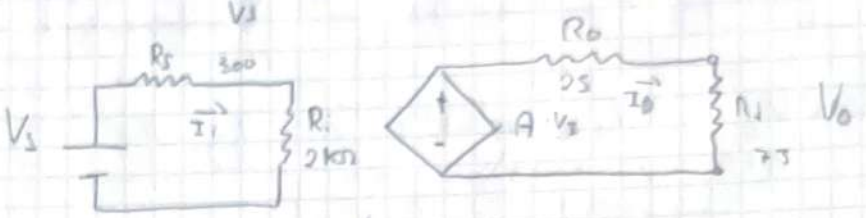
$$t = -\ln(0'1) \cdot 40 \cdot 10^3 \cdot 10^{-6} = 0'0921\ s$$

$$t = 92'1\ ms$$

1: $A_{vo} = 300$ $R_{in} = 2k\Omega$ $R_{out} = 25\Omega$

$V_s = 20mV$ $R_s = 300\Omega$ $R_L = 75\Omega$

A_v? $A_v = \frac{V_o}{V_s}$



$$\frac{V_o}{V_s} = A \cdot \left(\frac{R_i}{R_i + R_s} \cdot \frac{R_L}{R_L + R_o} \right) = 300 \cdot \frac{2000}{2500} \cdot \frac{75}{100} = 300$$

$A_v = 300$

$V_s = I_i \, (R_s + R_i)$

$I_i = \frac{V_i}{R_i}$

$V_s = \frac{V_i}{R_i} (R_s + R_i)$

$$\frac{V_o}{V_s} = \frac{\frac{A V_i \cdot R_L}{R_o + R_L}}{\frac{V_i (R_s + R_i)}{R_i}} = \frac{A \cdot R_i \cdot R_L}{(R_o + R_L)(R_s + R_i)}$$

$A V_I = I_o \, (R_o + R_L)$

$I_o = \frac{V_o}{R_L}$

$A_{VI} = \frac{V_o}{R_L} (R_o + R_L)$

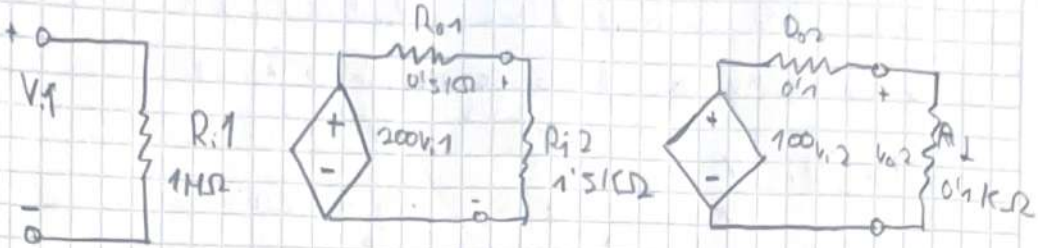
$V_o = \frac{A V_i \cdot R_L}{R_o + R_L}$

También es útil

$V_i = V_s \cdot \frac{R_i}{R_s + R_i}$ $V_L = A_{vo} \cdot V_i \, \frac{R_L}{R_o + R_L}$

$V_L = A_{V_o} \, V_s \, \frac{R_i}{R_s + R_i} \, \frac{R_L}{R_s + R_i}$

2:



$$A_{V_1} = \frac{V_{i2}}{V_{i1}} \qquad V_{i1} = I_{i1} \cdot R_{i1} \Rightarrow V_{i1} = \frac{V_{i1}}{R_{i1}} \cdot R_{i1}$$

$$200V_{i1} = I_{i2} \cdot (R_{o1} + R_{i2})$$

$$I_{i2} = \frac{V_{i2}}{R_{i2}}$$

$$V_{i2} = \frac{200\, V_{i1} \cdot R_{i2}}{(R_{o1} + R_{i2})}$$

$$A_{V_1} = \frac{\dfrac{200 V_{i1} \cdot R_{i2}}{(R_{o1}+R_{i2})}}{V_{i1}}$$

$$A_{V1} = \frac{200 \cdot 1500}{(1500+500)} = 150 \qquad V_{i1} = \frac{V_{i2}}{150}$$

$$A_{V_2} = \frac{V_{o2}}{V_{i2}} \qquad 100V_{i2} = I_1 (R_{o2} + R_L)$$

$$I_1 = \frac{V_{o2}}{R_2}$$

$$A_{V_2} = \frac{\dfrac{100 V_{i2} R_L}{(R_{o2}+R_1)}}{V_{i2}} = \frac{100 \cdot 100}{(100+100)} = 50$$

$$V_{o2} = \frac{100 V_{i2} R_L}{(R_{o2}+R_1)}$$

$$A_V = \frac{V_{o2}}{V_{i1}} = \frac{\dfrac{100 \cdot 150 V_{i1} \cdot R_2}{(R_{o2}+R_2)}}{V_{i1}} = 7500$$

$$V_{i2} = 150 V_{i1}$$

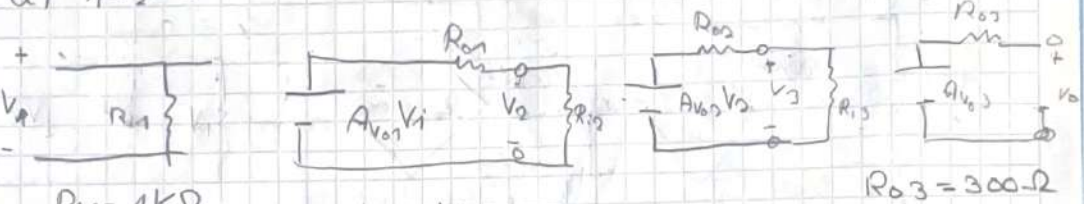
3: Amplificador

1: $A_{Vo1} = 10$ $R_{i1} = 1\ K\Omega$ $R_{o1} = 100\Omega$

2: $A_{Vo2} = 20$ $R_{i2} = 21K\Omega$ $R_{o2} = 200\Omega$

3: $A_{Vo3} = 30$ $R_{i3} = 31K\Omega$ $R_{o3} = 300\Omega$

a) 1-2-3



$R_{o3} = 300\Omega$

$R_{i1} = 1K\Omega$

A_{Vo}?

$A_{Vo} = \frac{V_o}{V_1}$

$V_1 = V_1$

$A_{Vo1}^{V_1} = I_{12}(R_{o1} + R_{i2})$ $I_2 = \frac{V_2}{R_{i2}}$

$V_2 = \frac{10 V_1 R_{i2}}{(R_{o1} + R_{i2})}$

$A_{Vo2}^{V_2} = I_3 (R_{o2} + R_{i3})$ $I_3 = \frac{V_3}{R_{i3}}$

$V_3 = \frac{20\ R_{i3}\ 10 V_1 R_{i2}}{(R_{o2} + R_{i3})(R_{o1} + R_{i2})}$

$A_{Vo3}^{V_3} = I_4 R_{o3}$ $I_4 = \frac{V_o}{R_{o3}}$

$V_o = \frac{30 \cdot 20 \cdot 10\ R_{i3} R_{i2} V_1}{(R_{o2} + R_{i3})(R_{o1} + R_{i2})}$

$A = \frac{V_o}{V_i}$

$A_{Vi} = V_o$

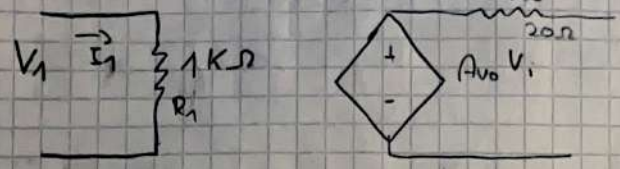
$A_{Vo} = \frac{30 \cdot 20 \cdot 10 \cdot 3.2}{(6'2 + 3) \cdot (6'1 + 2)} = 5357$

* b)

4- $R_i = 1K\Omega$ $R_o = 20\Omega$ $A_{IS} = 200$

A_v?

$$A_{IS} = \frac{I_2}{I_1} \qquad I_2 = 200\, I_1$$



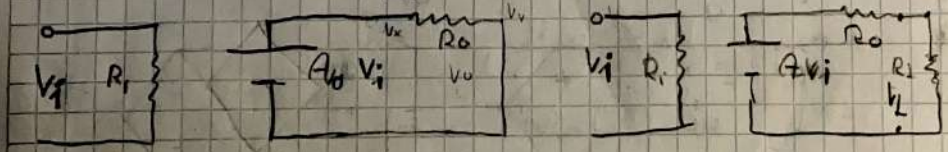
$$A_{vo} = \frac{V_2}{V_1} \qquad A_{vo} = \frac{4000}{1000} = 4$$

$$V_1 = 1000\, I_1 \qquad V_2 = 200\, I_1 \cdot 20$$

$A_{vo} = 4$ $R_1 = 1\,K\Omega$ $R_o = 20\Omega$

5: $A_o = 100$ $R_1 = 10K\Omega$ R_o?

$A_{vo} = 90$



$I = 0$

$V_o = A_o \cdot V_1 - I R_o = 100 V_i$ | $90\, V_i = V_1$ | $V_1 = V_o - I_1 R_o$

$$A_{vo} = \frac{V_o}{V_1}$$

$$90 \cdot V_i = 100 V_i - \frac{100 V_i}{R_o + R_1} R_o$$

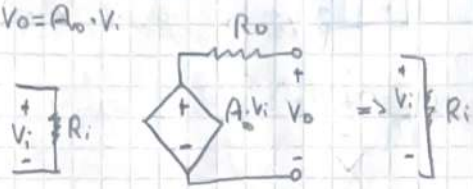
$$9 = 10\left(1 - \frac{R_o}{R_o + 10}\right)$$

$$R_o = \frac{10}{9} = 1\tilde{1}\,K\Omega$$

6-

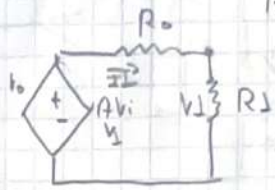
$A_{V_0} = 2\,mV/°C$

$V_0 = A_0 \cdot V_i$



$A_{V_1} = 10\,mV/10°C = 1\,mV/°C$

$R_1 = 10K\Omega$

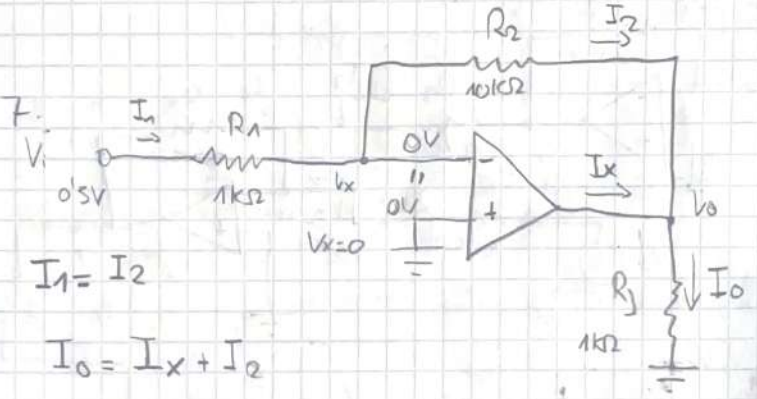


$I_1 = \frac{V_0}{R_0 + R_1} = \frac{2V_i}{R_0 + 10}$

$V_1 = V_0 - I_1 R_0 \Rightarrow 1 \cdot V_i = 2V_i - \frac{2V_i R_0}{R_0 + 10}$

$R_0 = 10\,K\Omega$

7.



$I_1 = I_2$

$I_0 = I_x + I_2$

$I_1 = \frac{0'5}{1000} = 0'5\,mA = I_2$

$V_0 = I_0 R_L$

$\frac{0'5 - V_x}{R_1} = \frac{V_x - V_0}{R_2}$

$\frac{V_0 - 0}{R_1} = I_x + \frac{V_x - V_0}{R_2}$

$5 - 11V_x + V_0 = 0$

$11V_0 - 10I_x - V_x = 0$

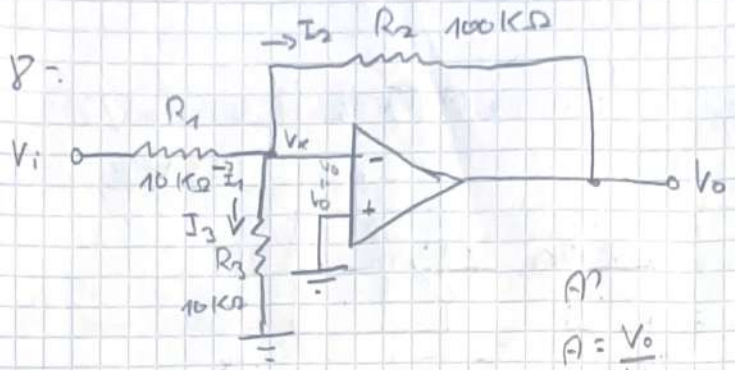
$V_0 = -5$

$-55 - 10I_x = 0$

$I_0 = \frac{V_0}{R_1} = -5\,mA$

$I_x = -5'5\,mA$

8 -



A?

$A = \frac{V_o}{V_i}$

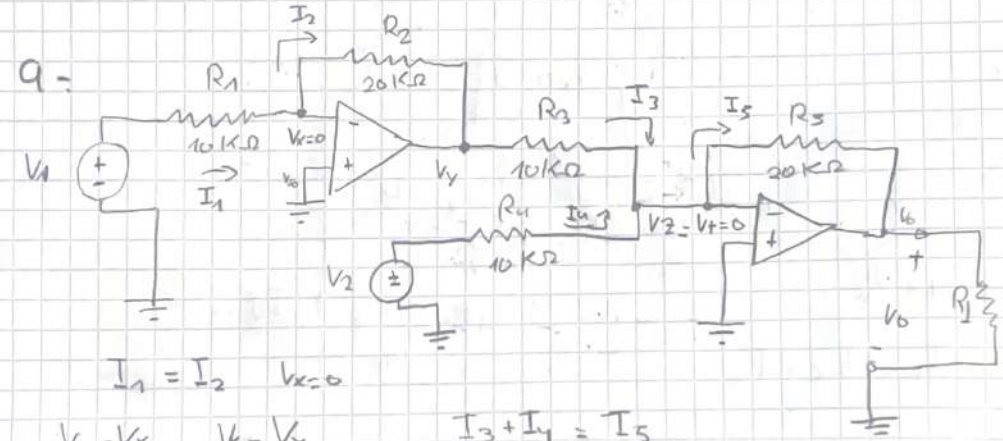
$I_1 - I_2 - I_3 = 0$

$\frac{V_i - V_x}{R_1} - \frac{V_x - V_o}{R_2} - \frac{V_x - 0}{R_3} = 0$

$10 V_i + V_o = 0 \qquad V_o = -10 V_i$

$A = \frac{-10 V_i}{V_i} = -10$

9 -



$I_1 = I_2 \qquad V_x = 0$

$\frac{V_1 - V_x}{R_1} = \frac{V_x - V_y}{R_2}$

$2V_1 + V_y = 0$

$V_y = -2V_1$

$I_3 + I_4 = I_5$

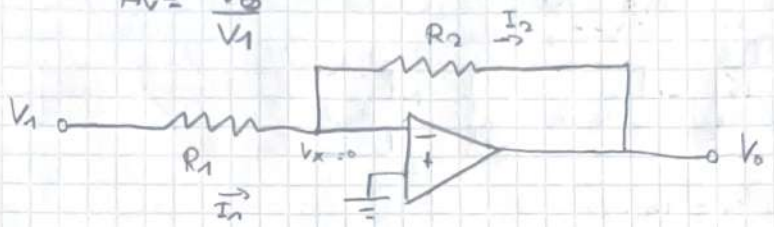
$\frac{V_y - V_+}{R_3} + \frac{V_2 - V_+}{R_4} = \frac{V_+ - V_o}{R_5}$

$2V_y + 2V_2 = -V_o$

$+4V_1 - 2V_2 = V_o$

10- $A_v = -5$ $R_T = 120\ K\Omega$

$$A_v = \frac{V_o}{V_1}$$



$V_o = -5 V_1$

$I_1 = I_2$

$$\frac{V_1 - V_x}{R_1} = \frac{V_x - V_o}{R_2}$$

$$V_o = -\frac{R_2}{R_1} V_1$$

$$-5 = -\frac{R_2}{R_1}$$

$$R_2 + R_1 = 120$$

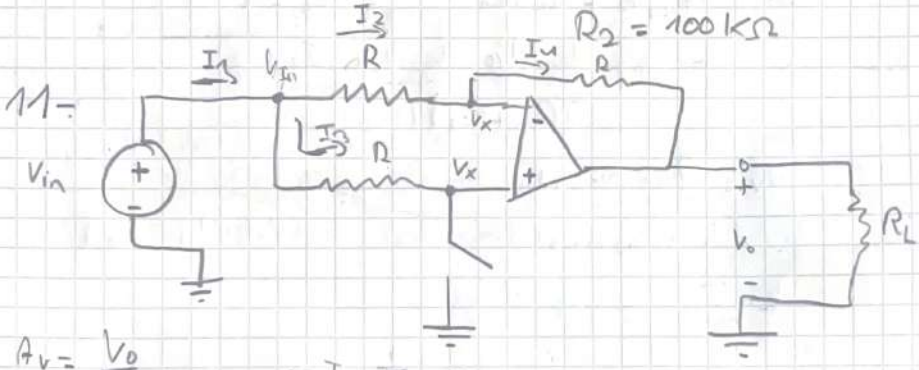
$$5R_1 - R_2 = 0$$

$$R_1 + R_2 = 120$$

$R_1 = 20\ K\Omega$

$R_2 = 100\ K\Omega$

11-



$$A_v = \frac{V_o}{V_{IN}}$$

$I_1 = I_2 + I_3$

$$I_1 = \frac{V_{IN} - V_x}{R} + \frac{V_{IN} - V_x}{R}$$

$0 = 2V_{IN} - 2V_x$

$V_x = V_{in}$

$I_2 = I_4$

$$\frac{V_{IN} - V_x}{R} = \frac{V_x - V_o}{R}$$

$V_{IN} - 2V_x + V_o = 0$

$V_{IN} - 2V_{in} + V_o = 0$

$-V_{in} = -V_o$

$V_{in} = V_o$

$$A_v = \frac{V_o}{V_{IN}} = \frac{V_o}{V_o} = 1$$

b) $V_x = 0$

$V_{IN} = -V_o$

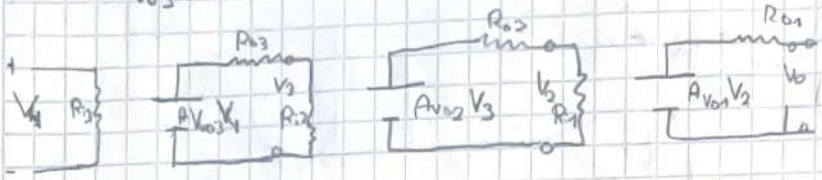
$A_v = 1$

* 3: b) 3-2-1

$A_{Vo1} = 10$ $R_{i1} = 1\,K\Omega$ $R_{o1} = 100\,\Omega$

$A_{Vo2} = 20$ $R_{i2} = 2\,K\Omega$ $R_{o2} = 200\,\Omega$

$A_{Vo3} = 30$ $R_{i3} = 3\,K\Omega$ $R_{o3} = 300\,\Omega$



$R_i = 3\,K\Omega$ $R_o = 100\,\Omega$

$A_v = \frac{V_o}{V_4}$ $V_4 = V_4$

$A_{Vo3} V_4 = I_3 \cdot (R_{o3} + R_{i2})$ $I_3 = \frac{V_3}{R_{i2}}$

$V_3 = \frac{A_{Vo3} V_4 R_{i2}}{(R_{o3} + R_{i2})}$

$A_{Vo2} V_3 = I_2 (R_{o2} + R_{i1})$ $I_2 = \frac{V_2}{R_{i1}}$

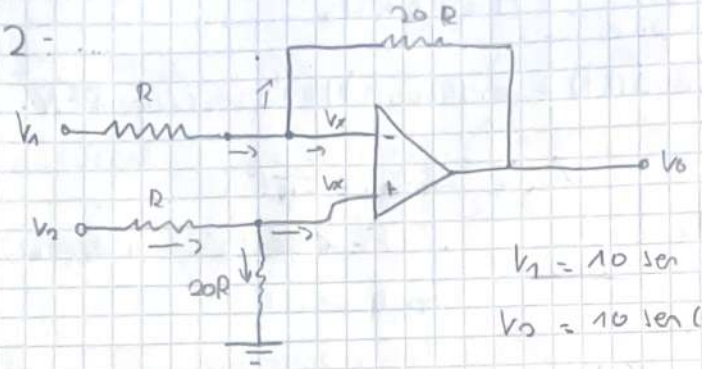
$V_2 = \frac{A_{Vo2} A_{Vo3} V_4 R_{i2} R_{i1}}{(R_{o2} + R_{i1})(R_{o3} + R_{i2})}$

$A_{Vo1} V_2 = I_o R_{o1}$ $I_o = \frac{V_o}{R_{o1}}$

$V_o = \frac{A_{Vo1} A_{Vo2} A_{Vo3} V_4 R_{i2} R_{i1}}{(R_{o2} + R_{i1})(R_{o3} + R_{i2})}$

$A_V = \frac{A_{Vo1} A_{Vo2} A_{Vo3} R_{i2} R_{i1}}{(R_{o2} + R_{i1})(R_{o3} + R_{i2})} = \frac{10 \cdot 20 \cdot 30 \cdot 2 \cdot 1}{(0'2+1)(0'3+2)}$

12 :



$V_1 = 10 \operatorname{sen}(120\pi t) - 0{,}1 \operatorname{sen}(20000\pi t)\ V$

$V_2 = 10 \operatorname{sen}(120\pi t) + 0{,}1 \operatorname{sen}(20000\pi t)\ V$

$I_1 = I_2 + I_3$

$i(t) = \frac{v(t)}{R} = V_m \operatorname{sen}(\omega t) = I_m \operatorname{sen}(\omega t)$

$I_m = \frac{V_m}{R}$

$I_4 = I_2 + I_6$

$$\frac{V_1 - V_x}{R} - \frac{V_x - V_0}{20R} = \frac{V_2 - V_x}{R} - \frac{V_x}{20R}$$

$$20V_1 - 20V_x - V_x + V_0 = 20V_2 - 20V_x - V_x$$

$$21V_1 - 20V_2 + V_0 = 0$$

$$V_0 = -20V_1 + 20V_2$$

$V_0(t) = -200 \operatorname{sen}(120\pi t) + 2 \operatorname{sen}(20000\pi t) + 200 \operatorname{sen}(120\pi t) + 2 \operatorname{sen}(20000\pi t)$

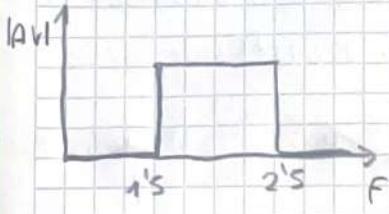
$V_0(t) = 4 \operatorname{sen}(20000\pi t)$

13: $f_1 = 1'5\ KH_z$ $f_H = 2'5\ KH_z$

$v_i(t) = 0'5 \operatorname{sen}(2000\pi t) + \operatorname{sen}(4000\pi t) + 1'5 \operatorname{sen}(6000\pi t)$ V

$v_o(t)$?

Filtro pasabanda



$2000\pi = 2\pi f$

$F = 1000 Hz < 1'500 Hz$

$4000\pi = 2\pi F$

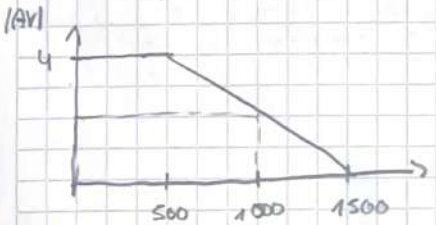
$F = 2000 Hz$

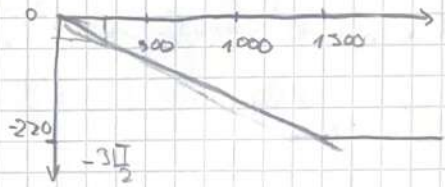
$6000\pi = 2\pi F$

$F = 3000 Hz > 2500 Hz$

$v_o(t) = \operatorname{sen}(4000\pi t)$

14: $v_i(t) = 0'5 + \cos(200\pi t) + \cos(2000\pi t)$





$-0'1\pi$

$v_o = 2v_i$ $v_o = 4 + 4\cos(2000\pi t) - 2\cos(2000\pi t)$

$200\pi = 2\pi F$

$F = 100 Hz < 500$

$2000\pi = 2\pi F$

$F = 1000$

$A(500,4)$ $B = (1300,0)$

$$\frac{x - 500}{1300 - 500} = \frac{y - 4}{0 - 4}$$

$-4x + 2000 = 1000y - 4000$

$$y = \frac{-4x + 6000}{1000}$$

$x = 1000$

$y = 2$

$x = 1000$ $y = -1\pi$

$A = (0,0)$

$B = (150°, -270)$ $\frac{x - 0}{1500 - 0} = \frac{y - 0}{\frac{\pi}{3} - 0} \Rightarrow y = \frac{-\pi x}{1000}$

$x = 100$

$y = 0'1\pi$

15- ADC 12 bits $V = [0, 10]V$

a) resolución $\Delta = \frac{V_A(max)}{2^N} = \frac{10}{2^{12}} = 2'44\ mV$

b) Error $= \frac{\Delta}{2} = 1'22\ mV$

16- DAC 10 bits $V_{ref} = 5'12$

$V_o = DV_{ref}$

$V_o = d_n 2^{-n} V_{ref}$

a) $V_o = 1 \cdot 2^{-10} \cdot 5'12 = 0'005\ V$

b) $V_o = 1 \cdot 2^{-1} \cdot 5'12 = 2'56\ V$

c) $V_o = (1 \cdot 2^{-1} + 1 \cdot 2^{-2} + 1 \cdot 2^{-6} + 1 \cdot 2^{-10}) \cdot 5'12 = 3'905\ V$

1- $n_i^2 = BT^3 e^{\left(-\frac{E_G}{KT}\right)}$ (portadores/cm³)²

$E_G = 1'12$ eV (Ge) $K = 8'6173 \cdot 10^{-5}$ cte Boltzmann

$T = 300$ K → $n_i = 10^{10}$

$(10^{10})^2 = B \cdot 300^3 \, e^{\left(-\frac{1'12}{K \cdot 300}\right)}$

$B = 2'42 \cdot 10^{31}$

$n = p = n_i$

$T = 500$ K

$n_i = \sqrt{2'42 \cdot 10^{31} \cdot 500^3 \cdot e^{\left(\frac{-1'12}{500 \cdot K}\right)}} = 1'24 \cdot 10^{\ldots}$

$n_i = p = n$

$T = 50$ K lo calculadora no da

$p = n \; 6'43 \cdot 10^{-39} \, cm^{-3}$

2- $T = 300$ K $N_D = 2 \cdot 10^{16}$ at/cm³ $n_i = 10^{10} \, cm^{-3}$

$n \cdot p = n_i^2$

Intrínseco → $n = p = n_i$ → $n \cong N_D$

$p = \frac{n_i^2}{n} \cong \frac{n_i^2}{N_D} = \frac{10^{20}}{2 \cdot 10^{16}} = 5 \cdot 10^3 \, cm^{-3}$

3- $n_i = p = n = 10^{13} \, cm^{-3}$ $N_D = 10^{19} \, cm^{-3}$

intrínseco

$n \cong 10^{19} \, cm^{-3} \Rightarrow p = \frac{n_i^2}{n} = \frac{10^{26}}{10^{19}} = 10^{11}$

4- $n_{i_1} = 10^{15}\ cm^{-3}$ $\quad n = p = n_i$

$n_{i_2} = 10^{19}\ cm^{-3}$ $\quad p = 10^{19}\ cm^{-3}$

5- $\lambda = 1'0$ $\quad E = hF = \frac{h \cdot c}{\lambda} = 1'03\ eV$

$E_g(Si) = 1'12\ eV$

$E_g(Ge) = 0'67\ eV$

$E_g(GaAs) = 1'43\ eV$

Sólo detecta el fotón de germanio. Independientemente de la intensidad.

6- $N_B = 10^{15} \Rightarrow n_B = 10^{15}\ cm^{-3} \Rightarrow p_B = \frac{n_B^2}{n_B} = \frac{10^{20}}{10^{15}} = 10^5\ cm^{-3}$

$N_A = 10^{15} \Rightarrow p_A = 10^{15}\ cm^{-3} \Rightarrow n_A = 10^5\ cm^{-3}$

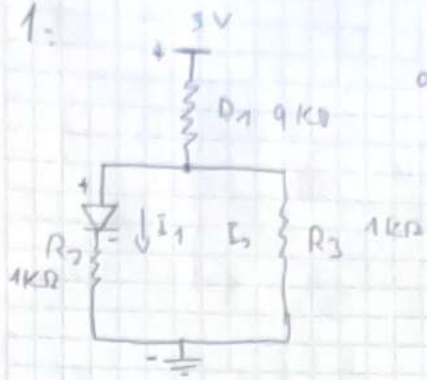
$\vec{J} = (q n N_n + q p N_p)\vec{\epsilon}$

$\vec{J}_A = q\, p_A\, N_p\, \vec{\epsilon}$

$\vec{J}_B = q\, p_B\, N_p\, \vec{\epsilon}$

$p_A = n_B \rightarrow$ La corriente de arrastre será mayor en la muestra B porque $N_n > N_p$

1.



a) $V_\gamma = 0'7$

está apagado

$$\frac{5-V_x}{9} = \frac{V_x - 0'7}{1} + \frac{V_x - 0}{1}$$

$$5 - V_x = 9V_x - 6'3 + 9V_x$$

$$\frac{11'3}{19} = V_x \qquad V_x = 0'59 < 0'7$$ está apagado así que

$$I_{D1} = 0\ A$$

$$I_{D2} = \frac{5\ V}{10\ K\Omega} = 0'5\ mA$$

b) Ideal

$$\frac{5-V_x}{9} = \frac{V_x}{1} + \frac{V_x}{1}$$

$$V_x = \frac{5}{18} \qquad I_1 = \frac{\frac{5}{18}}{1000} = 0'26\ mA = I_2$$