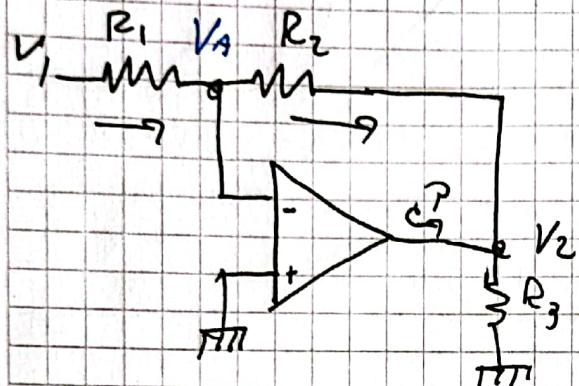


TP #1

#1 $Z_1 = 4 + kR$

$$\frac{V_2}{V_1} = -70 \text{ dB}$$



$$Y_1 = \frac{1}{R_1} \quad Y_2 = \frac{1}{R_3}$$

$$Y_3 = \frac{1}{R_2}$$

$$\cancel{V_1 Y_1 - V_A Y_1 = 0} \quad V_A (Y_1 + Y_2) - V_1 Y_1 - V_2 Y_2 = 0$$

$$\cancel{V_1 Y_1 - V_A Y_1 = 0} \quad V_A (Y_1 + Y_2) - V_1 Y_1 - V_2 Y_2 = 0$$

$$\frac{V_1}{R_1 + R_2 + R_3} \cdot R_3 = V_2$$

$$V_A = -\frac{V_1 Y_1}{Y_1 + Y_2} - V_2$$

en la que ~~no~~ ~~esta~~ ~~valga~~.

$$V_1 \cancel{Y_1} - V_A \cancel{Y_1} = (V_A - V_2) Y_2$$

$$\cancel{V_1} (V_1 - V_A) = (V_A - V_2) Y_2$$

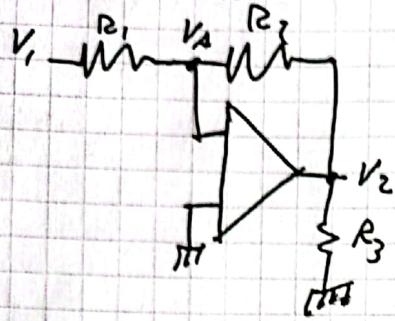
$$V_A \cancel{Y_1}$$

$$V_1 Y_1 - V_A Y_1 = V_A Y_2 - V_2 Y_2$$

$$V_1 Y_1 + V_2 Y_2 = V_A (Y_2 + Y_1)$$

$$\boxed{\frac{V_1 Y_1}{Y_1 + Y_2} + \frac{V_2 Y_2}{Y_2 + Y_1} = V_A} \quad \textcircled{1}$$

valor de mire:



$$V_A(Y_1 + Y_2) - V_2 Y_2 - V_1 Y_1 = 0$$

$$V_A = V_2 \frac{Y_2}{Y_2 + Y_1} + V_1 \frac{Y_1}{Y_1 + Y_2} \quad (1)$$

$$V_A \frac{Y_2}{Y_2 + Y_3} = V_2$$

$$V_A = \frac{Y_2 + Y_3}{Y_2} V_2$$

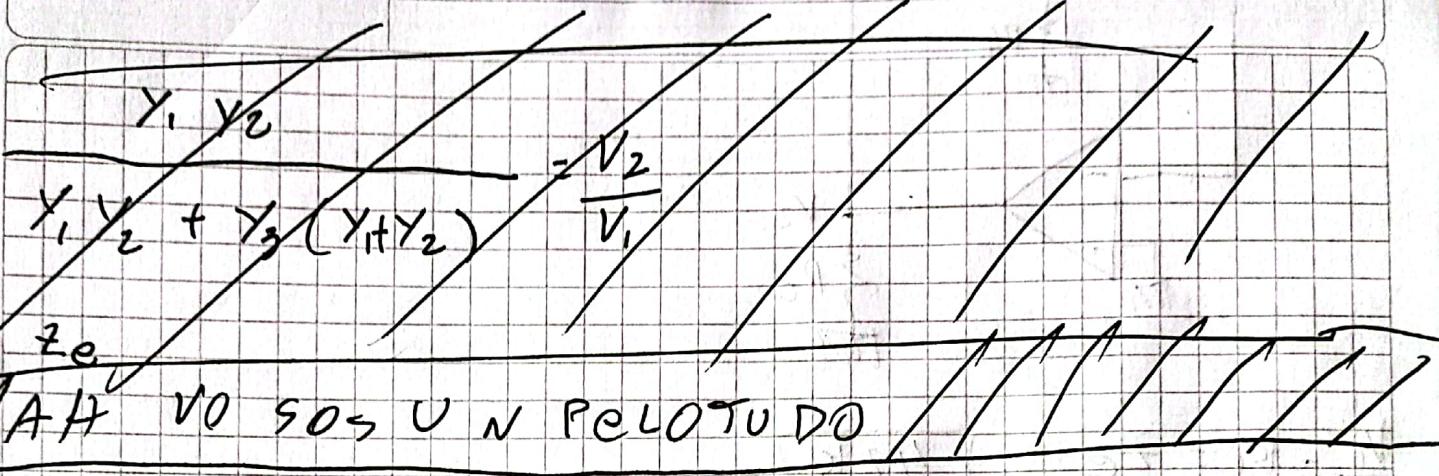
$$\frac{Y_2 + Y_3}{Y_2} V_2 = V_2 \frac{Y_2}{Y_2 + Y_1} + V_1 \frac{Y_1}{Y_2 + Y_1}$$

$$V_2 \left(\frac{Y_2 + Y_3}{Y_2} - \frac{Y_2}{Y_2 + Y_1} \right) = V_1 \frac{Y_1}{Y_2 + Y_1}$$

$$\frac{Y_2^2 + Y_1 Y_2 + Y_3 Y_2 + Y_3 Y_1 - Y_2^2}{Y_2 (Y_2 + Y_1)} V_2 = V_1 \frac{Y_1}{Y_2 + Y_1}$$

$$\frac{Y_1}{Y_1 + Y_2} \cdot \frac{Y_2 (Y_2 + Y_1)}{Y_1 Y_2 + Y_3 Y_2 + Y_3 Y_1} = \frac{V_2}{V_1}$$

$$\frac{Y_1 Y_2}{Y_1 Y_2 + Y_3 (Y_2 + Y_1)} = \frac{V_2}{V_1}$$



$$V_1 = I_1 R_1 \quad Z_C = R_1 = 47k$$

$$V_1 Y_1 = -V_2 Y_2$$

$$\frac{V_2}{V_1} = -\frac{Y_1}{Y_2} = \frac{|R_2|}{|R_1|}$$

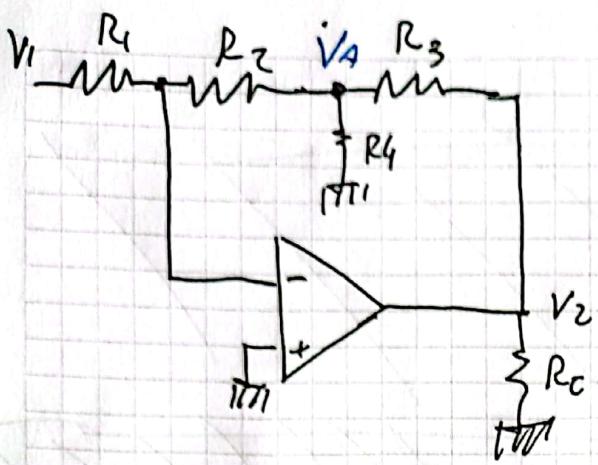
$$20 \log \left(\frac{V_2}{V_1} \right) = 20 \log \left(-\frac{R_2}{R_1} \times \frac{1}{47k} \right) = -70 \text{ dB}$$

$$20 \log \left(\frac{R_2}{R_1} \right) = -70 \text{ dB}$$

$$\frac{R_2}{R_1} = 0,316 \times 10^{-6} \quad R_2 = 14,86 \Omega$$

$$R_1 = 47k$$

$$R_2 = 14 \Omega \quad R_3 \rightarrow \text{wever}$$



$$\frac{V_1}{I_1} = R_1 = \pm c \quad | \quad 47 \text{ k}\Omega$$

$$V_1 Y_1 = -V_A Y_2$$

$$\boxed{\frac{V_1 Y_1}{Y_2} = V_A}$$

$$V_A (Y_2 + Y_3 + Y_4) - V_2 Y_3 = 0$$

$$-V_1 \frac{Y_1}{Y_2} (Y_2 + Y_3 + Y_4) = V_2 Y_3$$

$$-\frac{Y_1}{Y_2} \frac{Y_2 + Y_3 + Y_4}{Y_3} = \frac{V_2}{V_1}$$

$$-\frac{R_2}{R_1} \frac{\left(\frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}\right)}{\frac{1}{R_3}} = -\frac{R_3 R_2}{R_1} \cdot \left(\frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}\right)$$

$$-\frac{R_3 R_2}{R_1} \cdot \left(\frac{R_3 R_4 + R_2 R_4 + R_2 R_3}{R_C R_3 R_4} \right) = \frac{V_2}{V_1}$$

$$\frac{V_2}{V_1} = -\frac{1}{R_1} \left(\frac{R_3 R_4 + R_2 R_4 + R_2 R_3}{R_4} \right)$$

$$\frac{V_2}{V_1} = - \frac{1}{R_1} \left(\frac{R_3 R_4 + R_2 R_4 + R_2 R_3}{R_4} \right)$$

$$\frac{V_2}{V_1} = - \frac{1}{R_1} R_3 \left(\frac{R_3}{R_3} + \frac{R_2}{R_3} + \frac{R_2 R_3}{R_3 R_4} \right) = - \frac{R_3}{R_1} \left(1 + \frac{R_2}{R_3} + \frac{R_2}{R_4} \right)$$

$$\frac{V_2}{V_1} = - \frac{R_3}{R_1} \left(1 + R_2 \left(\frac{1}{R_3} + \frac{1}{R_4} \right) \right) = - \frac{R_3}{R_1} \left(1 + R_2 \left(\frac{1}{R_3} + \frac{1}{R_4} \right) \right)$$

~~$$\left| \frac{V_2}{V_1} \right| = 0,376 \text{ m} = \frac{R_3}{R_1} \left(1 + R_2 \left(\frac{1}{R_3} + \frac{1}{R_4} \right) \right)$$~~

~~$$\text{S1: } R_3 = R_1 \quad 0,376 = 1 + R_2 \left(\frac{1}{R_3} + \frac{1}{R_4} \right)$$~~

~~$$1,98 \frac{1}{R_3} = 1 + R_2 \left(\frac{1}{R_3} + \frac{1}{R_4} \right)$$~~

~~$$R_3 = 10$$~~

~~$$1,98 = 1 + R_2 \left(\frac{1}{10} + \frac{1}{R_4} \right)$$~~

~~$$\frac{0,98}{R_2} = \frac{1}{10} + \frac{1}{R_4}$$~~

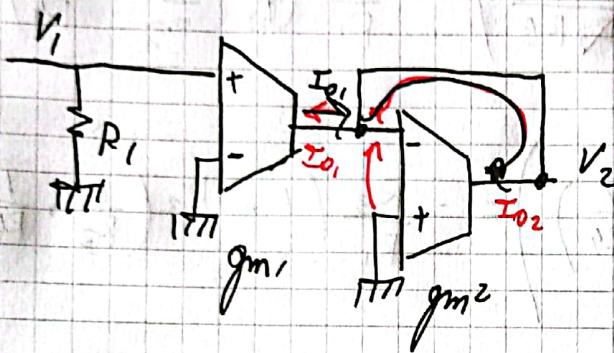
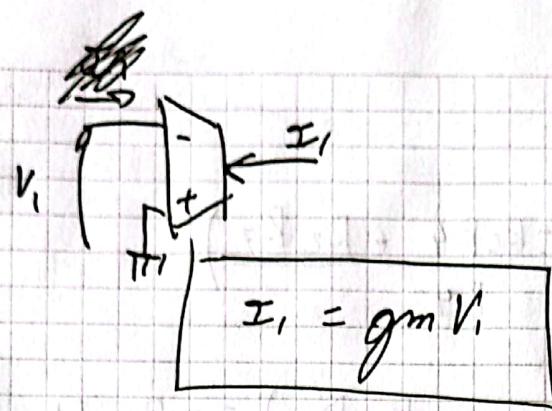
~~$$R_2 = 0,5$$~~

~~$$0,98 = 0,1 - \frac{1}{R_4} \Rightarrow R_4 =$$~~

~~$$R_2 = 1 \Rightarrow 0,98 - 0,1 = \frac{1}{R_4} \Rightarrow R_4 = 2,63$$~~

~~zu viel zuviel~~

2.



$$V_1 g_{m1} = I_{O1}$$

$$V_2 g_{m2} = I_{O2}$$

$$V_1 g_{m1} = V_2 g_{m2}$$

$$\frac{V_2}{V_1} = \frac{g_{m1}}{g_{m2}}$$

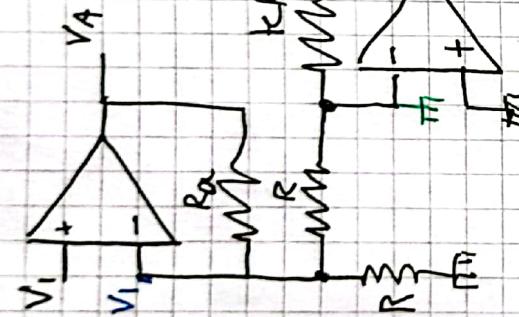
$$g_{m1} = 10 \text{ mA/V}$$

~~$g_{m2} = 31,62 \text{ mA}$~~

$g_{m2} = 31,622$

Shows in this color.

#2



$$R_Q = \frac{R(k-1)}{2}$$

(a)

$$G = \frac{1}{R}$$

(b)

$$G_A = \frac{1}{R_A} = \frac{1}{R} \cdot \frac{2}{k-1}$$

(c)

$$G_K = \frac{1}{kR}$$

$$\frac{V_A}{V_1} G^2$$

$$V_1 (G_A + 2G) - V_A G_A = 0$$

$$V_1 (G_A + 2G) - V_A G_A \Rightarrow V_A = V_1 \left(\frac{G_A + 2G}{G_A} \right) = V_A$$

(d)

$$V_1 G = -V_B G_K$$

$$(e) - (d) = V_{AB}$$

$$-V_1 \frac{G}{G_K} = V_B$$

(f)

$$V_{AB} = V_1 \frac{G_A + 2G}{G_A} + V_1 \frac{G}{G_K} = V_1 \left(\frac{G_A + 2G}{G_A} + \frac{G}{G_K} \right)$$

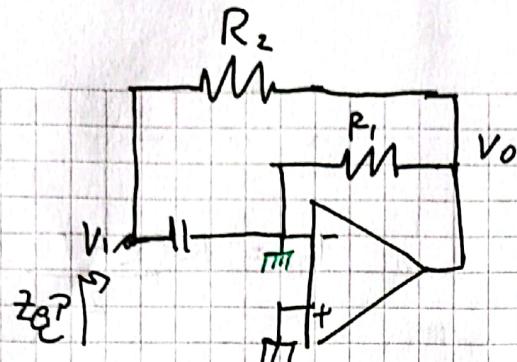
Reemplazando (d) en (f)

$$V_{AB} = V_1 \left(1 + \frac{2G}{G_A} + \frac{G}{G_K} \right) = V_1 \left(1 + \frac{2}{R} \frac{R(k-1)}{2} + \frac{1}{R} \frac{kR}{2} \right)$$

$$V_{AB} = V_1 (1 + k - 1 + k) = \boxed{2kV_1}$$

#3

A)



$$V_1(Y_C + Y_2) - V_o Y_2 = I_1 \quad \text{IV}$$

$$V_1 Y_C = -V_o Y_2 \quad \text{III}$$

$$-\frac{V_1 Y_C}{Y_1} = V_o \quad \text{II}$$

II en IV

$$V_1(Y_C + Y_2) + V_1 \frac{Y_C}{Y_1} Y_2 = I_1 = V_1 \left(Y_C + Y_2 + \frac{Y_C Y_2}{Y_1} \right) = I_1$$

$$V_1 \left(\frac{Y_C Y_1 + Y_2 Y_1 + Y_2 Y_C}{Y_1} \right) = I_1$$

$$\frac{V_1}{I_1} = z_{eq} = \frac{Y_1}{Y_C Y_1 + Y_2 Y_1 + Y_2 Y_C} = \frac{1}{R_1}$$

~~$$V_1 \left(\frac{1}{R_1} + \frac{1}{R_2 R_1} + \frac{1}{R_2} \right) R_1 = I_1$$~~

$$V_1 \left(\frac{1}{R_1} + \frac{1}{R_2 R_1} \right) R_1 = I_1$$

$$V_1 \left(\frac{1}{R_1} + \frac{1}{R_2} \right) = I_1$$

$$\frac{V_1}{I_1} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

~~meenstaat niet~~

$$\frac{1}{R_a} = \frac{1}{R} - \frac{2}{k-1}$$

Jugando un poco

$$Z_C = \frac{1}{\frac{1}{\$C} + \frac{R_2 + R_1}{R_2}} = \frac{1}{\frac{1}{\$C} + \frac{R_2}{R_2 + R_1}}$$

$$Z_C = \frac{1}{\frac{1}{\$C} + \frac{R_2}{R_2 + R_1}} = \frac{R_2}{R_2 + R_1} = \frac{R_2}{R_2 + R_1} - \frac{1}{\$C + \frac{1}{R_2 + R_1}}$$

$$Z_C \rightarrow \boxed{\text{C}} \quad \frac{1}{R_2}$$

$$Z_C = \frac{1}{\frac{1}{\$C \frac{R_2 + R_1}{R_2}} + \frac{1}{R_2}}$$

Tanque R_C regula la ω predominante
los componentes resistivos & la capacitancia

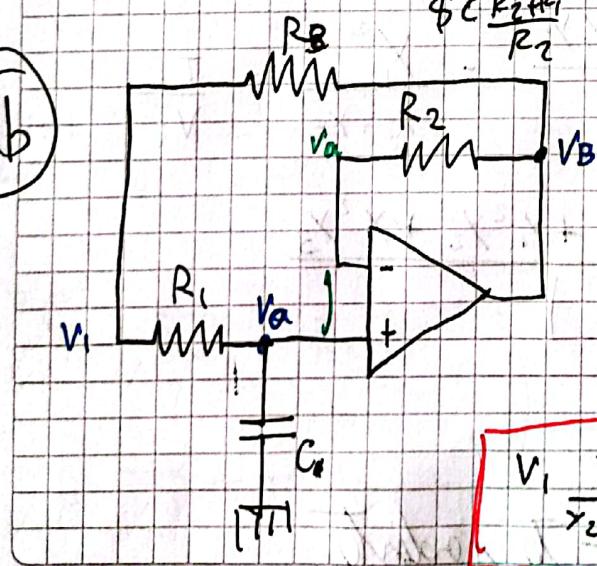
$$\omega = 0 \Rightarrow Z_C = R_2$$

$$(V_1 - V_a) Y_1 = V_a Y_C$$

$$\omega = \infty \Rightarrow Z_C \approx \frac{1}{\$C \frac{R_2 + R_1}{R_2}}$$

$$V_1 Y_1 = V_a (Y_C + Y_1)$$

b



$$\boxed{V_1 \frac{Y_1}{Y_1 + Y_C} = V_a} \quad \text{I}$$

$$(V_1 - V_b) Y_3 = (V_b - V_a) Y_2$$

$$V_1 Y_3 + V_a Y_2 = V_b (Y_2 + Y_3)$$

$$\boxed{V_1 \frac{Y_3}{Y_2 + Y_3} + V_a \frac{Y_2}{Y_2 + Y_3} = V_b} \quad \text{a}$$

$$V_1 (\gamma_1 + \gamma_3) - V_b \gamma_3 - V_b \gamma_1 = I_1 \quad (III)$$

~~(II) & (II)~~

$$V_1 \frac{\gamma_3}{\gamma_2 + \gamma_3} + \frac{\gamma_1}{\gamma_1 + \gamma_c} \frac{\gamma_2}{\gamma_2 + \gamma_3} V_1 = V_b$$

$$V_1 \frac{1}{\gamma_2 + \gamma_3} \left(\gamma_3 + \frac{\gamma_1 \gamma_2}{\gamma_1 + \gamma_c} \right) = V_b \quad (IV)$$

~~(IV) & (IV)~~

~~(IV) & (IV) on (III)~~

$$V_1 (\gamma_1 + \gamma_3) - V_1 \frac{\gamma_3}{\gamma_2 + \gamma_3} \left(\gamma_3 + \frac{\gamma_1 \gamma_2}{\gamma_1 + \gamma_c} \right) - V_1 \frac{\gamma_1 \gamma_2}{\gamma_1 + \gamma_c} = I_1$$

$$V_1 \left[\gamma_1 + \gamma_3 - \frac{\gamma_3}{\gamma_2 + \gamma_3} \left(\gamma_3 + \frac{\gamma_1 \gamma_2}{\gamma_1 + \gamma_c} \right) - \frac{\gamma_1 \gamma_2}{\gamma_1 + \gamma_c} \right] = I_1$$

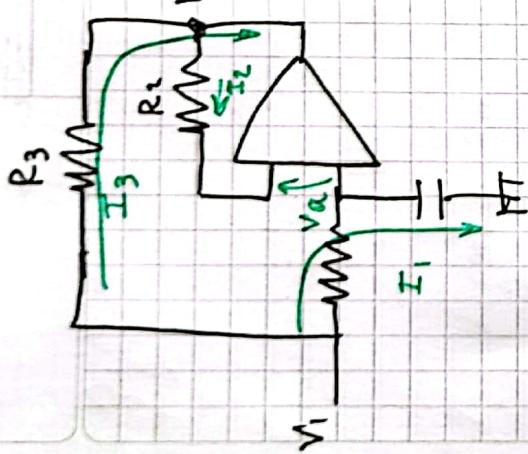
I

$$\gamma_1 + \gamma_3 - \frac{\gamma_3}{\gamma_2 + \gamma_3} \frac{\gamma_3 \gamma_1 + \gamma_3 \gamma_c + \gamma_1 \gamma_2}{\gamma_1 + \gamma_c} - \frac{\gamma_1 \gamma_2}{\gamma_1 + \gamma_c} = \frac{I_1}{V_1}$$

$$\frac{I_1}{V_1} = \gamma_1 + \gamma_3 - \frac{\gamma_3^2 \gamma_1 + \gamma_3^2 \gamma_c + \gamma_3 \gamma_1 \gamma_2 + \gamma_1^2 \gamma_2 + \gamma_1^2 \gamma_3}{(\gamma_1 + \gamma_3)(\gamma_1 + \gamma_c)}$$

$$\frac{I_1}{V_1} = \gamma_1 \gamma_2 + \gamma_1 \gamma_3$$

Also one can look to point.



$$I_2 = 0 \Rightarrow V_a = V_b$$

$$(V_1 - V_a) Y_1 = V_a Y_C$$

$$V_1 \frac{Y_1}{Y_1 + Y_C} = V_a \quad (\text{Eq})$$

$$V_1(Y_1 + Y_3) - V_a(Y_1 + Y_3) = I_1 = V_1(Y_1 + Y_3) - \frac{Y_1}{Y_1 + Y_C}(Y_1 + Y_3) = I_1$$

$$V_1 \left(Y_1 + Y_3 - \frac{Y_1^2 + Y_1 Y_3}{Y_1 + Y_C} \right) = \frac{Y_1^2 + Y_C Y_1 + Y_3 Y_C - Y_1^2}{Y_1 + Y_C}$$

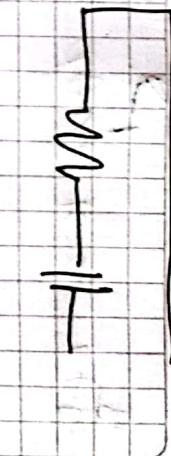
$$V_1 \left(\frac{Y_C Y_1 + Y_3 Y_C}{Y_1 + Y_C} \right) = I_1 = V_1 \left(\frac{\$C}{R_1} + \frac{\$C}{R_3} \right) \neq \frac{\$C}{R_3} \left(Y_1 + Y_C \right)$$

$$V_1 \left(\frac{\$C R_3 + \$C R_1}{R_3 R_1} \right) / \frac{\$C R_3 + 1}{R_3} = V_1 \left(\frac{\$C R_3 + \$C R_1}{R_3 R_1} \cdot \frac{R_3}{\$C R_3 + 1} \right)$$

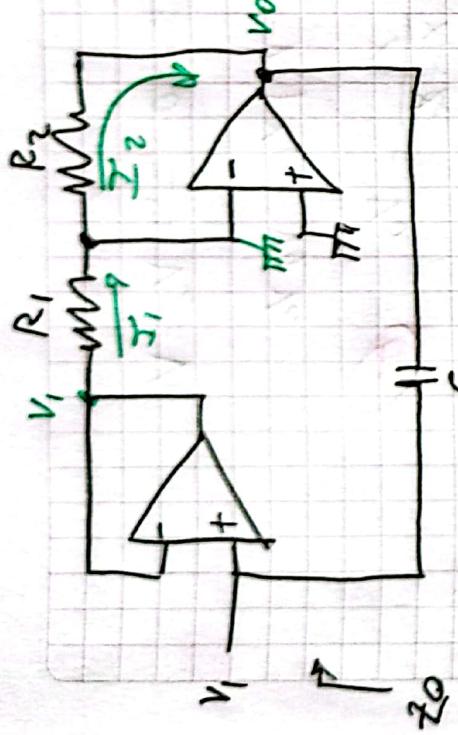
$$V_1 \left(\frac{\$C (R_3 + R_1)}{R_1 + \$C R_3 C} \right) = I_1$$

$$\frac{V_1}{I_1} = \frac{R_1 + \$C R_3}{\$C (R_3 + R_1)} = \frac{\frac{R_1}{R_3 + R_1}}{\frac{R_3 + R_1}{\$C}} + \frac{\frac{\$C}{R_3 + R_1}}{\frac{R_3 + R_1}{\$C}} = \frac{R_1 R_3}{R_3 + R_1}$$

$$Z_C = \frac{1}{\$C} + \frac{R_1}{R_3 + R_1} + \frac{R_1 R_3}{R_3 + R_1}$$



Capacitor can resist in this.



$$I_1 = I_2$$

$$(V_1 - V_0) \gamma_C = I_1 \quad \text{II}$$

$$-V_1 \frac{\gamma_1}{\gamma_2} = V_0 \quad \text{I}$$

$$V_1 \gamma_C - V_0 \gamma_C = I_1 \quad \text{III}$$

II & III

$$V_1 (\gamma_C + \frac{\gamma_1 \gamma_C}{\gamma_2}) = \left(\frac{\gamma_C \gamma_2 + \gamma_1 \gamma_C}{\gamma_2} \right) V_1 = I_1 = V_1 \left(\frac{\gamma_2 + \gamma_1}{\gamma_2} \right) \gamma_C$$

$$\frac{V_1}{I_1} = \frac{\gamma_2}{(\gamma_2 + \gamma_1) \gamma_C} = \frac{1}{\frac{\gamma_2}{\gamma_2 + \gamma_1} \gamma_C} = \frac{1}{\frac{R_2}{R_1 + R_2} \gamma_C}$$

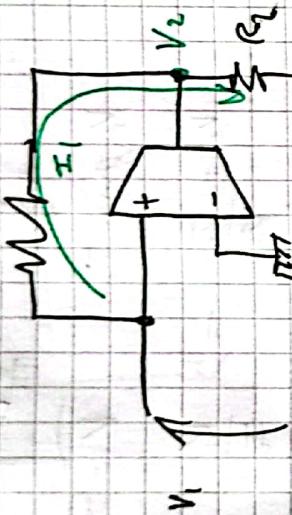
$$\frac{V_1}{I_1} = \frac{1}{R_2} \cdot \frac{R_1 R_2}{R_1 (R_1 + R_2) \frac{R_1}{R_1 + R_2}} = \frac{1}{R_2} = \frac{1}{R_2} = \frac{1}{R_2}$$

$$k = 1 + \frac{R_2}{R_1}$$

Een opgave de volgende dag
gevonden bij $\frac{R_2}{R_1}$ gelijk aan k^1

~~773/10~~

R_1



$$V_1 g_m = I_{01} \quad I_1 = (V_1 - V_2) Y_1 = V_1 Y_1 - V_2 Y_1$$

$$I_1 + I_{01} = V_2 Y_2$$

$$I_1 + g_m V_1 = V_2 Y_2 \quad \Rightarrow \quad I_1 \frac{Y_1}{Y_2} + g_m \frac{V_1}{Y_2} = V_2$$

~~773/10~~

$$I_1 \left(1 + \frac{Y_1}{Y_2} \right) = V_1 \left(Y_1 - \frac{g_m Y_1}{Y_2} \right)$$

$$\frac{I_1}{I_1 + I_{01}} = \frac{Y_1}{Y_2 + Y_1}$$

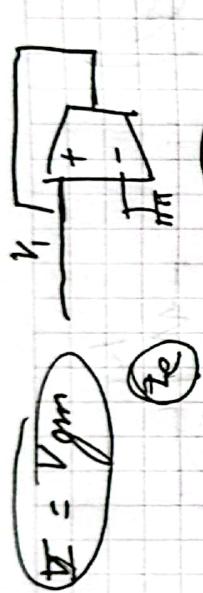
$$\frac{V_1}{I_1} = \frac{Y_1 - \frac{g_m Y_1}{Y_2}}{Y_1 + \frac{g_m Y_1}{Y_2}}$$

$$= \frac{Y_1 - \frac{g_m Y_1}{Y_2}}{Y_1 + \frac{g_m Y_1}{Y_2}} \cdot \frac{\frac{Y_2}{Y_1} \cdot Y_1}{Y_1 - \frac{g_m Y_1}{Y_2}}$$

$$= \frac{\frac{R_2 + R_1}{R_2 R_1} \cdot \frac{R_1}{R_2 - g_m}}{\frac{1}{R_2} \left(\frac{R_1}{R_2} - g_m \right)} = \frac{\frac{R_2 + R_1}{R_2 R_1}}{\frac{1}{R_2} \left(\frac{R_1}{R_2} - g_m \right)}$$

$$\frac{V_1}{I_1} = \frac{R_1 / R_2 \cdot \frac{1}{R_1 \left(\frac{R_1}{R_2} - g_m \right)}}{\frac{1}{R_2 \left(\frac{R_1}{R_2} - g_m \right)}} \quad \text{raíz de ambos que queda}$$

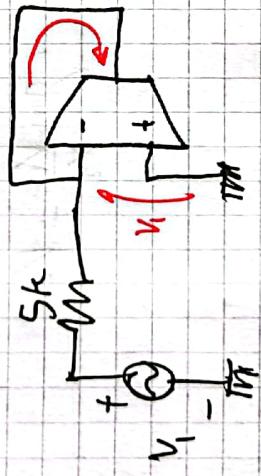
DIA AS RESISTOR



$$V_i / g_m = I_0 \quad V = I \cdot R$$
$$V_i = \frac{I_0}{g_m} \Rightarrow \frac{V_i}{I_0} = \frac{1}{g_m} = \frac{R}{20\Omega}$$

a)

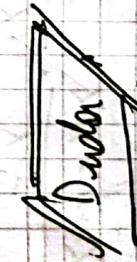
$$5k = \frac{V_i}{g_m}$$

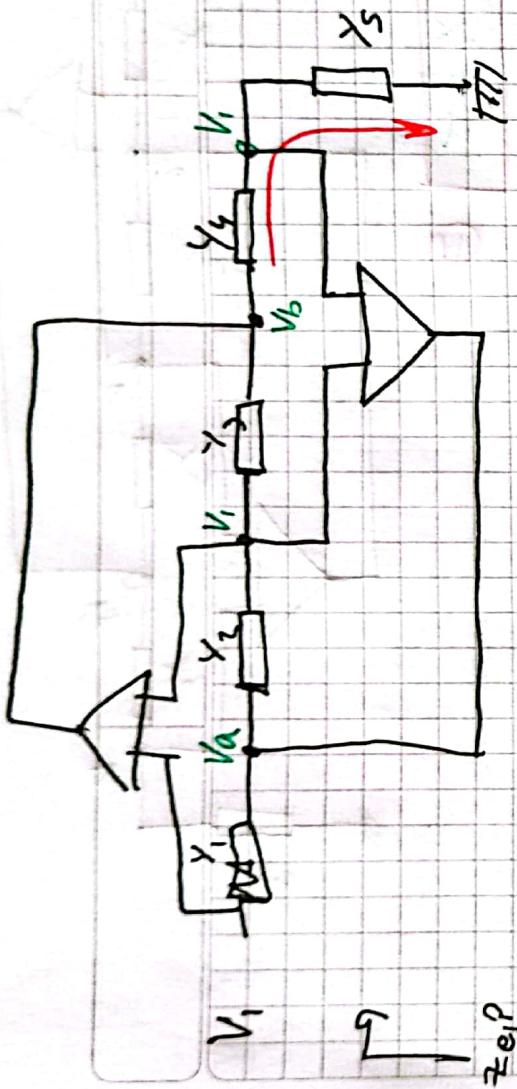


$$5k = \frac{1}{g_m} \Rightarrow g_m = 20\text{S}$$

Solución: $I_{ABC} \approx 200\mu\text{A}$ obtener $g_m = 20\text{S}$

Circuito de distorsión?





(a)

$$(V_1 - V_a) X_1 = I_1 - V_b Y_2 - V_b Y_3 = 0$$

III

$$V_b \frac{Y_4 + Y_5}{Y_4} = V_1 - V_a X_1 \Rightarrow V_1 = V_a \frac{Y_4 + Y_5}{Y_4}$$

IV

$$V_1 (Y_2 + Y_3) - V_1 Y_4 + Y_5 = V_a Y_2$$

II on IV

$$V_1 \left[\frac{Y_2 + Y_3}{Y_4} - \frac{Y_4 + Y_5}{Y_4} \right] = V_a = V_1 \left[\frac{Y_2 Y_3}{Y_4 Y_5} - \frac{Y_4 Y_5}{Y_4 Y_5} \right]$$

I

$$I = V_1 \left[Y_1 - \frac{Y_2 Y_3}{Y_4 Y_5} \right]$$

~~$$I = V_1 \left[Y_1 - \frac{Y_2 Y_3}{Y_4 Y_5} \right] = Y_1 Y_4 + Y_5 Y_1 - Y_3 Y_4 - Y_4 Y_5$$~~

X

X

X

X

X

X

X

X

X

X

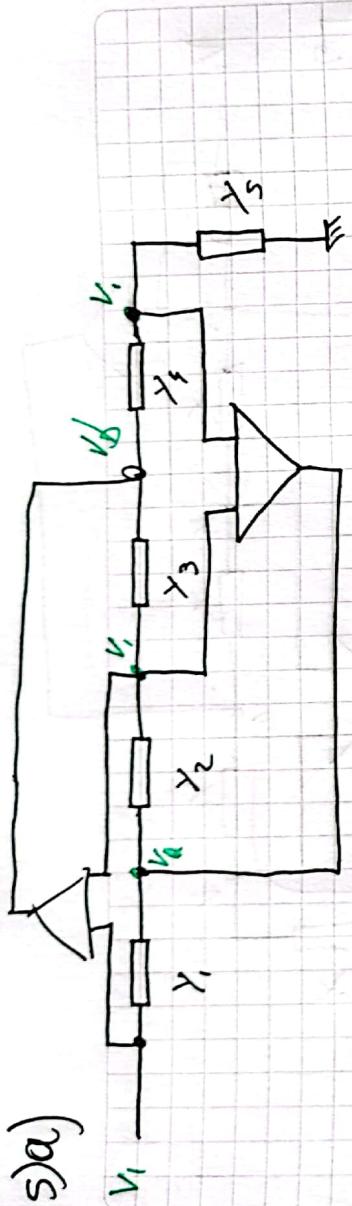
X

X

X

X

5)a)



$$V_b = V_1 \left(1 + \frac{\gamma_s}{\gamma_4} \right) \quad \text{I}$$

$$\frac{V_b - V_a}{\gamma_4 + \gamma_5} = V_1 \Rightarrow V_b = \left(\frac{\gamma_4}{\gamma_4 + \gamma_5} + \frac{\gamma_s}{\gamma_4} \right) V_1 = V_1 \left(1 + \frac{\gamma_s}{\gamma_4} \right)$$

$$V_b = V_1 \left(1 + \frac{\gamma_s}{\gamma_4} \right) \quad \text{II}$$

~~cancel~~

$$V_1 (\gamma_2 + \gamma_3) - V_a \gamma_2 - V_b \gamma_3 = 0$$

$$V_1 (\gamma_2 + \gamma_3) - V_1 \left(1 + \frac{\gamma_s}{\gamma_4} \right) \gamma_3 = V_a \gamma_2$$

$$V_1 \left(\frac{\gamma_2}{\gamma_2 + \gamma_3} + \frac{\gamma_3}{\gamma_2} \right) - V_1 \left(1 + \frac{\gamma_s}{\gamma_4} \right) \frac{\gamma_3}{\gamma_2} = V_a$$

$$V_1 \left[\frac{\gamma_2}{\gamma_2 + \gamma_3} - \frac{\gamma_3}{\gamma_2} - \frac{\gamma_s \gamma_3}{\gamma_4 \gamma_2} \right] = V_a$$

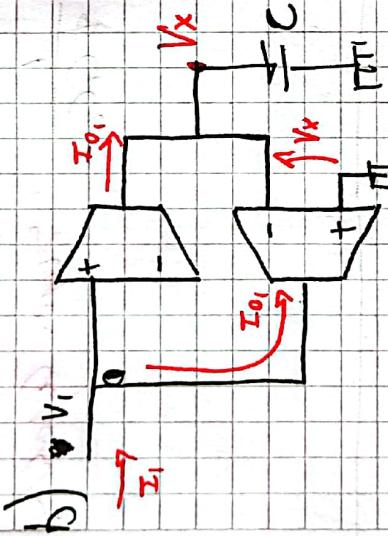
$$V_1 \left[1 - \frac{\gamma_s \gamma_3}{\gamma_4 \gamma_2} \right] = V_1 \left(\frac{\gamma_4 \gamma_2 - \gamma_5 \gamma_3}{\gamma_4 \gamma_2} \right) = V_a \quad \text{III}$$

$$V_1 Y_1 - V_1 \left(1 - \frac{Y_5 Y_3}{Y_4 Y_2} \right) Y_1 = I_1$$

$$V_1 \left(Y_1 - Y_1 + \frac{Y_5 Y_3 Y_1}{Y_4 Y_2} \right) = I_1$$

$$Z_C = \frac{Y_4 Y_2}{Y_5 Y_3 Y_1}$$

~~V_{in} of done~~



b) $\star V_1$

$$V_1 g_{m1} = I_{O1} \quad I_{O1} \frac{1}{g_C} = V_x \quad V_x g_{m2} = I_{O2} = I_1$$

$$I_1 = V_1 g_{m2} = g_{m2} I_0 \frac{1}{g_C} = g_{m1} g_{m2} \frac{1}{g_C} V_1$$

$$\frac{V_1}{I_1} = \frac{A_C}{g_{m1} g_{m2}}$$

$$Z_{eq} = \frac{Y_2 Y_4}{Y_1 Y_3 Y_5}$$

$$Y_1 = \frac{1}{R_1}, \quad Y_2 = \frac{1}{C}$$

$$Y_3 = \frac{1}{R_2}, \quad Y_4 = \frac{1}{R_3}, \quad Y_5 = \frac{1}{R_4}$$

$$Z_{eq} = \frac{1}{C} \cdot R_1 R_2 R_4$$

INDUCTIVE.

$$Z_{eq} = \frac{Y_2 Y_4}{Y_1 Y_3 Y_5}$$

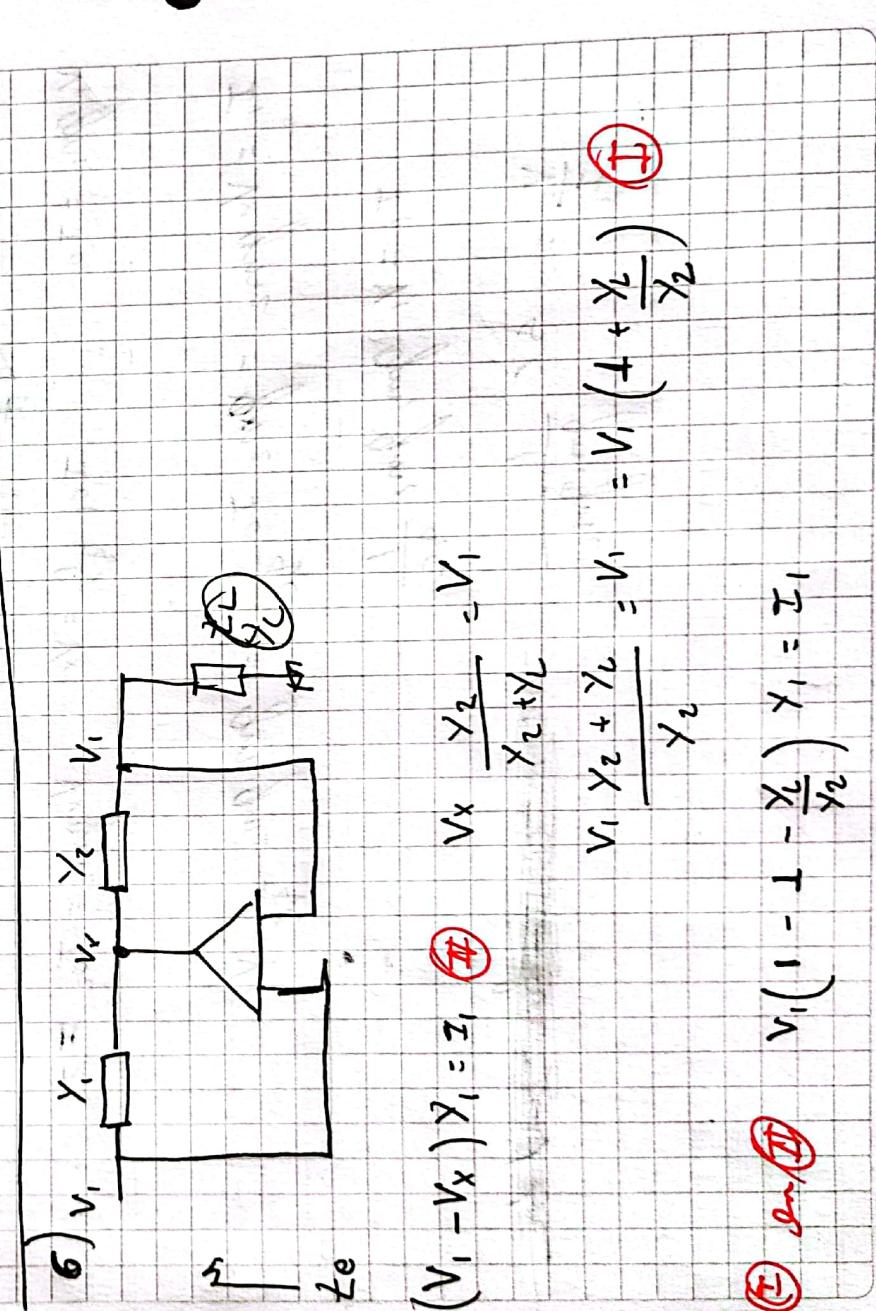
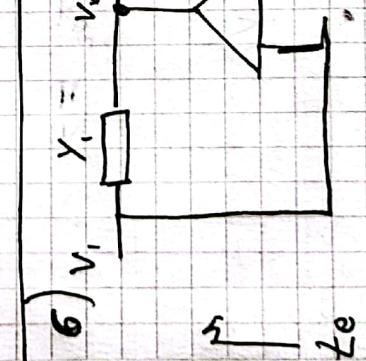
$$Y_1 = \frac{1}{R_1}, \quad Y_2 = \frac{1}{C_1}, \quad Y_3 = \frac{1}{R_2}, \quad Y_4 = \frac{1}{R_3}, \quad Y_5 = \frac{1}{R_4}$$

$$Y_2 = \frac{1}{C_1}, \quad Y_4 = \frac{1}{R_3}$$

$$Z_{eq} = \frac{R_4}{R_1 R_3} = \frac{R_4}{\frac{1}{C_1} \frac{1}{C_2}} = \frac{R_4 C_1 C_2}{1} \quad \text{Super capacitor.}$$

Von Wta ist die super cap.

Von sin 5 - alpha / beta / C

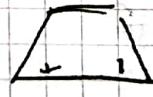


$$V_1 = -\gamma_L \frac{V_1}{\gamma_L} = I_1 \Rightarrow \frac{V_1}{I_1} = -\frac{\gamma_2}{\gamma_1} \frac{1}{\gamma_L} = -\frac{\gamma_2}{\gamma_1} Z_L$$

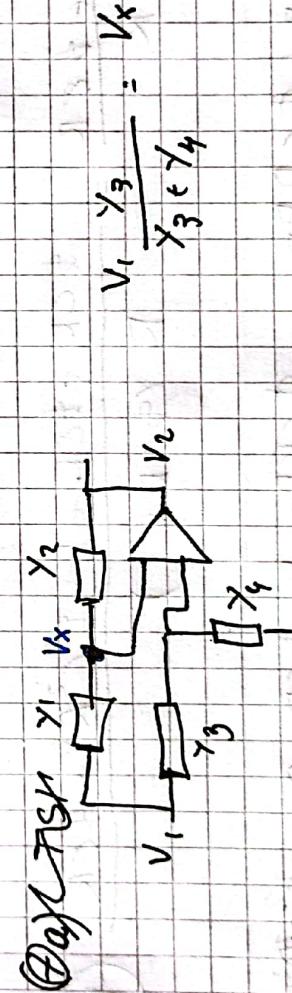
$$Z_C = -\frac{R_1}{R_2} Z_L$$

Entsprechend kann man für γ_3 und γ_4 schreiben

Properties of schmitt



- ⑦ \rightarrow TS #1
- ⑧ \rightarrow TS #2 \rightarrow Schmitt



$$V_x (\gamma_1 + \gamma_2) - V_2 \gamma_2 - V_1 \gamma_1 = 0$$

$$V_1 \frac{\gamma_3}{\gamma_3 + \gamma_4} (\gamma_1 + \gamma_2) - V_1 \gamma_1 = V_2 \gamma_2$$

$$V_1 \left(\frac{\gamma_3 \gamma_1 + \gamma_2 \gamma_3}{\gamma_3 + \gamma_4} - \gamma_1 \right) = \frac{\gamma_3 \gamma_1 + \gamma_3 \gamma_2 - \cancel{\gamma_1 \gamma_3} - \gamma_4 \gamma_1}{\gamma_3 + \gamma_4} = \frac{\gamma_2 \gamma_3}{\gamma_3 + \gamma_4}$$

$$\frac{Y_3 Y_2 - Y_4 Y_1}{Y_2 (Y_3 + Y_4)} = Av$$

$$b) \quad Y_1 = \frac{1}{R_A} \quad Y_2 = \frac{1}{R_B}$$

$$Y_3 = R + \frac{1}{\$C} = \frac{\$CR + 1}{\$C} \Rightarrow Y_3 = \frac{\$C}{\$CR + 1}$$

$$Y_4 = \frac{1}{R} + \$C = \frac{1 + \$CR}{R}$$

$$Av = \frac{\frac{\$C}{\$CR+1} \frac{1}{R_B} - \frac{1 + \$CR}{R} \frac{R_B}{R_A}}{\frac{1}{R_B} \left(\frac{\$C}{\$CR+1} + \frac{1 + \$CR}{R} \right)} = \frac{\frac{\$C}{\$CR+1} - \frac{\$C}{R} - \frac{R_B + \$CR R_B}{R_A}}{\frac{\$CR R_B + \$CR + 1 + \$C^2 R^2 + \$CR}{R_A}}$$

$$\frac{\$C}{\$CR+1} + \frac{1 + \$CR}{R} = \frac{\$CR + \$CR + 1 + \$C^2 R^2 + \$CR}{R (\$CR + 1)} \quad (B)$$

$$\frac{\$C}{\$CR+1} - \frac{R_B + \$CR R_B}{R R_A} = \frac{\$CR R_A - R_B \$CR - R^2 C^2 R^2 R_B - \$CR R_B}{R (\$CR + 1) R_A} \quad (A)$$

$$-\$^2 (C^2 R^2 R_B) + \$ (CR R_A - CR R_B - CR R_B) - R_B \\ - \$^2 (C^2 R^2 R_B) + \$ (CR R_A - CR R_B) - R_B$$

$$\frac{1}{C^2 R^2} = \omega_0^2 \quad \omega_0 = \frac{1}{CR}$$

~~Aur~~

$$\left(-\frac{\$^2 C^2 R^2 RB + \$CR(R_A - 2RB)}{\$^2 C^2 R^2 + \$3CR + 1} \right) \frac{1}{RA} \frac{1}{C^2 R^2}$$

$$\left(-\frac{\$^2 RB \cancel{C^2 R^2} + \$ \cancel{CR} (RA - 2RB)}{\cancel{C^2 R^2}} - \frac{RB}{C^2 R^2} \right) \frac{1}{RA}$$

$$\cancel{\$^2 C^2 R^2} + \$ 3 \cancel{CR} + \frac{1}{C^2 R^2}$$

$$\frac{-\$^2 \frac{RB}{RA} + \$ \frac{1}{CR} \left(\frac{RA}{RA} - 2 \frac{RB}{RA} \right) - \frac{RB}{C^2 R^2}}{\$^2 + \$ 3 \frac{1}{RC} + \frac{1}{C^2 R^2}} = A_V$$

$$-\frac{\$^2}{5} + \$ 3 \omega_0 \left(1 - 2 \frac{1}{5} \right) - \omega_0^2 \frac{1}{5} \quad \frac{RB}{RA} = \frac{1}{5}$$

$$\$^2 + \$ 3 \omega_0 + \omega_0^2$$

$$A_V = \frac{-\$^2 \frac{1}{5} + \$ \omega_0 \frac{3}{5} - \omega_0^2 \frac{1}{5}}{\$^2 + \$ 3 \omega_0 + \omega_0^2} = \frac{\frac{1}{5} (-\$^2 + \$ 3 \omega_0 + \omega_0^2)}{\$^2 + \$ 3 \omega_0 + \omega_0^2}$$

Ans: $\omega_0 = \omega_0$

$$A_V = \frac{1}{5} (-\$^2 + \$ 3 \$ - 1)$$

$$A_V(6) / A_V = e^{4820 \log(1.15)} = e^{-1394}$$

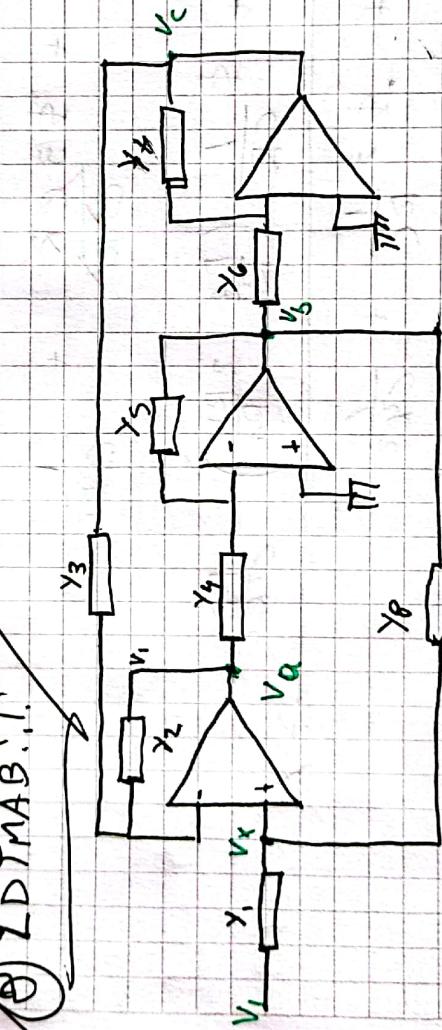
V_A ~~esta~~ \rightarrow ~~esta~~

$$"t_p - 1 - \gamma - b - \sin" \neq "t_p - 1 - \gamma - b - \alpha"$$

8) Es un filtro AP con ganancia $k = \frac{R_B}{R_A}$
que para altas frecuencias obtiene 14 dB.

Al ser de orden 2 la fase tiene mayor
exclusión en el rango $\alpha - 180^\circ$ ($\pi - \alpha - \pi$)

⑥ ZDTMAS!



$$V_x (\gamma_1 + \gamma_3) - V_A \gamma_2 - V_B \gamma_8 = 0 \quad \text{I}$$

$$V_A (\gamma_2 + \gamma_3) - V_A \gamma_2 - V_C \gamma_3 = 0 \quad \text{II}$$

$$V_A \gamma_4 = -V_B \gamma_5 \quad \text{III}$$

$$V_B \gamma_6 = -V_C \gamma_7 \quad \text{IV}$$

then γ_8

$$\textcircled{VI} \quad V_x = V_2 Y_c - (Y_s + Y_c) \left(\frac{Y_x + \epsilon_x}{V_1 Y_x} + \frac{Y_x + \epsilon_x}{\epsilon_x \epsilon_L} \right)$$

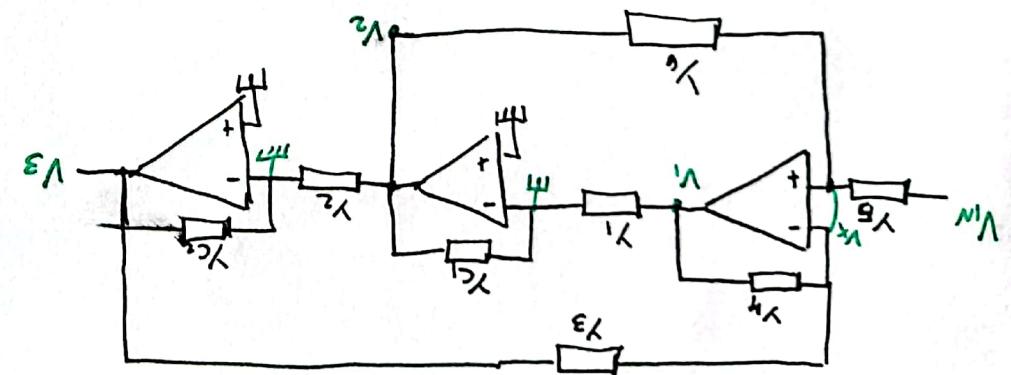
$$\textcircled{I} \quad \frac{Y_x \epsilon_x}{Y_x} V_1 + \frac{Y_x + \epsilon_x}{\epsilon_x \epsilon_L} \epsilon_L = V_x \quad \angle = Y_x V_1 + \epsilon_x \epsilon_L = (\epsilon_x + \epsilon_x) V_x$$

$$\textcircled{II} \quad V_2 Y_2 = -V_3 Y_C$$

$$\textcircled{III} \quad V_1(Y_4) = -V_2 Y_C$$

$$\textcircled{IV} \quad V_x(Y_4 + \epsilon_x) - V_3 Y_3 - V_1 Y_4 = 0$$

$$\textcircled{V} \quad 0 = Y_2 X - S_X V_1 - V_m Y_6 - V_x(Y_5 + Y_6)$$



006

$$V_1 V_5 = -V_2 \frac{X_1^2 X_3 X_5 + X_1 X_3 X_5 X_6 + X_1 X_3 X_5 + X_1 X_3 X_6 + X_6 X_3 X_1}{X_1^2 X_3 X_5 + X_1 X_3 X_6 + X_1 X_3 X_5 + X_1 X_3 X_6}$$

$$V_1 V_5 = -V_2 \frac{X_1^2 (X_3 + X_4) X_6}{X_1^2 X_3 X_5 + X_1 X_3 X_6 + X_1 X_3 X_5 + X_1 X_3 X_6}$$

~~$$= -V_2 \frac{X_1^2 (X_3 + X_4) X_6}{(2+5)(2+3)(2+4)(2+6)}$$~~

$$-V_2 \left[\frac{X_1^2 X_3}{X_1^2 X_3} - V_2 \frac{X_1^2 X_3}{X_4} \right] = V_1 V_5 = V_1 V_6 \left[\frac{X_1^2 (X_3 + X_4)}{(X_2 X_3 X_6 - X_1 X_4 X_5)(X_5 + X_6)} - V_2 \frac{X_1^2 X_3}{X_4} \right]$$

⑥ $\boxed{\frac{X_1^2 X_3}{X_1^2 X_3} = V_3}$

⑦ $\boxed{\frac{X_1^2 X_3}{X_4} = V_1 - V_2 V_5}$

~~CA = $\frac{X_1^2 X_3}{X_4} = V_1 - V_2 V_5$~~

⑧ $V_1 V_6$

Bruchterme von $V_1 \cdot V_3$ & $V_1 \cdot V_5$ aus Summen der V_i

⑨

$$V_1 V_3 = -V_2 V_5 \quad \text{und} \quad V_1 V_5 = -V_2 V_3$$

$$\begin{aligned}
 \frac{V_2}{V_{IN}} &= \frac{\frac{C_1 C_2 (Y_3 Y_5 + Y_4 Y_6) + Y_2 (Y_3 Y_6 + Y_1 Y_4 Y_6) + Y_1 Y_2 Y_3 (Y_5 + Y_6)}{X_2 X_1 X_5 (Y_3 + Y_4)}}{1} \\
 &= \frac{\frac{C_1 C_2 (Y_3 Y_5 + Y_4 Y_6) + Y_2 (Y_3 Y_6 + Y_1 Y_4 Y_6) + Y_1 Y_2 Y_3 (Y_5 + Y_6)}{X_2 X_1 X_5 (Y_3 + Y_4)}}{\frac{-C_2 R_1 R_5 (R_3 + R_4)}{R_4 - \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2}}} \\
 &= \frac{\frac{C_1 C_2 (Y_3 Y_5 + Y_4 Y_6) + Y_2 (Y_3 Y_6 + Y_1 Y_4 Y_6) + Y_1 Y_2 Y_3 (Y_5 + Y_6)}{X_2 X_1 X_5 (Y_3 + Y_4)}}{\frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} - \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2}} \\
 &= \frac{\frac{C_1 C_2 (Y_3 Y_5 + Y_4 Y_6) + Y_2 (Y_3 Y_6 + Y_1 Y_4 Y_6) + Y_1 Y_2 Y_3 (Y_5 + Y_6)}{X_2 X_1 X_5 (Y_3 + Y_4)}}{\frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2}} \\
 &= \frac{\frac{C_1 C_2 (Y_3 Y_5 + Y_4 Y_6) + Y_2 (Y_3 Y_6 + Y_1 Y_4 Y_6) + Y_1 Y_2 Y_3 (Y_5 + Y_6)}{X_2 X_1 X_5 (Y_3 + Y_4)}}{\frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2}} \\
 &= \frac{\frac{C_1 C_2 (Y_3 Y_5 + Y_4 Y_6) + Y_2 (Y_3 Y_6 + Y_1 Y_4 Y_6) + Y_1 Y_2 Y_3 (Y_5 + Y_6)}{X_2 X_1 X_5 (Y_3 + Y_4)}}{\frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2}} \\
 &= \frac{\frac{C_1 C_2 (Y_3 Y_5 + Y_4 Y_6) + Y_2 (Y_3 Y_6 + Y_1 Y_4 Y_6) + Y_1 Y_2 Y_3 (Y_5 + Y_6)}{X_2 X_1 X_5 (Y_3 + Y_4)}}{\frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{R_4} + \frac{C_2 R_1 R_5 (R_3 + R_4)}{C_1 C_2}} \\
 &\text{Final Answer: } \boxed{\frac{C_1 C_2 (Y_3 Y_5 + Y_4 Y_6) + Y_2 (Y_3 Y_6 + Y_1 Y_4 Y_6) + Y_1 Y_2 Y_3 (Y_5 + Y_6)}{X_2 X_1 X_5 (Y_3 + Y_4)}}
 \end{aligned}$$

③

111

• *Temporary*

falls jura legal.

$$S: R_4 = R_3 \wedge R_5 = R_6 \Leftrightarrow Q = 1$$

$$\boxed{Q = \frac{R_3 + R_4}{R_5 + R_6} \cdot \frac{R_5}{R_3}} \leq \frac{(R_5 + R_6) R_3}{(R_3 + R_4) R_5} = \cancel{Q} = \cancel{U_0} = \cancel{U_0} = \cancel{U_0}$$

$$\frac{U_0}{Q} = \frac{1}{R_C} \cdot \frac{R_6}{R_4} \frac{\cancel{R_5 + R_6}}{(R_3 + R_4)} = U_0 \frac{R_6}{R_4} \frac{\cancel{R_5 + R_6}}{(R_3 + R_4)} = \frac{\left(\frac{R_6}{R_4} \cdot \frac{R_5}{R_3}\right)}{\left(\frac{R_6}{R_4} + \frac{R_5}{R_3}\right)}$$

$$S: R_1 = R_2 = Q \wedge R_3 = 1 \quad C_1 = C_2 = C \Rightarrow U_0 = \frac{R_6}{R_4} = \frac{R_6}{R_3} = U_0$$

④

$$\begin{aligned}
 & \frac{\frac{x_1^2 c_2 (x_5 + x_6)}{x_3 + x_4} + \frac{x_1^2 c_2 (x_5 + x_6)}{x_3 + x_4} + \frac{x_1^2 c_2 (x_5 + x_6)}{x_3 + x_4}}{\frac{x_3 + x_4}{R_5}} = \frac{1}{V_{11}} \frac{\frac{x_1^2 c_2 (x_5 + x_6) + x_1^2 c_2 (x_5 + x_6) + x_1^2 c_2 (x_5 + x_6)}{(x_5 + x_6) x_1^2}}{\frac{x_1^2 c_2 (x_5 + x_6)}{R_5}} \\
 & V_{11} x_5 = \frac{x_1^2 c_2 (x_5 + x_6) + x_1^2 c_2 (x_5 + x_6) + x_1^2 c_2 (x_5 + x_6)}{x_1^2 c_2 (x_5 + x_6) + x_1^2 c_2 (x_5 + x_6)} = \frac{1}{V_{11}}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{x_1^2 (x_5 + x_6) x_1^2}{\cancel{x_1^2 x_5 + x_1^2 x_6 + x_1^2 x_5 + x_1^2 x_6 + x_1^2 x_5 + x_1^2 x_6}} = \frac{x_1^2}{c_2 x_6} + \frac{x_1^2 (x_5 + x_6) x_1^2}{c_2 x_6} = \frac{x_1^2}{c_1 c_2 x_6} + \frac{x_1^2 (x_5 + x_6) x_1^2}{c_1 c_2 x_6} = \frac{1}{V_{11}} x_5
 \end{aligned}$$

$$\begin{aligned}
 & \boxed{\frac{x_1^2 x_1}{c_1 c_2 x_6}} = \boxed{-V_1} \quad \text{and} \quad \boxed{\frac{x_1^2 x_1}{c_1 c_2 x_6}} = \boxed{-V_2} \\
 & \text{Velocities are } \textcircled{I} \text{ and } \textcircled{II} \quad \text{Velocities are } \textcircled{III} \text{ and } \textcircled{IV} \\
 & V_1 x_1 = -V_2 x_1 \quad V_1 x_1 = -V_2 x_1 \quad V_2 x_1 = -V_1 x_1
 \end{aligned}$$

For the parallel

$$\omega_0^2 = \frac{R_2 C}{1} = \omega_0$$

$$C_1 = C_2 = R$$

$$C_1 C_2 R_1 R_2$$

$$\frac{V_1}{V_3} = \frac{\frac{R_1 C_1}{Y_3 + Y_4} \frac{Y_5 + Y_6}{Y_4} + \frac{C_1 C_2 R_1 R_2}{1} \frac{R_3}{R_4}}{R_5 \frac{Y_3 + Y_4}{1} \frac{R_1 R_2 C_1 C_2}{1}}$$

Components of net

④ ~~to add ω_0^2 to result \rightarrow to modify~~

$$\frac{R_1 R_2 R_3 C_1 C_2}{1}$$

$$\frac{\frac{R_1 C_1}{Y_3 + Y_4} \frac{Y_5 + Y_6}{Y_4} \frac{R_6}{1} + \frac{R_2 R_3 C_1 C_2}{1}}{V_3} = \frac{V_1}{V_3}$$

⑤

For other nodes also

$$\frac{\frac{V_1}{V_1} + \frac{C_{12}C_1(Y_3+Y_4)}{Y_3(Y_3+Y_4)} + \frac{C_{14}(Y_5+Y_6)}{Y_4(Y_3+Y_4)} + \frac{C_{16}(Y_5+Y_6)}{Y_6(Y_3+Y_4)}}{\frac{C_{12}C_1(Y_3+Y_4)}{Y_3(Y_3+Y_4)} + \frac{C_{14}(Y_5+Y_6)}{Y_4(Y_3+Y_4)} + \frac{C_{16}(Y_5+Y_6)}{Y_6(Y_3+Y_4)}} = \frac{V_1}{V_1}$$

$$\frac{\frac{V_1}{V_1} + \frac{C_{12}C_1(Y_3+Y_4)}{Y_3(Y_3+Y_4)} + \frac{C_{14}(Y_5+Y_6)}{Y_4(Y_3+Y_4)} + \frac{C_{16}(Y_5+Y_6)}{Y_6(Y_3+Y_4)}}{\frac{C_{12}C_1(Y_3+Y_4)}{Y_3(Y_3+Y_4)} + \frac{C_{14}(Y_5+Y_6)}{Y_4(Y_3+Y_4)} + \frac{C_{16}(Y_5+Y_6)}{Y_6(Y_3+Y_4)}} = \frac{V_1}{V_1}$$

$$\frac{\frac{V_1}{V_1} + \frac{C_{12}C_1(Y_3+Y_4)}{Y_3(Y_3+Y_4)} + \frac{C_{14}(Y_5+Y_6)}{Y_4(Y_3+Y_4)} + \frac{C_{16}(Y_5+Y_6)}{Y_6(Y_3+Y_4)}}{\frac{C_{12}C_1(Y_3+Y_4)}{Y_3(Y_3+Y_4)} + \frac{C_{14}(Y_5+Y_6)}{Y_4(Y_3+Y_4)} + \frac{C_{16}(Y_5+Y_6)}{Y_6(Y_3+Y_4)}} = \frac{V_1}{V_1}$$

$$\frac{\frac{V_1}{V_1} + \frac{C_{12}C_1(Y_3+Y_4)}{Y_3(Y_3+Y_4)} + \frac{C_{14}(Y_5+Y_6)}{Y_4(Y_3+Y_4)} + \frac{C_{16}(Y_5+Y_6)}{Y_6(Y_3+Y_4)}}{\frac{C_{12}C_1(Y_3+Y_4)}{Y_3(Y_3+Y_4)} + \frac{C_{14}(Y_5+Y_6)}{Y_4(Y_3+Y_4)} + \frac{C_{16}(Y_5+Y_6)}{Y_6(Y_3+Y_4)}} = \frac{V_1}{V_1}$$

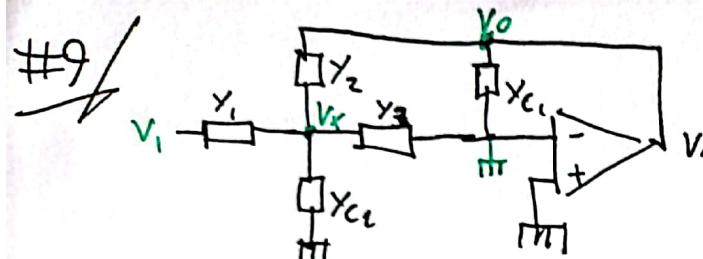
$$\cancel{V_1} + \frac{C_{12}C_1(Y_3+Y_4)}{Y_3(Y_3+Y_4)} + \frac{C_{14}(Y_5+Y_6)}{Y_4(Y_3+Y_4)} + \frac{C_{16}(Y_5+Y_6)}{Y_6(Y_3+Y_4)} = V_1 \cdot \frac{Y_1}{Y_1 Y_4} + V_1 \cdot \frac{Y_1}{Y_1 Y_6} + V_1 \cdot \frac{Y_1}{Y_1 Y_3} + V_1 \cdot \frac{Y_1}{Y_1 Y_2} + V_1 \cdot \frac{Y_1}{Y_1 Y_1} + (Y_5+Y_6) \left(\frac{Y_4}{Y_4 Y_4} + \frac{Y_6}{Y_6 Y_6} + \frac{Y_3}{Y_3 Y_3} + \frac{Y_2}{Y_2 Y_2} \right)$$

$$V_3 = -V_2 \frac{Y_2}{Y_2} = (-(-V_1)) \frac{Y_2}{Y_2} \frac{Y_1}{Y_1}$$

$$\frac{Y_1}{Y_1} = -V_1$$

$$V_2 = \frac{V_1}{V_1} \text{ and } V_4 = \frac{V_1}{V_1}$$

(5)



$$V_x (Y_1 + Y_2 + Y_3 + Y_{C_2}) - V_0 Y_2 - V_1 Y_1 = 0$$

$$V_x Y_3 = -V_0 Y_{C_1} \Rightarrow V_x = -V_0 \frac{Y_{C_1}}{Y_3}$$

$$-V_0 \frac{Y_{C_1}}{Y_3} (Y_1 + Y_2 + Y_3 + Y_{C_2}) - V_0 Y_2 = V_1 Y_1 = -V_0 (Y_1 + Y_2 + Y_3 + Y_{C_2})$$

$$-V_0 \left(\frac{Y_{C_2} Y_{C_1} + Y_{C_1} (Y_1 + Y_2 + Y_3) + Y_2 Y_3}{Y_3} \right) = V_1 Y_1 \Rightarrow \frac{V_0}{V_1} = \frac{-Y_3 Y_1}{Y_{C_2} Y_{C_1} + Y_{C_1} (Y_1 + Y_2 + Y_3) + Y_2 Y_3}$$

$$\frac{V_0}{V_1} = \frac{-\frac{1}{R_3 R_1} \frac{1}{C_2 C_1}}{\frac{f^2 C_2 C_1}{C_2 C_1} + \frac{1}{C_1} \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right) + \frac{1}{R_2 R_3} \frac{1}{C_2 C_1}} = \frac{-\frac{1}{R_3 R_1 C_2 C_1}}{\frac{f^2}{C_2} + \frac{1}{C_1} \frac{R_2 R_3 + R_1 R_3 + R_1 R_2}{R_1 R_2 R_3} + \frac{1}{R_2 R_3 C_2 C_1}}$$

$$W_0^2 = \frac{1}{R_2 R_3 C_1 C_2}$$

$$R_1 = R_2 = R_3 = 1 \quad W_0^2 = \frac{1}{C_1 C_2} \quad \left. \begin{array}{l} C_1 = 1 \\ C_2 = 0.01 \end{array} \right\} \Rightarrow W_0 = 10$$

$$\frac{W_0}{Q} = \frac{R_2 R_3 + R_1 R_3 + R_1 R_2}{C_2 R_1 R_2 R_3}$$

$$\frac{W_0}{Q} = \frac{1 + 1 + 1}{C_2 1} = \frac{3}{C_2} \quad \frac{10}{3} \cdot 1 = Q = 3,33$$

L8

L9

$$\omega_0^2 = 1000^2 = \frac{1}{C_1 C_2 R^2} = \frac{1}{C^2 R^2} \quad 1000 = \frac{1}{RC} \quad C = 4700 \times 10^{-12} \quad R = 212 k\Omega$$

$$R_1 = R_2 = R_3 = 212 k\Omega$$

$$\frac{\omega_0}{Q} = \frac{1000}{Q} = \frac{3 \cdot (212 k\Omega)^2}{C (212 k\Omega)^3}$$

$Q = 0,33$ La regla del cero dice negativo el Q

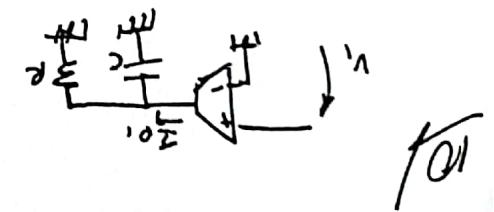
sin embargo.

con estos valores monta la ganancia (db) a la gráfica de punto pero el Q del filtro es menor.

$$\boxed{\left(\frac{d}{r} + 3f \right) \text{mb}} = \frac{2}{1 + CR + 1} \text{mb} = \left(\frac{2}{1} + \frac{2}{25} \right) \text{mb} = (2K + 2K) \text{mb} = \frac{1}{10} \text{mb}$$

$$x_{\text{mb}} = \frac{1}{10}$$

$$x_{\text{mb}} = \frac{1}{10} \quad 10 = x_{\text{mb}} \cdot x_{\text{mb}} \cdot \frac{2}{10} \quad \frac{2}{10} = 10 \quad \Leftrightarrow \quad x_{\text{mb}} = 10$$



10