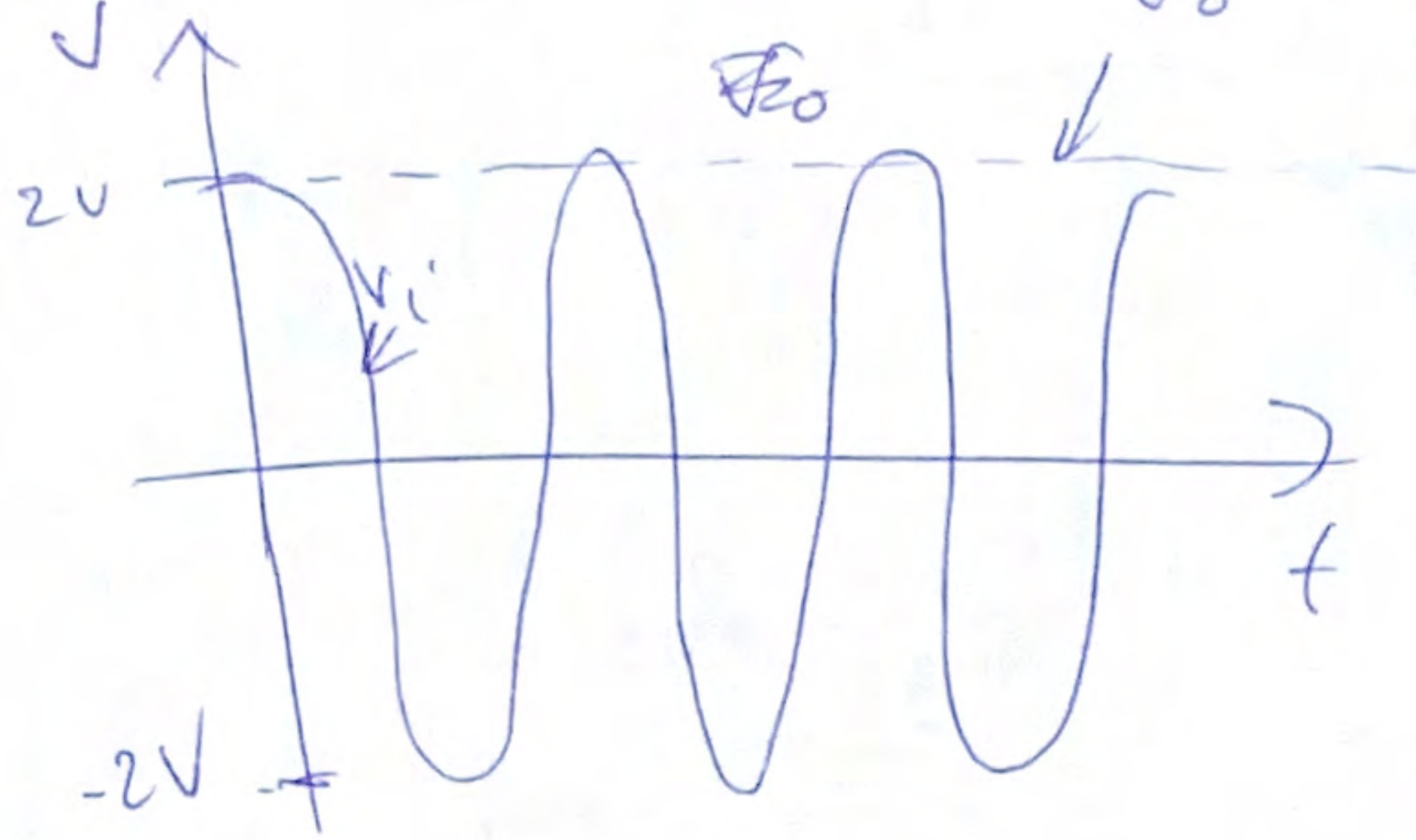
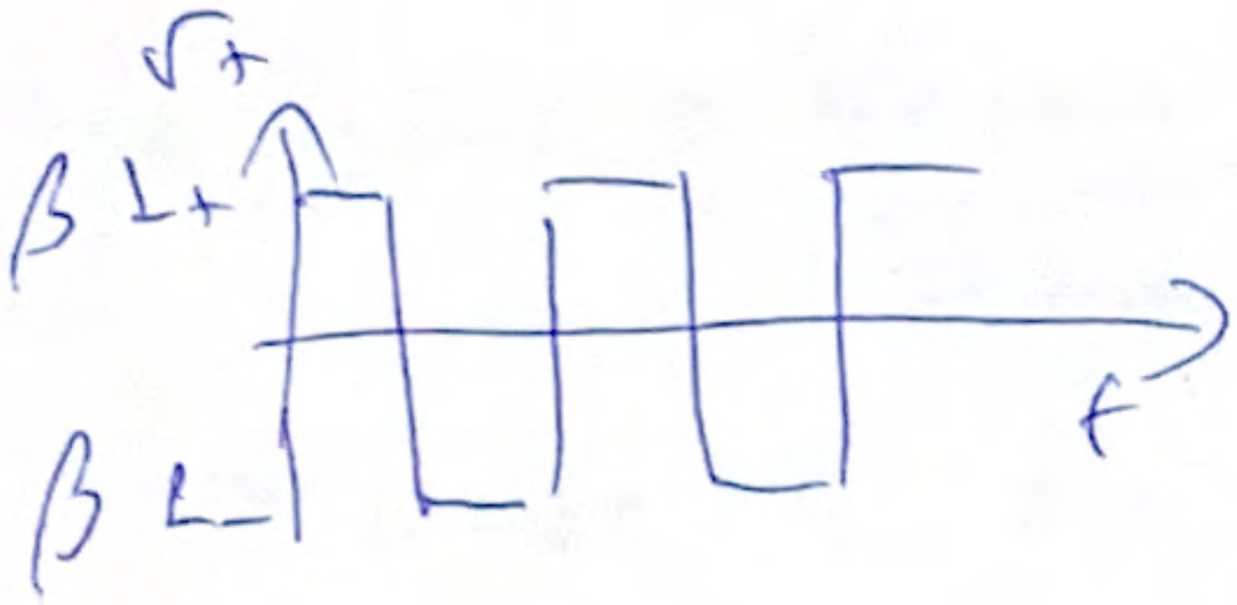
Examen Partiel 2022

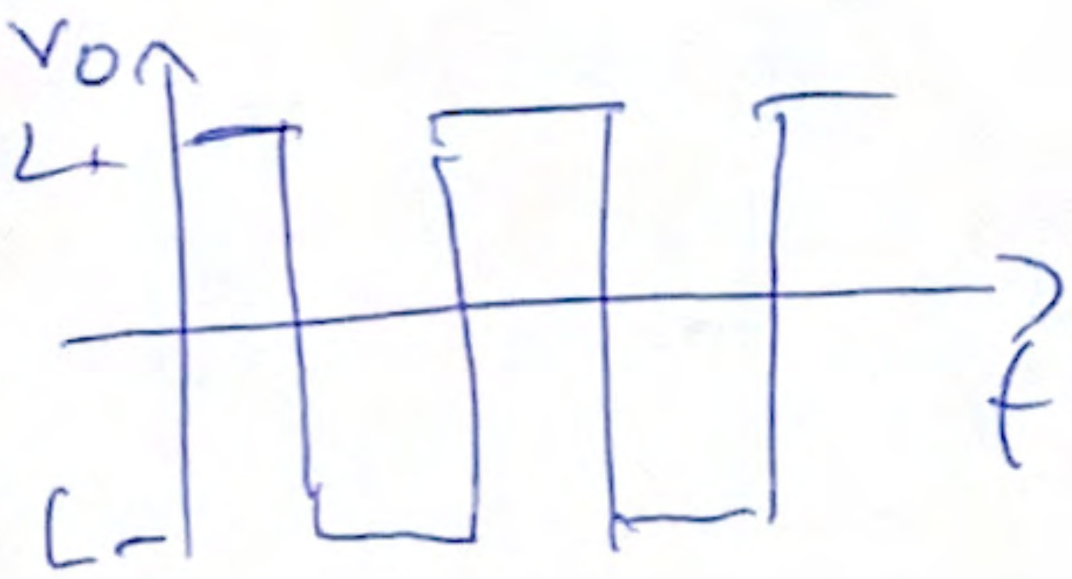
1- a)



b) c'est un oscillateur astable. R_1 et R_2 permettent d'établir les seuils V_{TH} et V_{TL} du bistable inverseur.



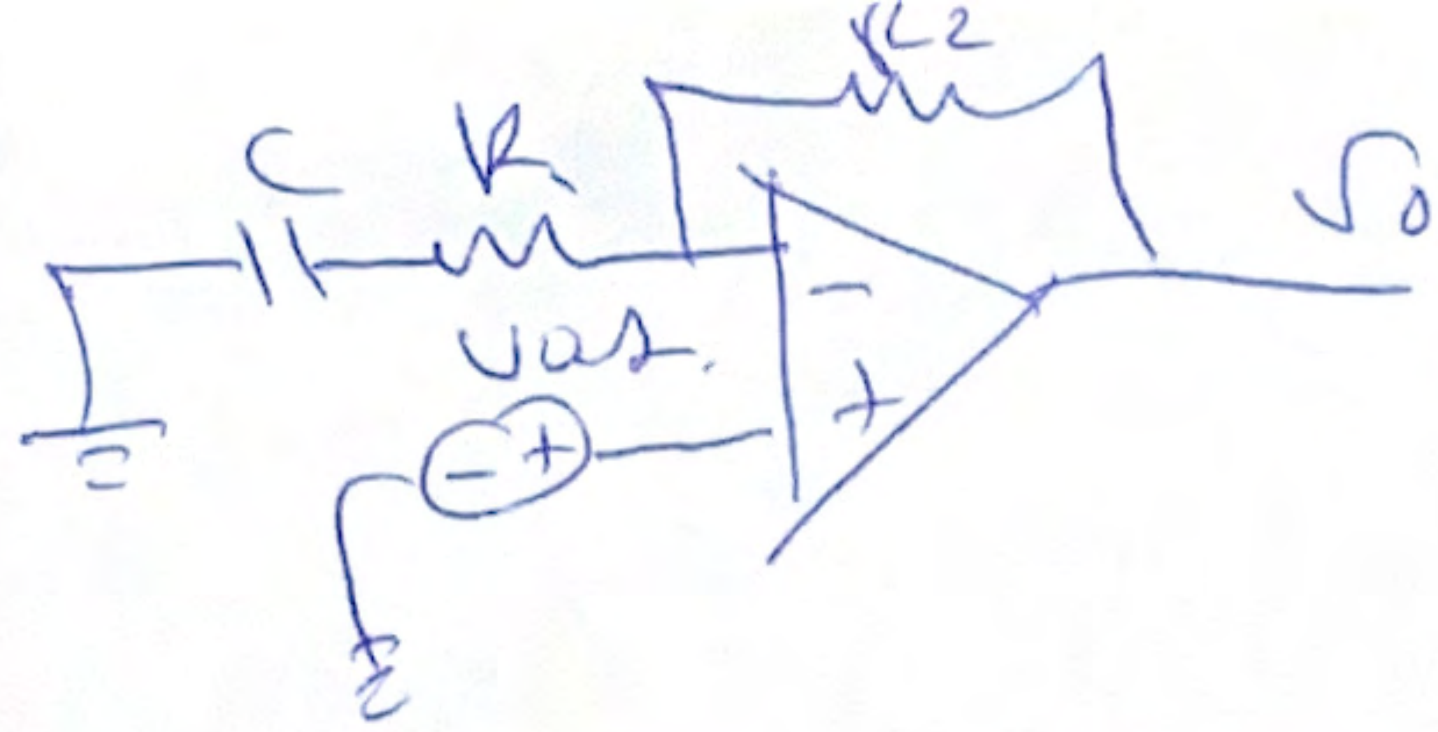
$$\beta = \frac{R_1}{R_1 + R_2}$$



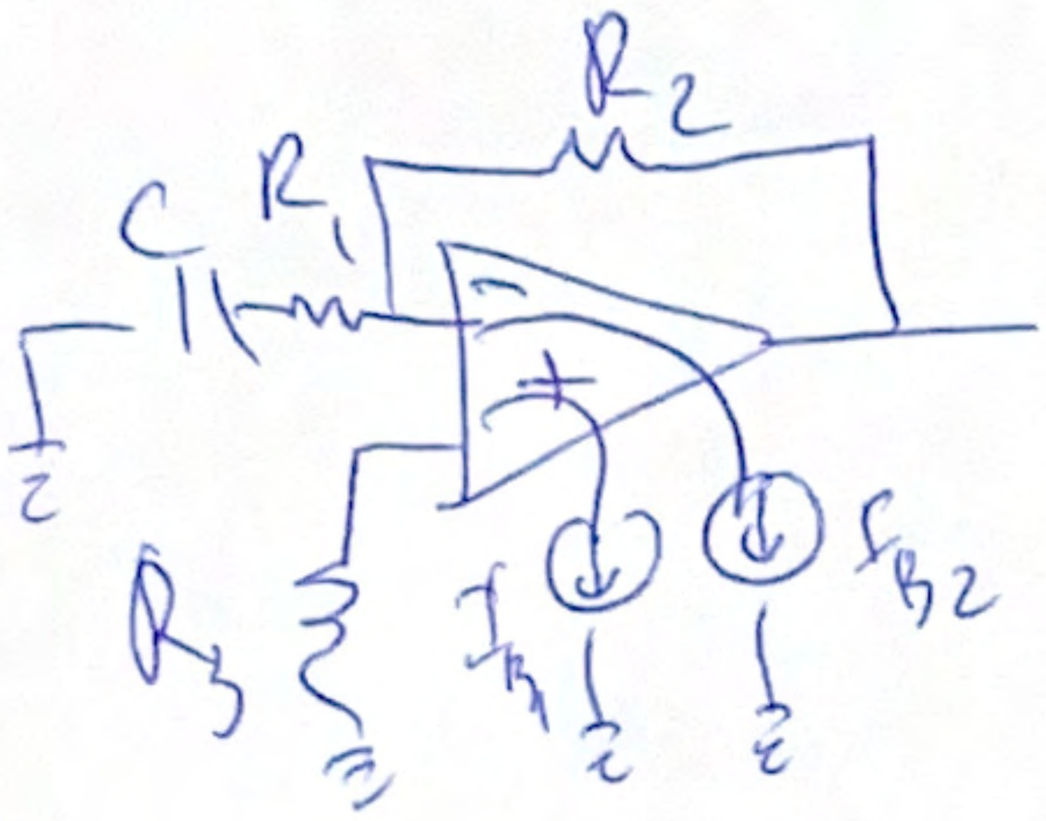
c) $f_{-3dB} = f_t / A_{BF} = 10\,MHz / 10 = 1\,MHz$

$$A_{BF} = 1 + \frac{9000\,\Omega}{1000\,\Omega} = 10\,V/V$$

d)



e)



$\underline{R_3 = R_2}$

2 - a) ampli d'instrumentation

$$\frac{v_o}{v_{id}} = \frac{R_4}{R_3}\left(1 + \frac{R_2}{R_1}\right)$$

étage 1 : $1 + \frac{R_2}{R_1} = 10$: $R_2/R_1 = 9$

étage 2 : $\frac{R_4}{R_3} = 10$

b) $v_{od} = 500\,mV$ $(v_{od} = A_d \cdot v_{id})$

c) $A_{cm} = \frac{v_{ocm}}{v_{icm}} = \frac{\cancel{100\,mV}\; 1\,mV}{100\,mV} = 0,01$

$TRMC = 20 \log\left(\frac{A_d}{A_{cm}}\right) = 20 \log\left(\frac{100}{0,01}\right)$

$= \underline{80\,db}$

d) $Z_{in} = \infty$ car $\underline{i_{in} = 0}$

e) $A_{cm}(\text{étage }1) = 1\ V/V$ car $V_1 = V_2 = V_{icm}$ ne créé pas de courant dans $\underline{2R_1}$.

f) (bonus) $v_1 = -\frac{0,005}{2}\cos\omega_1 t + 0,1\cos\omega_2 t$

$v_2 = \frac{0,005}{2}\cos\omega_1 t + 0,1\cos\omega_2 t$

$v_{o1} = -\frac{0,05}{2}\cos\omega_1 t + 0,1\cos\omega_2 t$

$v_{o2} = \frac{0,05}{2}\cos\omega_1 t + 0,1\cos\omega_2 t$

~~v_o — 0,5~~

$v_o = 0,5\cos\omega_1 t + \cancel{0,001}\ 0,001\cos\omega_2 t$

3- $\omega_p = 2\pi \cdot 5\,kHz$, $\omega_s = 2\pi \cdot 15\,kHz$.

$\varepsilon = \sqrt{10^{0{,}5/10} - 1} = 0{,}34931$

$A_{min} = 10\,dB \leq A(\omega_s = 15\,kHz) =$

$10 \log \left(1 + \varepsilon^2 (\omega_s/\omega_p)\right)^{2N}$

a) $N \geq 4$

b) $T(s) = \dfrac{K_1}{s^2 + 0{,}765 s + 1} \cdot \dfrac{K_2}{s^2 + 1{,}848 s + 1}$

$A(s) = T_d\left(s = \dfrac{s}{\omega_0}\right) = \dfrac{K_1 \omega_0^2}{s^2 + 0{,}765\,\omega_0 s + \omega_0^2} \cdot \dfrac{K_2 \omega_0^2}{s^2 + 1{,}848\,\omega_0 s + \omega_0^2}$

$\omega_0 = \omega_p (1/\varepsilon)^{1/N}$

$= 2\pi \cdot 5\,kHz (1/0{,}34931)^{1/4} =$

$= 2\pi \cdot 6{,}5\,kHz$

$Q_1 = \dfrac{1}{0{,}765}$, $Q_2 = \dfrac{1}{1{,}848}$

c) sallen key.

$T_{d_1}(s) = \dfrac{a K_1' \omega_0^2}{s^2 + s(\omega_0/Q) + \omega_0^2}$

$Q_1 = 1/0{,}765$

$C = 1nF$

$R_1 = R_2 = R_A = 1/\omega_0 C = 24{,}485\,\Omega$

$R_B = (2 - 1/Q_1) R_A = 30239\,\Omega$

$K_1' = 1 + R_B/R_A = 2{,}235$

$a = 1/K_1' = 1/2{,}235$

$K_1 = a \cdot K_1' = 1$

section inductance simullée :

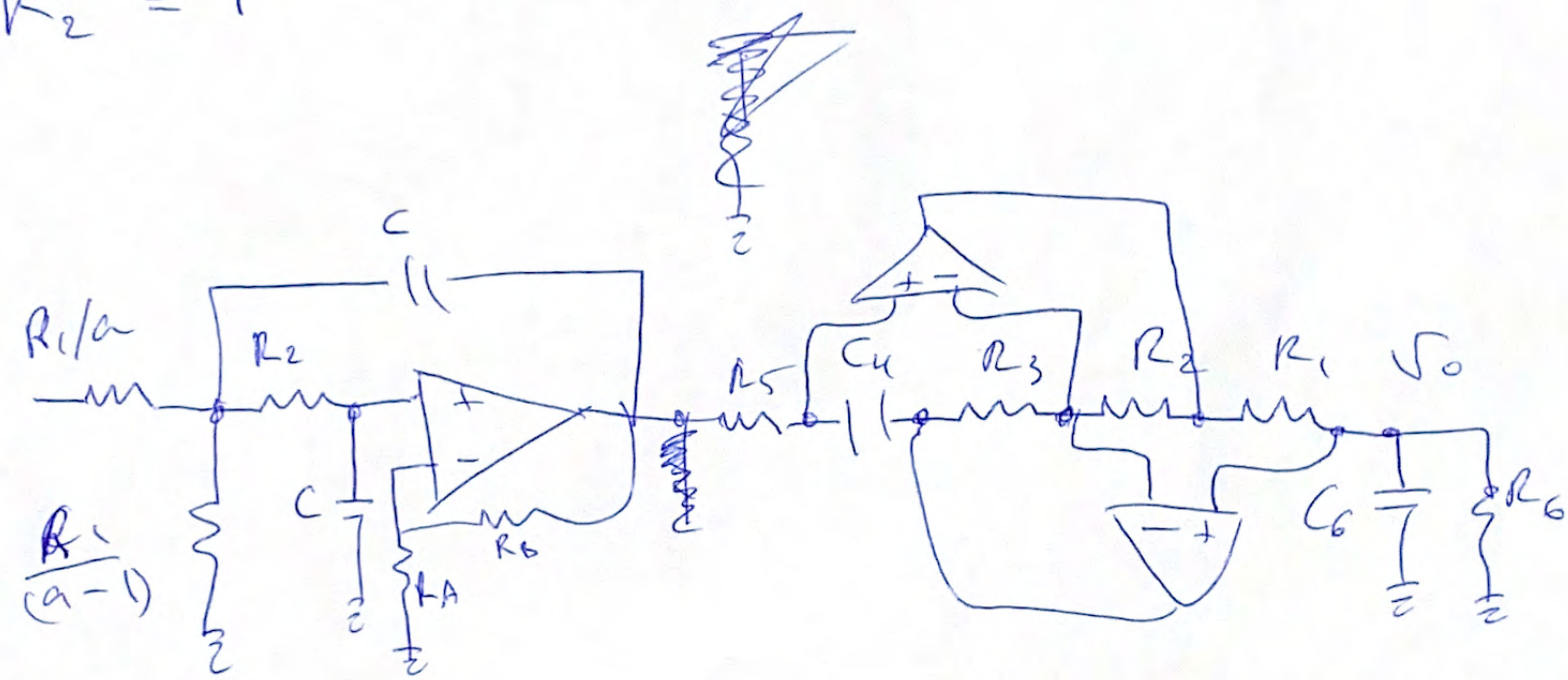
on donne $C_6 = C_4 = C = 1nF$. et $R_1 = R_2 = R_3 = R_5 = R$

$$R = \frac{1}{\omega_0 C} = \frac{1}{(2\pi \cdot 6{,}5kHz)(1nF)} = 24{,}485\,\Omega$$

$$\frac{\omega_0}{Q_2} = \frac{1}{C_6 R_6} \quad \text{donc} \quad R_6 = \frac{1/1{,}848}{2\pi \cdot 6{,}5kHz} \cdot \frac{1}{1nF} = 13250\,\Omega$$

$$Q_2 = \frac{1}{1{,}848}$$

$$K_2 = 1$$



d)