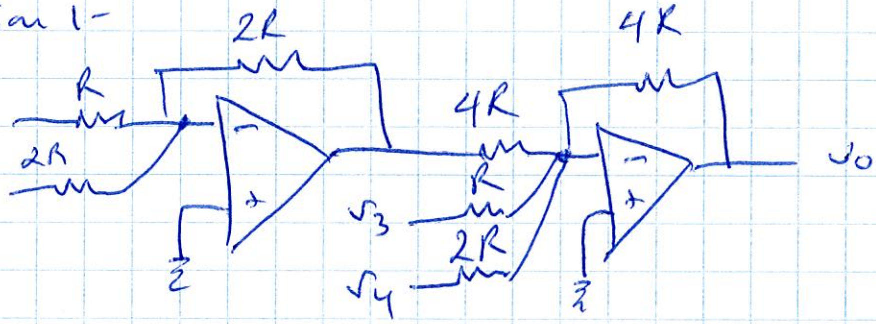
~~Questi~~ Examen partiel 2015

Question 1-

a)



b) il faut $\mathrm{Im}(L(j\omega)) = 0$ et $\mathrm{Re}(L(j\omega)) = 1$

i) $5\omega_0 CR - \omega_0^3 C^3 R^3 = 0$

$$5\omega_0 CR = \omega_0^3 C^3 R^3$$

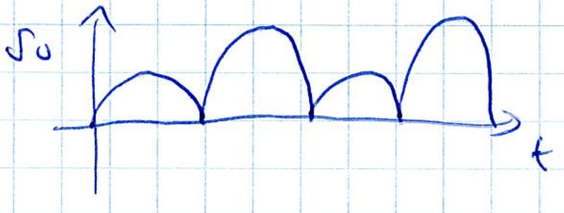
$$\omega_0 = \frac{1}{\sqrt{5}} \frac{1}{RC}$$

ii) $$\frac{R_f/R}{3 - 4\omega_0^2 C^2 R^2} \geq 1$$

$$\frac{R_f/R}{3 - 4 \cdot \frac{1}{5} \frac{1}{\cancel{C^2R^2}} \cdot \cancel{C^2R^2}} \geq 1$$

$$R_f/R \geq \underline{2{,}2.}$$

c) c'est un redresseur double alternance
1) quand v_1 est positif, D2 est activée et $v_o = v_1$
2) quand v_1 est négatif, D1 est activée et $v_o = 2v_1$



d) La tension aux bornes de Z_5 est V_1 (par court-circuit virtuel)

Question 2-

a) $V_{ocm} = 0{,}005 \, V_{pp}$ or $SNR_o = TRMC + SNR_i$

$V_{odmax} = L_+ - L_- = 1 \, V_{pp}$

$$SNR_o = 20 \log \left(\frac{1 V_{pp}}{0{,}005 V_{pp}} \right) = 46 db.$$

$SNR_i = SNR_o - TRMC = 46 \, db - 100 \, db = -54 \, db.$

b) $A_{cm} = 0{,}01 \, V/V$

$$TRMC = 20 \log \left| \frac{A_d}{A_{cm}} \right| \longrightarrow 100 db = 20 \log \frac{A_d}{0{,}01 V/V}$$

$$10^5 = \frac{A_d}{0{,}01} V/V$$

$$\underline{A_d = 1000 \, V/V}$$

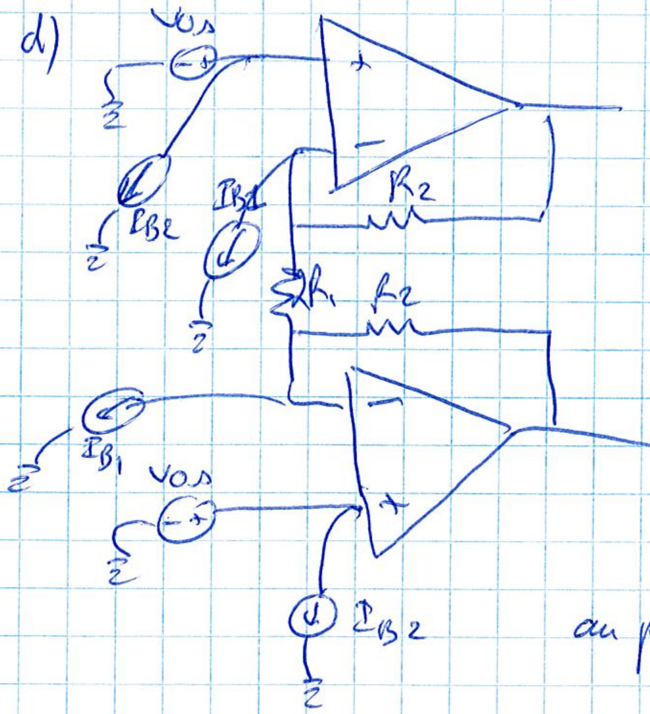
$$v_{id\,max} = \frac{V_{od\,max}}{A_d} = \frac{1 V_{pp}}{1000 V/V} = 0{,}001 \checkmark$$

c) il faut $1 + \frac{R_2}{R_1} = 10 V/V$ et $\frac{R_4}{R_3} = 1 V/V$

$R_2 = 9 R_1$

$R_1 = 11 \, K\Omega$ et $R_3 = 100 \, K\Omega$

d)

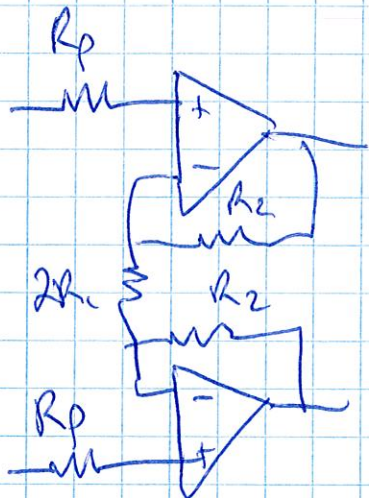


$V_{o1} = I_{B1} R_2 + V_{os}\left(1+\frac{R_2}{R_1}\right)$

$V_{o2} = I_{B1} R_2 + V_{os}\left(1+\frac{R_2}{R_1}\right)$

au pire cas : $2\left(I_{B1} R_2 + V_{os}\left(1+\frac{R_2}{R_1}\right)\right)$

e)



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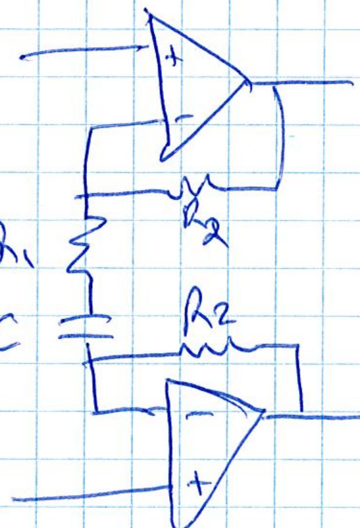
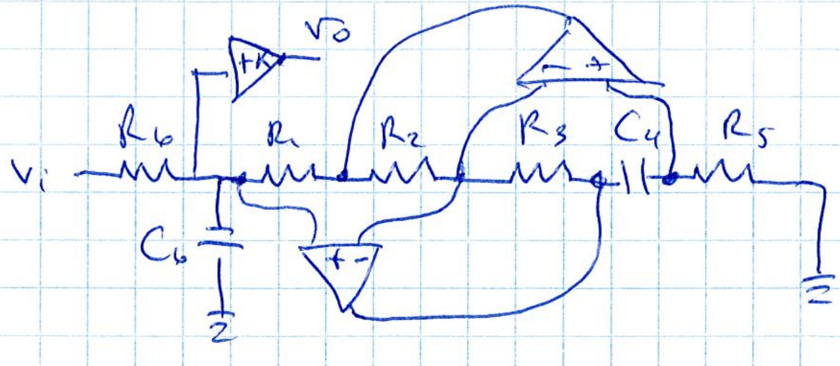


Question 3-

$\omega_0 = 2\pi \cdot 15\,KHz$
$\omega_2 - \omega_1 = 2\pi \cdot 10\,KHz$



on choisi $R_1 = R_2 = R_3 = R_5$
$C_4 = C_6$

filtre à inductance simulée

$$\frac{K s \dfrac{1}{C_6 R_6}}{s^2 + s\dfrac{1}{C_6 R_6} + \dfrac{1}{R^2 C^2}} = \frac{a_1 s}{s^2 + s\dfrac{\omega_0}{Q} + \omega_0^2}$$

$$\frac{\omega_0}{Q} = \omega_2 - \omega_1 = 2\pi \cdot 10\,KHz$$

$$Q = \frac{\omega_0}{\omega_2 - \omega_1} = \frac{2\pi \cdot 15\,KHz}{2\pi \cdot 10\,KHz} = 1{,}5$$

$$R = \frac{1}{\omega_0 C} = \frac{1}{2\pi \cdot 15\,KHz \cdot 10\,nF} = \underline{1061\,\Omega}$$

$$R_6 = \frac{1}{\dfrac{\omega_0}{Q} \cdot 10\,nF} = \underline{1592}\,\Omega$$

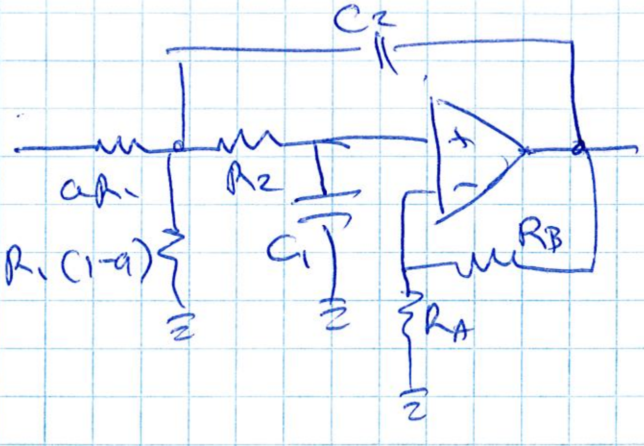
pour avoir ~~il faut~~ $a_1 \dfrac{Q}{\omega_0} = 1$ il faut $a_1 = \dfrac{\omega_0}{Q}$

or $a_1 = K \dfrac{1}{C_6 R_6} = K \dfrac{\omega_0}{Q}$

par conséquent $\underline{K = 1}$

$$H(s) = \frac{s\,\dfrac{2\pi \cdot 10\,KHz}{\cancel{0{,}707}}}{s^2 + s\,\dfrac{2\pi \cdot 10\,KHz}{\cancel{0{,}707}} + (2\pi \cdot 15\,KHz)^2}$$

b) *filtre Sallen-Key*



on choisi $R_1 = R_2 = R_A = R$

$C_1 = C_2 = C$

$$T(s) = \frac{aK\frac{1}{R^2C^2}}{s^2 + s\left(\frac{1}{R} + \frac{1}{R}(2-K)\right)\frac{1}{C} + \frac{1}{R^2C^2}} = \frac{aK\frac{1}{R^2C^2}}{s^2 + s(3-K)\frac{1}{RC} + \frac{1}{R^2C^2}}$$

$$R = \frac{1}{\omega_0 C} = \frac{1}{2\pi \cdot 10KHz \cdot 10nF} = \underline{1592\ \Omega}$$

$\underline{Q = 0,707}$

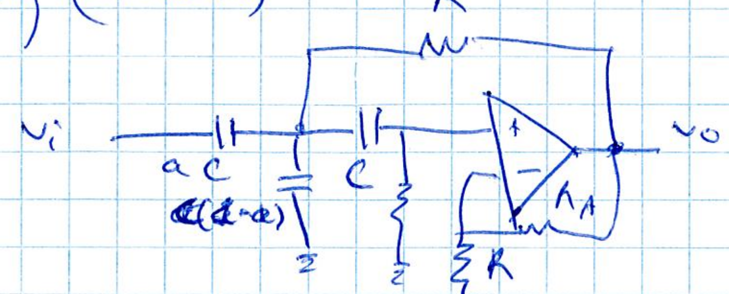
$K = 3 - 1/Q = \underline{1,59}$

$R_B = (2 - 1/Q)R_A = \underline{932\ \Omega}$

il faut $aK = 1 \longrightarrow a = \frac{1}{K} = \underline{0,63}$

on change en passe-haut $\quad C_{ij} = \frac{1}{\omega_0 R_{ij}}$; $R_{ij} = \frac{1}{\omega_0 C_{ij}}$

$$T(s) = \frac{s^2 \frac{1}{(2\pi\ 10KHz)}}{s^2 + s\left(\frac{2\pi \cdot 10KHz}{0,707}\right) + (2\pi \cdot 10KHz)^2}$$



c) $A_{max} = 0{,}1 \text{ db}$ *

$\omega_s = 2\pi \cdot \underline{42 \text{ KHz}}$

i) il faut $A(j\omega_s) \geq 15 \text{ dB}$.

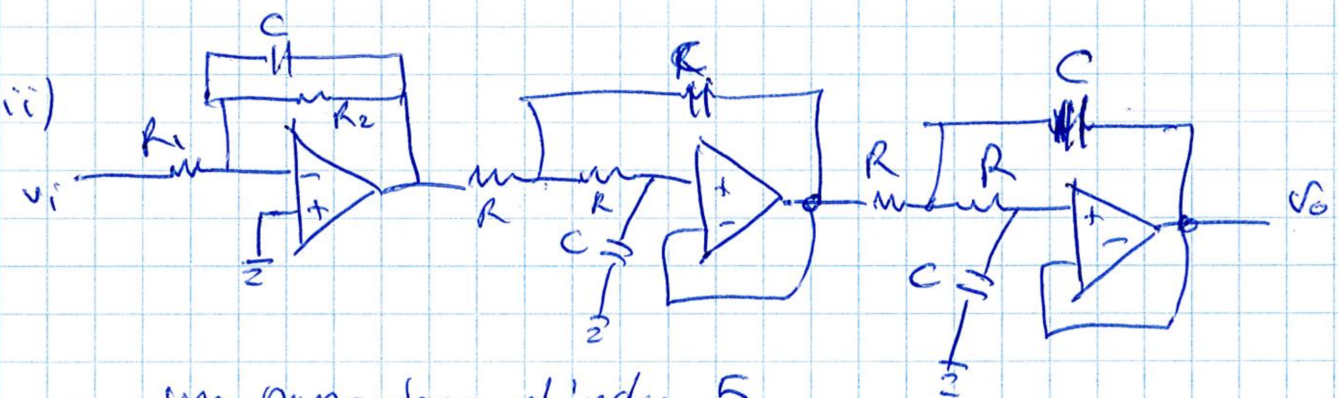
$A(j \cdot 2\pi \cdot 42 \text{ KHz}) \geq 15 \text{ db}$

$$\geq 10 \log \left(1 + \varepsilon^2 \left(\frac{2\pi \cdot 42 \text{ KHz}}{2\pi \cdot 20 \text{ KHz}}\right)^{2N}\right)$$

on trouve $N = 5$

ii) $$\frac{1}{(s+1)(1+0{,}618s+s^2)(1+1{,}618s+s^2)}$$

iii)



un <u>passe-bas d'ordre 5</u>