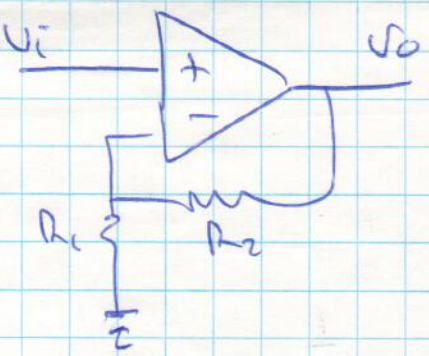
Question 1 — Examen partiel 2016

a)



$$\frac{V_o}{V_i} = 1 + \frac{R_2}{R_1} \qquad R_2 = 49 R_1$$

$$\omega_t = 2\pi \cdot 4\,MHz = \omega_{-3dB} \cdot A_0$$

$$\omega_t = \omega_{-3dB} \cdot \left(1 + \frac{R_2}{R_1}\right) \quad \begin{cases} \omega_{-3dB} = \beta \omega_t \\ \text{ai } \beta = \frac{1}{A_{BF}} \end{cases}$$

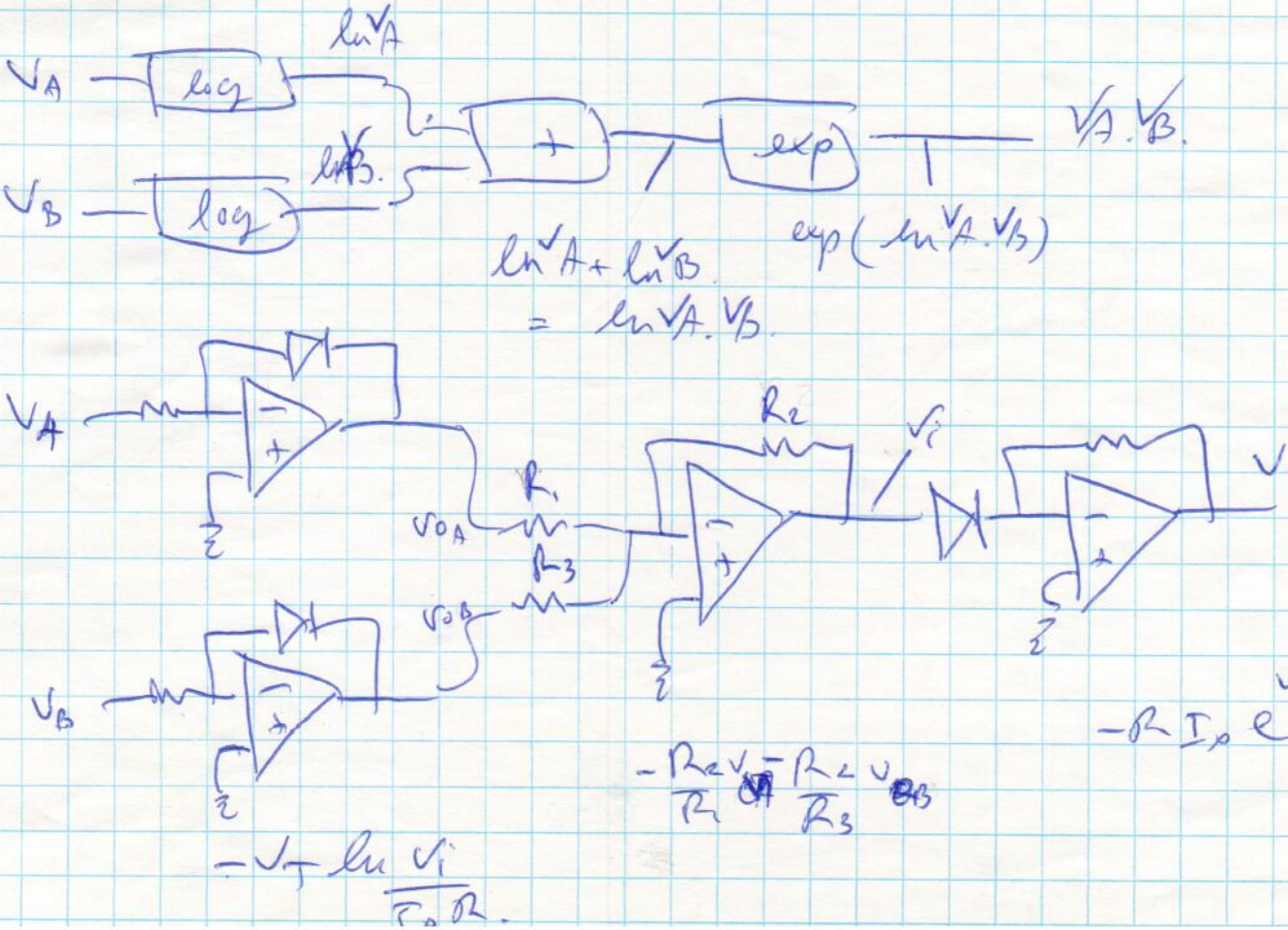
$$\omega_{-3dB} = \frac{2\pi \cdot 4\,MHz}{50} = 2\pi \cdot 80\,KHz$$

b) $f_M \leq \frac{SR}{2\pi \cdot V_{omax}} \Rightarrow SR = f_M \times 2\pi \cdot V_{omax}$

$= 320\,KHz \cdot 2\pi \cdot 10\,V$

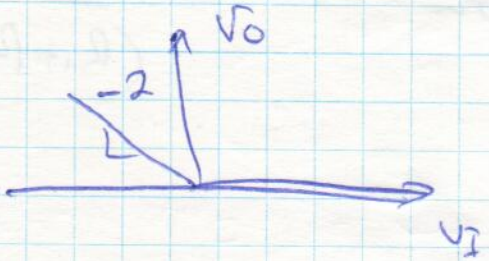
$= 2\pi \cdot 3{,}2\,MHz$

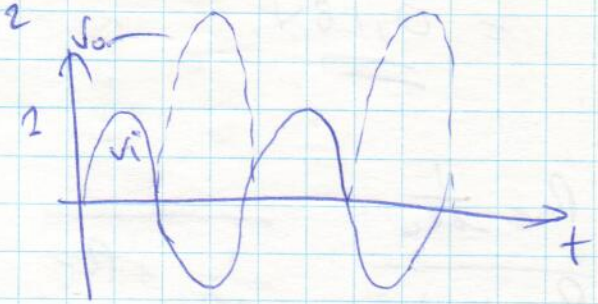
c)



d) $v_i = \cos \omega t$, $R_2 = 2R_1$

$$\text{Şimdi } \frac{v_o}{v_i} = -\frac{R_2}{R_1}$$





Question 2

a) $SNR_o = SNR_i + TRMC$

$TRMC = 60\,dB - 20\log \frac{1mV_{pp}}{20mV_{pp}} = \underline{86\,dB}$

b) il faut $R_2 = R_4$ et $R_1 = R_3 \rightarrow A_d = \frac{R_2}{R_1}$

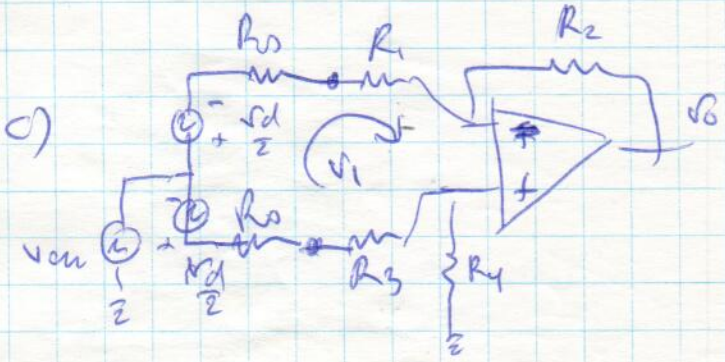
$R_2 = R_4 = 1K\Omega$

$R_1 = R_3 = 10\Omega$

$TRMC = 20\log \frac{A_d}{A_{cm}} \rightarrow A_{cm} = \frac{1}{10^{\left(\frac{TRMC}{20}\right)}}$

$= 50 \times 10^{-6}\ V/V$

c)



$v_d = I\,2R_3 + I\,2R_1$

$I = v_d / (2R_3 + 2R_1)$

$v_1 = I \cdot 2R_1$

$= v_d / (2R_3 + 2R_1) \cdot 2R_1$

$= 20mV \frac{2.10}{(2.10 + 2.100)} = \frac{1,8mV}{}$

$\rightarrow V_o = 100 \cdot \frac{1,8mV}{} = \frac{0,18V}{}$

→ utiliser l'amplificateur d'instrumentation à $Z_{in} = \infty$.

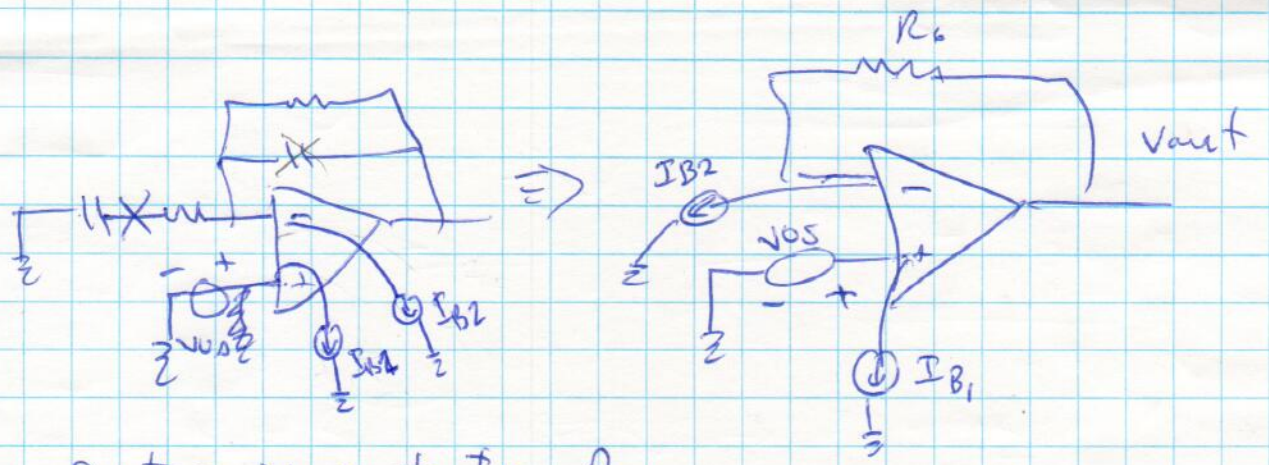
d) $\frac{v_o}{v_i} = \frac{-R_6 \,//\, 1/sC_6}{\frac{1}{sC_5} + R_5} = \frac{-R_6 \frac{1}{sC_6}}{R_6 + \frac{1}{sC_6}} \cdot \frac{1}{\frac{1}{sC_5} + R_5} = \frac{-R_6}{R_5}$

$= \frac{-R_6}{sC_6R_6 + 1} \cdot \frac{sC_5}{sC_5R_5 + 1}$

$\omega_{1p} = 1/C_6R_6 = \frac{1}{10nF \cdot 1592\Omega}$

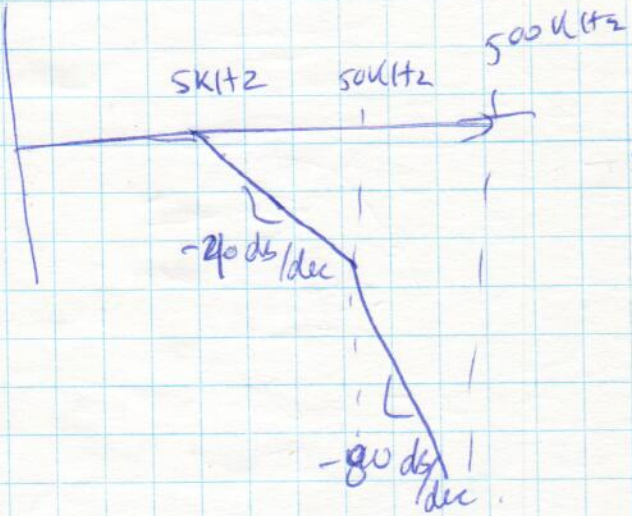
$\omega_{np} = 1/C_5R_5 = \frac{1}{10\mu F \cdot 31,8\Omega}$

e)



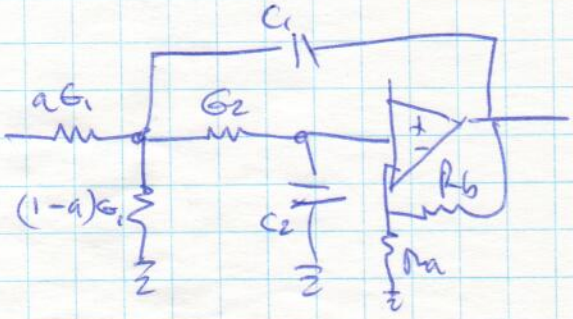
$$V_{out} = V_{OS} + I_{B2} R_6$$

Question 3-



$$T(s) = T_1(s) \cdot T_2(s)$$

a)



$$T_1(s) = \frac{ak G_1 G_2 / C^2}{s^2 + s\left(G_1 + G_2(2-k)\right)/C + \frac{G_1 G_2}{C^2}} \equiv \frac{a_0}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2}$$

$$R_1 = R_2 = R_a = \frac{1}{\omega_0 C} = \frac{1}{2\pi \cdot 5KHz \cdot 10nf} = 3183\,\Omega \qquad \omega_0 = \frac{1}{RC}$$

$$R_b = (2 - 1/Q) R_a = 1864\,\Omega$$

$C = 10nf$

$$K = 1 + \frac{R_b}{R_a} = 1 + \frac{1864\Omega}{3183} = 1{,}59 \qquad a = 1/K = 0{,}63$$

$$T_1(s) = \frac{(2\pi \cdot 5\,KHz)^2}{s^2 + \frac{2\pi \cdot 5KHz}{0{,}707} + (2\pi \cdot 5KHz)^2}$$

ii)

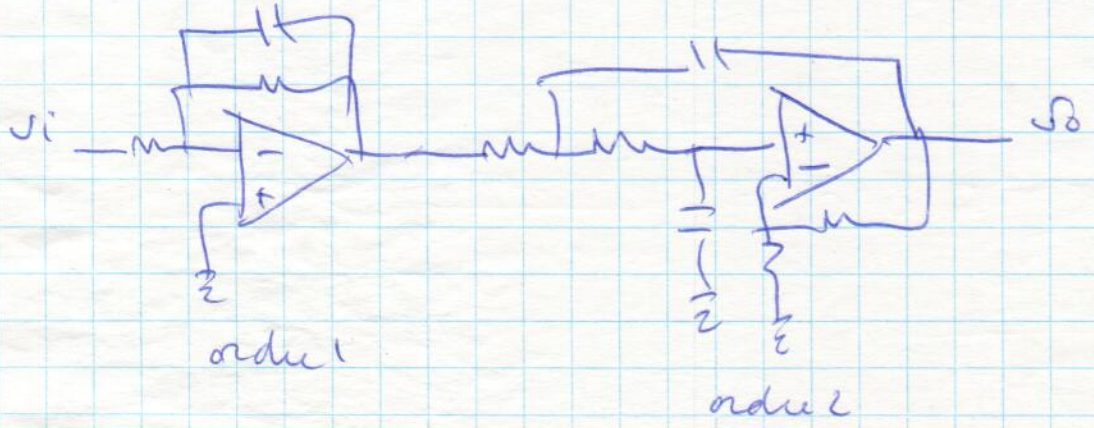
$$\frac{1}{(1+\Omega)(1+\Omega+\Omega^2)} = \frac{1}{\left(1+\frac{\Omega}{\frac{2\pi \cdot 5KHz}{\omega_0}}\right)\left(1+\frac{\Omega}{\frac{2\pi \cdot 5KHz}{\omega_0}}+\frac{\Omega^2}{\omega_0^2}\right)}$$

$$= \frac{\omega_0^3}{(\omega_0+s)(\omega_0^2+s\omega_0+s^2)}$$

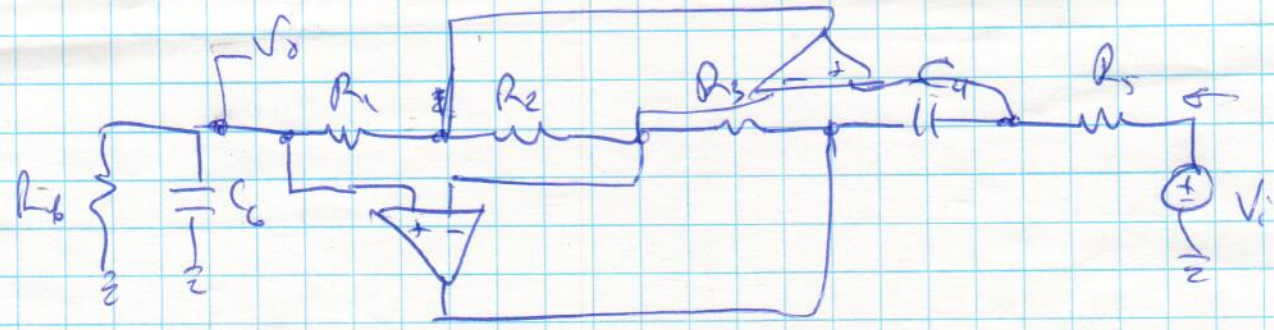
$$\omega_0 = \omega_p (1/\varepsilon)^{1/N} = 5KHz\,(1/1{,}47)^{1/3}$$

iii)

$$= 1{,}13\ KHz$$



b)



$$T(s) = \frac{K \frac{1}{C^2R^2}}{s^2 + s\frac{1}{R_6C_6} + \frac{1}{C^2R^2}} = \frac{a_0}{s^2 + \frac{\omega_0}{Q} + \omega_0^2}$$

$R_1 = R_2 = R_3 = R_5 = R$

$C_6 = C_4 = 10nf.$

$$R = \frac{1}{\omega_0 C} = \frac{1}{2\pi \cdot 50KHz \cdot 10nf} = 318\ \Omega$$

$Q = 0,707.$

$K = 1$

$$T_2(s) = \frac{(2\pi \cdot 50KHz)^2}{s^2 + s\frac{2\pi \cdot 50KHz}{0,707} + (2\pi \cdot 50KHz)^2}$$

c) $A_{max} = 120\ db.$

$A_{max} = 5\ db$

d) $\varepsilon = \sqrt{10^{A_{max}/10} - 1} = \sqrt{10^{5/10} - 1} = 1,47$

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

$$= 10\log\left(1 + (1,47)^2(500/5)^{2N}\right)$$

$N = 3$ →

$A(j\omega_s) = 123\ db.$ ok!