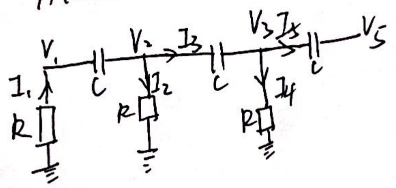
Devoir 3.

$R_1 = R_2 = R_3 = R_4 = R$

$C_1 = C_2 = C_3 = C \quad U_- = U_+ = 0$

Alors,



$I_1 = \frac{0 - V_1}{R} = j\omega C (V_1 - V_2) \Rightarrow V_2 = (1 + \frac{1}{j\omega R}) V_1$

$I = I_2 + I_3, \quad I_2 = \frac{V_2 - 0}{R} = \frac{V_2}{R}$

$I_3 = I_4 + I_5, \quad I_4 = \frac{V_3 - 0}{R} = \frac{V_3}{R}$

$I_5 = j\omega C (V_3 - V_5)$

$\Rightarrow \quad V_2 = (1 + \frac{1}{j\omega CR}) V_1.$

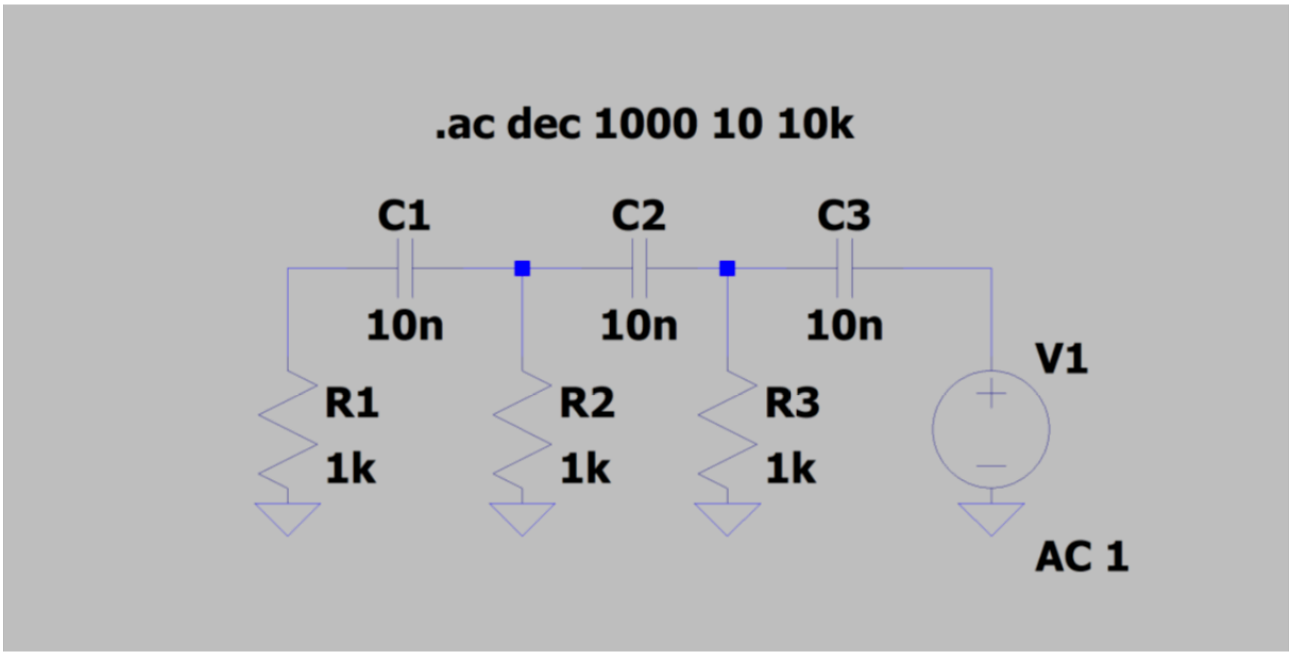
$V_3 = (2 + \frac{1}{j\omega CR}) V_2 - V_1$

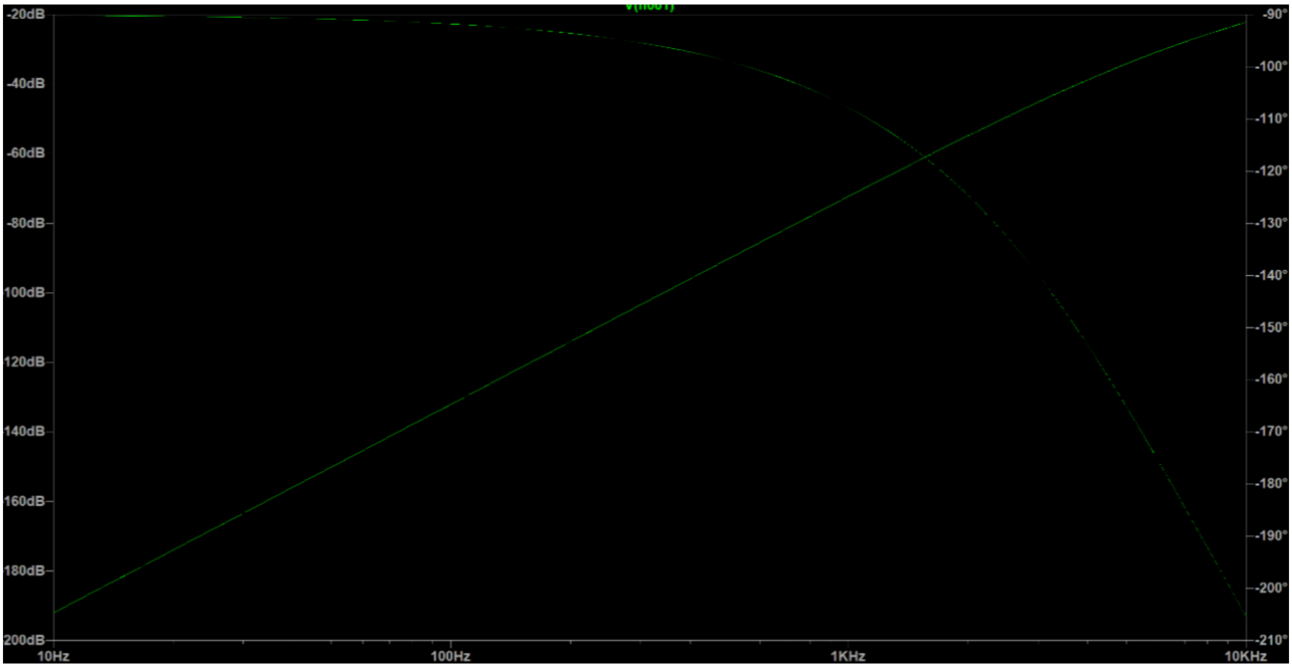
$V_2 = \frac{(2j\omega C + \frac{1}{R}) V_1 + j\omega C V_5}{(j\omega C + \frac{1}{R})(3 + \frac{1}{j\omega CR})}$

alors, on a :

$\frac{V_1}{V_5} = \frac{1}{1 + \frac{6}{j\omega CR} + \frac{5}{(j\omega CR)^2} + \frac{1}{(j\omega CR)^3}} \Leftrightarrow \frac{V_1}{V_5} = \frac{1}{1 - \frac{5}{(\omega CR)^2} + j(\frac{1}{(\omega CR)^3} - \frac{1}{\omega CR})}$

Donc on peut faire la simulation comme ici:


.ac dec 1000 10 10k
C1
10n
C2
10n
C3
10n
R1
1k
R2
1k
R3
1k
V1
AC 1


-20dB
-40dB
-60dB
-80dB
100dB
120dB
140dB
160dB
180dB
200dB
-90°
-100°
-110°
-120°
-130°
-140°
-150°
-160°
-170°
-180°
-190°
-200°
-210°
10Hz
100Hz
1KHz
10KHz

Q3. $\varphi = -\arctan \dfrac{6(\omega CR)^2 - 1}{(\omega CR)^3 - 5\omega CR}$

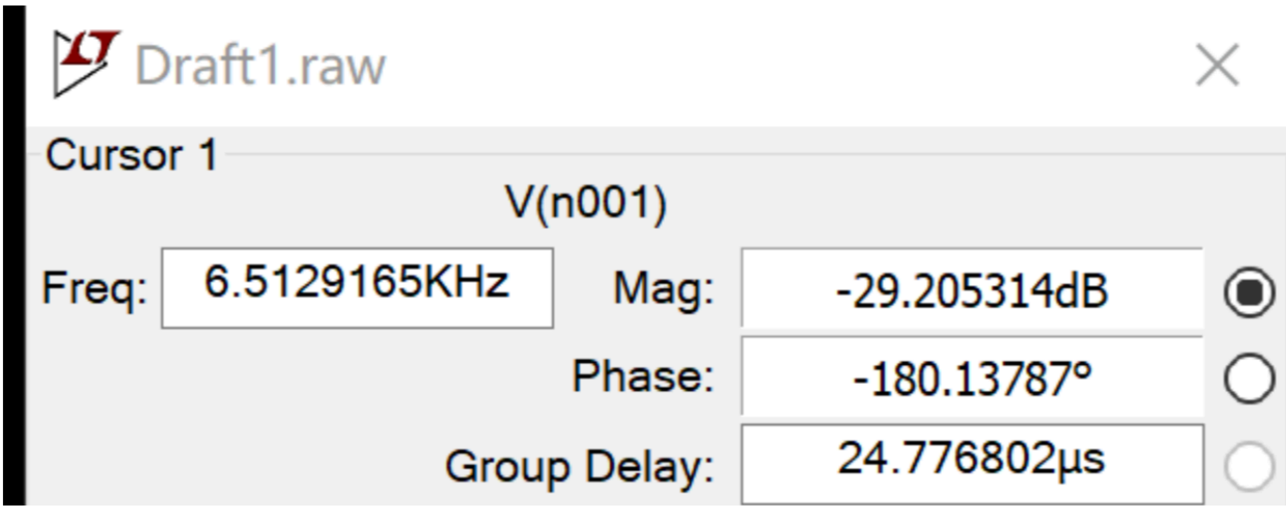
Or $\varphi = -\pi$

alors, $\omega = \dfrac{1}{\sqrt{6}\, CR}$

$\Rightarrow f_0 = \dfrac{\omega}{2\pi} = \dfrac{1}{2\pi\sqrt{6}\, CR} \simeq 6498\,Hz$

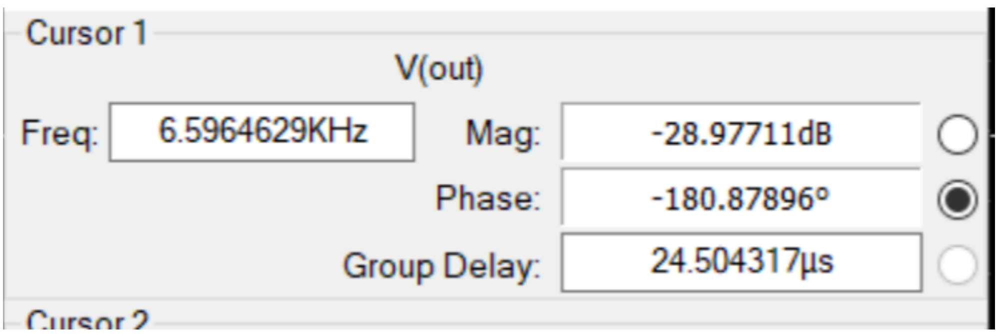
$A = \dfrac{1}{\beta} = 29$

Numériquement :



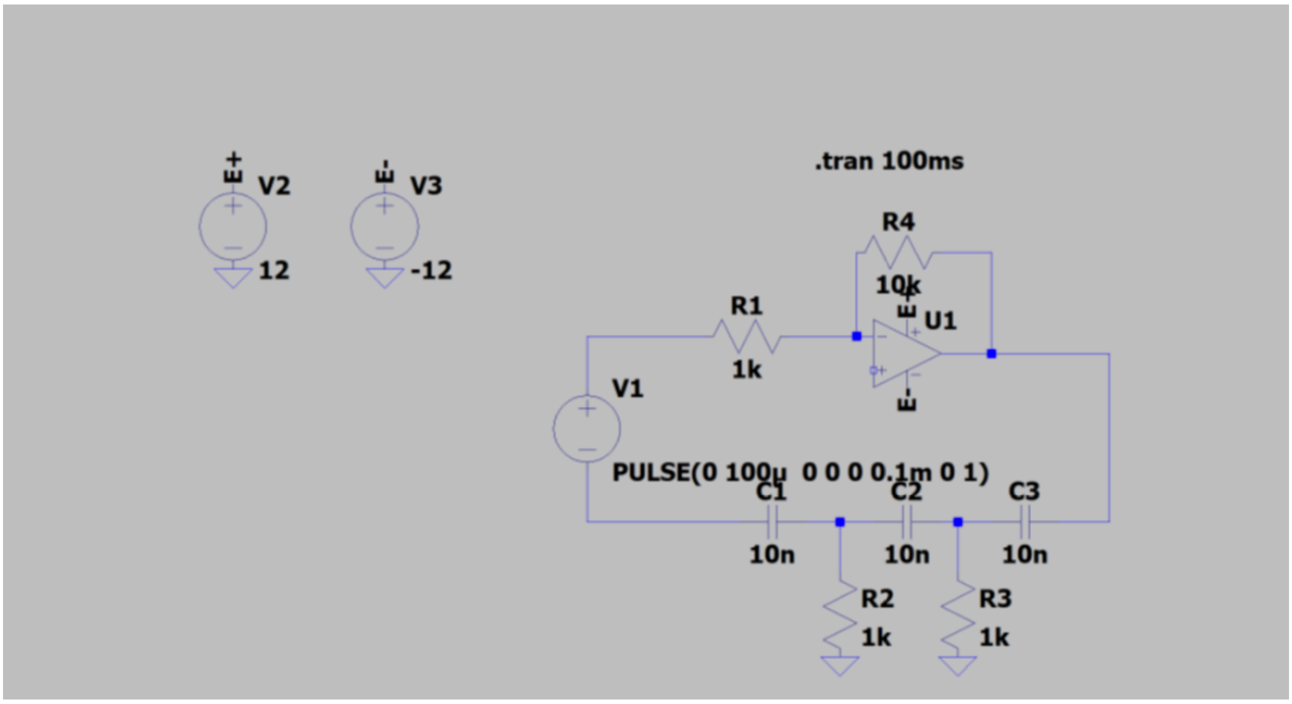
F_0 = 6.51kHz, A=29.205

Q4. La valeur théorique est 1. On calcule numériquement par choisir un autre point proche de F_0.

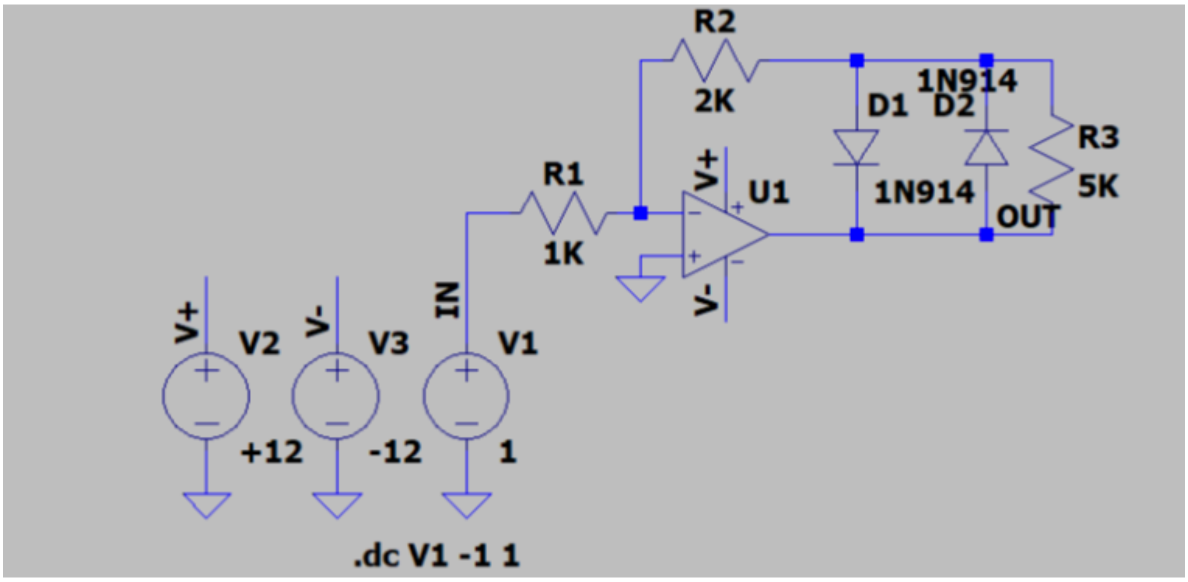


k=|w0*dphi/2pi*df*|=1.0142, c'est presque les mêmes

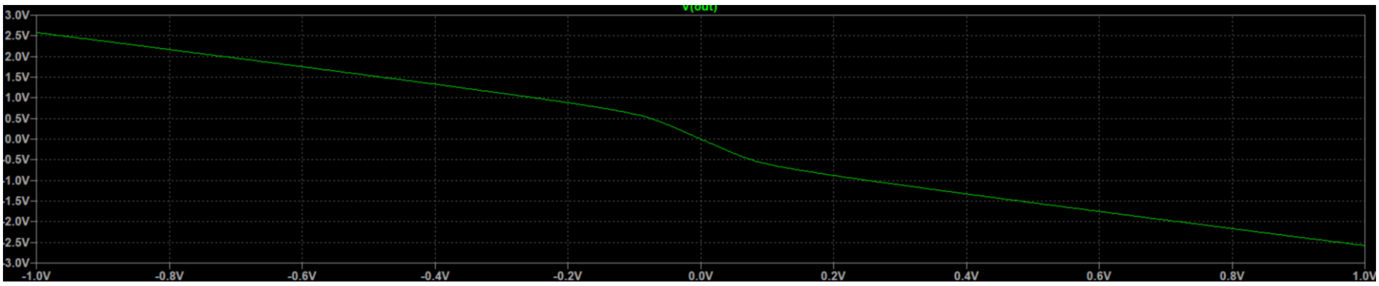
Q5



Q7



Q8



Il n’est pas linéaire au tour de 0.