Devoir 3

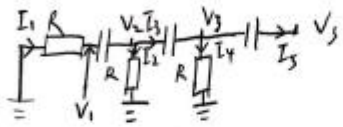
1.

Soit $R_1 = R_2 = R_3 = R_4 = R$

$C_1 = C_2 = C_3 = C$

$v_- = v_+ = 0V$

$\Rightarrow$



$I_1 = \frac{0 - V_1}{R} = jwC(V_1 - V_2) \Rightarrow V_2 = (1 + \frac{1}{jwCR})V_1$

$I_1 = I_2 + I_3 \; ; \; I_2 = \frac{V_2}{R} \; ; \; I_3 = jwC(V_2 - V_3)$

$I_3 = I_4 + I_5 \; ; \; I_4 = \frac{V_3}{R} \; ; \; I_5 = jwC(V_3 - V_5)$

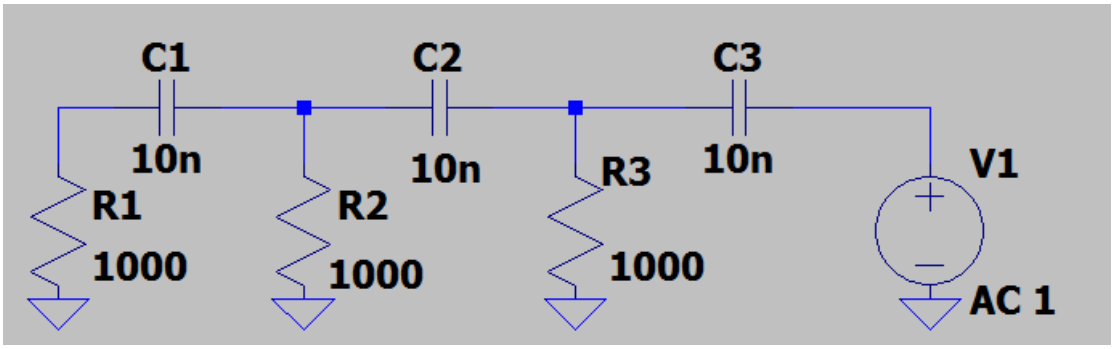
$\Rightarrow V_3 = (2 + \frac{1}{jwCR})V_2 - V_1$

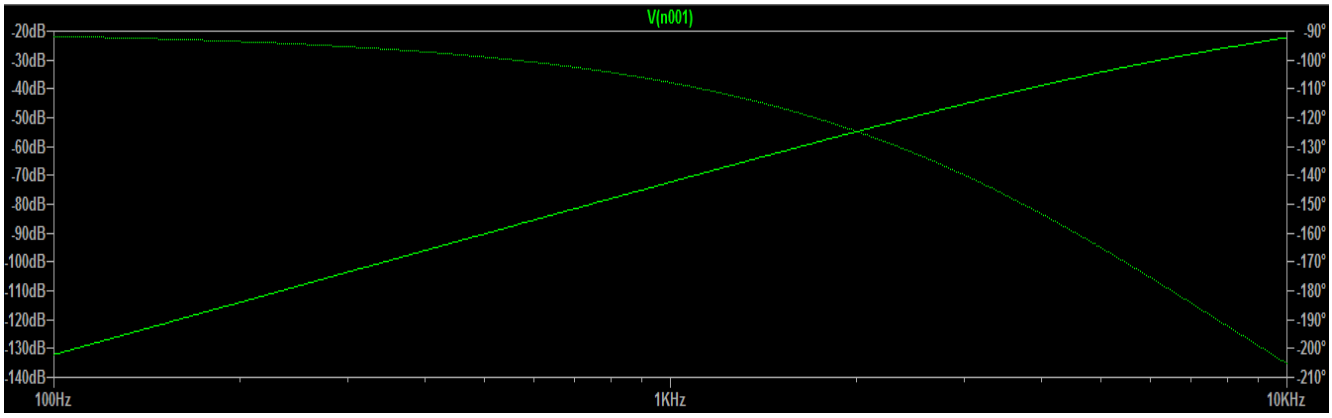
$V_2 = \frac{(\frac{1}{R}jwC + \frac{1}{R})V_1 + jwCV_5}{(jwC + \frac{1}{R})(3 + \frac{1}{jwCR})}$

$\Rightarrow \frac{V_1}{V_5} = \frac{1}{1 + \frac{6}{jwCR} + \frac{5}{(jwCR)^2} + (\frac{1}{jwCR})^3}$

$= \frac{1}{1 - \frac{5}{(wCR)^2} - j(\frac{6}{wCR} - \frac{1}{(wCR)^3})}$

2.



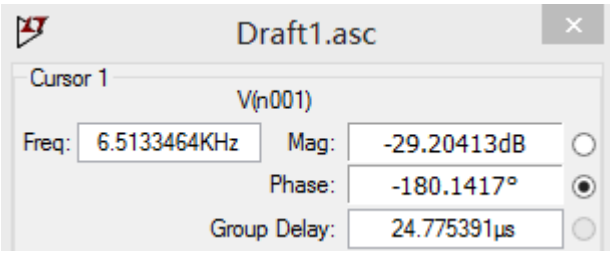


3.

Car $\varphi = -\arctan\left[\frac{6(wCR)^2-1}{(wCR)^3-5wCR}\right] = -\pi$

$\Rightarrow w = \frac{1}{\sqrt{6}CR} \Rightarrow f_0 = \frac{w}{2\pi} = \frac{1}{2\pi\sqrt{6}CR} \simeq 6497.5Hz$

$A = \frac{1}{|B|} = 29$



En pratique, f0=6.5khz,A=29.2.Cela est similaire aux valeurs théoriques.

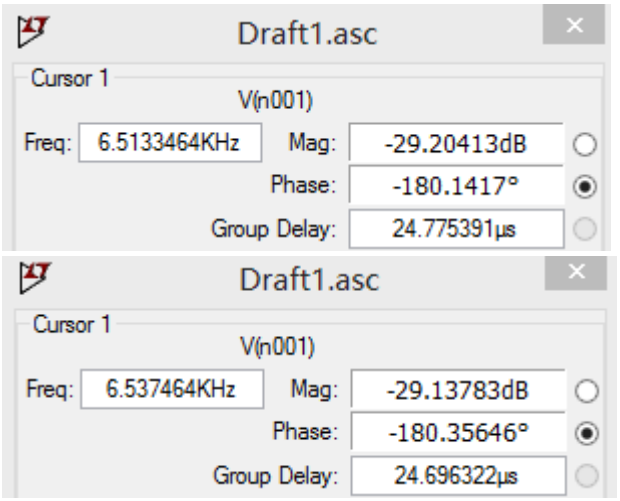
4.

Théoriquement:

$$d\varphi = -\frac{1}{1+\left[\frac{6(\omega CR)^2-1}{(\omega CR)^3-5\omega CR}\right]^2} \times \frac{12\omega CR((\omega CR)^3-5\omega CR)-(3(\omega CR)^2-5)(6(\omega CR)^2-1)}{((\omega CR)^3-5\omega CR)^2} \times CR\,d\omega$$

$$\Rightarrow \frac{d\varphi}{d\frac{\omega}{\omega_0}}\Big|_{\omega=\omega_0} = \frac{-12\omega CR}{(\omega CR)^3-5\omega CR} \times CR\omega\Big|_{\omega=\omega_0} = \frac{12\sqrt{6}}{29} \simeq 1.01$$

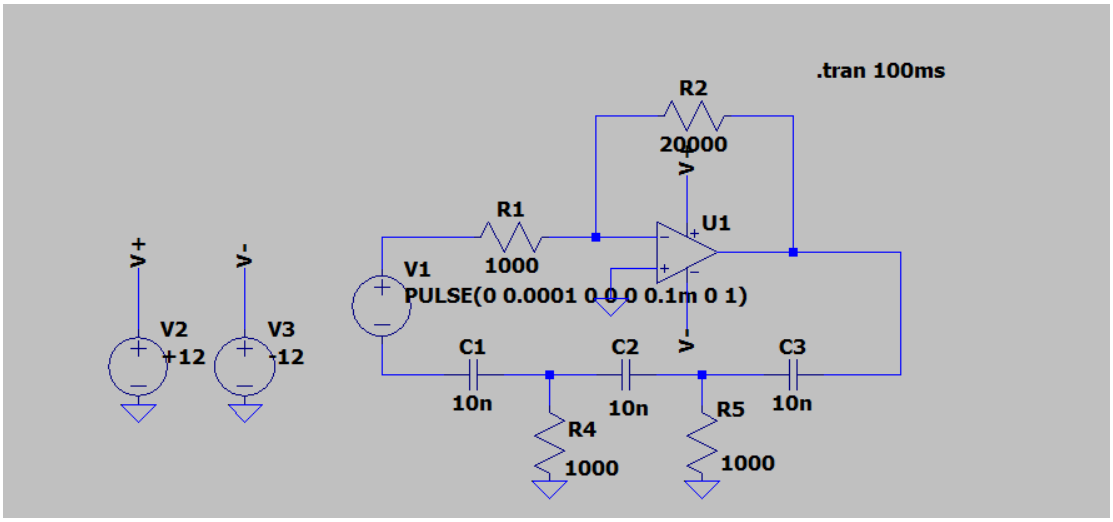
En pratique, on peut fixer un autre point et utiliser la valeur de fréquence et d'amplitude des deux points pour calculer la pente.



$$\left|\frac{d\varphi}{d\frac{\omega}{\omega_0}}\Big|_{\omega=\omega_0}\right| = \left|\frac{\omega_0}{2\pi}\frac{d\varphi}{df}\right| = \left|\frac{\omega_0}{2\pi}\frac{(-180.1417+180.35646)/180\times\pi}{6513.3464-6537.464}\right| = 1.0098$$

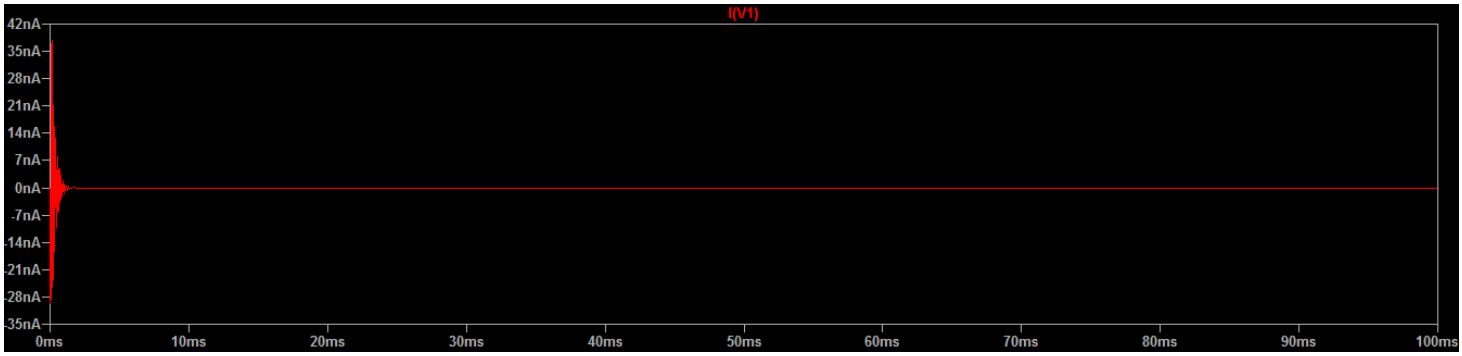
Donc la valeur théorique et celle de pratique sont très proches.

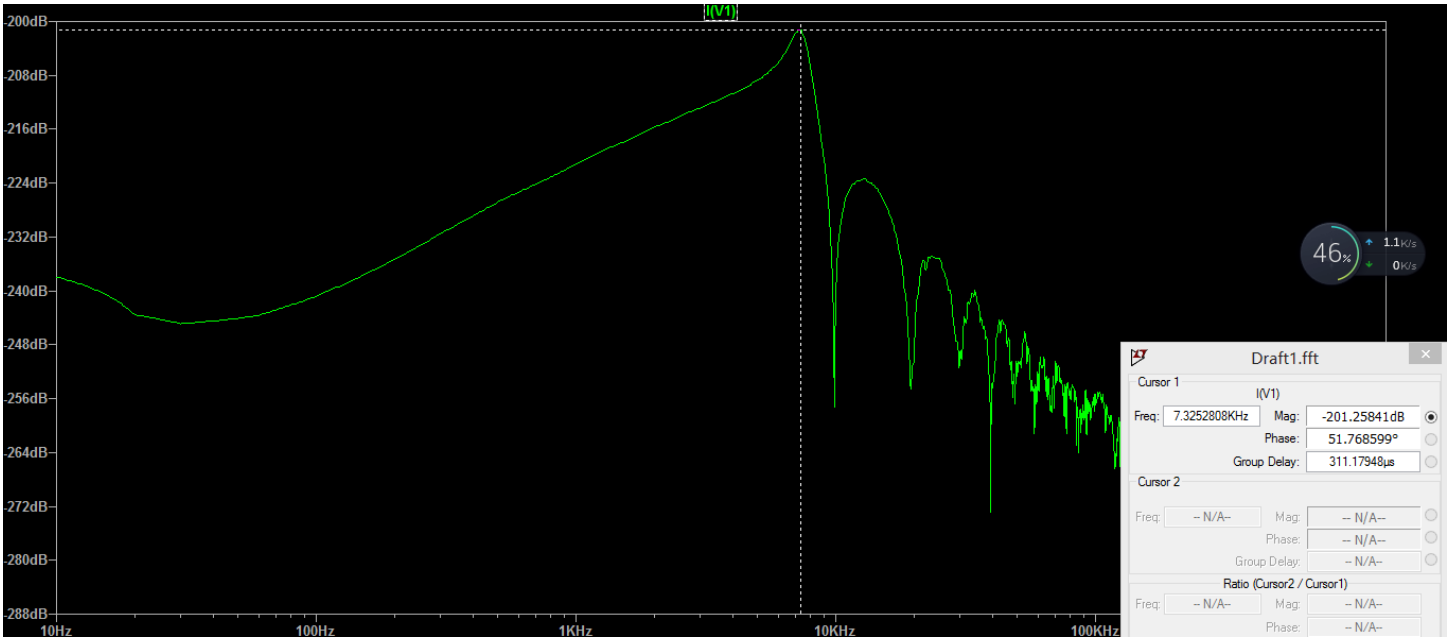
5.



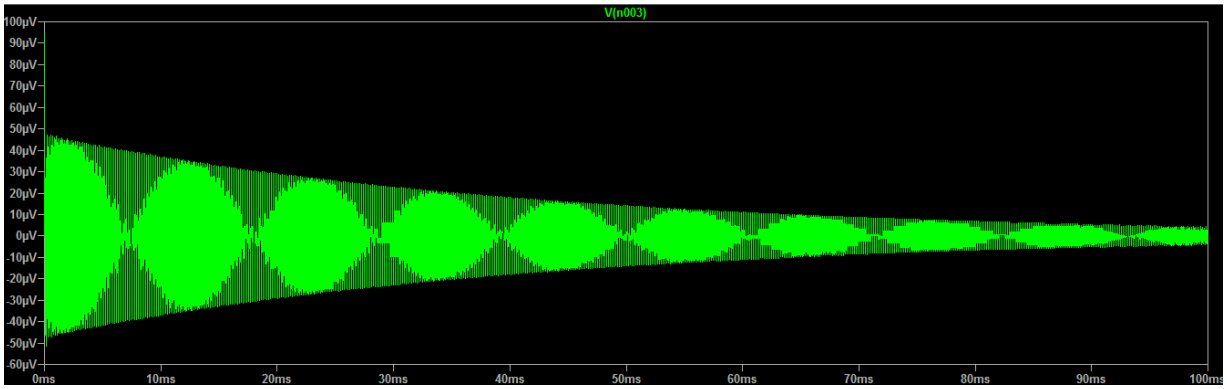
6.

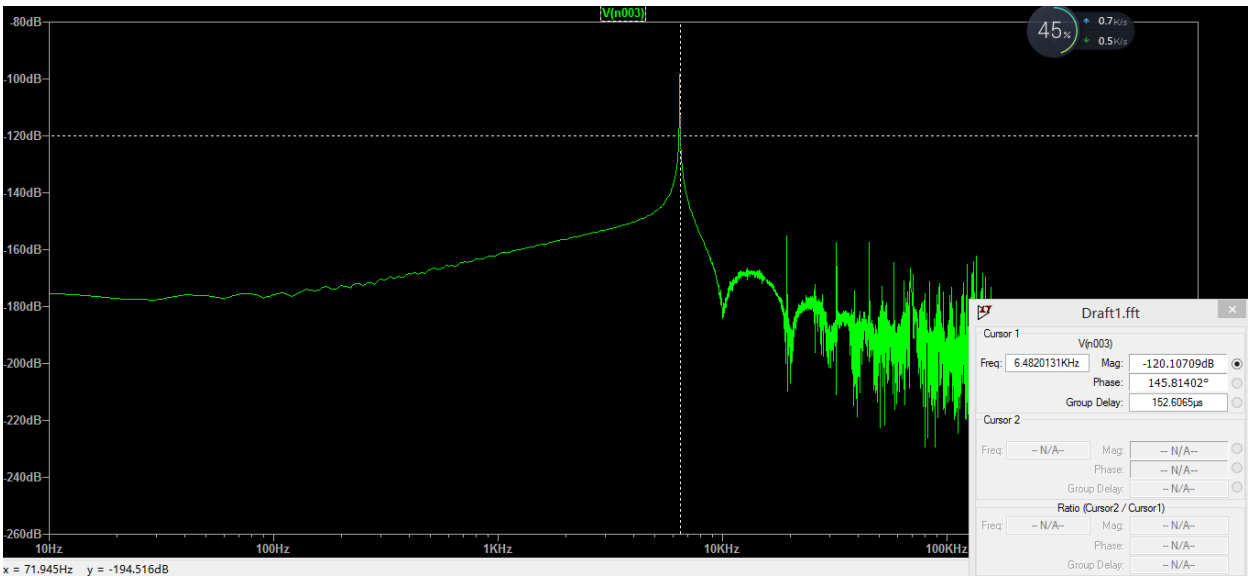
Quand R2=20k, Aβ<1, la figure est comme cela:





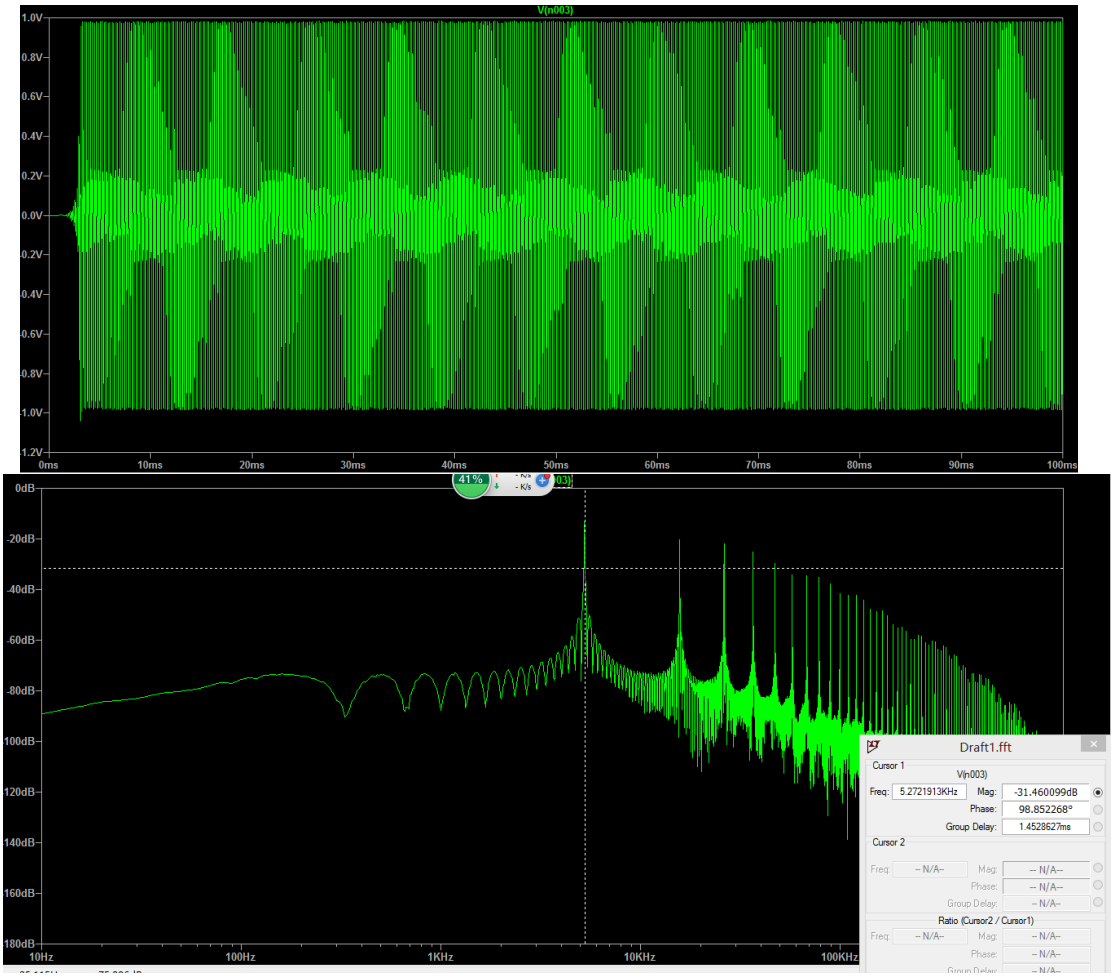
Quand R2=29k, Aβ=1, la figure est comme cela:



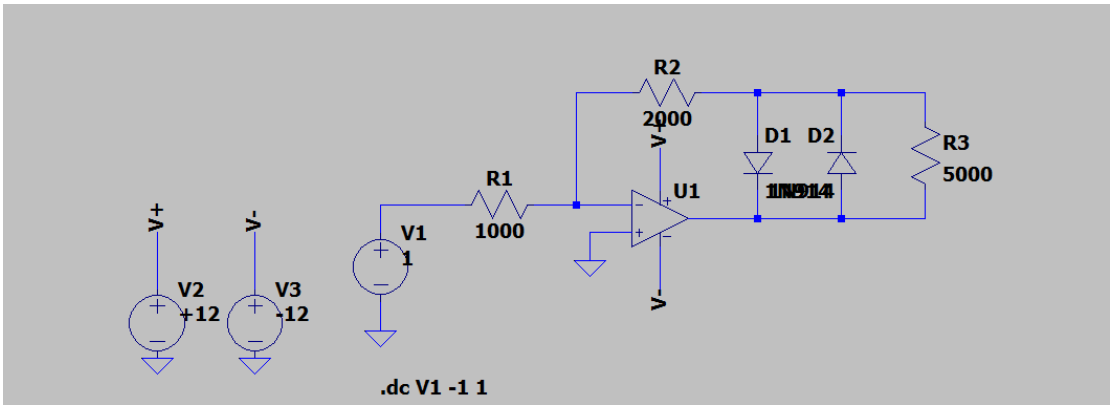


On peut voir que f=6.48k≈6.5k=f0.

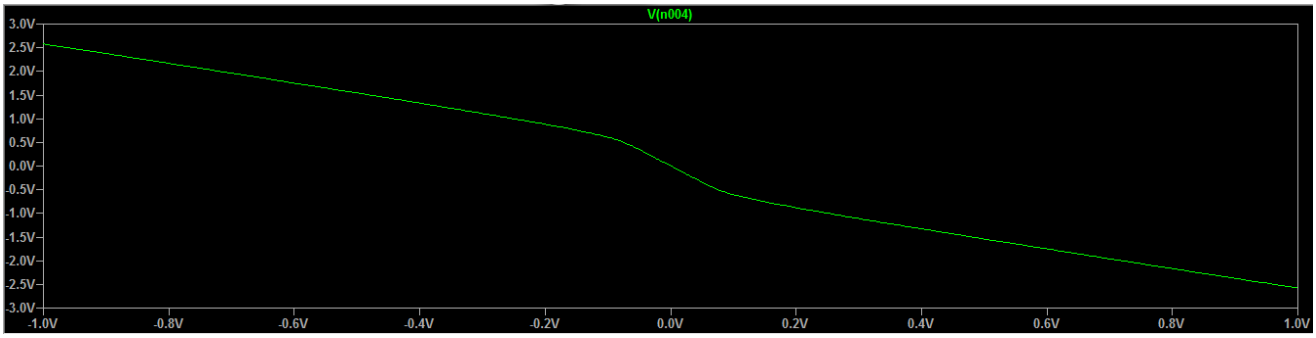
Quand R2=50k,Aβ>1, la figure est comme cela:



7.



8.



La relation n'est pas linéaire.