

### Devoir 3

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Q1

$$\dot{i}_1 = \frac{0 - V_1}{R_1} = (V_1 - V_2) j\omega C_1$$

$$\dot{i}_2 = \dot{i}_1 + \dot{i}_3 = (V_2 - V_3) j\omega C_2$$

$$\dot{i}_3 = \frac{V_2}{R_2}$$

$$\dot{i}_4 = \dot{i}_2 + \dot{i}_5 = (V_3 - V_5) j\omega C_3$$

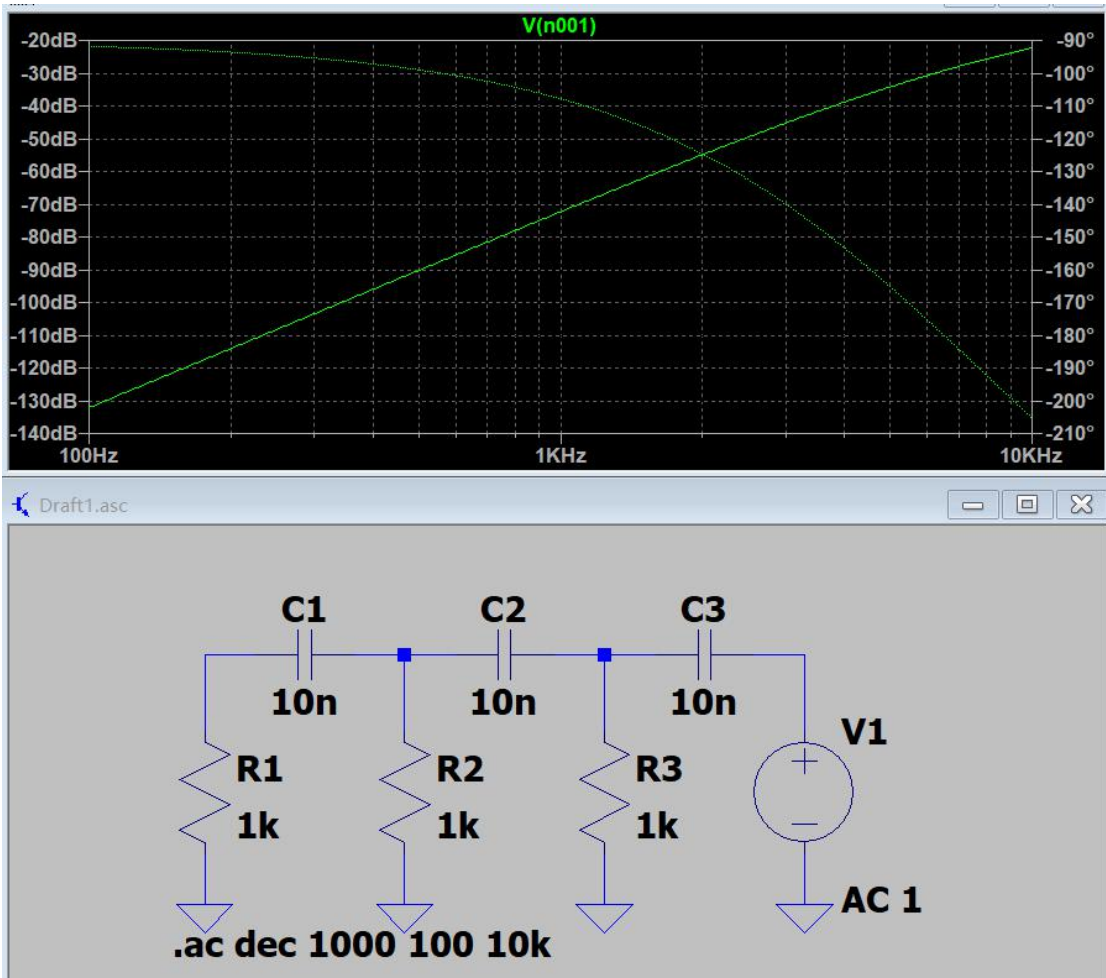
$$\dot{i}_5 = \frac{V_3}{R_4}$$

on a  $R_1 = R_2 = R_3 = R_4 = R = 1k\Omega$  .  $C_1 = C_2 = C_3 = C = 10nF$

$\Rightarrow V_2 = V_1 \left(1 + \frac{1}{j\omega RC}\right)$   
 $V_3 = \frac{V_1}{j\omega RC} + V_1 \left(1 + \frac{1}{j\omega RC}\right)^2$   
 $V_5 = \frac{V_1}{j\omega RC} \left(1 + \frac{1}{j\omega RC}\right) + V_1 \left(1 + \frac{1}{j\omega RC}\right)^3 + \frac{V_1}{(j\omega RC)^2}$

$$\beta(j\omega) = \frac{V_1}{V_5} = \frac{1}{1 - \frac{5}{(\omega RC)^2} - j\left(\frac{6}{\omega RC} - \frac{1}{(\omega RC)^3}\right)}$$

Q2



### Q3

On sait que  $f_0 = \frac{1}{2\pi\sqrt{6}RC} = 6497.47\text{Hz}$ ,  $A = -\frac{1}{|\beta(j\omega)|} = -29$

Dans la simulation :

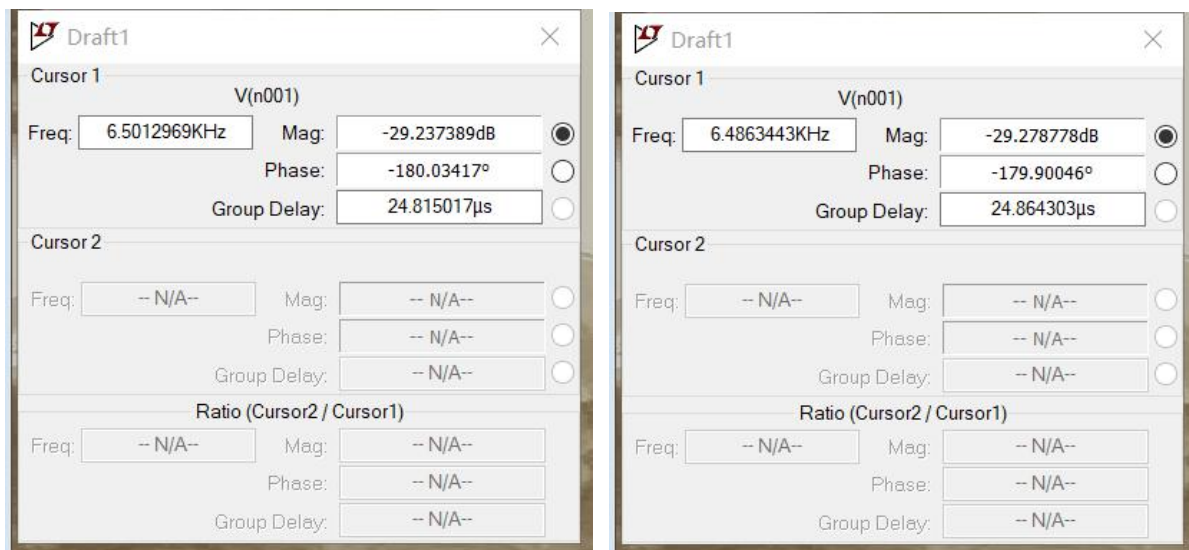


En  $-180.03^\circ$ ,  $f_0=6501.30\text{Hz}$ ,  $A=-29.24$

### Q4

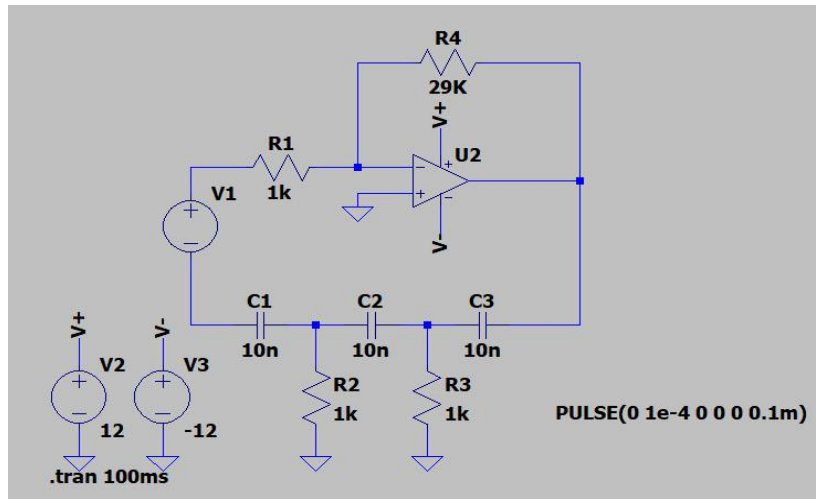
Dans le cours,  $S(w_0) \frac{12}{29} \sqrt{6} \approx 1.01$

Dans la simulation, on prend deux points proche de  $-180^\circ$



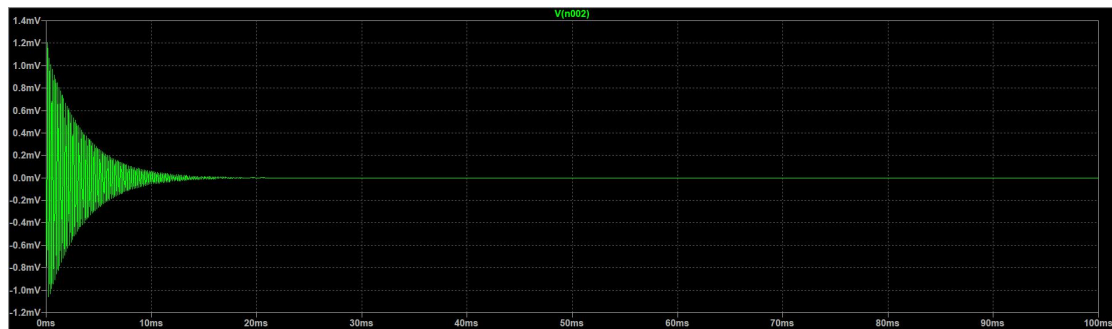
$$S(w_0) = \left| \frac{d\varphi(\beta(j\omega))}{d(w/w_0)} \right|_{w=w_0} = \left| \frac{w_0}{2\pi} \frac{d\varphi}{df} \right|_{f=f_0} = \left| \frac{w_0}{2\pi} \frac{-180.03 + 179.90}{6501.30 - 6486.34} \frac{\pi}{180} \right| = 0.98$$

Q5

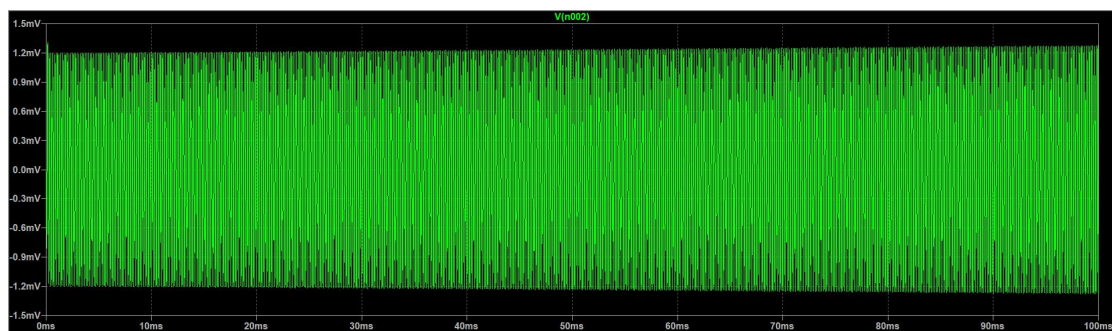


Q6

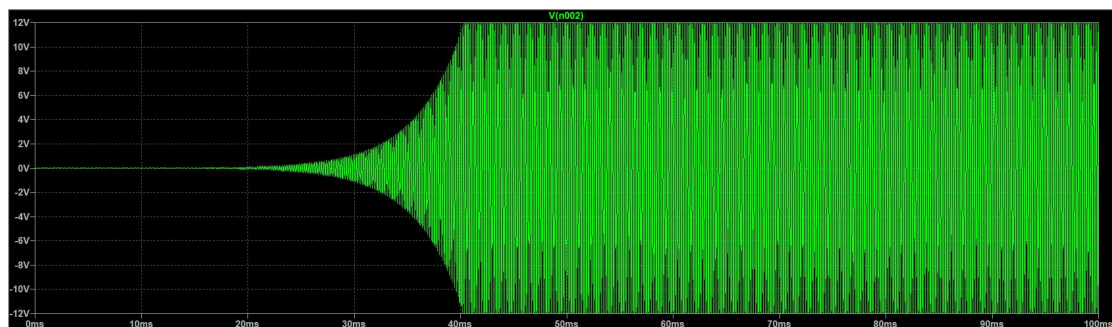
$R4=28K\Omega$ ,  $A\beta < 1$



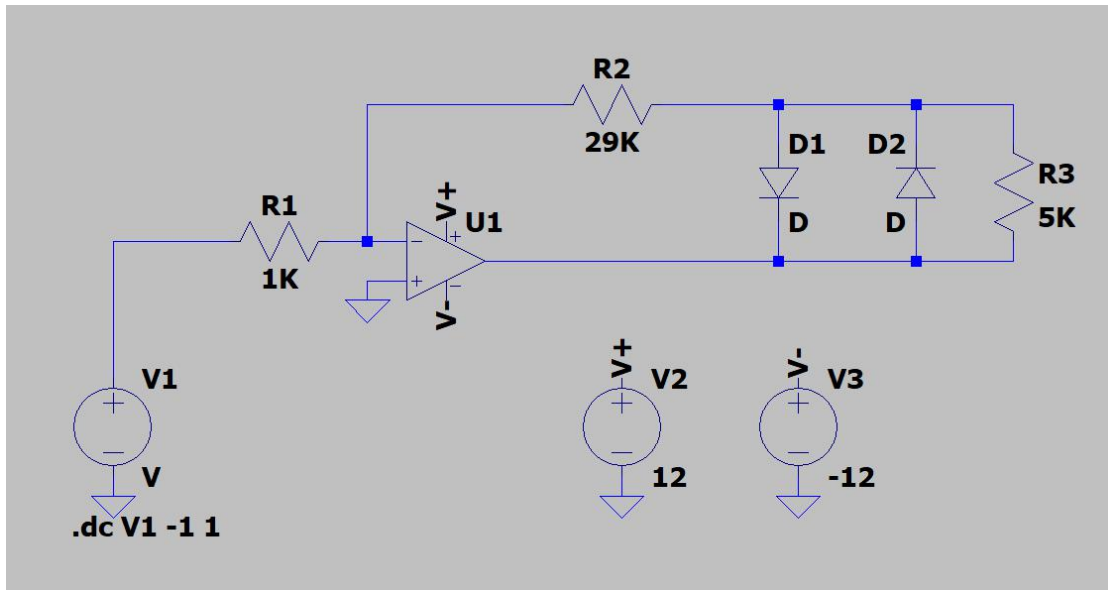
$R4=29.095K\Omega$ ,  $A\beta = 1$



$R4=30K\Omega$ ,  $A\beta > 1$

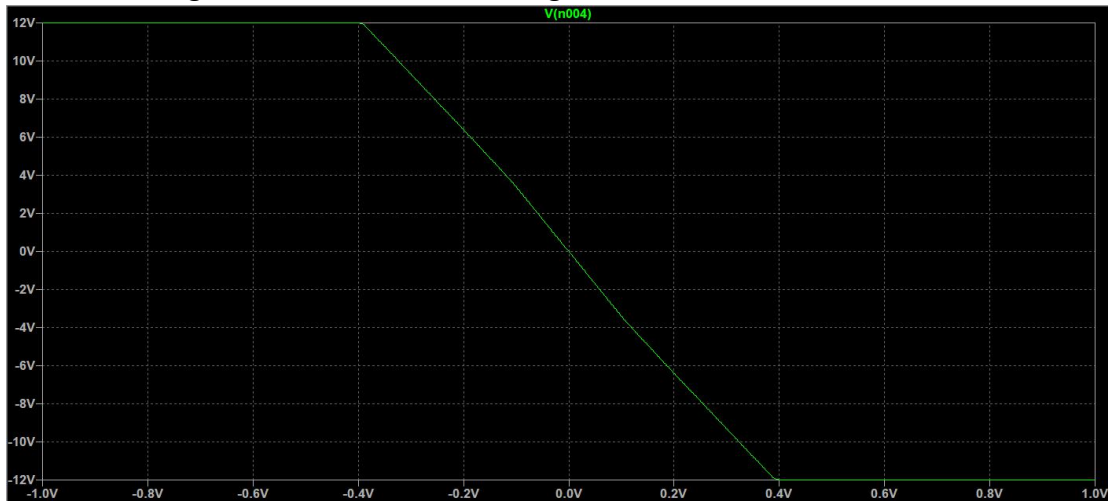


Q7



Q8

Quand R2 est grand, comme R2=29K $\Omega$ , le gain est linéaire



Quand R2 est petit, comme R2=3K $\Omega$ , le gain est non-linéaire

