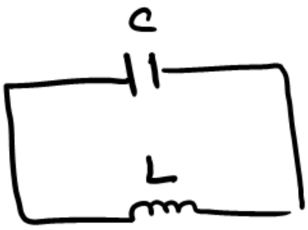
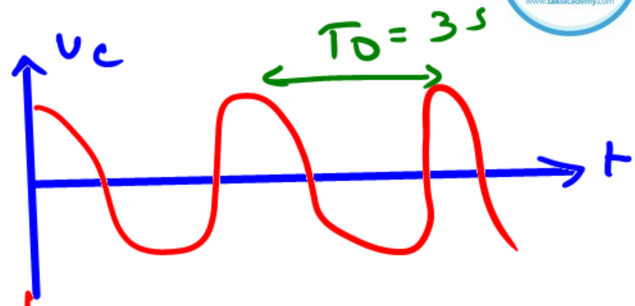
* RLC Libres :





pulsation propre

$$\begin{cases} * \ u_C(t) = U_{Cm} \sin(\omega_0 t + \phi_{u_C}) \\ * \ u_L(t) = U_{Lm} \sin(\omega_0 t + \phi_{u_L}) \end{cases}$$

$$\omega_0 = \frac{1}{\sqrt{LC}} \ ; \ T_0 = \frac{2\pi}{\omega_0} = 3s$$

* RLC Forcées :

$N, \omega, T = 2s$

$\omega_0, T_0 = 3s$ $\quad$ $\omega_0, T_0 = 3s$

* le GBF impose la fréquence des oscillations $\Rightarrow$ oscillations forcées

$$N = \frac{1}{T} = \frac{1}{\frac{2\pi}{\omega}} = \frac{\omega}{2\pi} \Rightarrow \boxed{\omega = 2\pi N}$$

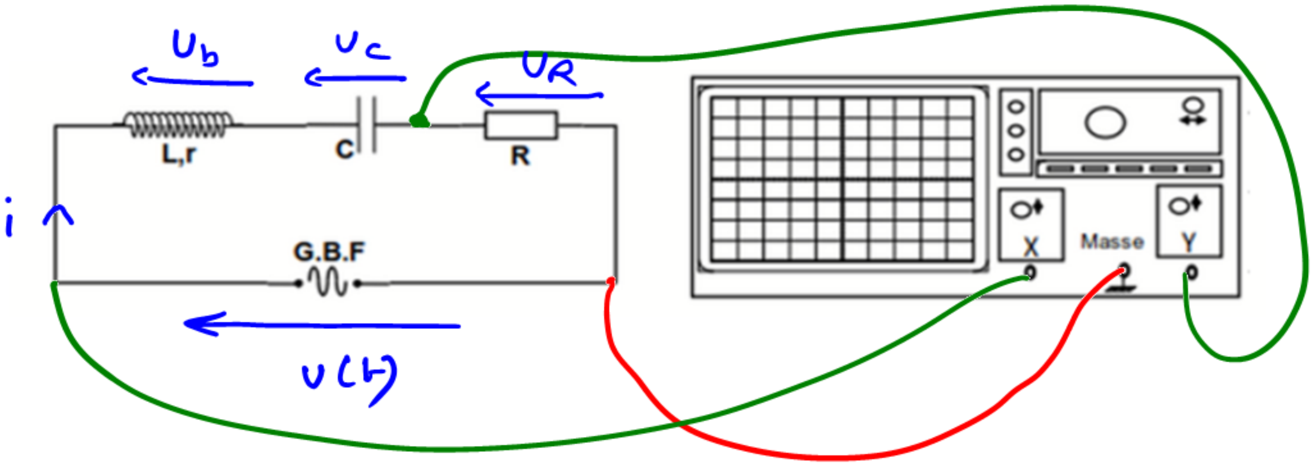
$$u(t) = U_m \sin(\omega t + \phi)$$

$$u_C(t) = U_{Cm} \sin(\omega t + \phi_{u_C})$$

Exercice 1 :

$u(t) = U_m \sin(\underbrace{2\pi N}_{w} t) \Rightarrow \Phi_u = 0$

1)



2) L'excitateur : Le GBF
Le résonateur : le circuit RLC

3) Le GBF impose la fréquence des oscillations.

4) La loi des mailles :

$u_R(t) + u_b(t) + u_c(t) - u(t) = 0$

$Ri + L\frac{di}{dt} + ri + \frac{q}{C} = u(t)$

$$\boxed{(R+r)i + L\frac{di}{dt} + \frac{1}{C}\int i\,dt = u(t)}$$

$i = \frac{dq}{dt} \Rightarrow q = \int i\,dt$

5) a)

$$\boxed{\underbrace{(R+r)\,i}_{\vec{V_1}} + \underbrace{L\frac{di}{dt}}_{\vec{V_2}} + \underbrace{\frac{1}{C}\int i\,dt}_{\vec{V_3}} = \underbrace{u(t)}_{\vec{V_4}}}$$

$$\Rightarrow \vec{V_1} + \vec{V_2} + \vec{V_3} = \vec{V_4}$$

$$* \ (R+r)\,i = \underbrace{(R+r)\,I_m}_{\text{norme}} \sin(\omega t + \underbrace{\phi_i}_{\text{phase}})$$

$$\vec{V_1} \left| \begin{array}{l} (R+r)\,I_m \\ \phi_i \end{array} \right.$$

$$* \ L\frac{di}{dt} = L\frac{d}{dt} I_m \sin(\omega t + \phi_i)$$

$$\frac{d}{dt} \begin{cases} \times \omega \\ +\frac{\pi}{2} \end{cases}$$

$$= L\,I_m\,\omega \sin\left(\omega t + \phi_i + \frac{\pi}{2}\right)$$

$$\vec{V_2} \left| \begin{array}{l} L\,I_m\,\omega \\ \phi_i + \frac{\pi}{2} \end{array} \right.$$

$$\int \begin{cases} \frac{1}{\omega} \\ -\frac{\pi}{2} \end{cases}$$

$$* \ \frac{1}{C}\int i\,dt = \frac{1}{C}\int I_m \sin(\omega t + \phi_i)$$

$$= \frac{I_m}{C\omega} \sin\left(\omega t + \phi_i - \frac{\pi}{2}\right)$$

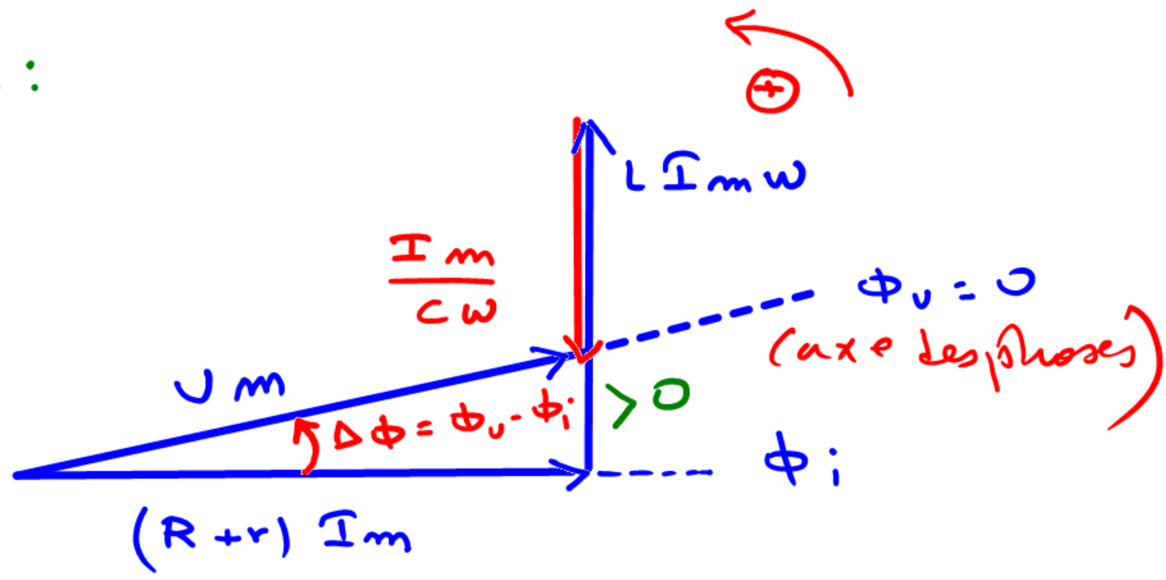
$$\vec{V_3}\ \left|\ \begin{matrix} \dfrac{I_m}{C\omega} \\ \phi_i - \dfrac{\pi}{2} \end{matrix}\right.$$

$$* \quad u(t) = U_m \sin(\omega t)$$

$$\vec{V_4}\ \left|\ \begin{matrix} U_m \\ \phi_u = 0 \end{matrix}\right.$$

$$\vec{V_1}\ \left|\ \begin{matrix} (R+r)\,I_m \\ \phi_i \end{matrix}\right. + \vec{V_2}\ \left|\ \begin{matrix} L I_m \omega \\ \phi_i + \dfrac{\pi}{2} \end{matrix}\right. + \vec{V_3}\ \left|\ \begin{matrix} \dfrac{I_m}{C\omega} \\ \phi_i - \dfrac{\pi}{2} \end{matrix}\right. = \vec{V_4}\ \left|\ \begin{matrix} U_m \\ \phi_u = 0 \end{matrix}\right.$$

1^{er} cas :



$$* \quad L\cancel{I_m}\omega > \frac{\cancel{I_m}}{C\omega} \quad \Rightarrow \quad \omega^2 > \frac{1}{LC} = \omega_0^2$$

$$L\omega > \frac{1}{C\omega}$$

$$\boxed{\omega > \omega_0}$$

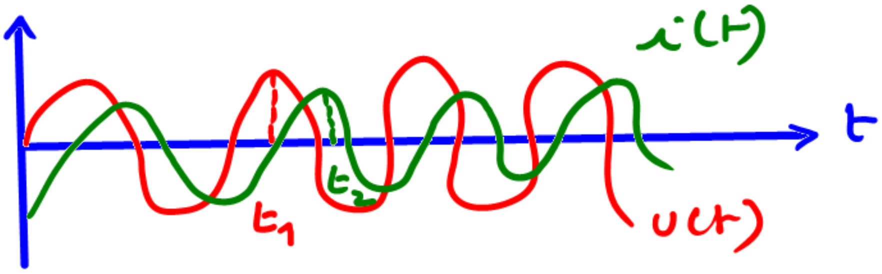
$$L\omega^2 > \frac{1}{C}$$

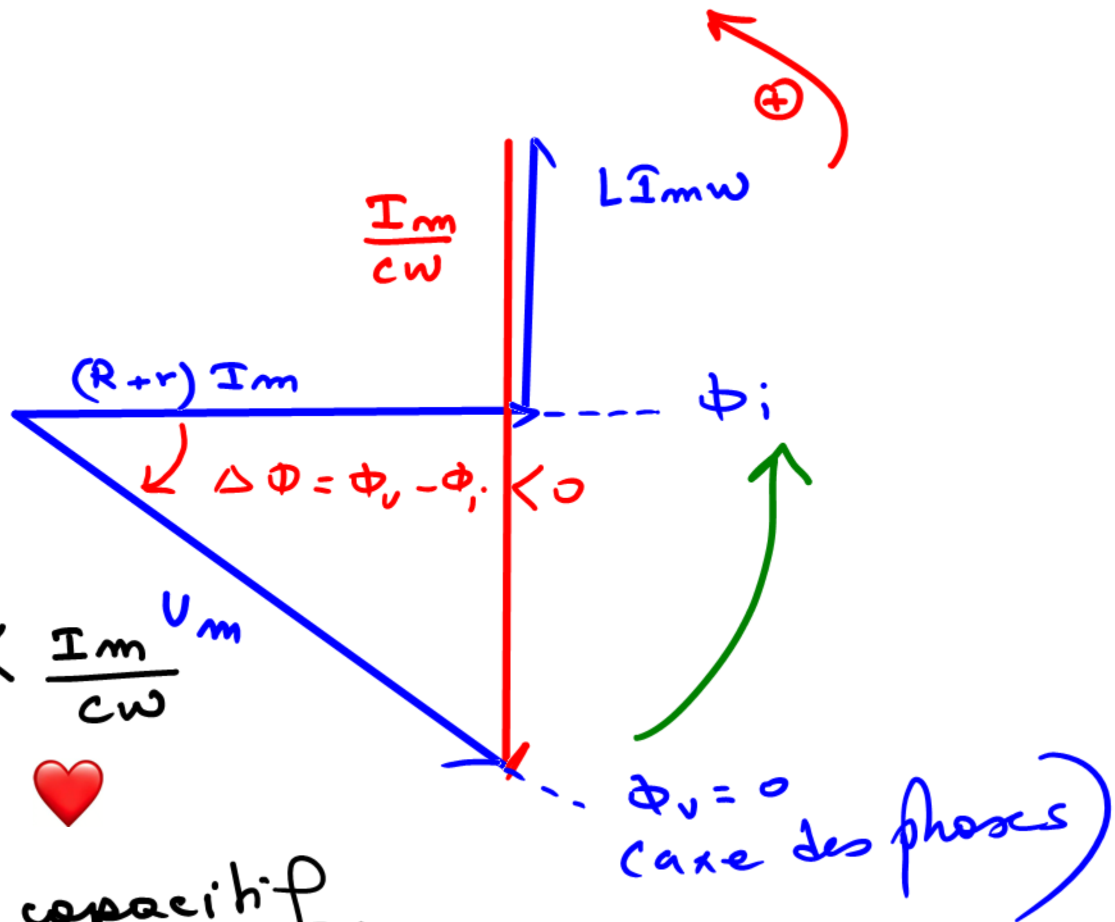
$2\pi N > 2\pi N_0 \Rightarrow \boxed{N > N_0}$

* circuit inductif.

* $\Delta\Phi = \Phi_u - \Phi_i > 0 \Rightarrow \Phi_u > \Phi_i$

déphasage $\Rightarrow$ $u(t)$ est en avance de phase % à $i(t)$





* $LI_m\omega < \dfrac{I_m}{C\omega}$

* $\omega < \omega_0$ ❤️

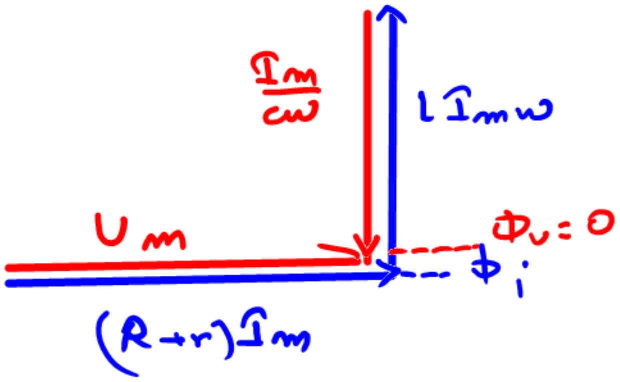
* circuit capacitif.

* $\Delta\Phi = \Phi_u - \Phi_i < 0 \Rightarrow \Phi_u < \Phi_i$

$\Rightarrow$ $i(t)$ est en avance de phase $\%$. à $u(t)$

3ème :

* $L I_m \omega = \dfrac{I_m}{C\omega}$

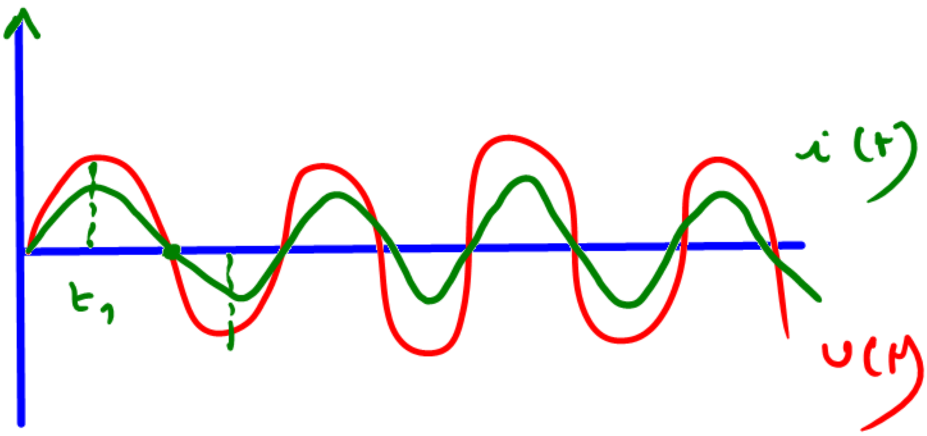


* $\omega = \omega_0$

* circuit résistif

* $i(t)$ et $u(t)$ sont en phase.

$\Delta\Phi = \Phi_u - \Phi_i = 0 \Rightarrow \Phi_u = \Phi_i$



c) D'après pythagore :

$$AC^2 = AB^2 + BC^2$$

$$U_m^2 = \left[(R+r)I_m\right]^2 + \left[L I_m \omega - \frac{I_m}{C\omega}\right]^2$$

$$U_m^2 = I_m^2 \left[(R+r)^2 + \left(L\omega - \frac{1}{C\omega}\right)^2\right]$$

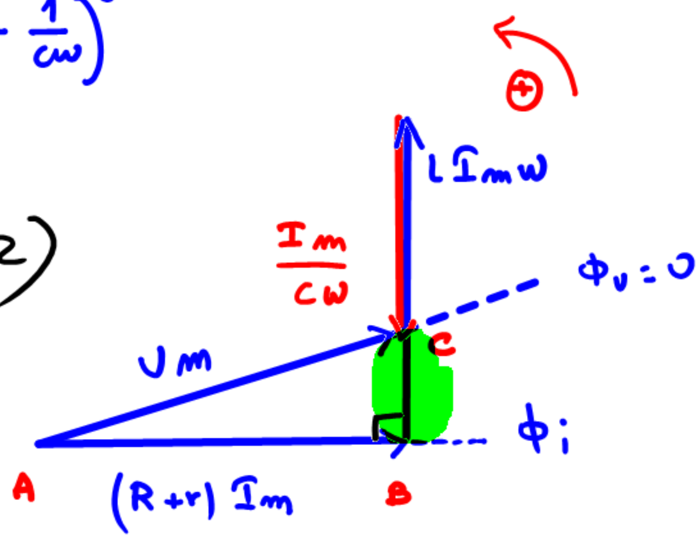
$$I_m^2 = \frac{U_m^2}{\left[(R+r)^2 + \left(L\omega - \frac{1}{C\omega}\right)^2\right]}$$

$$\boxed{I_m = \frac{U_m}{\sqrt{(R+r)^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}}}$$

$$\Rightarrow I_m = \frac{U_m}{Z}$$

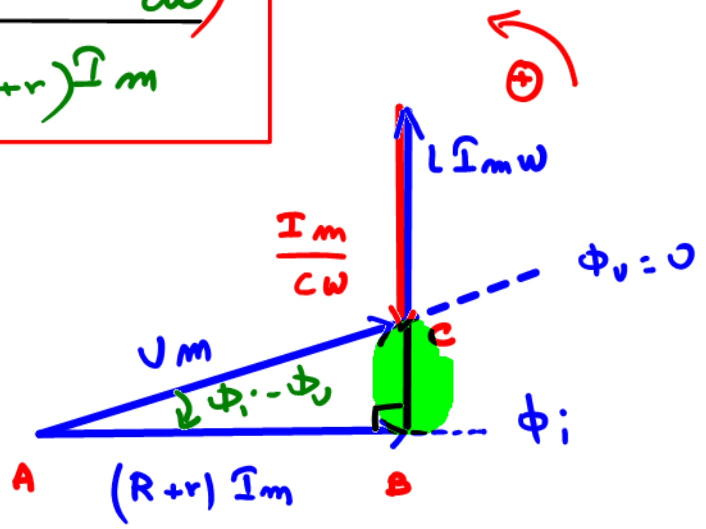
avec $Z = \sqrt{(R+r)^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}$

↳ L'impédance électrique (Ω)



$$\tan(\phi_i - \phi_u) = \frac{opp}{adj} = \frac{-\left(L I_m \omega - \frac{I_m}{C\omega}\right)}{(R+r) I_m}$$

$\Delta\phi < 0$



$$\tan(\phi_u - \phi_i) = \frac{L I_m \omega - \frac{I_m}{C\omega}}{(R+r) I_m}$$

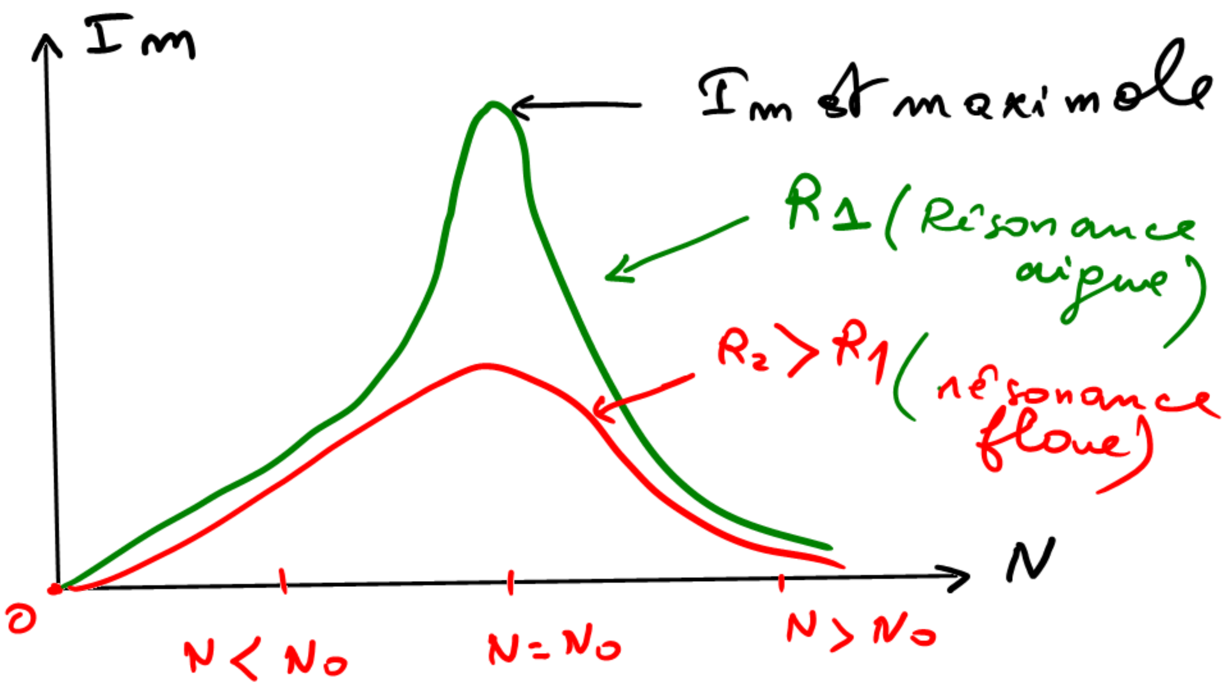
$\Delta\phi > 0$

$$\tan(\phi_u - \phi_i) = \frac{L\omega - \frac{1}{C\omega}}{(R+r)}$$

* $$\cos(\phi_u - \phi_i) = \cos(\phi_i - \phi_u) = \frac{(R+r) I_m}{U_m}$$

$$\cos(\phi_i - \phi_u) = \frac{(R+r) \cancel{I_m}}{Z \cancel{I_m}} = \frac{R+r}{Z}$$

d)



e)

$$\boxed{I_m = \frac{U_m}{\sqrt{(R+r)^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}}}$$

pour $N = N_0$ ($\omega = \omega_0$) $\Rightarrow L\omega = \frac{1}{C\omega}$

$\Rightarrow L\omega - \frac{1}{C\omega} = 0$

$$\Rightarrow \boxed{I_m = \frac{U_m}{R+r}}$$

$$\boxed{Z_r = R + r}$$