suite exercice série 1

6°/ (a) $u(t) \longrightarrow U_m = Z I_m$

$u_R(t) \longrightarrow U_{Rm} = R I_m$

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

$\Rightarrow U_m > U_{Rm}$: la courbe ayant l'amplitude la plus grande correspond à $u(t)$

Donc (a) $\longrightarrow u(t)$; (b) $\longrightarrow u_R(t)$

(b) $\Delta\varphi = \varphi_i - \varphi_u$? $\varphi_i = \varphi_{u_R}$ car $u_R(t) = R\,i(t)$

$\Rightarrow |\varphi_i - \varphi_u| = |\varphi_{u_R} - \varphi_u| = \omega \cdot \Delta t = \frac{2\pi}{T} \frac{T}{6}$

$= \frac{\pi}{3}$ rad

or $u_R(t)$ en retard sur $u(t)$ $\Rightarrow \varphi_i - \varphi_u = -\frac{\pi}{3}$ rad

$\varphi_u - \varphi_i > 0 \longrightarrow$ circuit inductif

(c) $U_m = 10\,V$

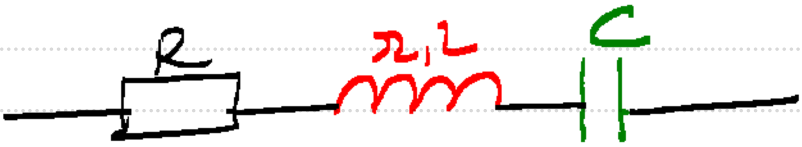
$U_{Rm} = 4\,V$

d) ① $I_m = \frac{U_{Rm}}{R} = \frac{4}{80} \Rightarrow \boxed{I_m = 0{,}05\,A}$

$$\boxed{I = \frac{I_m}{\sqrt{2}} = 3{,}53.10^{-2}\,A}$$

② $Z = \frac{U_m}{I_m} = \frac{10}{0{,}05} \Rightarrow \boxed{Z = 200\,\Omega}$

NB



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

e) $i(t) = I_m \sin(\omega t + \varphi_i)$

$\omega = 2\pi N_1 = 2189{,}25\ rad\,s^{-1}$

$\varphi_i = -\frac{\pi}{3}$ rad ($\varphi_u = 0$)

d'où $\boxed{i(t) = 0{,}05 \sin\left(2189{,}25\,t - \frac{\pi}{3}\right)}$

$$\boxed{u(t) = 10 \sin(2189{,}25\,t)}$$

(4) f-1

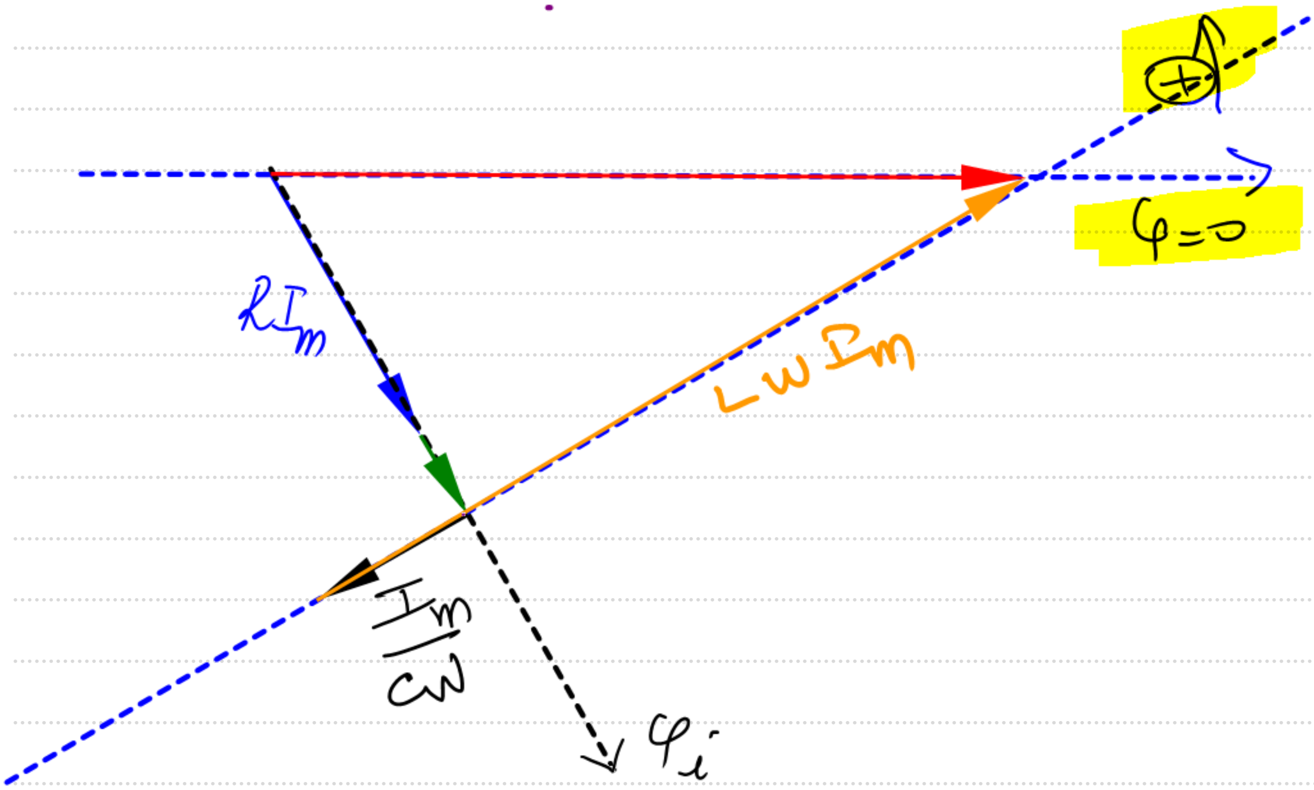
$Ri(t) \longrightarrow \begin{cases} RI_m = 4V \\ \varphi_i = \cancel{-\frac{\pi}{3}} \; ? \end{cases}$

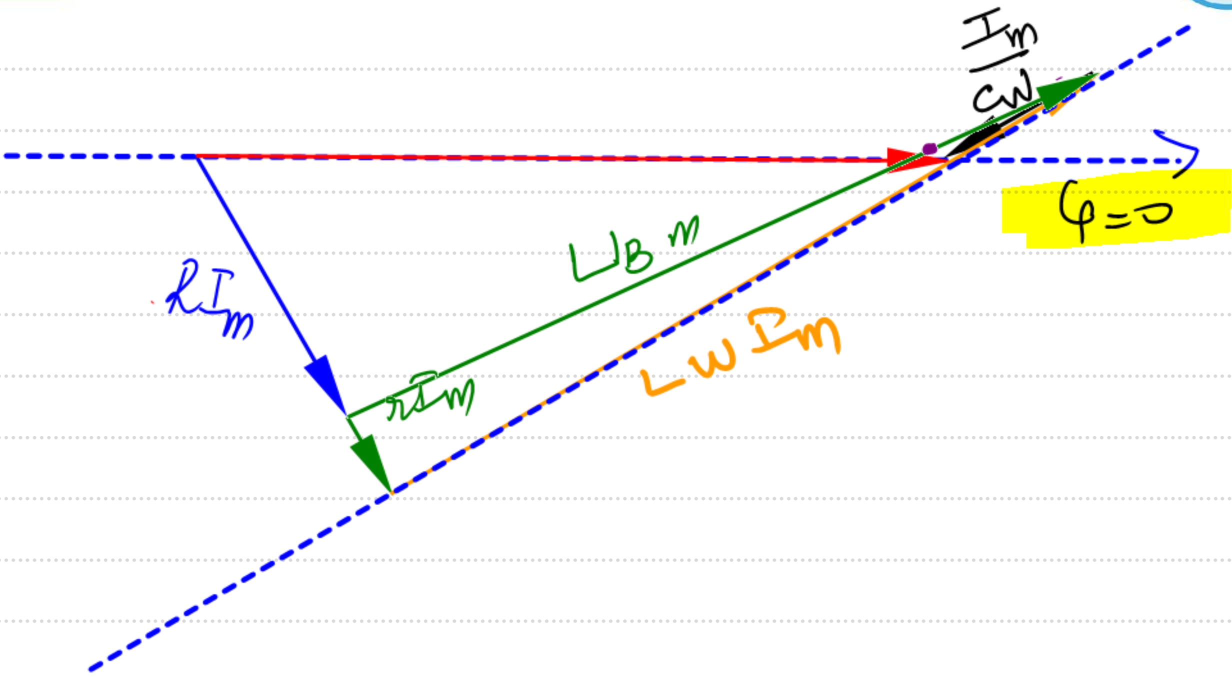
$r\,i(t) \longrightarrow \begin{cases} rI_m \; ? \\ \varphi_i \end{cases}$

$L\frac{di}{dt} \longrightarrow \begin{cases} L\omega I_m \; ? \\ \varphi_i + \frac{\pi}{2} \end{cases}$

$\frac{1}{C}\int i \longrightarrow \begin{cases} \frac{I_m}{C\omega} = U_{cm} = 2{,}28V \\ \varphi_i - \frac{\pi}{2} \end{cases}$

$u(t) \longrightarrow \begin{cases} U_m = 10V \\ \varphi_u = 0 \end{cases}$





f②: ⊙ $rI_m \longrightarrow 1\,cm \Rightarrow rI_m = 1\,V$

$r = \frac{1}{I_m} \Rightarrow \boxed{r = 20\,\Omega}$

⊙ $L\omega I_m \longrightarrow 11\,cm \Rightarrow L\omega I_m = 11\,V$

$\Rightarrow L = \frac{11}{\omega I_m} \Rightarrow \boxed{L = 0{,}1\,H}$

⊙ $U_{cm} = \frac{I_m}{C\omega} \Rightarrow \boxed{C = \frac{I_m}{U_c\,\omega} = 10^{-5}\,F}$

f⑦ $u_c = U_{cm}\sin(\omega t + \varphi_{u_c})$

or $\varphi_i = \varphi_{u_c} + \frac{\pi}{2} \Rightarrow \varphi_{u_c} = \varphi_i - \frac{\pi}{2}$

$\varphi_{u_c} = -\frac{5\pi}{6}\,rad$

$\boxed{u_c(t) = 2{,}28\sin\left(2189{,}25t - \frac{5\pi}{6}\right)}$

$u_B(t) = U_{Bm} \sin(2189{,}25t + \varphi_{u_B})$ $\left(u_B(t) = ri(t) + L\frac{di}{dt}\right)$

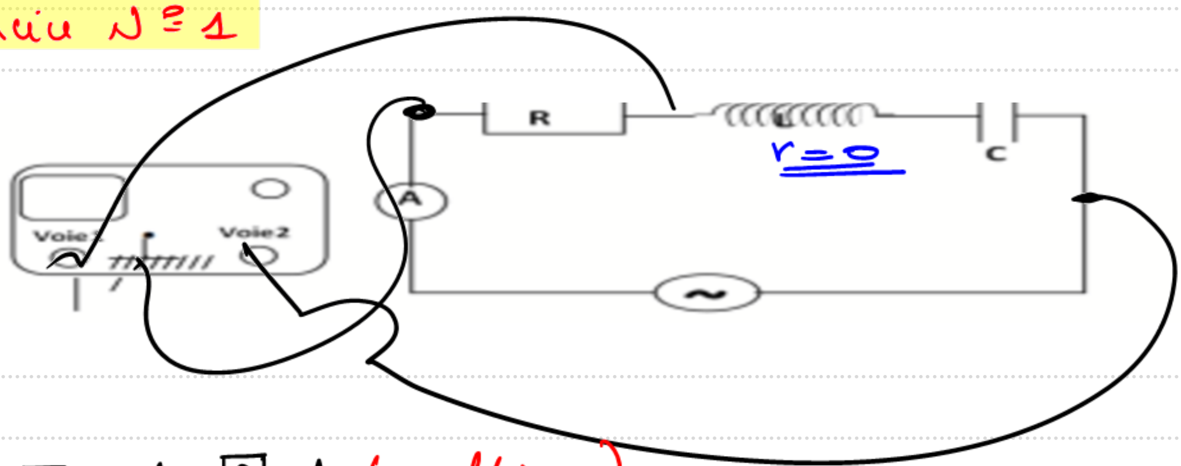
Construction $\begin{cases} U_{Bm} \longrightarrow 11\text{ cm} \Rightarrow U_{Bm} = 11\text{ V}. \\ \varphi_{u_B} = 25° = \frac{25\pi}{180} = 0{,}436\text{ rad} \end{cases}$

$$\boxed{u_B(t) = 11 \sin(2189{,}25t + 0{,}436)}$$

Oscillations électriques forcées : Série 2

Exercice N°1

1°)



2°) $I = 10\sqrt{2}\text{ mA}$ (efficace)

a) $u(t) \longrightarrow U_m = Z I_m = \sqrt{R^2 + (L\omega - \frac{1}{C\omega})^2}\, I_m$

$u_R(t) \longrightarrow U_{Rm} = R I_m.$

$\omega \neq \omega_0 \Longrightarrow Z I_m > R I_m \Rightarrow U_m > U_{Rm}$

Courbe ① $\longrightarrow u(t)$ (même sensibilité)

② $\longrightarrow u_R(t)$

b) $N_1 = \frac{1}{T_1} = \frac{1}{6\,10^{-3}} \Rightarrow \boxed{N_1 = 166{,}66\,Hz}$

$\omega_1 = 2\pi N_1 \Rightarrow \boxed{\omega_1 = 333{,}3\pi\ rad\,s^{-1}}$

c) $U_m = 4V \qquad U_{R_m} = 2V.$

d) $\varphi_i - \varphi_u$? $u_R(t) = R\,i(t) \Rightarrow \varphi_i = \varphi_{u_R}$

$|\varphi_i - \varphi_u| = |\varphi_{u_R} - \varphi_u| = \frac{2\pi}{T}\,\frac{T}{6} = \frac{\pi}{3}\,rad$

or $u_R(t)$ en avance sur $u(t)$

d'où $\boxed{\varphi_i - \varphi_u = \frac{\pi}{3}\,rad}$

e) $Z = \frac{U_m}{I_m}$ or $\boxed{I_m = I\sqrt{2} = 0{,}02A}$

$\Rightarrow Z = \frac{4}{0{,}02} = 200\,\Omega$

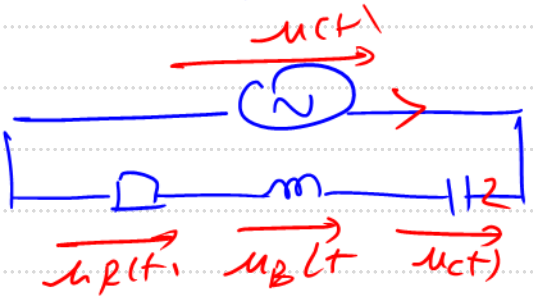
$\boxed{R = \frac{U_{R_m}}{I_m} = 100\,\Omega}$

NB

$U = \frac{U_m}{\sqrt{2}}$ — voltmètre — cours

$I = \frac{I_m}{\sqrt{2}}$ — Ampèremètre — cours

3°/ a)



Loi des mailles $u_R(t) + u_B(t) + u_C(t) - u(t) = 0$

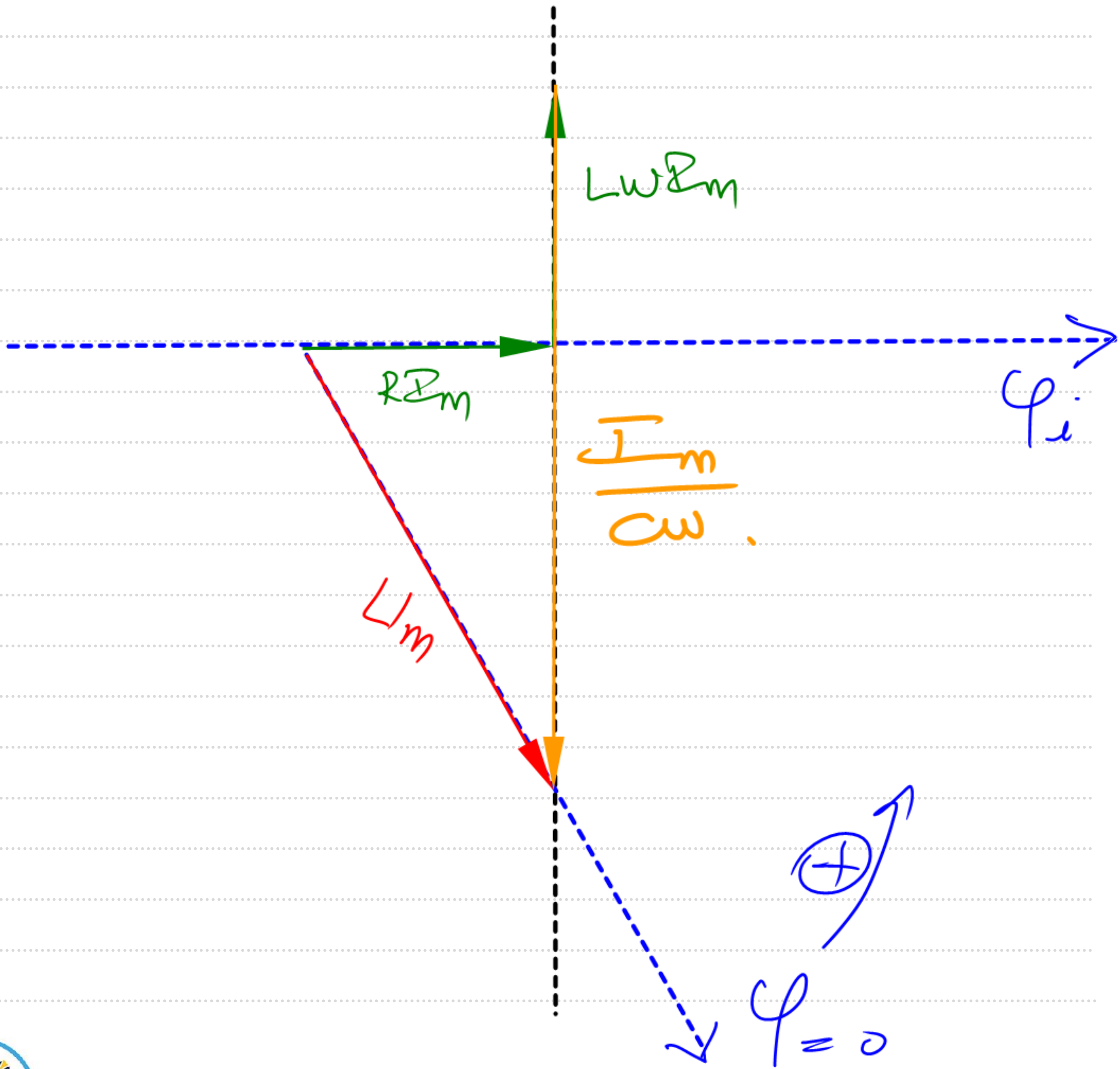
$$\boxed{R\,i(t) + L\frac{di(t)}{dt} + \frac{1}{C}\int i(t)\,dt = u(t)}$$

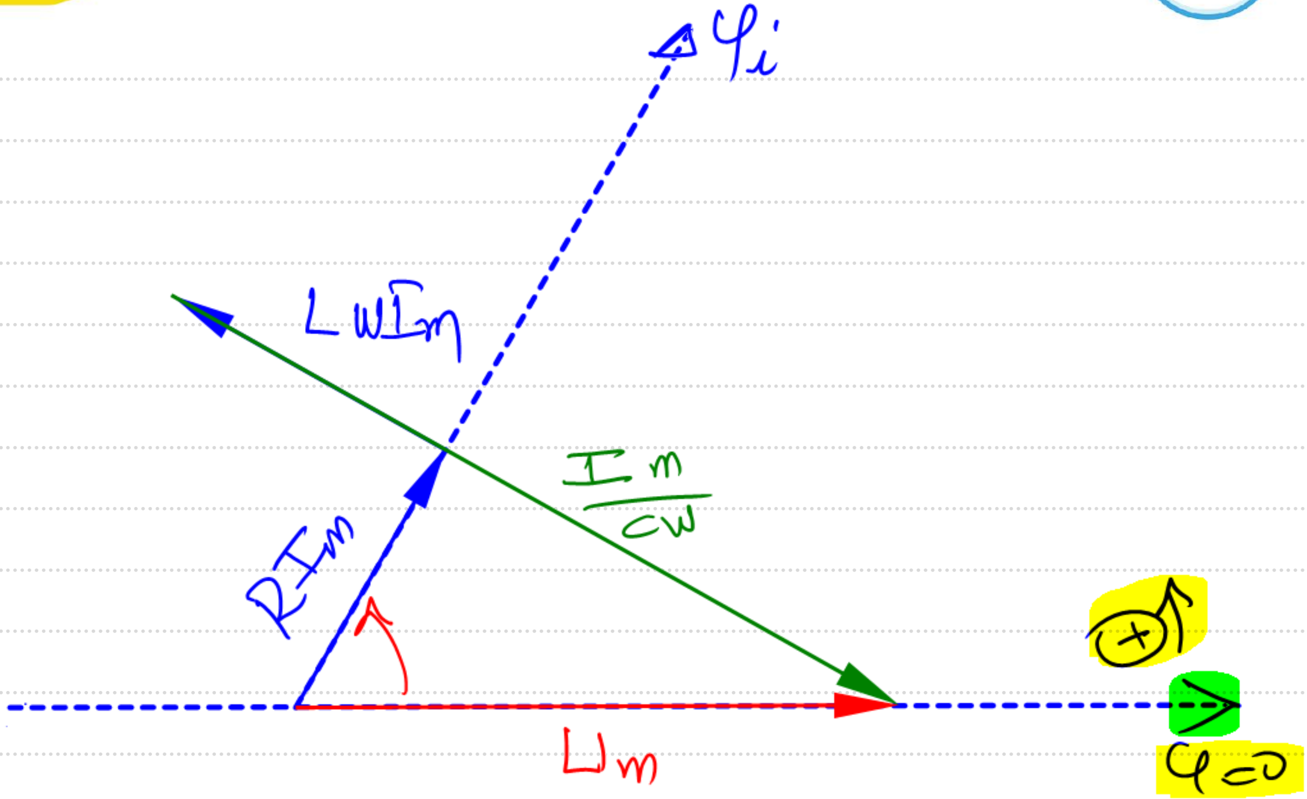
b) $Ri(t) \longrightarrow \begin{cases} RI_m = 2V \rightarrow 4cm \\ \varphi_i = \frac{\pi}{3} \end{cases}$

$L\frac{di}{dt} \longrightarrow \begin{cases} L\omega I_m = 2,1V \rightarrow 4,2cm \\ \varphi_i + \frac{\pi}{2} \end{cases}$

$\frac{1}{C}\int i\,dt \longrightarrow \begin{cases} \frac{I_m}{C\omega_1} \; ? \\ \varphi_i - \frac{\pi}{2} \end{cases}$

$u(t) \longrightarrow \begin{cases} U_m = 4V \rightarrow 8cm. \\ \varphi_u = 0 \end{cases}$





$\frac{I_m}{C\omega_1} \longrightarrow 11\ cm \Rightarrow \frac{I_m}{C\omega_1} = 5{,}5\ V$

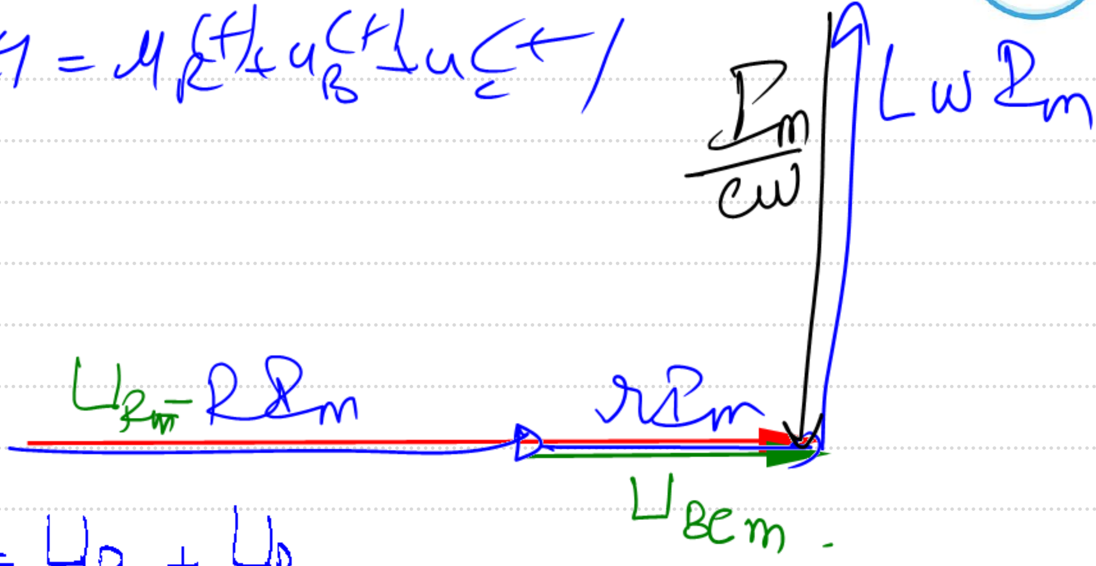
$\Rightarrow C = \frac{I_m}{5{,}5\ \omega_1}$ $\quad C = 3{,}47 \cdot 10^{-6}\ F$

4°/ cons Resonance d'intensité
$\begin{cases} I_m \text{ st max} \\ N = N_0 \begin{cases} \omega = \omega_0 \\ L\omega = \frac{1}{C\omega} \end{cases} \\ \varphi_u - \varphi_i = 0 \\ Z = R + r \\ \mathcal{P}_m \text{ st max} \end{cases}$

$$\boxed{\mathcal{P}_m = \frac{U_m I_m}{2} \underbrace{\cos(\varphi_u - \varphi_i)}_{\text{facteur de puissance}}\ (W)}$$

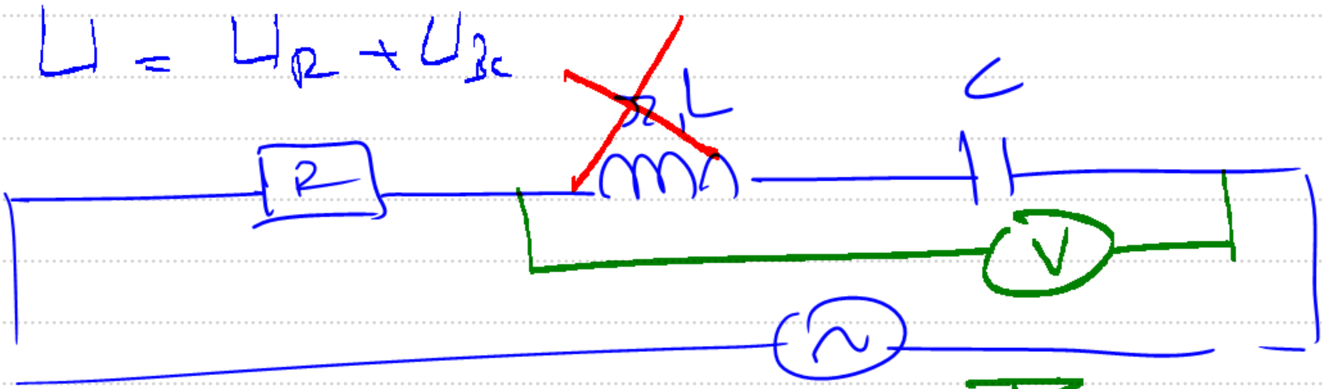
NB $\cos(\varphi_u - \varphi_i) = \frac{R + r}{Z}$

$$u(t) = u_R(t) + u_B(t) + u_C(t)$$



$$U_m = U_{Rm} + U_{BCm}$$

$$U = U_R + U_{BC}$$



$$U_{BC} = Z_{BC}\, I$$
$$= r\, I$$

4°/ a) $\varphi_u - \varphi_i = 0$ le circuit est en état de résonance d'intensité

b) A la résonance d'intensité

$$N = N_0 = \frac{1}{2\pi\sqrt{LC}} = 270,18\ Hz$$

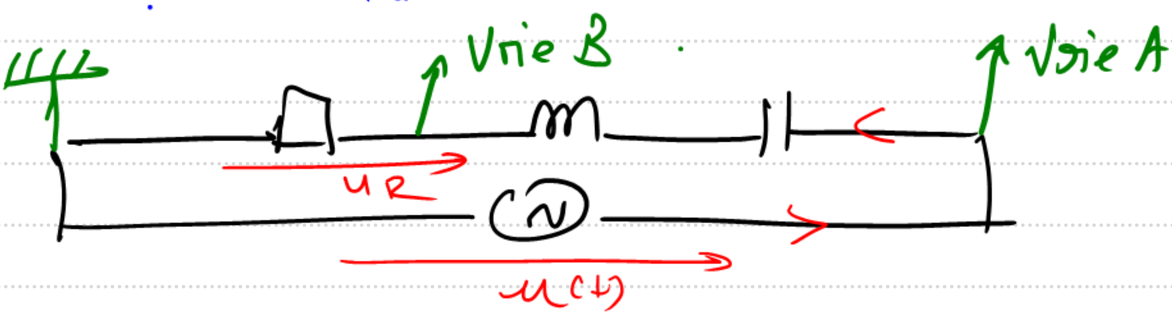
c) $I_0 = \frac{I_{mr}}{\sqrt{2}}$ or $I_{mr} = \frac{U_m}{Z_r} = \frac{U_m}{R}$

$$\Rightarrow \boxed{I_0 = \frac{U_m}{\sqrt{2}\, R} = \frac{4}{\sqrt{2} \times 100} = 0,028A}$$

Exercice N°2 $R = 100\,\Omega$ $L = 0{,}51\,H$ $C\,?$

$r\,?$ $\varphi_u = 0$

1°)



(a) $u(t) \longrightarrow U_m = 2\,I_m = \sqrt{\frac{R^2}{T} + \left(L\omega - \frac{1}{C\omega}\right)^2}\, I_m$

$u_R(t) \longrightarrow U_{Rm} = R\,I_m$

$\Rightarrow 2\,I_m > R\,I_m$

Courbe $C_1 \longrightarrow u(t)$

" $C_2 \longrightarrow u_R(t)$

(b) $N = \frac{1}{T} = 125\,Hz$

(c) $I_m = \frac{U_{Rm}}{R} = 0{,}02\,A \longrightarrow I = \frac{I_m}{\sqrt{2}} = 0{,}014\,A$

(d) $|\varphi_u - \varphi_{u_R}| = |\varphi_u - \varphi_i|$ car $u_R = R\,i$

$\Rightarrow |\varphi_u - \varphi_i| = \frac{2\pi}{T} \times \frac{T}{8} = \frac{\pi}{4}$ rad

or $u(t)$ en avance de phase sur $u_R(t)$

$\varphi_u - \varphi_i = \frac{\pi}{4}$ rad

circuit inductif car $\varphi_u - \varphi_i > 0$

3°) a) $Z = \frac{U_m}{I_m}$ et $I_m = \frac{U_{Rm}}{R}$

$$\boxed{Z = \frac{R\,U_m}{U_{Rm}}}$$

b) $$\boxed{\cos(\varphi_u - \varphi_i) = \frac{R + r}{Z}}$$ formule de cours.

$\varphi_u - \varphi_i = \frac{\pi}{4} \Rightarrow \frac{1}{\sqrt{2}} = \frac{R + r}{\frac{R\,U_m}{U_{Rm}}}$

$\frac{R\,U_m}{\sqrt{2}\,U_{Rm}} = R + r \Rightarrow \boxed{r = R\left(\frac{U_m}{\sqrt{2}\,U_{Rm}} - 1\right)}$

$$\boxed{r = 41{,}42\ \Omega}$$

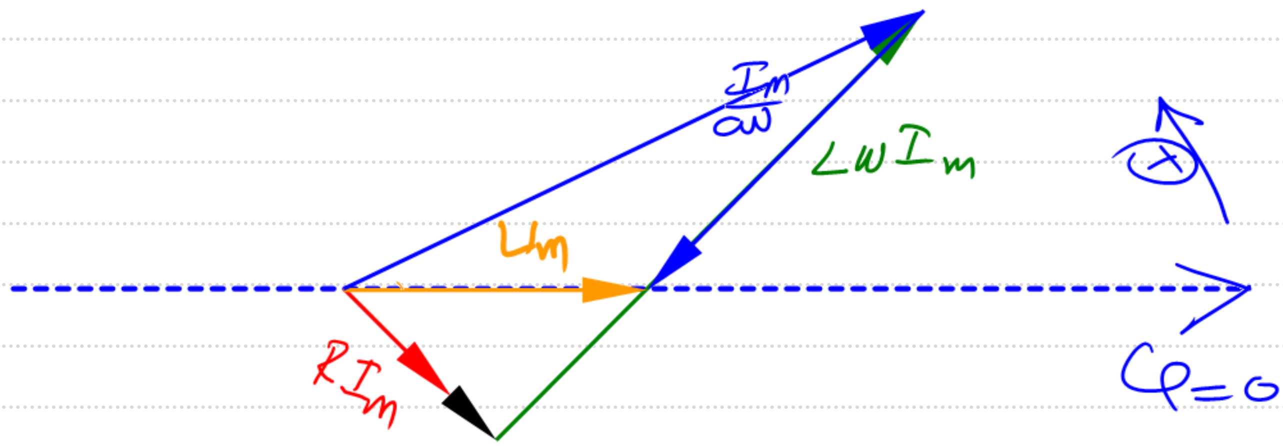
a) $R\,i(t) \longrightarrow \begin{cases} R I_m = 2\,V \\ \varphi_i = -\frac{\pi}{4} \end{cases}$

$r\,i(t) \longrightarrow \begin{cases} r I_m = 0{,}82\,V \\ \varphi_i \end{cases}$

$L\frac{di}{dt} \longrightarrow \begin{cases} L\omega I_m = 8\,V \\ \varphi_i + \frac{\pi}{2} \end{cases}$

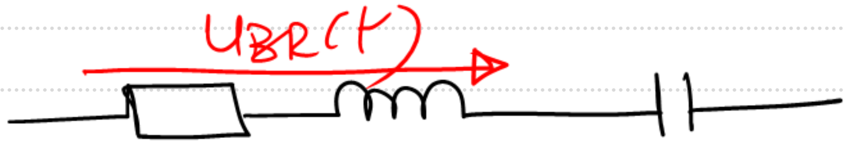
$\frac{1}{C}\int i\,dt \longrightarrow \begin{cases} \frac{I_m}{C\omega} \\ \varphi_i - \frac{\pi}{2} \end{cases}$?

$u(t) \longrightarrow \begin{cases} U_m = 4\,V \\ \varphi_u = 0 \end{cases}$



b) $\frac{I_m}{C\omega} \longrightarrow 5,2\ cm \Rightarrow \frac{I_m}{C\omega} = 5,2\ V$

$$\boxed{C = \frac{I_m}{5,2 \times 2\pi N}} \Rightarrow \boxed{C = 4,89\ \mu F}$$



c) $u_{BR}(t) = u_R(t) + u_B(t)$

$= R\,i(t) + r\,i(t) + L\frac{di(t)}{dt}$

$u_{BR}(t) = U_{BR_m}\sin(250\pi t + \varphi_{u_B})$

D'après la construction : $U_{BR_m} = 8,5\ V$

$\varphi_{u_{BR}} = 25° = 0,436\ rad$

$$\boxed{u_{BR}(t) = 8,5 \sin(250\pi t + 0,436)}$$

5°) R' ; $L' = 1H$; $r = 0$; C'

$u(t) = 4\sin(2\pi N t)$

ⓐ A la resonance d'intensité I_m est max et $N = N_0$

$\Rightarrow \boxed{N_0 = 120\,Hz}$

ⓑ ⓒ $N = N_0 = \dfrac{1}{2\pi\sqrt{L'C'}}$

$N_0^2 = \dfrac{1}{4\pi^2 L'C'} \Rightarrow C' = \dfrac{1}{N_0^2\, 4\pi^2 L'}$

$C' = 1{,}76 \cdot 10^{-6}\,F$

à la resonance d'intensité $\rightarrow Z = R' = \dfrac{U_m}{I_{mr}}$

$R' = 200\,\Omega$

ⓓ A la résonance d'intensité $\varphi_u - \varphi_i = 0$ ①

or dans ce cas $r = 0 \Rightarrow u_B(t) = L\dfrac{di(t)}{dt}$

$\hookrightarrow \varphi_{u_B} = \varphi_i + \dfrac{\pi}{2}$ ②

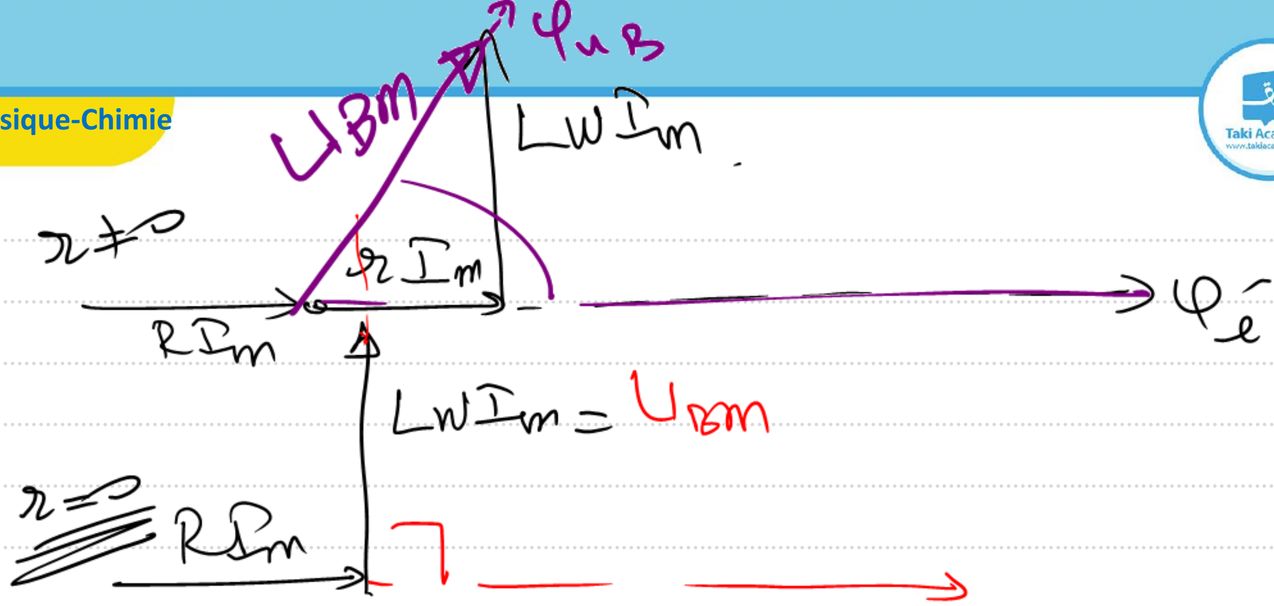
① − ② $\varphi_u - \cancel{\varphi_i} - \varphi_{u_B} = 0 - \cancel{\varphi_i} - \dfrac{\pi}{2}$

$\boxed{\varphi_u - \varphi_{u_B} = -\dfrac{\pi}{2}\ \text{rad}}$

Attention

si $r \neq 0$ $u_B(t) = r\,i(t) + L\dfrac{di}{dt}$

$0 < \varphi_{u_B} - \varphi_i < \dfrac{\pi}{2}$


$\vec{\varphi}_{uB}$
UBm
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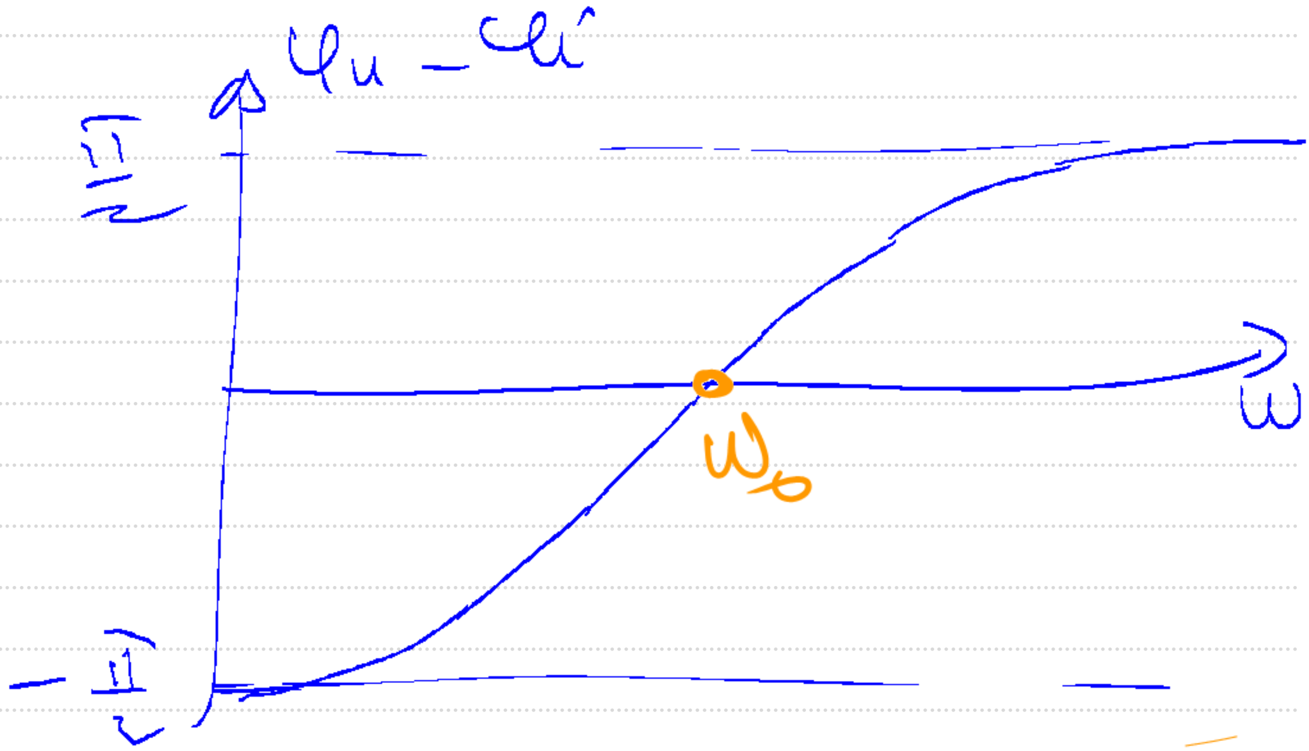
φu − ci
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ω
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NB $u_c(t)$ est tjrs en retard ----

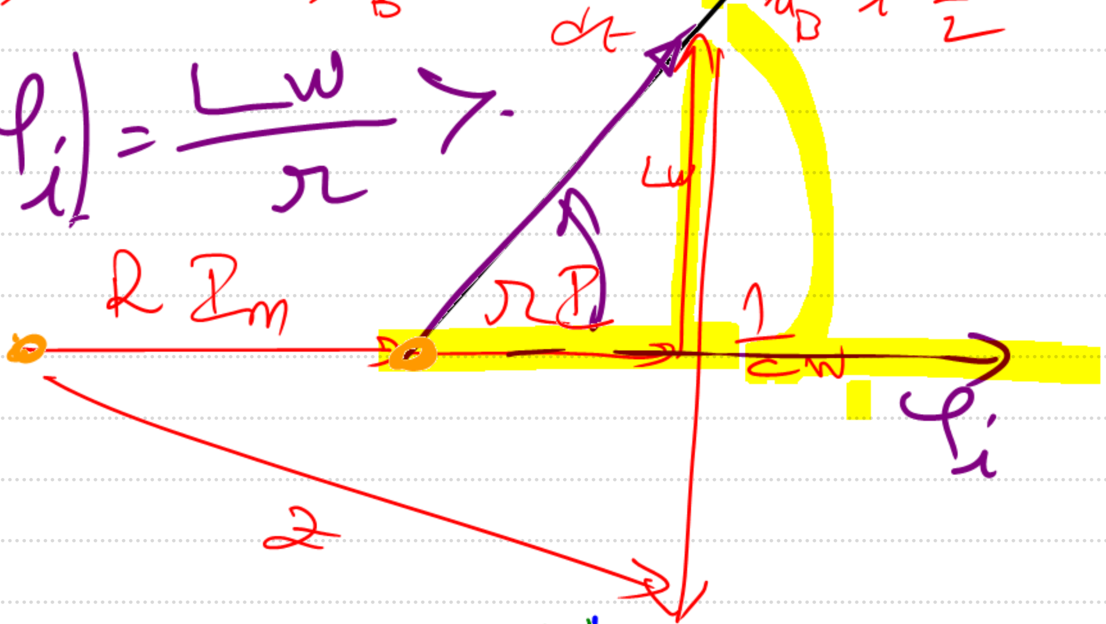
$tg\varphi = \frac{L\omega - \frac{1}{C\omega}}{R_T}$

$-\frac{\pi}{2} < \varphi_u - \varphi_i < \frac{\pi}{2} \Rightarrow \dots 0 < \varphi_u - \varphi_{u_c} < \pi$

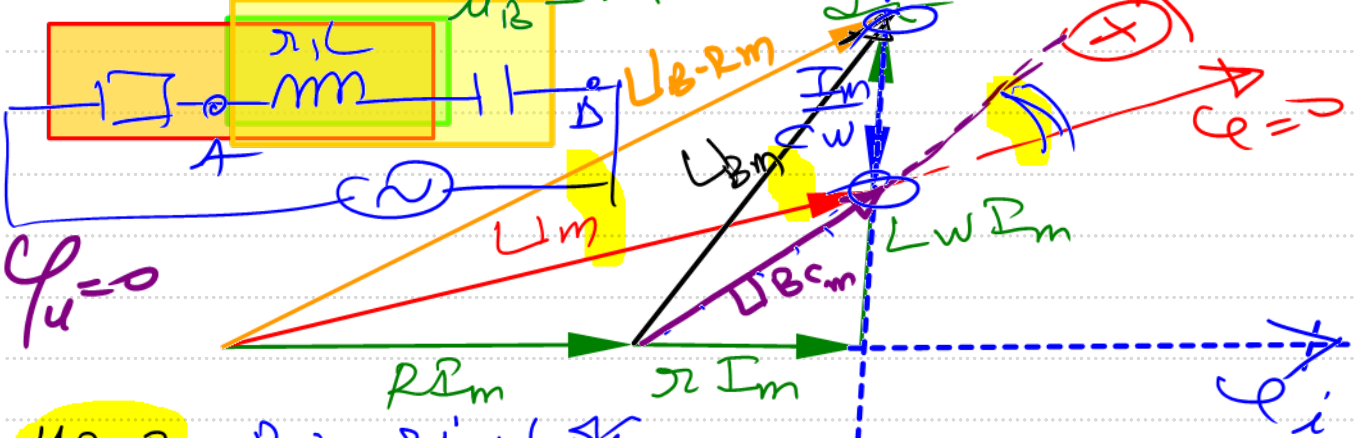
$u_B(t)$: tjrs en avance

$r = 0 \quad u_B = L\frac{di}{dt} \Rightarrow \varphi_{u_B} = \varphi_i + \frac{\pi}{2}$

$tg(\varphi_{u_B} - \varphi_i) = \frac{L\omega}{r} > 0$



$u_B = ri + L\frac{di}{dt}$



$u_{B-R} = Ri + ri + L\frac{di}{dt}$

$u_{AB}(t) = U_{ABm}\sin(\omega t + \varphi_{u_{AB}})$