1.a. $|\Delta\varphi| = \omega . \Delta t = \frac{2\pi}{T} . \frac{T}{4} = \frac{\pi}{2}$ rad

or $u_b(t)$ est en avance de phase p/r à $u(t)$

$\Rightarrow$ $\boxed{\varphi_{u_b} - \varphi_u = +\frac{\pi}{2} \text{ rad}}$

b. $u(t) = U_m \sin(2\pi N t)$ avec $U_m = 30$ V

$N = \frac{1}{T} = 50$ Hz.

d'où $\boxed{u(t) = 30 \sin(100\pi t)}$

$u_b(t) = U_{bm} \sin(2\pi N t + \varphi_{u_b})$.

or $U_{bm} = 20$ V ; $\varphi_{u_b} - \varphi_u = +\pi/2$ rad et $\varphi_u = 0$

$\Rightarrow \varphi_{u_b} = +\pi/2$ rad

$\boxed{u_b(t) = 20 \sin(100\pi t + \pi/2)}$

2a. $ri(t) = rI_m \sin(\omega t + \varphi_i) \rightarrow \vec{V_1} \left| \begin{array}{l} rI_m \\ \varphi_i \end{array}\right.$

$L \frac{di}{dt} = L\omega I_m \sin(\omega t + \varphi_i + \pi/2) \rightarrow \vec{V_2} \left| \begin{array}{l} L\omega I_m \\ \varphi_i + \pi/2 \end{array}\right.$

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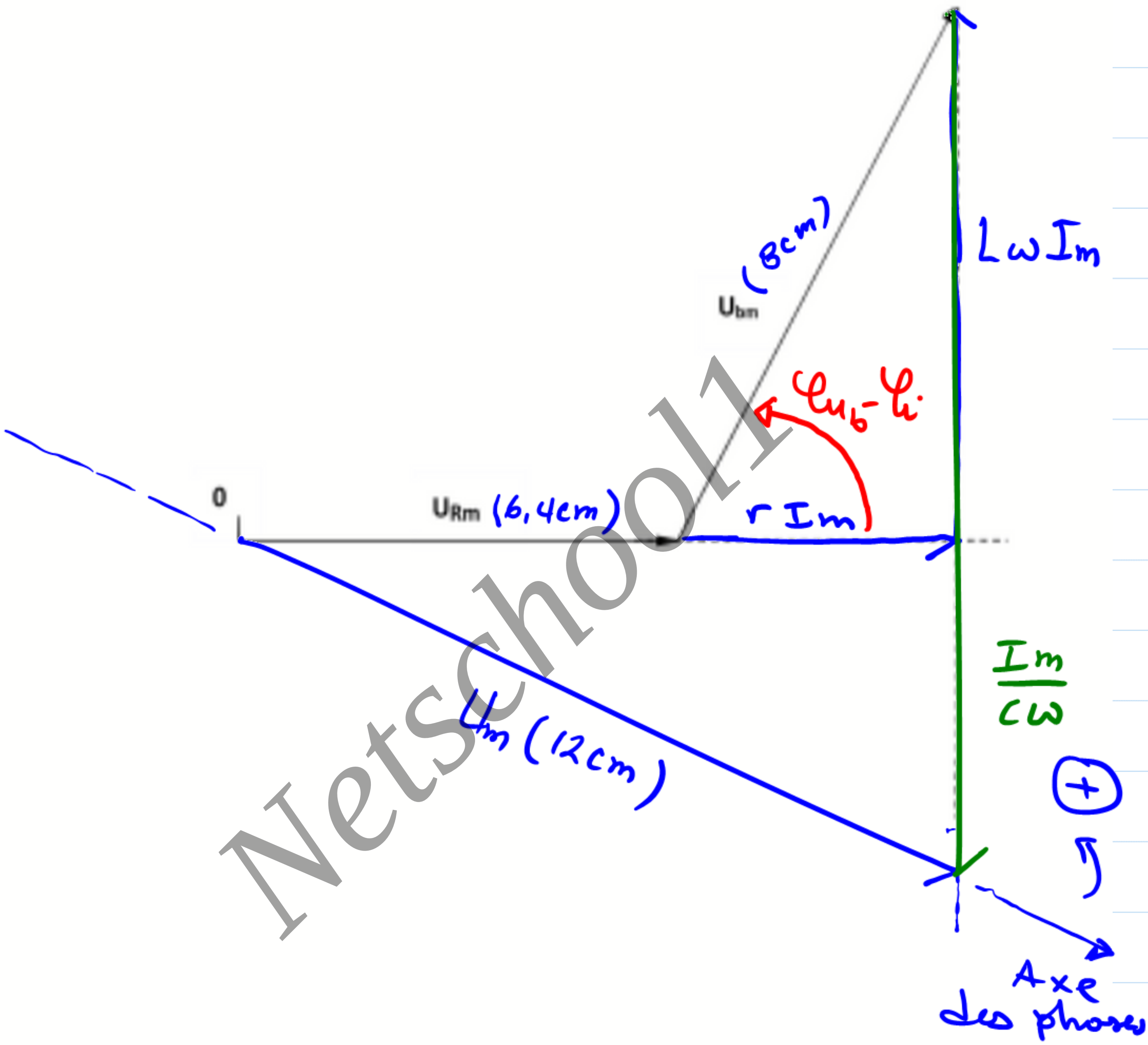
Echelle: 1cm ⟶ 2,5 V



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* $U_{Rm} \longrightarrow 6,4\,cm \Rightarrow U_{Rm} = \frac{6,4 \times 2,5}{1} = 16\,V$

$U_{Rm} = R\,I_m \Rightarrow \boxed{I_m = \frac{U_{Rm}}{R} = \frac{16}{32} = 0,5\,A}$

* $r\,I_m = \frac{4 \times 2,5}{1} = 10\,V \Rightarrow \boxed{r = \frac{10}{I_m} = 20\,\Omega}$.

* $L\omega I_m = \frac{7 \times 2,5}{1} = 17,5\,V$

$$\boxed{L = \frac{17,5}{\omega I_m} = \frac{17,5}{100\pi \times 0,5} = 0,11\,H}$$

* $\cos(\varphi_{u_b} - \varphi_i) = \frac{r I_m}{U_{bm}} = \frac{4}{8} = 1/2 \Rightarrow \boxed{\varphi_{u_b} - \varphi_i = \pi/3\ rad}$

b. $\begin{cases} \varphi_{u_b} - \varphi_i = \pi/3\ rad & (2) \\ \varphi_{u_b} - \varphi_u = \pi/2\ rad & (1) \end{cases}$

(1) - (2) donne : $\varphi_i - \varphi_u = \pi/2 - \pi/3 = \frac{\pi}{6}\ rad$

$\Rightarrow$ $i(t)$ est en avance de phase de $\frac{\pi}{6}$ rad

p/r à $u(t) \Rightarrow$ **le circuit est capacitif.**

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d. $u(t) = 30\sin(100\pi t) \longrightarrow \vec{V}\left|\begin{array}{l} 30\,V \rightarrow 12\,cm \\ 0 \end{array}\right.$

$$\frac{1}{C}\int i\,dt = \frac{I_m}{C\omega}\sin(100\pi t + \varphi_i - \pi/2) \longrightarrow \vec{V}_3\left|\begin{array}{l} \frac{I_m}{C\omega} \\ \varphi_i - \pi/2 \end{array}\right.$$

$$U_{C_m} = \frac{I_m}{C\omega} = \frac{13 \times 2{,}5}{1} = 32{,}5\,V$$

$$\Rightarrow \boxed{C =} \frac{I_m}{U_{C_m}\,\omega} = \frac{0{,}5}{32{,}5 \times 100\pi} = \boxed{4{,}9.10^{-5}\,F}$$

3) a. $P = (R+r)\,I^2$

P est maximale $\Rightarrow$ I est maximale : le circuit est en état de **résonance d'intensité**

b. A la résonance d'intensité $N = N_0 = \dfrac{1}{2\pi\sqrt{LC}}$

$$N_0 = \frac{1}{2\pi\sqrt{0{,}11 \times 4{,}9.10^{-5}}} = 68{,}55\,Hz.$$

$$* \; I_0 = \frac{I_m}{\sqrt{2}} = \frac{U_m}{(R+r)\sqrt{2}} = \frac{30}{(32+20)\sqrt{2}} = 0{,}408\,A.$$

$$P_0 = (R+r)\,I_0^2 = 8{,}65\,W.$$

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c. $i(t) = I_m \sin(\omega_0 t + \varphi_i)$ avec $I_m = I_0\sqrt{2}$

$\varphi_i = \varphi_u = 0$

$$\boxed{i(t) = 0{,}408\sqrt{2}\sin(430{,}7\,t)}$$

$$u_C(t) = \frac{q}{C} = \frac{1}{C}\int i\,dt = \frac{I_m}{C\omega_0}\sin(\omega_0 t + \varphi_i - \pi/2)$$

$$\boxed{u_C(t) = 27{,}34\sin(430{,}7\,t - \pi/2)}.$$

d. $$\boxed{Q = \frac{U_{cm}}{U_m} = \frac{27{,}34}{30} = 0{,}91}$$

Rq : $Q = \frac{1}{R+r}\sqrt{\frac{L}{C}} < 1 \Rightarrow$ il n'y a pas surtension.

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