$\varphi_u - \varphi_i = -15°$

$\pi \, rad \longrightarrow 180°$

$\frac{\pi}{12} \longrightarrow 15°$

$\varphi_u - \varphi_i = -\frac{\pi}{12} \, rad$

6) $\varphi_u - \varphi_i < 0 \Rightarrow$ circuit capacitif

EX3

$\varphi_u = 0 \, rad$

1) facteur de puissance : $\cos(\varphi_u - \varphi_i)$.

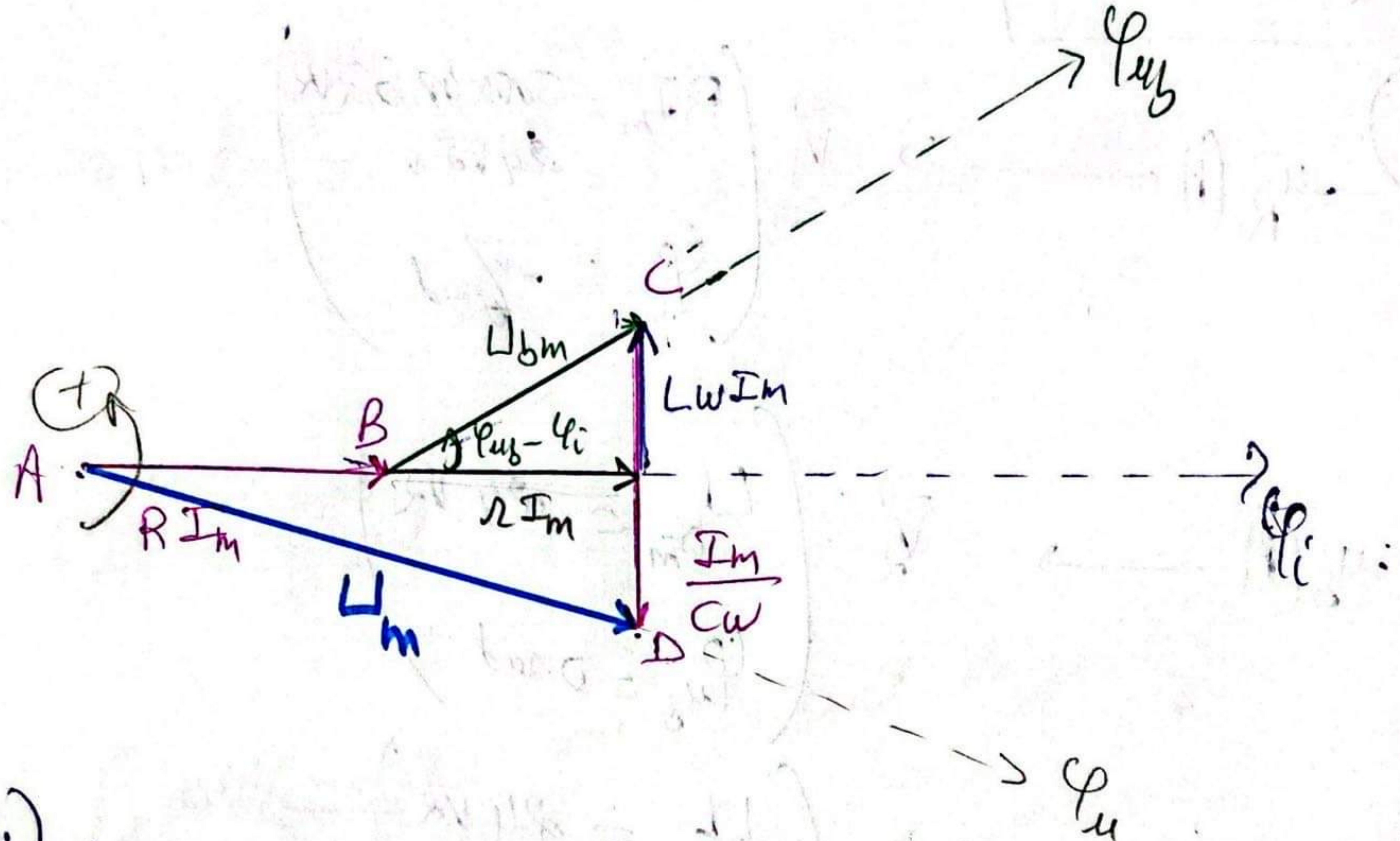
$\cos(\varphi_u - \varphi_i) = \frac{\sqrt{3}}{2}$

$U_{AB} = 20V = U_R$

$U_{DM} = 40V = U_C$

$U_{BM} = 20V = U_{b,C}$

$\boxed{\begin{array}{l} U_{BD} < U_{DM} \\ U_b < U_C \end{array}}$



4) $L\omega I_m = 2 \times 6\sqrt{2} = 12\sqrt{2}$

$$\boxed{L = \frac{12\sqrt{2}}{\omega I_m} = \frac{12\cancel{\sqrt{2}}}{2.10^3 \times 48\,10^{-3} \times \cancel{\sqrt{2}}} = 0,125\,H}$$

$rI_m = 3,5 \times 6\sqrt{2} = 21\sqrt{2}$

$$\boxed{r = \frac{21\sqrt{2}}{48.10^{-3}\sqrt{2}} = 437,5\ \Omega}$$

$$\boxed{U_m = 7,8 \times 6\sqrt{2} = 46,8\sqrt{2}\,V}$$

6

$\boxed{C = 10^{-6} F}$

3) $u_R(t) \longrightarrow \vec{V_1} \begin{cases} RI_m = 500 \times 48.10^{-3} \times \sqrt{2} \\ = 24\sqrt{2}\,V \longrightarrow 4\,cm \\ \varphi_i = -\frac{\pi}{6}\,rad \end{cases}$

$u_b(t) \longrightarrow \vec{V_2} \begin{cases} U_{bm} = 24\sqrt{2} \longrightarrow 4\,cm \\ \varphi_{u_b} = 0\,rad \end{cases}$

$u_C(t) \longrightarrow \vec{V_3} \begin{cases} U_{Cm} = 24\sqrt{2} \longrightarrow 4\,cm \\ \varphi_i - \frac{\pi}{2} = -\frac{2\pi}{3}\,rad \end{cases}$

$u(t) \longrightarrow \vec{V} \begin{cases} U_m \\ \varphi_u \end{cases}$

$\varphi_{u_b} - \varphi_C = \frac{\pi}{6}\,rad$

à $t=0$ $\quad u_b(0)=0=U_{bm}\sin\varphi_{u_b}$

$\Rightarrow \sin\varphi_{u_b}=0$

or la courbe $u_b=f(t)$ ~~est~~ croissante au voisinage de 0

$\Rightarrow$ sa dérivée >0 $\Rightarrow$ $\cos\varphi_{u_b}>0$

$$\boxed{\varphi_{u_b}=0\text{ rad}}$$

$T \longrightarrow 24$ div ; $\Delta t \longrightarrow 8$ div

$$\varphi_{u_b}-\varphi_{u_C}=\omega\Delta t=\frac{2\pi}{T}\times\frac{T}{3}=\frac{2\pi}{3}\text{ rad}$$

$$\boxed{\varphi_{u_C}=-\frac{2\pi}{3}\text{ rad}}$$

d) $\boxed{\varphi_i=\varphi_{u_C}+\frac{\pi}{2}=-\frac{2\pi}{3}+\frac{\pi}{2}=-\frac{\pi}{6}\text{ rad}}$

* $\boxed{\Delta\varphi=\varphi_{u_b}-\varphi_i=0-\left(-\frac{\pi}{6}\right)=\frac{\pi}{6}\text{ rad}}$

e) $U_{C_m}=\dfrac{I_m}{C\omega}\Rightarrow C=\dfrac{I_m}{U_{C_m}\,\omega}=\dfrac{48.10^{-3}\times\sqrt{2}}{24\sqrt{2}\times 2\pi 10^{3}}$

5

$$0 < \varphi_{u_b} - \varphi_{u_c} - \frac{\pi}{2} < \frac{\pi}{2}$$

$$0 < \frac{\pi}{2} < \varphi_{u_b} - \varphi_{u_c} < \pi$$

$$\varphi_{u_b} - \varphi_{u_c} > 0 \Rightarrow \varphi_{u_b} > \varphi_{u_c}$$

$u_b(t)$ est tjs en avance de phase /. $u_c(t)$

b) D'après le graphe la courbe (1) est en avance de phase /. à la courbe (2)

courbe (1) $\longrightarrow u_b(t)$

courbe (2) $\longrightarrow u_c(t)$

c) $T = 24 \times \frac{\pi}{24} \cdot 10^{-3} = \pi \cdot 10^{-3}\ s$

$U_{b_m} = 4 \times 6\sqrt{2} = 24\sqrt{2}\ V$

$U_{c_m} = 4 \times 6\sqrt{2} = 24\sqrt{2}\ V$

$w = \frac{2\pi}{T} = \frac{2\pi}{\pi \cdot 10^{-3}}$

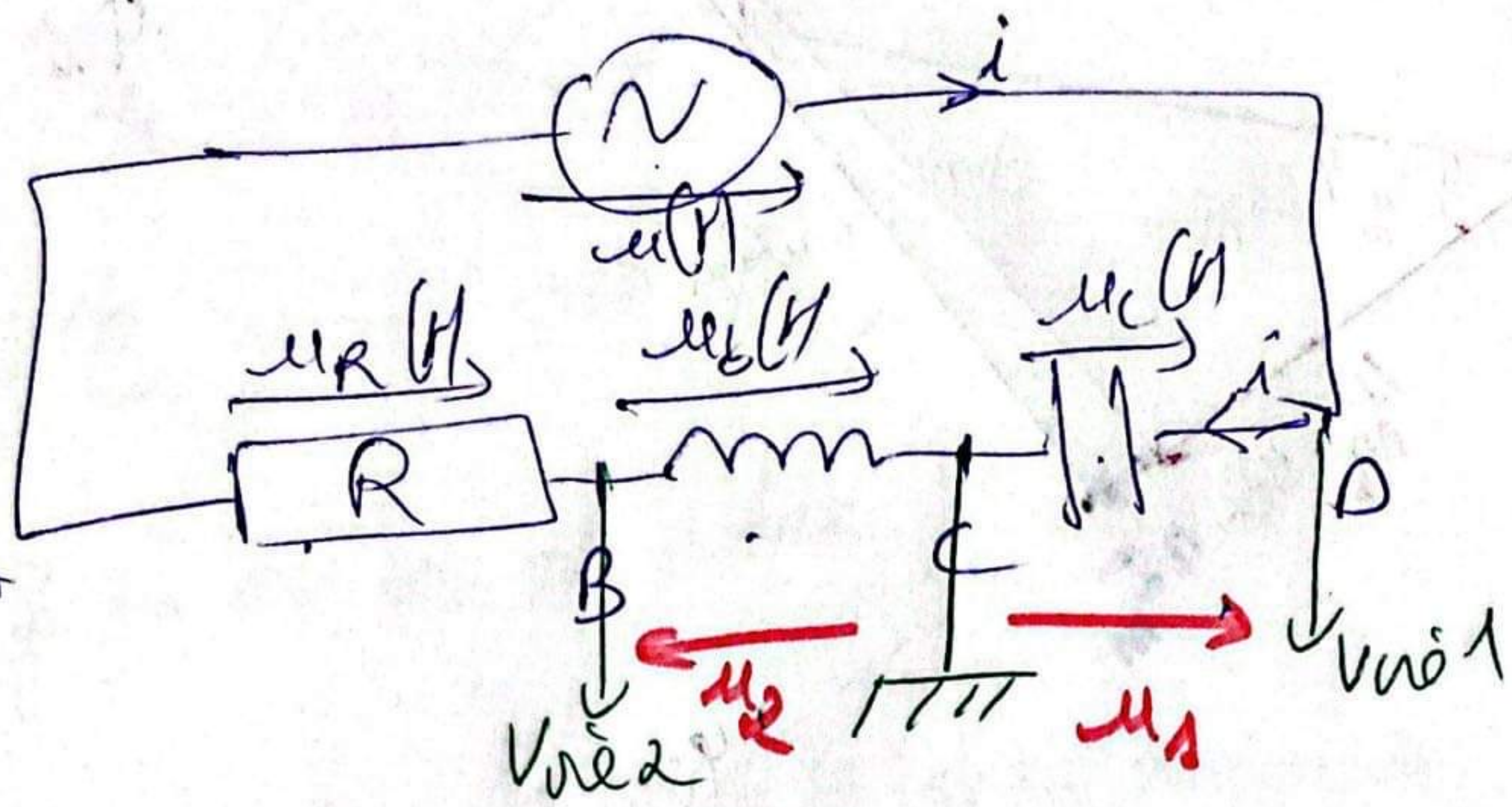
$= 2\,10^{3}\ rad$

$L\omega I_m = 10\times 5 = 50V$

$L = \dfrac{50}{\omega I_m} = \dfrac{50}{100\pi \times 1{,}25} = \dots H$

Ex2

1)



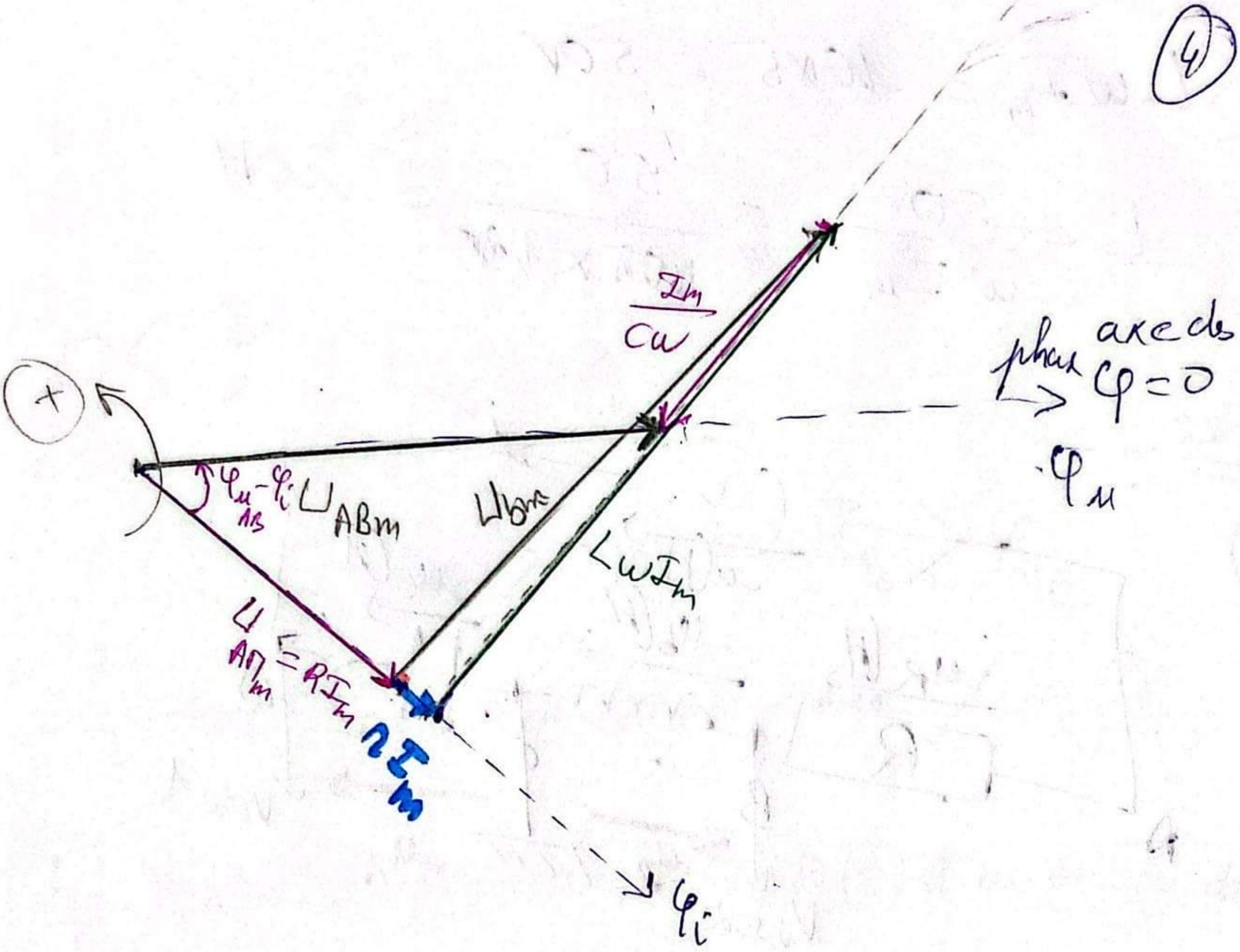
(+INV) $u_2 = u_b$

2)a)

$$\boxed{\begin{gathered} -\frac{\pi}{2} < \varphi_u - \varphi_i < \frac{\pi}{2} \\ 0 < \varphi_{u_b} - \varphi_i < \frac{\pi}{2} \end{gathered}}$$

$$0 < \varphi_{u_b} - \varphi_i < \frac{\pi}{2}$$

or $\varphi_i = \varphi_{u_C} + \frac{\pi}{2}$



a) $U_{B_m} \longrightarrow 9{,}8\,cm$

$$\boxed{U_{B_m} = 9{,}8 \times 5 = 49\,V}$$

b) $r I_m = 0{,}5 \times 5 = 2{,}5\,V$

$$\boxed{r = \frac{2{,}5}{1{,}25} = 2\,\Omega}$$

$$u_{AB}(t) = u(t) \longrightarrow \vec{V}\begin{pmatrix} U_{AB_m} = 40V \longrightarrow 8cm \\ \varphi_{u_{AB}} = 0rad \end{pmatrix}$$

$$u_{AN}(t) = u_R(t) \longrightarrow \vec{V_1}\begin{pmatrix} U_{AN_m} = 25V \longrightarrow 5cm \\ \varphi_i = -\pi/4 \, rad \end{pmatrix}$$

$$u_{ND}(t) = u_C(t) \longrightarrow \vec{V_2}\begin{pmatrix} U_{ND_m} = U_{Cm} = \frac{I_m}{C\omega} = 20V \longrightarrow 4cm \\ \varphi_i - \pi/2 \end{pmatrix}$$

$$u_{DB}(t) = u_b(t) \longrightarrow \vec{V_3}\begin{pmatrix} U_{DB_m} = U_{bm} \\ \varphi_{u_b} \end{pmatrix}$$

$$\varphi_{u_{AB}} - \varphi_i = \pi/4 \ rad.$$

$$I_m = \frac{U_{ABm}}{R} = \frac{25}{20} = 1{,}25\,A$$

$$\varphi_{u_{AB}} - \varphi_i = \frac{\pi}{4} \quad \text{or} \quad \varphi_{u_{AB}} = 0\,rad$$

$$\Rightarrow \varphi_i = -\frac{\pi}{4}\,rad$$

$$\boxed{i(t) = 1{,}25 \sin\left(100\pi t - \frac{\pi}{4}\right)}$$

i en A
t en s

(A) $\Rightarrow I_{eff} = I = \frac{I_m}{\sqrt{2}}$

(V) $\Rightarrow U_{eff} = U = \frac{U_m}{\sqrt{2}}$

sinusoïdal seulement

3) impédance $Z = \frac{U_m}{I_m} = \frac{U}{I} = \sqrt{(R+r)^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}$

(V)

(Ω) (A)

$$\boxed{Z = \frac{U_{ABm}}{I_m} = \frac{40}{1{,}25} = 32\,\Omega}$$

revenons à l'ex

②

$\varphi_{u_{AB}} - \varphi_i = \frac{\pi}{4}$ rad > 0

$\Rightarrow$ circuit inductif

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

$U_{AB_m} = 40V$; $\omega = 2\pi N = 100\pi$ rad.s^{-1}

à $t=0$ $u_{AB}(0) = 0 = U_{AB} \sin \varphi_{u_{AB}}$

$\sin \varphi_{u_{AB}} = 0$ or la courbe est croissante au voisinage de 0

$\Rightarrow$ sa dérivée $> 0 \Rightarrow \cos \varphi_{u_{AB}} > 0$

$\Rightarrow \varphi_{u_{AB}} = 0$ rad

$$\boxed{u_{AB}(t) = 40 \sin(100\pi t)}$$

t en s

u_{AB} en V

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

Rque

circuit inductif $\begin{cases} N > N_0 \\ \omega > \omega_0 \\ L\omega > \frac{1}{C\omega} \\ L\omega I_m > \frac{I_m}{C\omega} \Rightarrow U_{L_m} > U_{C_m} \\ \varphi_u - \varphi_i > 0 \Rightarrow \varphi_u > \varphi_i \end{cases}$

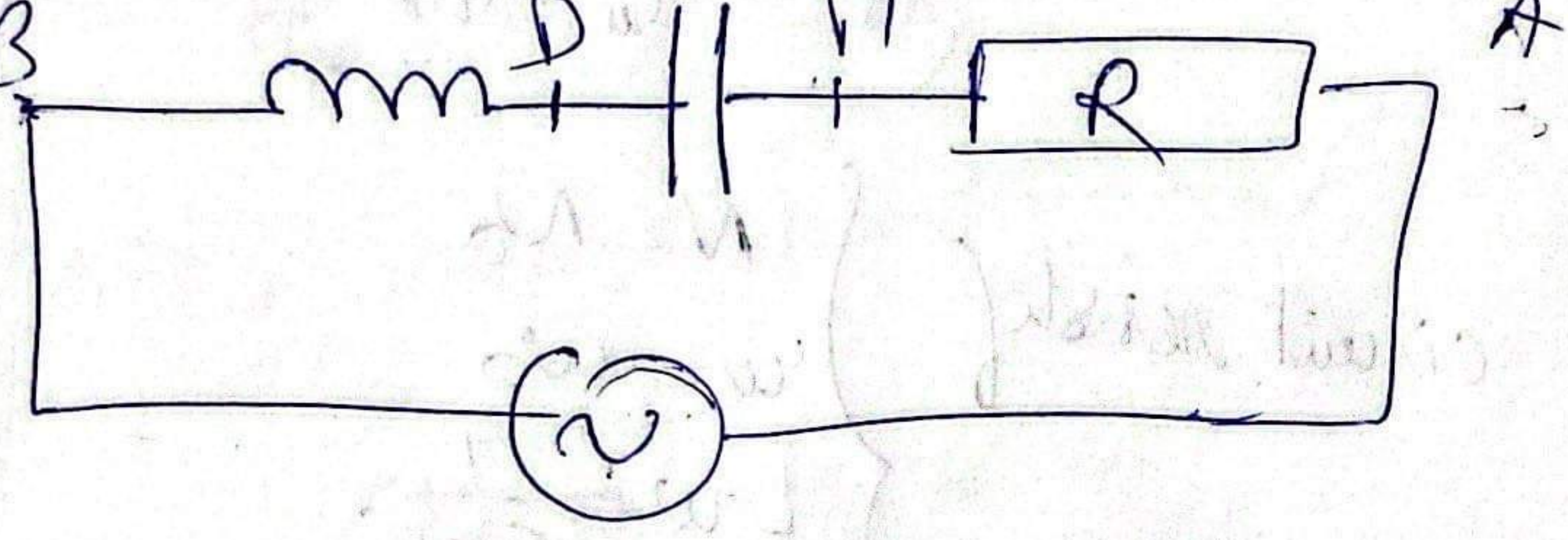
circuit résistif $\begin{cases} N = N_0 \\ \omega = \omega_0 \\ L\omega = \frac{1}{C\omega} \\ U_{L_m} = U_{C_m} \\ \varphi_u - \varphi_i = 0 \Rightarrow \varphi_u = \varphi_i \\ \text{résonance d'intensité} \end{cases}$

circuit capacitif $\begin{cases} N < N_0 \\ \omega < \omega_0 \\ L\omega < \frac{1}{C\omega} \\ U_{L_m} < U_{C_m} \\ \varphi_u - \varphi_i < 0 \Rightarrow \varphi_u < \varphi_i \end{cases}$

Oscillateurs électriques forcés

1

Ex1 :



1) a) $T = 0{,}02\,s \Rightarrow N = \frac{1}{T} = 50\,Hz$

b) $\Delta\varphi = \varphi_i - \varphi_{u_{AB}} = \varphi_{u_{AM}} - \varphi_{u_{AB}}$

$\Delta\varphi = \pm\, \omega\, \Delta t = \pm \frac{2\pi}{T} \Delta t$

décalage horaire

$\Delta t = f(T)$

$\Delta\varphi = \varphi_i - \varphi_{u_{AB}} = \varphi_{u_{AM}} - \varphi_{u_{AB}} = -\,\omega\,\Delta t$

$= -\frac{2\pi}{T} \times \frac{T}{8} = -\frac{\pi}{4}\,rad$