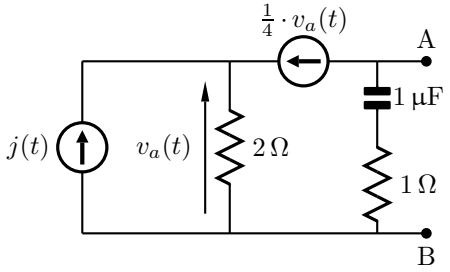
1. ARIKETA — DENBORA: 60 min (10 PUNTU)

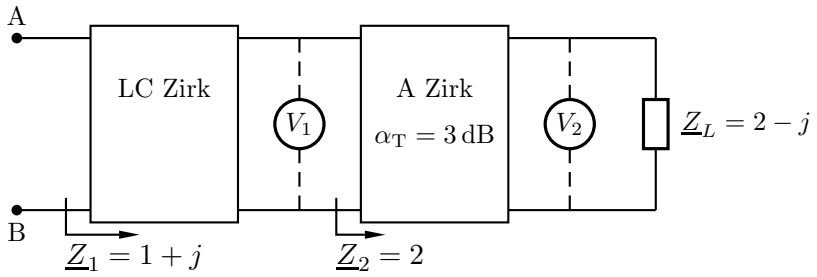
Irudiko zirkuituan sorgailu independientea hau da: $j(t) = \sqrt{2}\cos(10^6 t + \frac{\pi}{4})\,\mathrm{A}$.



Kalkulatu:

a A eta B arteko Thevenin baliokidea. **(3 puntu)**

a atalean kalkulatutako balioa edozein izanda, aurrerantzean erabili balio hauek A eta B arteko Theveninerako: $\underline{V}_{TH} = 2\angle_{\pi}$ (balio maximotan) eta $Z_{TH} = 1 - j$. Bigarren fase batean, a ataleko zirkuituari irudiko zirkuitua konektatzen zaio:



Kalkulatu:

b Kargan potentzia. **(1.5 puntu)**

c V_1 eta V_2 voltmetroetan irakurritako balioa. **(1.5 puntu)**

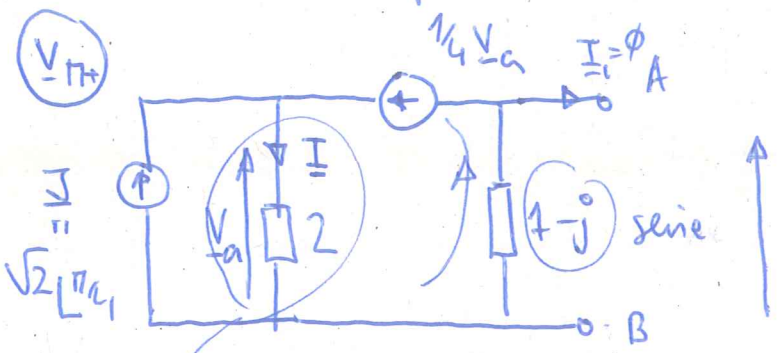
d Diseinatu LC zirkuitua, aukeratu soluziorik sinpleena. **(2 puntu)**

e Kalkulatu A zirkuituaren insertzio-galerak. **(2 puntu)**

(a) Thevenin baliokidea:

Zirkuitu konplexuetan $\omega = 10^6$ r/seg $\quad Z_C = \frac{-j}{\omega C} = \frac{-j}{10^6 \cdot 10^{-6}} = -j\,\Omega$

$\underline{V}_{TH}$



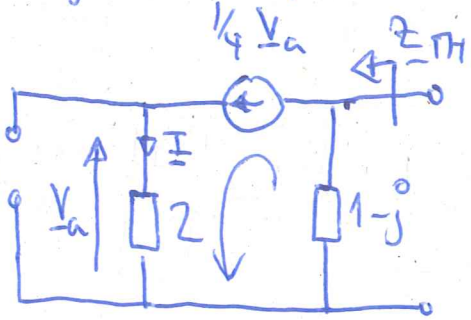
$$\underline{V}_{TH} = \underbrace{-}_{\text{korronte sorgailu}} \underbrace{\frac{1}{4}\underline{V}_a}_{\text{korronta}} \cdot \underbrace{(1-j)}_{2} = -(1+j)(1-j) = -2 = 2\lfloor \pi$$

$$\underline{I} = \underline{J} + \frac{1}{4}\underline{V}_a = \sqrt{2}\lfloor \pi/4 + \frac{1}{4}\underline{V}_a \Rightarrow \frac{\underline{V}_a}{2} = 1+j+\frac{1}{4}\underline{V}_a \Rightarrow \boxed{\frac{1}{4}\underline{V}_a = 1+j}$$

$$\underline{V}_a = 2\cdot\underline{I} \rightarrow \underline{I} = \frac{\underline{V}_a}{2}$$

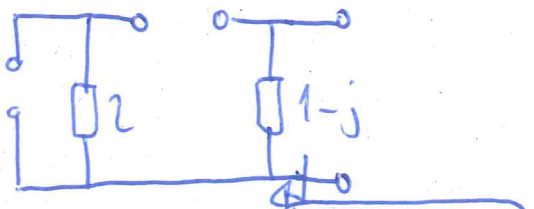
$4+j$

(b) $\underline{Z}_{TH}$ Sorgailu independienteak ametitu:



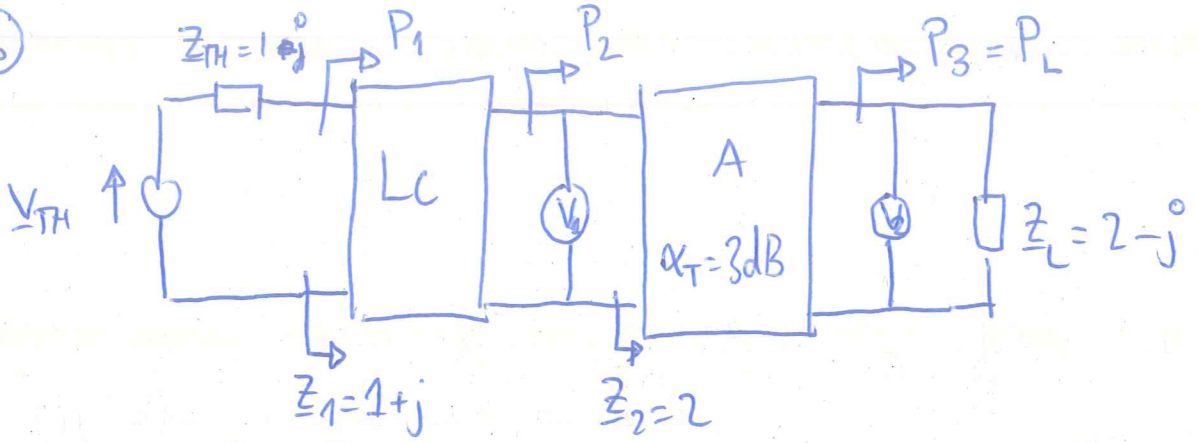
$$\underline{I} = \frac{1}{4}\underline{V}_a \Rightarrow \underline{V}_a = 2\underline{I} = 2\cdot\frac{1}{4}\underline{V}_a = \frac{\underline{V}_a}{2} \Rightarrow \underline{V}_a = 0$$ Ordun

itxuri kontuletan $\frac{1}{4}\underline{V}_a = 0$!! → Irekita



$\boxed{\underline{Z}_{TH} = 1-j}$ eta baliogo bestela eten (irekita)

(b)



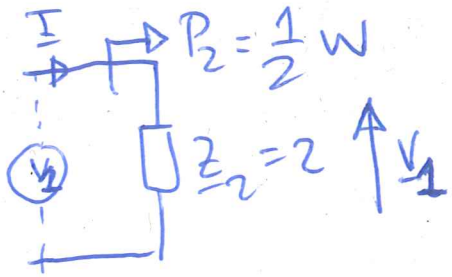
$\underline{Z}_{TH}=\underline{Z}_1^*$ egoluth $\Rightarrow P_1=P_{erh}=\frac{|\underline{V}_{TH}|^2}{8R_{TH}}=\frac{2^2}{8\cdot 1}=\frac{1}{2}W$

$P_2=P_1$ (LC zirk ist du ereten)

A zirkuitron $\alpha_T=10\log\frac{(P_2)_{sonen}}{(P_3)_{urteen}}$ $\quad P_3=P_2\cdot 10^{\frac{-\alpha_T}{10}}=\frac{1}{2}10^{0.3}$

$=\boxed{\frac{1}{4}W=P_3=P_L}$

(c) Voltimetroeton:



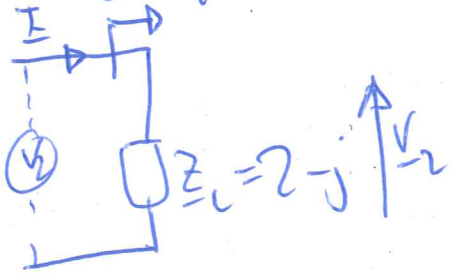
$\frac{1}{2}W$

$P_2=\frac{1}{2}\cdot R_2|\underline{I}|^2=\frac{1}{2}R_2\frac{|\underline{V}_1|^2}{|\underline{Z}_2|^2}=\frac{1}{2}\cdot 2\frac{|\underline{V}_1|^2}{4}=\frac{|\underline{V}_1|^2}{4}$

$|\underline{V}_1|^2=\frac{4}{2}=2 \quad |\underline{V}_1|=\sqrt{2}$

baliu maximuo

$\boxed{|\underline{V}_1|_{ef}=\frac{\sqrt{2}}{\sqrt{2}}=1}$ voltimetroan irakurriko



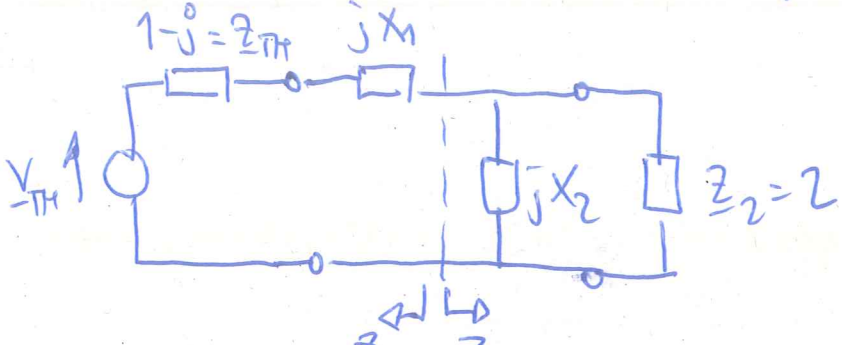
$P_3=\frac{1}{2}\cdot R_L|\underline{I}|^2=\frac{1}{2}R_L\frac{|\underline{V}_2|^2}{|\underline{Z}_L|^2}=$

$=\frac{1}{2}\cdot\frac{|\underline{V}_2|^2}{2^2+1^2}=\frac{|\underline{V}_2|^2}{5}=\frac{1}{4} \quad |\underline{V}_2|^2=\frac{5}{4}$

$|2-j|^2$

$|\underline{V}_2|=\frac{\sqrt{5}}{2}$ max $\rightarrow$ $|\underline{V}_2|_{ef}=\frac{\sqrt{5}}{2\sqrt{2}}=\boxed{\frac{\sqrt{10}}{4}=|\underline{V}|_{ef}}$

(d) LC zirkuitu, egoiliz beherako egoera:



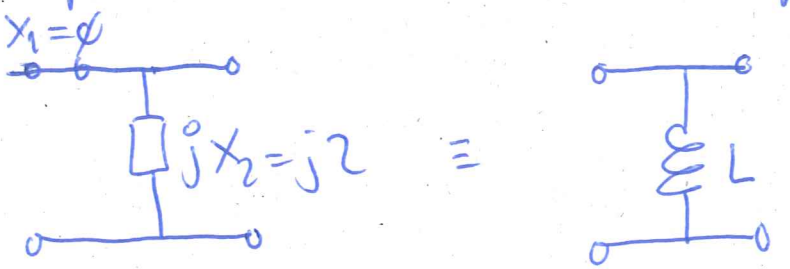
$$\underline{Z}_A = 1 - j + jX_1 \qquad \underline{Z}_B = 2 \,/\!/\, jX_2 = \frac{2jX_2(2-jX_2)}{(2+jX_2)(2-jX_2)} = \frac{2X_2^2 + j^{\circ}4X_2}{4+X_2^2}$$

$$\underline{Z}_A = \underline{Z}_B^* \equiv \begin{cases} \text{Re} \rightarrow & 1 = \dfrac{2X_2^2}{4+X_2^2} \Rightarrow 4+X_2^2 = 2X_2^2 \quad X_2^2 = 4 \\ & \boxed{X_2 = \pm 2} \\ \text{Im} \rightarrow & -1 + X_1 = \ominus \dfrac{4X_2}{4+X_2^2} \end{cases}$$

(⊖: konj.)

$$X_1 = 1 - \frac{4X_2}{4+X_2^2} \begin{cases} X_2 = 2 & 1 - \dfrac{4\cdot 2}{4+4} = \emptyset \\ X_2 = -2 & 1 - \dfrac{4(-2)}{4+4} = +2 \end{cases}$$

Soluzioak sinpleene $X_2 = 2$ $X_1 = \emptyset$ osagai bakean:

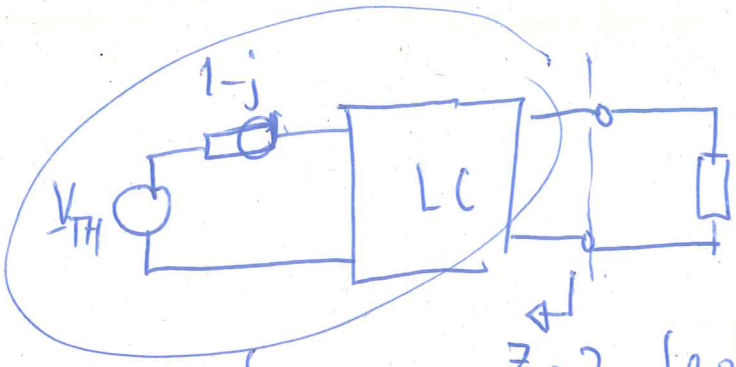


$$j^{\circ}\omega L = j2 \qquad \boxed{L = \frac{2}{10^6} = 2\mu H}$$

(e) Inserzio galenk. A zirkuitoreken

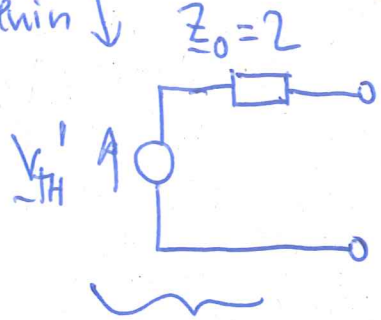
irteen potentzia → $P_3 = P_L$

A zirkuitua kendub (P_{20})



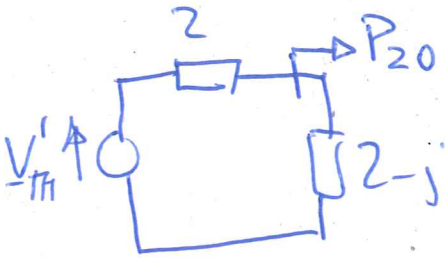
$Z_0 = 2$ (egokitu egiten zen lehen)

Thevenin ↓



$$P_{enb} = P_2 = \frac{1}{2} W = \frac{1}{2} \frac{|V'_{TH}|^2}{4 R_{TH}} = \frac{1}{8} \frac{|V'_{TH}|^2}{4 \cdot 2} = \frac{1}{8}$$

$$|V'_{TH}|^2 = 8$$



$$I_{20} = \frac{V'_{TH}}{2+2-j} = \frac{V'_{TH}}{4-j}$$

$$P_{20} = \frac{1}{2} R_L \cdot |I_{20}|^2 = \frac{1}{2} \cancel{2} \frac{|V'_{TH}|^2}{4^2+1} = \frac{|V'_{TH}|^2}{17}$$

$$= \frac{8}{17}$$

Bent $\alpha_I(A) = 10 \log \frac{\left(\frac{8}{17}\right)}{\left(\frac{1}{4}\right)} = 10 \log \frac{32}{17} = \boxed{2.74 dB = \alpha_I}$

$P_3'' = P_L$; P_{20}