Soru 1

$a = 10\angle -30$, $b = 12\angle -30$

Time Domain

a için

$j\omega c = j \cdot 377 \cdot 10^{-6} = 3{,}77 \cdot 10^{-4} j + 0$

$j\omega c = 3{,}77 \times 10^{-4} \angle 90$

$I_c = (3{,}77 \times 10^{-4} \angle 90) * (10\angle -30)$

$= (0 + 3{,}77 \times 10^{-4} j) \times 10(\cos -30 + j \sin -30)$

$8{,}6 - 5j$

$= 3{,}2422 \times 10^{-3} + 1{,}885 \times 10^{-3}$

$I_c = 3{,}75 \times 10^{-3} \angle 59{,}82^\circ$

b için

$I_c = (3{,}77 \times 10^{-4} \angle 90) \times (12 \angle -30)$

$= 3{,}77 \times 10^{-4} j \times (10{,}32 - 6j)$

$\cong 3{,}890\ 10^{-3} j + 2{,}262 \times 10^{-3}$

$\cong 4{,}499 \times 10^{-3} \angle 59{,}82^\circ$ $\quad I_c \cong 4{,}499 \times 10^{-3} \angle 59{,}82^\circ$

Frequency Domain

a için

$V = \dfrac{3{,}75 \times 10^{-3} \angle 59{,}82}{3{,}77 \times 10^{-4} \angle 90} \cong \boxed{9{,}94 \angle 30.18^\circ}$

b için

$\dfrac{4{,}499 \times 10^{-3} \angle 59{,}82^\circ}{3{,}77 \times 10^{-4} \angle 90} \cong \boxed{11{,}93 \angle 30.18^\circ}$

C

Time Domain: $i = C \cdot j\omega \cdot v$

Frequency domain: $V = \dfrac{I}{j\omega C}$

$\tan^{-1} \dfrac{3{,}73 \cdot 10^{-4}}{0} = \text{tanımsız} = \tan^{-1} 90$

$\cos -30 \cong 0{,}86$

$\tan^{-1} \dfrac{3{,}2422 \times 10^{-3}}{1{,}885 \times 10^{-3}} \cong 59{,}82$

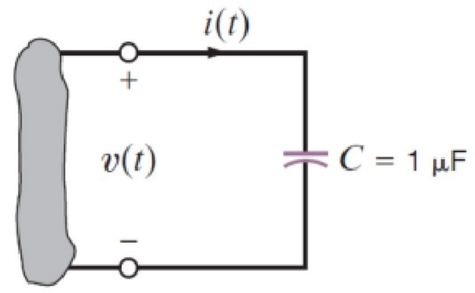
$(3{,}2422 \times 10^{-3})^2 + (1{,}885 \times 10^{-3})^2 \cong 3{,}75 \times 10^{-3}$

8.5 Calculate the current in the capacitor shown in Fig. P8.5 if the voltage input is

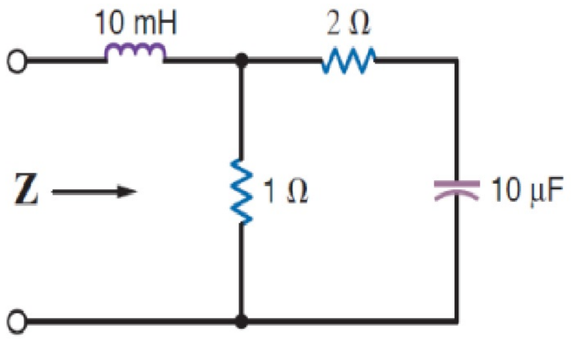
(a) $v_1(t) = 10 \cos (377t - 30°)$ V.

(b) $v_2(t) = 12 \sin (377t + 60°)$ V.

Give the answers in both the time and frequency domains.



8.7 Find the impedance, **Z**, shown in Fig. P8.7 at a frequency of 60 Hz.



8.7

$Z_L = (2\pi \cdot 60)(10^{-2})j$, $Z_C = \frac{-j}{w.C}$, $\frac{-j}{(2\pi \times 60)(10^{-5})}$

$\cong 3,769j$ $\quad Z_C \cong -265,2j$

$Z_{eq} = Z_L + (1 // (2 + Z_C))$

$= 3,769 \angle 90 + \frac{2 - 265,2j}{3 - 265,2j} \rightarrow \frac{265,2 \angle -89,56}{265,2 \angle -89,35} \quad 1 \angle 0,21$

$= 3,769 \angle 90 + 1 \angle 0,21$

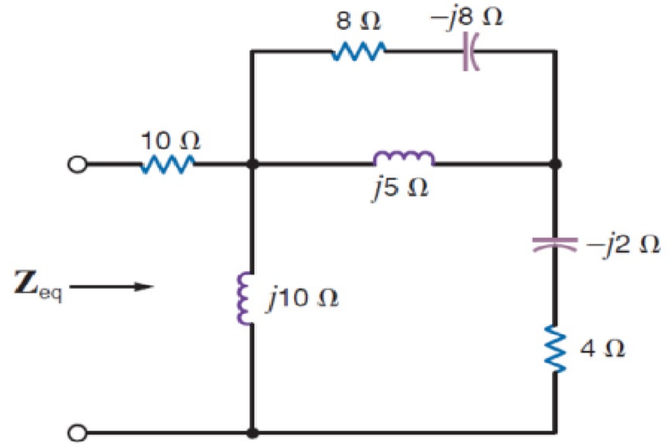
$= 3,769j + 0,999 + 3,661 \times 10^{-3} j$

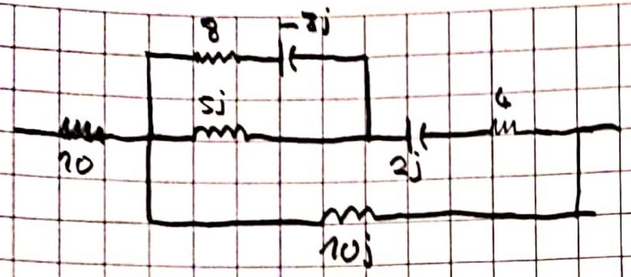
$Z_{eq} = \boxed{0.999 + 3,722j}$

$Z = \boxed{3,90 \angle 75°}$

8.9

8.9 Find the equivalent impedance for the circuit in Fig. P8.9.





$$Z_{eq} = 10 + (((8-8j) // 5j) + 4 - 2j) // 10j)$$

$$\frac{5j\,(8-8j)}{8-3j} + 4 - 2j$$

İçeriyi düzenleyelim

$$\frac{40j+40}{8-3j} + 4 - 2j = 2,74 + 6,02j + 4 - 2j = 6,74 + 4,02j$$

Yeni hali

$$10 + \left(\frac{(6,74+4,02j).10j}{6,74+14,02j}\right)$$

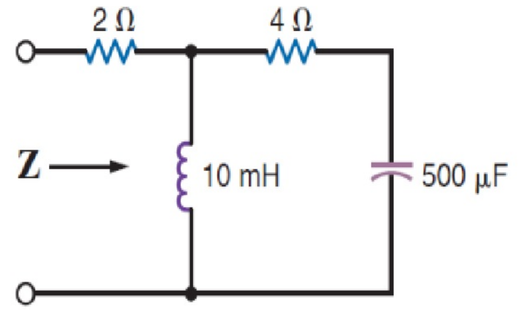
$$10 + \left(\frac{67,4j - 40,2}{6,74+14,02j}\right) = 12,78 + 4,206j$$

$$Z_{eq} = 12,78 + 4,206j$$

$$Z = 13,45 \angle 18,02^{\circ}$$

8.13

8.13 Find the impedance, **Z**, shown in Fig. P8.13 at a frequency of 60 Hz.



$Z_L = (2\pi \cdot 60) \times (10^{-3})$, $Z_C = \dfrac{-j}{(2\pi \cdot 60)(5 \cdot 10^{-4})}$

$Z_L \cong 0{,}376j$

$Z_C \cong -5{,}305j$

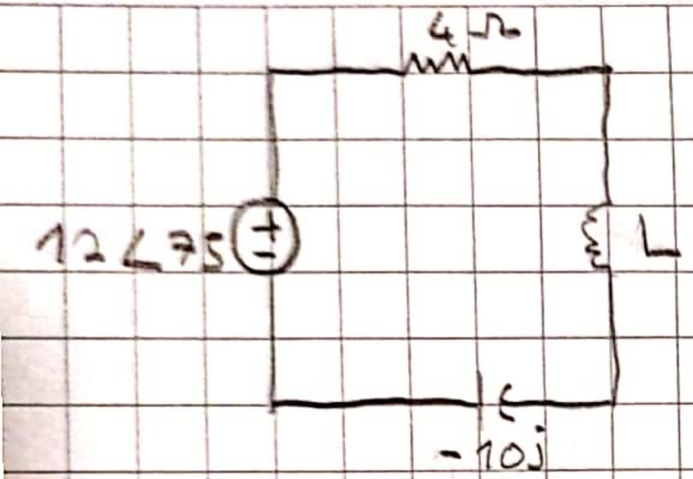
$Z_{eq} = 2 + (3{,}769j \,//\, (4 - 5{,}305j))$

$$2 + \frac{3{,}769j \times (4 - 5{,}305j)}{4 - 1{,}536j} = \frac{15.096j + 19.994}{4 - 1{,}536j} + 2$$

$Z_{eq} = 5{,}09 + 4{,}95j$

$Z_{eq} = 7.1 \angle 44{,}2$

8.15



$12\cos(1000t+75)\,V$

$R_c = \dfrac{-j}{100\cdot10^{-6}\cdot 1000j}$ $\qquad R_c = -10j$

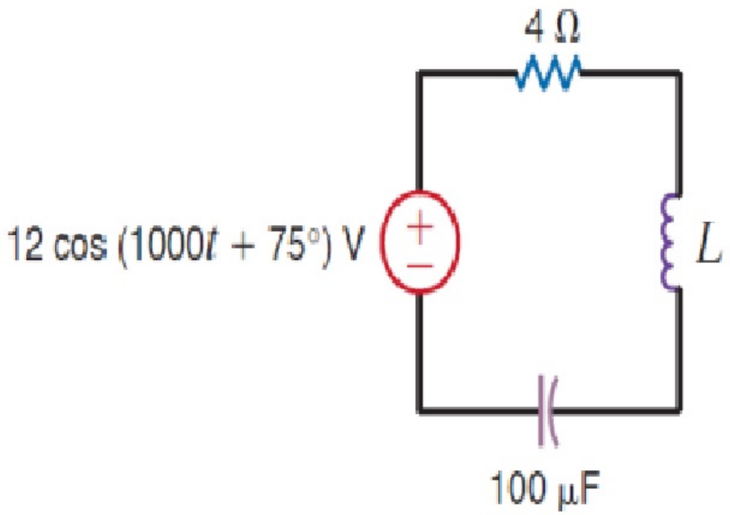
impedance

$Z = R + \angle X - 10j$

$Z = R$ olmalı ise

$1000 \cdot L \cdot j = +10j$ $\qquad L = 10^{-2}$ $\qquad \boxed{L = 10\ mH}$

8.15 In the circuit shown in Fig. P8.15, determine the value of the inductance such that the current is in phase with the source voltage.



8.25 In the diagram in Fig. P8.25 when $v(t) = 5 \cos 500t$ V, $i(t) = 0.4 \cos(500t - 30°)$ A. Calculate $i(t)$ if $v(t) = 5 \cos 1000t$ V.

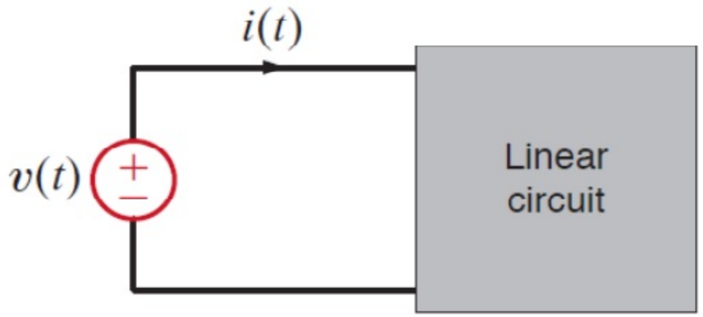


Figure P8.25

8.25

$v(t) = 5 \cos 500t$ V $V = 5 \angle 0°$

$i(t) = 0{,}4 \cos(500t - 30°)$ A $I = 0{,}4 \angle -30$

$Z_{eq} = \frac{V}{I} = \frac{5 \angle 0}{0{,}4 \angle -30} = 12{,}5 \angle 30$

$Z_{eq} = 12{,}5 \angle 30 \rightarrow 12{,}5(\cos 30) + j\, 12{,}5(\sin 30) = 10{,}82 + 6{,}25j$

w

$500 \cdot (2) = 1000$

ip $v(t) = 5 \cos 1000t$ V $i(t) = ?$

$i(t) = \frac{V}{Z}$

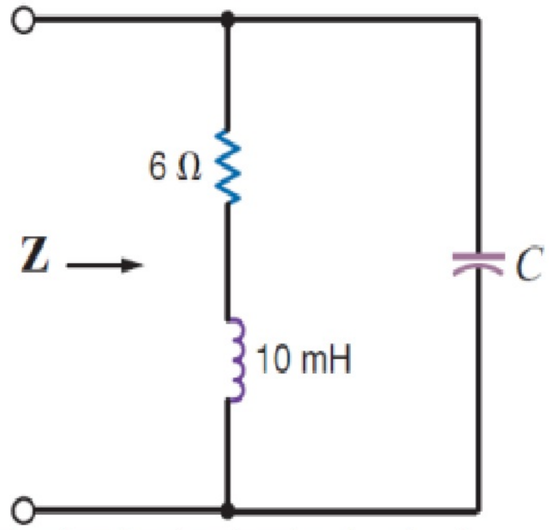
$\frac{5}{10{,}82 + 2 \times (6{,}25)i}$

$I = \frac{5 \angle 0}{16 \angle 49}$ $I = 0{,}3125 \angle -49$

$i(t) = 0.3125 \cos(1000t - 49)$ A

8.18

8.18 The impedance of the network in Fig. P8.18 is found to be purely real at $f = 400$ Hz. What is the value of C?



$Z_L = (2\pi \cdot 400)(10^{-2})j$

$Z_C = \dfrac{-j}{2\pi \cdot 400 \cdot C}$

$Z_{eq} = \dfrac{(6 + Z_L) \times (Z_C)}{6 + Z_L + Z_C} \rightarrow = \dfrac{6Z_C + Z_L \cdot Z_C}{6 + Z_C + Z_C}$

$2\pi \cdot 400 = k$ olsun

$$\frac{\frac{-6j}{kC} + \frac{10^{-2}}{C}}{6 + j\left(10^{-2}k - \frac{1}{kC}\right)}$$

paydadaki j değerlerinden kurtulmak için eşleniğiyle çarptım.

amaç imajinel kısmı 0 yapmak $\boxed{R = Z}$

bu yüzden sadece (im) kısmında işlem yapıyorum

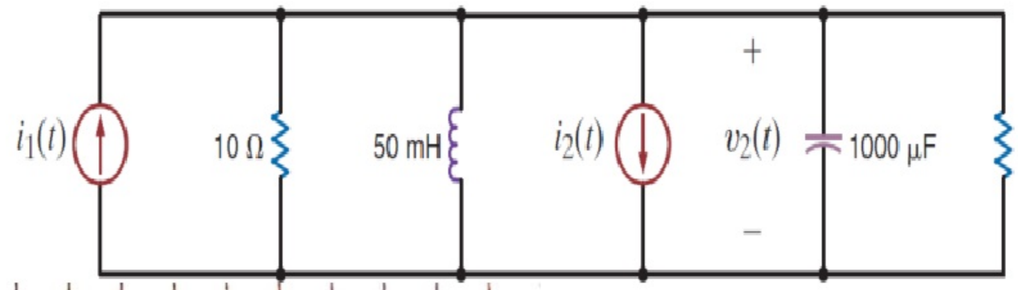
$$\frac{6 - j\left(10^{-2}k - \frac{1}{kC}\right)}{6 - j\left(10^{-2}k - \frac{1}{kC}\right)} \times \frac{\frac{-6j}{kC} + \frac{10^{-2}}{C}}{6 + j\left(10^{-2}k - \frac{1}{kC}\right)}$$

$$\frac{-36j}{kC} - j\left(\frac{10^{-4}k}{C} - \frac{10^{-2}}{kC^2}\right) = 0 \rightarrow \frac{36}{kC} + \frac{10^{-4}k}{C} - \frac{10^{-2}}{kC^2} = 0$$

$$\frac{36}{800\pi \cdot C} + \frac{10^{-4} \times (800\pi)}{C} - \frac{10^{-2}}{800\pi(C^2)} \rightarrow \frac{0,0143}{C} + \frac{0,2513}{C} = \frac{3.9788 \times 10^{-6}}{C^2}$$

$C = 15,832 \times 10^{-6} \rightarrow C \cong 15,832$ HF

8.31 Calculate $v_1(t)$ if $i_1(t) = 7 \cos 100t$ A and $i_2(t) = 3\cos(100t + 45°)$ in Fig. P8.31.

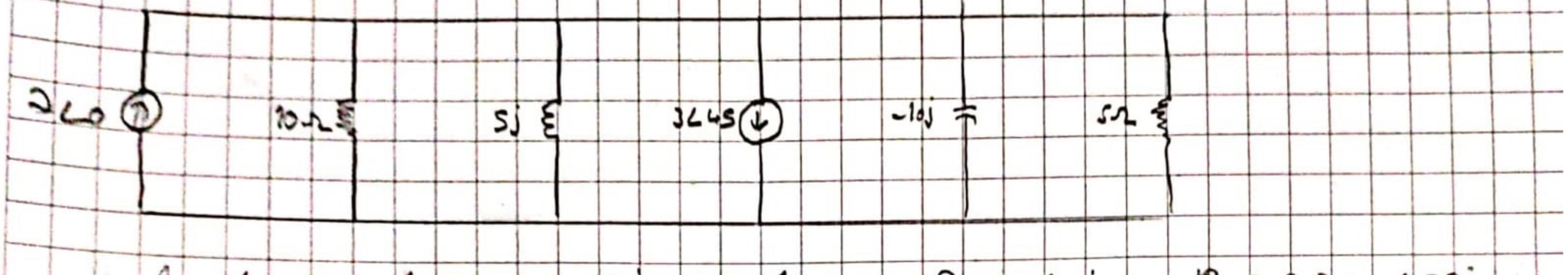


8.31

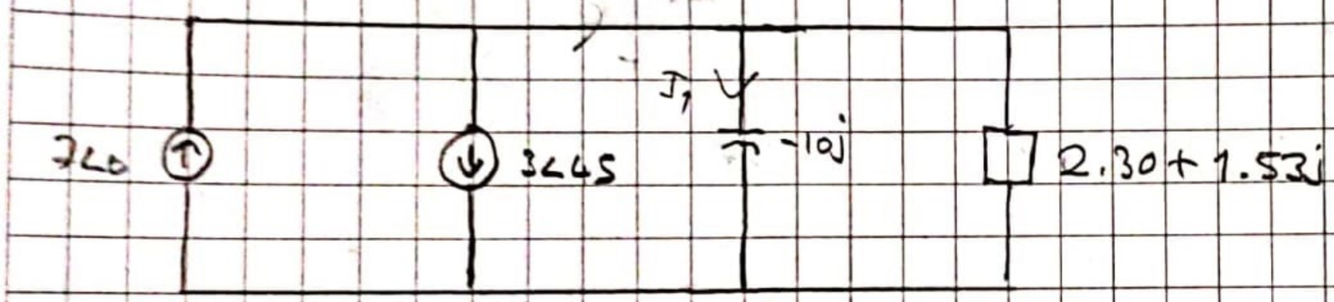
$i_1(t) = 7 \cos 100t$ $\quad i_2(t) = 3 \cos(100t + 45)$

$I_1 = 7\angle 0$ $\quad I_2 = 3\angle 45$

$Z_L = (50 \cdot 10^{-3})(100)j$, $Z_L = 5j$, $Z_C = \dfrac{-j}{10^2 \times 10^{-4} \times 10^2}$, $Z_C = -10j$



$+\frac{1}{10} + \frac{1}{5j} + \frac{1}{2} + \frac{1}{-2j} = \frac{1}{R_a}$ $\quad \frac{3j+2}{10j} = \frac{1}{R_a}$ (j) $\quad R_a = \frac{10j}{3j+2}$ $\quad R_a = 2.30 + 1.53j$



$I_1 = (7 - 2.12 - 2.12j) \times \left(\dfrac{2.30 + 1.53j}{2.30 - 8.47j} \right)$

$I_1 = (4.88 - 2.12j) \times (-0.09 + 0.20j)$, $I_1 = 0.12 + 1.60j$

$V_2 = I_1 \times (-10j)$, $V_2 = -16 - 1.70j$; $V_2 = 16.09\angle -6.06$

$V_2(t) = 16.09 \cos(100t - 6.06)$

8.31 Calculate $v_1(t)$ if $i_1(t) = 7 \cos 100t$ A and $i_2(t) = 3\cos(100t + 45°)$ in Fig. P8.31.

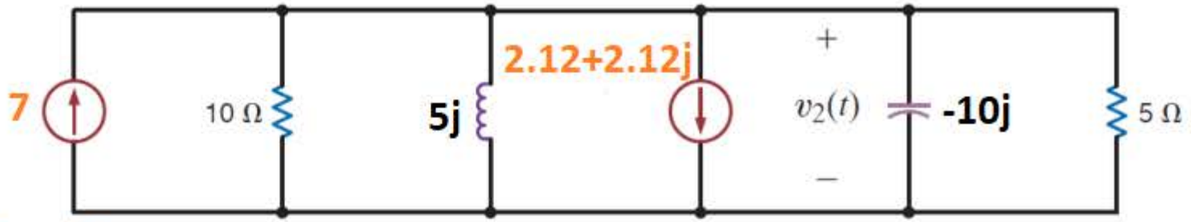
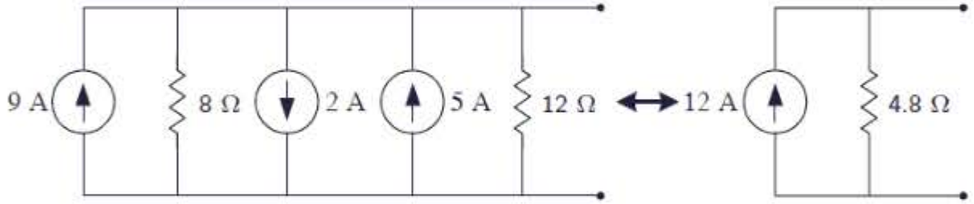
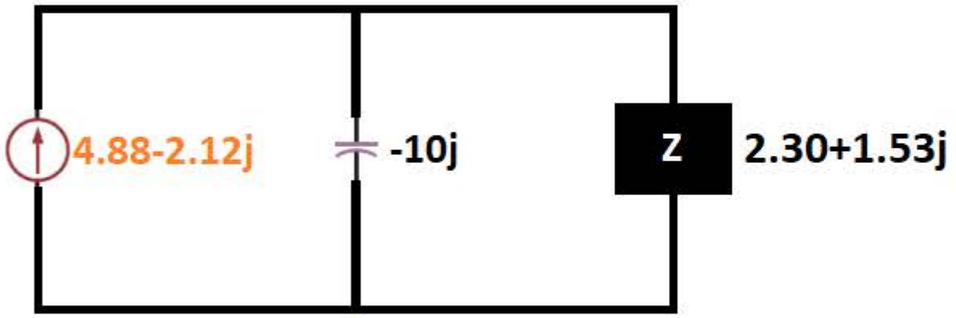


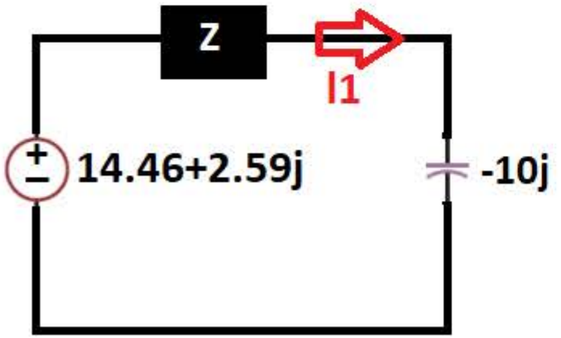
Figure P8.31

Source Transformation - Example



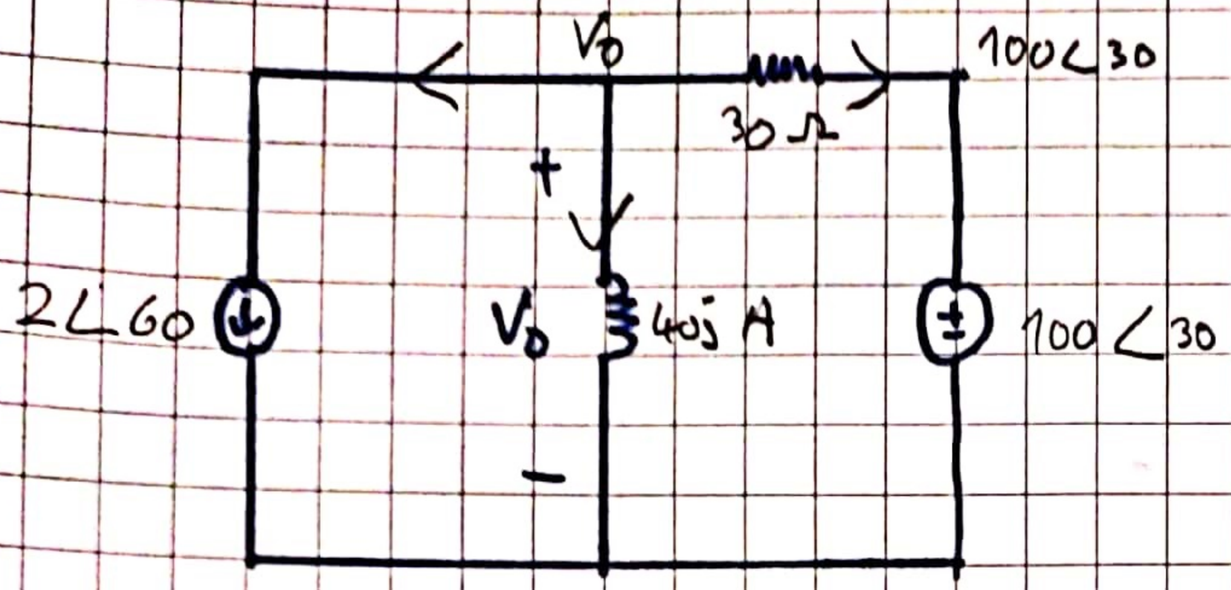
- Recall: Current sources in parallel add
- Recall: The conductance of resistors in parallel adds
- Mixture of both in parallel also has an equivalent
  - Equivalent current source = sum of the currents
  - Equivalent resistance = parallel combination
- Proof possible by KCL (left as exercise)





I1 = (14.46+2.59j)/(Z-10j)
I1 = (0.14+1.66j)
V2 = I1x(-10j)
V2 = 16.59 - 1.40j
V2(t) = 16.64(cos100t-4.82)

8.43



$$2\angle 60 + \frac{V_o}{40j} + \frac{(V_o - 100\angle 30)}{30\Omega} = 0$$

(3) (4j)

8.43 Find $\mathbf{V}_o$ in the network in Fig. P8.43.

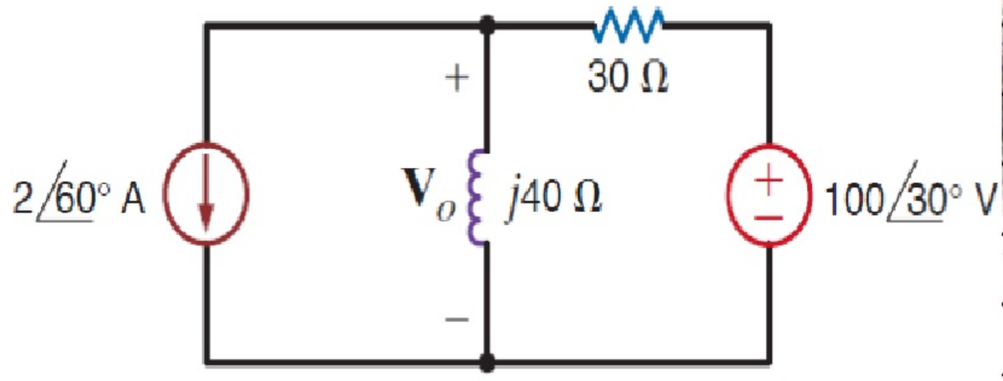


Figure P8.43

$$-2\angle 60 = \frac{3V_o + 4V_o j - 4j(100\angle 30)}{120j}$$

$$-120j(1 + 1{,}73j) = V_o(3+4j) - 4j(86.60 + 50j)$$

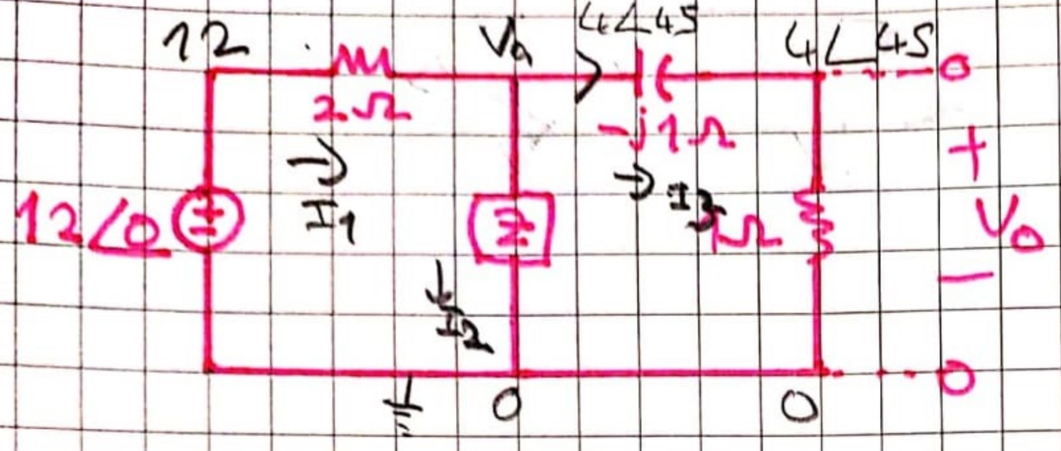
$$\frac{-120j + 207.6 + 346.4j - 200}{3+4j} = V_o \quad , \quad \frac{226.4j + 7.6}{3+4j} = V_o$$

$$\frac{226\angle 88}{5\angle 53} = 45.2\angle 35$$

$$\boxed{V_o = 45.2\angle 35}$$

8.47

$V_o = 4\angle 45$ Find Z



$$\frac{V_a - 0}{1 - j} = 4\angle 45$$

$$V_a = (2.82 + 2.82j)(1 - j)$$

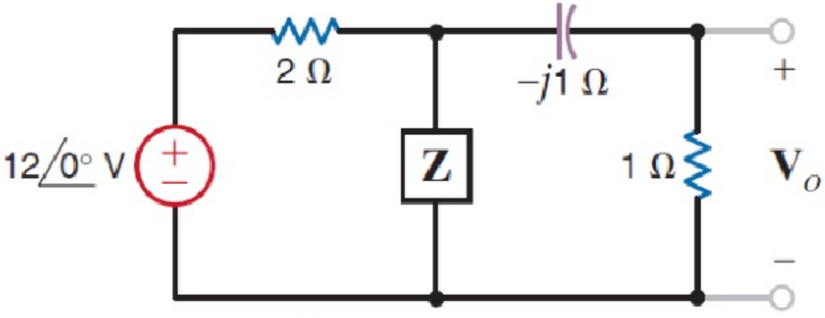
$$V_a = 5.64$$

$$I_1 = \frac{12 - 5.64}{2} \qquad I_1 = 3.18$$

$$(3.18 - 2.82 - 2.82j) = 0.36 - 2.82j = I_2$$

$$Z = \frac{5.64}{0.36 - 2.82j} = 0.35 + 1.96j$$

8.47 In the network in Fig. P8.47, $\mathbf{V}_o$ is known to be $4\angle 45°$ V. Find $\mathbf{Z}$.



8.51

$$\frac{(V_1 - 12\angle 0)}{1\Omega} + 2\angle 0\,A + \frac{V_1}{1\Omega} + \frac{V_1 - V_2}{1\Omega} = 0$$

$$V_1 - 12 + 2 + V_1 + V_1 - V_2 = 0 \Rightarrow V_2 = 3V_1 - 10$$

$$-\frac{(V_1 - V_2)}{1\Omega} - \frac{V_2}{j} - 4\angle 0 = 0 \Rightarrow -\frac{(V_1 - V_2)j + V_2}{j} = 4$$

(j)

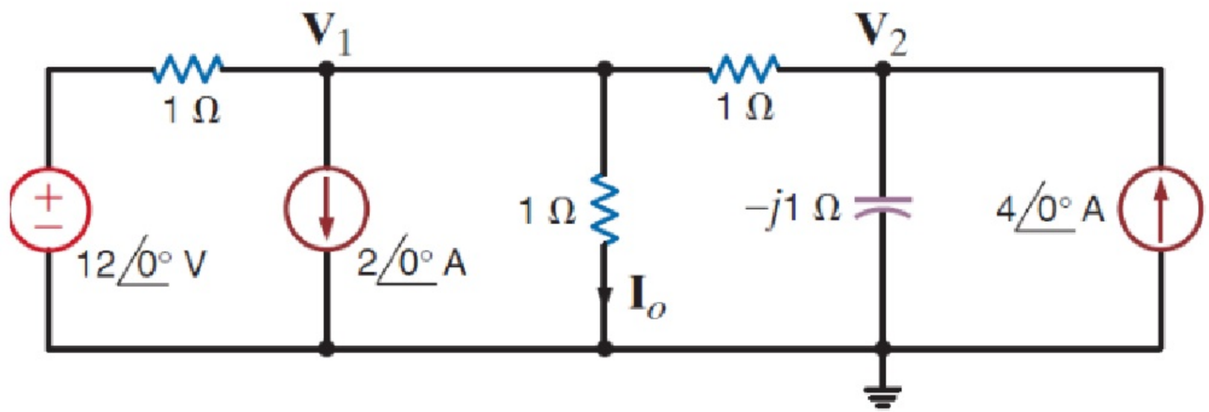
$$4j = -2V_1 j - 10j + 10 - 3V_1 \Rightarrow 14j - 10 = V_1(2j - 3)$$

$$V_1 = \frac{14j - 10}{2j - 3} \Rightarrow V_1 = \frac{\sqrt{(14)^2 + (10)^2}\ \angle \tan^{-1}\frac{14}{10}}{\sqrt{(2)^2 + (3)^2}\ \angle \tan^{-1}\frac{2}{3}}$$

$$V_1 = 4.271\angle 20.33$$

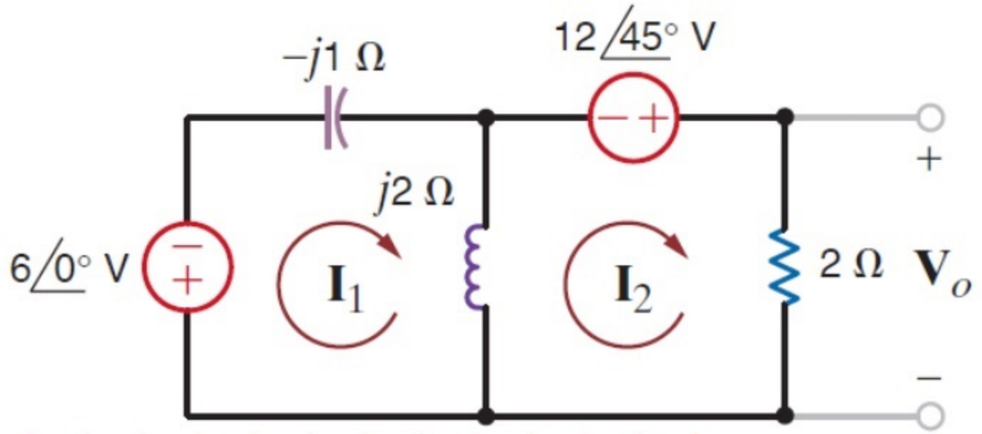
$$\boxed{I_o = 4.271\angle 20.33\,A}$$

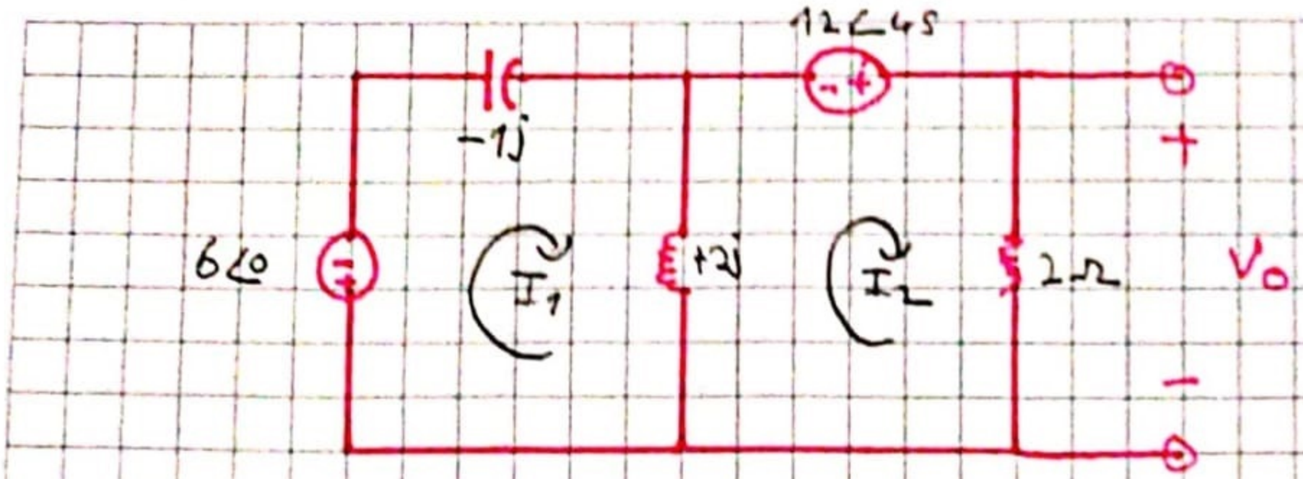
8.51 Using nodal analysis, find $\mathbf{I}_o$ in the circuit in Fig. P8.51.



8.68

8.68 Use mesh analysis to find $\mathbf{V}_o$ in the circuit shown in Fig. P8.68.





1/

$6\angle 0 - j I_1 + 2j I_1 - 2j I_2 = 0$

$j(-I_1 + 2I_2) = 6$

$2I_2 j - 6 = I_1 j$

$2I_2 = V_o$

2/

$2j I_2 - 2j I_1 - 12\angle 45 + 2I_2 = 0$

$12\angle 45 = 8.48 + 8.48j$

$j(2I_2 - 2I_1 - 8.48) - 8.48 + 2I_2 = 0$

$8.48 = 2I_2 j - 2I_1 j - 8.48j + 2I_2$

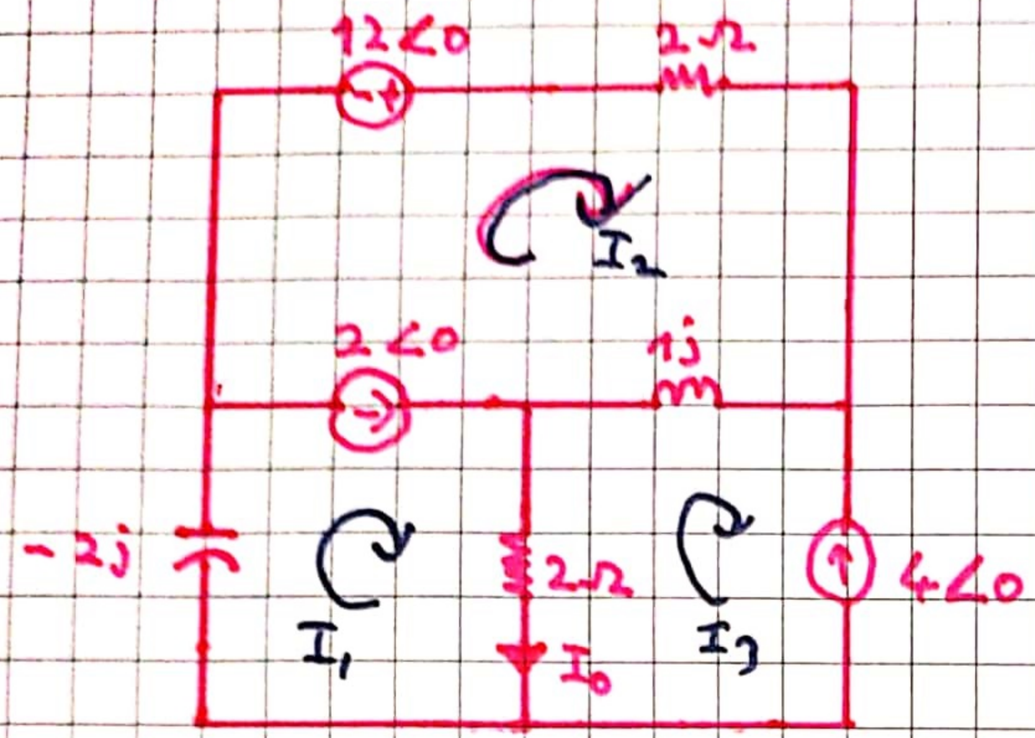
$8.48 = 2I_2 j - 4I_2 j + 12 - 8.48j + 2I_2$, $2I_2 j - 2I_2 = 3.52 - 8.48j$

$$I_2 = \frac{3.52 - 8.48j}{2j - 2} = \frac{9.18\angle -67.45}{2.82\angle -45}$$

$I_2 = 3.25\angle -22.45$ $\quad V_o = 2\angle 0 \times (I_2)$

$\boxed{V_o = 6.5\angle -22.45}$

8.72



$I_1 - I_3 = I_0$ $\quad I_3 = -4$ $\quad I_1 - I_2 = 2$

$I_2 = I_1 - 2$

I_1 ve I_2 SÜ permesh

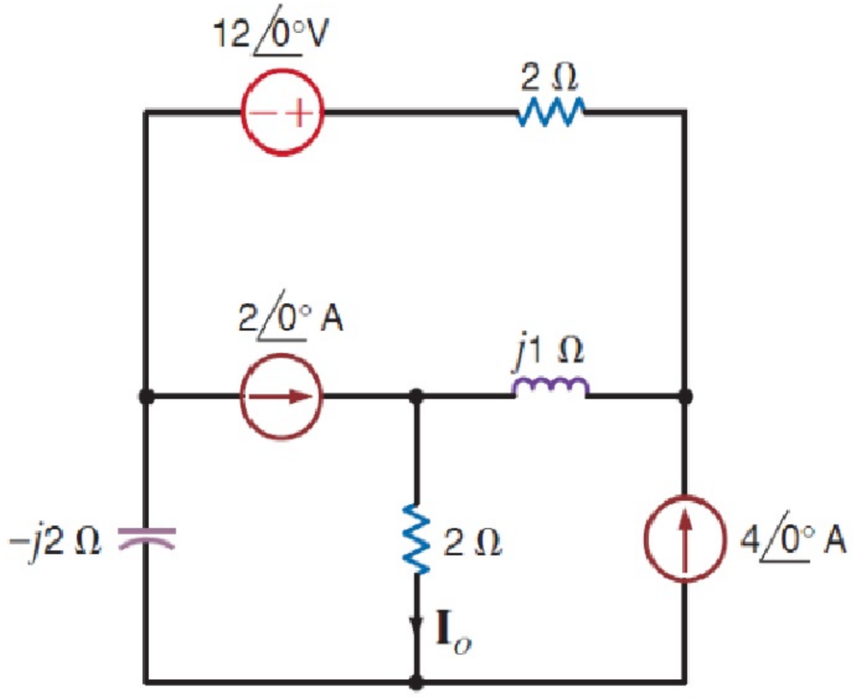
$-2I_1 j - 12 + 2I_2 + 2I_2 j + 4j + 2I_1 + 8 = 0$

I_2 'yi I_1 cinsinden yazalım

$-2I_1 j - 12 + 2I_1 - 4 + 2I_1 j - 4j + 4j + 2I_1 + 8 = 0$

$4I_1 - 8 = 0$ $\quad I_1 = 2$ $\quad I_0 = 6A = 6\angle 0 A$

8.72 Using loop analysis, find $\mathbf{I}_o$ in the network in Fig. P8.72.



8.80 Use loop analysis to find $\mathbf{V}_o$ in the circuit in Fig. P8.80.

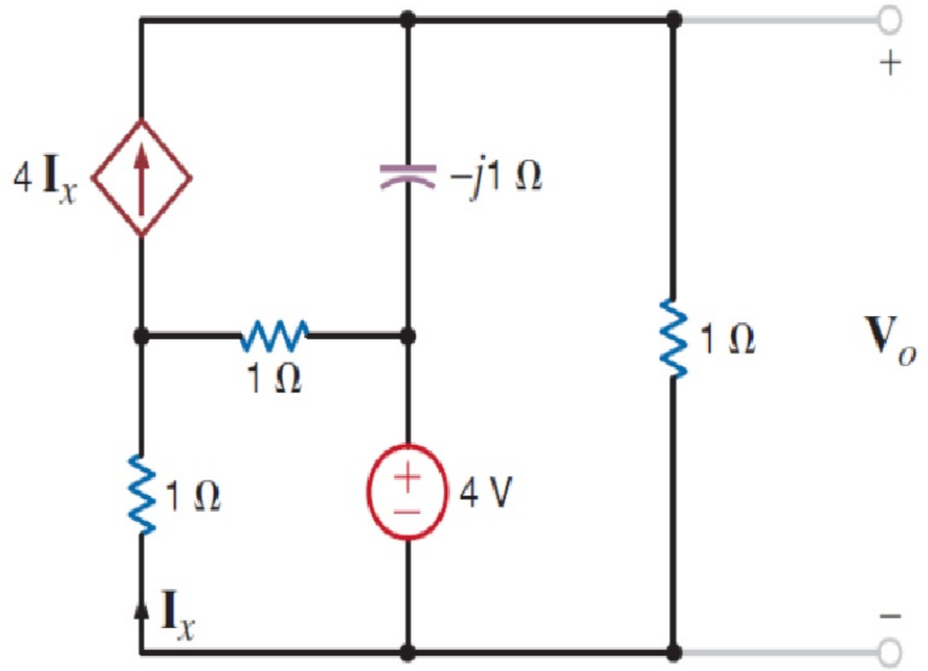
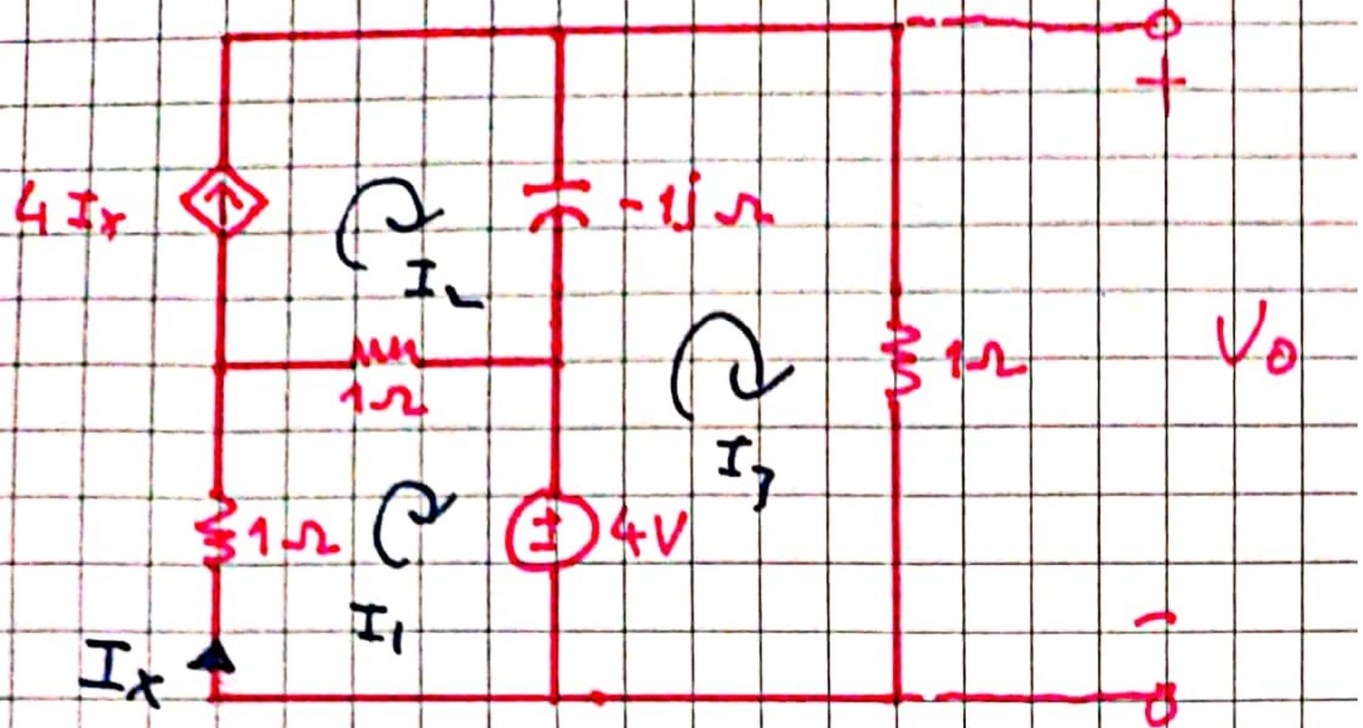


Figure P8.80

8.80



I_1 I_3

$-4V = I_1 + I_3 - I_2$

$I_x = I_1$, $I_2 = 4I_x$

$I_2 = 8$

$-4 = 2I_1 - I_2$ $\quad I_1 = 2$

$-4 = 2I_x - 4I_x$ $\quad I_x = 2$

$-I_3 j + I_2 j + I_3 = 4V$

$\downarrow$

$4 = I_3(1-j) + 8j$

$\downarrow$

$I_3(1-j) = 4 - 8j$

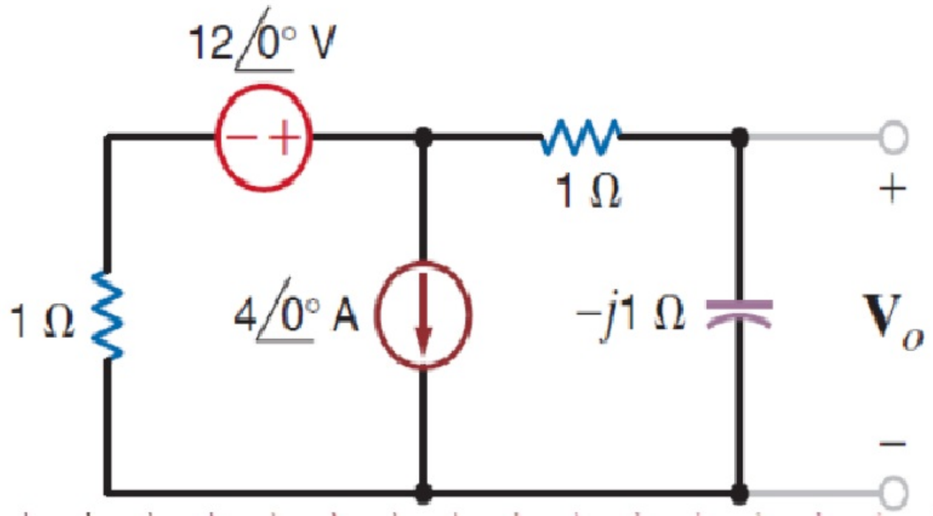
$I_3 = \dfrac{4-8j}{1-j} \Rightarrow \dfrac{4-8j+4j+8}{2} \Rightarrow \dfrac{12-4j}{2} \Rightarrow 6-2j$

$(1+j)$

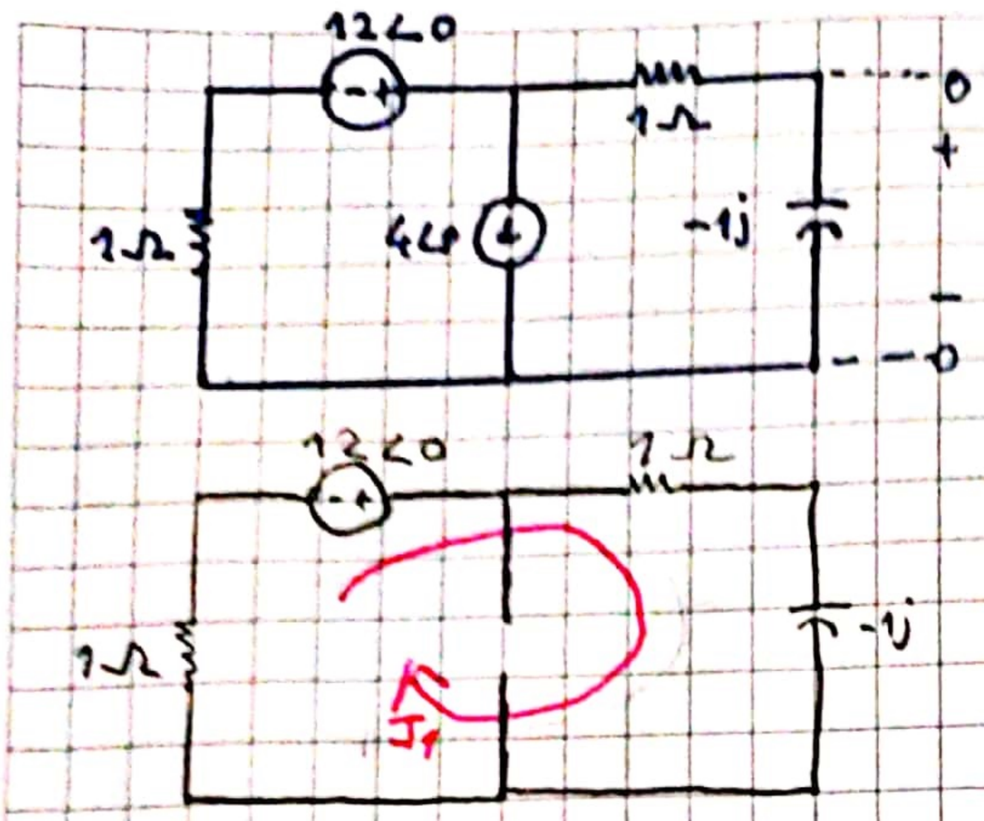
$V_o = 6-2j$

$V_o = 6.32 \angle -18.43$

8.85 Use superposition to find $\mathbf{V}_o$ in the network in Fig. P8.85.



8.85



ilk bosta alalım açık devre

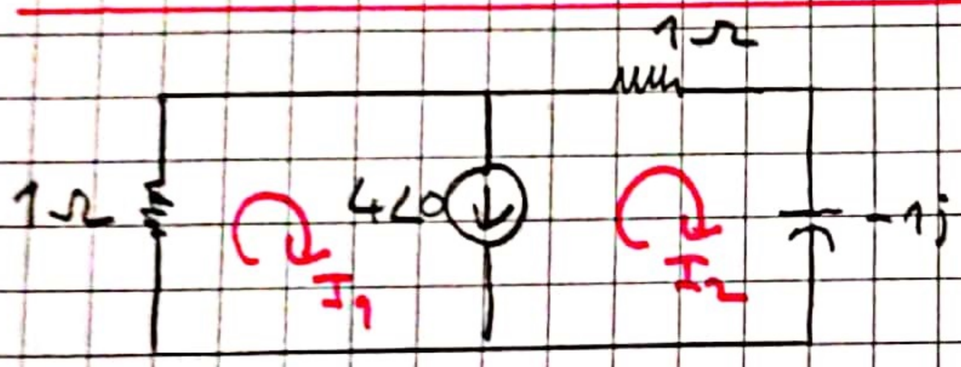
Mesh alalım

$1I_1 - 12 + 1I_1 - 1I_1 j = 0$

$12 = I_1(2-j) \Rightarrow I_1 = \frac{12}{2-j}$ $(2+j)$

$I_1 = \frac{24+12j}{5} \Rightarrow 4.8 + 2.4j$

$V_0' = -1j \times I_1 = -4.8j + 2.4 \Rightarrow V_0' = 2.4 - 4.8j$



Gerilim yerine devre

Süper mesh alalım

$I_1 + I_2 - I_2 j = 0$, $I_1 - I_2 = 4$

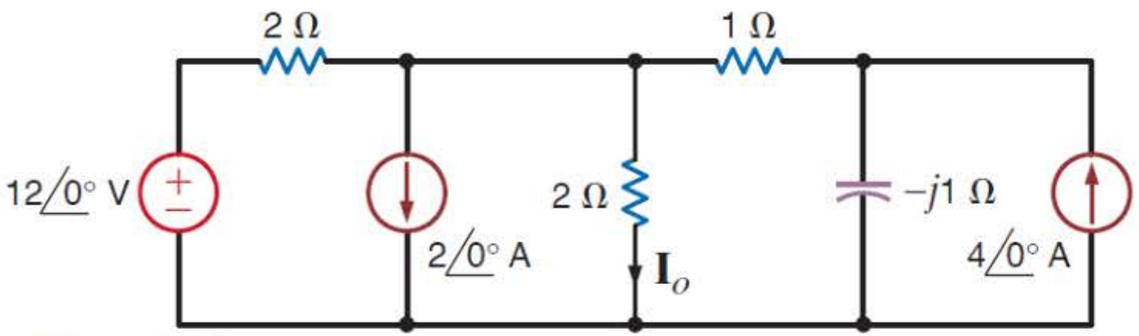
$4 + 2I_2 - I_2 j = 0 \Rightarrow I_2(2-j) = -4 \Rightarrow I_2 = \frac{-4}{2-j}$ $(2+j)$

$I_2 = \frac{-8-4j}{5} \Rightarrow I_2 = -1,6 - 0,8j \Rightarrow V_0'' = -1j \times (-1,6 - 0,8j)$

$V_0'' = 1,6j - 0,8$, $\boxed{V_0'' + V_0' = V_0}$, $V_0 = -3.2j + 1.6$

$\boxed{V_0 = 1.6 - 3.2j \qquad V_0 = 3.57\angle -63.43}$

8.93 Use source exchange to find the current $\mathbf{I}_o$ in the network in Fig. P8.93.



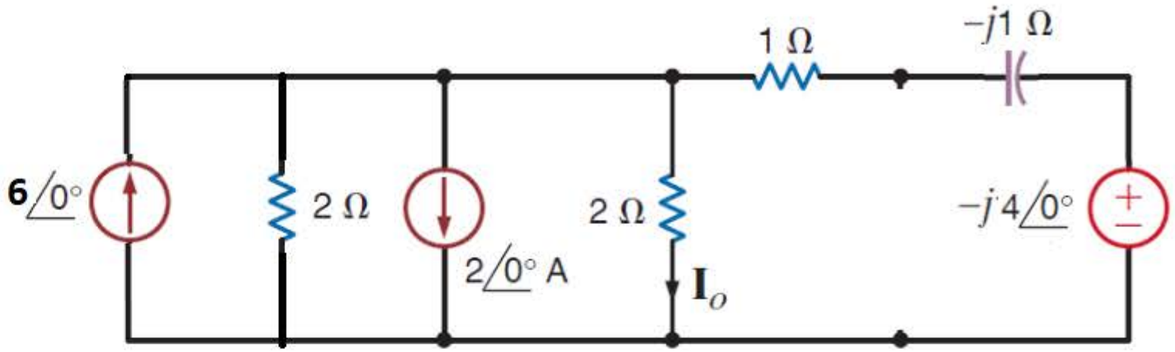
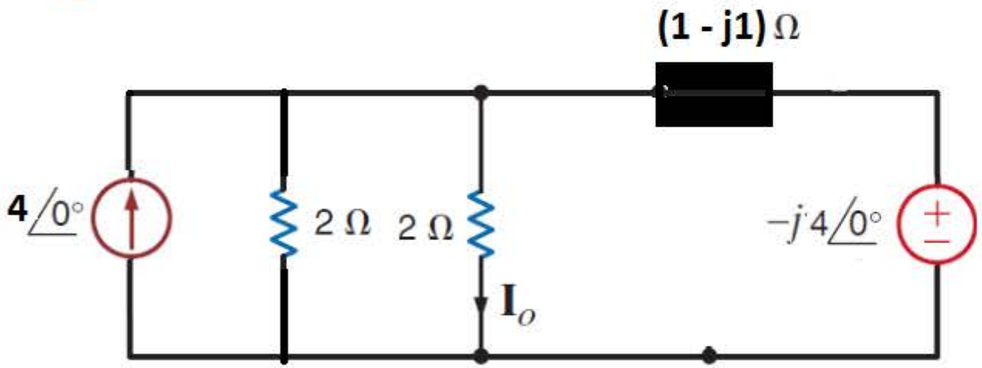
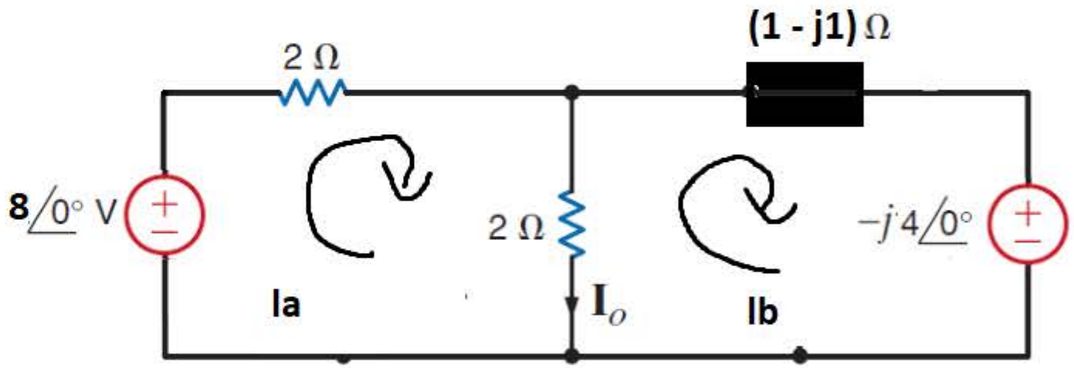


Figure P8.93





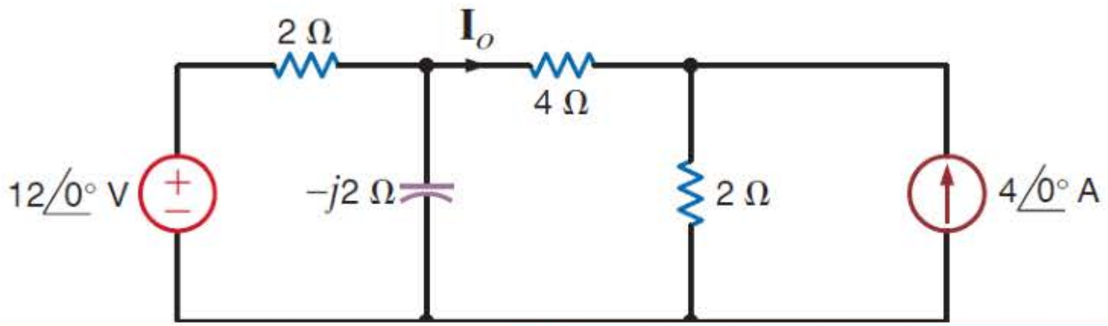
Io = Ia - Ib

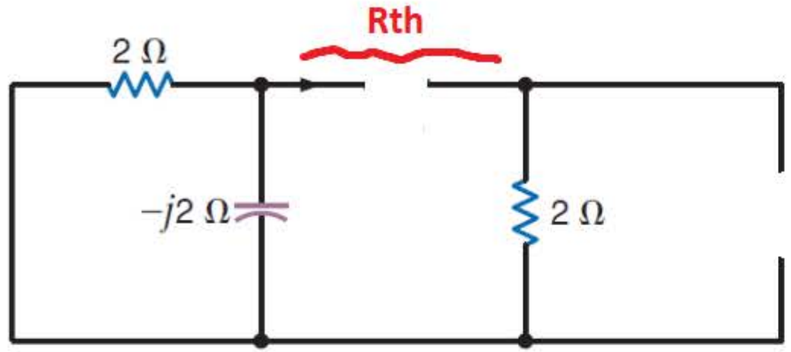
Ia için mesh: 8 = 2Ia + 2Ia - 2Ib , 4= 2Ia-Ib **Ib için mesh: 4j = Ib - Ibj + 2Ib -2Ia**

(Ib denkleminde Ib yerine 2Ia-4 yazalım) 4j = 2Ia - 4 - 2Iaj +4j +4Ia -8 -2Ia , 12 = Ia (4- 2j) 12/(4-2j) = Ia 2 tarafını da (4 +2j) ile çarpıyorum

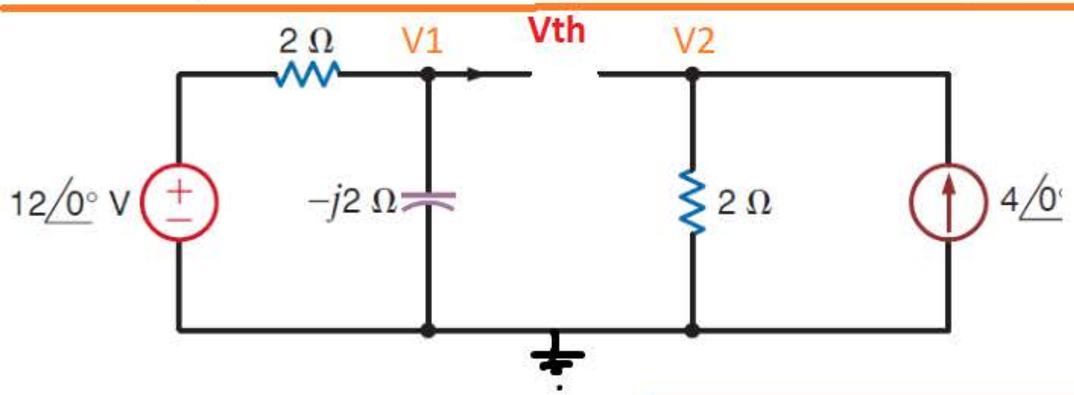
Ia = 2.4 +1.2j geldi 4 = 2Ia - Ib de yerine yerleştirelim 0.8 + 2.4j = Ib geldi , Io(t) = 1.6 - 1.2j Io = 2/-36.86

8.103 Use Thévenin's theorem to find $\mathbf{I}_o$ in the network in Fig. P8.103.





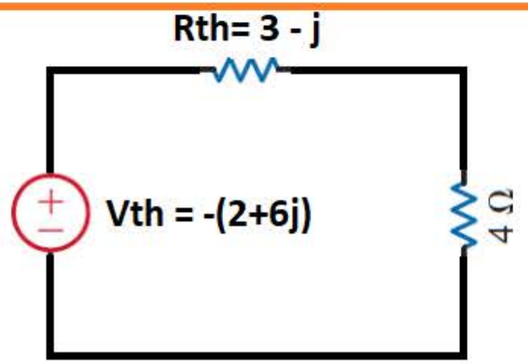
Rth= (2 // -j2) + 2
Rth= 3 - j



V2= 4A x 2ohm = 8V

V1'i bulabilmek için -j2 üzerinden geçen akımı bulmamız lazım bu yüzden mesh alalım
-12 + 2Ia - j2Ia
Ia(2-2j)=12 , Ia= 6/(1-j) , Ia = 3 + 3j ,Ia x (-j2) = V1 -6j + 6 = V1 geldi

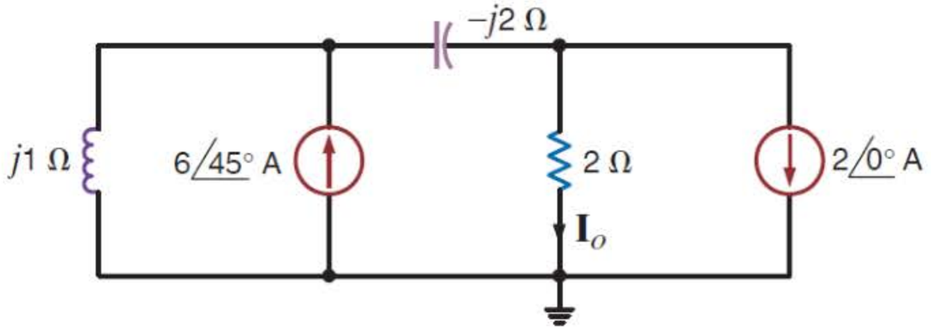
V1-V2 de bana Vth ı verir
-6j + 6 - 8 = -2 -6j Vth = -(2+6j) geldi

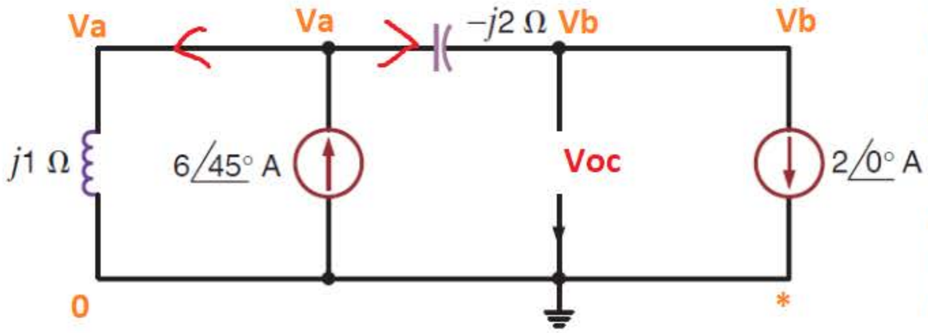


devrenin akımı Io a eşit olacaktır.
(-2-6j) / 7-j = -0.16 - 0.88j

Io = -0.16 -0.88j

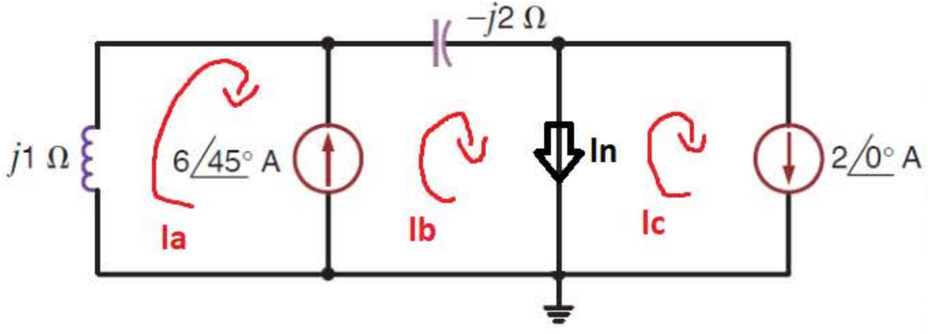
8.114 Find $\mathbf{I}_o$ in the network in Fig. P8.114 using Norton's theorem.





Va için mesh alalım , G = - , Ç = +
(Va/1j) - (4.24+4.24j) + ((Va-Vb)/-2j) = 0
paydaları -2j de birleştirince
Va+Vb = 8.48j - 8.48 geldi

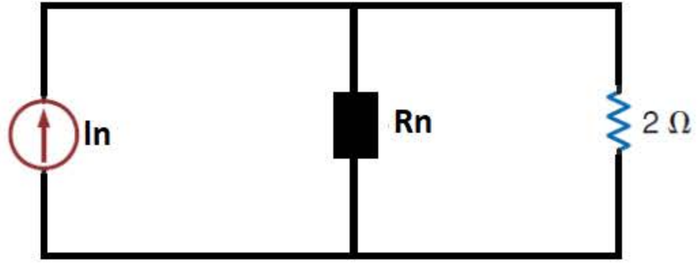
Vb için mesh
(Va-Vb/2j) +2 = 0 , Va - Vb = -4j
Vb = 6.24j -4.42
Voc = Vb = 6.24j -4.42



Ib-Ia = 4.24 + 4.24j , Ib-Ic=In Ic=2

-j2 üzerinden geçen akımı bulmak için akım bölücü uygulayalım

(Ib-Ia)x(1j/-1j) = -4.24 -4.24j geldi
giren akım çıkan akımlara eşittir
-4.24-4.24j = 2 + In
In = -6.24-4.24j Voc = 6.24j -4.42
Voc/In = Rn Rn = -j



2ohm üzerinden geçen akım = Io

Io = In x (Rn/Rn+2)
Io = (-6.24 - 4.24j) x (-j / 2-j) , (-6.24 - 4.24j) x (0.2 - 0.4j)
Io = -2.94 + 1.64j
Io = 3.366 ∠-29.153

8.142

$16\cos(377t+45) = 16\angle 45$

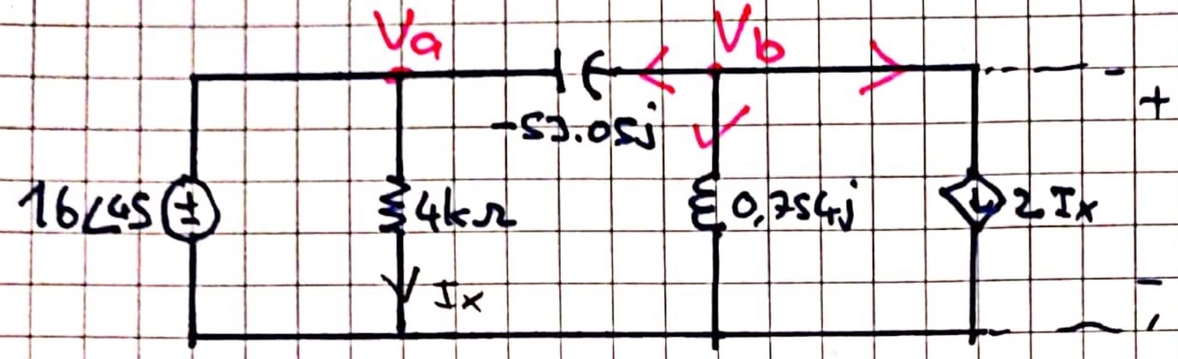
$\omega = 377$

$2\text{mH} = j \times 377 \times 2 \times 10^{-3}$

$Z_L = 0.754j$

$50\mu F = \frac{1}{j\omega C}$

$Z_C = -53.05j$



$I_x = \frac{16\angle 45}{4\times 10^3} = \frac{11.31 + 11.31j}{4\times 10^3} = 2.8275\times 10^{-3}(1+j)$

$\frac{(V_b - 11.31 - 11.31j)}{-53.05j} + \frac{V_b}{0.754j} + 2 \times (2.82\times 10^{-3}(1+j)) = 0$

(-20) yokladigik 20 kati $20 \times 0.754 = -53.05$

$V_b - 11.31 - 11.31j - 20V_b = 106 \times (2.82\times 10^{-3})(1+j)$

$-69V_b = 0.29 + 0.29j + 11.31 + 11.31j$

$-11.6 - 11.6j = 69V_b$

$-0.16 - 0.16j = V_b = V_o$, $V_o = 0.22\angle 45$

$\boxed{V_o(t) = 0.22\cos(377t+45)}$

142 Find $v_o(t)$ in the network in Fig. P8.142.