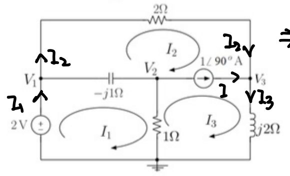
1. In the following circuit determine the node-voltage phasors $V_1$, $V_2$, and $V_3$ and express them in polar form.




$\Rightarrow 1\angle\frac{\pi}{2} = e^{i\frac{\pi}{2}} = \cos\frac{\pi}{2} + j\sin\frac{\pi}{2} = j$, $V_1 = 2V$

For $I_1$: $2V = (I_1 - I_2)(-1j\,\Omega) + (I_1 - I_3)$

For $I_2$: $2\cdot I_2 + I_3(2j\,\Omega) + (I_3 - I_1) + (I_2 - I_1)\cdot(-1j) = 0$

Fo loop: $i + I_2 = I_3$

$$\Rightarrow \begin{cases} 2V = -jI_1 + jI_2 + I_1 - I_3 \\ 2I_2 + 2jI_3 + I_3 - I_1 - jI_2 + jI_1 = 0 \\ I_3 - I_2 = j \end{cases}$$

$$\begin{cases} (j-1)I_1 + (2-j)I_2 + (1+2j)I_3 = 0 \\ (1-j)I_1 + jI_2 - I_3 = 2 \\ 0I_1 - I_2 + I_3 = j \end{cases}$$

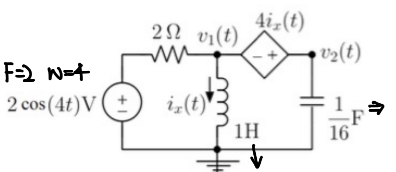
$$\boxed{\Rightarrow \begin{cases} V_1 = 2V = 2\angle 0 \\ V_2 = 0.5 + 0.5j = \frac{\sqrt{2}}{2}\angle\frac{\pi}{4} \\ V_3 = 2jV = 2\angle\frac{\pi}{2} \end{cases}}$$

2. In the circuit shown for Problem 1, determine the loop-current phasors $I_1$, $I_2$, and $I_3$ and express them in polar form.

$$\Rightarrow \begin{bmatrix} j-1 & 2-j & 1+2j \\ 1-j & j & -1 \\ 0 & -1 & 1 \end{bmatrix}\begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 2 \\ j \end{bmatrix} \Rightarrow \begin{cases} I_1 = \frac{3+j}{2}A = \frac{3}{2} + \frac{j}{2} = \frac{\sqrt{10}}{2}\angle\arctan\frac{1}{3} \\ I_2 = (1-j)A = \sqrt{2}\angle -\frac{\pi}{4} \\ I_3 = 1 \quad A = \angle 0 \end{cases}$$

3. Use the phasor method to determine $v_1(t)$ in the following circuit:

F=2 w=4



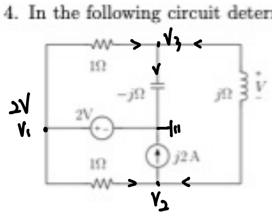

$\Rightarrow Z = \frac{1}{j\omega C} = \frac{16}{4j} = -4j$

$Z = j\omega L = 4j$

$$\Rightarrow \begin{cases} \frac{2-V_1}{2} = \frac{V_2}{-4j} + \frac{V_1}{4j} \\ \frac{V_1}{4j}\cdot 4 = (V_2 - V_1) \end{cases} \Rightarrow \begin{cases} 2j(2-V_1) = -V_2 + V_1 \\ -jV_1 = V_2 - V_1 \end{cases}$$

$$\Rightarrow \begin{cases} (1+2j)V_1 - V_2 = 4j \\ (j-1)V_1 + V_2 = 0 \end{cases} \Rightarrow \begin{cases} V_1 = \frac{4}{3} \\ V_2 = \frac{4}{3} - \frac{4}{3}j \end{cases} \Rightarrow \boxed{\begin{aligned} V_1(t) &= \frac{4}{3}\,\mathrm{Re}\{e^{i\omega t}\} \\ &= \frac{4}{3}\cos 4t \end{aligned}}$$

4. In the following circuit determine the phasor $V$ and express it in polar form:




$$\begin{cases} \frac{2-V_3}{1} + \frac{V_2 - V_3}{j} = \frac{V_3}{-j} \\ 2j = \frac{2-V_2}{1} + \frac{V_3 - V_2}{j} \end{cases}$$

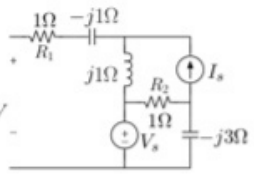
$$\begin{cases} \frac{2-V_2}{1} + \frac{2-V_3}{1} = 2j + jV_3 \\ j(V_3 - V_2) + 2 - V_3 = jV_3 \end{cases}$$

$= V_2 = \frac{8-6j}{5} \Rightarrow V = \frac{-4-2j}{5}$

$V_3 = \frac{4-8j}{5}$

$= -\frac{2}{5}(2+j) = \boxed{-\frac{2\sqrt{5}}{5}\angle\arctan\frac{1}{2}}$

5. Use the following network to answer (a) through (d):



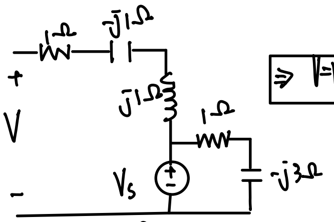

(a) Determine the phasor $V$ when $I_s = 0$.

(b) Determine the phasor $V$ when $V_s = 0$.

(c) Determine $V$ when $V_s = 4\,\text{V}$ and $I_s = -2\,\text{A}$, and calculate the average power absorbed in the resistors.

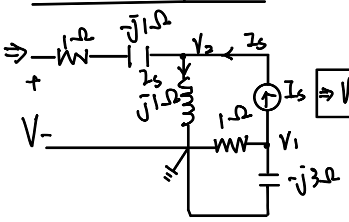
(d) What is the Thevenin equivalent and the available average power of the network when $V_s = 4\,\text{V}$ and $I_s = -2\,\text{A}$?

(a) $I_s=0 \Rightarrow$



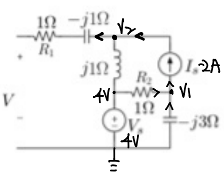

$\Rightarrow \boxed{V=V_s}$

(b) $V_s=0 \Rightarrow$




$\boxed{\Rightarrow V = I_s \cdot j}$

(C)




$\Rightarrow \begin{cases} \frac{-V_1}{-3j} + \frac{4-V_1}{1} = -2A \\ \frac{V_2-4}{j1\Omega} = -2A \end{cases}$

$= \begin{cases} V_1 = \frac{54-18j}{10}\ V \\ V_2 = 4-2j\ V \end{cases}$

$\Rightarrow I = \frac{V_1-4}{R} = \frac{14-18j}{10} A$

$\Rightarrow \boxed{P_{avg} = \frac{1}{2} Re\left\{\frac{14-18j}{10} \cdot \frac{14+18j}{10}\right\} = \frac{1}{2} \times \frac{26}{5} = \frac{13}{5} W}$

(d) short the ckt,

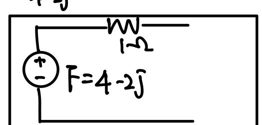
$\begin{cases} \frac{-V_1}{-3j} + \frac{4-V_1}{1} = -2A \\ \frac{V_2-0}{1-j} = \frac{4-V_2}{j} - 2 \end{cases}$

$\Rightarrow \begin{cases} V_1 = \frac{54-18j}{10} \\ V_2 = 2-6j \end{cases}$

$\Rightarrow I = \frac{2-6j}{1-j} = 4-2j\ V$

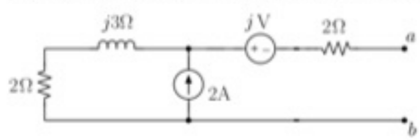
$\Rightarrow R = \frac{4-2j}{4-2j} = 1\Omega$

$\Rightarrow$

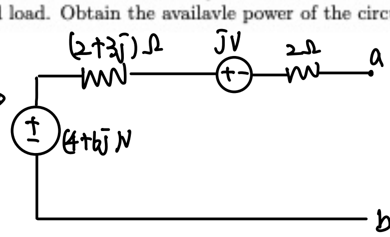



$\boxed{\Rightarrow P_{ava} = \frac{|V_T|^2}{8R} = \frac{4^2+2^2}{8} = \frac{5}{2} W}$

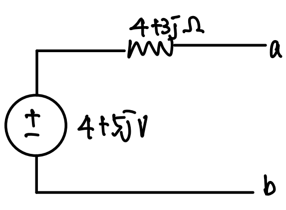
6. Determine the impedance $Z_L$ of a load that is matched to the following network at terminals $a$ and $b$, and determine the net power absorbed by the matched load. Obtain the availavle power of the circuit.




$\Rightarrow$




$\Leftrightarrow$




$\Rightarrow R_L = 4-3j\ \Omega$

$\Rightarrow$ net power absorbed

Avaiible Pwr: $P = |V_T|^2/8 \cdot 4 = \frac{41}{32} W$