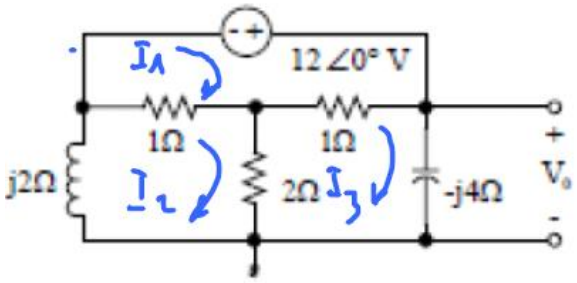
1. ω = 1 rad/s. (a) Use mesh analysis to find $I_0$ and $V_0$ in the network in next figure. (b) Find the average power and the power factor in the branch corresponding to $I_0$.




$I_3 = I_0$

(a) $2I_1 - I_2 - I_3 = 12\angle 0°$

$-I_1 + (3+2j)I_2 - 2I_3 = 0$

$-I_1 - 2I_2 + (3-j4)I_3 = 0$

$$\begin{bmatrix} 2 & -1 & -1 \\ -1 & (3+2j) & -2 \\ -1 & -2 & (3-4j) \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 12\angle 0 \\ 0 \\ 0 \end{bmatrix}$$

$I_1 = 9.03 + 1.15j$

$I_2 = 4.04 - 0.47j$

$I_3 = 2.02 + 2.76j = I_0$ $\quad V_0 = (2.02 + 2.76j)(-j4) = 11.04 - 8.08j$

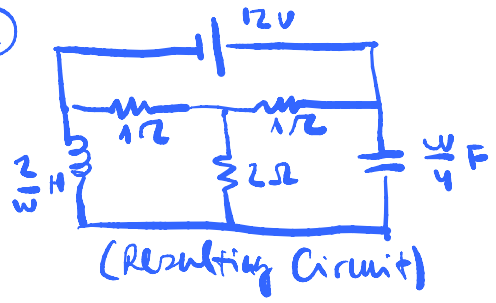
$I_0 = 3.42\angle 53.8$ $\quad V_0 = 13.68\angle -36.2$

(b) $P_{av} = \frac{1}{2} I_0 \cdot V_0 \cdot \cos(\theta_{V_0} - \theta_{I_0}) = \frac{1}{2} 3.42 \cdot 13.68 \cos(90) = 0$ W

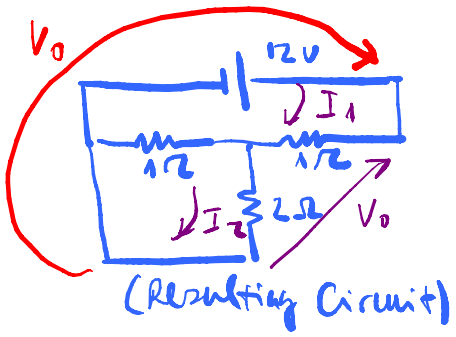
Power factor $= \cos(90) = 0$ Watt

2. Replace the AC source in the previous figure with a DC source of 12 V. (same polarity) (a) Draw the resulting circuit and the equivalent circuit for DC steady state analisys. (b) Use mesh analisys to find $V_0$. (steady state). (c) Find the power dissipated in the 2 ohm resistance.

(a)




(Resulting Circuit)




(Resulting Circuit)

$V_0 = I_1 \cdot 1\Omega + I_2 \cdot 2\Omega$

OR $V_0 = 12\ V$ (also)

(b)

$2I_1 - I_2 = 12$

$-I_1 + 3I_2 = 0$

$\begin{bmatrix} 2 & -1 \\ -1 & 3 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 12 \\ 0 \end{bmatrix}$

$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 0.59 & 0.20 \\ 0.20 & 0.40 \end{bmatrix} \begin{bmatrix} 12 \\ 0 \end{bmatrix} = \begin{bmatrix} 0.59 \times 12 \\ 0.20 \times 12 \end{bmatrix} = \begin{bmatrix} 7.2 \\ 2.4 \end{bmatrix}$

$I_1 = 7.2\ A$ , $I_2 = 2.4\ A$

$V_0 = 7.2A \cdot 1\Omega + 2.4A \cdot 2\Omega = 12\ V$

(c) $P = I_2^2 \cdot 2\ W = 11.52\ W$