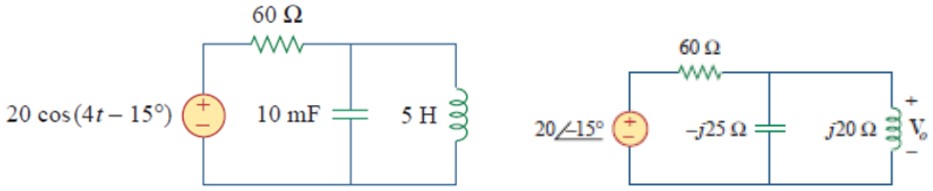
Problem 1 (5 points)

Given the AC circuit in the next figure. Calculate:

a) The total equivalent impedance of the circuit.
b) The maximum value of the current through the total equivalent impedance.
c) The effective values for the voltage and current found in (b).
d) The phasor representation for the current found in (b) and the voltage (Max Values).
e) The power factor and average power for the total circuit.
f) The máximum current through the 5H inductor branch.

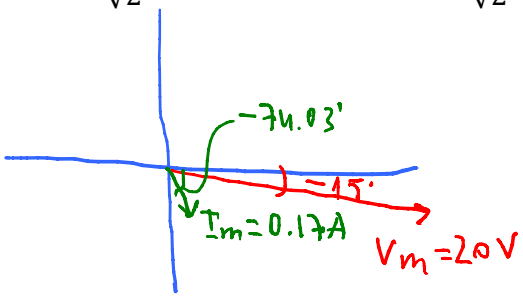


(a) $Z_{eq}= (60 + 100j)\Omega = 116.62_{59.04^o}\ \Omega$

(b) $I_m = 0.17_{-74.04^o}$ A

(c) $V_{eff} = \frac{20}{\sqrt{2}} = 14.14$ V ,, $I_{eff} = \frac{0.17}{\sqrt{2}} = 0.12$ A

(d)



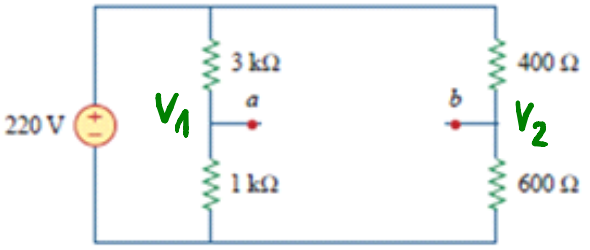
(e) $PF_{TOT}=\cos(-15^o-(-74.04^o))=0.51$,, $PTOT_{av}= V_{eff}* I_{eff}*PF_{TOT}=0.87$W

(f) $V_{5H}= \frac{100j}{60+100j} 20_{-15^o} = 17.20_{15.96^o}$ V ,,

$I_{5H}= V_{5H}/20j = (17.20_{15.96^o})/20_{90^o} = 0.86_{-74.04^o}$ A

Problem 2 (5 points)

Given the following DC circuit. Find across nodes a and b: (a) the Thevenin equivalent, (b) the Norton equivalent. Note: Do not use Source Transformation.



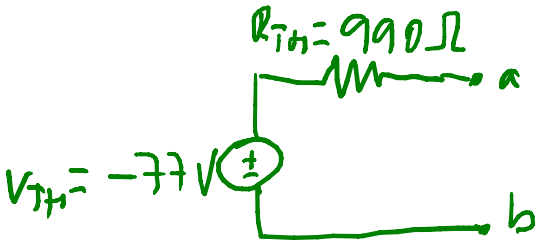
(a)

$$R_{Th} = 3000 \parallel 1000 + 400 \parallel 600$$
$$= \frac{3000 \times 1000}{3000 + 1000} + \frac{400 \times 600}{400 + 600} = 750 + 240 = 990\ \Omega$$

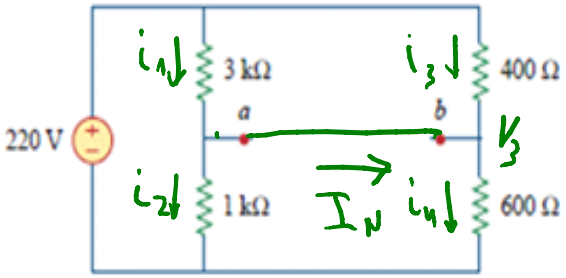
$$v_1 = \frac{1000}{1000 + 3000}(220) = 55 \text{ V}, \qquad v_2 = \frac{600}{600 + 400}(220) = 132 \text{ V}$$

Applying KVL around loop *ab* gives

$$-v_1 + V_{\text{Th}} + v_2 = 0 \quad \text{or} \quad V_{\text{Th}} = v_1 - v_2 = 55 - 132 = -77 \text{ V}$$



(b) $R_N = 990\ \Omega$



$$V_3 = 220 \cdot \frac{(1\,k\Omega \| 600\,\Omega)}{(1\,k\Omega \| 600\,\Omega) + (3\,k\Omega \| 400\,\Omega)} = 220 \cdot \frac{375}{375 + 352.94} = 113.33\ V$$

$$i_1 = i_2 + I_N \;\Rightarrow\; I_N = i_1 - i_2 = \frac{220 - 113.3}{3\,k\Omega} - \frac{113.3}{1\,k\Omega} = -0.08\ A$$