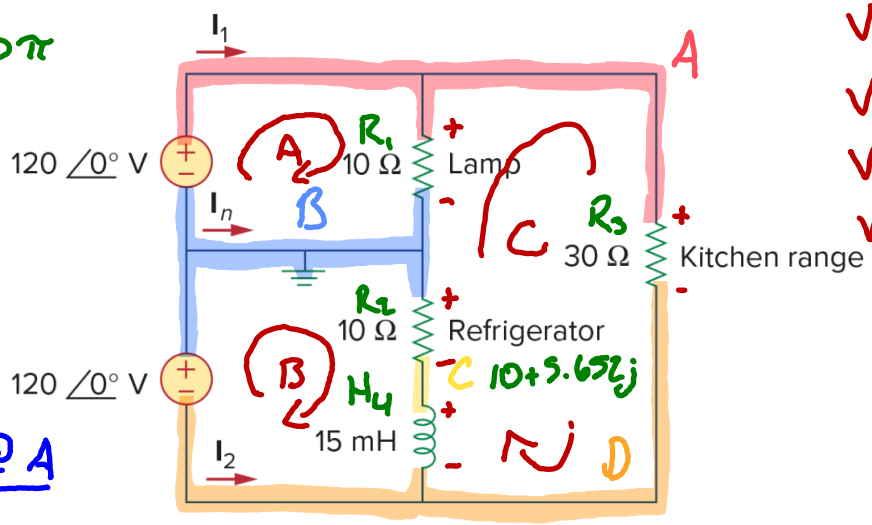
Homework 7
Due: Friday, March 24th, 2023 by 7PM.

Note: In order to receive full credit, you must show your work and carefully justify your answers. The correct answer without any work will receive little or no credit.

1. A regular household system of a single-phase three-wire circuit allows the operation of both 120V and 240V, 60Hz appliances. The household circuit is modeled as shown below:
   A. Calculate the currents i1(t), in(t), and i2(t).
   B. Find the total complex power supplied. 16.73
   C. Find the overall power factor of the circuit. 99



$\omega = 120\pi$

$V_A = 120\angle 0°\ V$

$V_B = 0V$

$V_C =$

$V_D = -120\angle 0°\ V$

$I_L = I_A - I_C$

$I_R = I_B - I_C$

$I_k =$

KVL @ A

$120 = V_L$

$120 = 10 I_L$

$12 = I_A - I_C$

KVL @ B

$120 = V_R$

$120 = (10+5.6j) I_R$

$120 = (10+5.6j) I_B - (10+5.6j) I_C$

KVL @ C

$V_k = V_L + V_R$

$240 = V_k$

$240 = 30 I_C$

$8 = I_C$

$$\begin{array}{ccc|c} 1 & 0 & -1 & 12 \\ 0 & 10+5.6j & -10-5.6j & 120 \\ 0 & 0 & 1 & 8 \end{array}$$

$I_A = 20$

$I_B = 17.88266\, e^{-16.623j}$

$I_C = 8$

A)

$I_1 = 20A$

$I_n = I_B - I_A = 5.9\, e^{-1.45j}\ A$

$I_2 = -17.88266\, e^{-16.623j}\ A$

$= \frac{1}{2}\, 120\, (-17.85 \angle 163.26°)^*$

$= 60\, (17.85 \angle -16.74°)^*$

$= 60 \cdot 17.85 \angle 16.74°$

$= 1071 \angle 16.74°\ VA \approx 1025.61 + 308.48j\ VA$

$S_{tot} = S_1 + S_2 = 2225.61 + 308.48j\ VA$

B.

$S_{tot} \approx 2246.89 \angle 7.89°\ VA$

C

$$PF = \frac{P}{|S|} = \frac{2207.54}{\sqrt{2207.54^2 + 346.92^2}} = .9878$$