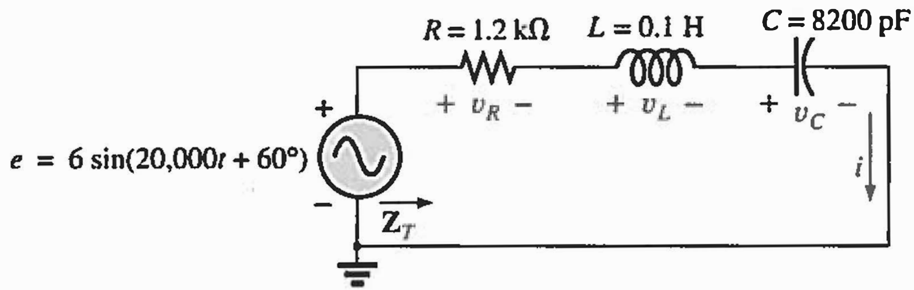


For the circuit shown above, answer the following questions:

1. Calculate Z_T:

A) $(1.20k + j4.10k)\ \Omega$
B) $(1.20k - j8.10k)\ \Omega$
C) $(1.20k - j4.10k)\ \Omega$
D) $(1.20k + j8.10k)\ \Omega$

$X_C = 6.1K\ \Omega \qquad X_L = 2.0K\ \Omega$

$Z_T = R + j X_L - j X_C = 1.2K + j\,2K - j\,6.1 = (1.20k - j4.10k)$

2. Determine V_L:

A) 2.8 Vrms <-136°
B) 2.0 Vrms <-136°
C) 2.0 Vrms < -14°
D) 2.8 Vrms <- 14°

$I_T = Es / Z_T = 4.24\text{Vrms}\angle 60° / 4.27K\angle -73.7°$

$I_T = 993\text{uArms}\ \angle 134°$

$V_L = j X_L * I_T = 1.98\ \text{Vrms}\ \angle 224° \rightarrow -136°$

3. At what frequency is X_L equivalent to X_C?

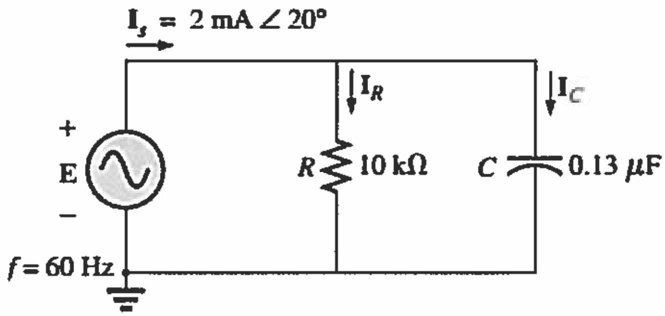
A) 443 Hz
B) 886 Hz
C) 5560 Hz
D) 11.1K Hz

$F_R = 1/(2 * \pi * \sqrt{L * C}) = 1/(2 * \pi * \sqrt{0.1 * 8200pF}) = 5558\text{Hz}$

4. At the frequency at which $X_L = X_C$, $|Z_T|$ will:

A) Increase from its value at 20,000 r/s
B) Decrease from its value at 20,000 r/s
C) Stay the same as its value at 20,000 r/s
D) Reach its maximum value

X_L will cancel X_C leaving only R



$Is = 2mA_{RMS} < 20°$

For the circuit shown above, answer the following questions:

5. Find Y_T, the total admittance looking into the network from the source:

A) 111μ mhos < 26 °
B) 500μ mhos < -79 °
C) 500μ mhos < 26 °
D) 111μ mhos < -64 °

$Y_T = (1 / R) + (1 / -j X_C)$ where $X_C = 20.4K\ \Omega$
$Y_T = (1 / R) + (1 / -j X_C)$
Y_T = 100u mhos +j 49.0u mhos = 111μ mhos < 26 °

6. Determine the value of **E**:

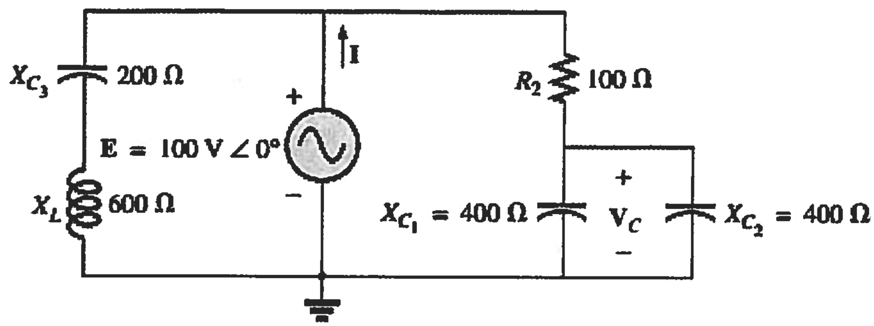
A) 18 V_{RMS} < 84 °
B) 18 V_{RMS} < -6 °
C) 20 V_{RMS} < 20 °
D) 4 V_{RMS} < -6 °

$E = I_s / Y_T$ = 2ma< 20°/ 111μ mhos < 26 ° = 18Vrms < -6.1 °

7. As the frequency is increased above 60Hz, what happens to **IR** and **IC**?

A) **IR** remains the same but **IC** will decrease
B) **IR** and **IC** will remain the same
C) IR remains the same but IC will increase
D) **IC** remains the same but **IR** will increase

as f ↑, X_C ↓, I_C ↑
and I_R →

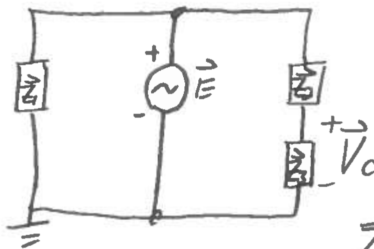


E = 100V$_{RMS}$ < 0 °

<u>For the circuit shown above</u>, answer the following questions:

8. Find **Z$_T$**, the total impedance looking into the network from the source:

A) 783 Ω < -7 °
B) 563 Ω < -86 °
C) 783 Ω < +86 °
D) 400 Ω < -37 °



$\vec{Z}_T = \vec{Z}_1 // (\vec{Z}_2 + \vec{Z}_3)$

$\vec{Z}_1 = (-j200 + j600)\,\Omega$

$\vec{Z}_2 = 100\,\Omega$

$\vec{Z}_3 = -j200\,\Omega$

$\vec{Z}_T = (+j400)\,\Omega // (100 - j200)\,\Omega$

$\boxed{\vec{Z}_T = 400\,\Omega \angle -36.9°}$

9. Determine the value of **Vc**:

A) 89.4 V$_{RMS}$ < -26.6 °
B) 97.1 V$_{RMS}$ < -14.0 °
C) 66.7 V$_{RMS}$ < -41.0 °
D) 53.2 V$_{RMS}$ < -14.0 °

$\vec{V}_c = \vec{E}\left(\frac{\vec{Z}_3}{\vec{Z}_2 + \vec{Z}_3}\right) = 100V_{RMS} \angle 0° \frac{-j200\,\Omega}{(100 - j200)\,\Omega}$

$\boxed{\vec{V}_c = 89.4V_{RMS} \angle -26.6°}$

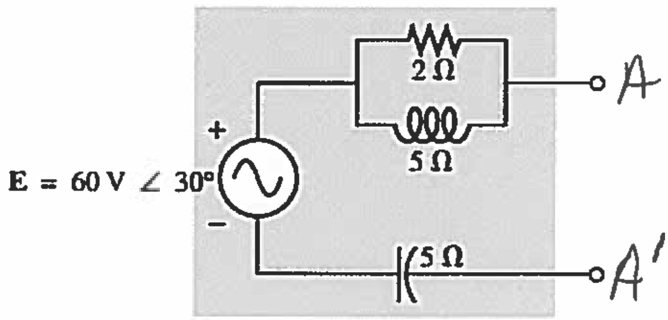
10. If the source frequency is 5 kHz, find the value of C1:

A) 79.6 nF
B) 796 nF
C) 38.9 nF
D) 398 nF

$X_{C_1} = \frac{1}{2\pi f C_1}$

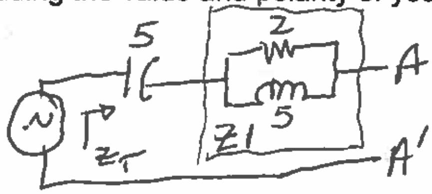
$400\,\Omega = \frac{1}{2\pi (5kHz) C_1}$

$\therefore \boxed{C_1 = 79.6nF}$



$\mathbf{E} = 60V_{RMS} < 30°$

11. Convert the voltage source shown above to an equivalent current source. Make sure you label the terminals on both sources appropriately and draw the complete schematic diagram including the value and polarity of your current source:



$Z_1 = \frac{2 \cdot j5}{2+j5} = 1.86\Omega \angle 21.8^\circ$

$= 1.73 + j0.69$

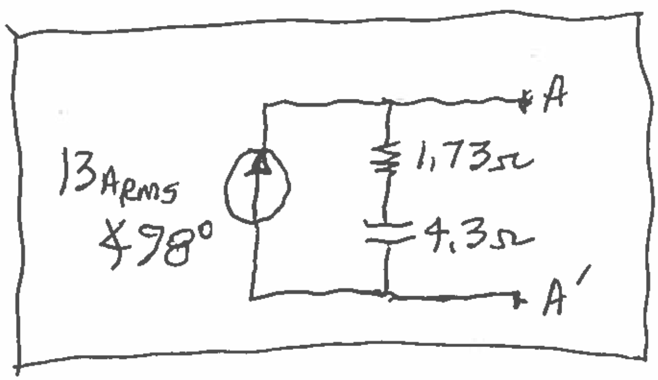
$Z_T = -j5 + (1.73 - j0.69)$

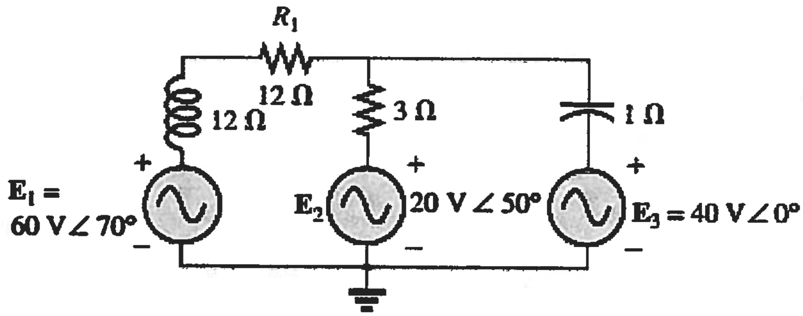
$Z_T = 1.73 - j4.3$

$Z_T = 4.63\Omega \angle -68.1^\circ$

$I_{SC} = \frac{60V \angle 30^\circ}{4.63 \angle -68.1^\circ}$

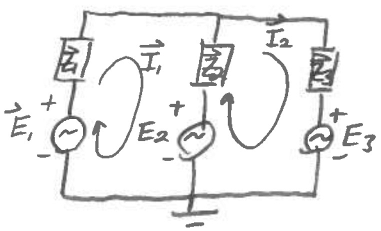
$= 12.96 \angle 98.1^\circ A_{RMS}$





Voltage source values in RMS

12. Develop the MESH equations for the circuit shown above. Convert the circuit to impedance boxes and show your MESH currents on this circuit. Box-in your MESH equations once you have them in their simplest form:



$\vec{Z}_1 = (12 + j12)\,\Omega$ $\quad$ $\vec{E}_1 = 60V_{RMS} \angle 70°$

$\vec{Z}_2 = 3\,\Omega$ $\quad$ $\vec{E}_2 = 20V_{RMS} \angle 50°$

$\vec{Z}_3 = -j1\,\Omega$ $\quad$ $\vec{E}_3 = 40V_{RMS} \angle 0°$

$\vec{I}_1 : \vec{E}_1 - \vec{I}_1\vec{Z}_1 - (\vec{I}_1 - \vec{I}_2)\vec{Z}_2 - \vec{E}_2 = 0$

$\vec{I}_1(\vec{Z}_1 + \vec{Z}_2) - \vec{I}_2\vec{Z}_2 = \vec{E}_1 - \vec{E}_2 \quad (1)$

$\vec{I}_2 : \vec{E}_2 - (\vec{I}_2 - \vec{I}_1)\vec{Z}_2 - \vec{I}_2\vec{Z}_3 - \vec{E}_3 = 0$

$-\vec{I}_1\vec{Z}_2 + \vec{I}_2(\vec{Z}_2 + \vec{Z}_3) = \vec{E}_2 - \vec{E}_3 \quad (2)$

OR: 1) & 2)

$$\boxed{\begin{aligned} \vec{I}_1(15 + j12) - \vec{I}_2(3) &= 41.77\angle 79.43° \\ -\vec{I}_1(3) + \vec{I}_2(3 - j1) &= 31.17\angle 150.6° \end{aligned}}$$

$AX = B$ FORM

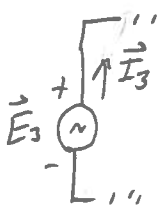
$$A = \begin{bmatrix} (15 + j12) & (-3) \\ (-3) & (3 - j1) \end{bmatrix}$$

$$B = \begin{bmatrix} 41.77\angle 79.43° \\ 31.17\angle 150.6° \end{bmatrix}$$

$$X = \begin{bmatrix} \vec{I}_1 \\ \vec{I}_2 \end{bmatrix}$$

$$X = A^{-1}B = \begin{bmatrix} 3.099\angle 72.53° \\ 10.85\angle 153.7° \end{bmatrix} \begin{matrix} \leftarrow \vec{I}_1 \\ \leftarrow \vec{I}_2 \end{matrix}$$

13. Find the average power delivered by source E3 in the circuit shown above:



$P_{AVE} = |\vec{E}_3|_{RMS}\,|\vec{I}_3|_{RMS}\cos(\theta_{\vec{E}_3} - \theta_{\vec{I}_3})$

$|\vec{E}_3|_{RMS} = 40V \quad , \quad \theta_{\vec{E}_3} = 0°$

$\vec{I}_3 = -\vec{I}_2 = 10.85A_{RMS} \angle -26.3°$

$\therefore |\vec{I}_3|_{RMS} = 10.85A \quad \theta_{\vec{I}_3} = -26.3°$

$P_{AVE} = (40V)(10.85A)\cos(26.3°)$

$\boxed{389.1W}$