8

7.32

✓ Answer

Using sin phasors

$\omega = 300$

$I = 0.035\angle -15^\circ\ A$

$Z_R = 80\ \Omega$

$Z_C = -\frac{i}{\omega C} = -\frac{50}{3} i\ \Omega$

$Z_L = i\omega L = \frac{9}{2} i\ \Omega$

$Z_{eq} = \left(\frac{1}{Z_R} + \frac{1}{Z_C + Z_L}\right)^{-1} = \left(\frac{1}{80} - \frac{6}{73} i\right)^{-1}$

$= (0.08313686808316859\angle -81.35253065183718^\circ)^{-1}$

$= 12.028357852013604\angle -81.35253065183718^\circ$

$V = IR$

$V = 0.42099252482047617\angle -96.35253065183718^\circ$

$V = 0.421 \sin(300t - 96.352^\circ)\ V$

7.38

✓ Answer

$Z_1 = 13\ \Omega$

$Z_2 = -5i\ \Omega$

$Z_3 = 12i\ \Omega$

$Z_4 = 10\ \Omega$

$Z_{eq1} = \left(\frac{1}{Z_1 + Z_2}\right)^{-1} = 1.6752577319587627 - 4.355670103092783i$

$Z_{eq2} = \left(\frac{1}{Z_3 + Z_4}\right)^{-1} = 5.9016393442622945 + 4.918032786885245i$

$Z_{total} = Z_{eq1} + Z_{eq2} = 7.576897076221057 + 0.562362683792462i$

$I_{total} = \frac{V}{Z_{total}} = 3.281427264409882 - 0.243549862763037 47i$

By current division,

$I_R = I_{total} \frac{Z_3}{Z_3 + Z_4} = 2.056358645928637 + 1.4700823421774936i$

$I_R = 2.528\angle 35.56^\circ\ A$

7.44

✓ **Answer**

L needs to counteract the effects of the $4\ \mu F$ capacitor which is parallel to it.

$Z_C = -25i$

$Z_{eq} = \left(\frac{1}{Z_C} + \frac{1}{Z_L}\right)^{-1}$

If Z_{eq} is real, then $\frac{1}{Z_C} + \frac{1}{Z_L}$ must be real

$\Im\left(\frac{1}{Z_C}\right) = -\Im\left(\frac{1}{Z_L}\right) = -\Im\left(-\frac{i}{\omega L}\right) = \frac{1}{\omega L}$

$0.04 = \frac{1}{\omega L}$

$L = 2.5\ mH$

7.58

✓ **Answer**

$\omega = 400$

$V = 12\angle -30^\circ = 1.495474719088341 + 0.7315611130626767i$

$Z_1 = 5\ \Omega$

$Z_2 = 8i\ \Omega$

$Z_3 = -4i\ \Omega$

$Z_4 = 5\ \Omega$

$Z_5 = 8i\ \Omega$

$Z_6 = 5\ \Omega$

$Z_{eq1} = \left(\frac{1}{Z_1} + \frac{1}{Z_2}\right)^{-1} = 3.595505617977528 + 2.2471910112359548i$

$Z_{eq2} = Z_3 + Z_{eq1} = 3.595505617977528 - 1.7528089887640452i$

$Z_{eq3} = \left(\frac{1}{Z_5} + \frac{1}{Z_6}\right)^{-1} = 3.595505617977528 + 2.2471910112359548i$

$Z_{eq4} = \left(\frac{1}{Z_{eq2}} + \frac{1}{Z_{eq3}}\right)^{-1} = 2.3513860269818436 + 0.08553322188095305i$

$Z_{total} = Z_{eq4} + Z_4 = 7.351386026981844 + 0.08553322188095305i$

$I_{tot} = \frac{V}{Z_{tot}} = 1.403966236900478 - 0.832507738430764i$

By Current division:

$I_C = I_{tot}\frac{Z_{eq3}}{Z_{eq2}+Z_{eq3}} = 0.9591541681990755 - 0.04345626924766902i$

$= 0.96\angle -2.59^\circ$

$= 0.96\cos(400t - 2.59^\circ)\ A$

7.67

Solve the problem using the Node-Voltage method

✓ **Answer**

$\omega = 2.5 \times 10^4$

$I = 6\angle 0 = 6\ A$

$Z_1 = 25i\ \Omega$

$Z_2 = 10\ \Omega$

$Z_3 = -40i\ \Omega$

$Z_4 = 5\ \Omega$

$Z_5 = 10\ \Omega$

$Z_{eq1} = Z_1 + Z_2 = 10 + 25i\ \Omega$

$A: 6 - 3i_C + \frac{V_A - V_B}{Z_{eq1}}$

$B: \frac{V_B - V_A}{Z_{eq1}} + \frac{V_B - V_C}{Z_4} + \frac{V_B}{Z_3}$

$C: 3i_C + \frac{V_C - V_B}{Z_4} + \frac{V_C}{Z_5}$

$G: 6 + \frac{V_B}{Z_3} + \frac{V_C}{Z_5}$

$\frac{V_B}{Z_3} = i_C$

Where $A, B, C, G = 0$

$A: \frac{3V_B}{Z_3} - 6 = \frac{V_A - V_B}{Z_{eq1}}$

$C: \frac{3V_B}{Z_3} + \frac{V_C - V_B}{Z_4} + \frac{V_C}{Z_5} = 0$

$G: -6Z_5 - \frac{V_B Z_5}{Z_3} = V_C$

$C: \frac{3V_B}{Z_3} + \frac{-6Z_5 - \frac{V_B Z_5}{Z_3} - V_B}{Z_4} + \frac{-6Z_5 - \frac{V_B Z_5}{Z_3}}{Z_5} = 0$

$C: \frac{3V_B}{Z_3} + \frac{-6Z_5 - \frac{V_B Z_5}{Z_3} - V_B}{Z_4} + \frac{-6Z_5 - \frac{V_B Z_5}{Z_3}}{Z_5} = 0$

$V_B = \frac{\frac{6Z_5}{Z_4} + 6}{\frac{3}{Z_3} - \frac{Z_5}{Z_4 Z_3} - \frac{1}{Z_4} - \frac{1}{Z_3}}$

$V_B = -12 - 84i$

$i_C = \frac{V_B}{Z_3} = 2.1 - 0.3i = 2.12\angle - 8.13^\circ$

$= 2.12 \cos(2.5 \times 10^4 t - 8.13^\circ)\ A$