From the problem, we have the angular frequency as 3000 rad/s. First step is to find the reactive impedance of the inductor $L = 190$ mH:

$$X_L = \omega L = 3000 \times 190 \times 10^{-3} = 0.57 \, \text{k}\Omega$$

Then find $Z_L$ which will be equal to $j0.57 \, \text{k}\Omega$. Second step is to find the capacitive impedance of the capacitor $C = 55$ nF:

$$X_C = \frac{1}{\omega C} = \frac{1}{3000 \times 55 \times 10^{-9}} = 6.061 \, \text{k}\Omega$$

Then find $Z_C = -j6.061 \, \text{k}\Omega$.

Third step is to combine $R_1$ with $Z_L$ to be called $Z_{eq1}$. The following combination is in rectangular form

$$Z_{eq1} = R_1 + Z_L = 2.3 + j0.57$$

Convert the rectangular form into polar form. In the polar form we need the magnitude and the angle: $A \angle \theta$. In order to find the magnitude $A$ we should do the following:

$$A = \sqrt{2.3^2 + 0.57^2} = 2.37$$

The angle $\theta$ is found as:

$$\tan^{-1}\left(\frac{0.57}{2.3}\right) = 13.92$$

Now combine the magnitude and angle in the polar form to have $Z_{eq1}$ as: $2.37 \angle 13.92^\circ \, \text{k}\Omega$.

Follow the same procedure to find $Z_{eq2}$ in rectangular form first and polar form second:

$$Z_{eq2} = R_2 - jX_C = 1.1 - j6.061 = 6.16 \angle -79.71^\circ \, \text{k}\Omega$$

Since $Z_{eq1}$ and $Z_{eq2}$ are in parallel, then their total equivalent impedance is

$$Z_{eq} = \frac{Z_{eq1} \times Z_{eq2}}{Z_{eq1} + Z_{eq2}} = \frac{(2.37 \angle 13.92^\circ)(6.16 \angle -79.71^\circ)}{(2.3 + j0.57) + (1.1 - j6.061)}$$

$$= \frac{14.60 \angle -65.79^\circ}{3.4 - j5.491} = \frac{14.60 \angle -65.79^\circ}{6.458 \angle -58.23^\circ} = 2.261 \angle -7.56^\circ \, \text{k}\Omega$$

You may convert the value of $Z_{eq}$ from polar form into rectangular form again. We will get: $Z_{eq} = 2.241 - j0.297$. This is obtained by calculating $(2.261 \times \cos -7.56^\circ = 2.241$ as the real part) and $(2.262 \times \sin -7.56^\circ = -0.297$ as the imaginary part). This is a “capacitive load”. A capacitive load means a load ($Z$) that has a resistance and a capacitance.
P4.52:

\[ w = 3 \text{ rad/s ( )} \]

\[ V_s = 36 \angle -60^\circ \text{ (polar form)} \]

\[ Z_{L1} = jwL_1 = j3 \times 3 = j9\Omega \]

\[ Z_{L2} = jwL_2 = j3 \times 3 = j9\Omega \]

\[ Z_{L3} = jwL_3 = j3 \times 3 = j9\Omega \]

\[ Z_C = \frac{1}{jwC} = \frac{1}{j3 \times \left(\frac{1}{18}\right)} = -j6\Omega \]

\[ Z_{eq} = Z_{L2} // Z_{L3} + Z_C = j9 // (j9 - j6) = 2.25 \angle 90^\circ \Omega \]

\[ Z_T = Z_R + Z_{L1} + Zeq = 9 + j9 + j2.25 = 9 + j11.25 = 14.4 \angle 51.34^\circ \Omega \]

Now find the total current from the source \( I \)

\[ I = \frac{V_s}{Z_T} = \frac{36 \angle -60^\circ}{14.4 \angle 51.34^\circ} = 2.499 \angle -111.34^\circ \text{ A} \]

Find the voltage across \( Z_{eq} \)

\[ V_{eq} = IZ_{eq} = \left(2.499 \angle -111.34^\circ \right) \left(2.25 \angle 90^\circ \right) = 5.623 \angle -21.34^\circ \text{ V} \]

We will perform voltage divider between \( Z_{L3} \) and \( Z_C \) to find \( V \)

\[ V = \left(\frac{Z_C}{Z_C + Z_{L3}}\right) V_{eq} = \left(-\frac{j6}{j9 - j6}\right) \left(5.623 \angle -21.34^\circ \right) = 11.25 \angle 158.66^\circ \text{ V} \]

Now convert this value into time domain

\[ v(t) = 11.25 \cos(3t - 158.66^\circ) \text{ V} \]

P4.53:

This is a current divider problem

\[ w = 2 \text{ rad/s} \]

\[ Z_{L2} = j\omega L_2 = j2 \times 10 = j20\Omega \]

\[ Z_{L3} = j2 \times 1 = j2\Omega \]

\[ Z_C = \frac{1}{j\omega C} = -j2\Omega \]

\[ I = \left(\frac{Z_{L3} + Z_C}{Z_{L2} + Z_C + (R + Z_{L3})}\right) I_s = \left(\frac{j20 - j}{j20 - j} + (5 + j2)\right) \times 6 \angle 0^\circ = 5.28 \angle 13.4^\circ \text{ A} \]

\[ i(t) = 5.28 \cos (2t + 13.4^\circ) \text{ A} \]
P4.57:  
In this circuit we have two meshes.  
First find $Z_C$ and $Z_L$

\[
Z_C = \frac{1}{j1500 \times 10^{-6}} = -j666.7\Omega \\
Z_L = j(1500)(0.5) = j750\Omega
\]

Apply KVL in the first loop

\[-V_5 + R_1I_1 + Z_C(I_1 - I_2) = 0\]

Apply KVL in the second loop

\[Z_LI_2 + I_2R_2 + Z_C(I_2 - I_1) = 0\]

Substitute values and find $I_1$ and $I_2$

Answer in phasor form:

\[
I_1 = 3.8 \times 10^{-3} \angle 46.6^\circ \text{ A} \\
I_2 = 19.6 \times 10^{-3} \angle -83.2^\circ \text{ A}
\]

Write the answer in time domain
P4.58
We have a circuit with a current source. Also, the requirement is to find \(v_1\) and \(v_2\). In such case, it is better and easier to apply KCL.

First, find the capacitive impedance \(Z_C\) and the inductive impedance \(Z_L\)
\[
Z_C = \frac{1}{j/\omega C} = -j\frac{1}{100 \times 500 \times 10^{-6}} = -\frac{20}{20}\Omega
\]
\[
Z_L = j\omega L = j100 \times 0.2 = j2\Omega
\]

Apply KCL at node 1, we have three currents joining at the node, namely: \(I_S\); current through \(R_1\) (assume its direction from \(v_1\) toward the reference); and current through the capacitor (assume its direction from \(v_1\) to \(v_2\))
\[
I_S = \frac{V_1}{R_1} + \frac{V_1 - V_2}{Z_C} = \left(\frac{1}{R_1} + \frac{1}{Z_C}\right)V_1 - \frac{1}{Z_C}V_2
40^\circ = \left(\frac{1}{R_1} + \frac{j}{20}\right)V_1 - \frac{j}{20}V_2
\]

Now apply KCL at node 2, we have three currents joining at the node, namely: current through the capacitor (assume its direction from \(v_1\) to \(v_2\)); current through \(R_2\) (assume its direction from \(v_2\) toward the reference); and current through the inductor (assume its direction from \(v_2\) toward the reference)
\[
\frac{V_1 - V_2}{Z_C} = \frac{V_2}{R_2} + \frac{V_2}{Z_L}
\]
\[
\frac{V_1}{Z_C} = \left(\frac{1}{R_2} + \frac{1}{Z_L} + \frac{1}{Z_C}\right)V_2
\]
\[
\frac{jV_1}{20} = \left(\frac{1}{10} - \frac{j}{20} + \frac{j}{20}\right)V_2
\]
\[
\frac{jV_1}{20} = \left(\frac{1}{10}\right)V_2
\]
\[
V_1 = -j2V_2
\]

Now, substitute the values and find \(V_1\) and \(V_2\).

Answers in phasor form:
\[
V_1 = 565.7 \angle -45^\circ \text{ V}
\]
\[
V_2 = 282.85 \angle 45^\circ \text{ V}
\]

Write them in time domain: