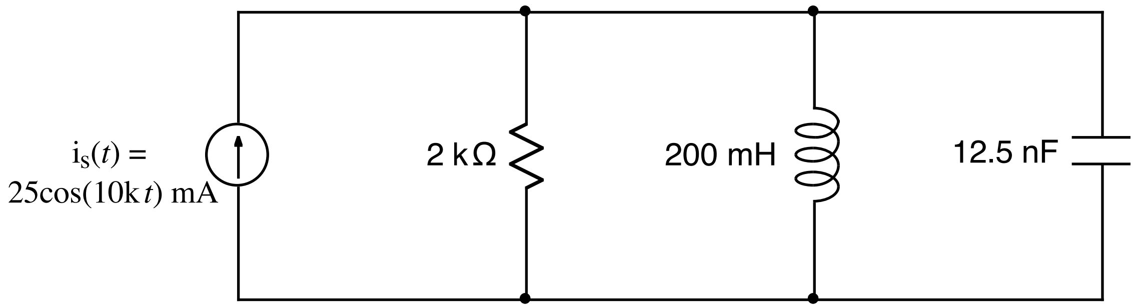
HOMEWORK #15 solution probs 3 and 4

Ex:



a) Find the phasor value for $i_S(t)$.

b) Draw the frequency-domain circuit diagram, including the phasor value for $i_S(t)$ and impedance values for components.

c) Find the phasor value for $i_L(t)$, (measurement arrow points down).

Sol'n: a) The phasor for $A\cos(\omega t+\phi)$ is $Ae^{j\phi}$.

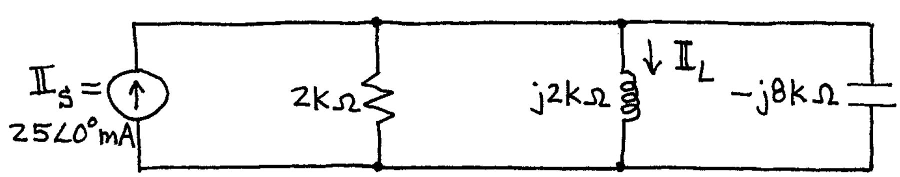
$\therefore \mathbb{I}_s = 25\, e^{j0^\circ}$ mA or $25\angle 0^\circ$ mA

b) From $i_s(t)$, we see that $\omega = 10\text{k rad/s}$.

Impedance $Z_L = j\omega L = j\,10\text{k}\;200\text{mH} = j2\text{k}\Omega$

$$Z_C = \frac{-j}{\omega C} = \frac{-j}{10\text{k}\;12.5\text{nF}} = \frac{-j}{125\mu}\,\Omega$$

$$Z_C = \frac{-j\,8\text{k}\,\Omega}{8\text{k}\cdot 125\mu} = -j8\text{k}\Omega$$



c) The value for $\mathbb{I}_L$ is given by the current divider formula:

$$\mathbb{I}_L = \mathbb{I}_S \cdot \frac{R \| z_C}{R \| z_C + z_L}$$

$$= \mathbb{I}_S \frac{1}{1 + \dfrac{z_L}{R \| z_C}}$$

$$= \mathbb{I}_S \frac{1}{1 + z_L \left(\dfrac{1}{R} + \dfrac{1}{z_C} \right)}$$

$$= 25 \angle 0^\circ \, mA \frac{1}{1 + j2k\Omega \left(\dfrac{1}{2k\Omega} + \dfrac{1}{-j8k\Omega} \right)}$$

$$= 25 \angle 0^\circ \, mA \; \frac{4}{4} \; \frac{1}{1 + j - \frac{1}{4}}$$

$$= 25 \angle 0^\circ \, mA \; \frac{4}{3 + j4}$$

$$= 25 \angle 0^\circ \, mA \; \frac{4}{3 + j4} \cdot \frac{3 - j4}{3 - j4}$$

$$= \cancel{25} \angle 0^\circ \, mA \; \frac{12 - j16}{\cancel{3^2 + 4^2}}$$

$$= 1 \angle 0^\circ \, mA \cdot 20 \angle -53.1^\circ$$

$$\mathbb{I}_L = 20 \, mA \angle -53.1^\circ$$