Phasors (EC_phasors_1.sqproj)

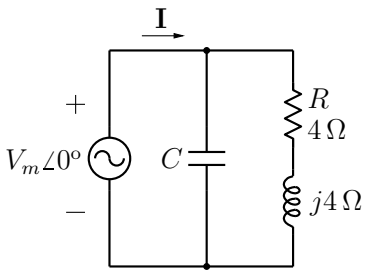

Figure 1: Phasor calculation example.

Question: In the circuit shown in the figure, the frequency is 50 Hz. Let $\mathbf{I} = I_m\angle\theta$. What value of C is required for $\theta = 45°$?

Solution:

The impedance as seen by the source is given by

$$\begin{aligned} \mathbf{Z}_{\text{eq}} &= (-jX_c) \parallel (4 + j4) \\ &= \frac{X_c\angle -90° \times 4\sqrt{2}\angle 45°}{-jX_c + (4 + j4)} \\ &= \frac{X_c \times 4\sqrt{2}\angle -45°}{4 + j(4 - X_c)} \equiv \frac{a\angle -45°}{b\angle \alpha}, \end{aligned} \tag{1}$$

where α is 45° and −90° for $X_c \to 0$ and $X_c \to \infty$, respectively. For $\mathbf{I}$ to lead the source voltage by 45°, $\mathbf{Z}_{\text{eq}}$ must be of the form $Z_m\angle -45°$, i.e., α in Eq. 1 must be 0°. This gives $4 - X_c = 0 \to X_c = 4 \to \dfrac{1}{\omega C} = 4 \to C = \dfrac{1}{2\pi \times 50 \times 4} = 800\,\mu\text{F}$.

SequelApp Exercises: Find the value of C required for (a) $\theta = 0°$, (b) $\theta = 20°$.

Verify your answers using SequelApp.