

Each voltage-current pair below is the voltage across an element and the current through that element, adhering to the passive sign convention.

$$\begin{aligned} v_1(t) &= A_1 \cdot \cos(400t + 25) & i_1(t) &= B_1 \cdot \sin(400t + 25) \\ v_2(t) &= A_2 \cdot \sin(500t + 70) & i_2(t) &= B_2 \cdot \sin(500t + 160) \\ v_3(t) &= A_3 \cdot \cos(700t + 30) & i_3(t) &= B_3 \cdot \sin(700t + 120) \end{aligned}$$

For each element:

- Indicate the type of element. Enter 1 for resistor, 2 for inductor, and 3 for capacitor.
- Find the value of the element. Assume the units are $\text{m}\Omega$, mH or mF respectively.

$$A1 : 16 \text{ V}$$

$$B1 : 2 \text{ A}$$

$$A2 : 32 \text{ V}$$

$$B2 : 8 \text{ A}$$

$$A3 : 3 \text{ V}$$

$$B3 : 30 \text{ A}$$

$$\sin(\alpha) = \cos(\alpha - 90^\circ)$$

$$V = Z \cdot I$$

$$Z_L = j\omega L \Rightarrow \angle Z = 90^\circ$$

$$Z_C = \frac{1}{j\omega C} \Rightarrow \angle Z = -90^\circ$$

$$Z_R = R \Rightarrow \angle Z = 0^\circ$$

$$(1) \quad V_1 = 16 e^{j25^\circ} \quad I_1 = 2 e^{j(25^\circ - 90^\circ)}$$

$$\angle Z_1 = \angle V_1 - \angle I_1 = 25^\circ - (25^\circ - 90^\circ) = 90^\circ \Rightarrow \boxed{\text{INDUCTOR}}$$

$$|Z_1| = \frac{|V_1|}{|I_1|} = \frac{16}{2} = \omega L \Rightarrow L = \frac{16}{2 \cdot 400} = \frac{1}{400} \Rightarrow \boxed{L = 2.5 \text{ mH}}$$

$$(2) \quad V_2 = 32 e^{j(70^\circ - 90^\circ)} \quad I_2 = 8 e^{j(160^\circ - 90^\circ)}$$

$$\angle Z_2 = \angle V_2 - \angle I_2 = (70^\circ - 90^\circ) - (160^\circ - 90^\circ) = -90^\circ$$

$$\Rightarrow \boxed{\text{CAPACITOR}}$$

$$|Z_2| = \frac{|V_2|}{|I_2|} = \frac{32}{8} = \frac{1}{\omega C} \Rightarrow C = \frac{1}{500 \cdot 32} = \frac{1}{16000} \Rightarrow \boxed{C = 6.25 \text{ }\mu\text{F}}$$

$$(3) \quad V_3 = 3 e^{j30^\circ} \quad I_3 = 30 e^{j(120^\circ - 90^\circ)}$$

$$\angle Z_3 = \angle V_3 - \angle I_3 = 30^\circ - (120^\circ - 90^\circ) = 0^\circ \Rightarrow \boxed{\text{RESISTOR}}$$

$$|Z_3| = \frac{|V_3|}{|I_3|} = \frac{3}{30} = R \Rightarrow R = \frac{1}{10} \Rightarrow \boxed{R = 10 \text{ }\Omega}$$