Problem 10.6

Sketch a phasor representation of a balanced three-phase system containing both phase voltages and line voltages if $\mathbf{V}_{ab} = 208\angle 45°$ V rms. Label all phasors and assume an *abc*-phase sequence.

Suggested Solution

$\mathbf{V}_{ab} = 208\angle 45°$ V rms

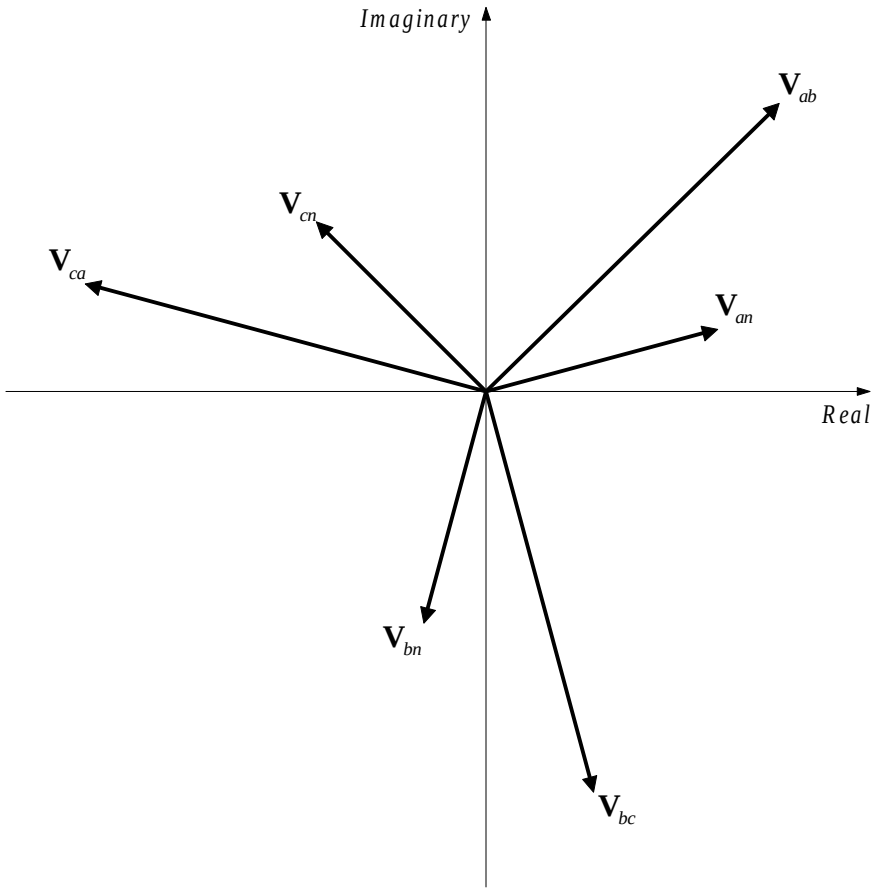
$\mathbf{V}_{an} = \dfrac{|\mathbf{V}_{ab}|}{\sqrt{3}}\angle\left(\theta_{\mathbf{V}_{ab}} - 30°\right) = 120\angle 15°$ V rms

$\mathbf{V}_{bc} = 208\angle -75°$ V rms

$\mathbf{V}_{bn} = 120\angle -105°$ V rms

$\mathbf{V}_{ca} = 208\angle 165°$ V rms

$\mathbf{V}_{cn} = 120\angle 135°$ V rms



Problem 10.14

In a balanced three-phase wye-wye system, the source is an *abc*-sequence set of voltages. $\mathbf{Z}_{line} = 1 + j1.8\ \Omega$, $\mathbf{Z}_{load} = 14 + j12\ \Omega$, and the load voltage on the *a* phase is $\mathbf{V}_{AN} = 398.1\angle 17.99°$ V rms. Find the line voltage $\mathbf{V}_{ab}$.

Suggested Solution

$$\mathbf{I}_a = \frac{\mathbf{V}_{AN}}{\mathbf{Z}_{load}} = \frac{398.1\angle 17.99°}{14 + j12} = 21.59\angle -22.61° \text{ A rms}$$

$$\mathbf{V}_{an} = \mathbf{I}_a\left(\mathbf{Z}_{line} + \mathbf{Z}_{load}\right) = \left(21.59\angle -22.61°\right)\left(15 + j13.8\right) = 440\angle 20° \text{ V rms}$$

$$\Rightarrow \quad \mathbf{V}_{ab} = 440\sqrt{3}\angle 50° = 762.1\angle 50° \text{ V rms}$$

Problem 10.25

In a balanced three-phase delta-wye system the source had an *abc*-phase sequence. The line and load impedances are $0.6 + j0.3\ \Omega$ and $12 + j7\ \Omega$, respectively. If the line current $\mathbf{I}_{aA} = 9.6\angle -20°$ A rms, determine the phase voltages of the source.

Suggested Solution

$$\mathbf{V}_{an} = \left(9.6\angle -20°\right)\left(12.6 + j7.3\right) = 139.78\angle 10.09° \text{ V rms}$$

$$\mathbf{V}_{ab} = 139.78\sqrt{3}\angle\left(10.09° + 30°\right) = 242.11\angle 40.09° \text{ V rms}$$

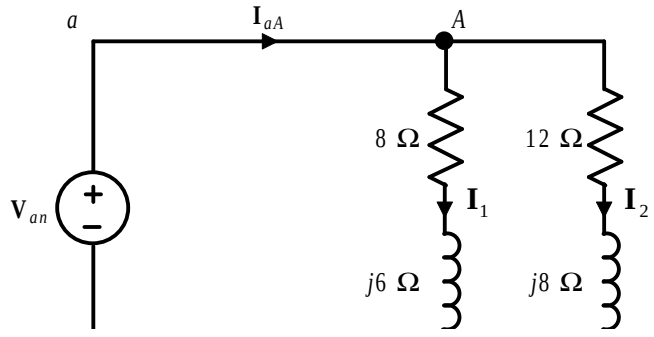
$$\mathbf{V}_{bc} = 242.11\angle\left(40.09° - 120°\right) = 242.11\angle -79.91° \text{ V rms}$$

$$\mathbf{V}_{ca} = 242.11\angle\left(40.09° + 120°\right) = 242.11\angle 160.09° \text{ V rms}$$

Problem 10.36

In a balanced three-phase system, the *abc*-phase-sequence source is wye connected and $\mathbf{V}_{an} = 120\angle 20°$ V rms. The load consists of two balanced wyes with phase impedances of $8 + j6\ \Omega$ and $12 + j8\ \Omega$. If the line impedance is zero, find the line currents and the phase currents in each load.

Suggested Solution



$$\mathbf{I}_1 = \frac{120\angle 20^\circ}{8 + j6} = 12\angle -16.87^\circ \text{ A rms}$$

$$\mathbf{I}_2 = \frac{120\angle 20^\circ}{12 + j8} = 8.32\angle -13.69^\circ \text{ A rms}$$

$$\mathbf{I}_{aA} = \mathbf{I}_1 + \mathbf{I}_2 = 20.3\angle -15.57^\circ \text{ A rms}$$

The other currents are shifted by -120° and -240°