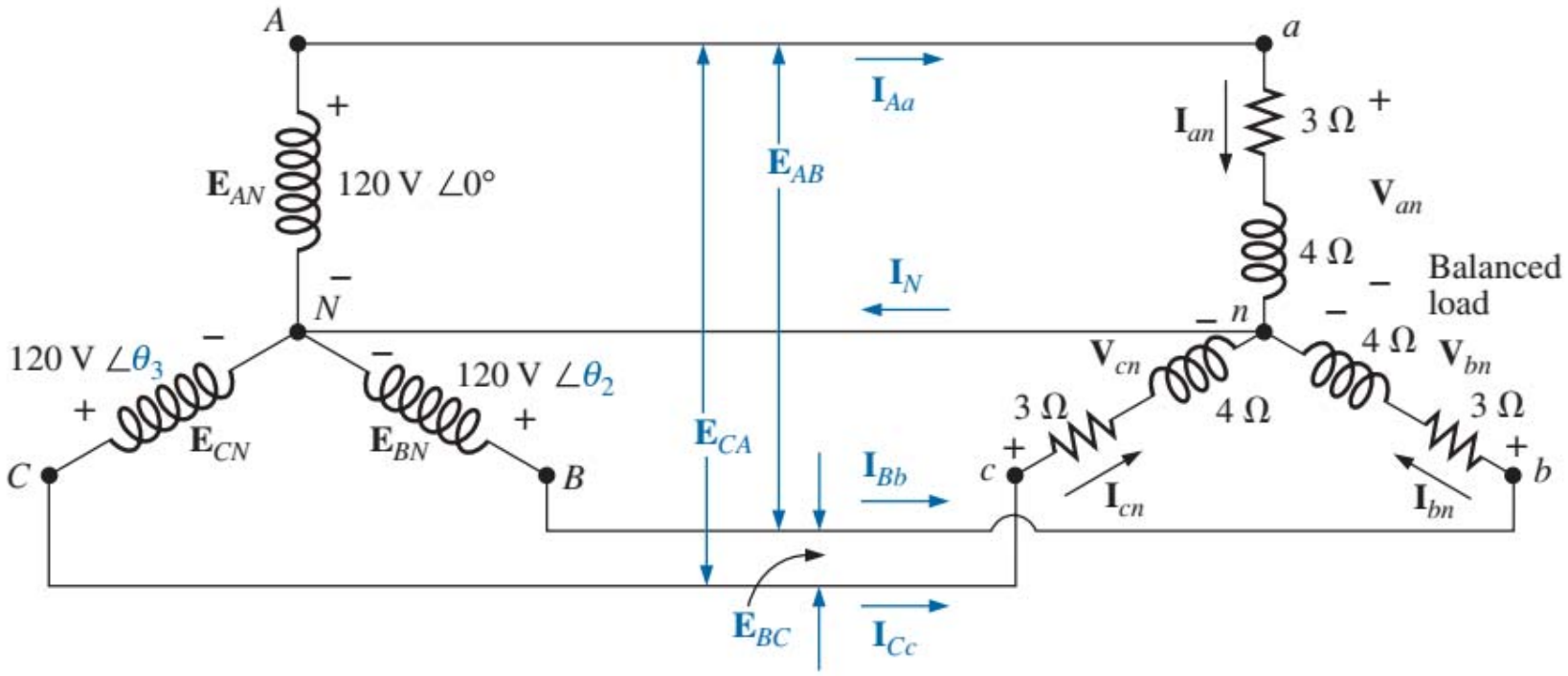
Y Connected Generator and Load – In Class Problem



- All voltages and currents in RMS
- ABC Phase Sequence

Find:

a) Θ_2 and Θ_3

b) $\mathbf{E_{AB}}$, $\mathbf{E_{BC}}$ and $\mathbf{E_{CA}}$, the line voltages

c) The line currents

d) $\mathbf{I_N}$, the neutral current

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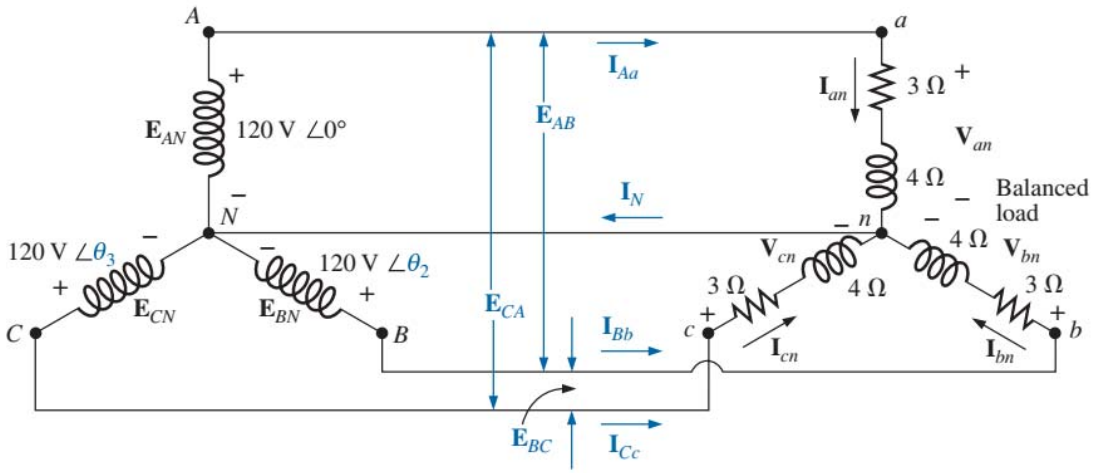

a) Θ_2 and Θ_3

Recall – For an ABC phase sequence, we have:

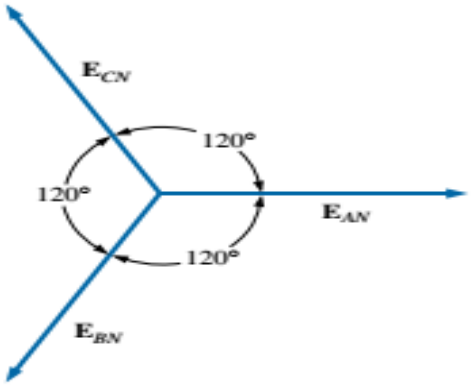

FIG. 24.3
Phasor diagram for the phase voltages of a three-phase generator.

Hence:

$\theta_2 = \theta_{bN} = -120°$

$\theta_3 = \theta_{cN} = 120°$

NP

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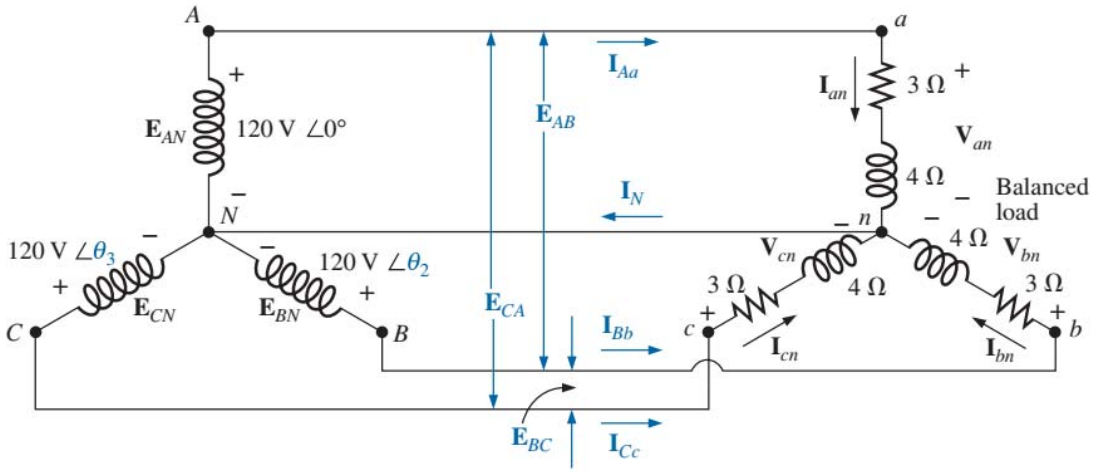

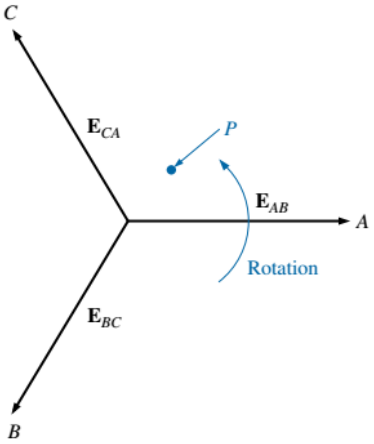

ABC phase sequence described by the line voltages

b) **E_{AB}, E_{BC}** and **E_{CA}**, the line voltages

$$\vec{E}_{AB} = \vec{E}_{AN} - \vec{E}_{BN}$$
$$= 120 V_{RMS} \angle 0^\circ - 120 V_{RMS} \angle -120^\circ$$
$$= 207.9 V_{RMS} \angle 30^\circ$$

$$\vec{E}_{CA} = \vec{E}_{CN} - \vec{E}_{AN}$$
$$= 120 V_{RMS} \angle 120^\circ - 120 V_{RMS} \angle 0^\circ$$
$$= 207.9 V_{RMS} \angle 150^\circ$$

$$\vec{E}_{BC} = \vec{E}_{BN} - \vec{E}_{CN}$$
$$= 120 V_{RMS} \angle -120^\circ - 120 V_{RMS} \angle 120^\circ$$
$$= 207.9 V_{RMS} \angle -90^\circ$$

Check:

$$E_L = \sqrt{3} V_\phi \qquad (24.8)$$

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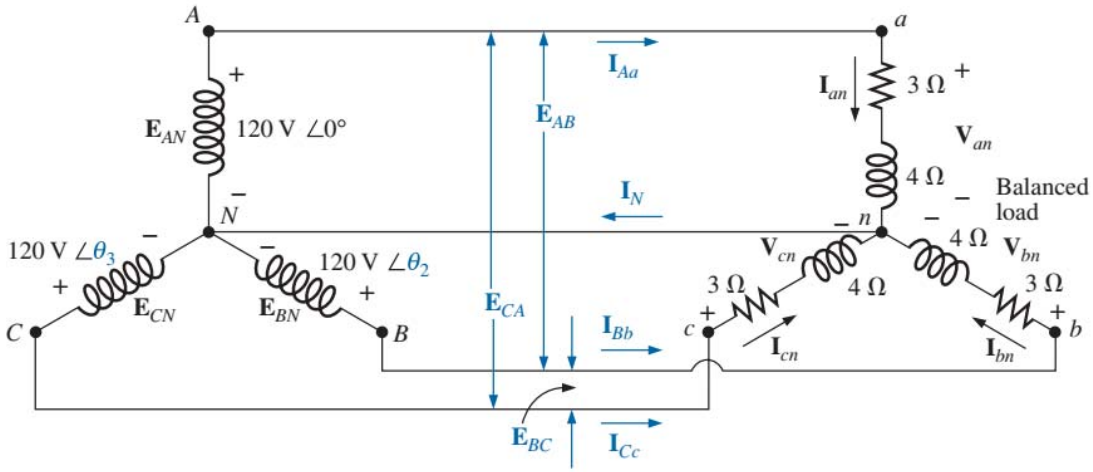

c) The line currents

- Recall the line currents are equivalent to the phase currents in this configuration

$$\vec{I}_{AN} = \frac{V_{AN}}{(3+j4)_\sim} = \frac{120\,V_{RMS}\angle 0^\circ}{(3+j4)_\sim}$$

$$= \boxed{24\,A_{RMS}\angle -53.13^\circ}$$

$$\vec{I}_{CN} = \frac{V_{CN}}{(3+j4)_\sim} = \frac{120\,V_{RMS}\angle 120^\circ}{(3+j4)_\sim}$$

$$= \boxed{24\,A_{RMS}\angle 66.87^\circ}$$

$$\vec{I}_{bN} = \frac{V_{bN}}{(3+j4)_\sim} = \frac{120\,V_{RMS}\angle -120^\circ}{(3+j4)_\sim}$$

$$= \boxed{24\,A_{RMS}\angle -173.13^\circ}$$

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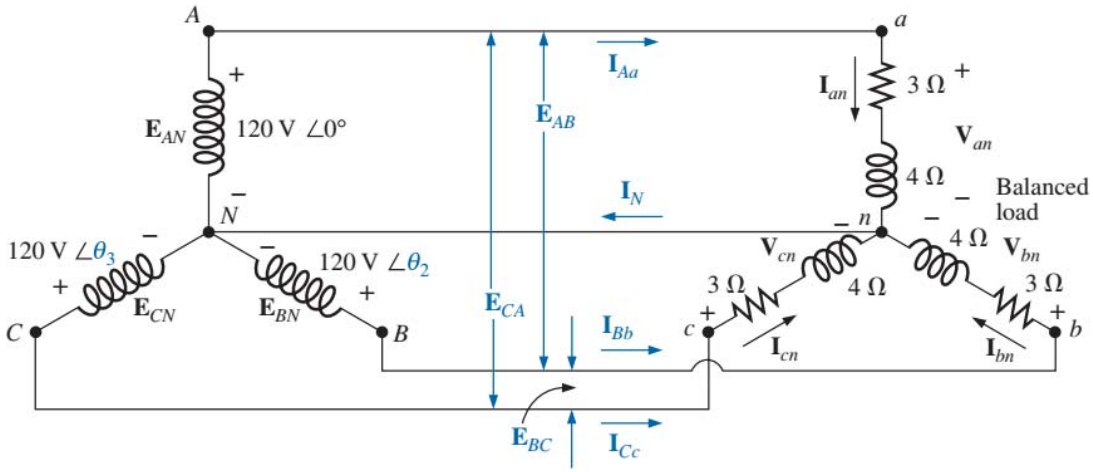

d) **I_N**, the neutral current

$$\vec{I}_N = \vec{I}_{AN} + \vec{I}_{BN} + \vec{I}_{CN} = \boxed{0A}$$

Check:

If the load is balanced, the **neutral connection** can be removed without affecting the circuit in any manner; that is, if

$$\mathbf{Z}_1 = \mathbf{Z}_2 = \mathbf{Z}_3$$

NP