Poly phase circuits

Q1

13. The phase sequence for the Y-Δ system of Fig. 23.44 is *ABC*.

a. Find the angles θ_2 and θ_3 for the specified phase sequence.

b. Find the voltage across each phase impedance in phasor form.

c. Draw the phasor diagram of the voltages found in part (b), and show that their sum is zero around the closed loop of the Δ load.

d. Find the current through each phase impedance in phasor form.

e. Find the magnitude of the line currents.

f. Find the magnitude of the generator phase voltages.

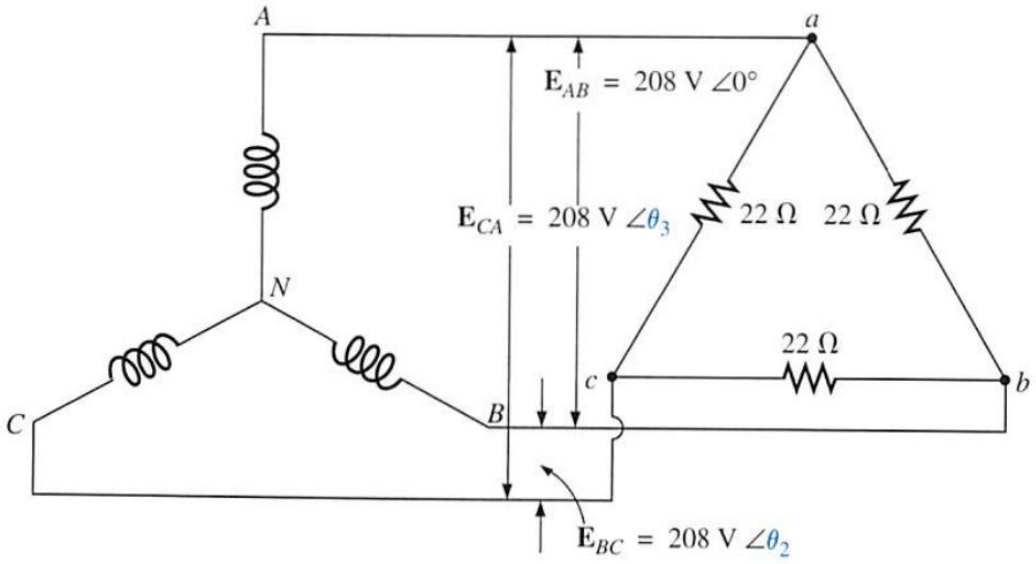

FIG. 23.44

Q2

7. For the system of Fig. 23.41, find the magnitude of the unknown voltages and currents.

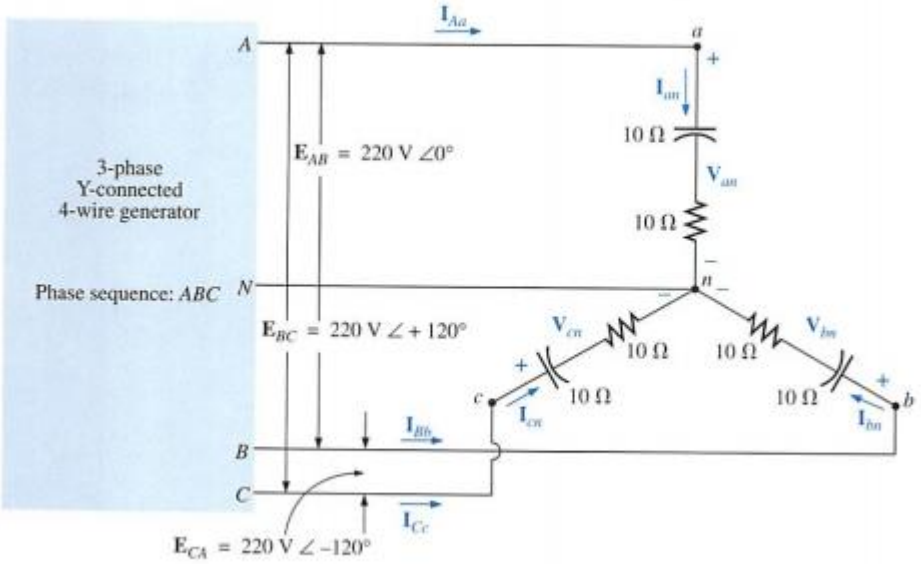

FIG. 23.41

Q3

16. For the system of Fig. 23.45, find the magnitude of the unknown voltages and currents.

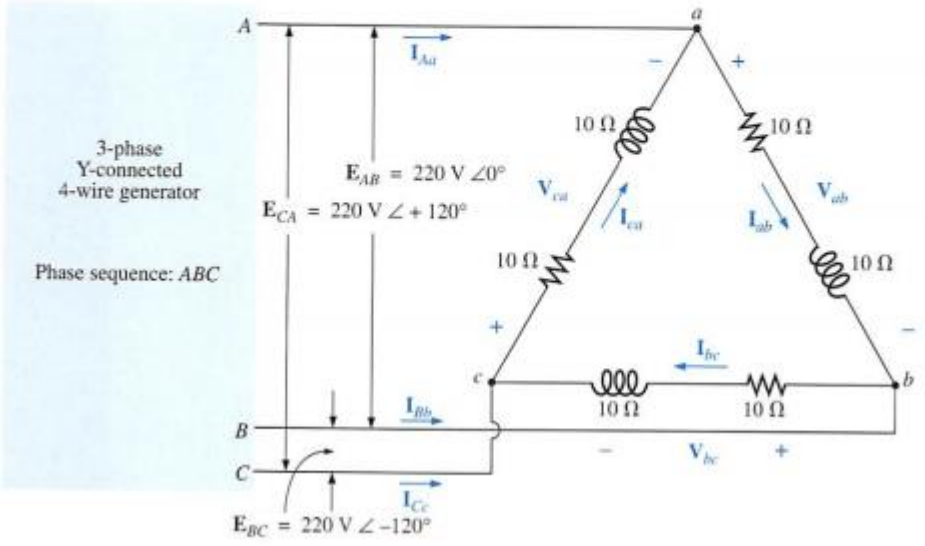

FIG. 23.45

SOLUTION

Q1

13. a. $\theta_2 = -120°, \theta_3 = +120°$

b. $\mathbf{V}_{ab} = 208\ \text{V}\ \angle 0°, \mathbf{V}_{bc} = 208\ \text{V}\ \angle -120°, \mathbf{V}_{ca} = 208\ \text{V}\ \angle 120°$

c. —

d. $$\mathbf{I}_{ab} = \frac{\mathbf{V}_{ab}}{\mathbf{Z}_{ab}} = \frac{208\ \text{V}\ \angle 0°}{22\ \Omega\ \angle 0°} = 9.455\ \text{A}\ \angle 0°$$

$$\mathbf{I}_{bc} = \frac{\mathbf{V}_{bc}}{\mathbf{Z}_{bc}} = \frac{208\ \text{V}\ \angle -120°}{22\ \Omega\ \angle 0°} = 9.455\ \text{A}\ \angle -120°$$

$$\mathbf{I}_{ca} = \frac{\mathbf{V}_{ca}}{\mathbf{Z}_{ca}} = \frac{208\ \text{V}\ \angle 120°}{22\ \Omega\ \angle 0°} = 9.455\ \text{A}\ \angle 120°$$

e. $I_L = \sqrt{3}\, I_\phi = (1.732)(9.455\ \text{A}) = 16.376\ \text{A}$

f. $E_\phi = E_L/\sqrt{3} = 208\ \text{V}/1.732 = 120.1\ \text{V}$

Q2

7. $$V_\phi = V_{an} = V_{bn} = V_{cn} = \frac{V_L}{\sqrt{3}} = \frac{220\ \text{V}}{1.732} = 127.0\ \text{V}$$

$$\mathbf{Z}_\phi = 10\ \Omega - j10\ \Omega = 14.42\ \Omega\ \angle -45°$$

$$I_\phi = I_{an} = I_{bn} = I_{cn} = \frac{V_\phi}{Z_\phi} = \frac{127\ \text{V}}{14.142\ \Omega} = 8.98\ \text{A}$$

$$I_L = I_{Aa} = I_{Bb} = I_{Cc} = I_\phi = 8.98\ \text{A}$$

Q3

16. $$V_{ab} = V_{bc} = V_{ca} = 220\ \text{V}$$

$$\mathbf{Z}_\phi = 10\ \Omega + j10\ \Omega = 14.142\ \Omega \angle 45°$$

$$I_{ab} = I_{bc} = I_{ca} = \frac{V_\phi}{Z_\phi} = \frac{220\ \text{V}}{14.142\ \Omega} = 15.56\ \text{A}$$