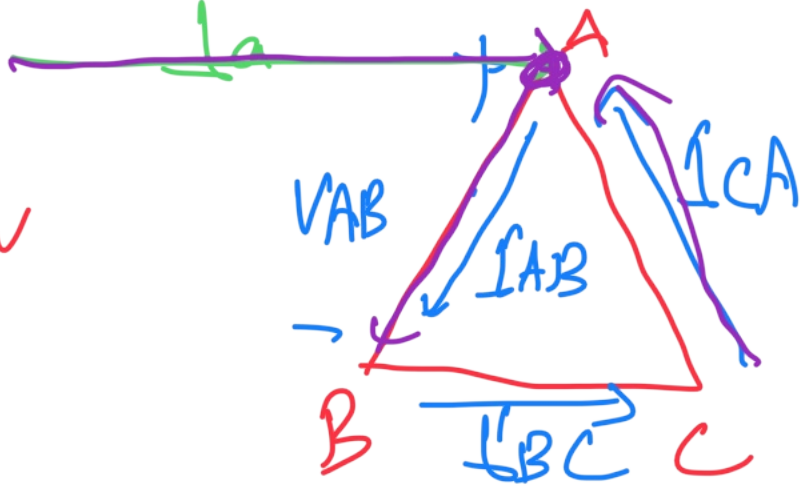
One line voltage of a balanced Y-connected source is $\mathbf{V}_{AB} = 120\angle -20^\circ$ V. If the source is connected to a Δ-connected load of $20\angle 40^\circ\ \Omega$, find the phase and line currents. Assume the *abc* sequence.

Answer: $6\angle -60^\circ$ A, $6\angle -180^\circ$ A, $6\angle 60^\circ$ A, $10.392\angle -90^\circ$ A, $10.392\angle 150^\circ$ A, $10.392\angle 30^\circ$ A.

Y

$V_{AB} = 120\angle -20^\circ V$

line - line voltage



$Z_\Delta = 20\angle 40\ \Omega$

phase current = تيار طور

$$I_{AB} = \frac{V_{AB}}{Z_\Delta} = \frac{120\angle -20}{20\angle 40} = 6\angle -60\ A$$

$$I_{BC} = 6\angle -60 - 120$$

$$I_{CA} = 6\angle -60 + 120$$

$$\Longrightarrow I_{AB} = 6\angle -60\ A$$

$$I_{BC} = 6\angle -180\ A$$

$$I_{CA} = 6\angle 60\ A$$

Line current

يلي متساوي العواتين

$$\sum I_{in} = I_{out}$$

$$I_a + I_{CA} = I_{AB}$$

$$I_a = I_{AB} - I_{CA}$$

$$I_a = (6\angle -60) - (6\angle 60)$$

$$\boxed{I_a = 6\sqrt{3}\angle -90^\circ A}$$

∴ Y ⟶ Δ

line current ، خارجي =

$$I_a = I_{AB} * (\sqrt{3} \angle -30)$$

$$I_a = (6 \angle -60)(\sqrt{3} \angle -30)$$

$$I'_a = 6\sqrt{3} \angle -90 \ A$$

$$I_b = 6\sqrt{3} \angle -210 \ A \quad (-120)$$

$$I_c = 6\sqrt{3} \angle 30^\circ \ A \quad (+120)$$

$$I'_a = 6\sqrt{3} \angle -90^\circ A$$

$$I'_b = 6\sqrt{3} \angle 150^\circ A$$

$$I_c = 6\sqrt{3} \angle 30^\circ A$$

$$-120 \le \theta \le 120$$

$$\hookrightarrow 10.392$$

Example 12.10

For the unbalanced circuit in Fig. 12.25, find: (a) the line currents,

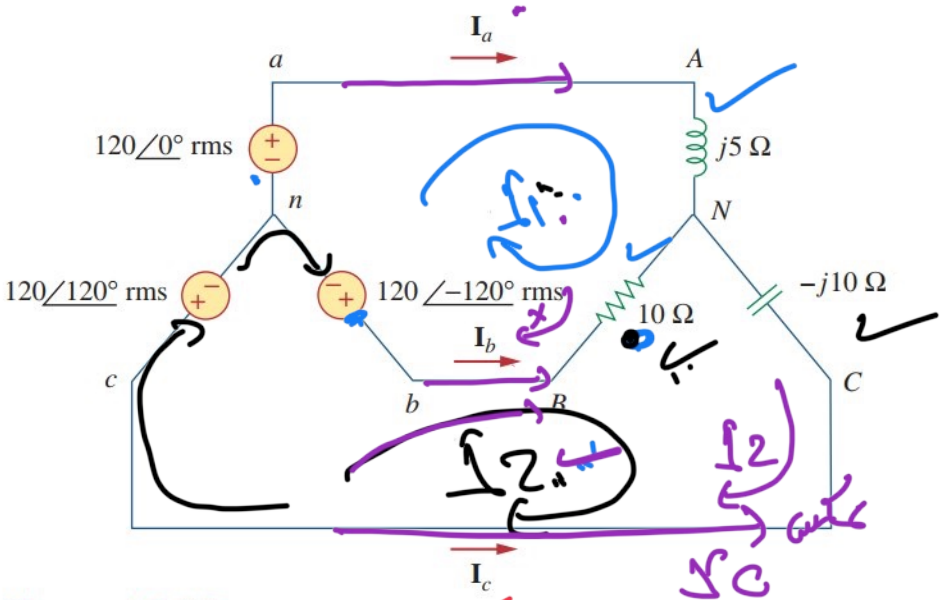


Figure 12.25
For Example 12.10.

$$(10+j5)\underset{A}{I_1} + (-j10)\underset{B}{I_2} = 120\angle -120 - 120\angle -120$$
$$\underset{E}{\quad}$$

$$(-10)\underset{C}{I_1} + (10-j10)\underset{D}{I_2} = 120\angle 120 - 120\angle 120$$
$$\underset{F}{\quad}$$

$$I_1 = \frac{ED - BF}{AD - BC} = 56.78\,A$$

$$I_2 = \frac{AF - EC}{AD - BC} = 42.76\angle 24.89^\circ A$$

$$I_a = I_1 = 56.78\,A$$

$$I_b = I_2 - I_1 = 18\sqrt{2}\angle 135\,A$$

$$I_c = -I_2 = 42.76\angle -155.10\,A$$

12.16 A balanced delta-connected load has a phase current $\mathbf{I}_{AC} = 5\angle -30^\circ$ A.

(a) Determine the three line currents assuming that the circuit operates in the positive phase sequence.

(b) Calculate the load impedance if the line voltage is $\mathbf{V}_{AB} = 110\angle 0^\circ$ V.

12.17 A balanced delta-connected load has line current $\mathbf{I}_a = 5\angle -25^\circ$ A. Find the phase currents $\mathbf{I}_{AB}$, $\mathbf{I}_{BC}$, and $\mathbf{I}_{CA}$.

12.16 load Δ

+ seq abc



$I_{AC} = 5\angle -30\ A$

a) $I_{AC} = -I_{CA}$

$I_{CA} = -1 * 5\angle -30 \Rightarrow 5\angle 150\ A$

Phase current

$I_{AB} = 5\angle 30\ A$

$I_{BC} = 5\angle -90\ A$ (−120)

$I_{CA} = 5\angle 150\ A$ (+120)

Line current

$I_a = (I_{AB}) * (\sqrt{3}\angle -30)$

$$I_a = (5\angle 30) * \sqrt{3}\angle -30)$$

$$I_a = 5\sqrt{3}\angle 0 \text{ A}$$

$$I_b = 5\sqrt{3}\angle -120 \text{A}$$

$$I_c = 5\sqrt{3}\angle +120 \text{ A}$$

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b) $V_{AB} = 110\angle 0 \text{ V}$

$$I_{AB} = 5\angle 30 \text{ A}$$

$$Z_\Delta = \frac{V_{AB}}{I_{AB}} = \frac{110\angle 0}{5\angle 30}$$

$$\Longrightarrow \boxed{Z_\Delta = 22\angle -30 \ \Omega}$$

12.17 load Δ

$I_a = 5\angle -25A$ line current

$$\frac{I_a}{\sqrt{3}\angle -30} = \frac{(I_{AB})(\sqrt{3}\angle -30)}{\sqrt{3}\angle -30}$$

$$I_{AB} = \frac{I_a}{(\sqrt{3}\angle -30)} = \frac{5\angle -25}{\sqrt{3}\angle -30}$$

$$I_{AB} = 2.89\angle 5\ A$$

$$I_{BC} = 2.89\angle -115\ A \quad (-120)$$

$$I_{CA} = 2.89\angle 125\ A \quad (+120)$$

?