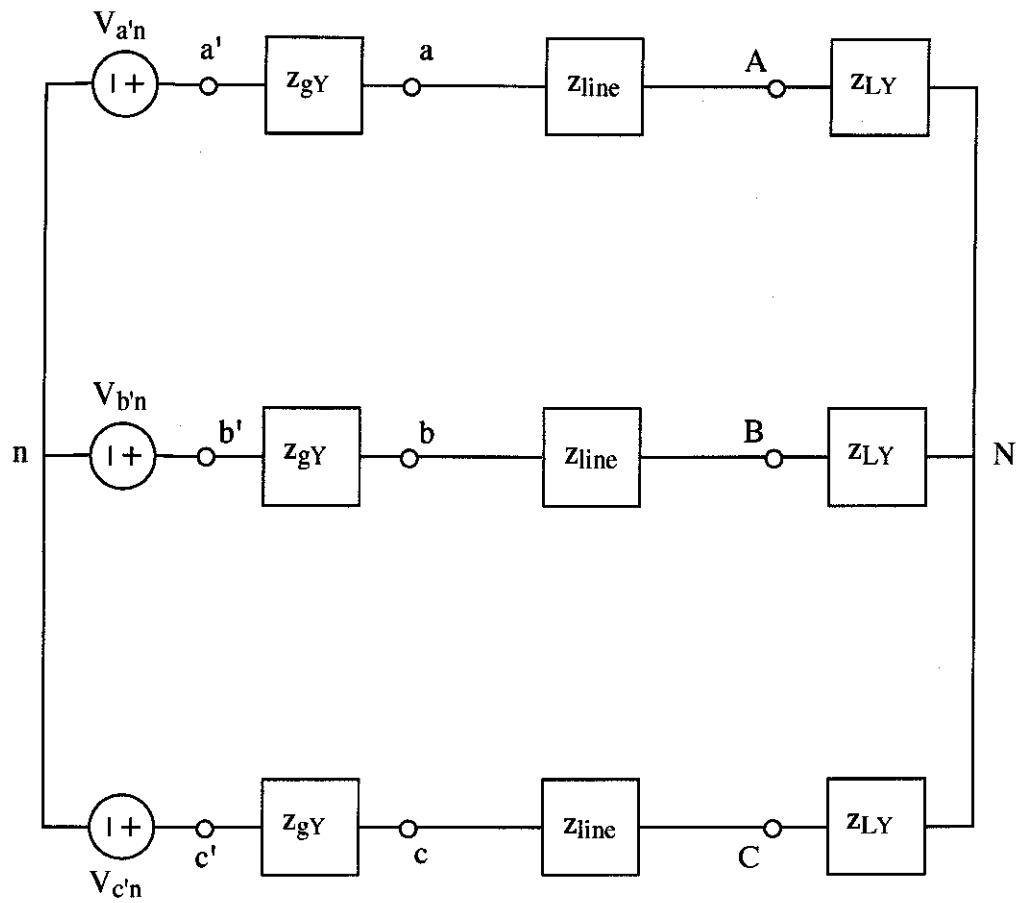


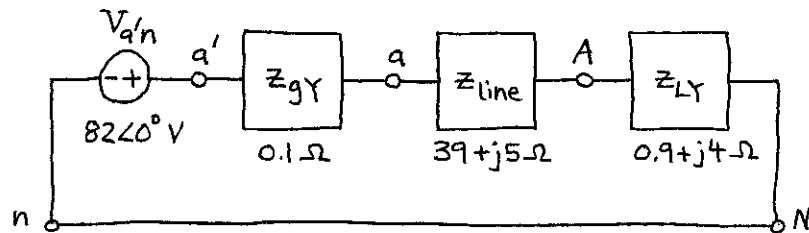
EX:



$$\begin{aligned} V_{a'n} &= 82\angle 0^\circ \text{ V} & z_{gY} &= 0.1 \, \Omega \\ V_{b'n} &= 82\angle 120^\circ \text{ V} & z_{line} &= 39 + j5 \, \Omega \\ V_{c'n} &= 82\angle -120^\circ \text{ V} & z_{LY} &= 0.9 + j4 \, \Omega \end{aligned}$$

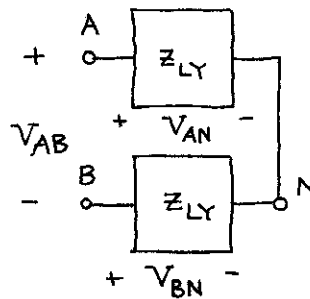
- Draw a single-phase equivalent circuit.
- Calculate V_{AB} .

- Sol'n: a) Since this circuit is already a Y-Y configuration, we obtain the single-phase equivalent circuit by adding a wire from n to N (which carries no current) and drawing only the A phase.



- b) We find V_{AB} from V_{AN} and a phasor diagram that shows how V_{AN} and V_{AB} are related.

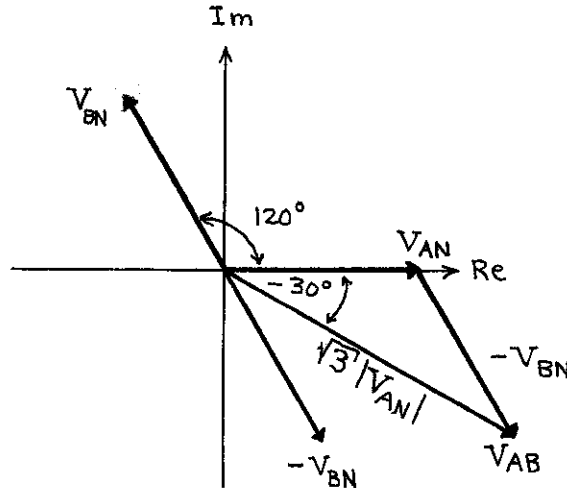
We have $V_{AB} = V_{AN} - V_{BN}$:



From symmetry and the phase angle shift of $+120^\circ$ from $V_{a'n}$ to $V_{b'n}$, we know $V_{BN} = V_{AN} \cdot 1\angle +120^\circ$.

$$\therefore V_{AB} = V_{AN} - V_{AN} \cdot 1\angle +120^\circ$$

We use a phasor diagram for the subtraction.



Note: We translate the $-V_{BN}$ vector so it starts where V_{AN} ends. This allows us to add V_{AN} and $-V_{BN}$ graphically.

Note: We always draw the diagram by starting with the shorter vector, V_{AN} , on the real axis. Then we perform the subtraction of the two shorter vectors, V_{AN} and V_{BN} , to get the longer vector V_{AB} . Thus, the diagram indicates how V_{AN} and V_{AB} are related by magnitude and phase rather than the actual phase of either V_{AN} or V_{AB} .

From the diagram, we have the following relationship between V_{AN} and V_{AB} :

$$V_{AB} = V_{AN} \cdot \sqrt{3} \angle -30^\circ$$

Now we find V_{AN} from the single-phase model.

We use a voltage-divider eq'n to find V_{AN} :

$$\begin{aligned}
 V_{AN} &= V_{a'n} \cdot \frac{Z_{LY}}{Z_{gY} + Z_{line} + Z_{LY}} \\
 &= 82 \angle 0^\circ \text{ V} \cdot \frac{0.9 + j4 \, \Omega}{0.1 + 39 + j5 + 0.9 + j4 \, \Omega} \\
 &= 82 \angle 0^\circ \text{ V} \cdot \frac{0.9 + j4}{40 + j9} \\
 &= 82 \angle 0^\circ \text{ V} \cdot \frac{4.1 \angle 77.3^\circ}{41 \angle 12.7^\circ} \\
 &= 8.2 \angle (0^\circ + 77.3^\circ - 12.7^\circ) \text{ V}
 \end{aligned}$$

$$V_{AN} = 8.2 \angle 64.6^\circ \text{ V}$$

Using our eq'n from earlier

$$\begin{aligned}
 V_{AB} &= V_{AN} \cdot \sqrt{3} \angle -30^\circ \\
 &= 8.2 \angle 64.6^\circ \text{ V} \cdot \sqrt{3} \angle -30^\circ
 \end{aligned}$$

$$V_{AB} = 14.2 \angle 34.6^\circ \text{ V}$$

$$\text{or } V_{AB} \doteq 11.7 + j8.1 \text{ V}$$