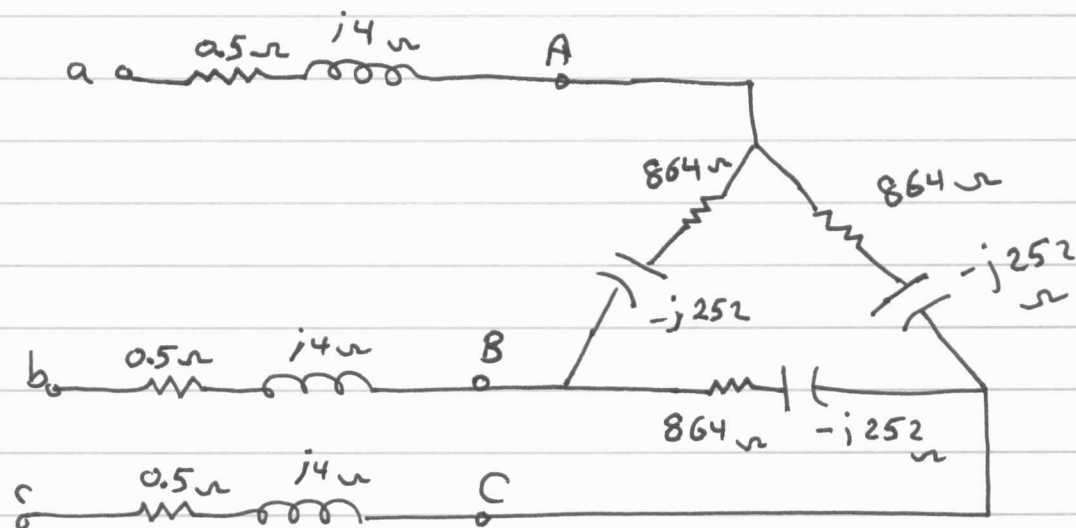


11.14



$$\vec{V}_{AB} = 69 \angle 0^\circ \text{ kV}$$

$$\vec{I}_{AB} = \frac{69 \angle 0^\circ \text{ kV}}{864 - j252} = 76.67 \angle 16.26^\circ \text{ A}$$

$$\therefore \vec{I}_{BC} = 76.67 \angle -103.74^\circ \text{ A}$$

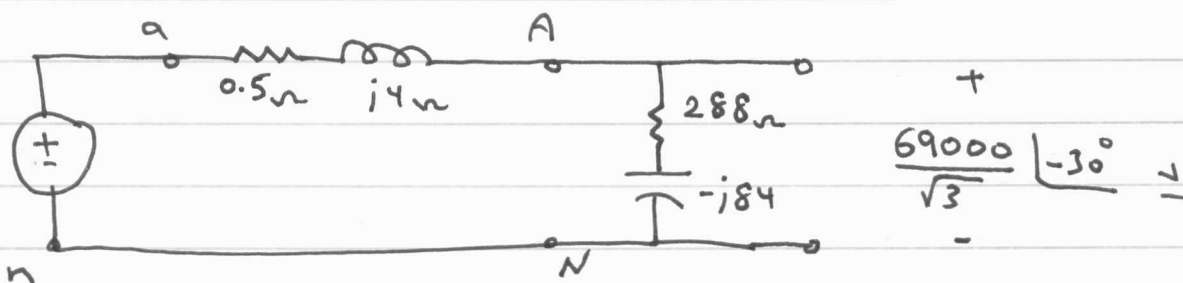
$$\vec{I}_{CA} = 76.67 \angle 139.26^\circ \text{ A}$$

$$\vec{I}_{aA} = \sqrt{3} \angle -30^\circ \vec{I}_{AB} = 132.79 \angle -13.74^\circ \text{ A}$$

$$\vec{I}_{bB} = 132.79 \angle -133.74^\circ \text{ A}$$

$$\vec{I}_{cC} = 132.79 \angle 106.76^\circ \text{ A}$$

single phase equivalent circuit



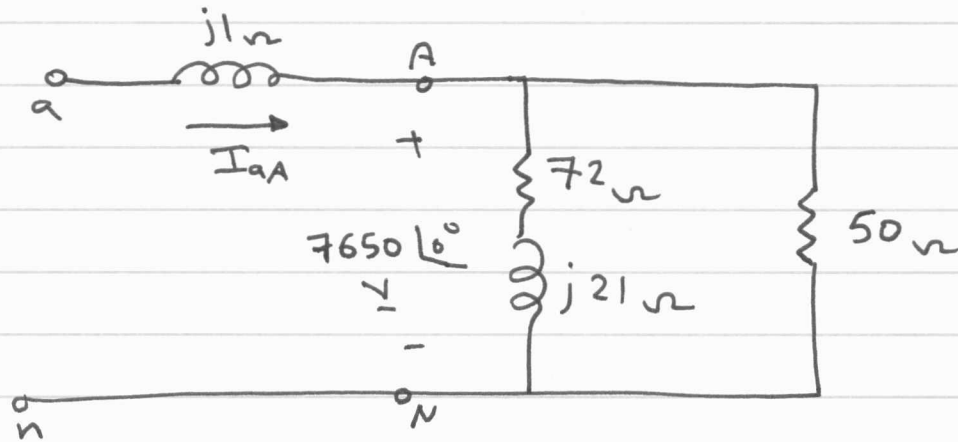
$$\vec{V}_{an} = (0.5 + j4) \vec{I}_{aA} + \frac{69000}{\sqrt{3}} \angle -30^\circ = 39755.7 \angle -29.24^\circ \text{ V}$$

$$\vec{V}_{ab} = \sqrt{3} \angle +30^\circ \vec{V}_{an} = 68858.88 \angle 0.76^\circ \text{ V}$$

$$\vec{V}_{bc} = 68858.88 \angle -119.24^\circ \text{ V}$$

11.15

Single-phase equivalent circuit



$$\vec{I}_{aA} = \frac{7650 \angle 0^\circ}{50} + \frac{7650 \angle 0^\circ}{72 + j21} = 252.54 \angle -6.49^\circ \text{ A}$$

$$|I_{aA}| = 252.54 \text{ A}$$

$$\vec{I}_{AB} = \frac{\vec{V}_{AB}}{150} = \frac{7650 \sqrt{3} \angle 30^\circ}{150} = 88.33 \angle 30^\circ \text{ A}$$

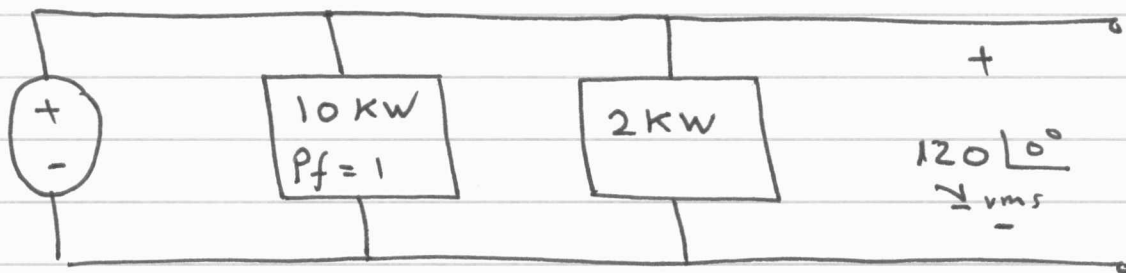
$$\vec{I}_{AN} = \frac{\vec{V}_{AN}}{72 + j21} = 102 \angle -16.26^\circ \text{ A}$$

$$\vec{V}_{an} = (j1) \vec{I}_{aA} + 7650 \angle 0^\circ = 7682.66 \angle 1.87^\circ \text{ V}$$

$$|N_{ab}| = \sqrt{3} \cdot 7682.66 = 13306.76 \text{ V}$$

11.23

Single-phase equivalent circuit



$$S_{g\phi} = 20 \angle 53.13^\circ \text{ kVA}$$

$$S_{g\phi} = 12000 + j16000$$

$$S_{g\phi} = S_{1\phi} + S_{2\phi}$$

$$\therefore S_{2\phi} = 2000 + j16000$$

$$S_{2\phi} = \frac{|V_{rms}|^2}{Z_2^*}$$

$$\therefore Z_2^* = 0.11 - j0.89 \Omega$$

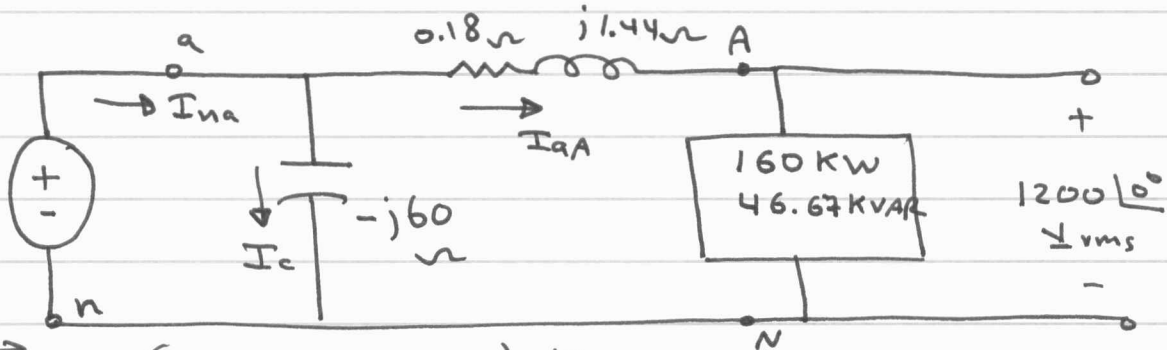
$$\therefore Z_2 = 0.11 + j0.89 \Omega$$

11.30

$$|S_L| = 500 \text{ KVA}, \text{ Pf} = 0.96 \text{ lag}$$

$$\therefore P_L = 480 \text{ KW}, \text{ and } Q_L = 140 \text{ KVAR}$$

Single-phase equivalent circuit



$$\vec{S}_{L\phi} = (160 + j46.67) \text{ KVA}$$

$$\vec{S}_{L\phi} = \vec{V}_{AN} \cdot \vec{I}_{aA}^*$$

$$\therefore \vec{I}_{aA} = 133.3 - j38.9 \text{ A rms}$$

$$\vec{V}_{an} = (0.18 + j1.44) \vec{I}_{aA} + 1200 \angle 0^\circ$$

$$\vec{V}_{an} = 1280 + j185 \text{ V rms}$$

$$\vec{I}_c = \frac{\vec{V}_{an}}{-j60} = -3.1 + j21.3 \text{ A rms}$$

$$\vec{I}_{na} = \vec{I}_c + \vec{I}_{aA} = 131.4 \angle -7.68^\circ \text{ A rms}$$

$$\vec{S}_{g\phi} = \vec{V}_{an} \cdot \vec{I}_{na}^* = 163472 + j46567 \text{ VA}$$

$$\therefore \vec{S}_{gT} = 3 \vec{S}_{g\phi} = (490.4 + j139.7) \text{ KVA}$$

$$\therefore P_{deliv} = 490.4 \text{ KW}$$

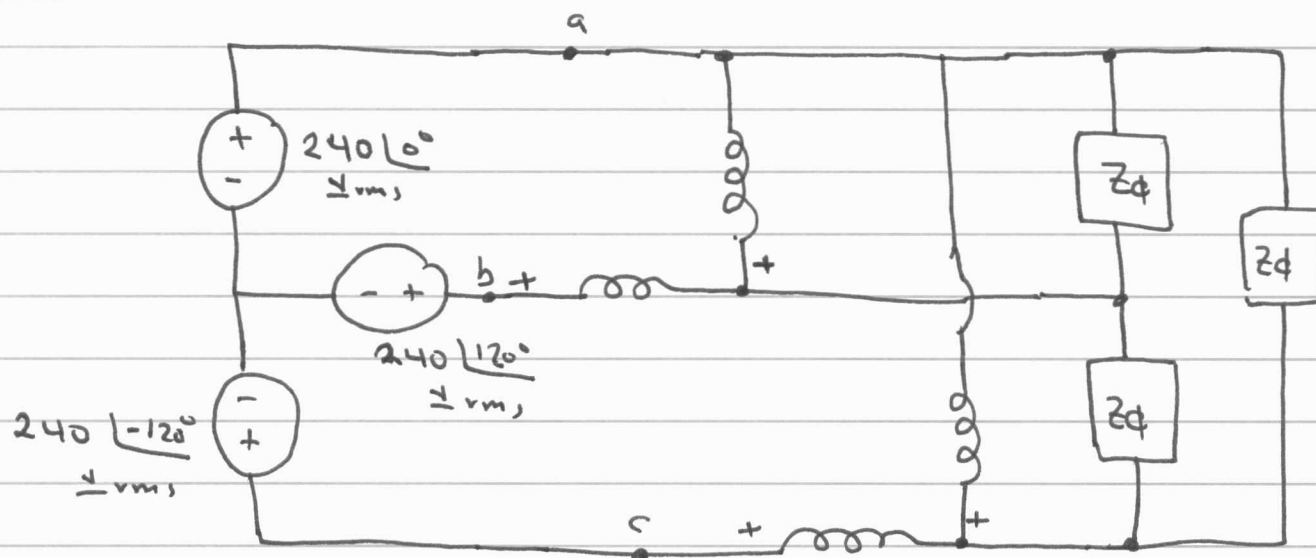
$$P_{abs} = (3)(160 \text{ KW}) + (3)(|I_{aA}|^2)(0.18) = 490.4 \text{ KW}$$

$$Q_{deliv} = (3)|I_c|^2(60) + 139.7 \text{ KVAR} = 223.3 \text{ KVAR}$$

$$Q_{abs} = (3)(46.67) \text{ KVAR} + (3)(|I_{aA}|^2)(1.44)$$

$$= 223.3 \text{ KVAR}$$

11.46



$$Z_{\phi} = 40 \angle -30^{\circ} \Omega, \text{ negative sequence}$$

$$W_1 = \sqrt{3} V_{BA} I_{bB} \cos \theta_1$$

$$\vec{V}_{an} = 240 \angle 0^{\circ} \text{ V rms}$$

$$\vec{V}_{ab} = \sqrt{3} 240 \angle -30^{\circ} \text{ V rms}$$

$$\therefore \vec{V}_{BA} = \sqrt{3} 240 \angle 150^{\circ} \text{ V rms}$$

$$\vec{I}_{aA} = \frac{240 \angle 0^{\circ}}{\frac{40}{3} \angle -30^{\circ}} = 18 \angle 30^{\circ}$$

$$\therefore W_1 = (240 \sqrt{3})(18) \cos(150 - 150)$$

$$\therefore W_1 = 7482.46 \text{ W}$$

$$W_2 = \sqrt{3} V_{CA} I_{cC} \cos \theta_2$$

$$\vec{V}_{cA} = \sqrt{3} 240 \angle -150^{\circ} \text{ V rms}$$

$$\vec{I}_{cC} = 18 \angle -90^{\circ}$$

$$W_2 = (\sqrt{3} 240)(18) \cos(-150 + 90^{\circ}) = 3741.23 \text{ W}$$

$$\therefore W_1 + W_2 = 11223.69 \text{ W}$$

$$P_{\phi} = \sqrt{3} V_{AB} I_{AB} \cos \theta_2$$

$$P_{\phi} = (\sqrt{3} 240) \left(\frac{18}{\sqrt{3}} \right) \cos(-30^{\circ}) = 3741.23 \text{ W}$$

$$\therefore P_T = 3 P_{\phi} = 11223.69 \text{ W}$$