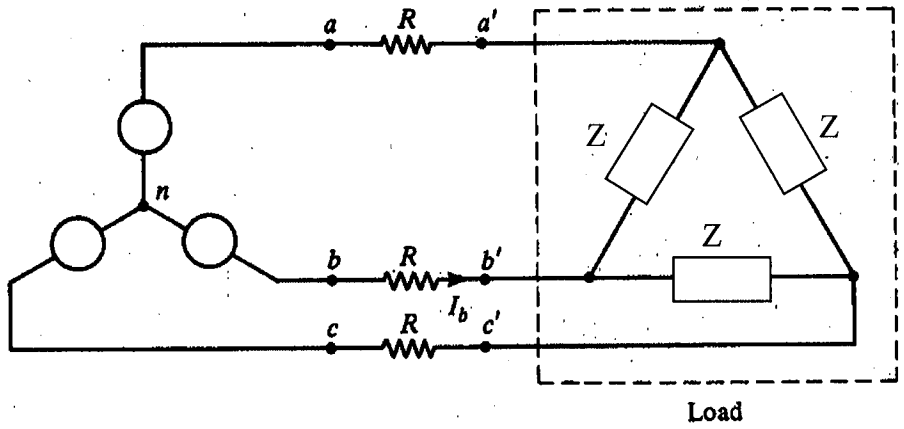
EE369/394J, Test #2, Sept. 10, 2004. Name KEY 1/2

One sheet of notes permitted. Show all steps.

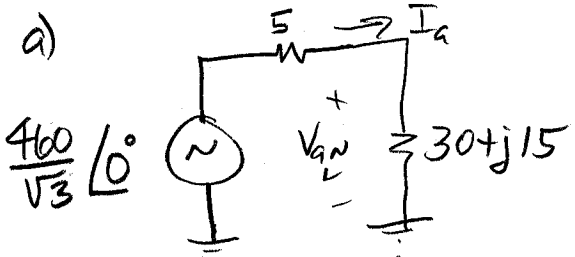
The 60Hz system shown below is balanced. The line-to-line voltage of the source is 460V. Resistors R are each 5Ω.



Part a. If each Z is (90 + j45)Ω, determine the three-phase complex power delivered by the source, and the three-phase complex power absorbed by the delta-connected Z loads.

Part b. If $\tilde{V}_{an}$ at the source has phase angle zero, find $\tilde{V}_{a'b'}$ at the load.

a)



Equivalent Y

$$\tilde{I}_a = \frac{\frac{460}{\sqrt{3}}\angle 0}{35+j15} = \frac{266\angle 0}{38.1\angle 23.2^\circ} = 6.98\angle -23.2$$

$$P_{L1\phi} = |I_A|^2 R_{LY} = (6.98)^2(30) = 1462\,W$$

$$Q_{L1\phi} = |I_A|^2 X_{LY} = 731\,VAr$$

$$S_{L1\phi} = P_{L1\phi} + jQ_{L1\phi} = 1635\angle 26.6^\circ\,VA$$

$$S_{L3\phi} = 3S_{L1\phi} = 4905\angle 26.6\,VA$$

4385 + j2196

Source

$3V_{aN}I_a^* = 3\left(\frac{460}{\sqrt{3}}\angle 0\right)(6.98\angle 23.2)$

$= 5561\angle 23.2\,VA$

5111 + j2191

b) $\tilde{V}_{aN} = \tilde{I}_a Z_Y = (6.98\angle -23.2)(30+j15) = 234\angle 3.4°$

$30+j15 = 33.5\angle 26.6$

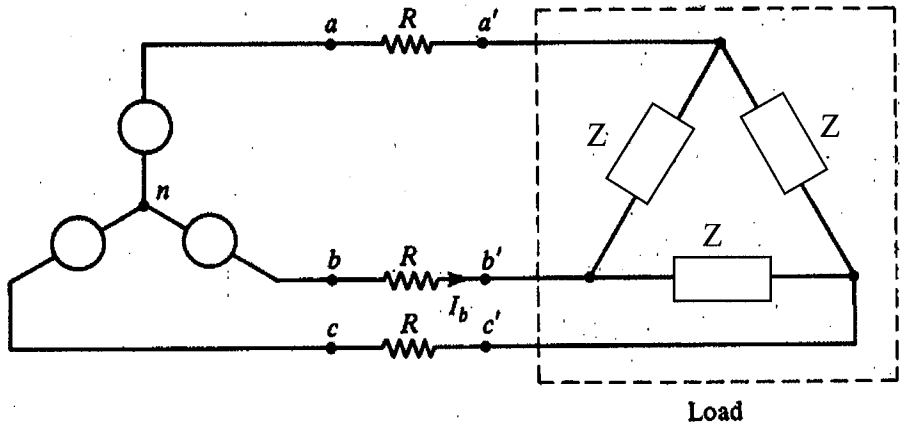
$\tilde{V}_{ab} = \sqrt{3}\,\tilde{V}_{aN} \cdot 1\angle 30$

$\tilde{V}_{ab} = (\sqrt{3})(234\angle 3.4)(1\angle 30) = 405\angle 33.4^\circ\,V$

EE369/394J, Test #2, Sept. 10, 2004. Name KEY 2/2

One sheet of notes permitted. Show all steps.

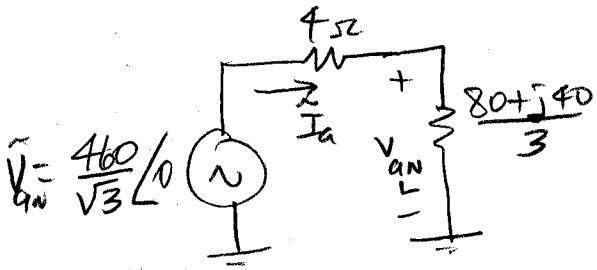
The 60Hz system shown below is balanced. The line-to-line voltage of the source is 460V. Resistors R are each 4Ω.



Part a. If each Z is (80 + j40)Ω, determine the three-phase complex power delivered by the source, and the three-phase complex power absorbed by the delta-connected Z loads.

Part b. If $\tilde{V}_{an}$ at the source has phase angle zero, find $\tilde{V}_{a'b'}$ at the load.

Convert the load to a Y, where $Z_Y = \frac{80+j40}{3}$



$$\tilde{I}_a = \frac{\tilde{V}_{AN}}{4 + \frac{80+j40}{3}} = \frac{\frac{460}{\sqrt{3}}\angle 0}{30.7 + j13.33}$$

$$\tilde{I}_a = \frac{266\angle 0}{33.5\angle 23.5} = 7.95\angle -23.5^\circ \text{ A}$$

$$P_{L1\phi} = |I_a|^2 R_{L_Y} = (7.95)^2\left(\tfrac{80}{3}\right) = 1685 \text{ W}$$

$$Q_{L1\phi} = |I_a|^2 X_{L_Y} = (7.95)^2\left(\tfrac{40}{3}\right) = 843 \text{ VAr}$$

$$S_{L1\phi} = P_{L1\phi} + jQ_{L1\phi} = 1884\angle 26.6 \text{ VA}$$

Source $S_{3\phi}$
$3\left(\frac{460}{\sqrt{3}}\angle 0\right)(7.95\angle +23.5)$
$= 6334\angle 23.5$ VA

(a) $S_{L3\phi} = 3S_{L1\phi} = 5652\angle 26.6 \text{ VA}$ $\quad (5054 + j2531)$ VA

(b) $\tilde{V}_{aN_L} = Z_Y \tilde{I}_a = \left(\frac{80+j40}{3}\right)(7.95\angle -23.5) = (29.8\angle 26.6)(7.95\angle -23.5)$

$\tilde{V}_{aN_L} = 237\angle 3.1^\circ$, $\quad \tilde{V}_{ab_L} = \sqrt{3}\tilde{V}_{aN_L} \cdot 1\angle 30 = 410\angle 33.1^\circ$ V