P 11.24 [a] $P_{OUT} = 746 \times 200 = 149{,}200$ W

$$P_{IN} = 149{,}200/(0.96) = 155{,}416.67 \text{ W}$$

$$\sqrt{3}V_L I_L \cos\theta = 155{,}416.67$$

$$I_L = \frac{155{,}416.67}{\sqrt{3}(208)(0.92)} = 468.91 \text{ A}$$

66,207.79 VAR

[b] $Q = \sqrt{3}V_L I_L \sin\phi = \sqrt{3}(208)(468.91)(0.39) = 66{,}207.79$ VAR

P 11.27 [a] $S_1 = 72 - j21$ kVA

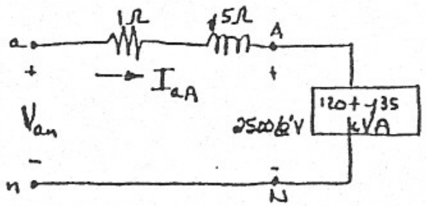
$S_2 = 120 + j90$ kVA

$S_3 = 168 + j36$ kVA

$S_T = S_1 + S_2 + S_3 = 360 + j105$ kVA

$S_T/\phi = 120 + j35$ kVA

Single phase equivalent circuit



$\therefore\ I^*_{aA} = \frac{120{,}000 + j35{,}000}{2500} = 48 + j14$

$\therefore\ I_{aA} = 48 - j14$ A $= 50\angle{-16.26^\circ}$ A

$V_{an} = 2500 + (1 + j5)(48 - j14) = 2618 + j226$

$= 2627.74\angle{4.93^\circ}$ V

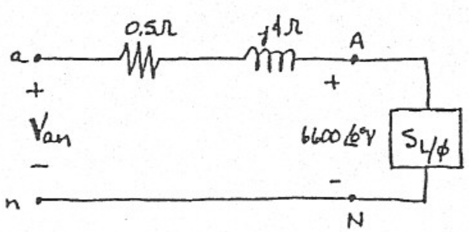
$\therefore\ |V_{ab}| = \sqrt{3}(2627.74) = 4534.51$ V

[b] $P_L/\phi = 120$ kW

$P_S/\phi = 120{,}000 + |I_{aA}|^2(1) = 122{,}500$ W $= 122.5$ kW

$\eta = \left(\frac{120}{122.5}\right) 100 = 97.96\%$

P 11.28 [a]



$S_{L/\phi} = \frac{1}{3}\left[1188 + j\frac{1188}{0.6}(0.8)\right] 10^3 = 396{,}000 + j528{,}000$ VA

$I^*_{aA} = \frac{396{,}000 + j528{,}000}{6600} = 60 + j80$ A

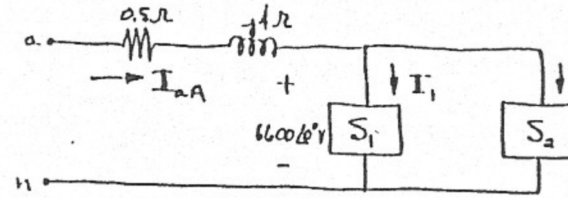
$I_{aA} = 60 - j80$ A

$V_{an} = 6600 + (60 - j80)(0.5 + j4)$

$= 6950 + j200 = 6952.88\angle{1.65^\circ}$ V

$|V_{ab}| = \sqrt{3}(6952.88) = 12{,}042.74$ V

[b]



$I_1 = 60 - j80$ A (from part [a])

$S_2 = 0 - j\frac{1}{3}(1920) \times 10^3 = -j6~~60~~40,000$ VAR

$I^*_2 = \frac{-j6~~60~~40{,}000}{6600} = ~~-j100~~$ A $= -j96.97$

$\therefore\ I_2 = ~~j100~~$ A $= j96.97$

$I_{aA} = 60 - j80 + ~~j100~~$ j96.97 $= ~~60 + j20~~$ A $= 60 + j16.97$

$V_{an} = 6600 + (60 + j20)(0.5 + j4)$

$= 6550 + j250 = 6554.77\angle{2.19^\circ}$ V

$|V_{ab}| = \sqrt{3}(6554.77) = 11{,}353.19$ V

[c] $I_{aA} = 100$ A

$P_{loss/\phi} = (100)^2(0.5) = 5000$ W

$P_{g/\phi} = 396{,}000 + 5000 = 401$ kW

$\%\eta = \frac{396}{401}(100) = 98.75\%$

[d] $|I_{aA}| = \sqrt{4000}$ A $= 62.35$

$P_{l/\phi} = (4000)(0.5) = ~~2000~~$ W $= 1944$

$\%\eta = \frac{396}{~~398~~}(100) = ~~99.50\%~~ = 99.51\%$

397.974

[e] $Z_{\text{cap/Y}} = -j\frac{6600}{100} = -j66\,\Omega$ = $-j68$

66.97

$Z_{\text{cap}/\Delta} = 3Z_{\text{cap/Y}} = -j192\,\Omega$ $Z_{\text{cap}\Delta} = -j204$

for Δ connected capacitors.

$\therefore\ \frac{1}{\omega C} = 192;\qquad C = \frac{1}{(192)(120\pi)} = 13.40\,\mu\text{F}$

204

P 11.38 $\tan\phi = \frac{\sqrt{3}(W_2 - W_1)}{W_1 + W_2} = \frac{873{,}290.66}{732{,}777.88} = 1.1918$

$\therefore\ \phi = 50^\circ$;

$\therefore\ 7600\sqrt{3}|I_L|\cos 80^\circ = 114{,}291.64$

$|I_L| = 50\,A$

$|Z| = \frac{7600}{50} = 152\,\Omega \qquad \therefore\ Z = 152\underline{/50^\circ}\,\Omega$