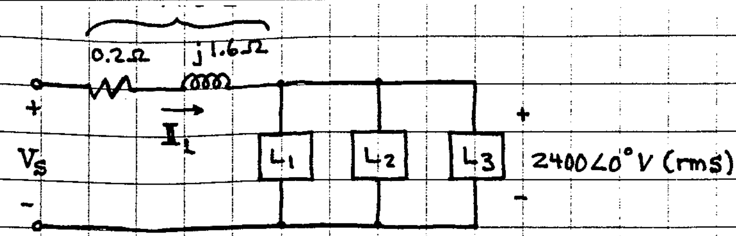

a) Calculate V_s (rms) given $I_L = 30 + j10\text{A}$ (rms)

sol'n: $V_s\text{(rms)} = I_L\text{(rms)}\,(0.2 + j1.6\,\Omega) + 2400\angle 0°\text{ V (rms)}$

$= \quad i \cdot z \quad + \quad v_{load}$

$= (30+j10)(0.2+j1.6)\text{ V} + 2400\text{ V} \quad \text{(rms)}$

$= 6 - 16 + j(2+48) + 2400 \quad \text{V(rms)}$

$= 2390 + j\,50 \quad \text{V (rms)}$

or $V_s\text{(rms)} = 2391\angle 1.2°\text{ V (rms)}$

b) Calculate ave (or real) and reactive power for line z.

sol'n: Only the resistance dissipates real power.

$\therefore\ P = |I_L\text{(rms)}|^2 \cdot 0.2\,\Omega = |30+j10|^2 \cdot 0.2\text{ W}$

$P = \left(\sqrt{30^2+10^2}\right)^2 \cdot 0.2\text{ W} = 1000 \cdot 0.2\text{ W} = 200\text{ W}$

$Q = |I_L\text{(rms)}|^2 \cdot 1.6\,\Omega = 1600\text{ VAR}$ ← Only j1.6Ω "dissipates" reactive pwr.

VAR = Volt-Amps Reactive

c) Calculate ave and reactive power for V_s.

sol'n: $\theta_v - \theta_i = \angle V_s\text{(rms)} - \angle I_L = 1.2° - \tan^{-1}\frac{10}{30}$

$= 1.2° - 18.4° = -17.2°$

$P = \underbrace{|V_s\text{(rms)}|}_{2391}\underbrace{|I_L\text{(rms)}|}_{\sqrt{1000}}\cos(-17.2°) = 72.2\text{ kW}$

$Q = |V_s\text{(rms)}||I_L\text{(rms)}|\sin(-17.2°) = -22.4\text{ kW}$

d) Calculate efficiency, $\eta = \frac{P_{load}}{P_{source}} \cdot 100\ \%$

given $P_{load} = 72\text{ kW}$

sol'n: $\eta = \frac{72\text{ kW}}{72.2\text{ kW}} \cdot 100\% = 99.72\ \%$

Note: $P_{load} = |\underset{(rms)}{I_L}||2400\angle 0° \text{ V (rms)}| \cos(\underset{0°}{\theta_v} - \theta_i)$

$= |I_L(rms)| \cos(-\angle I_L) \cdot 2400\text{ V}$

$= |I_L(rms)| \cos(\angle I_L) \cdot 2400\text{ V}$

$= \text{Re}\{I_L(rms)\} \cdot 2400\text{ V}$

$= 30 \cdot 2400\text{ W}$

$= 72\text{ kW}$