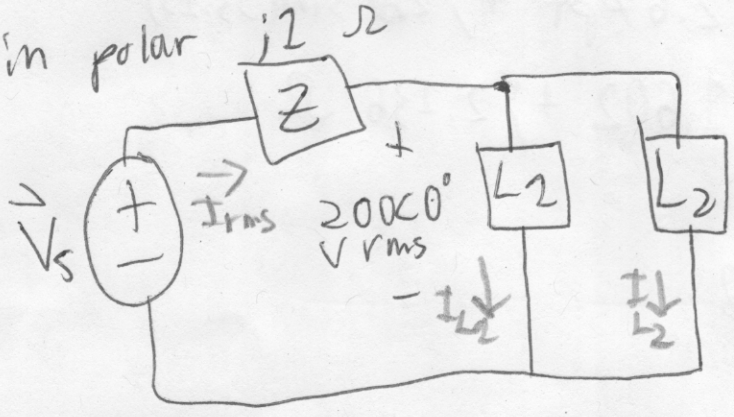
Peter A. Dranishnikov EEL 3212C

AP 10.6, 10.7

10.2, 10.28, 10.46

AP10.6 Find $V_{s_{rms}}$ in circuit below if loads L_1, L_2

V_s in polar



15 kVA, 0.6 pf (lag)

6 kVA, −0.8 pf (lead)

$|S_{L_1}| = 15000$ VA $\quad 0.6 = \cos(\theta_v - \theta_i)$ $\quad \theta_v - \theta_i = 53.13°$

$|S_{L_2}| = 6000$ VA $\quad -0.8 = \cos(\theta_v - \theta_i)$ $\quad \theta_v - \theta_i = ~~143.13°~~ \; 36.87°$

$P_{L_2} = |S_{L_1}| \cos(\theta) = 15000 \cdot 0.6 = 9000$ W

$Q_{L_2} = |S_{L_1}| \sin(\theta) = 15000 \cdot \sin(53.13) = 12000$ VAR

$P_{L_2} = |S_{L_2}| \cos(\theta) = 6000 \cdot 0.8 = 4800$ W

$Q_{L_2} = |S_{L_2}| - \sin(\theta) = 6000 \cdot -0.6 = -3600$ VAR

$S_{L_1} = 9000 + j12000$ VA $\quad S_{L_1} + S_{L_2} = S = 13800 + j8400$ VA

$S_{L_2} = 4800 - j3600$ VA $\quad \theta = \tan^{-1}\left(\frac{8400}{13800}\right) = 31.33°$

$\cos(\theta) = pf = 0.85$ lag

$9000 = 200\,|I_{eff}|\,0.6$

$|I_{eff}| = 75\ A$

$|Z| = \frac{|V_{eff}|}{|I_{eff}|} = \frac{200}{75} = 2.67\ \Omega$

$Z_1 = 2.67 \angle 53.13 = 2.67\,pf + j\,267 \sin(53.13)$

$= 1.602 + j\,2.136\ \Omega$

$4800 = 200\,|I_{eff}|\,0.8$

$|I_{eff}| = 30\ A$

$|Z| = \frac{|V_{eff}|}{|I_{eff}|} = \frac{200}{30} = 6.67\ \Omega$

$Z_2 = 6.67 \angle 36.87 = 5.336 - j\,4.00\ \Omega$

$\vec{I}_1 = \frac{200}{1.602 + j\,2.136} = 44.944 - j\,59.93\ A$

$\vec{I}_2 = \frac{200}{5.336 - j4} = 24.00 + j\,17.99\ A$

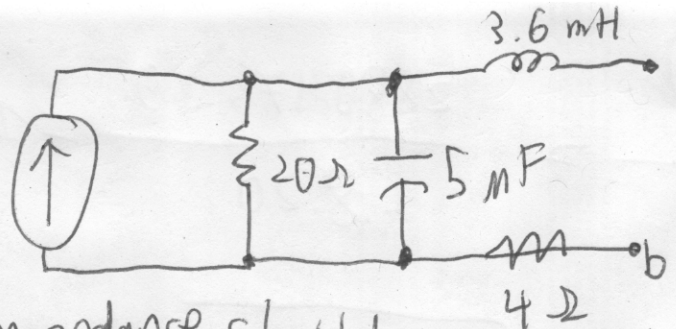
$\vec{I}_1 + \vec{I}_2 = 68.94 - j\,41.94\ A = \vec{I}$

$\vec{I} \cdot j1 = 41.94 + j\,68.94\ V$

$\vec{V}_S = 41.94 + j\,68.94 + 200 = 241.94 + j\,68.94\ V =$

$251.57 \angle 15.91^\circ\ V$

AP 20.7



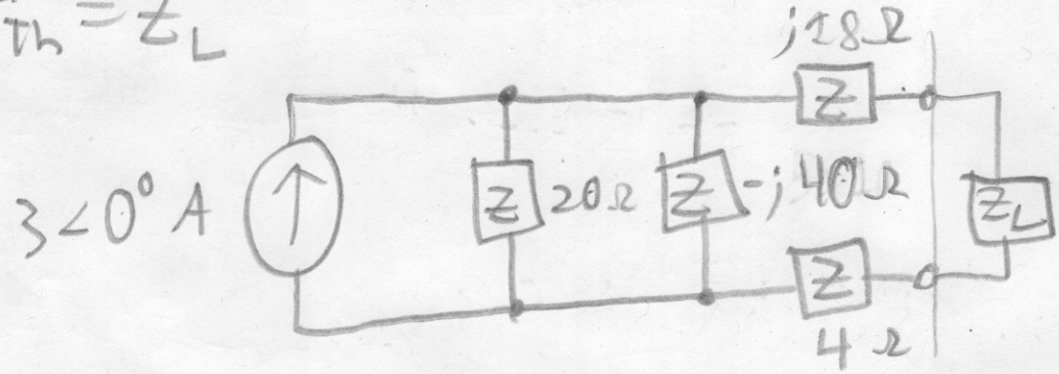
a) what impedance should be loaded for max avg power transfer?

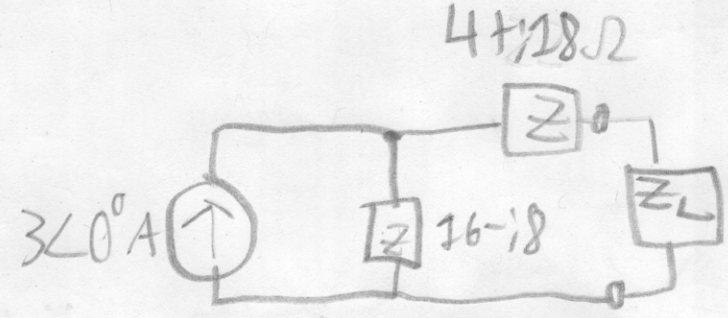
b) what is average power transferred? ↑

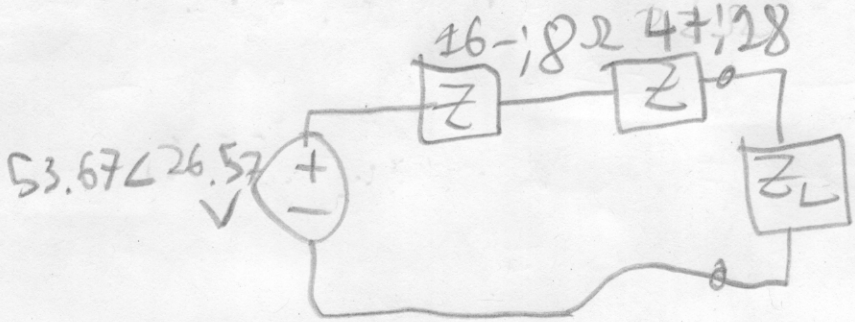
c) Load must be pure resistance. What resistance loaded for max avg power transfer?

d) what is the average power transferred? ↑

a) $Z_{Th}^{*} = Z_L$







$Z_{Th} = 20 + j10\ \Omega$

$Z_{Th}^{*} = 20 - j10\Omega$

$= Z_L$

b) $\frac{|V_m|^2 R_L}{8 R_L^2}$ (max tr) $\Rightarrow \frac{2880.47 \cdot 20}{8.20} = 18\,W$

c) $\sqrt{R_{Th}^2 + (0 + X_{Th})^2} = \sqrt{20^2 + 10^2} \approx 22.36\,\Omega = R_L$

d) $\frac{|V_{rms}|^2 R_L}{(R_{Th} + R_L)^2 + (X_{Th} + X_L)^2} \Rightarrow \frac{1440.23 \cdot 22.36}{(20 + 22.36)^2 + 10^2} = 17\,W$

$V_{rms} = \frac{V_m}{\sqrt{2}} = 37.95$

10.2 a) TL;PR coffe maker, microwave, toaster, hot plate in sum trip 50A breaker on $120V_{rms}$ single phase?

b) add AC and Vacuum. Will it trip?

Too vague to answer tutor

power (avg) (W)

coffee: ~~1200~~

microwave: 1450

toaster: ~~1146~~ 1450

hot plate: ~~1196~~ ~~1246~~ 1196

AC: ~~630~~ 4000 ~~860~~

Vacuum: ~~630~~ 1400

a)

~~4442~~

5296

$5296 + 4442 = 9738$

$\frac{9738}{120} = 81.15\ A$ ~~44.13A~~ ~~41.6 A~~

NO ~~NO~~

$5296 + 5400 = 10696$

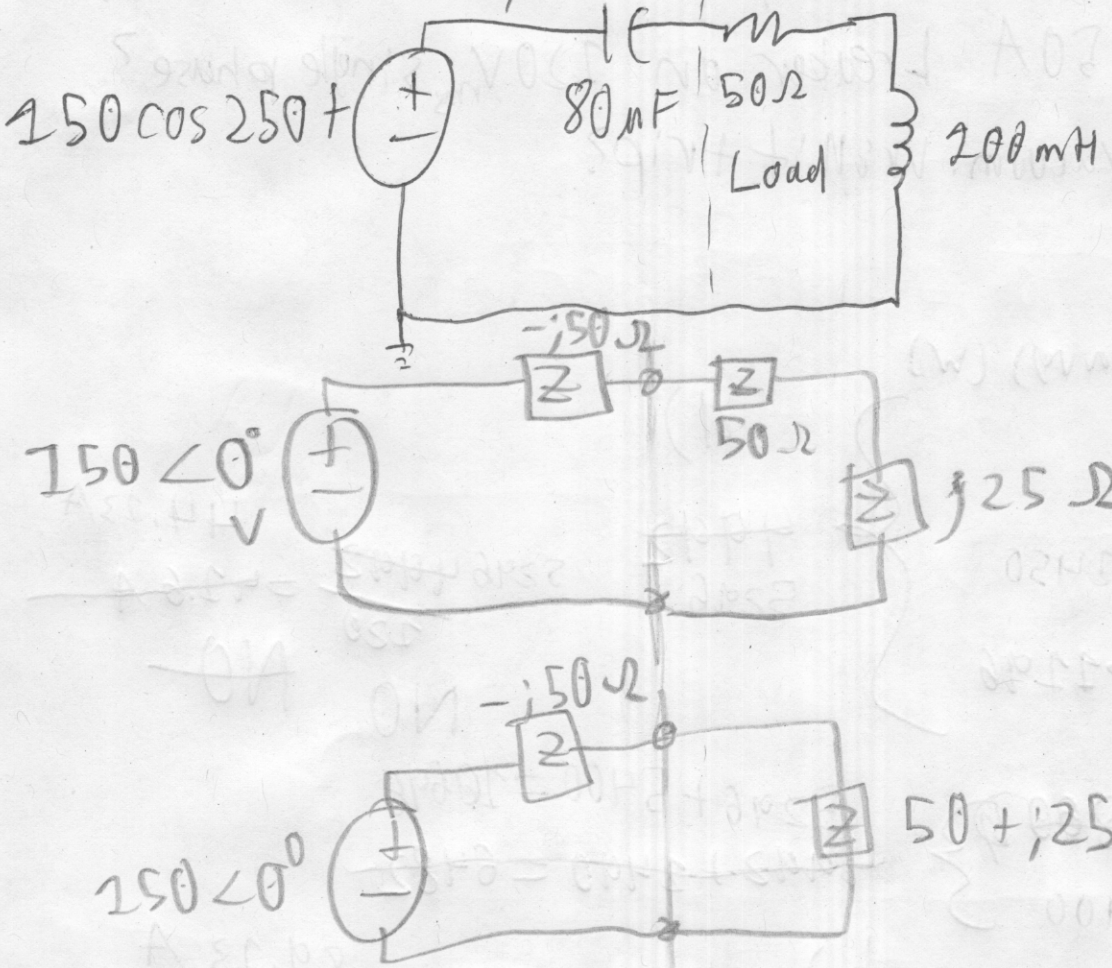
~~$4442 + 1400 = 6482$~~

b) 10696 ~~6482~~

$\frac{10696}{120} = 89.13\ A$ ~~54.026 A~~

YES

10.28 Find P, Q, |S| absorbed by load



$\frac{150}{\sqrt{2}}$ $V_{rms} = 106.07\ V$

$$P = \frac{V_{rms}^2 \cdot R_L}{R_L^2 + (X_{Th} + X_L)^2} = \frac{(106.07)^2 \cdot 50}{50^2 + (-25)^2} = 180.01\ W$$

$$\frac{V_{rms}}{Z} = I_{rms} = \frac{106.07}{50 + j25} = 1.70 - j0.85\ A = 1.90\angle -26.57^\circ\ A$$

$$\frac{P}{|V_{rms}||I_{rms}|} = pf = \frac{180.01}{106.07 \cdot 1.9} = 0.89 \text{ lagging}$$

$\cos^{-1}(0.89) = 27.13^\circ$

$$Q = |V_{rms}||I_{rms}| \sin(27.13) = +91.90\ VAR$$

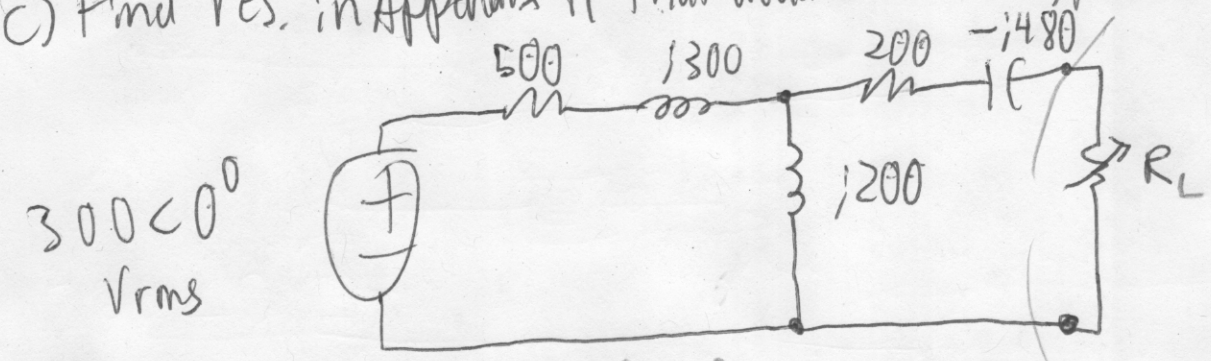
$S = P + jQ = 180.01 + j91.90\ VA$ $\quad |S| = 202.11\ VA$

10.46 ~~Varistor~~ Var. resistor adjusted to max power

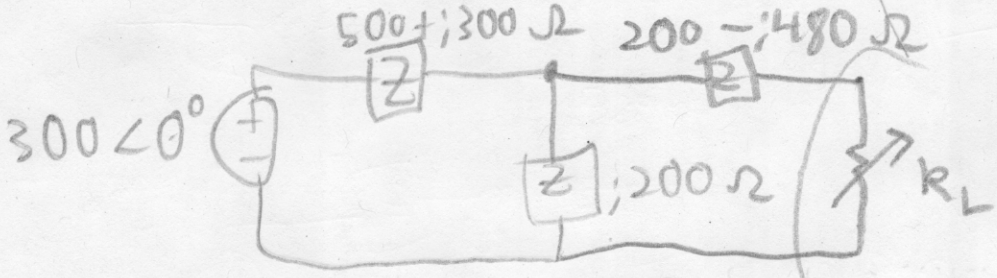
a) Find R

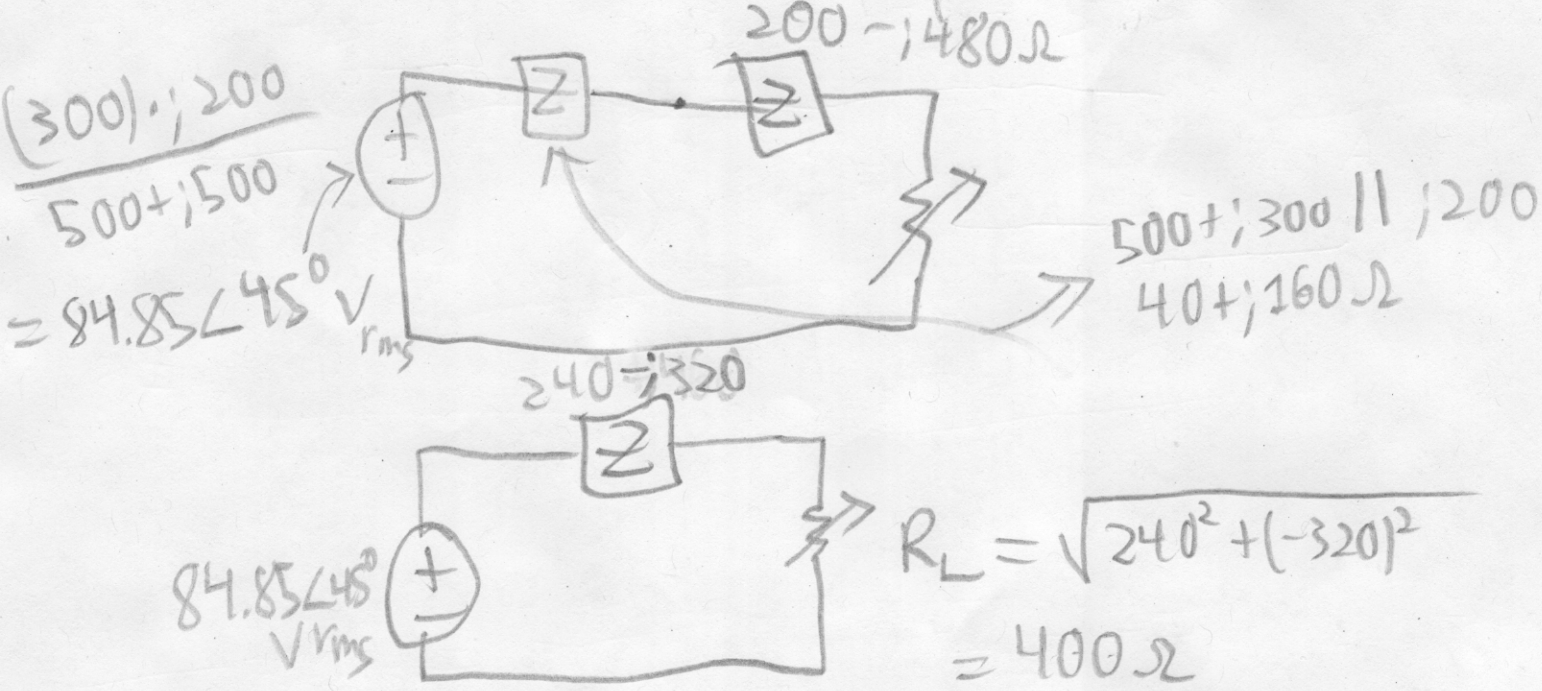
b) Find max avg power

c) Find res. in Appendix H that would have max avg power delivered



a)





$R_L = \sqrt{240^2 + (-320)^2}$

$= 400\,\Omega$

b) $\frac{|84.85|^2}{4 \cdot 400} = 4.50\ W$

c) 390 Ω nearest value