

p 10.20

$$a) \bar{S}_1 = (18 + j24) \text{ kVA}$$

$$\bar{S}_2 = (36 - j48) \text{ kVA}$$

$$\bar{S}_3 = (18 + j0) \text{ kVA}$$

$$\bar{S}_T = \bar{S}_1 + \bar{S}_2 + \bar{S}_3 = (72 - j24) \text{ kVA}$$

$$2400 \bar{I}^* = \bar{S}_T = (72 - j24) \times 10^3$$

$$\therefore \bar{I} = 30 + j10 \text{ A r.m.s.}$$

$$\therefore \bar{V}_s = 2400 \angle 0^\circ + (30 + j10)(0.2 + j1.6)$$

$$= 2390 + j50$$

$$= 2390.52 \angle 1.20^\circ \text{ V r.m.s.}$$

$$b) |\bar{I}_L| = \sqrt{1000}$$

$$P_L = 1000(0.2) = 200 \text{ W}$$

$$Q_L = 1000(1.6) = 1600 \text{ VAR}$$

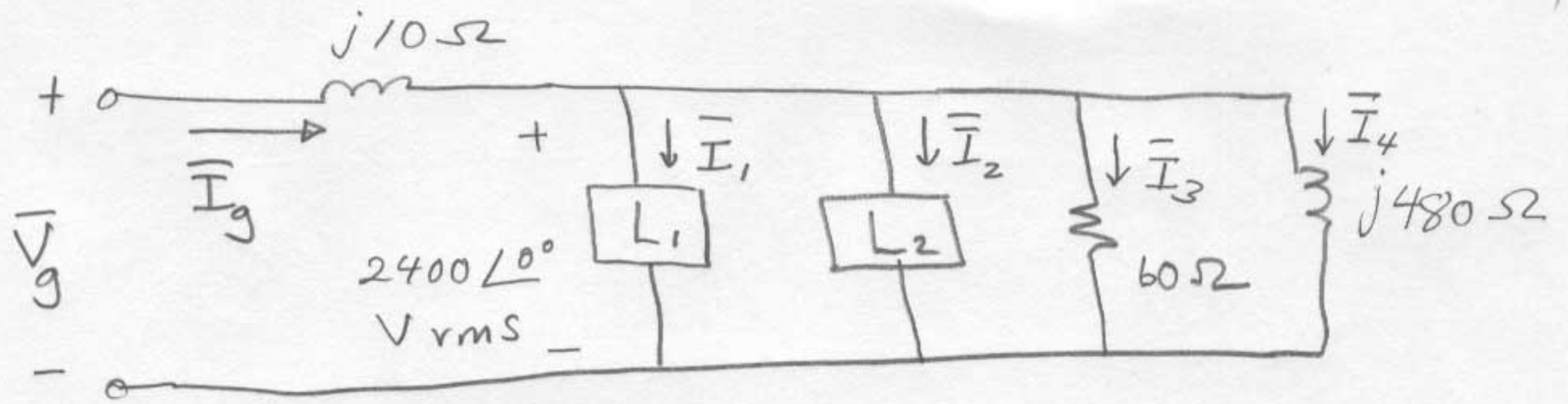
$$c) P_s = 72000 + 200 = 72.2 \text{ kW}$$

$$Q_s = -24000 + 1600 = -22.4 \text{ kVAR}$$

$$d) \eta = \frac{72}{72.2} \times 100 = 99.72\%$$

P10.21

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$$2400 \bar{I}_1^* = 24,000 + j18,000$$

$$\bar{I}_1^* = 10 + j7.5, \therefore \bar{I}_1 = 10 - j7.5 \text{ A rms}$$

$$2400 \bar{I}_2^* = 48,000 - j30,000$$

$$\bar{I}_2^* = 20 - j12.5, \therefore \bar{I}_2 = 20 + j12.5 \text{ A rms}$$

$$\bar{I}_3 = \frac{2400 \angle 0^\circ}{60} = 40 \text{ A rms}$$

$$\bar{I}_4 = \frac{2400 \angle 0^\circ}{j480} = -j5 \text{ A rms}$$

$$\bar{I}_g = \bar{I}_1 + \bar{I}_2 + \bar{I}_3 + \bar{I}_4 = 70 \text{ A rms}$$

$$\begin{aligned} \bar{V}_g &= 2400 + 70(j10) = 2400 + j700 \\ &= 2500 \angle 16.26^\circ \text{ V rms.} \end{aligned}$$

P10.22

$$\bar{S}_T = 52,800 - j \frac{52,800}{0.8} (0.6) = 52,800 - j39,600 \text{ VA}$$

$$\bar{S}_1 = 40,000 (0.96 + j0.28) = 38,400 + j11,200 \text{ VA}$$

$$\bar{S}_2 = \bar{S}_T - \bar{S}_1 = 14,400 - j50,800 = 52,801.52 \angle -74.17^\circ \text{ VA}$$

$$\text{r.f.} = \cos(-74.17^\circ) = -0.9621, \text{ P.f.} = \cos(-74.17^\circ) = 0.273 \text{ leading}$$

P10.31 a) Find Thevenin equiv. circuit first:

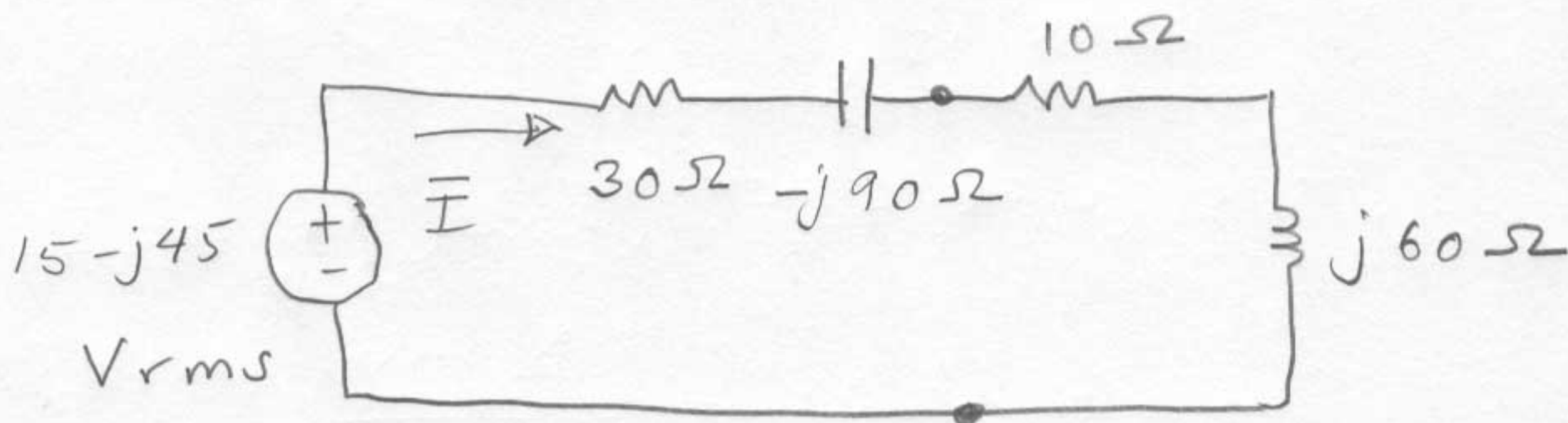
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$$\frac{1}{j\omega C} = \frac{10^6}{j10^4} = -j100 \Omega$$

$$\bar{E}_{TH} = \frac{300(-j100)}{300 - j100} = 30 - j90 \Omega$$

$$\bar{V}_{TH} = \frac{150(-j100)}{300 - j100} = 15 - j45 \text{ V rms}$$

$$j\omega L = j10^4 (6 \times 10^{-3}) = j60 \Omega$$



$$\bar{I} = \frac{15 - j45}{40 - j30} = \frac{1.5}{25} (13 - j9) \text{ A rms}$$

$$I = |\bar{I}| = \frac{1.5}{25} \sqrt{250} \text{ A rms}$$

$$P = \frac{2 \cdot 25}{625} (250)(10) = 9 \text{ W}$$

b) Set $L_o = 8 \text{ mH}$, set R_o as close as possible to:

$$R_o = \sqrt{30^2 + 10^2} = \sqrt{1000} = 31.62 \Omega$$

$$\therefore R_o = 20 \Omega$$

$$c) \bar{I} = \frac{15 - j45}{50 - j10} = \frac{3 - j9}{10 - j2} \text{ A rms}$$

$$\therefore I = |\bar{I}| = \frac{\sqrt{90}}{104}$$

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$$P = |\bar{I}|^2 (20) = \frac{90}{104} (20) = 17.31 \text{ W}$$

Yes, $17.31 \text{ W} > 9 \text{ W}$

$$d) \bar{I} = \frac{15 - j45}{60} = \frac{1 - j3}{4} \text{ A rms}$$

$$P = \left(\frac{\sqrt{10}}{4} \right)^2 30 = 18.75 \text{ W}$$

$$e) R_0 = 30 \Omega, L_0 = 9 \text{ mH}$$

f) Yes, $18.75 \text{ W} > 17.31 \text{ W}$

$$P10.32 \quad a) L_0 = 8 \text{ mH}, R_0 = \sqrt{30^2 + 10^2} = 31.62 \Omega$$

$$\bar{I} = \frac{15(1 - j3)}{61.62 - j10} = \frac{15\sqrt{10}}{62.43} \angle -62.35^\circ \text{ A rms}$$

$$P = \left(\frac{15\sqrt{10}}{62.43} \right)^2 (31.62) = 18.26 \text{ W}$$

b) Yes, $18.26 \text{ W} > 17.31 \text{ W}$

c) Yes, $18.26 \text{ W} < 18.75 \text{ W}$