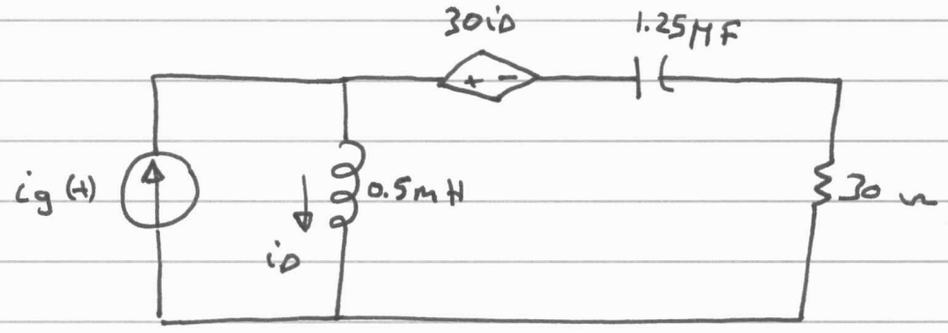
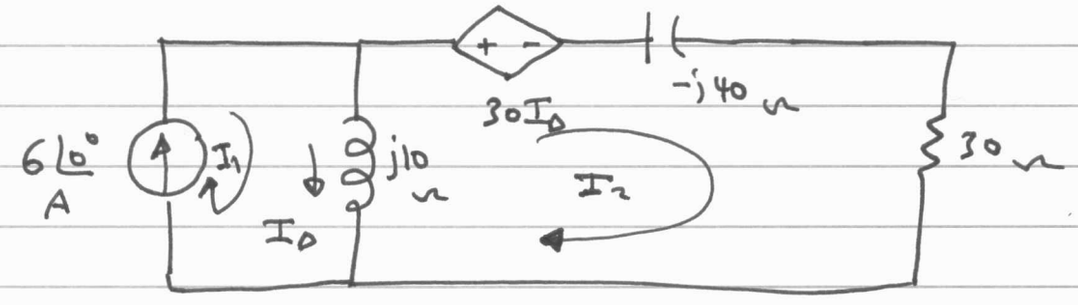
10.6



$i_g(t) = 6 \cos 20{,}000t \text{ A}$

$j\omega L = j10\ \Omega \quad ; \quad \frac{1}{j\omega C} = -j\frac{1}{\omega C} = -j40\ \Omega$



$\vec{I}_1 = 6\angle 0^\circ$

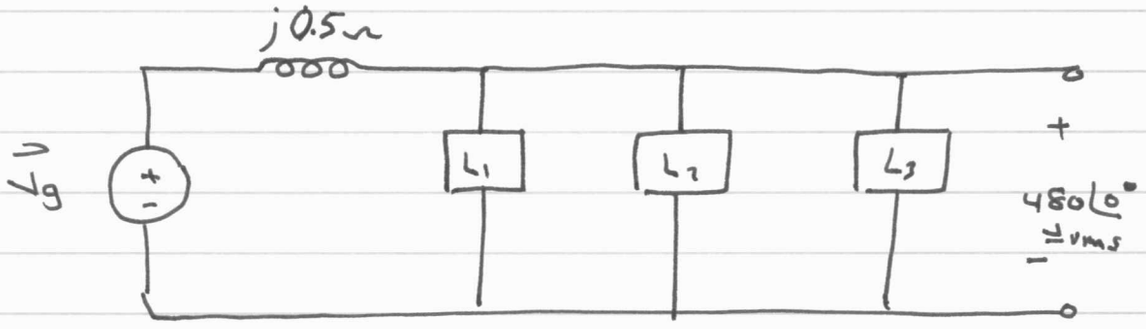
$-30\vec{I}_o = -j10\vec{I}_1 + (30 - j30)\vec{I}_2$

$\vec{I}_o = \vec{I}_1 - \vec{I}_2$

$\therefore \vec{I}_2 = -2 - j6 = 6.32\angle -108.43^\circ \text{ A}$

$p_{30\Omega} = \frac{|I_2|^2 \cdot 30}{2} = 600 \text{ watt}.$

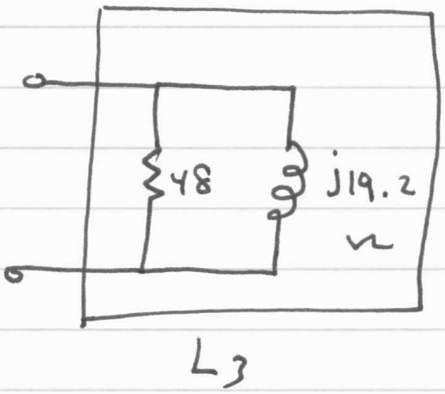
10.25



L_1 : $P_{av_1} = 7.5\,KW$, $Q_1 = 9\,KVAR$

L_2 : $P_{av_2} = 2.1\,KW$, $Q_2 = -1.8\,KVAR$

L_3 : consist of a $48\,\Omega$ resistor in parallel with an inductive reactance of $19.2\,\Omega$.



L_3

$$\vec{S}_1 = 7500 + j\,9000 = \vec{V}_{rms} \cdot \vec{I}^{*}_{rms_1}$$

$$\therefore \vec{I}_{rms_1} = 15.625 - j\,18.75 \quad A\ rms$$

$$\vec{S}_2 = 2100 - j\,1800 = \vec{V}_{rms} \cdot \vec{I}^{*}_{rms_2}$$

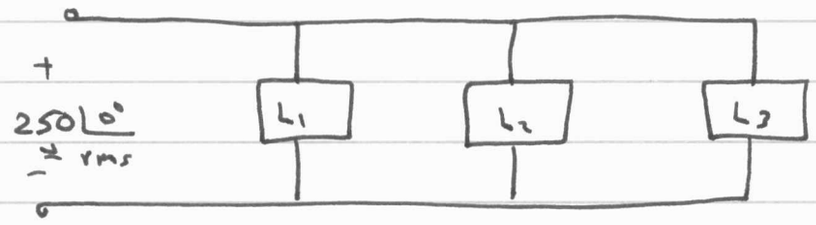
$$\therefore \vec{I}_{rms_2} = 4.375 + j\,3.75 \quad A\ rms$$

$$\vec{I}_{rms_3} = \frac{480\angle 0^\circ}{48} + \frac{480\angle 0^\circ}{j19.2} = 10 - j\,25 \quad A\ rms$$

$$\vec{I}_g = \vec{I}_{1rms} + \vec{I}_{rms_2} + \vec{I}_{rms_3} = 30 - j\,40 \quad A\ rms$$

$$\vec{V}_g = 480\angle 0^\circ + j0.5\,\vec{I}_g = 500.22\angle 1.72^\circ \quad V\ rms$$

10.27



L_1 : $P_{av_1} = 16\,KW$; $Q_1 = 28\,KVAR$

L_2 : $P_{av_2} = 10\,KVA$, at 0.6 pf Lead

L_3 : $P_{av_3} = 8\,KW$, at unity power factor

$$\vec{S_1} = 16000 + j\,28000 \quad VA$$

$$P_{av_2} = (10)(0.6) = 6\,KW$$

$$Q_2 = -.6 \tan(\cos^{-1} pf) = -8\,KVAR$$

$$\therefore \vec{S_2} = 6 - j8 \quad KVA$$

$$\vec{S_2} = 6000 - j8000 \quad VA$$

$$\vec{S_3} = 8000$$

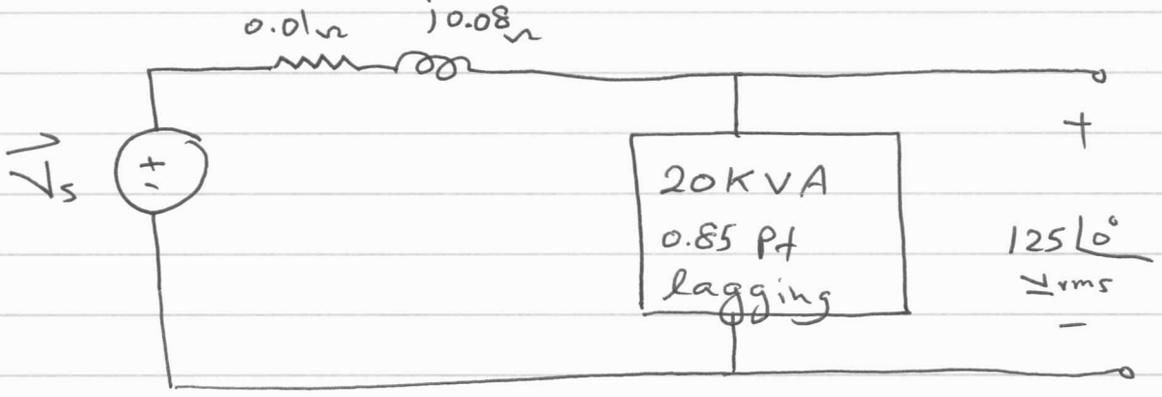
$$\vec{S_T} = \vec{S_1} + \vec{S_2} + \vec{S_3} = 30000 + j\,10000 \quad VA$$

$$\vec{S_T} = (250\angle 0^\circ)\,\vec{I_s}^*$$

$$\therefore \vec{I_s} = 120 - j\,40 \quad A\ rms$$

$$Z = \frac{\vec{V}}{\vec{I}} = \frac{250\angle 0^\circ}{120 - j40} = 1.98\angle 18.43^\circ \quad \Omega$$

10.34



$$P_{av_L} = (20{,}000)(0.85) = 17000 \text{ W}$$

$$Q_L = P_{av_L} \tan(\cos^{-1} Pf) = 10535.65 \text{ VAR}$$

$$\therefore \vec{S}_L = 17000 + j\,10535.65$$

$$\vec{S}_L = \vec{V}_L \cdot \vec{I}_L^{*}$$

$$\therefore \vec{I}_L = 138 - j\,84.29 \quad \text{A rms}$$

$$\vec{V}_s = (0.01 + j\,0.08)\,\vec{I}_L + 125\angle 0^\circ = 133.48\angle 4.31^\circ \text{ V rms}$$

$$\therefore |\vec{V}_s| = 133.48 \text{ V rms}$$

b) $P_{loss} = 0.01\,|I_L|^2 = 256 \text{ W}$

c) $Q_{L_{ini}} = 103535.65 \text{ VAR}$

$Q_{L_{Fin}} = 0$

$$\therefore Q_c = -103535.65 \text{ VAR}$$

$$C = -\frac{Q_c}{\omega V^2} = 1788.59 \ \mu F$$

d) $\overrightarrow{S_{L\,new}} = 17000\angle 0^\circ = \overrightarrow{V_L} \cdot \overrightarrow{I^*_{L\,new}}$

$\therefore \overrightarrow{I_{L\,new}} = 136\angle 0^\circ$ A rms

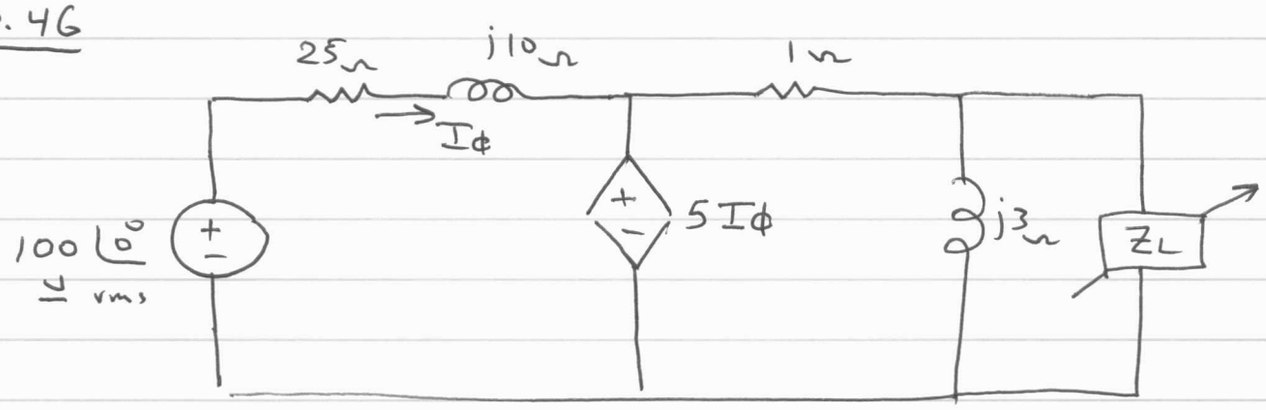
$\overrightarrow{V_s} = (0.01 + j\,0.08)\,\overrightarrow{I_{L\,new}} + 125\angle 0^\circ$

$\overrightarrow{V_s} = 126.83\angle 4.92^\circ$ V rms

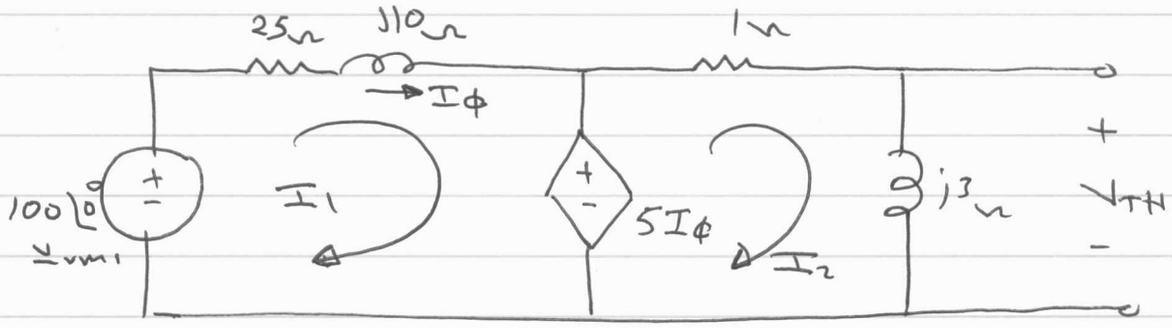
$\therefore |\overrightarrow{V_s}| = 126.83$ V rms

e) $P_{\substack{loss \\ new}} = (0.01)\,|I_{L\,new}|^2 = 184.96$ W

10.46



To find $\vec{V}_{TH}$, and Z_{TH}



$$100\angle 0^\circ - 5\vec{I}\phi = (25 + j10)I_1$$

$$\vec{I}\phi = \vec{I}_1$$

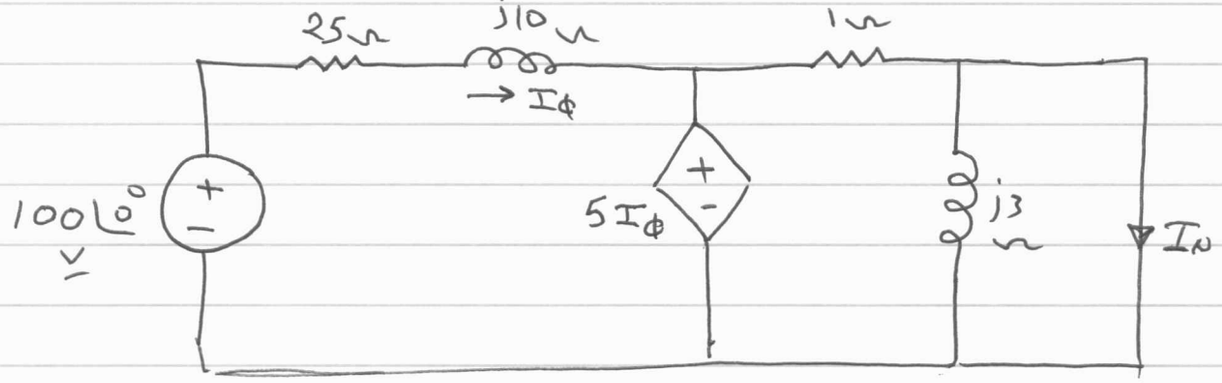
$$\therefore \vec{I}_1 = \vec{I}\phi = 3 - j1 \quad A \text{ rms}$$

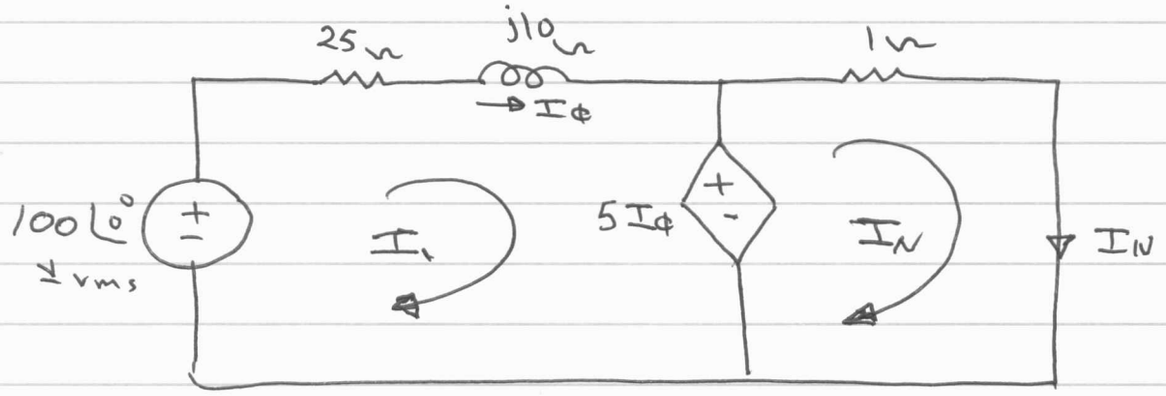
$$5\vec{I}\phi = (1 + j3)\vec{I}_2$$

$$\therefore \vec{I}_2 = \frac{15 - j5}{1 + j3}$$

$$\therefore \vec{V}_{TH} = j3\,\vec{I}_2 = 15\angle 0^\circ \quad V \text{ rms}$$

To find $Z_{TH} = \dfrac{\vec{V}_{TH}}{I_N}$





$$100\angle 0° - 5\vec{I}_\phi = (25+j10)I_1$$

$$\vec{I}_\phi = \vec{I}_1$$

$$\therefore \vec{I}_1 = \vec{I}_\phi = 3-j1 \quad A_{rms}$$

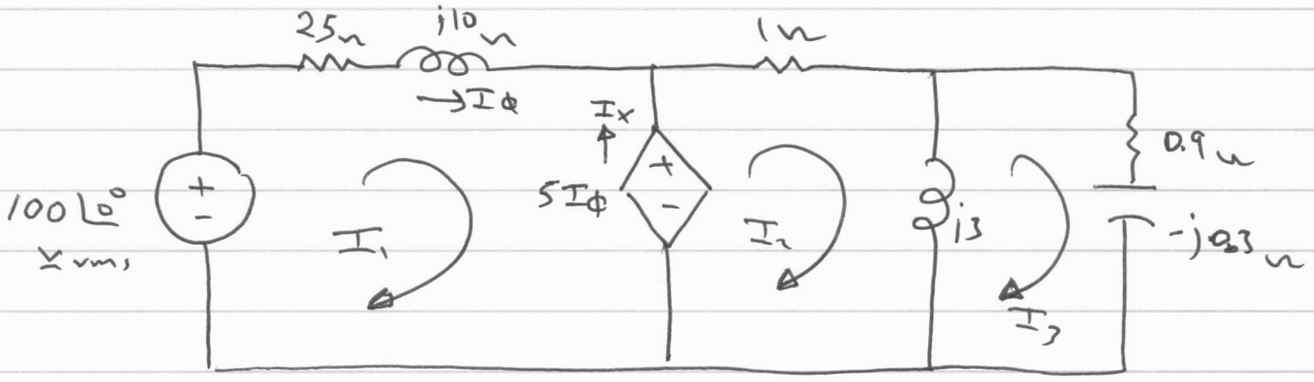
$$5\vec{I}_\phi = 1\cdot\vec{I}_N$$

$$\therefore I_N = 15-j5 \quad A$$

$$\therefore Z_{TH} = \frac{\vec{V}_{TH}}{\vec{I}_N} = 0.9+j0.03 \quad \Omega$$

$$\therefore Z_L = Z_{TH}^* = 0.9-j.03$$

$$P_{L,max} = \frac{|\vec{V}_{TH}|^2}{8R_{TH}} = 62.5\ W$$



$$100\angle 0° - 5I_\phi = (25+j10)\vec{I_1}$$

$$\vec{I_\phi} = \vec{I_1}$$

$$\therefore \vec{I_1} = \vec{I_\phi} = 3-j1 \quad A \text{ vms} = 3.162\angle -18.435° \quad A \text{ vms}$$

$$5\vec{I_\phi} = (1+j3)\vec{I_2} - j3\vec{I_3}$$

$$0 = -j3\vec{I_2} + (0.9+j2.7)\vec{I_3}$$

$$\therefore \vec{I_2} = 7.5-j2.5 \quad A \text{ vms}$$

$$\vec{I_x} = \vec{I_2} - \vec{I_1} = 4.5-j1.5 \quad A \text{ vms}$$

$$P_{100\angle 0°} = (100)(3.162)\cos(0+18.435)$$

$$= 300 \text{ W} \quad \text{supply}$$

$$P_{5I_\phi} = |5\vec{I_\phi}| \cdot |\vec{I_x}| \cos 0$$

$$= 75 \text{ W} \quad \text{supply}$$

$\therefore$ Total power developed = 375 W

$$\%_0 \text{ delivered} = \frac{62.5}{375} \times 100$$

$$= 16.67\%$$