

$$\begin{aligned}
 2.9 \quad \text{KVL: } 120\angle 0^\circ &= (60\angle 0^\circ)(0.1 + j0.5) + \bar{V}_{LOAD} \\
 \therefore \bar{V}_{LOAD} &= 120\angle 0^\circ - (60\angle 0^\circ)(0.1 + j0.5) \\
 &= 114 - j30.0 = 117.9\angle -14.7^\circ \text{ V} \leftarrow
 \end{aligned}$$

$$\begin{aligned}
 2.22 \quad (a) \quad \bar{Y}_1 &= \frac{1}{\bar{Z}_1} = \frac{1}{(3 + j4)} = \frac{1}{5\angle 53.13^\circ} = 0.2\angle -53.13^\circ \\
 &= (0.12 - j0.16) \text{ S}
 \end{aligned}$$

$$\bar{Y}_2 = \frac{1}{\bar{Z}_2} = \frac{1}{10} = 0.1 \text{ S}$$

$$P = V^2 (G_1 + G_2) \Rightarrow V = \sqrt{\frac{P}{G_1 + G_2}} = \sqrt{\frac{1100}{(0.12 + 0.1)}} = 70.71 \text{ V}$$

$$P_1 = V^2 G_1 = (70.71)^2 0.12 = 600 \text{ W}$$

$$P_2 = V^2 G_2 = (70.71)^2 0.1 = 500 \text{ W}$$

$$\begin{aligned}
 (b) \quad \bar{Y}_{eq} &= \bar{Y}_1 + \bar{Y}_2 = (0.12 - j0.16) + 0.1 = 0.22 - j0.16 \\
 &= 0.272\angle -36.03^\circ \text{ S}
 \end{aligned}$$

$$I_s = V Y_{eq} = 70.71(0.272) = 19.23 \text{ A}$$

$$\begin{aligned}
 2.28 \quad \bar{S}_1 &= 12 + j6.667 \\
 \bar{S}_2 &= 4(0.96) - j4[\sin(\cos^{-1} 0.96)] = 3.84 - j1.12 \\
 \bar{S}_3 &= 15 + j0
 \end{aligned}$$

$$\bar{S}_{TOTAL} = \bar{S}_1 + \bar{S}_2 + \bar{S}_3 = (30.84 + j5.547) \text{ kVA}$$

(i) Let $\bar{Z}$ be the impedance of a series combination of R and X

$$\text{Since } \bar{S} = \bar{V} \bar{I}^* = \bar{V} \left(\frac{\bar{V}}{\bar{Z}} \right)^* = \frac{V^2}{\bar{Z}^*}, \text{ it follows that}$$

$$\bar{Z}^* = \frac{V^2}{\bar{S}} = \frac{(240)^2}{(30.84 + j5.547)10^3} = (1.809 - j0.3254) \Omega$$

$$\therefore \bar{Z} = (1.809 + j0.3254) \Omega \leftarrow$$

(ii) Let $\bar{Z}$ be the impedance of a parallel combination of R and X

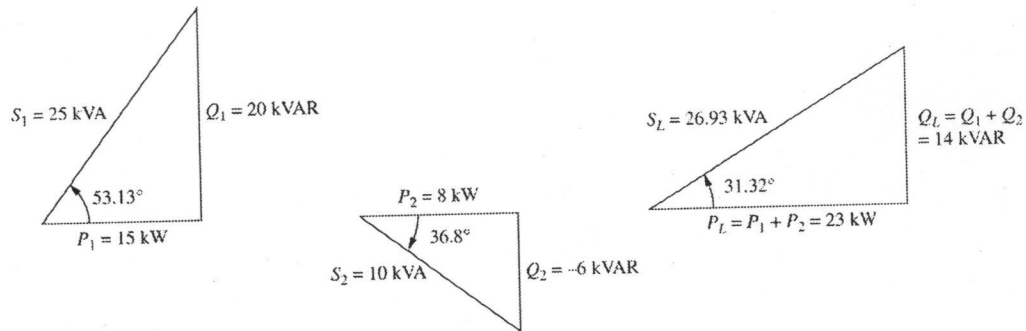
$$\text{Then } R = \frac{(240)^2}{(30.84)10^3} = 1.8677 \Omega$$

$$X = \frac{(240)^2}{(5.547)10^3} = 10.3838 \Omega$$

$$\therefore \bar{Z} = (1.8677 \parallel j10.3838) \Omega \leftarrow$$

2.32 4 Mvar minimizes the real power line losses, while 4.5 Mvar minimizes the MVA power flow into the feeder.

2.48 (a)



(b) $pf = \cos 31.32^\circ = 0.854$ Lagging

(c) $I_L = \frac{S_L}{\sqrt{3}V_{LL}} = \frac{26.93 \times 10^3}{\sqrt{3}(480)} = 32.39 \text{ A}$

(d) $Q_C = Q_L = 14 \times 10^3 \text{ VAR} = 3(V_{LL})^2 / X_\Delta$

$$X_\Delta = \frac{3(480)^2}{14 \times 10^3} = 49.37 \Omega$$

(e) $I_C = V_{LL} / X_\Delta = 480 / 49.37 = 9.72 \text{ A}$

$$I_{LINE} = \frac{P_L}{\sqrt{3}V_{LL}} = \frac{23 \times 10^3}{\sqrt{3}480} = 27.66 \text{ A}$$