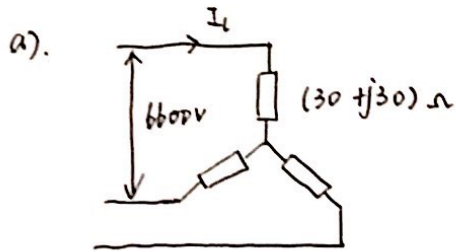


Problem 1.1.



$$V_{\text{line}} = 6600 \text{ V} \quad \bar{Z}_{\text{phase}} = 30 + j30 \, \Omega$$

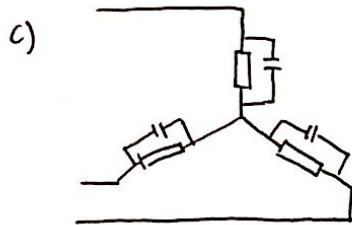
$$V_{\text{phase}} = \frac{6600}{\sqrt{3}} \text{ V.}$$

$$\bar{V}_{\text{phase},a} = \frac{6600}{\sqrt{3}} \angle 0^\circ \text{ V}$$

$$\bar{I}_{L,a} = \frac{\bar{V}_{\text{phase},a}}{\bar{Z}_{\text{phase}}} = \frac{6600 \angle 0^\circ}{30 + j30} = \boxed{89.81 \angle -45^\circ \text{ A}}$$

$$\begin{aligned} \bar{S} &= 3 \cdot \bar{V}_{\text{phase},a} \cdot \bar{I}_{L,a}^* \\ &= 3 \left(\frac{6600}{\sqrt{3}} \angle 0^\circ \right) (89.81 \angle +45^\circ) \\ &= \boxed{726 + j726 \text{ kVA}} \end{aligned}$$

$$\begin{aligned} b) \quad P_1 &= \text{Re} \{ \bar{V}_{ab} \cdot \bar{I}_a^* \} = \text{Re} \{ (6600 \angle 30^\circ) (89.81 \angle 45^\circ) \} = 6600 \cdot 89.81 \cdot \cos(45^\circ + 30^\circ) = \boxed{153 \text{ kW}} \\ P_2 &= \text{Re} \{ \bar{V}_{cb} \cdot \bar{I}_c^* \} = \text{Re} \{ (6600 \angle 90^\circ) (89.81 \angle (45^\circ - 120^\circ)) \} = 6600 \cdot 89.81 \cdot \cos(45^\circ - 30^\circ) = \boxed{57.3 \text{ kW}} \end{aligned}$$



$$\cos \theta = 0.9 \rightarrow \theta = \cos^{-1} 0.9 = 25.84^\circ$$

$$P = |S| \cos \theta \rightarrow |S| = \frac{P}{\cos \theta} = \frac{726 \text{ kW}}{0.9} = 807 \text{ kVA}$$

$$|I_L| = \frac{|S|}{3 |V_{\text{phase}}|} = \frac{807 \text{ kVA}}{3 \times \frac{6600}{\sqrt{3}} \text{ V}} = \boxed{70.6 \text{ A}}$$

$$d) \quad P_1 = 6600 \cdot 70.6 \cdot \cos(30^\circ + 25.84^\circ) = \boxed{262 \text{ kW}}$$

$$P_2 = 6600 \cdot 70.6 \cdot \cos(25.84^\circ - 30^\circ) = \boxed{46.4 \text{ kW}}$$

Problem 1.2.

$$\begin{cases} 250 = 460 \cdot I_L \cdot \cos(30^\circ + \theta) \\ 300 = 460 \cdot I_L \cdot \cos(30^\circ - \theta) \end{cases} \Rightarrow \begin{cases} I_L = 0.70 \text{ A} \\ \theta = 9.07^\circ \end{cases}$$

a) $I_L = \boxed{0.70 \text{ A}}$

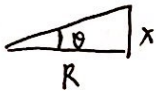
$$\text{PF} = \cos(9.07^\circ) = 0.988$$

b) $P = 250 + 300 = \boxed{550 \text{ W.}}$

$$|S| = \frac{P}{\text{PF}} = \frac{550}{0.988} = 557 \text{ VA.}$$

$$Q = |S| \sin \theta = 88 \text{ VAR.}$$

c) $P = 3 I_L^2 R \rightarrow R = \frac{P}{3 I_L^2} = \frac{550}{3 (0.70)^2} = 375 \Omega$



$$X = R \tan \theta = 60 \Omega$$

$$\mathbf{z} = 375 + j60 \Omega$$

Problem 1.3.

Load #1.

$$\theta = \cos^{-1} 0.8 = 36.87^\circ$$

$$\bar{S}_1 = 3 \cdot \bar{V}_{line} \cdot \bar{I}_{ph}^* = 3 \cdot 480 \cdot 40 \angle 36.87^\circ = \boxed{46.1 + j34.6 \text{ kVA}}$$

Load #2.

$$\theta = -\cos^{-1} 0.85 = -31.79^\circ$$

$$|S_2| = \frac{P}{PF} = \frac{30 \text{ k}}{0.85} = 35.3 \text{ kVA}$$

$$Q = |S_2| \sin \theta = -18.6 \text{ kVAR}$$

$$\bar{S}_2 = \boxed{30 - j18.6 \text{ kVAR}}$$

Load #3.

$$\theta = \cos^{-1} 0.8 = 36.87^\circ$$

$$\bar{S}_3 = 30 \angle 36.87^\circ = \boxed{24.0 + j18.0 \text{ kVA}}$$

$$\bar{S}_{total} = \bar{S}_1 + \bar{S}_2 + \bar{S}_3 = 100.1 + j34 \text{ kVA} = \boxed{105.7 \angle 18.76^\circ \text{ kVA}}$$

$$PF = \cos(18.76^\circ) = \boxed{0.947 \text{ Lag}}$$