

Solution 10a-2 (5.6)

Exercise 5

$$P = 120 \text{ W}, \cos \varphi = 0,7$$

$$Q_c = 200 \text{ VAR}$$

$$U = 220 \text{ V} \quad f = 50 \text{ Hz}$$

1) $R = ?$

$$P = UI \cos \varphi \Rightarrow I = \frac{P}{U \cos \varphi} = \frac{120}{220 \times 0,7} = 0,78 \text{ A}$$

$$P = R I^2 \Rightarrow R = \frac{P}{I^2} = \frac{120}{(0,78)^2} = 197,23 \Omega$$

$$\underline{R = 197,23 \Omega}$$

2) $L = ?$

$$Q_L = U_L I = X_L I^2$$

$$Q_L = ? \quad S = UI = 220 \times 0,78 = 171,6 \text{ VA}$$

$$S = \sqrt{P^2 + Q^2}$$

$$S = \sqrt{P^2 + (Q_L - Q_c)^2}$$

$$\Rightarrow S^2 = P^2 + (Q_L - Q_c)^2$$

$$\sqrt{S^2 - P^2} + Q_c = Q_L$$

$$\sqrt{(171,6)^2 - (120)^2} + 200 = Q_L$$
$$\underline{322,66 \text{ VAR} = Q_L}$$

$$X_L = \omega L = \frac{Q_L}{I^2} \Rightarrow L = \frac{Q_L}{\omega \cdot I^2}$$

$$L = \frac{322,66}{2\pi \cdot 50 \times (0,78)^2}$$

$$\underline{L = 1,68 \text{ H}}$$

3) $C = ?$

$$Q_c = X_c I^2 \Rightarrow$$

$$= \frac{1}{\omega C} I^2 \Rightarrow C = \frac{I^2}{2\pi f Q_c} = \frac{(0,78)^2}{2\pi \cdot 50 \times 200}$$

$$\underline{C = 9,68 \cdot 10^{-6} \text{ F}}$$

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exercice no 6

U = 127 V, L = 10 mH, R = 10 Ω

$$\begin{aligned} 1) \underline{S} &= \underline{V} \cdot \underline{I} \\ &= \underline{V} \cdot \underline{V} \underline{Y} \\ &= \underline{V}^2 \left[\frac{1}{R} + \frac{1}{j\omega L} + \frac{1}{j\omega C} \right] \\ &= \underline{V}^2 \left[\frac{1}{R} + j \left(-\frac{1}{\omega L} + \omega C \right) \right] \\ \underline{S} &= \underline{V}^2 \frac{1}{R} + j \underline{V}^2 \left(\omega C - \frac{1}{\omega L} \right) \end{aligned}$$

$$\begin{aligned} 2) \underline{S} &= \underline{P} + j\underline{Q} \\ \underline{S} &= \underline{V}^2 \frac{1}{R} + j \underline{V}^2 \left(\omega C - \frac{1}{\omega L} \right) \end{aligned}$$

$$\begin{cases} \underline{P} = \underline{V}^2 \frac{1}{R} \\ \underline{Q} = \underline{V}^2 \left(\omega C - \frac{1}{\omega L} \right) \end{cases}$$

$$3) \underline{Q} = 0 \Rightarrow \omega C - \frac{1}{\omega L} = 0 \Rightarrow C = \frac{1}{\omega^2 L}$$

$$\begin{aligned} 4) U &= Z_{eq} \cdot I \\ I &= \frac{U \cdot 1}{Z_{eq}} = U \cdot \underline{Y}_{eq} \end{aligned}$$

$$U \left[\frac{1}{R} \right] \Rightarrow I = \frac{U}{R} = \frac{127}{10} = 12,7 \text{ A}$$

exercice no 7

1)

| charge 1 | charge 2 | charge 3 |
|--|---|---|
| $P_1 = 20 \text{ kW}$ | $S_2 = 47 \text{ KVA}$ | $S_3 = 10 \text{ KVA}$ |
| $Q_1 = 15 \text{ KVAR}$ | $\cos \phi_2 = 0,6$ | $Q_3 = -5 \text{ KVAR}$ |
| $S_1 = \sqrt{P_1^2 + Q_1^2} = 25 \text{ KVA}$ | $P_2 = S_2 \cos \phi_2 = 27 \text{ kW}$ | $P_3 = \sqrt{S_3^2 - Q_3^2} = 8,68 \text{ kW}$ |
| $I_1 = \frac{S_1}{V} = 102,7 \text{ A}$ | $Q_2 = S_2 \sin \phi_2 = 36 \text{ KVAR}$ | $I_3 = \frac{S_3}{V} = 43,7 \text{ A}$ |
| $\cos \phi_1 = \frac{P_1}{S_1} = 0,8 \text{ car } Q > 0$ | $I_2 = \frac{S_2}{V} = 197,7 \text{ A}$ | $\cos \phi_3 = \frac{P_3}{S_3} = 0,86 \text{ AV}$ |
| | $\phi_2 = 53,1^\circ$ | car $Q < 0$ |
| | | $\phi_3 = -30,7^\circ$ |

2) $P_{\text{AT}} = P_1 + P_2 + P_3$
 $= 55,66 \text{ kW}$

$Q_T = Q_1 + Q_2 + Q_3 = 15 + 36 - 5 = 46 \text{ KVAR}$
 $S_T = \sqrt{P_T^2 + Q_T^2} = 72,2 \text{ KVA}$
 $\cos \phi = \frac{P}{S} = 0,77$
 $I = \frac{S}{V} = 314 \text{ A}$

3)

