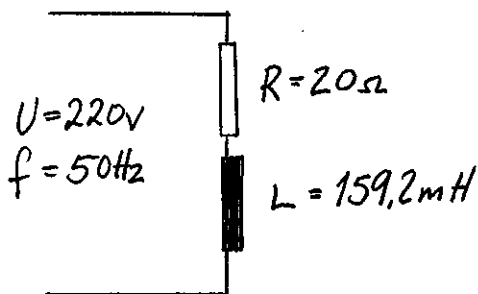


### 7.3 RESISTANS - SPOLE - KONDENSATOR KOPLET TIL VEKSELSTRØM I KOMBINERINGER

7.3.1



$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50 \text{ Hz} \cdot 159,2 \cdot 10^{-3} \text{ H} = \underline{50,0 \Omega}$$

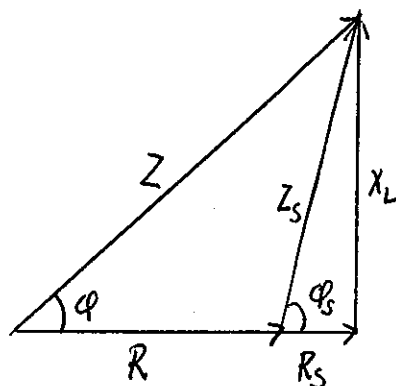
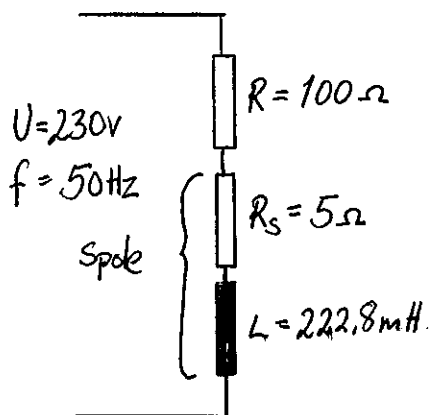
$$a) \bar{Z} = R + jX_L = 20 \Omega + j50 \Omega = \underline{\underline{53,85 \Omega \angle 68,2^\circ}}$$

$$b) \bar{I} = \frac{U}{Z} = \frac{220 \text{ V}}{53,85 \Omega} = \underline{\underline{4,09 \text{ A}}}$$

$$c) S = U \cdot I = 220 \text{ V} \cdot 4,09 \text{ A} = \underline{\underline{898,8 \text{ VA}}}$$

$$\bar{S} = S \angle \varphi = 898,8 \text{ VA} \angle 68,2^\circ = \underline{\underline{333,8 \text{ W} + j 834,5 \text{ VAR}}}$$

7.3.2



$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50 \text{ Hz} \cdot 222,8 \cdot 10^{-3} \text{ H} = \underline{70,0 \Omega}$$

$$a) \bar{Z} = R + R_s + jX_L = 100 \Omega + 5 \Omega + j70,0 \Omega = 105 \Omega + j70,0 \Omega$$

$$\bar{Z} = \underline{\underline{126,2 \Omega \angle 33,7^\circ}}$$

$$b) \bar{I} = \frac{U}{Z} = \frac{230 \text{ V}}{126,2 \Omega} = \underline{\underline{1,82 \text{ A}}}$$

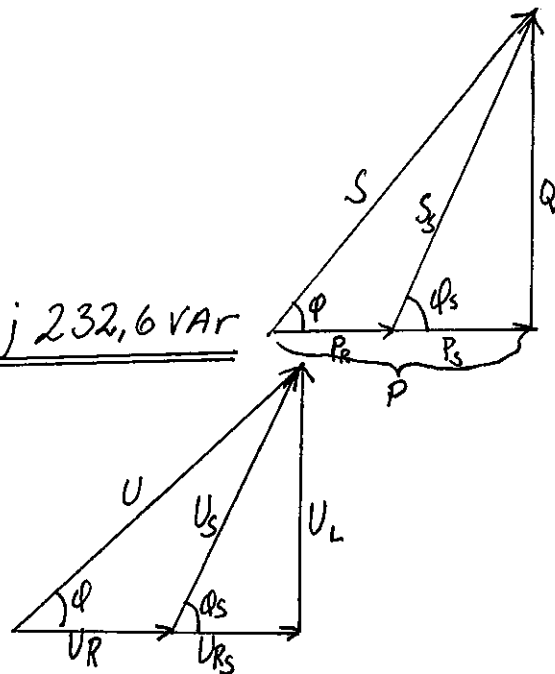
$$c) S = U \cdot I = 230 \text{ V} \cdot 1,82 \text{ A} = \underline{\underline{419,2 \text{ VA}}}$$

$$\bar{S} = S \angle \varphi = 419,2 \text{ VA} \angle 33,7^\circ = \underline{\underline{348,8 \text{ W} + j 232,6 \text{ VAR}}}$$

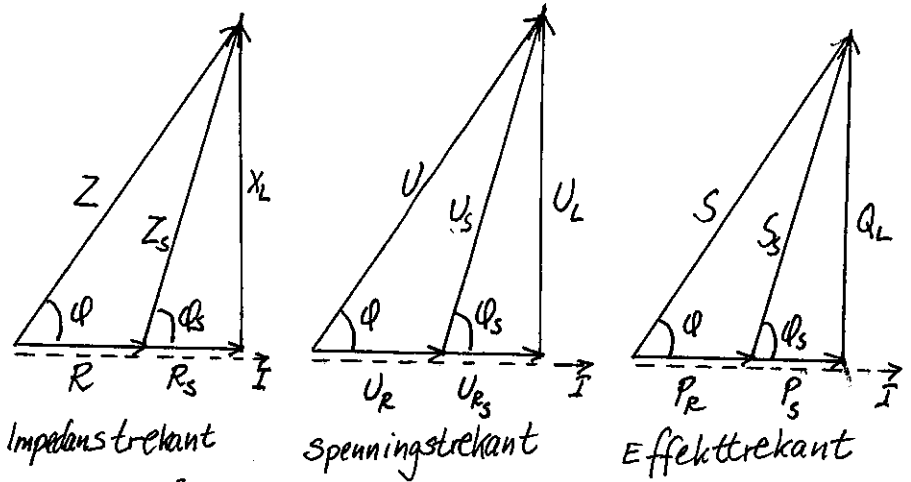
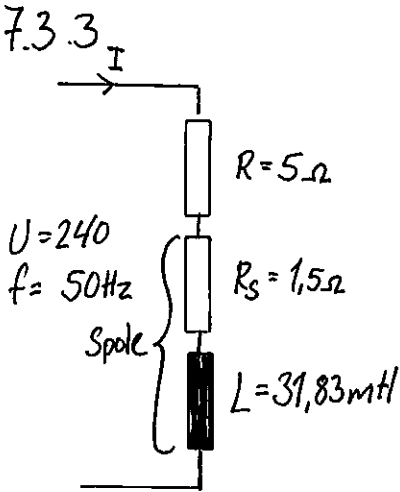
$$d) U_R = I \cdot R = 1,82 \text{ A} \cdot 100 \Omega = \underline{\underline{182 \Omega}}$$

$$U_s = I \cdot Z_s = 1,82 \text{ A} \cdot 70,2 \Omega = \underline{\underline{127,7 \Omega}}$$

$$Z_s = R_s + jX_L = 5 \Omega + j70 \Omega = \underline{\underline{70,2 \Omega}}$$



7.3.3



$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50 \text{ Hz} \cdot 31,83 \cdot 10^{-3} \text{ H} = 10,0 \Omega$$

a)  $\bar{Z} = R + R_s + jX_L = 5 \Omega + 1,5 \Omega + j 10,0 \Omega = 6,5 \Omega + j 10,0 \Omega = \underline{\underline{11,9 \Omega \angle 56,98^\circ}}$

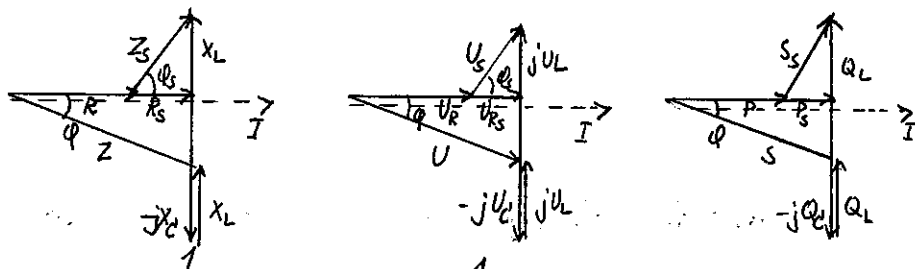
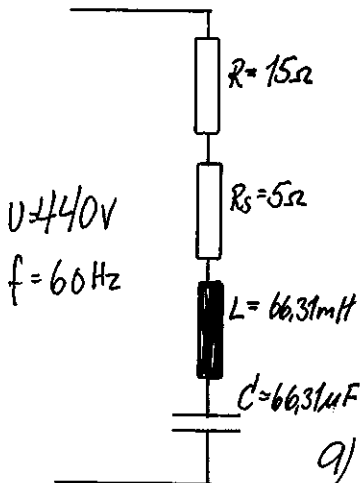
b)  $I = \frac{U}{Z} = \frac{240 \text{ V}}{11,9 \Omega} = \underline{\underline{20,12 \text{ A}}}$

c)  $S = U \cdot I = 240 \text{ V} \cdot 20,12 \text{ A} = \underline{\underline{4829,4 \text{ VA}}}$

$$\bar{S} = S \angle \varphi = 4829,4 \text{ VA} \angle 56,98^\circ = \underline{\underline{2631,7 \text{ W} + j 4049,4 \text{ VAR}}}$$

d)  $U_R = I \cdot R = 20,12 \text{ A} \cdot 5 \Omega = \underline{\underline{100,6 \text{ V}}}$   
 $U_L = I \cdot X_L = 20,12 \text{ A} \cdot 10 \Omega = \underline{\underline{201,2 \text{ V}}}$

7.3.4



$$X_C = \frac{1}{2 \cdot \pi \cdot f \cdot C} = \frac{1}{2 \cdot \pi \cdot 60 \text{ Hz} \cdot 66,31 \cdot 10^{-6} \text{ F}} = \underline{\underline{40 \Omega}}$$

$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 60 \text{ Hz} \cdot 66,31 \cdot 10^{-3} \text{ H} = \underline{\underline{25 \Omega}}$$

a)  $\bar{Z} = R + R_s + jX_L - jX_C = 15 \Omega + 5 \Omega + j 25 \Omega - j 40 \Omega = 20 \Omega - j 15 \Omega = \underline{\underline{25 \Omega \angle -36,9^\circ}}$

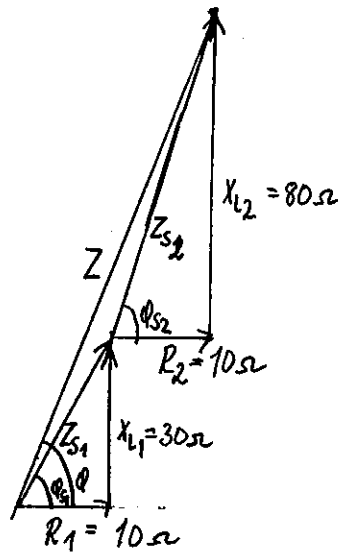
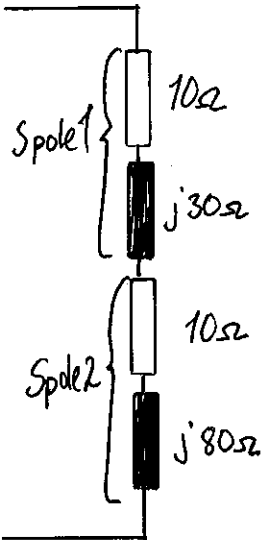
b)  $I = \frac{U}{Z} = \frac{440 \text{ V}}{25 \Omega} = \underline{\underline{17,6 \text{ A}}}$

c)  $S = U \cdot I = 440 \text{ V} \cdot 17,6 \text{ A} = \underline{\underline{7744 \text{ VA}}}$

$$\bar{S} = S \angle \varphi = 7744 \text{ VA} \angle -36,9^\circ = \underline{\underline{6192,8 \text{ W} - j 4649,7 \text{ VAR}}}$$

d)  $U_C = I \cdot X_C = 17,6 \text{ A} \cdot 40 \Omega = 704 \text{ V}$   $\bar{Z}_S = R_s + jX_L = 5 \Omega + j 25 \Omega = 25,5 \Omega \angle 78,7^\circ$   
 $U_C = I \cdot Z_C = 17,6 \text{ A} \cdot 25,5 \Omega = 448,7 \text{ V}$   $U_R = I \cdot R = 17,6 \text{ A} \cdot 15 \Omega = 264 \text{ V}$

F.3.5



a) 
$$\bar{Z} = R_1 + R_2 + jX_{L1} + jX_{L2} = 10\Omega + 10\Omega + j30\Omega + j80\Omega = 20\Omega + j110\Omega = \underline{\underline{111,8\Omega \angle 79,7^\circ}}$$

b) 
$$U = \bar{I} \cdot Z = 1,0A \cdot 111,8\Omega = \underline{\underline{111,8V}}$$

$$\bar{Z}_1 = R_1 + jX_{L1} = 10\Omega + j30\Omega = \underline{\underline{31,6\Omega \angle 71,6^\circ}}$$

$$\bar{Z}_2 = R_2 + jX_{L2} = 10\Omega + j80\Omega = \underline{\underline{80,6\Omega \angle 82,9^\circ}}$$

$$U_{S1} = \bar{I} \cdot Z_1 = 1,0A \cdot 31,6\Omega = \underline{\underline{31,6V}}$$

$$U_{S2} = \bar{I} \cdot Z_2 = 1,0A \cdot 80,6\Omega = \underline{\underline{80,6V}}$$

c) 
$$P_1 = U_{S1} \cdot \bar{I} \cdot \cos\phi_{S1} = 31,6V \cdot 1,0A \cdot \cos 71,6^\circ = \underline{\underline{10,0W}}$$

$$Q_1 = U_{S1} \cdot \bar{I} \cdot \sin\phi_{S1} = 31,6V \cdot 1,0A \cdot \sin 71,6^\circ = \underline{\underline{30,0VAR}}$$

$$P_2 = U_{S2} \cdot \bar{I} \cdot \cos\phi_{S2} = 80,6V \cdot 1,0A \cdot \cos 82,9^\circ = \underline{\underline{10,0W}}$$

$$Q_2 = U_{S2} \cdot \bar{I} \cdot \sin\phi_{S2} = 80,6V \cdot 1,0A \cdot \sin 82,9^\circ = \underline{\underline{80,0VAR}}$$

$$\bar{S}_1 = P_1 + jQ_1 = 10,0W + j30,0VAR = \underline{\underline{31,6VA}}$$

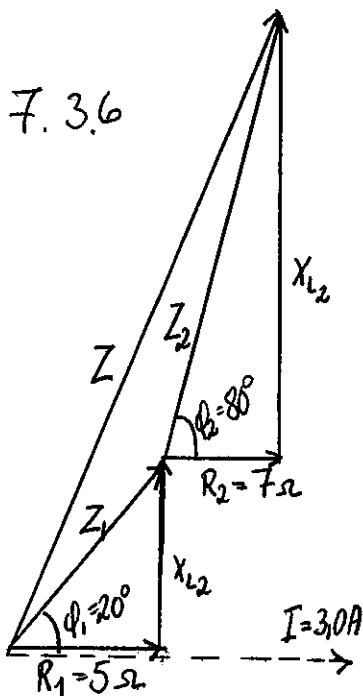
$$\bar{S}_2 = P_2 + jQ_2 = 10,0W + j80,0VAR = \underline{\underline{80,6VA}}$$

$$\bar{S} = P_1 + P_2 + jQ_1 + jQ_2 = 10,0W + 10,0W + j30,0VAR + j80,0VAR = \underline{\underline{111,8VA}}$$

d) 
$$L_1 = \frac{X_{L1}}{2 \cdot \pi \cdot f} = \frac{30\Omega}{2 \cdot \pi \cdot 50Hz} = \underline{\underline{955 \cdot 10^{-3}H}} = \underline{\underline{955mH}}$$

$$L_2 = \frac{X_{L2}}{2 \cdot \pi \cdot f} = \frac{80\Omega}{2 \cdot \pi \cdot 50Hz} = \underline{\underline{254,6 \cdot 10^{-3}H}} = \underline{\underline{254,6mH}}$$

7.3.6



$$a) Z = \frac{U}{I} = \frac{220V}{5,25A} = \underline{\underline{41,9\Omega}}$$

$$\cos\varphi = \frac{R_T}{Z} = \frac{5\Omega + 7\Omega}{41,9\Omega} = \underline{\underline{0,286}} \quad \angle\varphi = \underline{\underline{73,4^\circ}}$$

$$b) \cos\varphi = \underline{\underline{0,286}}$$

$$c) \cos\varphi_1 = \frac{R_1}{Z_1} \Rightarrow Z_1 = \frac{R_1}{\cos\varphi_1} = \frac{5\Omega}{\cos 20^\circ} = \underline{\underline{5,32\Omega}}$$

$$U_1 = I \cdot Z_1 = 5,25A \cdot 5,32\Omega = \underline{\underline{27,9V}}$$

$$\cos\varphi_2 = \frac{R_2}{Z_2} \Rightarrow Z_2 = \frac{R_2}{\cos\varphi_2} = \frac{7\Omega}{\cos 80^\circ} = \underline{\underline{40,3\Omega}}$$

$$U_2 = I \cdot Z_2 = 5,25A \cdot 40,3\Omega = \underline{\underline{211,6V}}$$

$$S_1 = U_1 \cdot I = 27,9V \cdot 5,25A = \underline{\underline{146,5VA}}$$

$$\bar{S}_1 = S_1 \angle\varphi_1 = 146,5VA \angle 20^\circ = \underline{\underline{137,6W + j 50,1VAR}}$$

$$S_2 = U_2 \cdot I = 211,6V \cdot 5,25A = \underline{\underline{1110,9VA}}$$

$$\bar{S}_2 = S_2 \angle\varphi_2 = 1110,9VA \angle 80^\circ = \underline{\underline{192,9W + j 1094,0VAR}}$$

## 7.3.7

$$R = 5 \Omega$$

$$R_s = 2 \Omega$$

$$L = 22,28 \text{ mH}$$

$$C = 530,5 \text{ nF}$$

$$U = 200, 50 \text{ Hz}$$

$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50 \text{ Hz} \cdot 22,28 \cdot 10^{-3} \text{ H} = \underline{7 \Omega}$$

$$X_C = \frac{1}{2 \cdot \pi \cdot f \cdot C} = \frac{1}{2 \cdot \pi \cdot 50 \text{ Hz} \cdot 530,5 \cdot 10^{-6} \text{ F}} = \underline{6 \Omega}$$

$$a) \bar{Z} = R + R_s + jX_L + jX_C = 5 \Omega + 2 \Omega + j7 \Omega - j6 \Omega =$$

$$\underline{\underline{\bar{Z} = 7,07 \Omega \angle \varphi = 8,13^\circ}}$$

$$b) I = \frac{U}{Z} = \frac{200 \text{ V}}{7,07 \Omega} = \underline{\underline{28,3 \text{ A}}}$$

$$c) S = U \cdot I = 200 \text{ V} \cdot 28,3 \text{ A} = \underline{\underline{5656,9 \text{ VA}}}$$

$$\bar{S} = S \angle \varphi = 5656,9 \text{ VA} \angle 8,13^\circ = \underline{\underline{5600 \text{ W} + j800 \text{ VAR}}}$$

$$d) U = I \cdot R = 28,3 \text{ A} \cdot 5 \Omega = \underline{\underline{141,5 \text{ V}}}$$

$$Z_s = R_s + jX_L = 2 \Omega + j7 \Omega = \underline{\underline{7,28 \Omega \angle 74,1^\circ}}$$

$$U = I \cdot Z = 28,3 \text{ A} \cdot 7,28 \Omega = \underline{\underline{206,0 \text{ V}}}$$

## 7.3.8

$$a) X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50 \text{ Hz} \cdot 47,75 \cdot 10^{-3} \text{ H} = \underline{15 \Omega}$$

$$X_C = \frac{1}{2 \cdot \pi \cdot f \cdot C} = \frac{1}{2 \cdot \pi \cdot 50 \text{ Hz} \cdot 79,58 \cdot 10^{-6} \text{ F}} = \underline{40 \Omega}$$

$$\bar{Z} = R + R_s + jX_L - jX_C = 7 \Omega + 3 \Omega + j15 \Omega - j40 \Omega = \underline{\underline{26,9 \Omega \angle -68,2^\circ}}$$

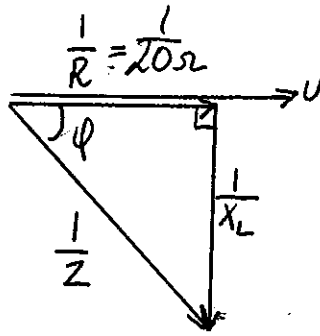
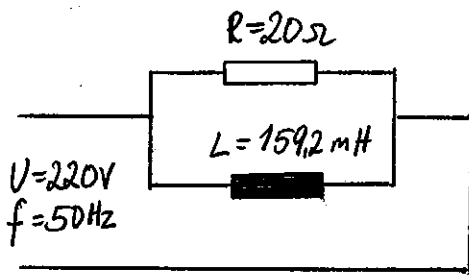
$$b) U = I \cdot Z = 10 \text{ A} \cdot 26,9 \Omega = \underline{269,3 \text{ V}} \quad U_C = I \cdot X_C = 10 \text{ A} \cdot 40 \Omega = \underline{400 \text{ V}}$$

$$U_R = I \cdot R = 10 \text{ A} \cdot 7 \Omega = \underline{70,0 \text{ V}} \quad \bar{Z}_s = R_s + jX_L = 3 \Omega + j15 \Omega = \underline{15,3 \Omega \angle 78,7^\circ}$$

$$c) \text{SPOLE:} \quad U_s = I \cdot Z_s = 10 \text{ A} \cdot 15,3 \Omega = \underline{153,0 \text{ V}}$$

$$S_s = U \cdot I = 153,0 \text{ V} \cdot 10 \text{ A} = \underline{1530 \text{ VA}}$$

$$\bar{S}_s = S_s \angle \varphi_s = 1530 \text{ VA} \angle 78,7^\circ = \underline{\underline{300 \text{ W} + j1500 \text{ VAR}}}$$



$$a) X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50 \text{ Hz} \cdot 159,2 \cdot 10^{-3} \text{ H} = \underline{50,0 \Omega}$$

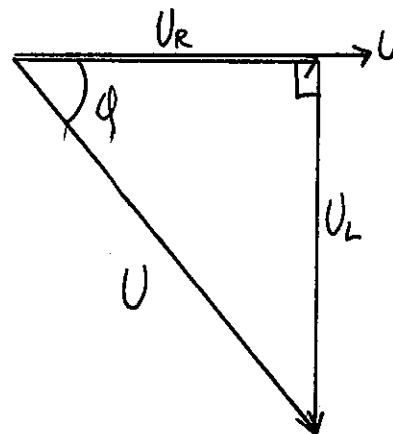
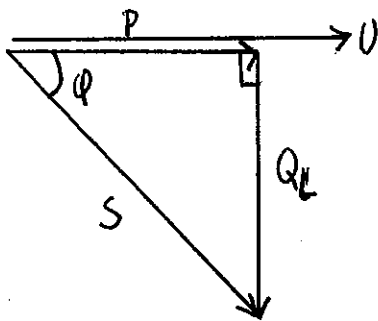
$$\bar{Z} = \frac{Z_R \cdot Z_L}{Z_R + Z_L} = \frac{R \cdot (-jX_L)}{R + (-jX_L)} = \frac{20 \Omega \cdot (-j50 \Omega)}{20 \Omega - j50 \Omega} = \frac{0 - j1000 \Omega^2}{20 - j50 \Omega} = \frac{1000 \Omega^2 \angle -90^\circ}{53,9 \Omega \angle -68,2^\circ}$$

$$\bar{Z} = \underline{18,57 \Omega} \quad \varphi = \varphi_1 - \varphi_2 = -90^\circ - (-68,2^\circ) = \underline{-21,8^\circ}$$

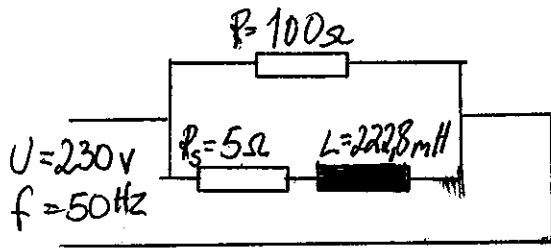
$$b) I = \frac{U}{Z} = \frac{220 \text{ V}}{18,57 \Omega} = \underline{11,85 \text{ A}}$$

$$c) S = U \cdot I = 220 \text{ V} \cdot 11,85 \text{ A} = \underline{2606 \text{ VA}}$$

$$\bar{S} = S \angle \varphi = 2606 \text{ VA} \angle -21,8^\circ = \underline{2420 \text{ W} - j967,9 \text{ VAR}}$$



7.3.10



$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50\text{Hz} \cdot 2228 \cdot 10^{-3}\text{H} = \underline{70,0\Omega}$$

$$\begin{aligned} \text{a) } \bar{Z} &= \frac{Z_R \cdot Z_L}{Z_R + Z_L} = \frac{R \cdot (R_s - jX_L)}{R + R_s - jX_L} = \frac{100\Omega \cdot (5\Omega - j70\Omega)}{100\Omega + 5\Omega - j70\Omega} \\ &= \frac{500(\Omega^2) - j7000(\Omega^2)}{105\Omega - j70\Omega} = \frac{7017,8(\Omega^2) \angle -85,91^\circ}{126,2\Omega \angle -33,69^\circ} = \underline{\underline{55,6\Omega}} \end{aligned}$$

$$\angle \phi = \angle \phi_1 - \angle \phi_2 = -85,91^\circ - (-33,69^\circ) = \underline{\underline{-52,22^\circ}}$$

$$\text{b) } I = \frac{U}{Z} = \frac{230\text{V}}{55,6\Omega} = \underline{\underline{4,14\text{A}}}$$

$$\text{c) } S = U \cdot I = 230\text{V} \cdot 4,14\text{A} = \underline{\underline{951,2\text{VA}}}$$

$$\bar{S} = S \angle \phi = 951,2\text{VA} \angle -52,22^\circ = \underline{\underline{582,8\text{W} - j751,8\text{VAR}}}$$

$$\text{d) } \bar{Z}_S = R_s - jX_L = 5\Omega - j70\Omega = \underline{\underline{70,2\Omega \angle -85,9^\circ}}$$

↑ Minus fordi spolen er tilknyttet en parallel krets

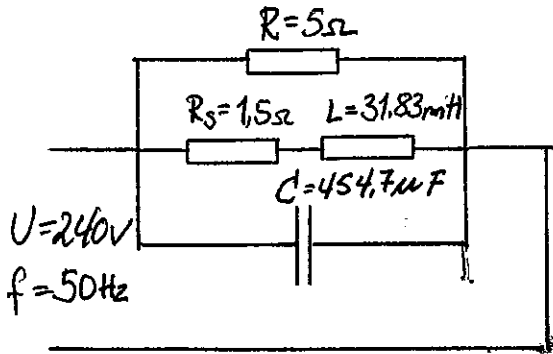
$$U_R = I \cdot R = 4,14\text{A} \cdot 100\Omega = \underline{\underline{414\text{V}}}$$

$$U_{Z_S} = I \cdot Z_S = 4,14\text{A} \cdot 70,2\Omega = \underline{\underline{290,6\text{V}}}$$

$$U_R = \underline{\underline{230\text{V}}}$$

$$U_L = \underline{\underline{230\text{V}}}$$

7.3.11



$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50 \text{ Hz} \cdot 31,83 \cdot 10^{-3} \text{ H} = 10,0 \Omega$$

$$X_C = \frac{1}{2 \cdot \pi \cdot f \cdot C} = \frac{1}{2 \cdot \pi \cdot 50 \text{ Hz} \cdot 454,7 \cdot 10^{-6} \text{ F}} = 7,0 \Omega$$

$$\begin{aligned} \bar{Z}_1 &= \frac{Z_R \cdot Z_L}{Z_R + Z_L} = \frac{R \cdot (R_s - jX_L)}{R + R_s - jX_L} = \frac{5 \Omega \cdot (1,5 \Omega - j10 \Omega)}{5 \Omega + 1,5 \Omega - j10 \Omega} = \\ &= \frac{7,5(\Omega^2) - j15(\Omega^2)}{6,5 \Omega - j10 \Omega} = \frac{16,77 \Omega \angle -63,43^\circ}{11,93 \Omega \angle -56,98^\circ} = \underline{1,41 \Omega} \end{aligned}$$

$$\angle \phi_1 = \angle \phi_A - \angle \phi_B = -63,43^\circ - (-56,98^\circ) = \underline{-6,45^\circ}$$

$$\bar{Z}_1 = Z \angle \phi_1 = 1,41 \angle -6,45^\circ = \underline{1,40 \Omega - j0,158 \Omega}$$

$$\begin{aligned} \bar{Z} &= \frac{Z_1 \cdot Z_C}{Z_1 + Z_C} = \frac{(R_1 - jX_1) \cdot jX_C}{R_1 - jX_1 + jX_C} = \frac{(1,40 \Omega - j0,158 \Omega) \cdot j7 \Omega}{1,40 \Omega - j0,158 \Omega + j7 \Omega} = \\ &= \frac{j9,8(\Omega^2) - j^2 1,106(\Omega^2)}{1,40 \Omega + j6,842 \Omega} = \frac{1,106(\Omega^2) + j9,8(\Omega^2)}{1,40 \Omega + j6,842 \Omega} = \frac{9,86 \Omega^2 \angle 83,56^\circ}{6,98 \Omega \angle 78,43^\circ} \end{aligned}$$

$$= \underline{1,41 \Omega} \quad \angle \phi = \angle \phi_C - \angle \phi_D = 83,56^\circ - 78,43^\circ = \underline{5,13^\circ}$$

$$b) \quad I = \frac{U}{Z} = \frac{240 \text{ V}}{1,41 \Omega} = \underline{170 \text{ A}} \quad I_R = \frac{U}{R} = \frac{240 \text{ V}}{5 \Omega} = \underline{48 \text{ A}}$$

$$I_C = \frac{U}{X_C} = \frac{240 \text{ V}}{7,0 \Omega} = \underline{34,3 \text{ A}} \quad \bar{Z}_s = R_s - jX_L = 1,5 \Omega - j10 \Omega = \underline{10,1 \Omega \angle -81,5^\circ}$$

$$I_{Z_s} = \frac{U}{Z_s} = \frac{240 \text{ V}}{10,1 \Omega} = \underline{23,7 \text{ A}}$$

↑ Minus fordi spolen er tilkopleet en parallell krets



$$g) X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 60 \text{ Hz} \cdot 66,31 \cdot 10^{-3} \text{ H} = \underline{25,0 \Omega}$$

$$X_C = \frac{1}{2 \cdot \pi \cdot f \cdot C} = \frac{1}{2 \cdot \pi \cdot 60 \text{ Hz} \cdot 66,31 \cdot 10^{-6} \text{ F}} = \underline{40,0 \Omega}$$

$$\bar{Z}_1 = \frac{Z_R \cdot Z_L}{Z_R + Z_L} = \frac{R \cdot R_S - jX_L}{R + R_S - jX_L} = \frac{15 \Omega \cdot (5 \Omega - j25 \Omega)}{15 \Omega + 5 \Omega - j25 \Omega} =$$

$$= \frac{75(\Omega^2) - j375(\Omega^2)}{20 \Omega - j25 \Omega} = \frac{382,4 \Omega \angle -78,69^\circ}{32,0 \Omega \angle -51,34^\circ} = \underline{11,94 \Omega \angle -27,35^\circ}$$

$$\bar{Z}_1 = Z \angle \varphi = 11,94 \Omega \angle -27,35^\circ = \underline{10,61 \Omega - j5,49 \Omega}$$

$$\bar{Z} = \frac{Z_1 \cdot Z_C}{Z_1 + Z_C} = \frac{(R_1 - jX_1) \cdot jX_C}{R_1 - jX_1 + jX_C} = \frac{(10,61 \Omega - j5,49 \Omega) \cdot j40,0 \Omega}{10,61 \Omega - j5,49 \Omega + j40,0 \Omega} =$$

$$= \frac{j424,4(\Omega^2) - j^2219,5(\Omega^2)}{10,61 \Omega + j34,51 \Omega} = \frac{219,5(\Omega^2) + j424,4(\Omega^2)}{10,61 \Omega + j34,51 \Omega} = \frac{477,8 \Omega \angle 62,7^\circ}{36,1 \Omega \angle 72,9^\circ}$$

$$= \underline{13,23 \Omega \angle 10,2^\circ}$$

$$b) I = \frac{U}{Z} = \frac{440 \text{ V}}{13,23 \Omega} = \underline{33,25 \text{ A}}$$

$$c) \text{ RESISTANSEN: } I_R = \frac{U}{R} = \frac{440 \text{ V}}{15 \Omega} = \underline{29,3 \text{ A}} \quad P = U \cdot I_R = 440 \text{ V} \cdot 29,3 \text{ A} = \underline{12906,7 \text{ W}}$$

$$\text{KONDENSATOREN: } I_C = \frac{U}{X_C} = \frac{440 \text{ V}}{40 \Omega} = \underline{11 \text{ A}} \quad Q_C = U \cdot I_C = 440 \text{ V} \cdot 11 \text{ A} = \underline{4840 \text{ VAR}}$$

SPOLEN:

$$\bar{Z}_S = R_S - jX_L = 5 \Omega - j25 \Omega = \underline{25,5 \Omega \angle -78,7^\circ}$$

Minus fordi spolen er tilkoplet en parallell krets

$$I_{Z_S} = \frac{440 \text{ V}}{25,5 \Omega} = \underline{17,26 \text{ A}}$$

$$S_S = U \cdot I_{Z_S} = 440 \text{ V} \cdot 17,26 \text{ A} = \underline{7593,6 \text{ VA}}$$

7.3.13

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KOPLET ALENETIL VEKSELSPENNING 50HZ:

$$R_{S1} = 5\Omega$$

$$R_{S2} = 7\Omega$$

$$\angle\phi_1 = 40^\circ$$

$$\angle\phi_2 = 75^\circ$$

$$\cos\phi_1 = \frac{R_{S1}}{Z_{S1}} \Rightarrow Z_{S1} = \frac{R_{S1}}{\cos\phi_1} = \frac{5\Omega}{\cos 40^\circ} = \underline{6,53\Omega}$$

$$\cos\phi_2 = \frac{R_{S2}}{Z_{S2}} \Rightarrow Z_{S2} = \frac{R_{S2}}{\cos\phi_2} = \frac{7\Omega}{\cos 75^\circ} = \underline{27,05\Omega}$$

$$X_{L1} = \sqrt{Z_{S1}^2 - R_{S1}^2} = \sqrt{6,53\Omega^2 - 5\Omega^2} = \underline{4,2\Omega}$$

$$X_{L2} = \sqrt{Z_{S2}^2 - R_{S2}^2} = \sqrt{27,05\Omega^2 - 7\Omega^2} = \underline{26,1\Omega}$$

$$L_1 = \frac{X_{L1}}{2 \cdot \pi \cdot f} = \frac{4,2\Omega}{2 \cdot \pi \cdot 50\text{Hz}} = 0,01337\text{H} = \underline{13,37\text{mH}}$$

$$L_2 = \frac{X_{L2}}{2 \cdot \pi \cdot f} = \frac{26,1\Omega}{2 \cdot \pi \cdot 50\text{Hz}} = 0,08308\text{H} = \underline{83,08\text{mH}}$$

KOPLET SAMMEN TIL VEKSELSPENNING 60HZ:

$$X_{L1} = 2 \cdot \pi \cdot f \cdot L_1 = 2 \cdot \pi \cdot 60\text{Hz} \cdot 13,37\text{mH} = \underline{5,04\Omega}$$

$$X_{L2} = 2 \cdot \pi \cdot f \cdot L_2 = 2 \cdot \pi \cdot 60\text{Hz} \cdot 83,08\text{mH} = \underline{31,32\Omega}$$

$$\underline{Z} = \frac{Z_{S1} \cdot Z_{S2}}{Z_{S1} + Z_{S2}} = \frac{(R_{S1} - jX_{L1})(R_{S2} - jX_{L2})}{R_{S1} - jX_{L1} + R_{S2} - jX_{L2}} = \frac{(5\Omega - j5,04\Omega) \cdot (7\Omega - j31,32\Omega)}{5\Omega - j5,04\Omega + 7\Omega - j31,32\Omega}$$

$$= \frac{35(\Omega^2) - j156,6(\Omega^2) - j35,28(\Omega^2) + j^2 157,9(\Omega^2)}{12\Omega - j36,36\Omega} =$$

$$= \frac{-122,9(\Omega^2) - j191,9(\Omega^2)}{12\Omega - j36,36\Omega} = \frac{227,88(\Omega^2) \angle -122,6^\circ}{38,29\Omega \angle -71,74^\circ} = \underline{\underline{5,95\Omega \angle -50,86^\circ}}$$

7.3.14

$$\begin{aligned}\bar{Z}_1 &= \frac{Z_A \cdot Z_B}{Z_A + Z_B} = \frac{(R_1 - jX_L) \cdot (R_2 + jX_C)}{R_1 - jX_L + R_2 + jX_C} = \frac{(20\Omega - j50\Omega) \cdot (10\Omega + j40\Omega)}{20\Omega - j50\Omega + 10\Omega + j40\Omega} = \\ &= \frac{200(\Omega^2) + j800(\Omega^2) - j500(\Omega^2) - j^2 2000(\Omega^2)}{30\Omega - j10\Omega} = \\ &= \frac{2200(\Omega^2) + j300(\Omega^2)}{30\Omega - j10\Omega} = \frac{2220,36\Omega \angle 7,77^\circ}{31,62\Omega \angle -18,43^\circ} = \underline{\underline{70,2\Omega \angle 26,2^\circ}}\end{aligned}$$

$$\bar{I} = \frac{U}{Z} = \frac{230V}{70,2\Omega} = \underline{\underline{3,28A}}$$

$$S = U \cdot I = 230V \cdot 3,28A = \underline{\underline{753,4VA}}$$

$$\bar{S} = S \angle \varphi = 753,4VA \angle 26,2^\circ = \underline{\underline{676,0W + j332,6VAR}}$$

$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 60 \text{ Hz} \cdot 0,05 \text{ H} = \underline{18,8 \Omega}$$

$$X_C = \frac{1}{2 \cdot \pi \cdot f \cdot C} = \frac{1}{2 \cdot \pi \cdot 60 \text{ Hz} \cdot 159 \cdot 10^{-6} \text{ F}} = \underline{16,7 \Omega}$$

$$\bar{Z}_1 = \frac{Z_A \cdot Z_B}{Z_A + Z_B} = \frac{(R_1 + R_5 - jX_L) \cdot (R_5 - jX_L + jX_C)}{R_1 + R_5 - jX_L + R_5 - jX_L + jX_C}$$

$$= \frac{(10 \Omega + 7 \Omega - j 18,8 \Omega) \cdot (7 \Omega - j 18,8 \Omega + j 16,7 \Omega)}{10 \Omega + 7 \Omega - j 18,8 \Omega + 7 \Omega - j 18,8 \Omega + j 16,7 \Omega}$$

$$= \frac{(17 \Omega - j 18,8 \Omega) (7 \Omega - j 2,1 \Omega)}{24 \Omega - j 20,9 \Omega} = \frac{119(\Omega^2) - j 35,7(\Omega^2) - j 131,6(\Omega^2) + j^2 39,48(\Omega^2)}{24 \Omega - j 20,9 \Omega}$$

$$= \frac{79,52(\Omega^2) - j 167,3(\Omega^2)}{24 \Omega - j 20,9 \Omega} = \frac{185,24 \Omega \angle -64,58^\circ}{31,82 \Omega \angle -41,05^\circ} = \underline{5,82 \Omega \angle -23,53^\circ}$$

$$\bar{Z} = Z \angle \varphi = 5,82 \Omega \angle -23,53^\circ = \underline{5,34 \Omega - j 2,32 \Omega}$$

$$Z = \frac{Z_1 \cdot Z_C}{Z_1 + Z_C} = \frac{(R_1 - jX_1) \cdot (R_5 - jX_L)}{R_1 - jX_1 + R_5 - jX_L} = \frac{(5,34 \Omega - j 2,32 \Omega) \cdot (7 \Omega - j 18,8 \Omega)}{5,34 \Omega - j 2,32 \Omega + 7 \Omega - j 18,8 \Omega}$$

$$= \frac{37,38(\Omega^2) - j 100,39(\Omega^2) - j 16,24(\Omega^2) + j^2 43,62(\Omega^2)}{12,34 \Omega - j 21,12 \Omega}$$

$$= \frac{-6,24(\Omega^2) - j 116,63(\Omega^2)}{12,34 \Omega - j 21,12 \Omega} = \frac{116,8 \Omega \angle -93,06^\circ}{24,46 \Omega \angle -59,7^\circ} = \underline{\underline{4,77 \Omega \angle -33,36^\circ}}$$