

$$R = 100 \Omega$$

2.3

Fall 1

Fall 2

a)

$$U_f = 230V$$

$$\frac{U_f}{R} = I_{H1} = 23A$$

$$U_H = 400V$$

$$I_f = \frac{U_H}{R} = \frac{400}{100} = 4A$$

$$I_H = 40 \cdot \sqrt{3} = 6.9A$$

b)

$$P_Y = 3 \cdot \frac{U_f^2}{R} = 1587W$$

$$\approx 1600W$$

$$P_A = 3 \cdot \frac{U_H^2}{R} = 4800W$$

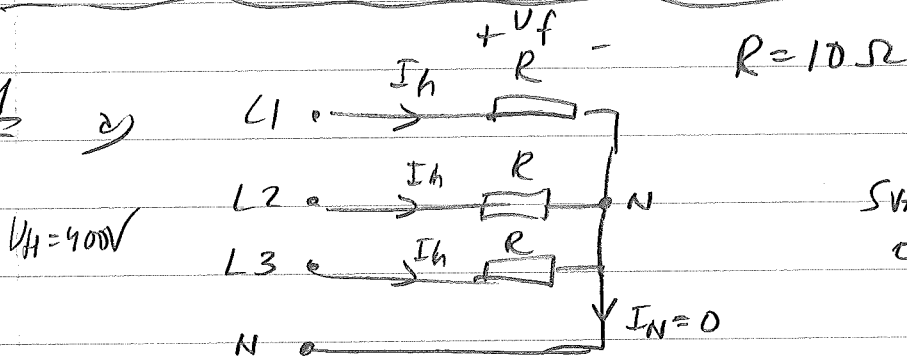
c)

$$\frac{I_{H1}}{I_{H2}} = 3$$

$$\frac{P_A}{P_Y} = 3$$

2.4

a)

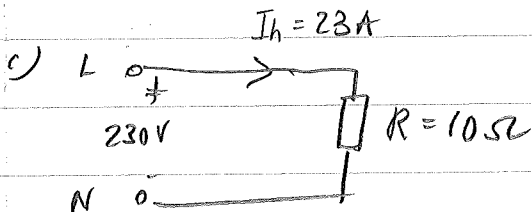


SWAR: 0V

b)

$$I_H = \frac{U_f}{R} = \frac{230}{10} = 23A$$

finns bara 1 ström i ett Y-kopplat nät.



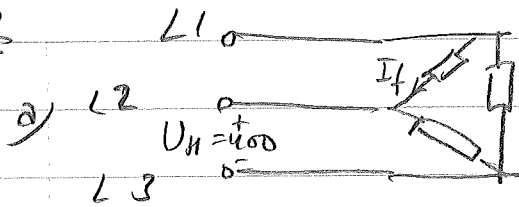
SWAR: 10 Ohm / f25

d)

$$P = 3 \cdot \frac{U_f^2}{R} = 3 \cdot \frac{230^2}{10} = 15.9 kW$$

$$R = 10$$

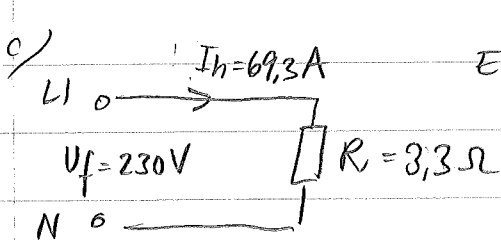
2.5



$$P_{tot} = 3 \cdot \frac{U_H^2}{R} = 48 \text{ kW}$$

b)  $I_f = \frac{U_H}{R} = \frac{400 \text{ V}}{10 \Omega} = 40 \text{ A}$

$$I_h = \sqrt{3} \cdot I_f = 69,3 \text{ A}$$



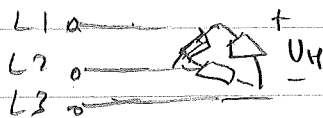
Ekvivalent/schemo för en fas.

Strömmen som går genom en fasledare.

Spänning som ligger mellan fas och noll.

d)  $P_{tot} = 3 \cdot \frac{U_H^2}{R} = 48 \text{ kW}$

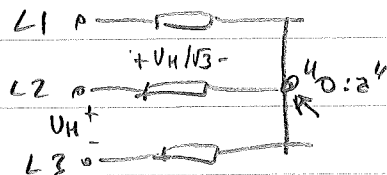
2.6



endast  $U_H$  över varje resistor

a) Om  $U_H = 230 \text{ V} \Rightarrow$  skall motorn vara  $\Delta$ -kopplad

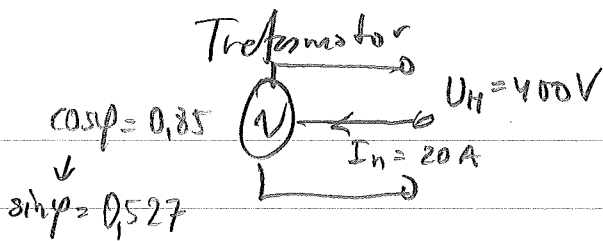
b) Om  $U_H = 400 \text{ V} \Rightarrow$  skall motorn vara  $Y$ -kopplad



$$U_f = \frac{U_H}{\sqrt{3}} = \frac{400 \text{ V}}{\sqrt{3}} = 230$$

vid en  $Y$ -koppling ligger fasspänning över resistorerna.

2.7

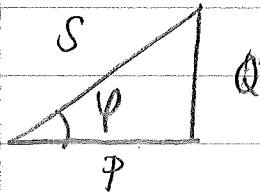


aktiv  
reaktiv  
scheinbar

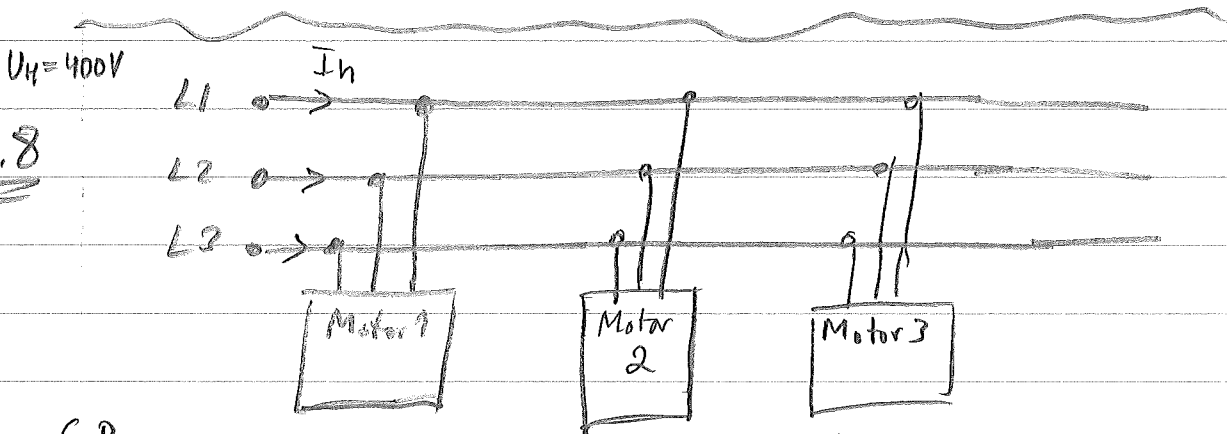
$$P = \sqrt{3} \cdot U_H \cdot I_H \cdot \cos \varphi = 11778 \text{ [W]}$$

$$Q = \sqrt{3} \cdot U_H \cdot I_H \cdot \sin \varphi = 7302 \text{ [VAr]}$$

$$S = \sqrt{3} \cdot U_H \cdot I_H = \sqrt{P^2 + Q^2} = 13858 \text{ VA}$$



2.8



$$\left\{ \begin{array}{l} P_{\text{mech}} = 11 \text{ kW} \\ \eta = 0,76 \\ \cos \varphi_1 = 0,7 \end{array} \right.$$

$$\left\{ \begin{array}{l} P_{\text{mech}} = 15 \text{ kW} \\ \eta = 0,82 \\ \cos \varphi_2 = 0,8 \end{array} \right.$$

$$\left\{ \begin{array}{l} P_{\text{mech}} = 18,5 \text{ kW} \\ \eta = 0,86 \\ \cos \varphi_3 = 0,9 \end{array} \right.$$

$$\eta_{\text{eff}} = \frac{P_{\text{mech}}}{P_{\text{el}}} \rightarrow P_1 = 14,47 \text{ kW}$$

$$P_2 = 18,29 \text{ kW}$$

$$P_3 = 21,51 \text{ kW}$$

$$\left[ P_{\text{tot}} = P_1 + P_2 + P_3 = 54,27 \text{ kW} \right]$$

$$Q_1 = P_1 \cdot \tan \varphi_1 \\ \approx 14,47 \cdot \tan 45,6^\circ \\ \approx 14,76 \text{ kVAr}$$

$$Q_2 = P_2 \cdot \tan \varphi_2 \\ \approx 13,72 \text{ kVAr}$$

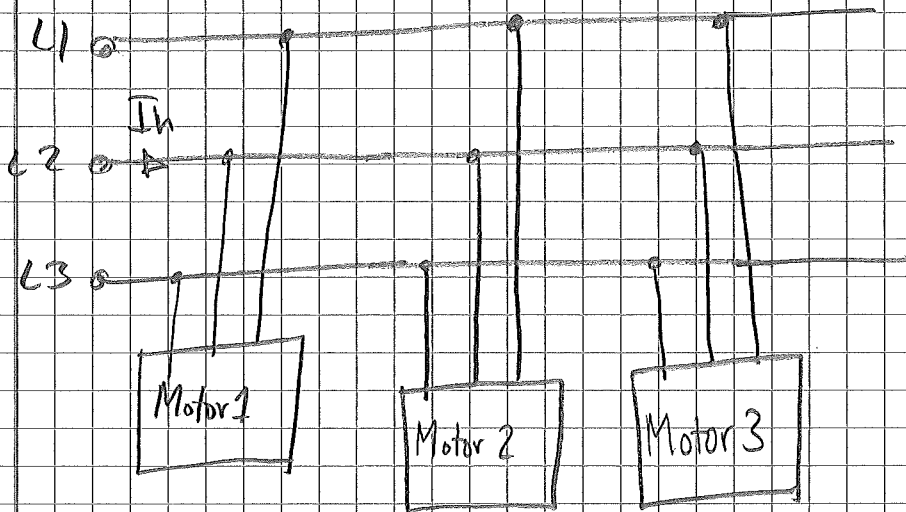
$$Q_3 = P_3 \cdot \tan \varphi_3 \\ \approx 10,42 \text{ kVAr}$$

$$Q_{\text{tot}} = Q_1 + Q_2 + Q_3 = 38,9 \text{ kVAr}$$

$$S_{\text{tot}} = \sqrt{P_{\text{tot}}^2 + Q_{\text{tot}}^2} = 66,37 \text{ kVA} = \sqrt{3} \cdot U_H \cdot I_H \rightarrow I_H = 96,4 \text{ A}$$

$$\cos \varphi = \frac{P_{\text{tot}}}{S_{\text{tot}}} = 0,81$$

2.8



$$\eta = \frac{P_{mech}}{P_{el}}$$

Motor 1  
 $P_{mech} = 11 \text{ kW}$

$\eta = 0,76$



$P_{el} = 14,47 \text{ kW}$

$\cos \varphi = 0,7$

$\varphi = 45,6^\circ$

Motor 2  
 $P_{mech} = 15 \text{ kW}$

$\eta = 0,82$



$P_{el} = 18,29 \text{ kW}$

$\cos \varphi = 0,8$

$\varphi = 36,9^\circ$

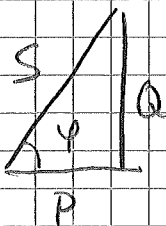
Motor 3  
 $P_{mech} = 18,5 \text{ kW}$

$\eta = 0,86$

$P_{el} = 21,51 \text{ kW}$

$\cos \varphi = 0,9$

$\varphi = 25,8^\circ$



$\tan \varphi = \frac{Q}{P}$

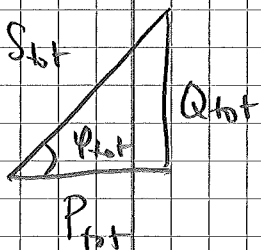
$Q = 14,78 \text{ kvar}$

$Q = 13,73 \text{ kvar}$

$Q = 10,40 \text{ kvar}$

$P_{tot} = 14,47 \text{ kW} + 18,29 \text{ kW} + 21,51 \text{ kW} = 54,27 \text{ kW}$

$Q_{tot} = 14,78 + 13,73 + 10,40 \text{ kvar} = 38,91 \text{ kvar}$

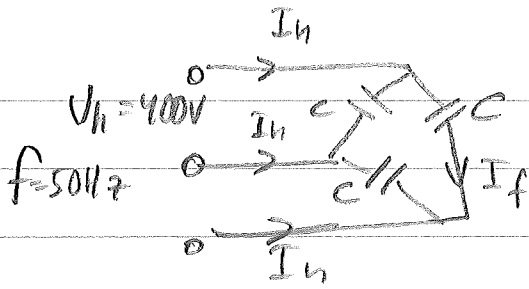


$S_{tot} = \sqrt{P_{tot}^2 + Q_{tot}^2} \approx 66,78 \text{ kVA} = \sqrt{3} \cdot U_n \cdot I_n$   
 $I_n \approx 96,4 \text{ A}$

$\tan \varphi_{tot} = \frac{Q_{tot}}{P_{tot}} \Rightarrow \varphi_{tot} = \arctan\left(\frac{Q_{tot}}{P_{tot}}\right) \approx 35,6^\circ$

$\cos \varphi_{tot} \approx 0,81$

2.9



$$C = 100 \mu\text{F}$$

$$|X_c| = \left| \frac{1}{\omega C} \right| = \left| \frac{1}{2\pi f \cdot C} \right|$$

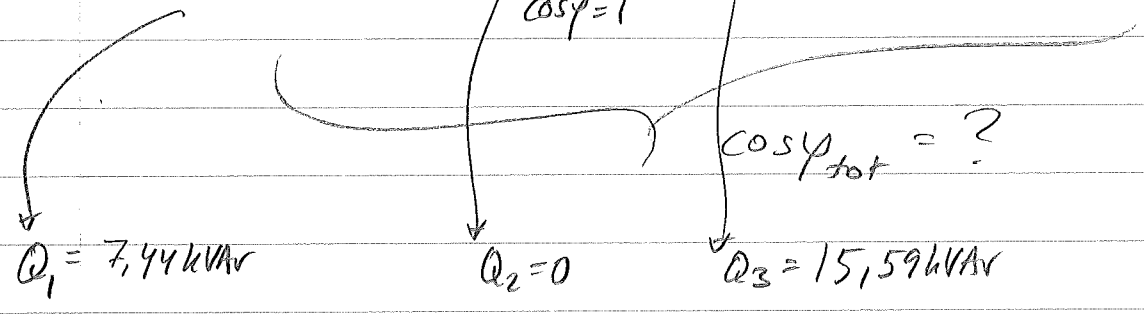
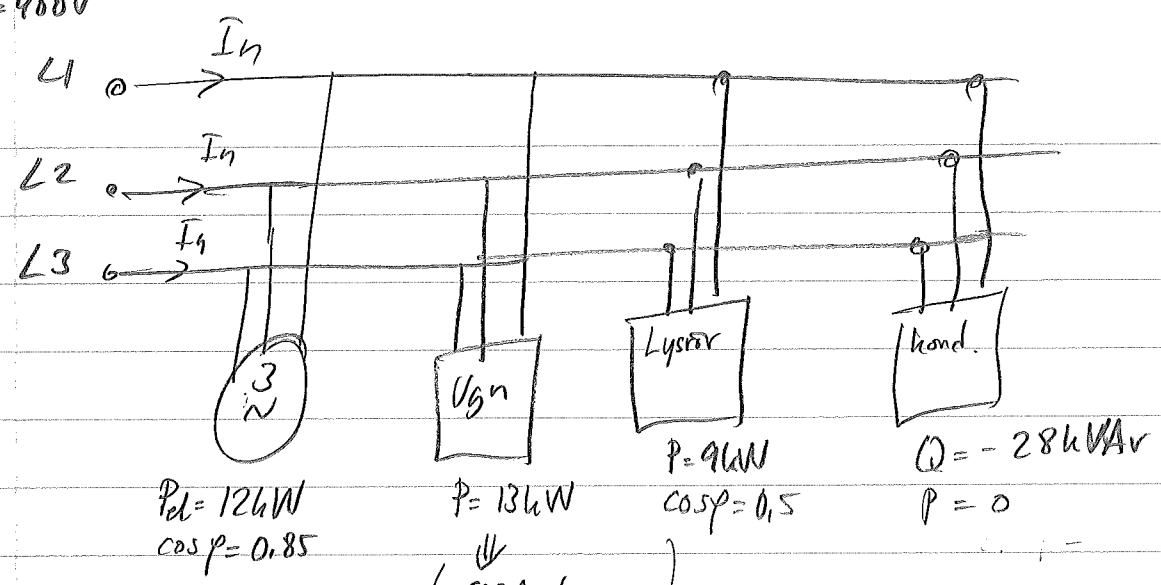
$$I_f = \frac{U_n}{|X_c|} = \frac{400}{\left| \frac{1}{2\pi \cdot 50 \cdot 10^{-4}} \right|} = 400 \cdot 2\pi \cdot 50 \cdot 10^{-4} \approx 4 \cdot \pi \approx 12,6 \text{ A}$$

$$I_n = \sqrt{3} \cdot I_f = 21,8 \text{ A}$$

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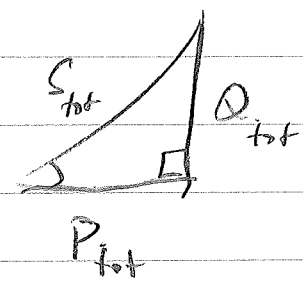
$V_H = 400V$

2.10



$Q_{\text{tot}} = -4.97 \text{ kVAR}$   
 $P_{\text{tot}} = 34 \text{ kW}$

$S_{\text{tot}} = \sqrt{Q_{\text{tot}}^2 + P_{\text{tot}}^2} \approx 34.4 \text{ kVA}$



$\cos \varphi_{\text{tot}} = \frac{P_{\text{tot}}}{S_{\text{tot}}} = 0.99 \text{ (hez)}$

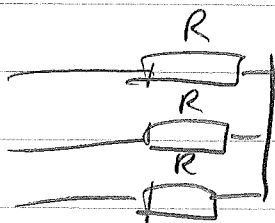
$S_{\text{tot}} = U_H \cdot I_H \cdot \sqrt{3}$

$I_H = \frac{S_{\text{tot}}}{U_H \cdot \sqrt{3}} = 49.6 \text{ A}$

2.11

Stjärnkoppling = Y-koppling

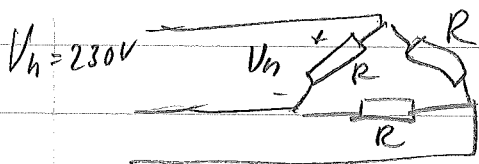
$$U_n = 400V$$



$$P_{\text{tot}} = 1,2 \text{ kW} = 3 \cdot \frac{(400/\sqrt{3})^2}{R}$$

$$\hookrightarrow R = 132,2 \Omega$$

Triangelkoppling = Δ-koppling



$$P = 3 \cdot \frac{230^2}{R} = 1200 \text{ W}$$