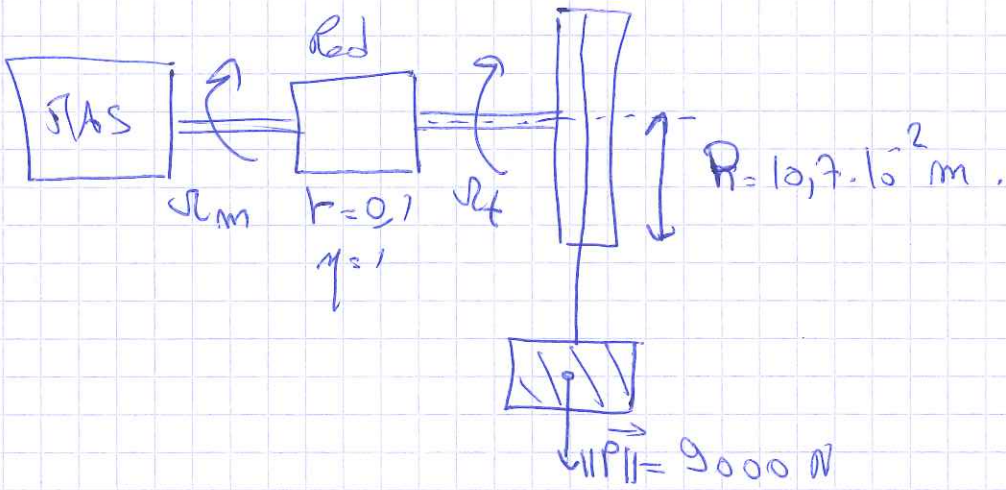
Exercice 4 :

Machine asynchrone

Stator Δ

Rotor Y

$U_{réseau} = 220\,V$. $f = 50\,Hz$.



Essai à vide : $U_0 = 220\,V$ $I_0 = 10\,A$ $P_0 = 3,5\,W$.

Essai en CC : $U_{cc} = 72,5\,V$ $I_{cc} = 30\,A$ $P_{cc} = 1400\,W$.

rotor bloqué

1/ Vitesse de déplacement $V = 1\,m.s^{-1}$

Ω moteur ?

$$\Omega_m = \frac{\Omega_{treuil}}{r}$$

$$\Omega_t = \frac{V}{R} = \frac{1}{10,7.10^{-2}} = 9,34\ rad.s^{-1}$$

$$\boxed{\Omega_m = \frac{\Omega_t}{r} = \frac{9,34}{0,1} = 93,4\ rad.s^{-1}}$$

p = ?

$$n_m = \frac{\Omega}{2\pi} \times 60 = 891,9$$

$\boxed{p = 3}$ donne $n_s = \frac{f \times 60}{3} = 1000\ tr.mn$

g ?

$$g = \frac{n_{ms} - n_m}{n_{ms}}$$

$$= \frac{1000 - 891,9}{1000}$$

$$\boxed{g = 0,109}$$

P_U = ?

$$T_{U\,Treuil} = T_r \Rightarrow T_r = P_{air} \times R$$

$$T_r = 9000 \times 10,7 \cdot 10^{-2}$$

$$\boxed{T_{U\,Treuil} = T_r = 963 \text{ Nm}}$$

Comme $\eta_{reducteur} = 1$, on peut écrire

$$P_{U\,moteur} = P_{U\,treuil} = T_{U\,moteur} \times \Omega_{moteur} = T_{U\,treuil} \times \Omega_{treuil}$$

$$P_{U\,rot} = T_{U\,rot} = T_{U\,Treuil} \times \frac{\Omega_{treuil}}{\Omega_{Moteur}}$$

$$(P_{U\,rot} = T_{U\,treuil} \times \Omega_{treuil})$$

$$= T_{U\,Treuil} \times 1$$

$$\boxed{T_{U\,rot}} = 963 \times 0,1 = \boxed{96,3 \text{ Nm}}$$

$$\boxed{P_{U\,rot}} = 963 \times 9,34 = \boxed{8994,4 \text{ W}}$$

P_{abs} ?

I_{ligne} ?

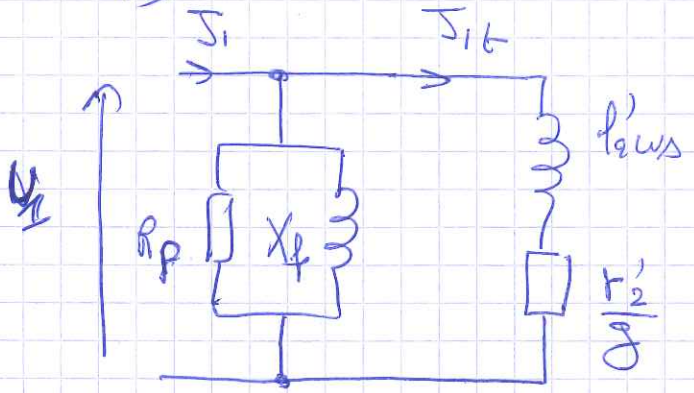
$$P_{abs} = \frac{P_{U\,rot}}{\eta_m} = \frac{8994,4}{0,84}$$

$$\boxed{P_{abs} = 10707,61 \text{ W}}$$

$$\boxed{I_{ligne}} = \frac{P_{abs}}{\sqrt{3} \cdot U \cos\varphi} = \frac{10707,6}{\sqrt{3} \times 220 \times 0,83} = \boxed{33,85 \text{ A}}$$

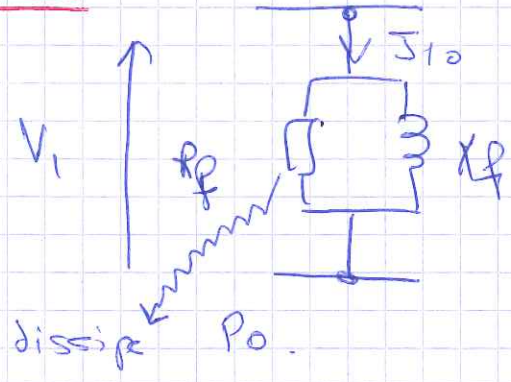
ex 4 (suite)

2)



J_1 est le courant polygonal et non par I_1 le courant en ligne.

2.1)



$I_{10} = 10A$

$J_{10} = \frac{I_{10}}{\sqrt{3}}$

$\boxed{J_{10} = \frac{10}{\sqrt{3}} = 5,77 A}$

$P_0 = 3 \times \frac{V_1^2}{R_f} \Rightarrow R_f = \frac{3V_1^2}{P_0}$

$R_f = \frac{3 \times 220^2}{305}$

$\boxed{R_f = 476,06 \Omega}$

$Q_0 = 3\frac{V_1^2}{X_f}$ $\quad X_f = \frac{3V_1^2}{\sqrt{S_{10}^2 - P_0^2}}$

$S_{10} = \sqrt{3} V_1 I_{10} = \sqrt{3} \times 220 \times 10$

$\boxed{S_{10} = 3810,5 VA}$

$X_f = \frac{3 \times 220^2}{\sqrt{3810,5^2 - 305^2}} = \frac{145200}{\sqrt{\quad}}$

$\boxed{X_f = \frac{145200}{3798} = 38,22 \Omega}$

22.) Essai en CC.

$$S_{cc} = \sqrt{3} \times U_{cc} \times I_{cc}$$
$$= \sqrt{3} \times 72,5 \times 30$$
$$= \sqrt{3} \times 2175$$

$$\boxed{S_{cc} = 3767,2 \text{ VA}}$$

$$\boxed{P_{cc} = 1400 \text{ W}}$$

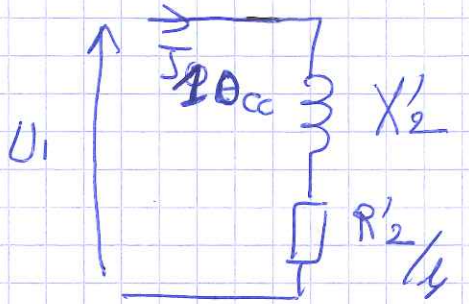
$$Q_{cc} = \sqrt{S_{cc}^2 - P_{cc}^2} = \sqrt{3767,2^2 - 1400^2}$$

$$\boxed{Q_{cc} = 3497,4 \text{ VAR}}$$

$$P_{cc} = \frac{3 U_1^2}{R'_2}$$

$g = 1$ (à rotor bloqué)

$$P_{cc} = 3 R'_2 J_{1cc}^2$$



$$I_{1cc} = 30 \text{ A}$$

$$J_{1cc} = \frac{I_{1cc}}{\sqrt{3}}$$

$$J_{1cc} = \frac{30}{\sqrt{3}} = 17,32 \text{ A}$$

$$R'_2 = \frac{P_{cc}}{3 J_{1cc}^2}$$

$$\boxed{R'_2 = \frac{1400}{3 \times 17,32^2} = 1,55 \, \Omega}$$

$$Q_{cc} = 3 X'_2 J_{1cc}^2$$

$$\boxed{X'_2 = \frac{Q_{cc}}{3 J_{1cc}^2} = \frac{3497,4}{3 \times 17,32^2} = 3,88 \, \Omega}$$

ex 4 (Suite)

3/ $$\underline{G} = \frac{1}{R_f} + \frac{1}{jX_f} + \frac{1}{\left(\frac{R'_2}{g} + jX'_2\right)}$$

$$= \frac{1}{R_f} + \frac{1}{jX_f} + \frac{\frac{R'_2}{g} - jX'_2}{\left(\frac{R'_2}{g}\right)^2 + X'^2_2}$$

$$= \frac{1}{R_f} + \frac{\frac{R'_2}{g}}{\left(\frac{R'_2}{g}\right)^2 + X'^2_2} + \frac{1}{jX_f} + \frac{1}{j}\left(-\frac{X'_2}{\left(\left(\frac{R'_2}{g}\right)^2 + X'^2_2\right)}\right)$$

$$\underline{G} = \frac{1}{R} + \frac{1}{jX}$$

D'où $$\left[\frac{1}{R} = \frac{1}{R_f} + \frac{\frac{R'_2}{g}}{\left(\frac{R'_2}{g}\right)^2 + X'^2_2}\right]$$

et $$\left[\frac{1}{X} = \frac{1}{X_f} - \frac{X'_2}{\left(\frac{R'_2}{g}\right)^2 + \left(X'_2\right)^2}\right]$$

4/ Si g petit.

$$\frac{1}{R} = \frac{1}{R_f} + \frac{\frac{R'_2}{g}}{\left(\frac{R'_2}{g}\right)^2}$$

$$= \frac{1}{R_f} + g \cdot \frac{1}{R'_2} = \frac{1}{476,06} + g\,\frac{1}{1,55}$$

$$\boxed{\frac{1}{R} = 2,1.10^{-3} + g\ 0,64}$$

$$\frac{1}{X} = \frac{1}{X_f} - g^2 \cdot \frac{X'_2}{R'^2_2} = \frac{1}{38,22} +(-) g^2 \frac{3,88}{1,55^2}$$

$$\boxed{\frac{1}{X} = 0,0261 - g^2 . 1,614}$$

5) On prend $\frac{1}{R} = 0,002 + 0,65\,g$

$$\frac{1}{X} = 0,025 + 1,5 . g^2$$

A.N. $\frac{1}{R} = 2.10^{-3} + 0,11 . 0,65$

$= 2.10^{-3} + 71,5.10^{-3}$

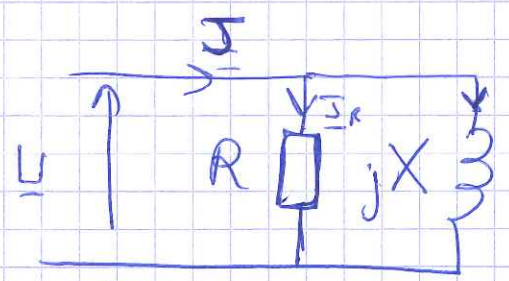
$= 73,5.10^{-3}$

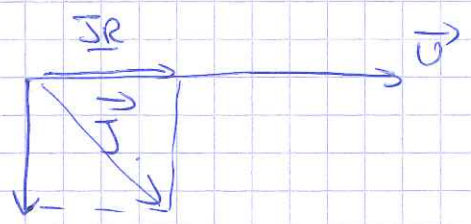
$\boxed{R = \frac{1}{73,5.10^{-3}} = 13,6\ \Omega}$

$\frac{1}{X} = 0,025 + 1,5 \times 0,11^2$

$= 43,15.10^{-3}$

$\boxed{X = \frac{1}{43,15.10^{-3}} = 23,174\ \Omega}$





$J_R = \frac{U}{R} = \frac{220}{13,6} = 16,17\,A$

$J_X = \frac{U}{X} = \frac{220}{23,17} = 9,49\,A$

$J = \sqrt{(J_R)^2 + (J_X)^2}$

$I = \sqrt{3} \times J = \sqrt{3} \times \sqrt{16,17^2 + 9,49^2}$

$\boxed{I = \sqrt{3} \times 18,74 = 32,47\,A}$