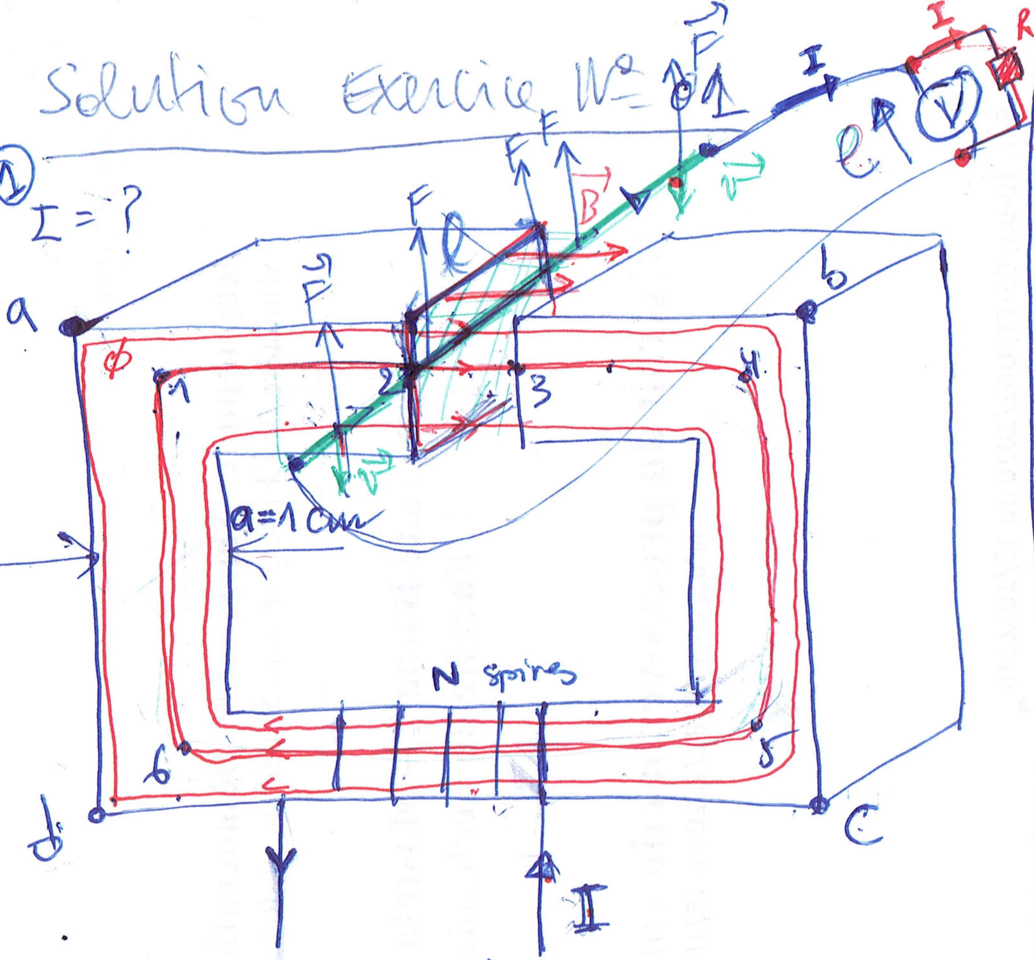
Solution Exercice N° 1 — page 1

① $I = ?$



$\phi = 3{,}6 \cdot 10^{-4}$ Wb

$N = 100$ Spires.

$\oint H \cdot dl = NI$

$H_{fer} \cdot l_{fer} + H_{air} \cdot l_{air} = NI$

$l_{fer} = l_{21} + l_{16} + l_{65} + l_{54} + l_{43}$

$l_{air} = l_{32} = e = 0{,}1 \cdot 10^{-2}$ m

$l_{fer} = \left\{ \left(\underset{-a}{ab} + \underset{-a}{bc} + \underset{-a}{cd} + \underset{-a}{da} \right) - 4a \right\} - e$

$l_{fer} = 0{,}06 \times 4 - 4 \cdot 1 \cdot 10^{-2} - 0{,}1 \cdot 10^{-2}$

$= 0{,}199$ m. $= 0{,}199$ m

$H_{fer} = \dfrac{B_{fer}}{\mu_{fer}} = \dfrac{\phi / S}{\mu_{fer}} = \dfrac{(3{,}6 \cdot 10^{-4}) / 0{,}2 \cdot 10^{-3}}{0{,}0028}$

$\phi = B \cdot S$

$H_{fer} = 642{,}85$ A/m.

$H_{air} = \dfrac{\phi / S}{\mu_0} = \dfrac{(3{,}6 \cdot 10^{-4}) / 0{,}2 \cdot 10^{-3}}{4\pi \cdot 10^{-7}}$

$= 1{,}433121 \cdot 10^{+6}$ A/m.

$I = \dfrac{H_{fer} \cdot l_{fer} + H_{air} \cdot l_{air}}{N}$

$= \dfrac{(642{,}85 \cdot 0{,}199) + (1{,}433121 \cdot 10^{6} \cdot 0{,}1 \cdot 10^{-2})}{100}$

$= \boxed{15{,}61 \text{ A}}$

2) $e = B \cdot l \cdot v \cdot \sin(\alpha)$ α angle entre $\vec{B}$, $\vec{v}$

$\alpha = 90°$

$e = B \cdot l \cdot v$

$= \frac{\phi}{S} \cdot l \cdot v$

$l = \frac{S}{a} = \frac{0,2 \cdot 10^{-3}}{1 \cdot 10^{-2}} = 0,02\ m$

$e = \left(\underbrace{\frac{3,6 \cdot 10^{-4}}{0,2 \cdot 10^{-3}}}_{1,8}\right) \cdot (0,02) \cdot 30 = \underline{1,08\ V}$

3) $F = ?$ pour calculer la force on utilise Laplace

$F = I\vec{dl} \wedge \vec{B} = I \cdot l \cdot B \cdot \underbrace{\sin\alpha}_{=1}$ α angle entre $\vec{B}$, $I\vec{l}$

$\alpha = 90°$

$F = I \cdot l \cdot B$

$I = \frac{e}{R} = \frac{1,08}{1} = \underline{1,08\ A}$

$F = 1,08 \cdot 0,02 \cdot 1,8 = \underline{0,038\ N}$

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Solution Exo N° 02

$2p = 6 \Rightarrow p = 3$

$220/380\,V$, $50\,Hz$, $5\,KW$, $\cos\varphi = 0{,}85$

$g = 5\,\%$

$R_s = 4\,\Omega$ entre deux bornes du stator

① $N_r = ?$, $N_s = ?$

$$N_s = \frac{60 f}{p}\ [tr/min] = \frac{60 \cdot 50}{3} = \boxed{1000\ tr/min}$$

$$\omega_s = \frac{\omega}{p} = \frac{2\pi f}{p}\ [rad/s] = \frac{2\pi \cdot 50}{3} = 104{,}6\ rad/s$$

$N_r = ?$

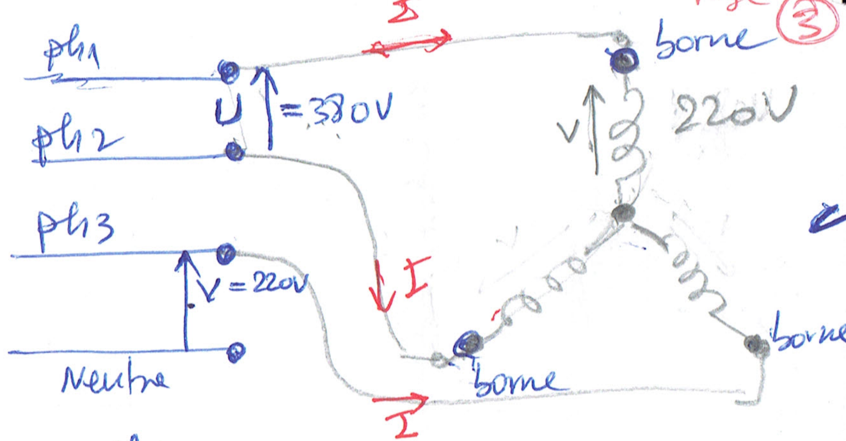
$$g = \frac{N_s - N_r}{N_s} = \frac{\omega_s - \omega_r}{\omega_s}$$

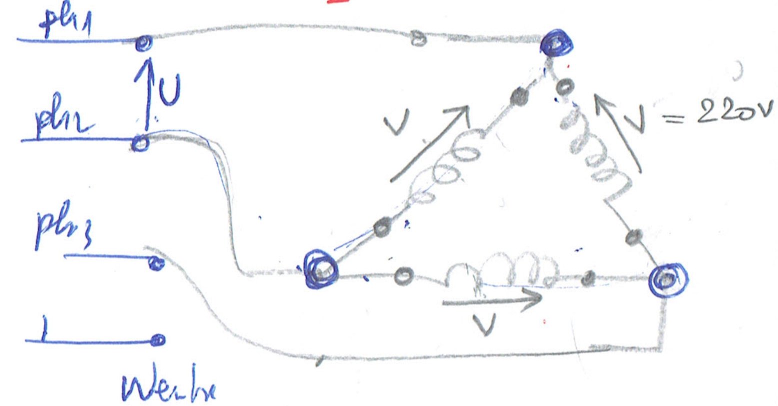
$$\Rightarrow N_r = (1 - g)\,N_s = (1 - 0{,}05) \cdot 1000$$

$g = 5\% \;\#\; \frac{5}{100}$

$$\boxed{N_r = 950\ tr/min}$$

②





→ Nous allons prendre le couplage ~~triangle~~ étoile (Y).
Car la tension maximale supportée par une bobine du moteur ne doit pas dépasser 220V.

③ $P_{10} = 800\ Watt$, $I_{10} = 5A$

$\Delta P_{fer} = ?$

$\Delta P_{rota} = \Delta P_{mec} = ?$

$P_{10} = \Delta P_{Js} + \Delta P_{fer} + \Delta P_{mec}$

dans l'énoncé de l'exercice $\Delta P_{mec} = \Delta P_{fer}$

$P_{10} = \Delta P_{Js} + 2\, \Delta P_{fer}$

$\Delta P_{Js} = 3 \cdot R_{ph} \cdot I_{10}^2$

$R_s = 4\,\Omega = 2\, R_{ph}$

$\Rightarrow R_{ph} = \frac{4}{2} = 2\,\Omega$

$\Delta P_{Js} = 3 \cdot 2 \cdot (5)^2 = 150\ \text{Watt}$.

$\Delta P_{fer} = \frac{P_{10} - \Delta P_{Js}}{2} = \frac{800 - 150}{2}$

$= 325\ \text{Watt} = \Delta P_{mec}$

4) $\eta = 0{,}8$, $P_u = 5\ \text{KW}$

$I = ?$

4.1 $P_{abs} = 3 \cdot V \cdot I \cdot \cos\varphi$

$= \sqrt{3}\, U\, I \cos\varphi$

$\eta = \frac{P_u}{P_{abs}} \Rightarrow$ ~~$P_{abs} = P_u$~~

$P_{abs} = \frac{P_u}{\eta} = \frac{5 \cdot 10^3}{0{,}8} = 6250\ \text{Watt}$

$\Rightarrow I = \frac{P_{abs}}{3 V \cos\varphi} = \frac{6250}{3 \cdot 220 \cdot 0{,}85} = 11{,}14\ A$

$= \frac{P_{abs}}{\sqrt{3}\, U \cos\varphi} = \frac{6250}{\sqrt{3} \cdot 380 \cdot 0{,}85} = 11{,}16\ A$

$\Delta P_{Js} = 3 \cdot R_{ph} \cdot I^2 = 3 \cdot 2 \cdot (11{,}14)^2$

$= 744{,}59\ \text{watt}$

4.2 $P_{em} = ?$, $\Delta P_{JR} = ?$

D'après le bilan de puissance

$P_{abs} = \Delta P_{Js} + \Delta P_{fer} + P_{em}$

$$P_{em} = P_{abs} - \Delta P_{JS} - \Delta P_{fer}$$
$$= 6250 - 744{,}59 - 325$$
$$= 5180{,}41 \text{ Watt}.$$

$$\Delta P_{JR} = g \cdot P_{em} = 0{,}05 \cdot 5180{,}41$$
$$= 259{,}02 \text{ Watt}$$

4.3 $C_u = ?$

$$C_u = \frac{P_u}{\Omega_r} = \frac{5 \cdot 10^3}{950\left(\frac{2\pi}{60}\right)} = 50{,}25 \text{ Nm}.$$

$$C_{em} = \frac{P_{em}}{\Omega_s} = \frac{5180{,}41}{104{,}6} = 49{,}52 \text{ Nm}.$$

$$C_{mec} = \frac{P_{mec}}{\Omega_r}$$

$$P_{mec} = P_{em} - \Delta P_{JR} - \cancelto{0}{\Delta P_{fer\text{-}rotor}}$$

$\Delta P_{fer\ rotorique}$ est très faible car la fréquence des courants rotoriques sont faibles devant la fréquence des courants statoriques.

$$P_{mec} = 5180{,}41 - 259{,}02$$
$$= 4921{,}39 \text{ Watt}$$

$$C_{mec} = \frac{4921{,}39}{950\left(\frac{2\pi}{60}\right)} = 49{,}46 \text{ Nm}$$