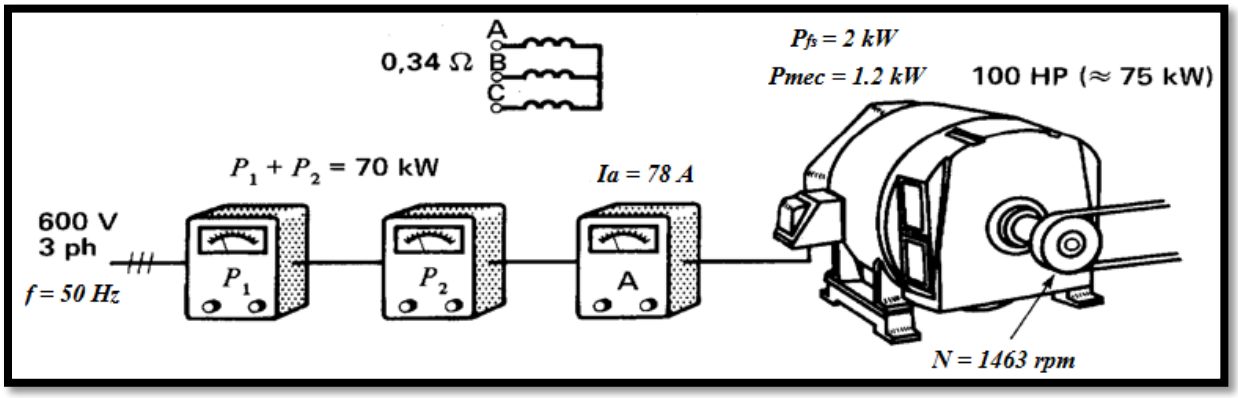
***Exercise:* Study of an induction motor**

A **600 V** line powers a three-phase induction motor with a nominal power of **100 hp (≈ 75 kW)**. Two wattmeters placed in the line wires indicate **a total power of** $P_a = 70\ kW$ and an amperemeter indicates a line current of $I_a = 78\ A$. Accurate measurements indicate a speed of rotation of $N = 1463\ rpm$.
In addition, the following information is provided:

- The iron losses in the stator: $P_{fs} = 2kW$
- Ventilation and mechanical losses: $P_{mec} = 1.2\ kW$
- Resistance **between two** stator terminals : $2 \times R_s = 0.34\Omega$




We suppose STAR connexion.

1- Give the number of poles of machine stator and the slip **s** of the machine
2- Calculate the stator joule losses $P_{js}$
3- Calculate the electromechanical power delivered to the rotor $P_{em}$
4- Deduce the joule losses in the rotor $P_{jr}$
5- Calculate the useful torque $T_u$ of the motor
6- Calculate the efficiency of the motor **η**

## ***Correction***

1) N=1463 rpm → Ns = 1500 rpm → 4 poles (synchronism speed: 1500 rpm).

$S = \frac{N_s - N}{N_s} = \frac{1500-1463}{1500} = 2.4\%$

2) Stator joule losses: $P_{js} = 3\ R_s I_a^2 = 3 \times \frac{0.34}{2} \times 78^2 = 3.1kW$

3) $P_{em} = P_a - (P_{js} + P_{fs}) = 70 - 3.1 - 2 = 64.9kW$

4) Rotor joule losses:

$$P_{jr} = s \times P_{em} = 0.024 \times 64.9 = 1.5\ kW$$

5) $T_u = \frac{P_u}{\Omega_n} = \frac{64900-1300-1200}{1463 \times \frac{\pi}{30}} = 407.3\ Nm$

6) $\eta = \frac{P_u}{P_a} = \frac{64900-1300-1200}{70000} = 89\ \%$