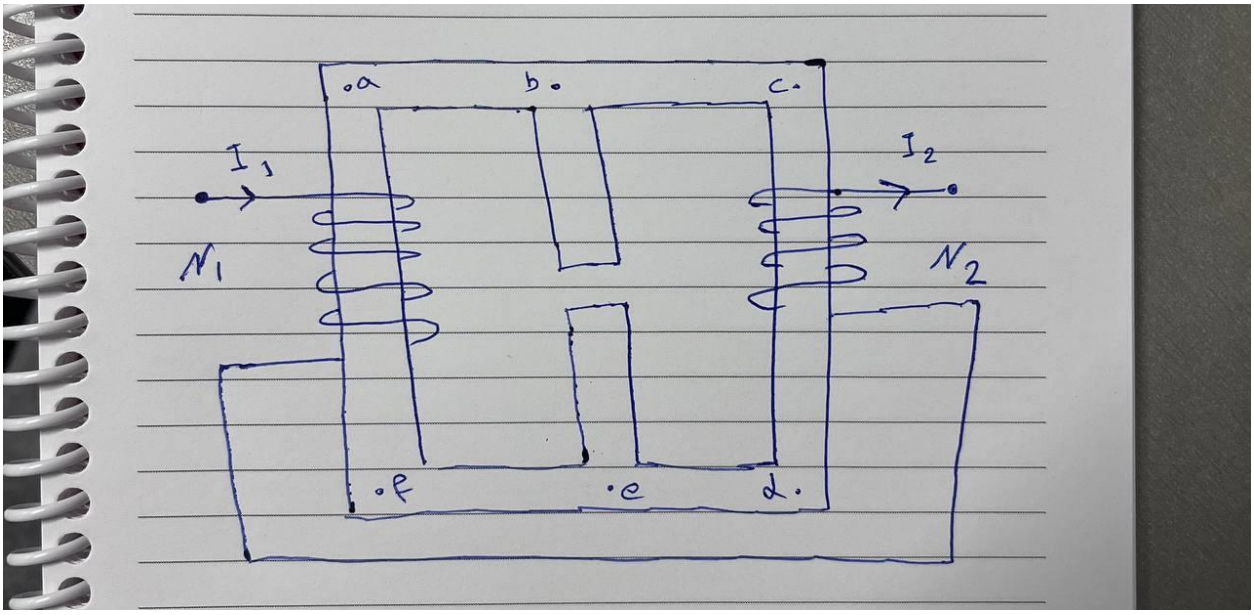
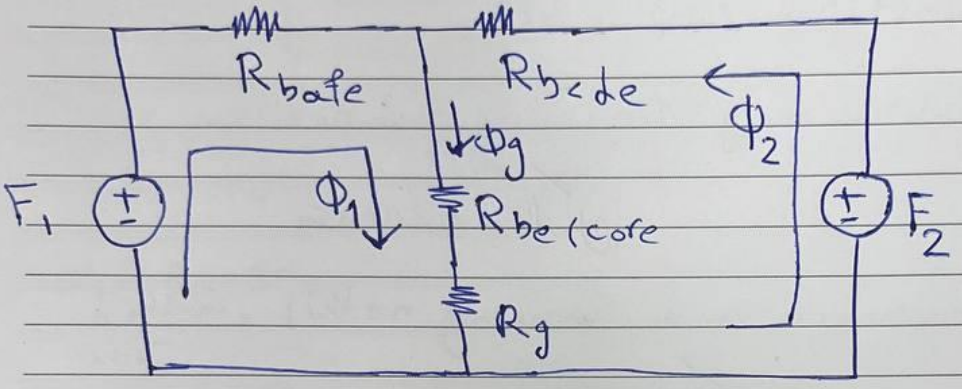
Example 1



Example 1

Solution:

the equivalent magnetic circuit:



$$F_1 = N_1 I_1 = 500 \times 10 = 5000 \text{ At}$$

$$F_2 = N_2 I_2 = 500 \times 10 = 5000 \text{ At}$$

$$R_{bafe} = \frac{l_{bafe}}{\mu_c A_c} = \frac{3 \times 52 \times 10^{-2}}{1200 \times 4\pi \times 10^{-7} \times 4 \times 10^{-4}}$$

$$= 2.58 \times 10^6 \text{ At/wb}$$

$$R_{bcde} = R_{bafe}$$

$$R_g = \frac{l_g}{\mu_0 A_g} = \frac{5\times10^{-3}}{4\pi\times10^{-7}\times2\times2\times10^{-4}}$$

$$= 9.94\times10^{6}\ At/wb$$

$$R_{be(core)} = \frac{l_{be(core)}}{\mu_c A_c} = \frac{51.5\times10^{-2}}{1200\times4\pi\times10^{-7}\times4\times10^{-4}}$$

$$= 0.82\times10^{6}\ At/wb$$

$$\Phi_1(R_{bafe}+R_{be}+R_g)+\Phi_2(R_{be}+R_g)=F_1$$

$$\Phi_1(R_{be}+R_g)+\Phi_2(R_{bcde}+R_{be}+R_g)=F_2$$

$$\Rightarrow \begin{cases} \Phi_1(13.34\times10^{6})+\Phi_2(10.76\times10^{6})=5000 \\ \Phi_1(10.76\times10^{6})+\Phi_2(13.34\times10^{6})=5000 \end{cases}$$

$$\Rightarrow \Phi_1=\Phi_2=2.067\times10^{-4}\ wb$$

$$\Phi_g=\Phi_1+\Phi_2=4.134\times10^{-4}\ wb$$

Air gap flux

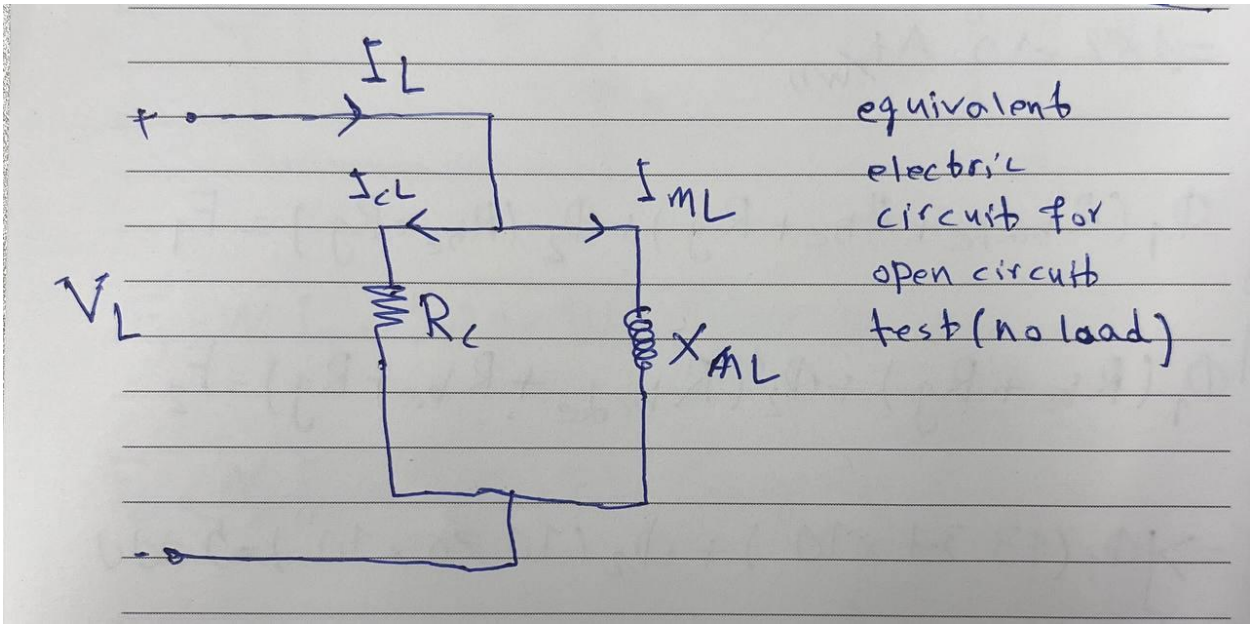
$$B_g = \frac{\Phi_g}{A_g} = \frac{4.134 \times 10^{-4}}{4 \times 10^{-4}} = 1.034 \text{ T}$$

Air gap flux density

magnetic intensity in the air gap:

$$H_g = \frac{B_g}{\mu_0} = \frac{1.034}{4\pi \times 10^{-7}} = 0.882 \times 10^6 \text{ At/m}$$

Example 2


I_L
I_{cL}
I_{mL}
V_L
R_c
X_{mL}
equivalent electric circuit for open circuit test (no load)

Example 2

solutions: $V_{H(rated)} = 2200$, $V_{L(rated)} = 220V$

$$I_{H(rated)} = \frac{10,000}{2200} = 4.55\ A$$

$$I_{L(rated)} = \frac{10,000}{220} = 45.5\ A$$

$$V_H I_H = V_L I_L = 10\ KVA$$

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a) $\underset{oc}{P} = V_L^2 / R_c \Rightarrow R_{cL} = \frac{220^2}{100} = 484\ \Omega$

open circuit

$$I_{cL} = \frac{220}{484} = 0.45\ A \Rightarrow I_{mL} = \sqrt{I_L^2 - I_{cL}^2}$$

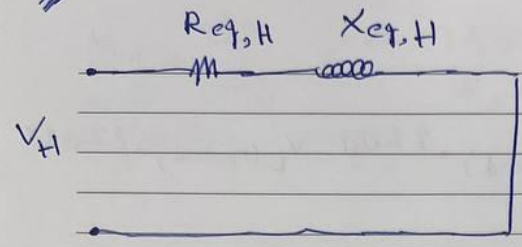
$$= \sqrt{(2.5)^2 - (0.45)^2} = 2.46\ A$$

$$X_{mL} = \frac{220}{2.46} = 89.4$$

turn ratio $= a = \frac{2200}{220} = 10 \Rightarrow R_{cH} = R_{cL} \times a^2$

$$= 484 \times 10^2 = 48,400\ \Omega$$

$$X_{mH} = 89.4 \times 10^2 = 8940\ \Omega$$



equivalent circuit for short-circuit test

$$P_{SC} = I_H^2 R_{eq,H} \Rightarrow R_{eq,H} = \frac{215}{4.55^2} = 10.4\ \Omega$$

$$Z_{eq,H} = \frac{V_H}{I_H} = \frac{150}{4.55} = 32.97\ \Omega$$

$$X_{eq,H} = \sqrt{Z_{eq,H}^2 - R_{eq,H}^2} = 31.3\ \Omega$$

$$\Rightarrow R_{eq,L} = \frac{R_{eq,H}}{a^2} = \frac{10.4}{10^2} = 0.104\ \Omega$$

$$X_{eq,L} = \frac{31.3}{10^2} = 0.313\ \Omega$$

b) $I_\Phi = 2.5\ A$

$$\Rightarrow \frac{2.5}{45.5} \times 100 = 5.5\ \%$$