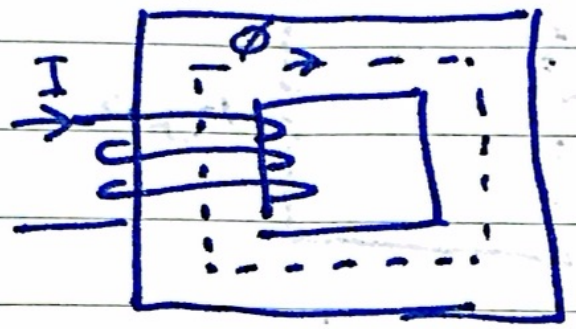
Exercise: (Reluctance Calculation)

a)



$l = 500mm$

$A_c = 2500mm^2$

$\mu_r = 4000$

Reluctance.

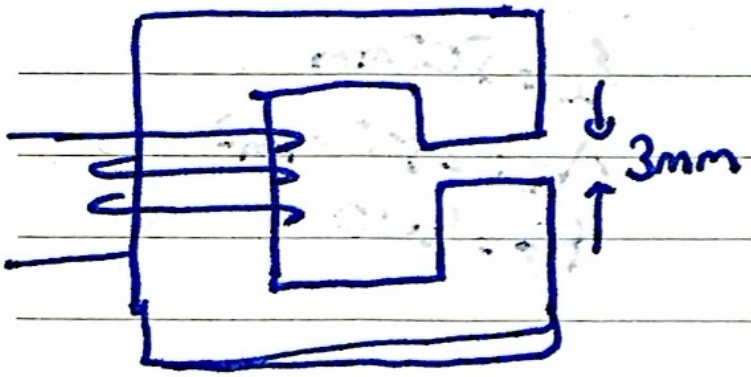
$$\mathcal{R} = \frac{l}{\mu . A} = \frac{0.5}{4000 . 4\pi . 10^{-7} . 2500 . 10^{-6}} =$$

(SI units!)

$$= 3978,9 . H^{-1} \ (A/Wb)$$

$$\simeq 40 k H^{-1}$$

b) with gap



$$\mathcal{R}_{core} = \frac{(0,5 - 0.003)}{4000 . 4\pi . 10^{-7} . 2500 . 10^{-6}} = 39550 H^{-1}$$

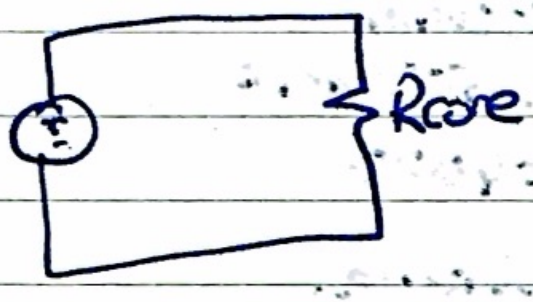
$$\mathcal{R}_{gap} = \frac{0.003}{4\pi . 10^{-7} . 2500 . 10^{-6}} \simeq 955 k H^{-1}$$

$\mu_r = 1$

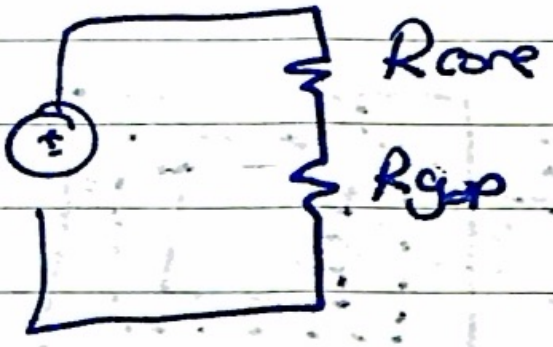
$$\mathcal{R}_{tobl} = \mathcal{R}_{gap} + \mathcal{R}_{core} \simeq \underline{995 k H^{-1}}$$

(Almost increased 25 times by 3mm gap)

a)



b)



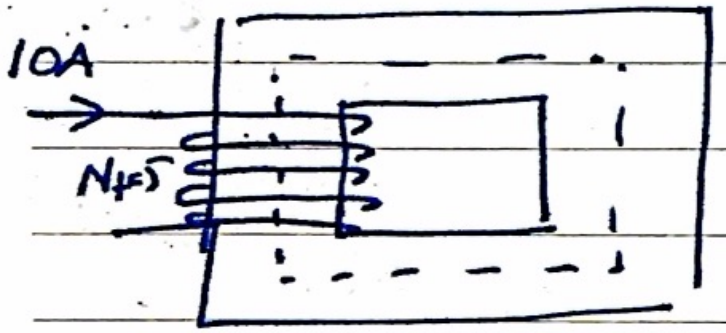
$\mathcal{F} = NI$

$\phi = \frac{\mathcal{F}}{R}$ $\quad \mathcal{F} = \phi . R$ $\quad \phi = \frac{\mathcal{F}}{(R_c + R_g)}$

Q2) Same core.

Assume $N_1 = 5$ $\quad I = 10\,A.$

Find. F, ϕ, B, H in the core.



$l_c = 500mm$

$A_c = 2500mm^2$

$\mu_r = 4000$

$MMF = NI = 50$ A.turns.

✓ Homogenous H.

$\oint H.dl = NI \Rightarrow \quad H.0.5 = 50\,A.$

$H = 100\,A/m$

$\phi . R = F \qquad \phi . 40k = 50$

$\phi = 1,25\,mWb$

$B = \frac{\Phi}{A}$ $\quad \Phi = \int B \cdot dA$ $\quad (I = \int J dA)$

$\rightarrow B = \frac{1,25 mWb}{2500.10^{-6} m^2} = 0,5\,T$ $\quad (Wb/m^2)$

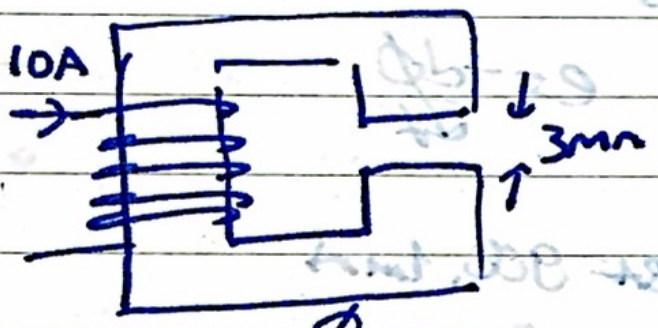
double check:

$B = \mu H$ $\quad B = 4000.4\pi.10^{-7}.100 A/m$

$= 0,5\,T$ ✓

Repeat

⇒ Core with the ~~core~~ gap.

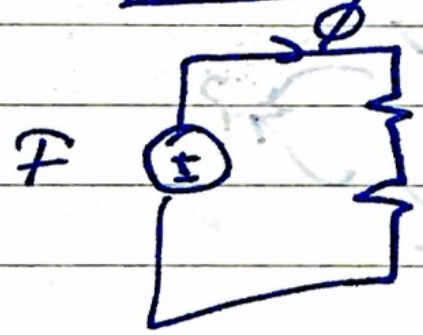


Calculate L

$L = \frac{\lambda}{I} = \frac{N\Phi}{I}$

L_1 without gap. $= \frac{5.1,25 mWb}{10A} = 0,625 mH = 625 \mu H$

$L_2 = \frac{5.0,05 mWb}{10} = 25 \mu H$ (with gap)



$F = \Phi.(R_{core} + R_{gap})$

$50 = \Phi.995k$

$\Phi = 0.05 mWb$

$B = \frac{\Phi}{A} \Rightarrow B_{gap} = 0,02\,T$ (reduced 25 times)

$B_{core} = 0.02 T$

16 kA/m

~~15,92 kA/m~~

$B_{gap} = \mu_0 H_{gap} \Rightarrow H_{gap} = \frac{0.02}{4\pi.10^{-7}} \cong$ ~~15,92 kA/m~~

$B_{core} = \mu_r.\mu_0 H_{core} \Rightarrow H_{core} = \frac{0.02}{4000.4\pi.10^{-7}} = 4 A/m$

$H_{core} l_{core} + H_{gap}.l_{gap} = NI$

$4.0.5 + 16 k 0.003 = 50$

$2 + 48 = 50$ ✓ correct.