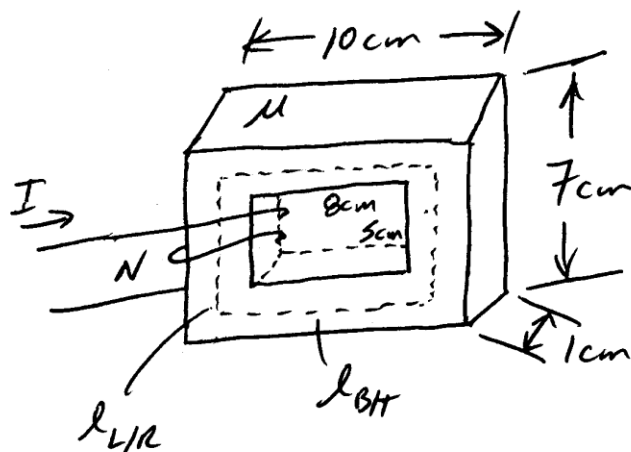


Magnetic Circuit Example

For the problem shown, find/estimate Φ , L , W_m , $|\vec{B}|$, and $|\vec{H}|$ using the magnetic circuit approach.



$$N = 50 \text{ turns}$$

$$I = 4 \text{ A}$$

$$\mu = 4000 \mu_0$$

$$l_{L/R} = 7 \text{ cm} - \left(\frac{7-5}{2}\right) = 7 - 1 = 6 \text{ cm} = \underline{0.06 \text{ m}}$$

$$l_{B/T} = 10 \text{ cm} - \left(\frac{10-8}{2}\right) = 10 - 1 = 9 \text{ cm} = \underline{0.09 \text{ m}}$$

$$A = 1 \text{ cm} (1 \text{ cm}) = \underline{10^{-4} \text{ m}^2}$$

$$R_{L/R} = \frac{l_{L/R}}{\mu A} = \frac{0.06}{4000(4\pi \times 10^{-7})(10^{-4})} = \underline{119,366.2 \frac{\text{A}\cdot\text{t}}{\text{wb}}}$$

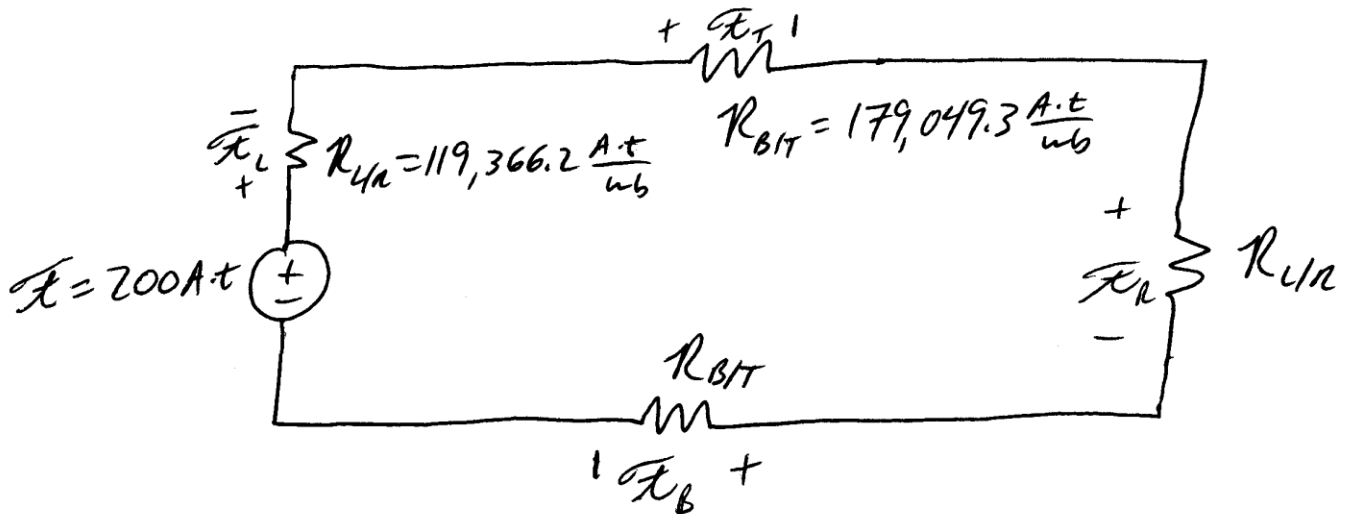
$$R_{B/T} = \frac{l_{B/T}}{\mu A} = \frac{0.09}{4000(4\pi \times 10^{-7})(10^{-4})} = \underline{179,049.3 \frac{\text{A}\cdot\text{t}}{\text{wb}}}$$

mmf

Source $\mathcal{F} = NI = 50(4) = \underline{200 \text{ A}\cdot\text{t}}$

ex. cont.

Equivalent Magnetic Circuit



$$R_{eq} = R_{L1} + R_{B1T} + R_{L1} + R_{B1T}$$

$$= 2(119,366.2) + 2(179,049.3)$$

$$\underline{R_{eq} = 596,831 \frac{\text{A}\cdot\text{t}}{\text{wb}}}$$

$$L = \frac{N^2}{R_{eq}} = \frac{50^2}{596,831} = \underline{\underline{4.189 \text{ mH}}}$$

$$\phi = \frac{\mathcal{F}}{R_{eq}} = \frac{200}{596,831} = \underline{\underline{0.3351 \text{ mWb}}}$$

$$W_m = \frac{1}{2} L I^2 = \frac{1}{2} (4.189 \times 10^{-3}) (4^2) = \underline{\underline{33.51 \text{ mJ}}}$$

ex. cont.

$$BA = \Phi \Rightarrow B = |\vec{B}| = \frac{\Phi}{A} = \frac{3.351 \times 10^{-4}}{10^{-4}} \\ = \underline{\underline{3.351 \text{ W/m}^2 = T}}$$

$$|\vec{H}| = H = \frac{B}{\mu} = \frac{3.351}{4000(4\pi \times 10^{-7})} = \underline{\underline{666.66 \text{ A/m}}}$$

mmf drops on each side of core?

$$\text{mmf}_{B/T} = \mathcal{F}_{B/T} = \Phi \mathcal{R}_{B/T} = (3.351 \times 10^{-4})(179,049.3)$$

$$\underline{\underline{\mathcal{F}_{B/T} = 60 \text{ A}\cdot\text{t}}}$$

"KVL"

$$\mathcal{F} = \mathcal{F}_B + \mathcal{F}_T + \mathcal{F}_L + \mathcal{F}_R$$

$$\hookrightarrow \mathcal{F}_L + \mathcal{F}_R = 200 - 60 - 60 = 80$$

$$\mathcal{F}_{L/R} = \frac{80}{2} = \underline{\underline{40 \text{ A}\cdot\text{t}}}$$