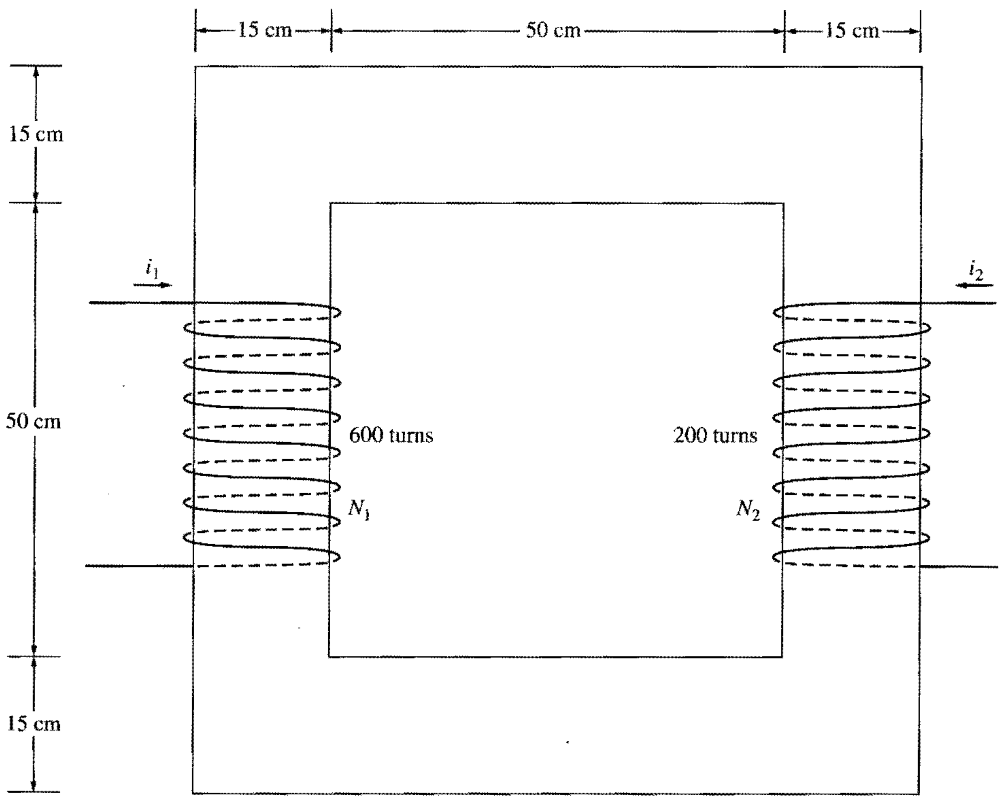
1–7 A two-legged core is shown in Figure P1–4. The winding on the left leg of the core (N_1) has 600 turns, and the winding on the right (N_2) has 200 turns. The coils are wound in the directions shown in the figure. If the dimensions are as shown, then what flux would be produced by currents $i_1 = 0.5$ A and $i_2 = 1.00$ A? Assume $\mu_r = 1000$ and constant.

Figure P1–4 | The core of Problems 1–7 and 1–12.



Find core cross-sectional area: $A = 15\text{ cm}\,(15\text{ cm}) = 225\text{ cm}^2 = 0.0225\text{ m}^2$ and mean path lengths: $\ell_L = \ell_R = \ell_T = \ell_B = \ell = 15/2 + 50 + 15/2 = 65\text{ cm} = 0.65\text{ m}$.

Calculate reluctances, using (1-32) $\mathcal{R} = \dfrac{\ell}{\mu A}$, as:

$$\mathcal{R}_L = \mathcal{R}_T = \mathcal{R}_R = \mathcal{R}_B = \frac{\ell}{\mu A} = \frac{0.65}{1000(4\pi \bullet 10^{-7})0.0225}$$

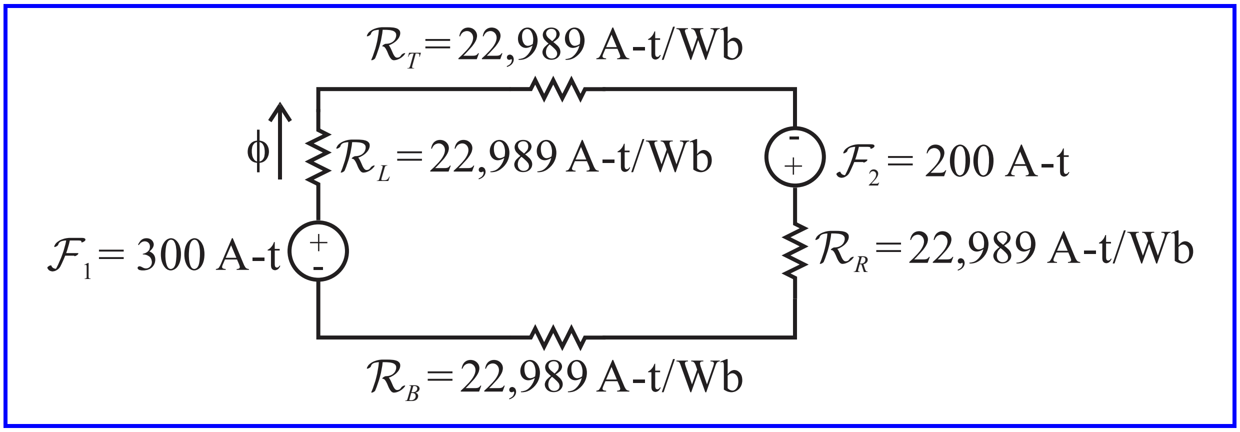
$\Rightarrow$ $\underline{\mathcal{R}_L = \mathcal{R}_T = \mathcal{R}_R = \mathcal{R}_B = 22{,}989.05\text{ A-t/Wb}}$,

Calculate coil mmfs, using (1-27) $\mathcal{F} = Ni$, as:

$\mathcal{F}_1 = 600(0.5)$ $\Rightarrow$ $\underline{\boldsymbol{\mathcal{F}_1 = 300\text{ A-t}}}$ and $\mathcal{F}_2 = 200(1)$ $\Rightarrow$ $\underline{\boldsymbol{\mathcal{F}_2 = 200\text{ A-t}}}$.

Use RHR with currents, to find the polarity of each coil mmf.

Magnetic circuit



Use (1-33) to calculate the series equivalent reluctance 'seen' by the coils as

$\mathcal{R} = \mathcal{R}_L + \mathcal{R}_T + \mathcal{R}_R + \mathcal{R}_B = 4\ (22{,}989.05)$ $\Rightarrow$ $\underline{\mathcal{R} = 91{,}956.2 \text{ A-t/Wb}}$.

The total mmf on the core is $\mathcal{F} = \mathcal{F}_1 + \mathcal{F}_2 = 300 + 200$ $\Rightarrow$ $\underline{\mathcal{F} = 500 \text{ A-t}}$.

Per (1-28), $\mathcal{F} = \phi\,\mathcal{R}$ $\Rightarrow$ $\phi = 500 / 91{,}956.2$ $\Rightarrow$ $\underline{\boldsymbol{\phi = 5.437 \text{ mWb}}}$.