EEE 3352

Electromechanics & Electrical Machines

Lecture 3: Examples

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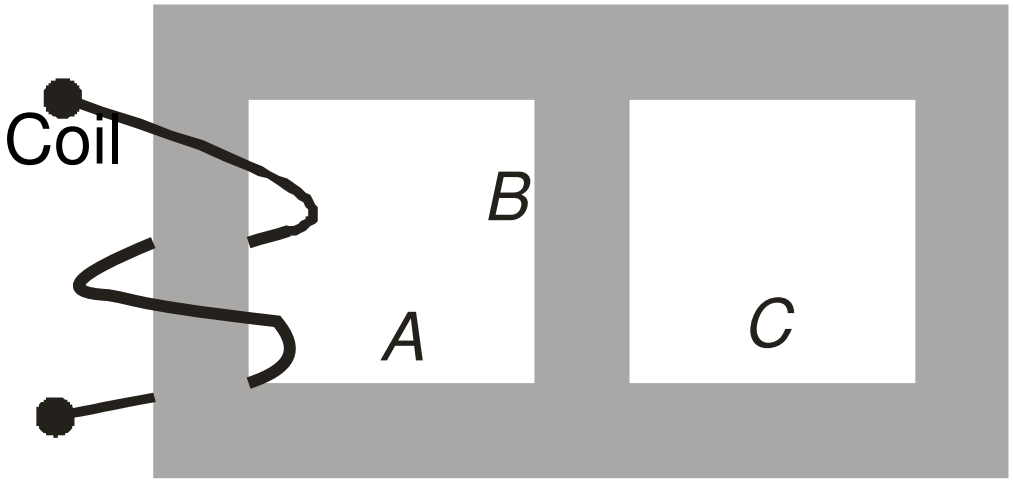
Example 3.1

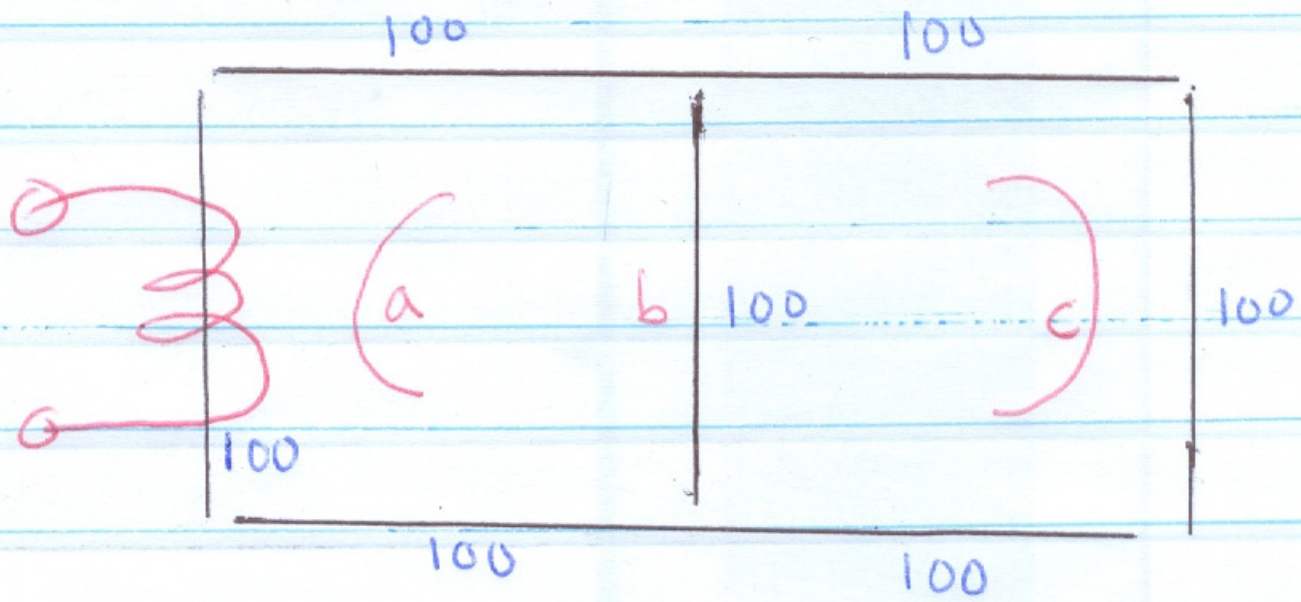
The magnetic circuit shown in the figure has a cross-sectional area everywhere of 100 mm^2, and permeability of 10^{-3} H/m.

- If the coil has 100 turns and carries a steady current of 10 A, calculate the magnetic flux in the various portions *A*, *B* and *C*.

Assume that the effective length of each side of the squares is 100 mm, and neglect complications at the corners.

- What is the self-inductance of the coil?





$\mu = 10^{-3}$ H/m

$l_b = 100$ mm

$A = 100\ mm^2$

$$S_a = S_c = 3S_b$$

$$S_b = \text{“}\frac{l}{\mu A}\text{”} = \frac{100 \times 10^{-3}}{10^{-3} \times 100 \times 10^{-6}} = 10^6 \text{ At/Wb}$$

$I = 10\,A$; $N = 100$; $F = NI = 1000\,At$

$$\phi_{tot} = \frac{F}{S_a + S_b // S_c} = \frac{1000}{\left(3 + \frac{1 \times 3}{4}\right) \times 10^6} = 2.67 \times 10^{-4}\ Wb$$

$$\phi_a = 2.67 \times 10^{-4}\ Wb$$

$$\phi_b = 2.67 \times 10^{-4} \times \frac{S_c}{S_b + S_c} = 2.67 \times 10^{-4} \times \left(\frac{3}{1+3}\right) = 2 \times 10^{-4}\ \text{Wb}$$

$$\phi_c = \phi_a - \phi_c = 0.67 \times 10^{-4}\ \text{Wb}$$

$$L = \frac{N^2}{S_{tot}} = \frac{100^2}{S_a + S_b \,//\, S_c} = \frac{100^2}{3.75 \times 10^6} = 2.67 \times 10^{-3}\ H$$