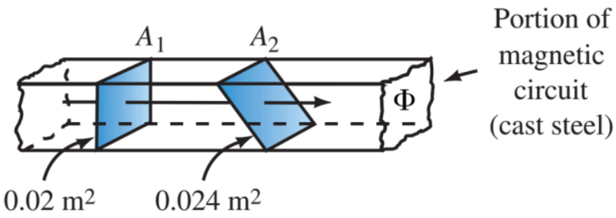
Sheet (8)

Q1:- Answer the following questions

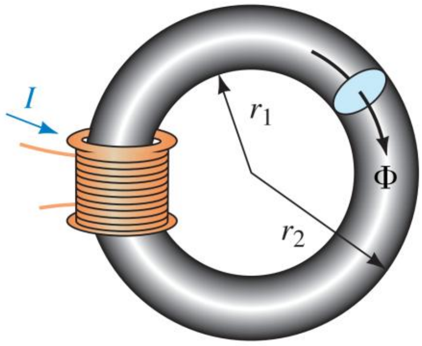
1. Refer to the following figure:

   a. Which area, A_1 or A_2, do you use to calculate flux density? [*Solution:* A_1]

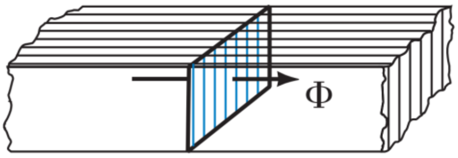
   b. If Φ = 28 mWb, what is flux density in teslas? [*Solution:* 1.4T]



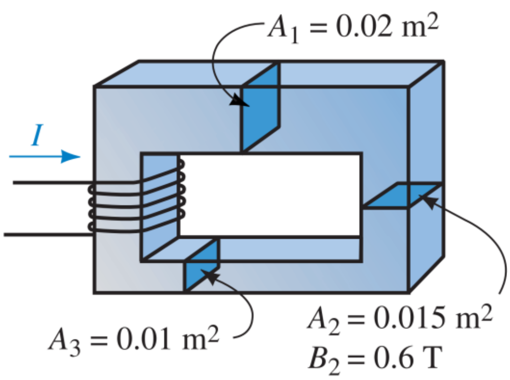
2. The toroid of the following figure has a circular cross section and Φ = 628 mWb. If r_1 = 8 cm and r_2 = 12 cm, what is the flux density in teslas? [*Solution:* 0.5T]



3. If the section of core in the following figure is 0.025 m by 0.04 m, has a stacking factor of 0.85, and B = 1.45 T, what is Φ in webers? [*Solution:* 1.23 x 10^{-3} Wb]

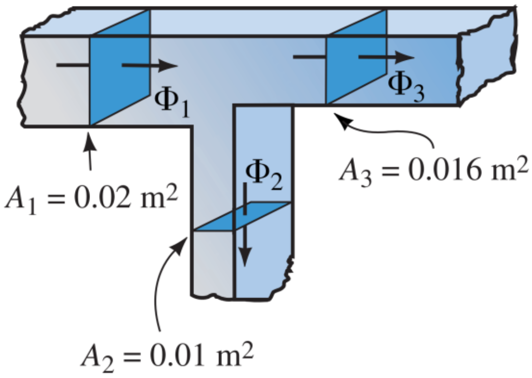


4. For the iron core of the following figure, flux density B_2 = 0.6 T. Compute B_1 and B_3. [*Solution:* 0.45T and 0.9T]

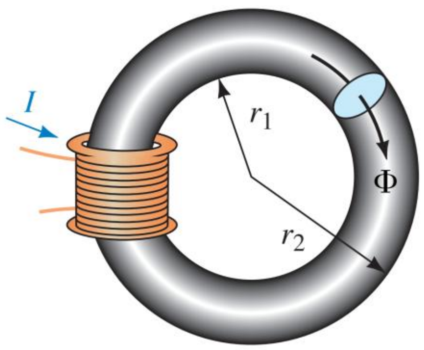


5. For the section of iron core of the following figure, if $B_1 = 0.8$ T and $B_2 = 0.6$ T, what is B_3? [*Solution:* 0.625T]

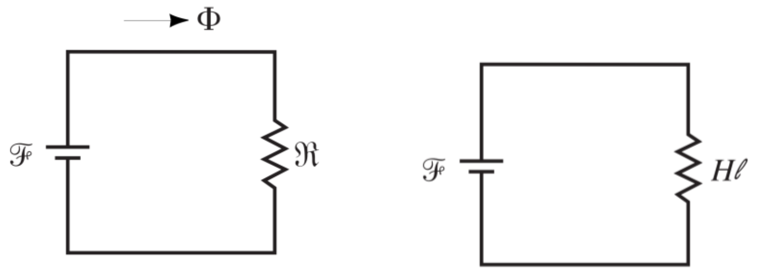
6. For the section of iron core of the following figure, if $\Phi_1 = 12$ mWb and $\Phi_3 = 2$ mWb, what is B_2?



7. Consider the following figure. If $I = 10$ A, $N = 40$ turns, $r_1 = 5$ cm, and $r_2 = 7$ cm, what is H in ampere-turns per meter?



8. The following figure shows the two electric circuit equivalents for magnetic circuits. Show that μ in $R = \ell/\mu A$ is the same as m in $B = \mu H$.



(a) $\Re = \frac{\ell}{\mu A}$ (b) $B = \mu H$

9. Let H_1 and ℓ_1 be the magnetizing force and path length respectively, where flux Φ_1 exists in the following figure and similarly for Φ_2 and Φ_3. Write Ampere's law around each of the windows.

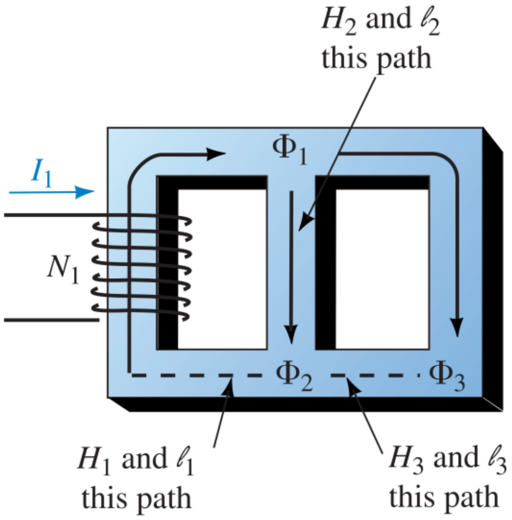
Solution:

Ampere's Law

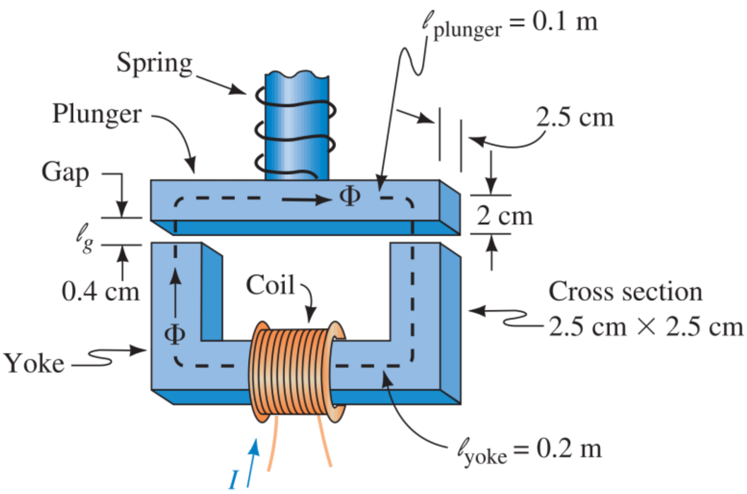
$$\sum NI = \sum H\ell$$

(Loop-1) $N_1I_1 = H_1 \ell_1 + H_2 \ell_2$

(Loop-2) $0 = H_2 \ell_2 - H_3 \ell_3$



10. The following figure shows a portion of a solenoid. Flux Φ = 4 x10^{-4} Wb when I = 2.5 amps. Find the number of turns on the coil. (The plunger and yoke made from cast steel)



Solution:

Yoke

A_{yoke} = 2.5 cm x 2.5 cm = 6.25 cm2 = 6.25 x 10^{-4} m2

$B_{yoke} = \Phi / A_{yoke} = (4 \times 10^{-4}) / (6.25 \times 10^{-4}) = 0.64$ T

H_{yoke} = 410 At/m (from B-H curves)

Plunger

$A_{plunger}$ = 2 cm x 2.5 cm = 5 cm2 = 5 x 10^{-4} m2

$B_{plunger} = \Phi / A_{yoke} = (4 \times 10^{-4}) / (5 \times 10^{-4}) = 0.8$ T

$H_{plunger}$ = 500 At/m (from B-H curves)

Air Gap

$B_g = B_{yoke} = \Phi / A_{yoke} = 0.64$ T

$H_g = B_{yoke} / (4\pi \times 10^{-7}) = 5.09 \times 10^5$ At/m

Ampere's Law

$NI = H_{yoke}\ell_{yoke} + H_{plunger}\ell_{plunger} + 2H_g\ell_g = 82 + 50 + 2(2036) = 4204$ At

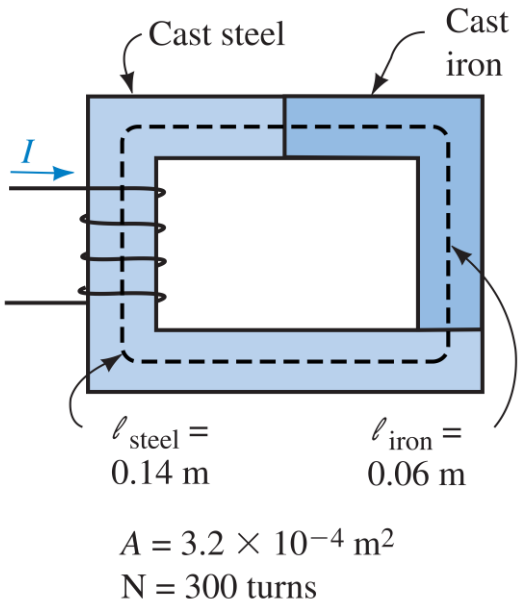
N = 4204/2.5 = 1682 turns

11. Find the current I in the following figure if Φ = 0.16 mWb. [*Solution: I=0.47A*]

12. Let everything be the same as in previous problem except that the cast steel portion is replaced with laminated sheet steel with a stacking factor of 0.85.

13. A gap of 0.5 mm is cut in the cast steel portion of the core in problem 11. Find the current for Φ = 0.128 mWb. Neglect fringing. [*Solution: I=0.88A*]

14. Two gaps, each 1 mm, are cut in the circuit of problem 11, one in the cast steel portion and the other in the cast iron portion. Determine current for Φ = 0.128 mWb. Neglect fringing



15. For the following figure, if Φ_g = 80 mWb, find I.

16. If the circuit of problem 14 has no gap and Φ_3 = 0.2 mWb, find I. [*Solution: I=3.7A*]