TUTORIAL- 2

PROBLEM 1.5

1-5. A ferromagnetic core is shown in Figure P1–2. The depth of the core is 5 cm. The other dimensions of the core are as shown in the figure. Find the value of the current that will produce a flux of 0.005 Wb. With this current, what is the flux density at the top of the core? What is the flux density at the right side of the core? Assume that the relative permeability of the core is 1000.

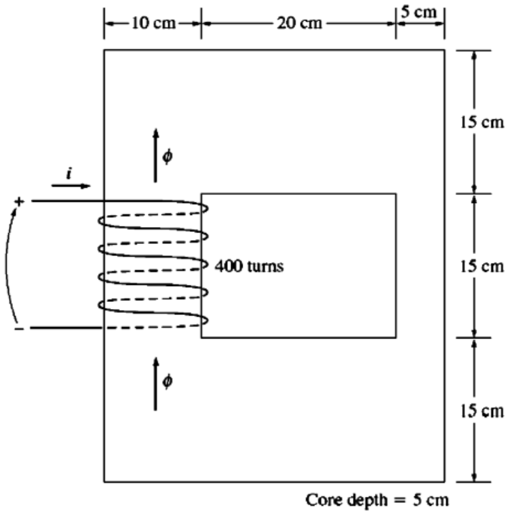

FIGURE P1–2
The core of Problems 1–5 and 1–16.

PROBLEM 1.6

1-6. A ferromagnetic core with a relative permeability of 1500 is shown in Figure P1–3. The dimensions are as shown in the diagram, and the depth of the core is 7 cm. The air gaps on the left and right sides of the core are 0.070 and 0.050 cm, respectively. Because of fringing effects, the effective area of the air gaps is 5 percent larger than their physical size. If there are 400 turns in the coil wrapped around the center leg of the core and if the current in the coil is 1.0 A, what is the flux in each of the left, center, and right legs of the core? What is the flux density in each air gap?

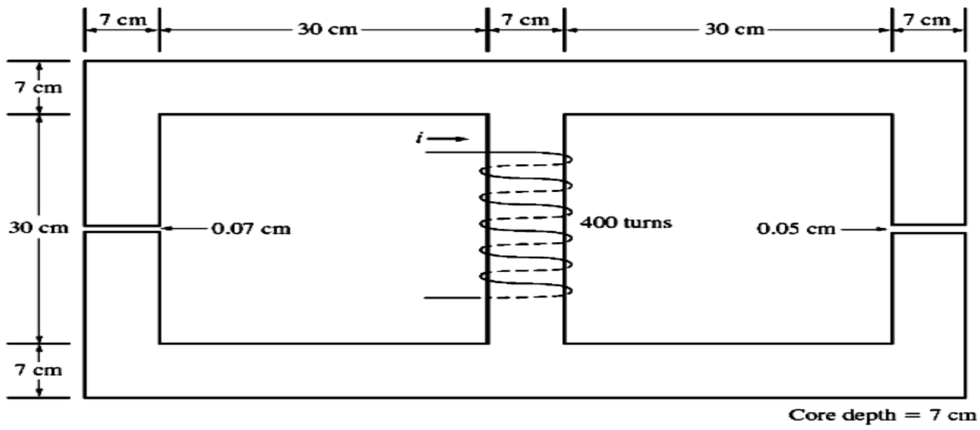

FIGURE P1–3
The core of Problem 1–6.

PROBLEM 1.7

1–7. A two-legged core is shown in Figure P1–4. The winding on the left leg of the core (N_1) has 400 turns, and the winding on the right (N_2) has 300 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 $i_2 = 0.75$ A? Assume $\mu_r = 1000$ and constant.

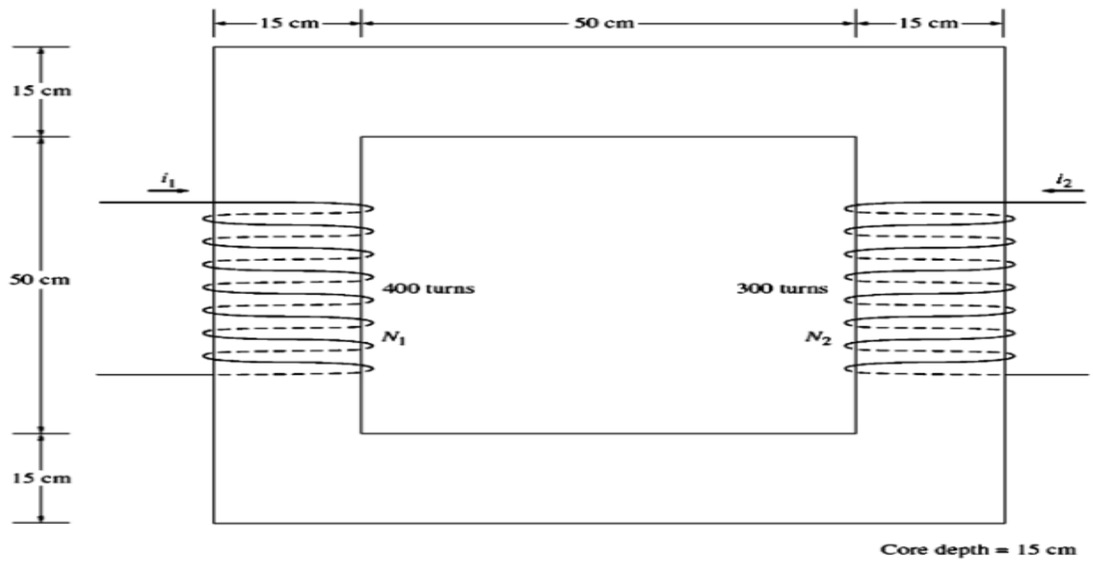

FIGURE P1–4
The core of Problems 1–7 and 1–12.

PROBLEM 1.8

1–8. A core with three legs is shown in Figure P1–5. Its depth is 5 cm, and there are 200 turns on the leftmost leg. The relative permeability of the core can be assumed to be 1500 and constant. What flux exists in each of the three legs of the core? What is the flux density in each of the legs? Assume a 4 percent increase in the effective area of the air gap due to fringing effects.

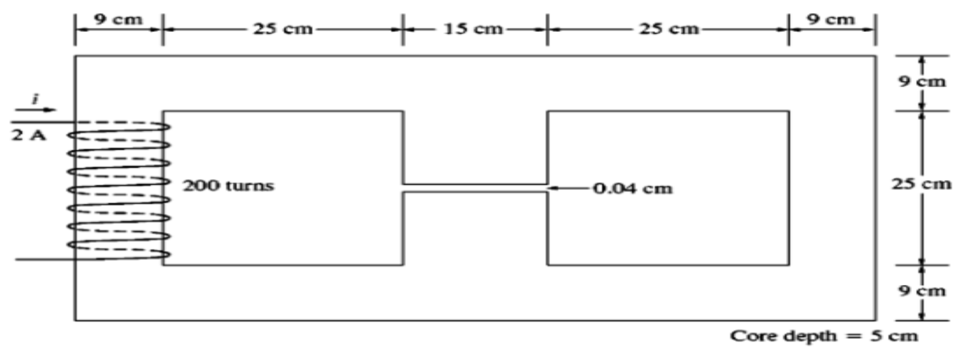

FIGURE P1–5
The core of Problem 1–8.

PROBLEM 1.9

1–9. The wire shown in Figure P1–6 is carrying 5.0 A in the presence of a magnetic field. Calculate the magnitude and direction of the force induced on the wire.

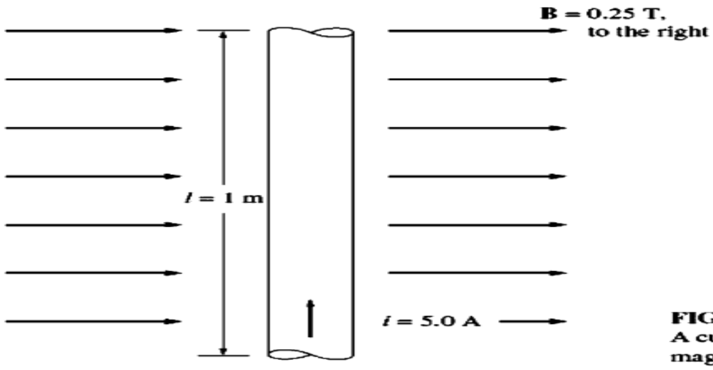

FIGURE P1–6
A current-carrying wire in a magnetic field (Problem 1–9).

PROBLEM 1.10

1–10. The wire shown in Figure P1–7 is moving in the presence of a magnetic field. With the information given in the figure, determine the magnitude and direction of the induced voltage in the wire.

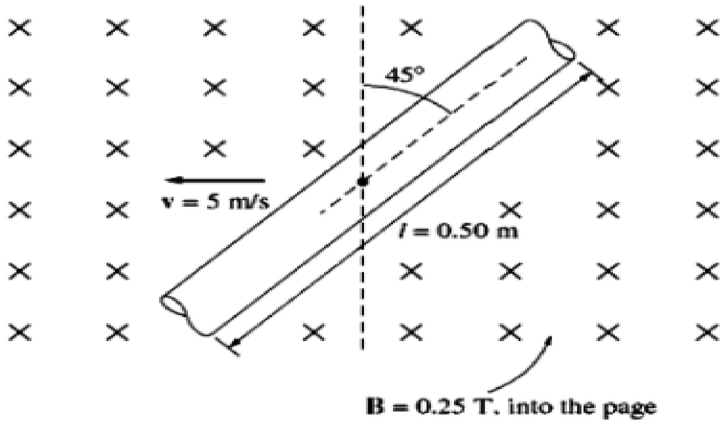

FIGURE P1–7
A wire moving in a magnetic field (Problem 1–10).

PROBLEM 1.11

I- **II. Repeat Problem 1. 10 for the wire in Figure PI-8.**

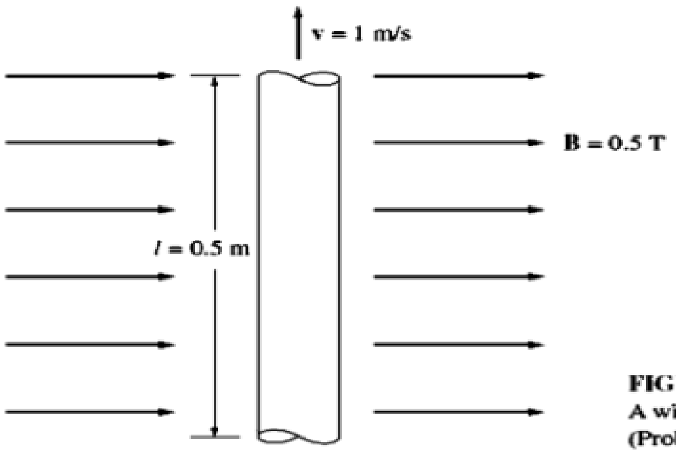

FIGURE P1–8
A wire moving in a magnetic field (Problem 1–11).

PROBLEM 1.12

1–12. The core shown in Figure P1–4 is made of a steel whose magnetization curve is shown in Figure P1–9. Repeat Problem 1–7, but this time do *not* assume a constant value of μ_r. How much flux is produced in the core by the currents specified? What is the relative permeability of this core under these conditions? Was the assumption

in Problem 1–7 that the relative permeability was equal to 1000 a good assumption for these conditions? Is it a good assumption in general?

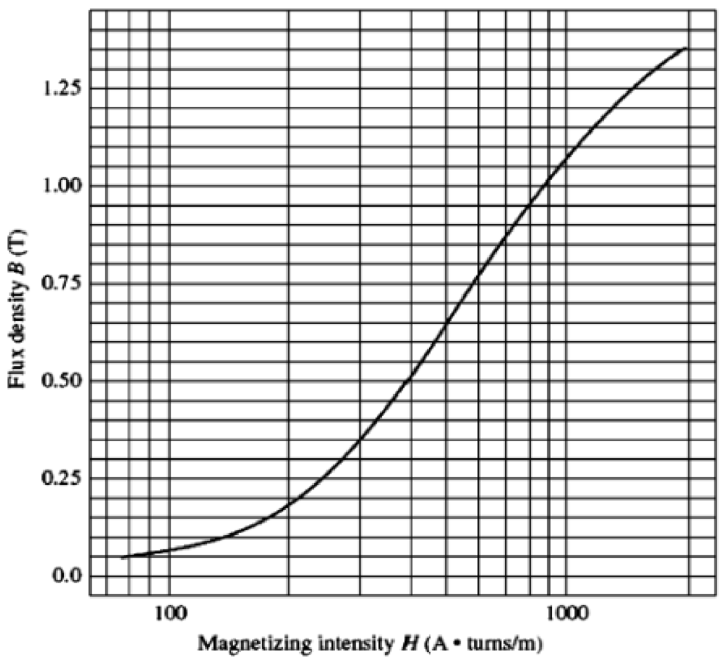

FIGURE P1–9
The magnetization curve for the core material of Problems 1–12 and 1–14.

PROBLEM 1.13

1–13. A core with three legs is shown in Figure P1–10. Its depth is 8 cm, and there are 400 turns on the center leg. The remaining dimensions are shown in the figure. The core is composed of a steel having the magnetization curve shown in Figure 1–10c. Answer the following questions about this core:

(a) What current is required to produce a flux density of 0.5 T in the central leg of the core?

(b) What current is required to produce a flux density of 1.0 T in the central leg of the core? Is it twice the current in part *(a)*?

(c) What are the reluctances of the central and right legs of the core under the conditions in part *(a)*?

(d) What are the reluctances of the central and right legs of the core under the conditions in part *(b)*?

(e) What conclusion can you make about reluctances in real magnetic cores?

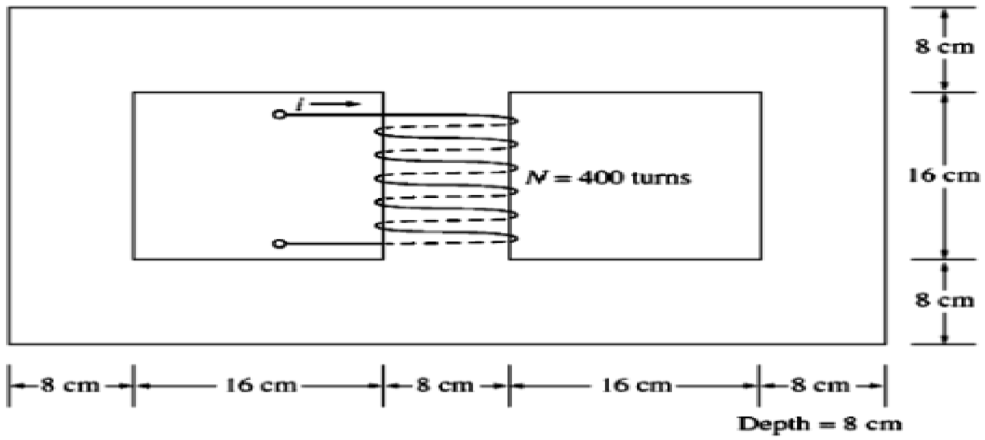

FIGURE P1–10
The core of Problem 1–13.

PROBLEM 1.14

1–14. A two-legged magnetic core with an air gap is shown in Figure P1–11. The depth of the core is 5 cm, the length of the air gap in the core is 0.06 cm, and the number of turns on the coil is 1000. The magnetization curve of the core material is shown in

Figure P1–9. Assume a 5 percent increase in effective air-gap area to account for fringing. How much current is required to produce an air-gap flux density of 0.5 T? What are the flux densities of the four sides of the core at that current? What is the total flux present in the air gap?

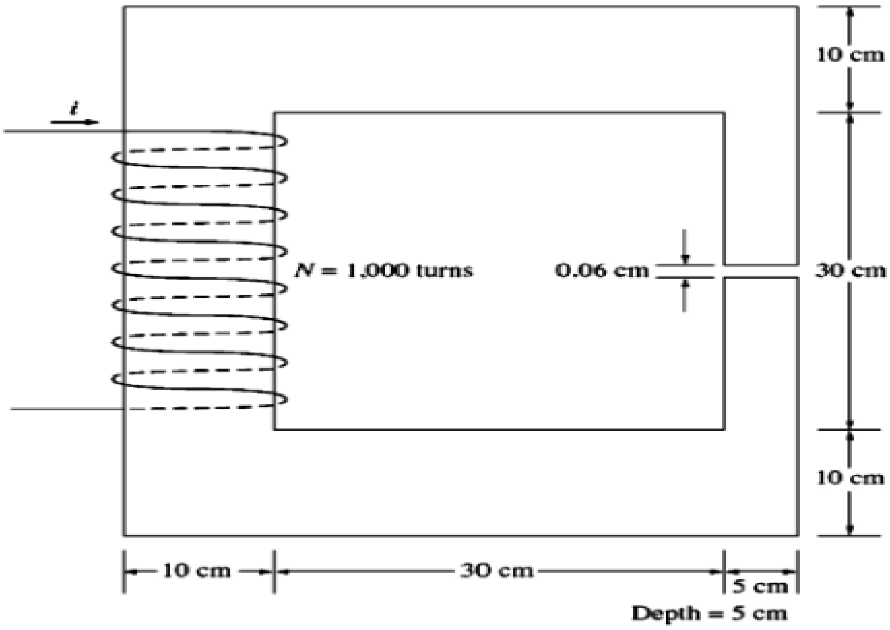

FIGURE P1–11
The core of Problem 1–14.

PROBLEM 1.15

1–15. A transformer core with an effective mean path length of 10 in has a 300-turn coil wrapped around one leg. Its cross-sectional area is 0.25 in^2, and its magnetization curve is shown in Figure 1–10c. If current of 0.25 A is flowing in the coil, what is the total flux in the core? What is the flux density?