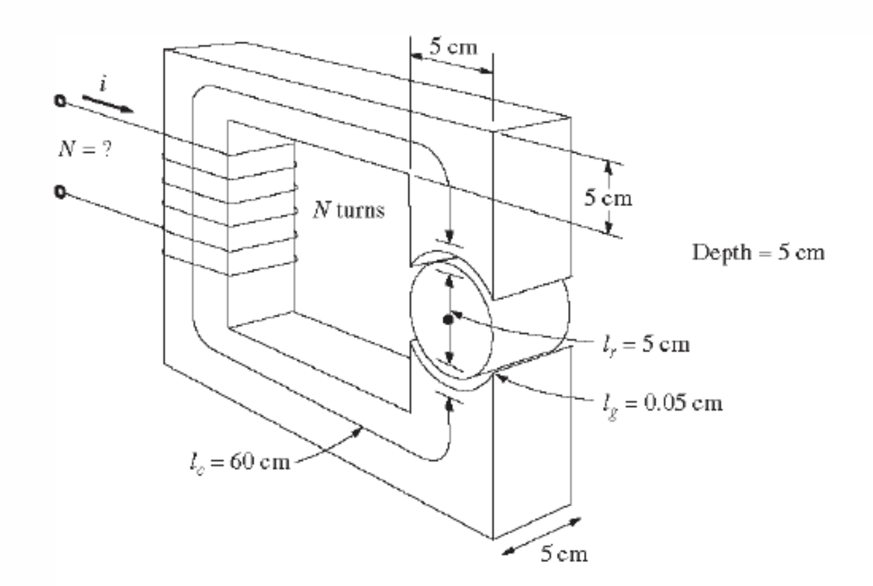
(1) Figure P1-1 shows the core of a simple dc motor. The magnetization curve for the metal in this core is given by Figure P1-2. Assume that the cross-sectional area of each air gap is 18 cm^2 and that the width of each air gap is 0.05 cm. The effective diameter of the rotor core is 5 cm.

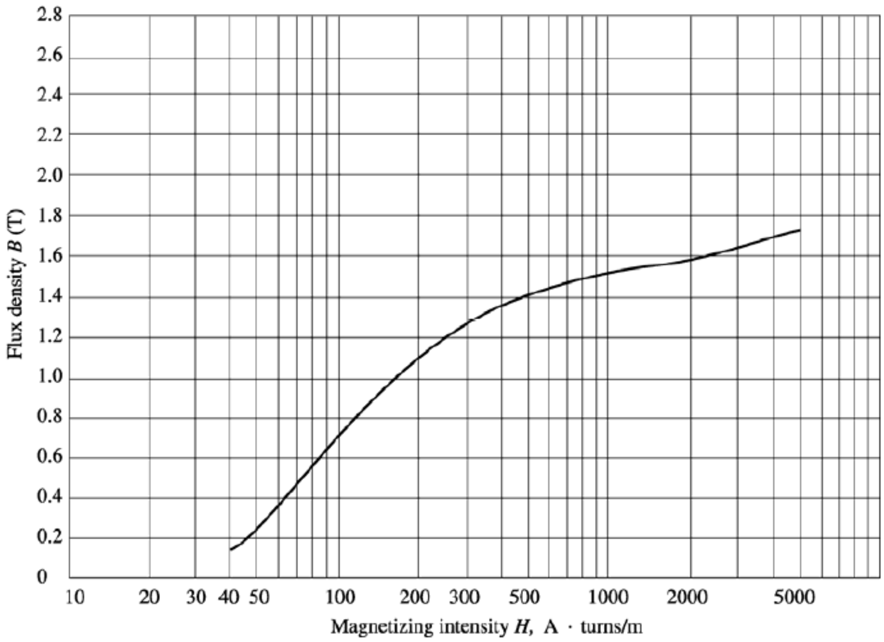
(a) We wish to build a machine with as great a flux density as possible while avoiding excessive saturation in the core. What would be a reasonable maximum flux density for this core?

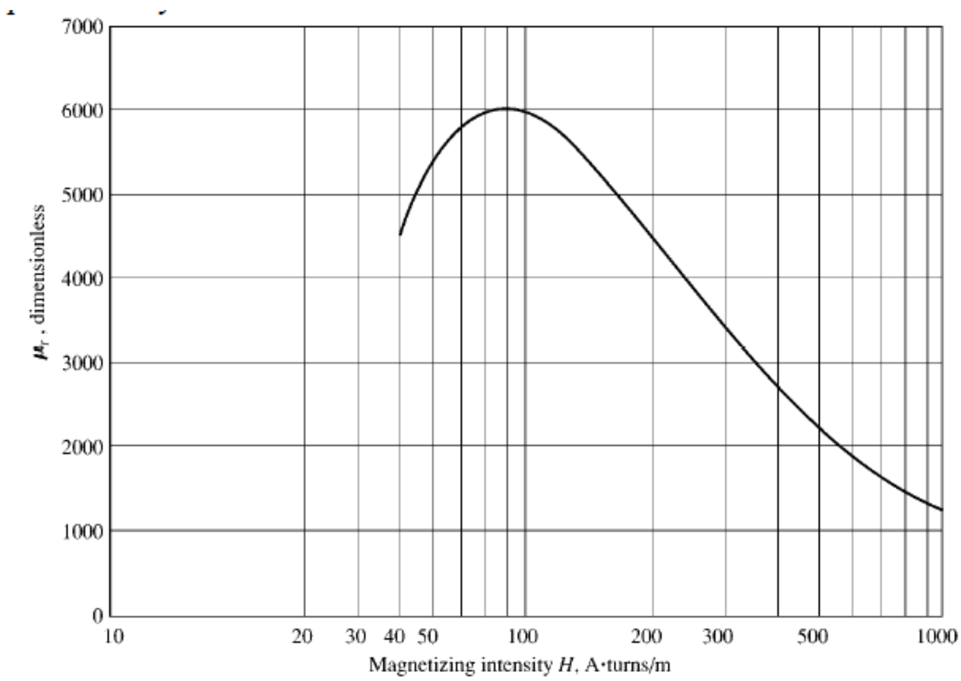
(b) What would be the total flux in the core at the flux density of part *(a)*?

(c) The maximum possible field current for this machine is 1 A. Select a reasonable number of turns of wire to provide the desired flux density while not exceeding the maximum available current.



P1-1



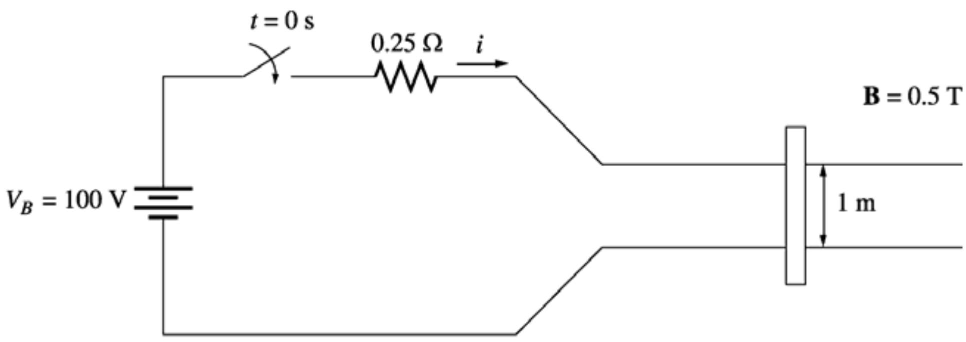


P1-2

（2）A linear machine has a magnetic flux density of 0.5 T directed into the page, a resistance of 0.25 , a bar length l = 1.0 m, and a battery voltage of 100 V.

(a) What is the initial force on the bar at starting? What is the initial current flow?

(b) What is the no-load steady-state speed of the bar?



Homework 2

(1) (a) Avoiding excessive saturation, take $B = 1.5T \longrightarrow H \longrightarrow 1000$ A·t/m

(b) $\phi = B \cdot A$

$= 1.5 \cdot 0.05 \times 0.05$

$= 3.75 \times 10^{-3}$ (Wb)

(c) $\phi_c = \phi_g$

$B_c A_c = B_g A_g$

$1.5 \times 0.05 \times 0.05 = B_g \quad 18 \times 10^{-4}$

$B_g = 2.083$ (T)

$\Rightarrow$

$H_g = \frac{B_g}{\mu_0}$

$H_g = \frac{2.083}{4\pi \times 10^{-7}}$

$H_g = 1657598$ (At/m)

$l_c = 0.6m$, $l_g = 0.0005m$, $l_r = 0.05m$

$\mathcal{F} = H_c l_c + 2 H_g l_g + H_r l_r$

$= 1000 \times 0.6 + 2 \times 1657598 \times 0.05 \times 10^{-2} + 1000 \times 0.05$

$= 2307.598$ (A·t)

$\mathcal{F} = Ni$

$N = \frac{2307.598}{1}$

$N = 2307.598$ (t)

$N \approx 2307$ (t)

(2) (a) $i = \frac{V_B - e_{ind}}{R}$

$= \frac{100 - 0}{0.25}$

$= 400$(A)

$F = Bil$

$= 0.5 \times 400 \times 1$

$= 200$ (N)

(b) $e = B l v_{ss} = V_B$

$v_{ss} = \frac{V_B}{Bl}$

$v_{ss} = \frac{100}{0.5 \times 1}$

$v_{ss} = 200$(m/s)