Princeton University

Ph304 Problem Set 6
Electrodynamics

(Due in class, Wed. Mar. 26, 2003)

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Problem session: Sunday, Mar. 23, 7 pm, Jadwin 303 (no session on Mar. 16)

Text: *Introduction to Electrodynamics, 3rd ed.*
by D.J. Griffiths (Prentice Hall, ISBN 0-13-805326-X, now in 6th printing)
Errata at http://academic.reed.edu/physics/faculty/griffiths.html

Reading: Griffiths chap 6.

1. Griffiths' prob. 5.57.

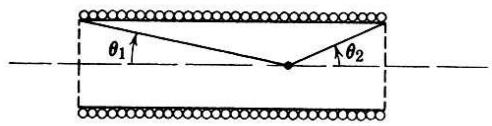
2. Griffiths' prob. 5.58.

3. Griffiths' prob. 5.59.

4. Griffiths' probs. 6.9 and 6.14. As a possible aid to making careful sketches, deduce that the magnetic field **B** on the axis of the cylindrical magnet is given by

$$B = \mu_0 M \frac{\cos\theta_1 + \cos\theta_2}{2},$$

where the angles are as shown below:



This famous result holds for points outside the magnet as well as for points inside, and is also applicable to solenoid magnets with n turns per unit length each carrying current I on substitution of nI for M.

In the present problem, evaulate **B** and **H** at the geometric center of the magnet, and just inside and outside of the magnet at the center of its endplanes.

5. Griffiths' prob. 6.13. You may consider the "needle" of 6.13b and the disk of 6.13c to be right circular cylinders of length L and radius a. While the main message of 6.13b and c is obtained by neglecting small terms, use the result quoted in prob. 4 above to give **B** and **H** at the centers of the cavities accurate to first order in the small quantities a/L or L/a.

6. Griffiths' prob. 6.15.