Princeton University

Ph304 Problem Set 2
Electrodynamics

(Due 5 pm, Tuesday Feb. 18, 2003 in Sullivan's mailbox, Jadwin atrium)

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Problem sessions: Sundays, 7 pm, Jadwin 303

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 secs. 2.4-2.5, 3.1-3.2.

1. Griffiths' prob. 2.34.

2. Griffiths' prob. 2.38. Hint: integrate the "pressure" (2.51) over the surface of one hemisphere. Then, also integrate the "pressure" (2.52) over the equatorial plane (outside the sphere), which should yield the same result.

   The message is that there exists a "tension" along field lines and a "pressure" transverse to field lines both of whose magnitudes are given by eq. (2.52). [Recall Figs. 2.13 and 2.14.] This is the origin of the colloquial expression "high tension" used to describe situations of large electric fields.

   Since the sign of the effect is opposite for different directions, the effect is not that of a scalar pressure, but rather a tensor – the Maxwell stress tensor – that will be encountered again in sec. 8.2.2.

3. Griffiths' prob. 2.39. An engineering question is: what is the effect on the capacitance if the axis of the inner cylinder is offset from the axis of the outer cylinder by a small distance $\delta \ll a$? You need not answer this for credit, but note that problem 2.47 provides a glimpse of a path to a solution. Details are presented in, for example, http://kirkmcd.princeton.edu/examples/coax.pdf

4. a) Griffiths' prob. 3.1. b) Griffiths' prob. 3.2. For the example of the cube of charges, show explicitly that the tangential component of the electric field is positive along a ray of your choice that emanates from the center of the cube.

5. a) Griffiths' prob. 3.8. b) Griffiths' prob. 3.46. Note that the image charges form a dipole, the potential of which can be written as in Griffiths' eq. (3.99).

6. Griffiths' prob. 3.41. In part a), Recall Griffiths' eq. (2.5) when considering the field due to a uniform sphere of charge.