Honors Calculus 252-2
Winter 2002
Hermann Riecke

Problem Set 5

to be handed in Friday February 15, 2002, in class

1. The electric field due to a point charge, q, at the origin is

$$\mathbf{E} = q\frac{\hat{R}}{R^2} \qquad R = \sqrt{x^2+y^2+z^2} \qquad \hat{R} = \frac{(x,y,z)}{R}.$$

   (a) Compute the flux of the electric field,

$$\int\int_S \mathbf{E}\cdot\mathbf{n}\, dS \ ,$$

   for a sphere of radius A centered at the origin.

   (b) Compute the flux of the electric field for a cylinder of radius a and height $2b$ centered at the origin.

   (c) Gauss' Law states the flux of an electric field through a closed surface is proportional to the charge inside the surface. Comment on how this relates to the results in (a) and (b).

2. 8.3.1iv,

3. 8.3.2

4. 8.3.8 Note: the force exerted by charge q_1 on charge q_2 at locations $\mathbf{r}_1$ and $_2$, respectively, is given by

$$\mathbf{F} = \frac{q_1 q_2}{4\pi\epsilon_0}\frac{\mathbf{R}}{|\mathbf{R}|^3} \qquad \text{where} \qquad \mathbf{R} = \mathbf{r}_2 - \mathbf{r}_1, \tag{1}$$

   ϵ_0 is the dielectric constant of vacuum.

5. 8.3.11

6. 8.4.1

7. 8.4.5, 8.4.14 **Note:** do **not** evaluate these expressions componentwise.

8. 8.4.11