PHYS 1211 *University Physics I* — Problem Set 3

Winter Quarter, 2007 — Due: Monday, Jan. 22, 2007

Instructor

Barry L. Zink
Assistant Professor
Office: Physics 404
(303) 871-3025
barry.zink@du.edu
http://portfolio.du.edu/bzink2

Office Hours:
M&F 11am-12pm
Th 2-4pm
(or by appointment)

Halliday, Resnick, and Walker (HRW)

Read Chapter 3.

Complete the following problems from HRW Chapter 3: 1, 2, 6, 10, 12, 33, 41, 45 (each is worth 10 points)

And All That...

My favorite method of computing the vector product is the determinant method discussed in HRW Appendix E. Here we write that:

$$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix},$$

where for example $\vec{a} = a_x\hat{i} + a_x\hat{j} + a_x\hat{k}$. Answer the following (20 points total):

1. Show that evaluating this determinant gives an expression equivalent to Eq. 3-30 of HRW.

Now we consider a special vector called "del," written $\vec{\nabla}$. This vector will seem like a strange beast, because instead of numbers (such as those represented by a_x, and b_x and so on) this vector has *derivatives*:

$$\vec{\nabla} = \frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k}.$$

Here the use of ∂ instead of a regular d means that the derivative is taken *only* with respect to the indicated variable, for example:

$$\frac{\partial}{\partial x}xy^2 = y^2, \qquad \frac{\partial}{\partial y}xy^2 = 2xy, \qquad \frac{\partial}{\partial z}xy^2 = 0.$$

2. Write the vector product $\vec{\nabla} \times \vec{E}$ as a determinant.
3. If $\vec{E} = x\hat{i} + y\hat{j} + z\hat{k}$, what is $\vec{\nabla} \times \vec{E}$?
4. For the same $\vec{E}$, what is $\vec{\nabla} \cdot \vec{E}$?