Physics 3201
Problem Set 2

Due: Thursday, September 12. Solutions will be posted on September 13

Notes: We will continue to skip back and forth between chapters 1 and 2 of Griffiths. This problem set covers Sections 1.3, 1.4 (pp. 38-41), and the start of Section 2.2. Next we will discuss the remainder of Section 2.2, followed by 2.3 and 2.4.

1. (Based on Griffiths, problem 1.31). Calculate the volume integral of the function $F = z$ over a tetrahedron with corners at (0,0,0), (2,0,0), (0,2,0), and (0,0,2). The actual integrations are pretty easy, but if you're not use to this sort of thing it can be hard to set up the limits of integration properly. You will probably want to do the z-integration last (on the left) to make the expressions simpler. To help get things started, note that on the sloping surface of the tetrahedron, $x + y + z = 2$.

2. Find the divergence and the curl of the vector field $\mathbf{v} = y^2\hat{\mathbf{x}} + 2xy\,\hat{\mathbf{y}} + 6\hat{\mathbf{z}}$. Verify by explicit integration that $\oint \mathbf{v}\bullet\mathbf{dl} = 0$ for a path forming a unit circle in the xy plane, centered at z=0. It should suffice to evaluate the integral for a semicircle. (*Hint*: What is the relation between x and y that defines a unit circle? Use it to find the relation between dx and dy in the path element **dl**.)

3. Griffiths, problem 1.33 (problem 1.32 in 3rd Edition).

4. Griffiths, problem 1.34 (problem 1.33 in 3rd Edition).

5. Griffiths problem 1.37 (easy) (problem 1.36 in 3rd Edition).

6. Griffiths, problem 2.10. *Hint:* if the point were completely surrounded by eight cubes like the one shown, how could symmetry and Gauss' law be used?

Honors: If you are taking the course for honors credit, please add Griffiths 1.61, parts (a) and (c) (worked separately, for discussion during the next meeting of the honors students).