Physics 3201
Problem Set 1, Problem 1 corrected on 9/2/13

Due: Thursday, September 5. Solutions will be posted on September 6, so late problem sets will not be accepted except under unusual circumstances.

Notes: We will be skipping back and forth between chapters 1 and 2 of Griffiths. This problem set covers Sections 1.1, 1.2, and 2.1. We will then turn to Sections 1.3 and 1.4. If you would like a more extended discussion of vector operators and related topics, a useful elementary reference is H.M. Schey's book, *Div, Grad, Curl, and all That*.

1. If $\hat{\mathbf{n}}$ is a fixed unit vector (for example, along the *x*-direction), $\mathbf{r}$ is a position vector, and *a* is a scalar constant, describe each of the following surfaces:
   i. $|\mathbf{r}| = a$,
   ii. $\mathbf{r} \cdot \hat{\mathbf{n}} = a$,
   iii. $\mathbf{r} \cdot \hat{\mathbf{n}} = a|\mathbf{r}|$, with $|a| < 1$.

2. Find a vector perpendicular to both $4\hat{\mathbf{x}} + \hat{\mathbf{y}} + \hat{\mathbf{z}}$ and $\hat{\mathbf{x}} - 3\hat{\mathbf{y}} + \hat{\mathbf{z}}$. *Hint*: this is easily done by starting with a cross product (of what?). Verify your result using dot (scalar) products. Finally, normalize your result to form a unit vector pointing in the same direction.

3. Griffiths, problem 1.12.

4. Find the divergence of each of the following vector fields:
   i. $\mathbf{A} = 2y^2\hat{\mathbf{x}} + 2xy^2\,\hat{\mathbf{y}} - 4xz\,\hat{\mathbf{z}}$,
   ii. $\mathbf{A} = (2x + y^2)\hat{\mathbf{x}} + 2xy^2\,\hat{\mathbf{y}} - 2yz\,\hat{\mathbf{z}}$,
   iii. $\mathbf{A} = |\mathbf{r}|^n\,\mathbf{r}$, $n > 1$.

5. Griffiths, problem 2.2 (modified in 4th Edition).

6. Griffiths, problem 2.5. The idea is to find the field directly, without using the concept of an electric potential.

Honors: If you are taking the course for honors credit, please add 1.10 (worked separately, for discussion during a meeting of the honors students). Also, please meet with me briefly after class on September 3, so that we can arrange a weekly meeting time.