1. Prove that
$$\frac{\vec{r}-\vec{r}\,'}{|\vec{r}-\vec{r}\,'|^3} = -\vec{\nabla}\left(\frac{1}{|\vec{r}-\vec{r}\,'|}\right) \quad .$$
This is most easily done by writing $\vec{r} = \sum_i x_i \vec{e_i}$, $\vec{r}\,' = \sum_i x_i' \vec{e_i}$ (with $\vec{e_i} \cdot \vec{e_j} = \delta_{ij}$), and noting that in Cartesian coordinates $\vec{\nabla} = \sum_i \vec{e_i} \frac{\partial}{\partial x_i}$. We will need this identity when we introduce the electrostatic potential.

2. (a) Find the scale functions (h's) for the transformation from Cartesian (x, y, z) to (u, v, w) coordinates:
$$x = \frac{a \sinh(v)}{\cosh(v) - \cos(u)}$$
$$y = \frac{a \sin(u)}{\cosh(v) - \cos(u)}$$
$$z = w$$
(b) What is the divergence in these coordinates?

3. Griffiths 2.5

4. Griffiths 2.7 Do this problem using Coulomb's Law, not Gauss' Law (which would make it trivial). We'll do it using Gauss' Law later.