203a Homework 1, hints

1. Garg 4.3.

   Just work it out.

2. Garg 14.1.

   Just work it out.

3. Garg 16.2.

   $\vec{E} = -\hat{r}\phi'(r)$ and $\nabla \cdot \vec{E} = -r^{-2}\frac{d}{dr}(r^2\frac{d\phi}{dr}) = 4\pi\rho$; be careful about the delta function term, as we've discussed many times.

4. Garg 18.1.

   Just work it out.

5. Garg 21.1.

   Work out $U(\theta_1, \theta_2)$, where $\theta_1$ and $\theta_2$ are the angles of the dipoles relative to the external field. Show that $U_i \equiv \partial U/\partial\theta_i = 0$ at $\theta_i = 0$, but that $U_{ij} \equiv \partial^2 U/\partial\theta_i\partial\theta_j$ has positive eigenvalues only for $B > B_c$. The sign change in the eigenvalue is where one goes through zero, i.e. where the determinant of $U_{ij}$ vanishes. It is sufficient to Taylor expand $U(\theta_i)$ around $\theta_i = 0$ to quadratic order.

6. A "dyon"....

   Just work it out. You'll see that $\vec{r} \times \vec{F} \neq 0$, so $\vec{L}$ isn't constant, but $\vec{L} \cdot (\vec{r} \times \vec{F}) = 0$, so $|\vec{L}|$ is constant.