Problem set 4:

The following problems from Jackson:

Chapter 4: 1, 2
Chapter 5: 19, 22

Dipoles: Assume you have a dipole (electric or magnetic) at the coordinate $\vec{r}$. This can be thought of as due to a negative charge (electric or "magnetic") $-q$ at $\vec{r}$ and a positive charge q at $\vec{r}+\vec{d}$, where $\vec{d}$ is an infinitesimal vector (and we can define $\vec{p}=q\vec{d}$ as the dipole moment).

(a) Calculate the field around the dipole.

(b) Derive a formula for the *force* acting on this dipole in an external field.

(c) Imagine you now have two such moments, $\vec{p_1}$ and $\vec{p_2}$. Derive a general formula for the force between them.

(d) For a given small separation between the two dipoles, with say $\vec{p_2}$ pointing in an arbitrary direction, which orientation of $\vec{p_1}$ is more likely to result in binding between them: When $\vec{p_1}$ lies (i) parallel or (ii) perpendicular to the connecting line between them.