3 Electric Field Lines, Electric Dipoles, Electric Flux, Gauss' Law

3.1 Book Notes

- The direction of $\tilde{\mathbf{p}}$ is from the negative to the positive charge.

3.2 Lecture Notes

- The electric field always depends on qd.
  - dipole moment vector $\vec{p} = q\vec{d}$
  - Torque on the dipole is exactly the same as classical mechanics.
- Remember, zero potential energy does not mean minimum potential energy!
- The **electric flux** passing through a surface is the number of electric field lines that pass through it.
- For a closed surface, dA is normal to the surface and always points away from the inside.
- The electric field is a vector field, so a constant electric field is one that does not change with position or time.
- If a conductor is in electrostatic equilibrium, any excess charge must lie on its surface, so for the charge to be uniformly distributed throughout the volume, the object must be an insulator.

3.3 Recitation

- Electric field lines just give an easy way to imagine what the force would be.
- The distance $\vec{\mathbf{d}}$ points from the negative to the positive.
  - That where the dipole moment comes from.
- $U = -\vec{p}\vec{E}$
- $\phi_E = \oint \vec{E} \cdot d\vec{A}$
  - Area vector points outward.

$$\phi_E = \oint \vec{E} \cdot d\vec{A} \tag{1}$$

$$= \oint E \; da \cos\theta \qquad \text{Cross product expansions} \tag{2}$$

$$= E \oint dA \qquad \text{If E is constant, pull it out} \tag{3}$$

$$= E \times \text{Surface Area} \tag{4}$$

$$\tag{5}$$