Chapter Goals and Summaries

Chapter 23: Electric Fields

Point charges create electric fields that are according to Coulomb's law radial and inversely proportional to the square of the distance from the charge. Positive and negative charges create fields that are directed away and towards the charge respectively.
The fields created by charge distributions (line, surface or volume) must be found by adding up the vector fields created by each point charge in the distribution. Since the addition is over very small point charges the summation becomes an integral.
A point charge placed in an electric field (created by other charges) is easily found by multiplying the charge by the total vector electric field at the location of the point charge.
The motion of a point charge in a known electric field can be determined by first finding the electric force on the charge, then using Newton's II Law to find the acceleration.

After understanding these basic concepts you should be able to:

- ✓ find the total vector electric field at any location created by a collection of point charges.
- ✓ calculate the force on any point charge placed in a known electric field (created by other charges).
- ✓ determine the electric field of charge distributions (with emphasis on simple linear distributions).
- ✓ calculate the acceleration and the resulting motion of a charge in a known electric field.

Chapter 24: Gauss's Law

Gauss's law states that the surface integral of the electric field over any closed surface equals the net charge contained inside the surface divided by the constant "ε_0". This law can be used to find the electric field for certain types of charge distributions. The calculation of these fields using the methods of Chapter 23 would be much more difficult. However, find the field using Gauss's Law requires that we first must know the field direction from the basic symmetry of the charge distribution. This restriction occurs since we must know the angle between the field direction and the normal to the surface in order to calculate the surface integral in Gauss's Law. We need to choose the surface so that the field is parallel (or perpendicular in a few situations) to the normal to the surface. This requirement suggests that Gauss's Law can only be used to find the field for spherically and cylindrically symmetric charge distributions as well as large flat surface charge distributions.
Gauss's law method can also be used to solve certain types of problems involving static charges on spherical, cylindrical and flat conducting surfaces. The field inside a conductor under static conditions must be zero and any charges must be on the conductor surfaces.

After understanding these basic concepts you should be able to:

- ✓ calculate the field inside and outside spherical and cylindrical charge distributions.
- ✓ calculate the field of uniformly charged large, flat surfaces.
- ✓ determine the fields of charged spherical, cylindrical and flat conductors and find unknown charges for concentric spherical or cylindrical conductors.

Chapter 25: Electric Potential

Since the electric field (studied so far) is conservative we can define a difference in potential energy "ΔU" in exactly the same way we did in Mechanics. This potential difference is defined as the negative of the line integral of the electric force "q**E**" as a charge "q" is moved from an initial to a final location. It turns out that it is more convenient to use a quantity "ΔV" known as the difference in potential that is closely related to "ΔU". The value of "ΔV" is "ΔU" divided by the charge "q" and therefore "ΔV is defined as the negative of the line integral of the field "**E**" between the initial and final locations. *Note that this field is created by other charges, not by the charge that is being moved.*