#8 AP-C Electric Force and Electric Field

AP-C Objectives (from College Board Learning Objectives for AP Physics)

1. Charge and Coulomb's Law
   a. Describe the type of charge and the attraction and repulsion of charges
   b. Describe polarization and induced charges.
   c. Calculate the magnitude and direction of the force on a positive or negative charge due to other specified point charges.
   d. Analyze the motion of a particle of specified charge and mass under the influence of an electrostatic force.
   e. Describe the process of charging by induction.
   f. Explain why a neutral conductor is attracted to a charged object.

2. Electric Field due to Point Charges
   a. Define the electric field in terms of force on a test charge.
   b. Describe and calculate the electric field produced by one or more point charges.
   c. Calculate the magnitude and direction of the force on a positive or negative charge placed in a specified field.
   d. Interpret electric field diagrams.

3. Gauss's Law
   a. Understand the relationship between electric field and electric flux.
      i. Calculate the flux of an electric field through an arbitrary surface or of a uniform field over and perpendicular to a Gaussian surface.
      ii. Calculate the flux of the electric field through a rectangle when the field is perpendicular to the rectangle and a function of one coordinate only.
      iii. State and apply the relationship between flux and lines of force.
   b. Understand Gauss's Law
      i. State Gauss's Law in integral form and apply it qualitatively to relate flux and electric charge for a specified surface.
      ii. Apply Gauss's Law, along with symmetry arguments, to determine the electric field for a planar, spherical, or cylindrically symmetric charge distribution.
      iii. Apply Gauss's Law to determine the charge density or total charge on a surface in terms of the electric field near the surface.

4. Electric Fields due to Other Charge Distributions
   a. Calculate the electric field of a straight, uniformly charged wire; the axis of a thin ring of charge; and the center of a circular arc of charge.
   b. Identify situations in which the direction of the electric field produced by a charge distribution can be deduced from symmetry considerations.
   c. Describe the patterns and variation with distance of the electric field of oppositely charged parallel plates; a long uniformly charged wire; a thin cylindrical shell; and a thin spherical shell.
   d. Determine the fields of parallel charged planes, coaxial cylinders, and concentric spheres.