PHYSICS 117B EXAMINATION 2: A GUIDE FOR THE PERPLEXED

In general, you are responsible for understanding and applying the principles, concepts and definitions in the end-of-chapter summaries. Following is a list of specific things you should be prepared to do based on the skills developed in each chapter.

1. From Chapter 25, "Electric Charges and Forces." In this chapter, you were supposed to "develop a basic understanding of electric phenomena in terms of charges, forces and fields."

1.1. Use Coulomb's law to calculate forces between charged particles, and know roughly the strength of the electric force relative to the gravitational force.

1.2. Know the electrical properties of insulators and conductors and be able to describe the effects of charged particles on them (*e.g.*, polarization forces)

1.3. Know and be able to apply the concept of conservation of charge

2. From Chapter 26, "The Electric Field." The goal of this chapter is "to learn how to calculate and use the electric field." You should be able to

2.1. Calculate and draw the electric fields of positive and negative point charges, of the electric dipole, and of symmetric continuous distributions of charge, such as linear charges, charged rings or disks (on their symmetry axes, not in general).

2.2. Describe the ideal capacitor, how the charge separation is created (*e.g.*, by a battery) and how it differs from a real capacitor because of edge effects, for example.

2.3. Calculate the motion of a charged particle in an electric field, for example:

3.2.1. Point charges accelerated in electric fields, such as those inside a capacitor.

3.2.2. The motion of electric dipoles in constant electric fields, including the equilibrium configuration, and the energy of an electric dipole.

3. From Chapter 27, "Gauss's Law." From this chapter, you learned how to calculate the flux of the electric field, and from it the electric field, for highly symmetric charge distributions.

3.1. Understand the concept of flux (of the electric field) and be able to show how to calculate the flux of the electric field through a closed surface.

3.2. Know Gauss's law and be able to apply it to find the electric field of highly symmetric charge distributions, such as lines or rods, planes and spheres.

3.3. Know how electric fields and the directions of electric field lines are altered by the presence of metallic or insulating bodies in the field.

3.4. Understand the consequences of Gauss's law for differences in the location of charges between charged insulators and conductors, and especially to understand what it means for a conductor to be in a condition of electrostatic equilibrium.

4. From Chapter 28, "Current and Conductivity." The overall theme is "to learn how and why a charge moves through a conductor as a current."

4.1. Know about positive current *vs* electron current, and be able to define current and current density in terms of the density of charge carriers and their drift velocity.

4.2. Apply the microscopic model of electron current, including the effects of the mean time between collisions and the drift velocity.

4.3. Be able to apply the microscopic models of electrical resistivity and conductivity to calculations in real conductors. Know how a battery functions as a "charge escalator."

4.4. Understand and apply Kirchhoff's "junction rule" for electric circuits as a manifestation of the conservation of charge.

5. The objective of Chapter 29, "The Electric Potential," was to introduce you to the concepts of electric potential, and its relationship to electric potential energy. You should be able to

5.1. Calculate and graph the potential of point charges and simple, highly symmetric distributions of charge, such as rings, disks, lines, spheres and planes.

5.2. Describe the motion and the potential energy diagram for an electric dipole immersed in a constant electric field.

5.3. Recognize and describe the potential surfaces for isolated charges and simple distributions of point charges (such as the electric dipole).

5.4. Draw the equipotential surfaces (surfaces of constant potential) for simple charge distributions and especially for capacitors and conductors.

6. From Chapter 30, "Potential and Field," you learned about the connection between the electric field and the electric potential, including how to:

6.1. describe the mathematical and geometrical relationships between the electric field and the potential.

6.2. characterize the electric field and potential inside and outside conductors of varying shapes in electrostatic equilibrium,

6.3. understand the sources of potential (*e.g.*, batteries and $\mathcal{EMF}$) and the way they can be used to charge capacitors and drive currents through resistors.

6.4. calculate the properties of combinations of capacitors, including energy storage and release.