Building Conceptual Understanding

Chapter Opening Outline

At the beginning of each chapter is an outline presenting the section heads within the chapter. The outline also includes the titles of the Examples and Solved Problems found in the chapter. At a quick glance, you will know if a desired topic, example, or problem is in the chapter.

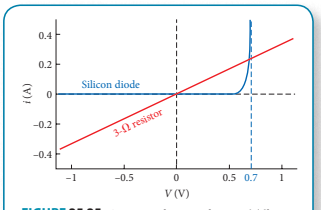

FIGURE 25.25 Current as a function of potential difference for a resistor (red) and a diode (blue).

What We Will Learn / What We Have Learned

Each chapter of *University Physics* is organized like a good research seminar. It was once said, "Tell them what you will tell them, then tell them, and then tell them what you told them!" Each chapter starts with **What We Will Learn**—a quick summary of the main points, without any equations. And at the end of each chapter, **What We Have Learned/Exam Study Guide** contains key concepts, including major equations.

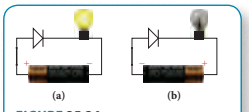

FIGURE 25.24 (a) The circuit of Figure 25.2c, but with a diode included. (b) Reversing the potential difference from the battery causes the current to stop flowing and the light bulb to stop shining.

WHAT WE WILL LEARN

- An electric field represents the electric force at different points in space.
- Electric field lines represent the net force vectors exerted on a unit positive electric charge. They originate on positive charges and terminate on negative charges.
- The electric field of a point charge is radial, proportional to the charge, and inversely proportional to the square of the distance from the charge.
- An electric dipole consists of a positive charge and a negative charge of equal magnitude.
- The electric flux is the electric field component normal to an area times the area.
- Gauss's Law states that the electric flux through a closed surface is proportional to the net electric charge enclosed within the surface. This law provides simple ways to solve seemingly complicated electric field problems.
- The electric field inside a conductor is zero.
- The magnitude of the electric field due to a uniformly charged, infinitely long wire varies as the inverse of the perpendicular distance from the wire.
- The electric field due to an infinite sheet of charge does not depend on the distance from the sheet.
- The electric field outside a spherical distribution of charge is the same as the field of a point charge with the same total charge located at the sphere's center.

Conceptual Introductions

Conceptual explanations are provided in the text prior to any mathematical explanations, formulas, or derivations in order to establish why the concept or quantity is needed, why it is useful, and why it must be defined accurately. The authors then move from the conceptual explanation and definition to a formula and exact terms.

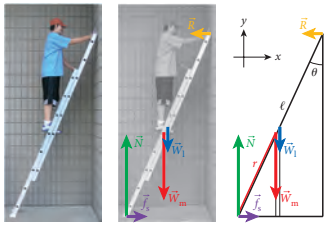

FIGURE 11.12 (a) Student standing on a ladder. (b) Force vectors superimposed. (c) Free-body diagram of the ladder.

Self-Test Opportunities

In each chapter, a series of questions focus on major concepts within the text to encourage students to develop an internal dialogue. These questions will help students think critically about what they have just read, decide whether they have a grasp of the concept, and develop a list of follow-up questions to ask in class. The answers to the Self-Tests are found at the end of each chapter.

Self-Test Opportunity 25.4

Suppose the battery in Figure 25.24 has a potential difference of 1.5 V across its terminals and the diode is a silicon diode like the one in Figure 25.25. What are the potential drops across the diode and the light bulb in parts (a) and (b) of Figure 25.24?

Concept Checks

Concept Checks are designed to be used with personal response system technology. They will appear in the text so that you may begin contemplating the concepts. Answers will only be available to instructors.

Concept Check 18.4

If you double the temperature (measured in kelvins) of an object, the thermal energy transferred away from it per unit time will

a) decrease by a factor of 2.

b) stay the same.

c) increase by a factor of 2.

d) increase by a factor of 4.

e) will change by an amount that cannot be determined without knowing the temperature of the object's surroundings.

Student Solutions Manual

The *Student Solutions Manual* contains answers and worked-out solutions to selected end-of-chapter Questions and Exercises (those indicated by a blue number). Worked-out solutions for all items in Chapters 1 through 13 follow the complete seven-step problem-solving method introduced in Section 1.5. Chapters 14 through 40 continue to use the seven-step method for challenging (one bullet) and most challenging (two bullet) exercises, but present more abbreviated solutions for the less challenging (no bullet) exercises.