

# Appendix

## Potentiometers, LEDs, and Viewing Tubes

### What Is a Potentiometer?

A potentiometer is a device that allows the user to vary the resistance between two electrical contacts or terminals by some means, such as turning a knob. Many potentiometers have three terminals (see Figure 1), with the left- and right-hand terminals being connected to either end of a fixed resistor. The central terminal is connected partway along the resistor; its exact position depends on the orientation of the knob. This provides a variable resistance between the central terminal and the other two terminals.

Turning the potentiometer knob fully clockwise results in the resistance between the central and right-hand terminals becoming  $0\ \Omega$ . Turning the knob counterclockwise increases the resistance between the central and right-hand terminals up to some maximum resistance ( $1\ \text{k}\Omega$  in the lab) and the potential difference across them.

When the LED is connected in parallel with the central and right-hand terminals, the potential difference across the LED-resistor combination is equal to the voltage across these two terminals. So, as we turn the knob counterclockwise, we increase the potential difference across the LED.



Figure 1 A potentiometer



Figure 2 An LED

### What Is an LED?

A *diode* is an electronic component that has very low resistance when a current flows through it in one direction and very high resistance when it flows through in the other direction. It acts similarly to a one-way valve that allows water to flow through a pipe in only one direction. A *light-emitting diode* (LED) is a diode that converts electrical energy into visible electromagnetic radiation (Figure 2). Thus, an LED emits light with a narrow frequency range when sufficient current flows through it in the low-resistance direction. LEDs are more energy efficient and have longer lifetimes than conventional incandescent light bulbs. They are used in devices such as traffic lights, digital alarm clocks, and TV remote controls.

### What Is a Viewing Tube?

A *viewing tube* is a small tube made of rubber (or anything else) that can be used to block out light from other sources. In this lab, a viewing tube is helpful when the user is trying to see when an LED just begins to glow. To use a viewing tube, place one end of it over the LED and look through the other end, as shown in Figure 3.



Figure 3 Looking at an LED through a viewing tube