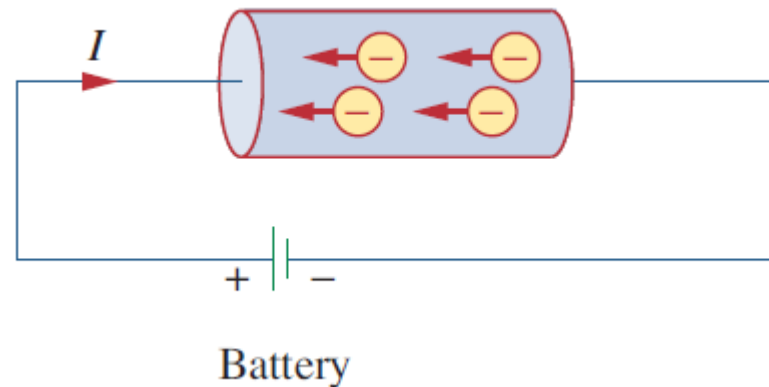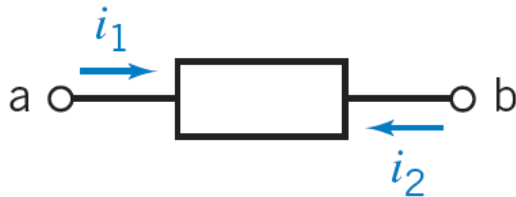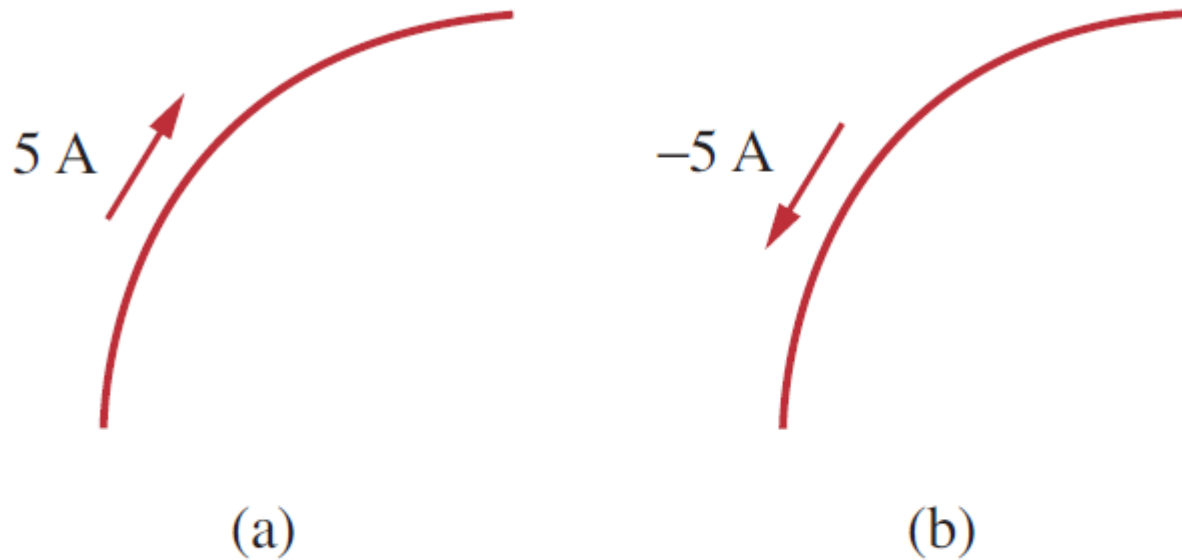# Optoelectronics Lab

Basic Concepts

Charge & Current

- Charge is the quantity of electricity responsible for electric phenomena.

- Current is the time rate of flow of electric charge past a given point. The unit of current is the ampere (A); an ampere is 1 coulomb per second.

$$i = \frac{dq}{dt}$$

Battery

5 A

−5 A

(a)

(b)

Figure 1.5

Conventional current flow: (a) positive current flow, (b) negative current flow.
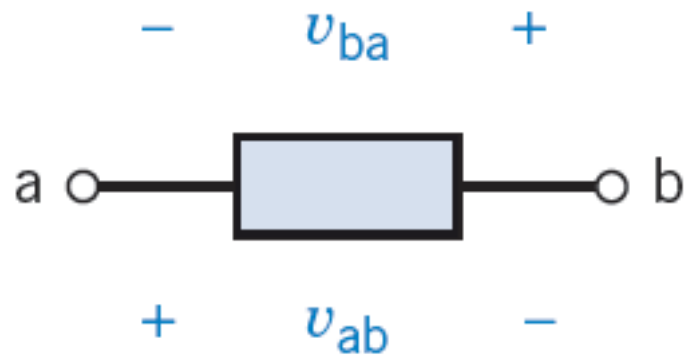
Voltage

- The voltage across an element is the work (energy) required to move a unit positive charge from the – (negative) terminal to the + (positive) terminal. The unit of voltage is the volt, V.
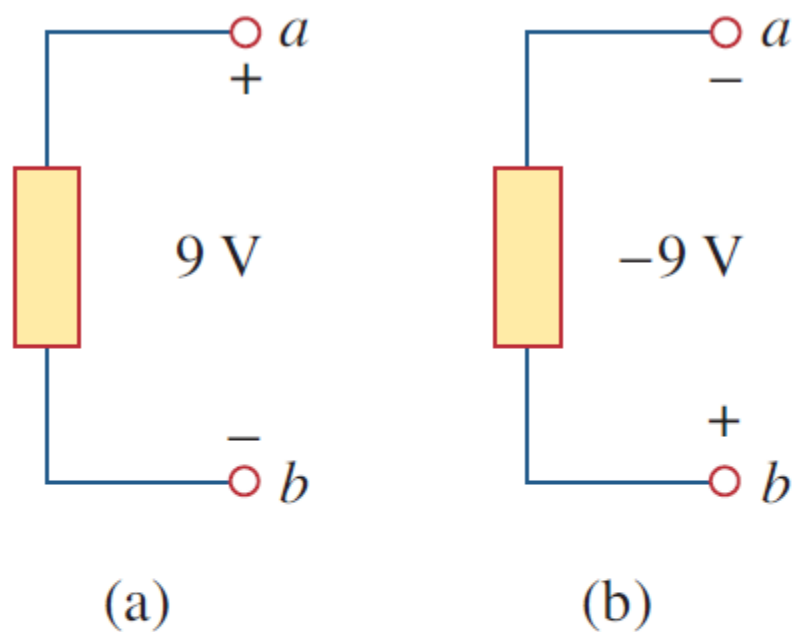
$$v_{ab} \overset{\Delta}{=} \frac{dw}{dq}$$

$$1 \text{ volt} = 1 \text{ joule/coulomb} = 1 \text{ newton-meter/coulomb}$$

Polarity of Voltage

$$-\quad\quad v_{ba}\quad\quad +$$

a O——[ ]——O b

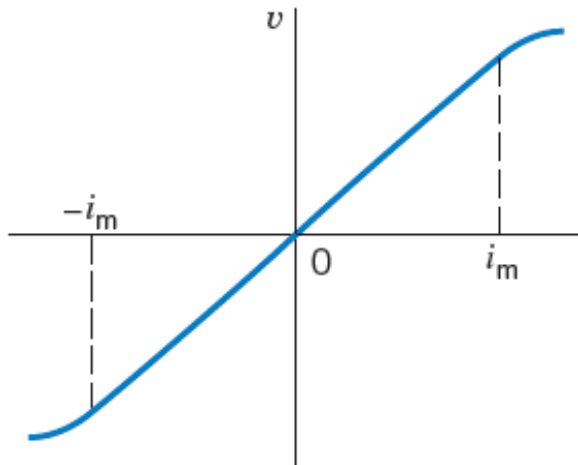$$+\quad\quad v_{ab}\quad\quad -$$

(a)   (b)

Figure 1.7

Two equivalent representations of the same voltage v_{ab}: (a) Point a is 9 V above point b; (b) point b is -9 V above point a.
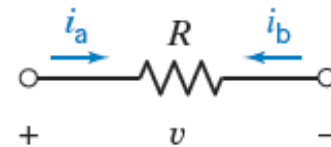
Resistors

- Ohm's Law

$$v = Ri$$

FIGURE 2.4-3 A resistor operating within its specified current range, $\pm i_m$, can be modeled by Ohm's law.

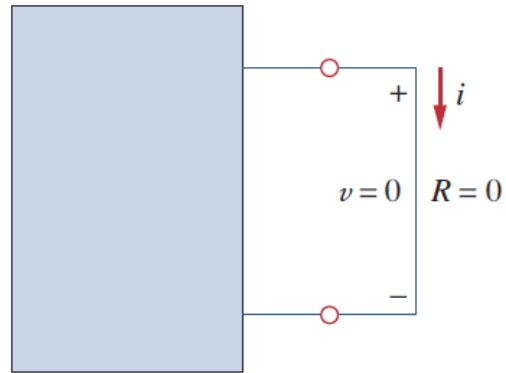**FIGURE 2.4-4** A resistor with element current and element voltage.

$$i_a = -i_b \qquad v = Ri_a$$
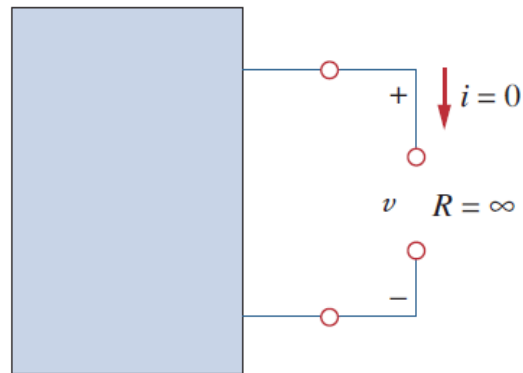
$$v = -Ri_b$$

Short Circuit/Open Circuit

(a)

(b)
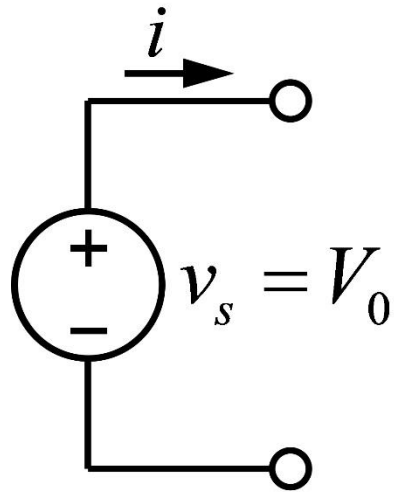
Figure 2.2
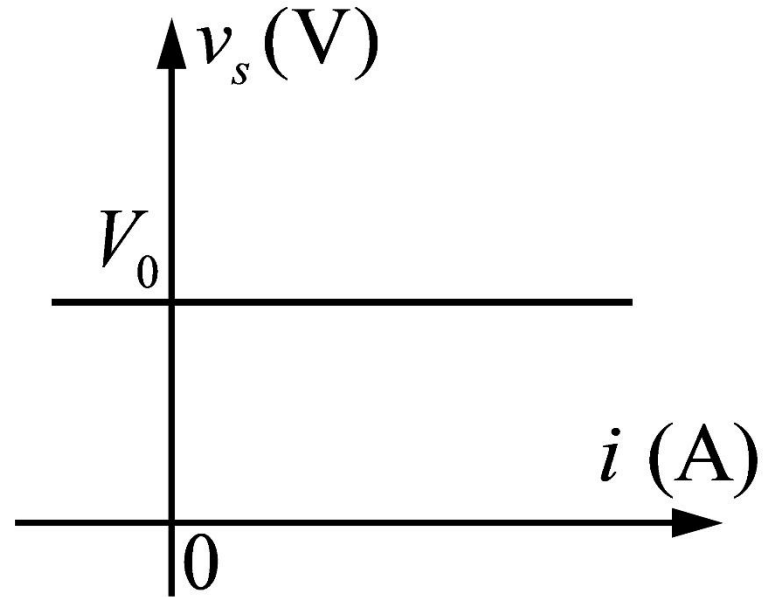(a) Short circuit ($R = 0$), (b) Open circuit
($R = \infty$).

Ideal Voltage Source

(a)

(b)

Ideal Current Source

$i_s = I_0$

v

+

−

(a)

i_s (A)

I_0

v (V)

0

(b)