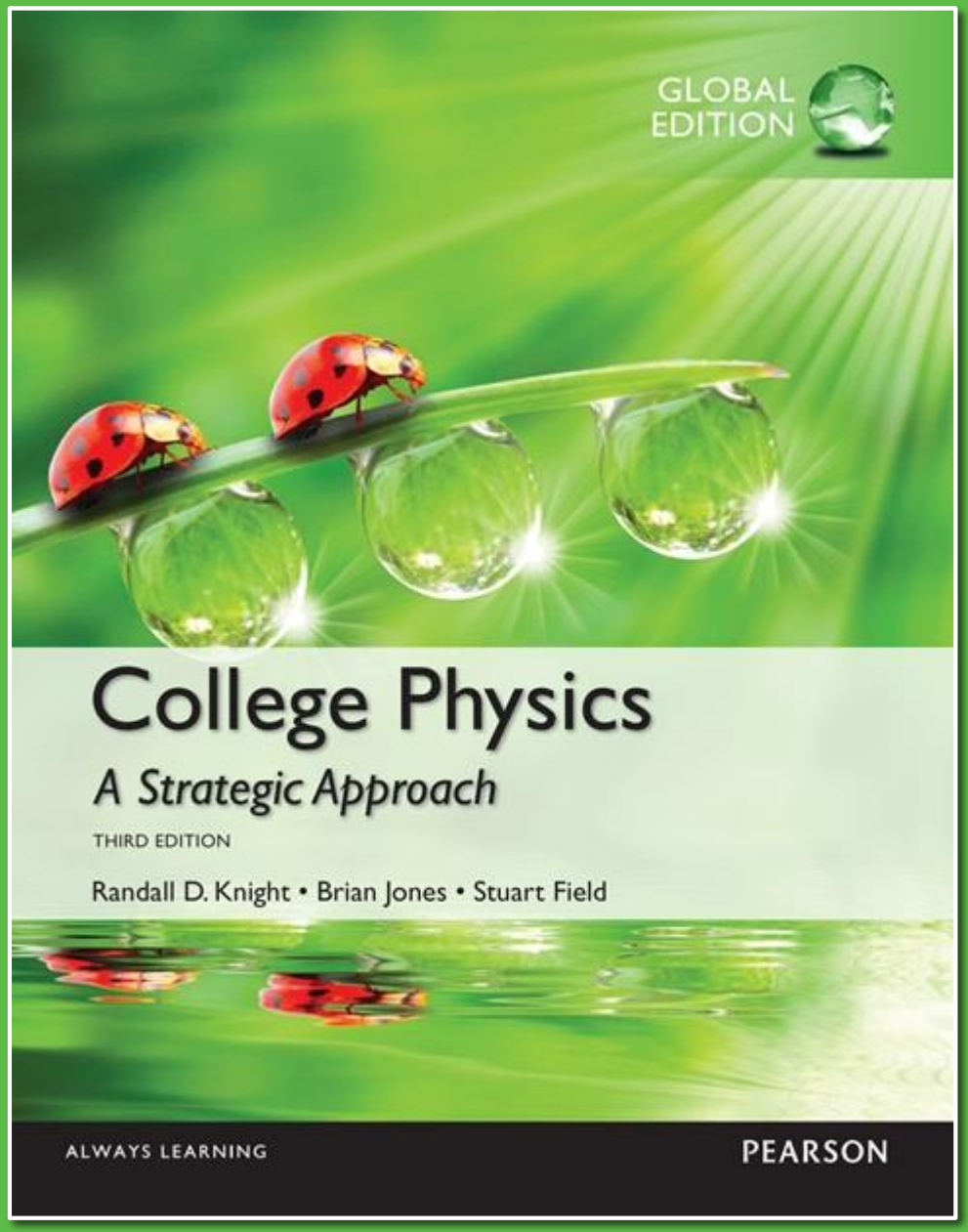


Lecture Presentation

Chapter 22

Current and Resistance

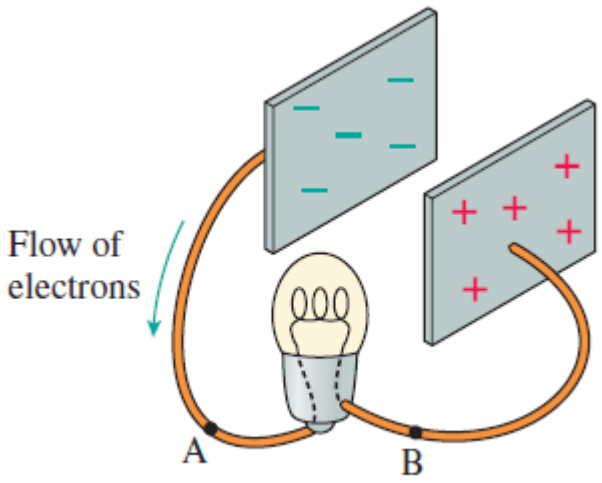
Chapter 22 Current and Resistances

Section 22.1 A Model of Current
Section 22.2 Defining and Describing Current
Section 22.5 Ohm's Law and Resistor Circuits

Section 22.1 A Model of Current

The Flow of electrons

The current at point B is *exactly equal* to the current at point A.



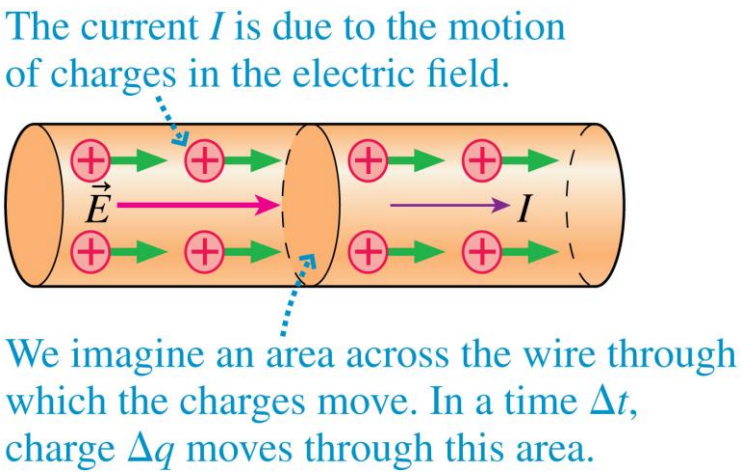
Section 22.2 Defining and Describing Current

Definition of Current

- The electric current is defined as the amount of charge Δq transferred through a cross-sectional area of the wire in time interval Δt.

$$I = \frac{\Delta q}{\Delta t}$$

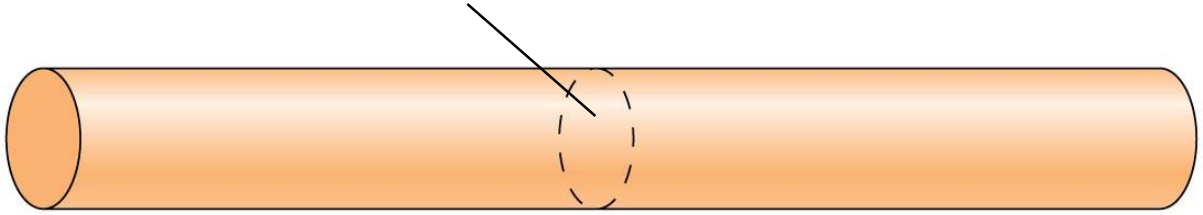
Definition of current



- The SI unit of current is the ampere (A).
- 1 A = 1 C/s

QuickCheck 22.2

Every minute, 120 C of charge flow through this cross section of the wire.



The wire's current is

A. 240 A
B. 120 A
C. 60 A
D. 2 A
E. Some other value

Example 22.2 Charge flow in a lightbulb

A 100 W lightbulb carries a current of 0.83 A. How much charge flows through the bulb in 1 minute?

SOLVE According to Equation 22.2, the total charge passing through the bulb in 1 min = 60 s is

$$q = I\,\Delta t = (0.83\text{ A})(60\text{ s}) = 50\text{ C}$$

Section 22.5 Ohm's Law and Resistor Circuits

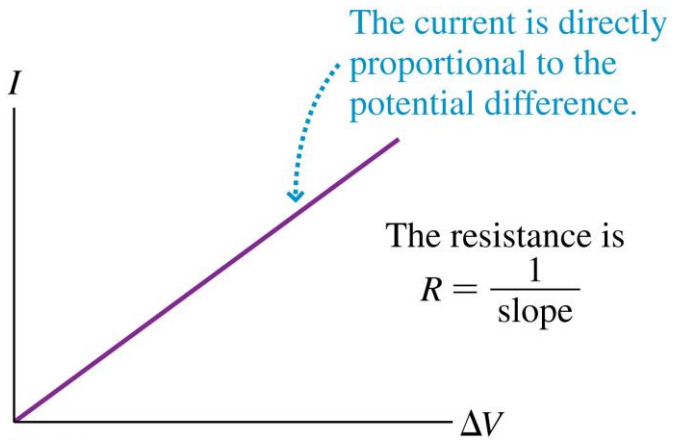
Ohm's Law and Resistor Circuits

- **Ohm's Law** describes the relationship between the potential difference across a conductor and the current passing through it:

$$I = \frac{\Delta V}{R}$$

Ohm's law for a conductor of resistance R

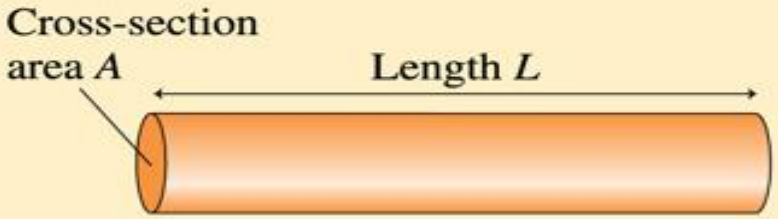
- The current through an ohmic material is directly proportional to the potential difference.



Resistance

The **resistance** is a property of a particular wire or conductor. The resistance of a wire depends on its resistivity and dimensions.

$$R = \frac{\rho L}{A}$$



ρ : resistivity in Ω.m

l : length of conductor in m

A : cross-sectional area of conductor in m^2

Resistivities of materials

Material	Resistivity ($\Omega \cdot m$)
Copper	1.7×10^{-8}
Aluminum	2.7×10^{-8}
Tungsten (20°C)	5.6×10^{-8}
Tungsten (1500°C)	5.0×10^{-7}
Iron	9.7×10^{-8}
Nichrome	1.5×10^{-6}
Seawater	0.22
Blood (average)	1.6
Muscle	13
Fat	25
Pure water	2.4×10^{5}
Cell membrane	3.6×10^{7}

Problems

What is the current produced with a 10 volt battery through a resistance of a 100 ohms?

$$I = \frac{\Delta V}{R} = \frac{10}{100} = 0.1\ A$$

What is the resistance of a wire made of a material with a resistivity of $3.20 \times 10^{-8} \Omega.\text{m}$ if its length is 3.50 m and its diameter is 0.50 mm?

$$R = \frac{\rho l}{A} = \frac{3.20 \times 10^{-8} \times 3.50}{\pi \left(\frac{0.50 \times 10^{-3}}{2}\right)^2} = 0.57\ \Omega$$

Summary: Important Concepts

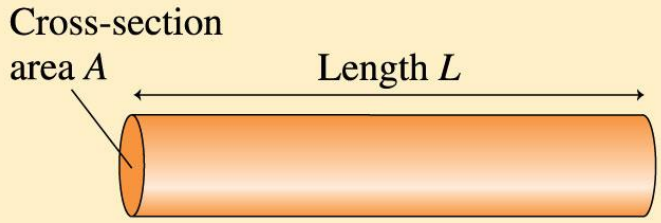
Resistance, resistivity, and Ohm's law

The **resistivity** ρ is a property of a material, a measure of how good a conductor the material is.

- Good conductors have low resistivity.
- Poor conductors have high resistivity.

The **resistance** is a property of a particular wire or conductor. The resistance of a wire depends on its resistivity and dimensions.

$$R = \frac{\rho L}{A}$$



Ohm's law describes the relationship between potential difference and current in a resistor:

$$I = \frac{\Delta V}{R}$$