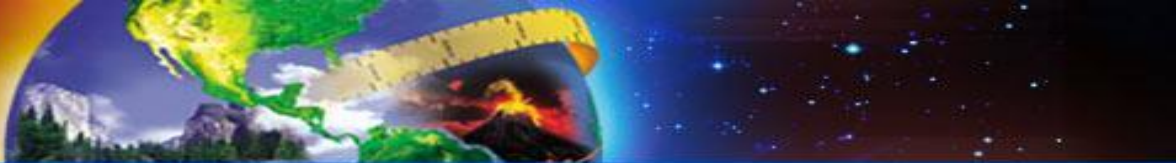




Chapter Six: Electricity

- **6.1 Charge and Electric Circuits**
- **6.2 Current and Voltage**
- **6.3 Resistance and Ohm's Law -
Types of Circuits**



Chapter 6.3 Learning Goals

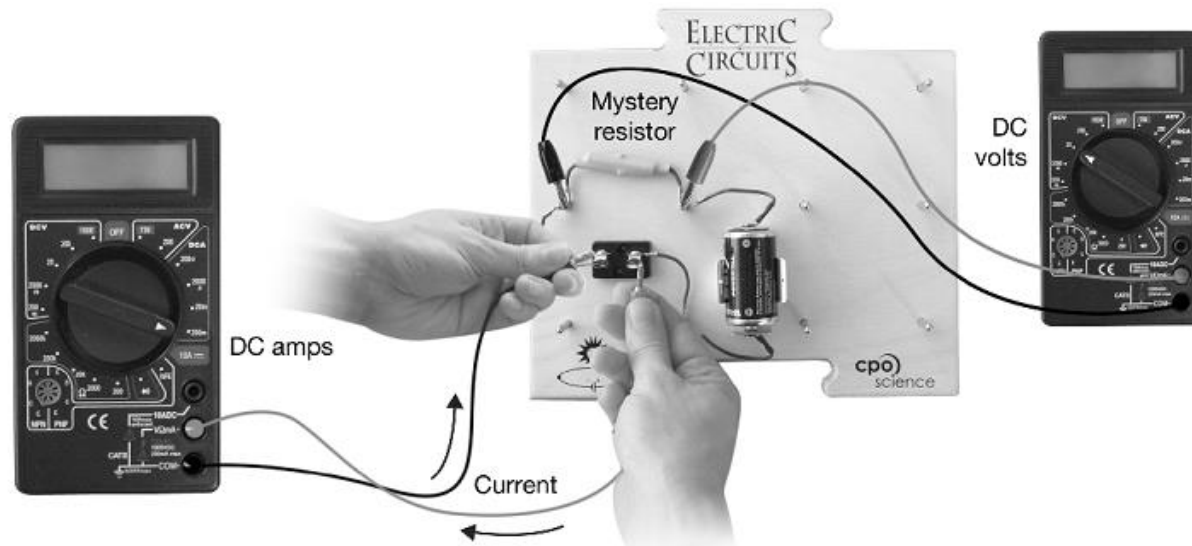
- Use Ohm's law to relate current, voltage and resistance.
- Apply Ohm's law to solve problems.
- Classify materials as conductors, insulators, and semiconductors.

Investigation 16B

Resistance and Ohm's Law

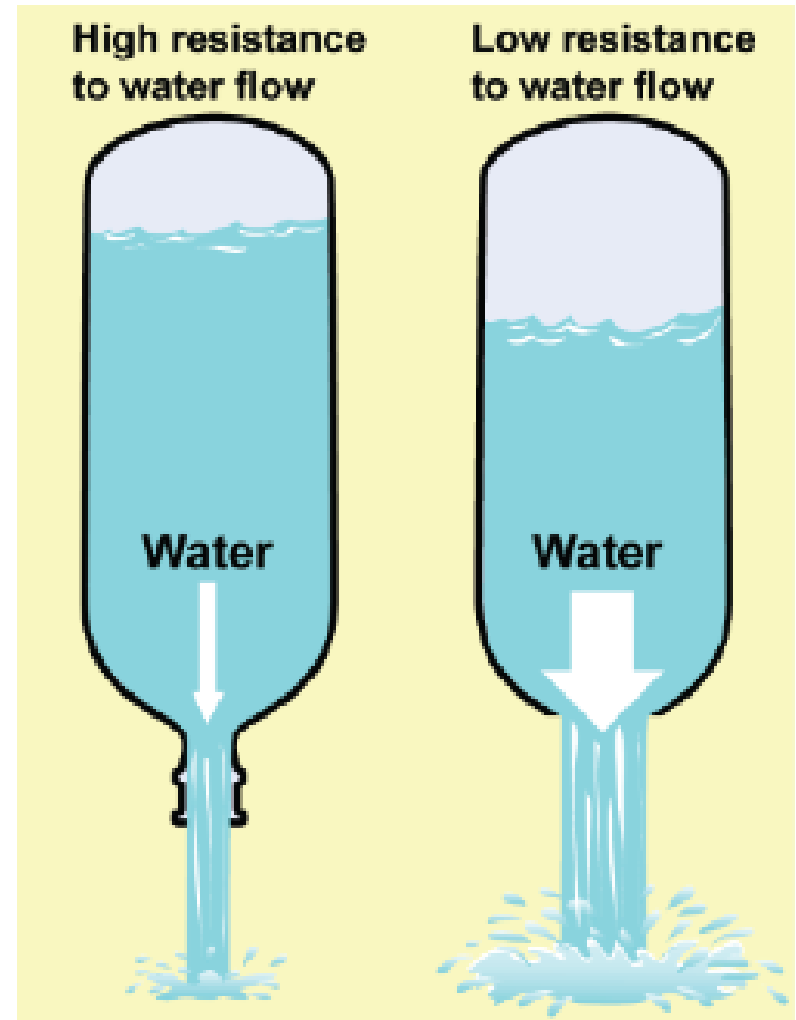
■ Key Question:

What is the relationship between current and voltage in a circuit?



6.3 Resistance

- **Resistance is the measure of how strongly an object resists current flowing through it.**
- **The relationship between electric current and resistance can be compared with water flowing from the open end of a bottle.**



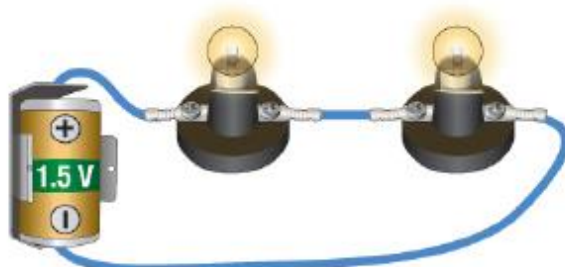
6.3 Resistance

- **The total amount of resistance in a circuit determines the amount of current in the circuit for a given voltage.**

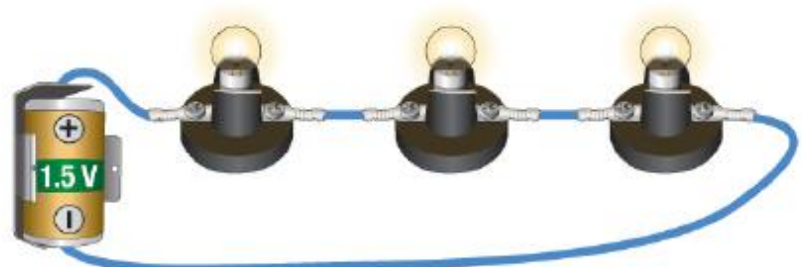
One bulb
Single resistance
Full current



Two bulbs
Twice the resistance
Half the current



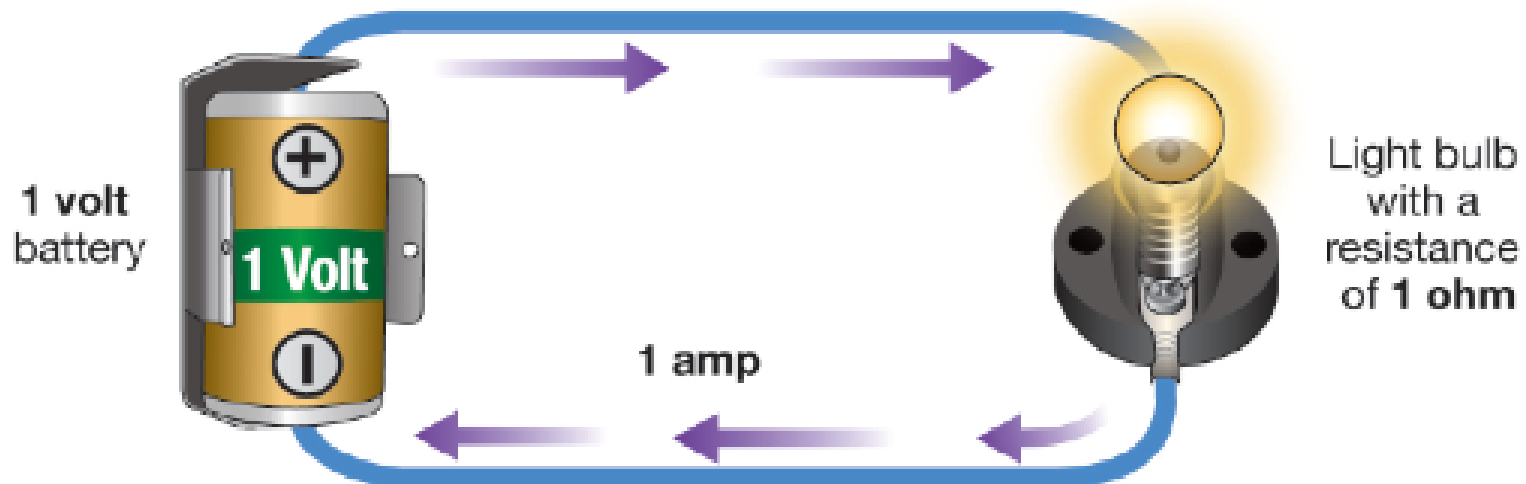
Three bulbs
Three times the resistance
One-third the current



6.3 Resistance

- **Electrical resistance is measured in units called ohms.**
- **This unit is abbreviated with the Greek letter omega (Ω).**

1 volt creates a current of 1 amp through a resistance of 1 ohm.





6.3 Ohm's Law

- The current in a circuit depends on voltage and resistance.
- Ohm's law relates current, voltage, and resistance with one formula.

| Equation | Gives you... | If you know... |
|-----------|--------------------|------------------------|
| $I = V/R$ | current (I) | voltage and resistance |
| $V = IR$ | voltage (V) | current and resistance |
| $R = V/I$ | resistance (R) | voltage and current |



Solving Problems: Ohm's Law

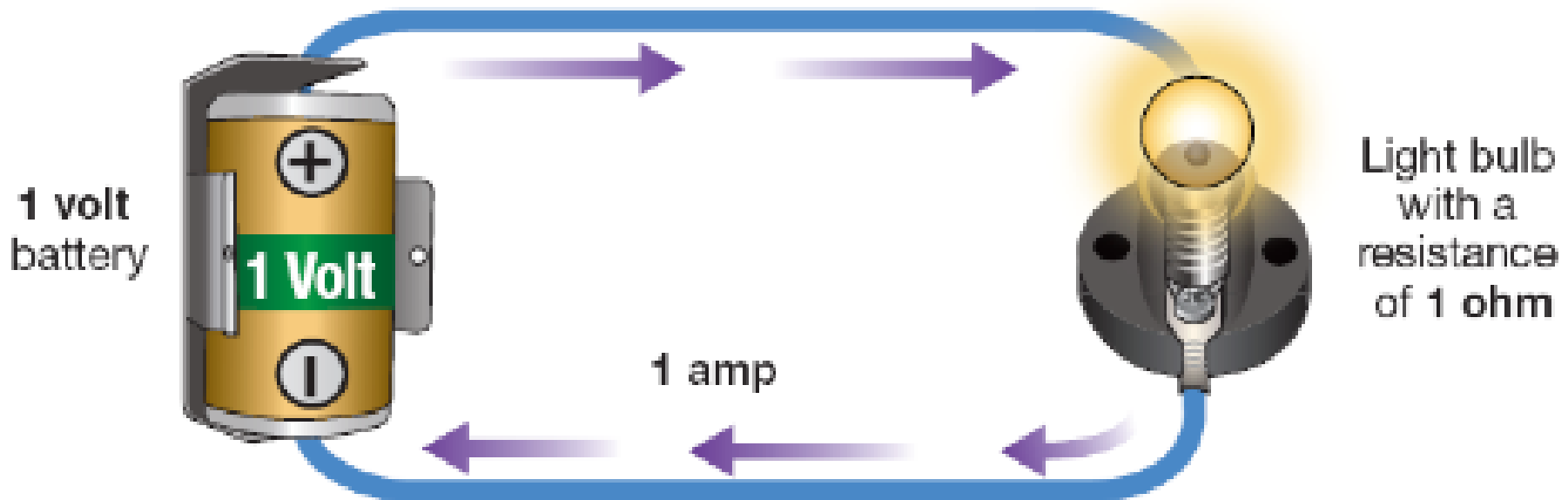
OHM'S LAW

Current (amps, A) $I = \frac{V}{R}$ **Voltage** (volts, V)
Resistance (ohms, Ω)



Volts, Amps, and Ohms

1 volt creates a current of 1 amp through a resistance of 1 ohm.





Solving Problems

A toaster oven has a resistance of 12 ohms and is plugged into a 120-volt outlet.

How much current does it draw?



Electric toaster



Solving Problems

1. Looking for:

- ...current in amps

2. Given

- ... $R = 12 \ \Omega$; $V = 120 \text{ V}$

3. Relationships:

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

4. Solution

- $I = \frac{120 \text{ V}}{12 \ \Omega} = 10 \text{ A}$

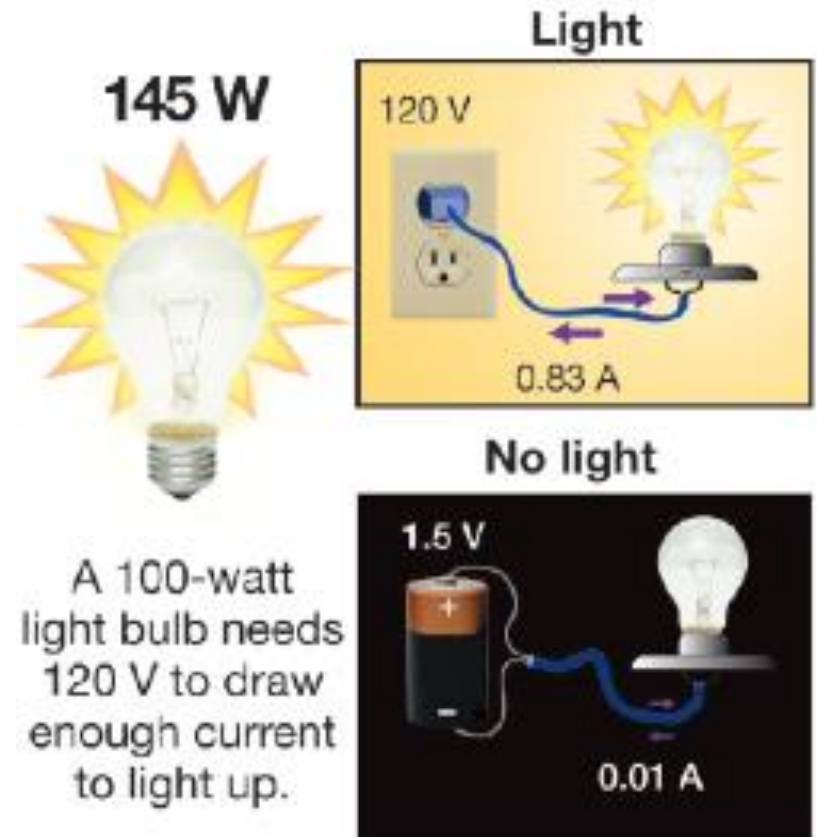


Electric toaster



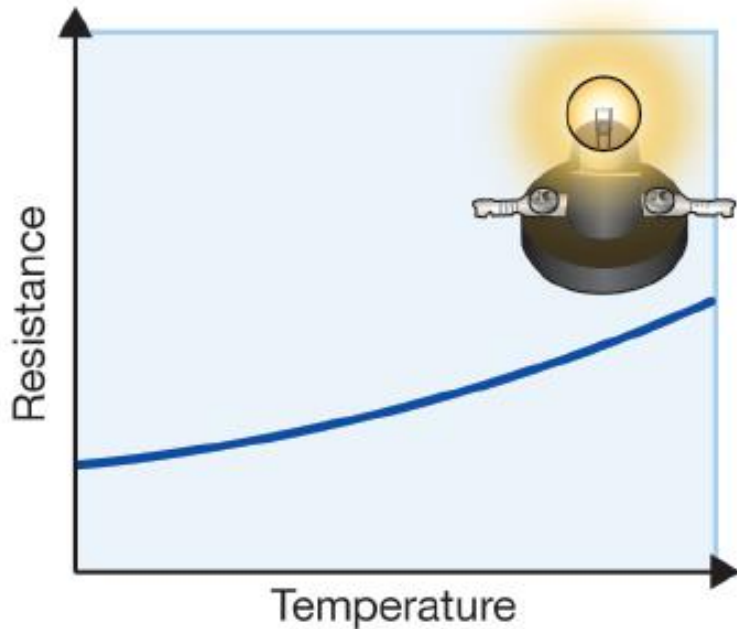
6.3 Resistance of common objects

- Every electrical device is designed with a resistor that causes the right amount of current to flow when the device is connected to voltage.





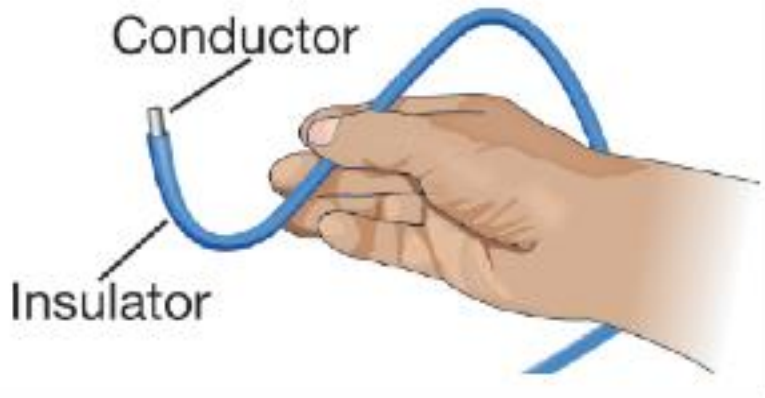
6.3 Resistance of common objects



- The resistance of many electrical devices varies with temperature and current.
- A light bulb's resistance increases when there is more current because the bulb gets hotter when more current passes through it.



6.3 Conductors and insulators



Name 20 items that require insulated wire to function...

- **Both conductors and insulators are necessary materials in technology.**
- **For example, a wire has one or more conductors on the inside and an insulator on the outside.**



Comparing Resistance of Materials

Low
resistance



Conductors

silver
copper
gold
aluminum
iron

Semiconductors

carbon
germanium
silicon

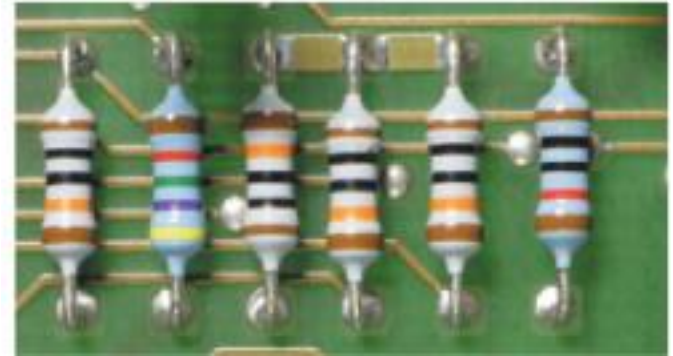
Insulators

air
wood
glass
rubber

High
resistance

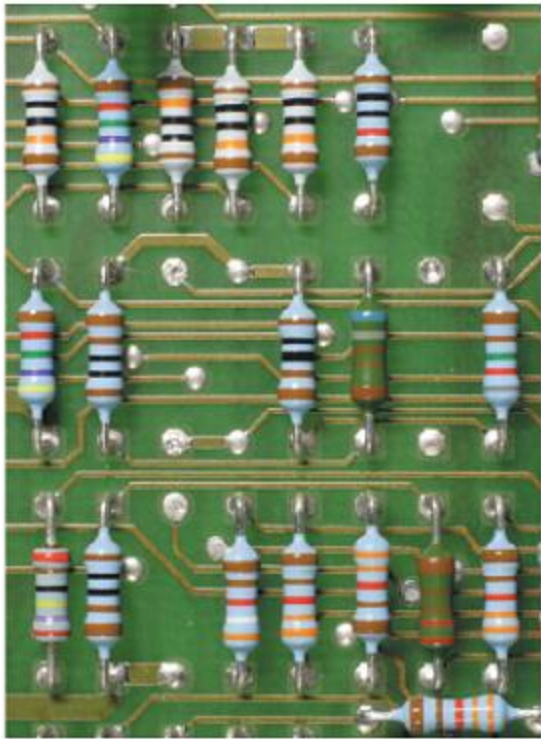
6.3 Resistors

- Resistors are used to control the current in circuits.
- There are two main types of resistors: fixed and variable.





6.3 Fixed resistors



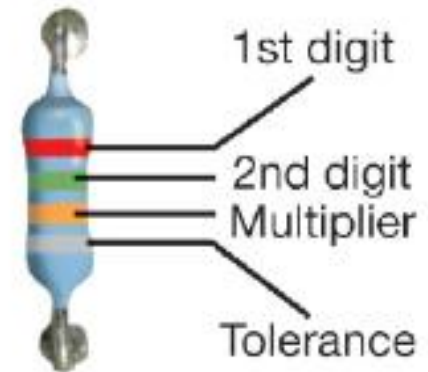
| Color | Number |
|--------|--------|
| black | 0 |
| brown | 1 |
| red | 2 |
| orange | 3 |
| yellow | 4 |
| green | 5 |
| blue | 6 |
| violet | 7 |
| grey | 8 |
| white | 9 |

- Fixed resistors have a resistance that cannot be changed.
- Because resistors are tiny, it is impossible to label each one with its resistance value.
- Instead, colored stripes tell you the resistance.

6.3 Fixed resistors

- Resistors are found in many common electronic devices such as computers, televisions, telephones, and stereos.

| Color | Tolerance |
|--------|-----------|
| silver | +/- 10% |
| gold | +/- 5% |
| brown | +/- 1% |



Reading the code

A diagram showing a resistor with four color bands: red, green, orange, and brown. Lines connect the bands to a calculation box below. The calculation is: $25 \times 10^3 = 25,000 \Omega$.

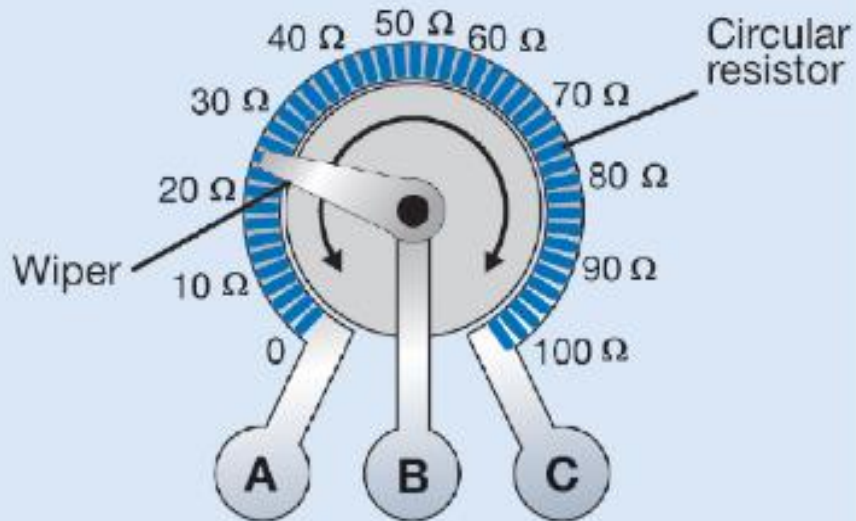
Can you read the code of this resistor?





6.3 Variable resistors

The inside of a potentiometer



Circuit diagram



- Variable resistors, also called potentiometers, can be adjusted to have a resistance within a certain range.
- Turning the dial changes the resistance between A and B and also changes either the current or the voltage in the circuit.

Measuring Voltage, Current, and Resistance

A multimeter can measure a battery's voltage if one probe touches each end.



The meter reads zero volts if both probes are connected at the same place.

