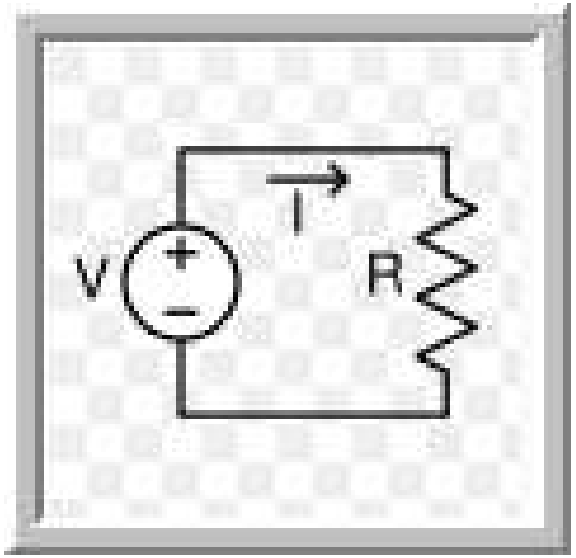
Ohm's Law

- Ohm's law states that, in an electrical circuit, the current passing through most materials is directly proportional to the potential difference applied across them.



3-1—3-3: Ohm's Law Formulas

- There are three forms of Ohm's Law:
  - $I = V/R$
  - $V = IR$
  - $R = V/I$
- where:
  - I = Current
  - V = Voltage
  - R = Resistance

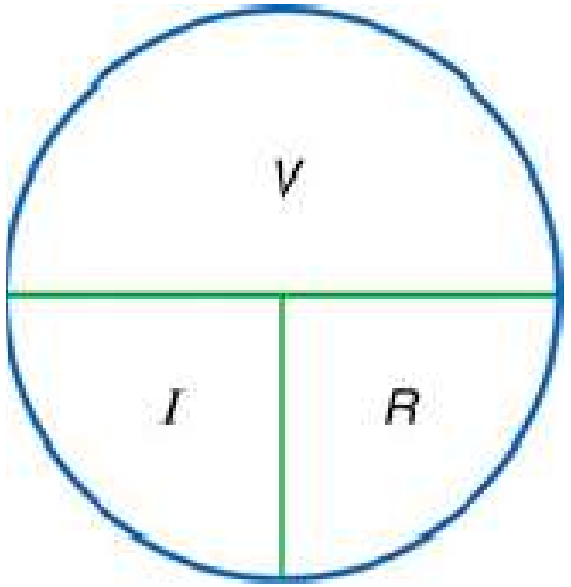


Fig. 3-4: A circle diagram to help in memorizing the Ohm's Law formulas V = *IR*, *I* = *V*/*R*, and *R*= *V*/*I*. The *V* is always at the top.

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3-1: The Current $I = V/R$

- $I = V/R$
- In practical units, this law may be stated as:
  - amperes = volts / ohms

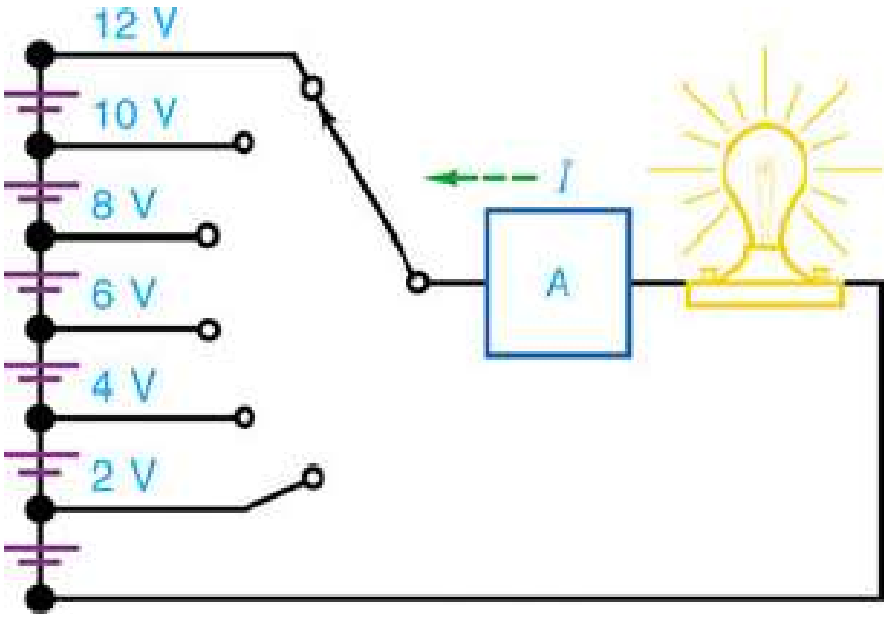

Fig. 3-1: Increasing the applied voltage *V* produces more current *I* to light the bulb with more intensity.

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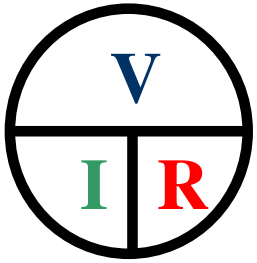
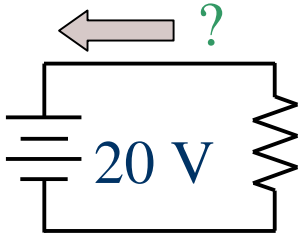
3-4: Practical Units

- The three forms of Ohm's law can be used to define the practical units of current, voltage, and resistance:
  - 1 ampere = 1 volt / 1 ohm
  - 1 volt = 1 ampere × 1 ohm
  - 1 ohm = 1 volt / 1 ampere

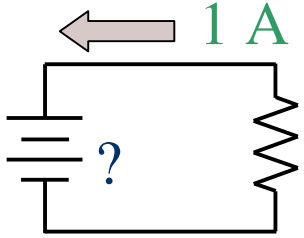
3-4: Practical Units

Applying Ohm's Law

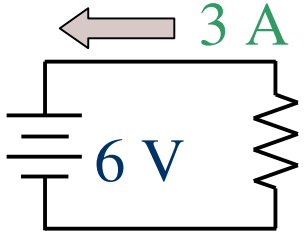




$$I = \frac{20\ V}{4\ \Omega} = 5\ A$$



$$V = 1A \times 12\ \Omega = 12\ V$$



$$R = \frac{6\ V}{3\ A} = 2\ \Omega$$

Problem

- Solve for the resistance, R, when V and I are known
  a. V = 14 V, I = 2 A, R = ?
  b. V = 25 V, I = 5 A, R = ?
  c. V = 6 V, I = 1.5 A, R = ?
  d. V = 24 V, I = 4 A, R = ?

3-5: Multiple and Submultiple Units

- Units of Voltage
  - The basic unit of voltage is the **volt (V).**
    - Multiple units of voltage are:
      - **kilovolt (kV)**
        1 thousand volts or 10^3 V
      - **megavolt (MV)**
        1 million volts or 10^6 V
    - Submultiple units of voltage are:
      - **millivolt (mV)**
        1-thousandth of a volt or 10^{-3} V
      - **microvolt (μV)**
        1-millionth of a volt or 10^{-6} V

3-5: Multiple and Submultiple Units

- **Units of Current**
  - The basic unit of current is the **ampere (A).**
  - Submultiple units of current are:
    - **milliampere (mA)**
      1-thousandth of an ampere or 10^{-3} A
    - **microampere (μA)**
      1-millionth of an ampere or 10^{-6} A

3-5: Multiple and Submultiple Units

- Units of Resistance
  - The basic unit of resistance is the **Ohm (Ω).**
  - Multiple units of resistance are:
    - **kilohm (kΩ)**
      1 thousand ohms or 10^3 Ω
    - **Megohm (MΩ)**
      1 million ohms or 10^6 Ω

Problem

- How much is the current, I, in a 470-kΩ resistor if its voltage is 23.5 V?

- How much voltage will be dropped across a 40 kΩ resistance whose current is 250 μA?