



Introduction

- **What is Ohm's Law?**
- **Why is ohms law important?**
- **The Electrical Components of Ohm's Law**
 - 1. Electromotive Force
 - 2. Current
 - 3. Resistance
 - 4. Power
- **Ohm's Law Formulas**
- **Using The Ohm's Law Chart to calculate electrical circuits.**



Terms to Remember

- The **Source** can be any source of electrical energy. In practice, there are three general possibilities: it can be a battery, an electrical generator, or some sort of electronic power supply.
- The **Load** is any device or circuit powered by electricity. It can be as simple as a light bulb or as complex as a modern high-speed computer.
- (**Path**) a wire or pathway which will allow electron to flow throughout a circuit.
- **Electricity** can be described as the flow of charged particles. If the particles accumulate on an object, we term this static electricity.
- (**Direct Current**) An electrical current that travels in one direction and used within the computer's electronic circuits.
- (**Alternating Current**) The common form of electricity from power plant to home/office. Its direction is reversed 60 times per second.
- **Circuit** is a conducting path for electrons.



What is Ohm's Law?

Ohm's Law states that, at constant temperature, the electric current flowing in a conducting material is directly proportional to the applied voltage, and inversely proportional to the Resistance.

Why is Ohms Law important?

Ohm's Law is the relationship between power, voltage, current and resistance. These are the very basic electrical units we work with. The principles apply to alternating current (ac)

The Electrical Components of Ohm's Law



Voltage

The electrical "pressure" that causes free electrons to travel through an electrical circuit.

Also known as electromotive force (emf).

Power measured in *volts*.

The amount of current times the voltage level at a given point measured in wattage or *watts*.

Resistance

That characteristic of a medium

which opposes the flow of electrical current through itself.

Resistance is measured in

Current *ohms*.

The amount of electrical charge

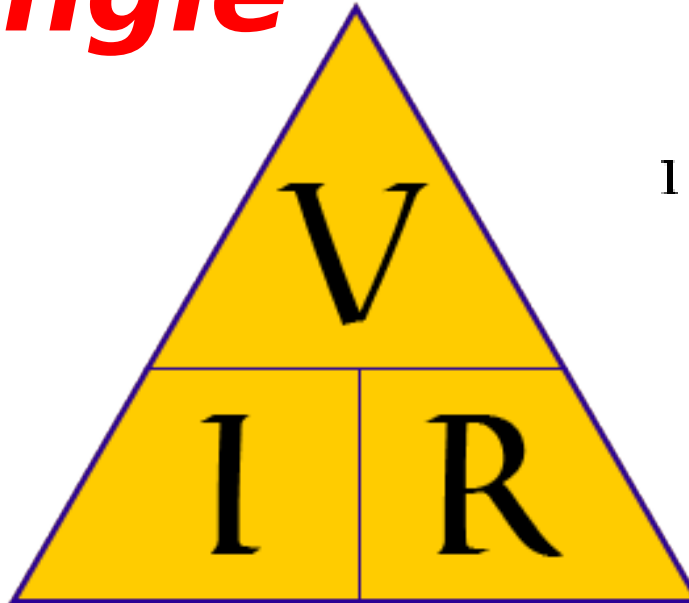
(the number of free electrons) moving past a given point in an

electrical circuit per unit of time.

Current is measured in

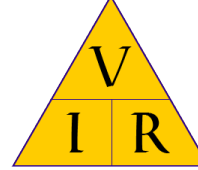
Ohm's law magic triangle

$$E = I R$$



$$I = \frac{E}{R}$$

$$R = \frac{E}{I}$$



Ohms law,

defines the relationship between voltage, current and resistance.

These basic electrical units apply to direct current, or alternating current.

Ohm's Law is the foundation of electronics and electricity.

This formula is used extensively by electricians. Without a thorough understanding of "Ohm's Law" an electrician **can not** design or troubleshoot even the simplest of electronic or electrical circuits.

Ohm established in the late 1820's that if a voltage was applied to a resistance then "current would flow and then power would be consumed"

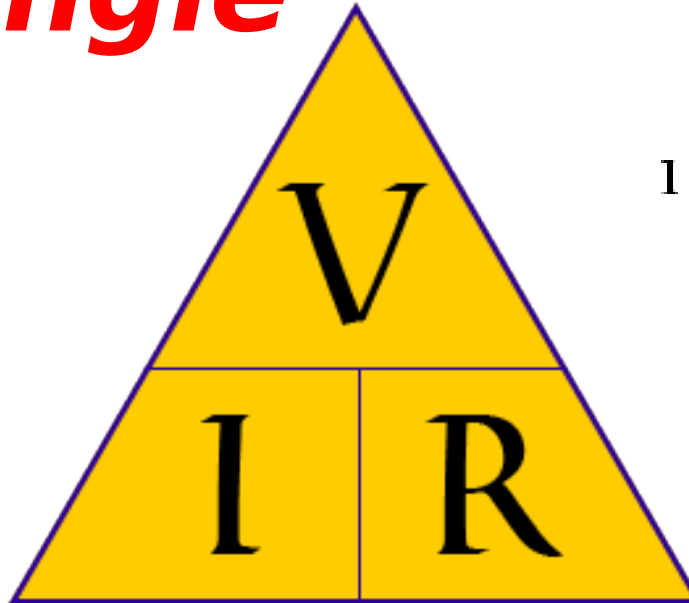
Voltage measured in *volts*,
symbolized by the letters "E" or
"V".

Current measured in *amps*,
symbolized by the letter "I".

Resistance measured in *ohms*,
symbolized by the letter "R".

Ohm's law magic triangle

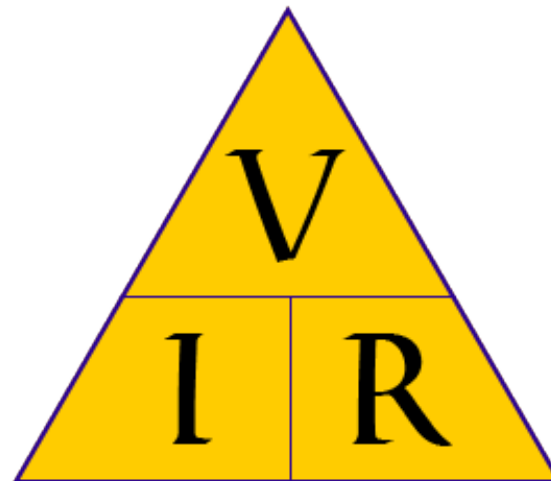
$$E = I R$$



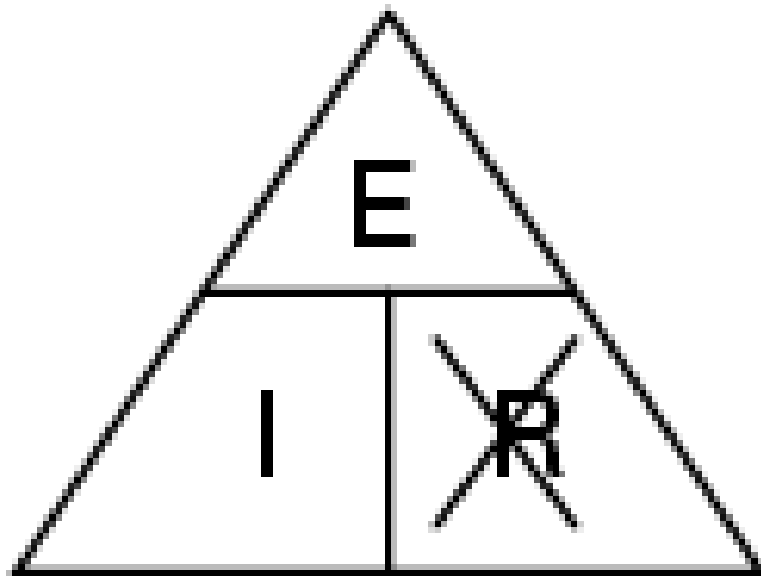
$$I = \frac{E}{R}$$

$$R = \frac{E}{I}$$

Quantity	Symbol	Unit of Measurement	Unit Abbreviation
Current	I	Ampere ("Amp")	A
Voltage	E <i>or</i> V	Volt	V
Resistance	R	Ohm	Ω

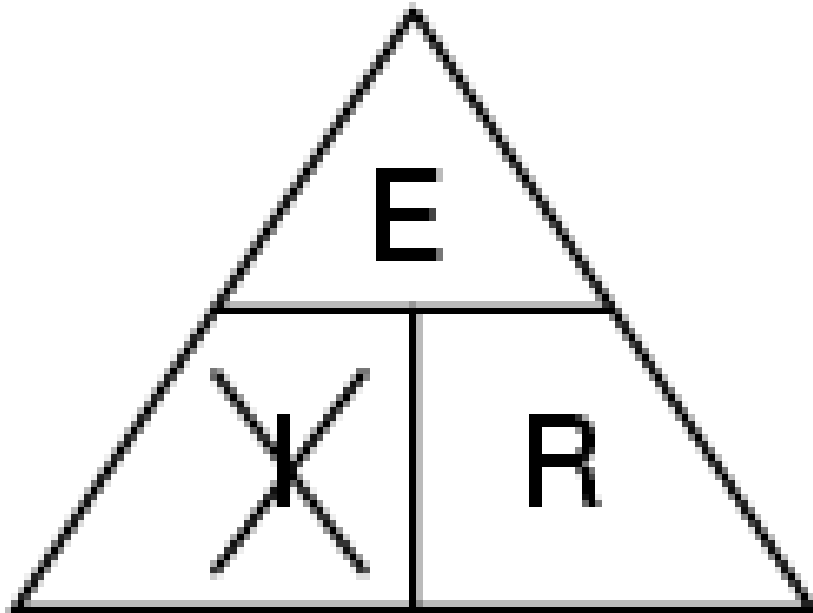


If you know E and I, and wish to determine R, just eliminate R from the picture and see what's left:



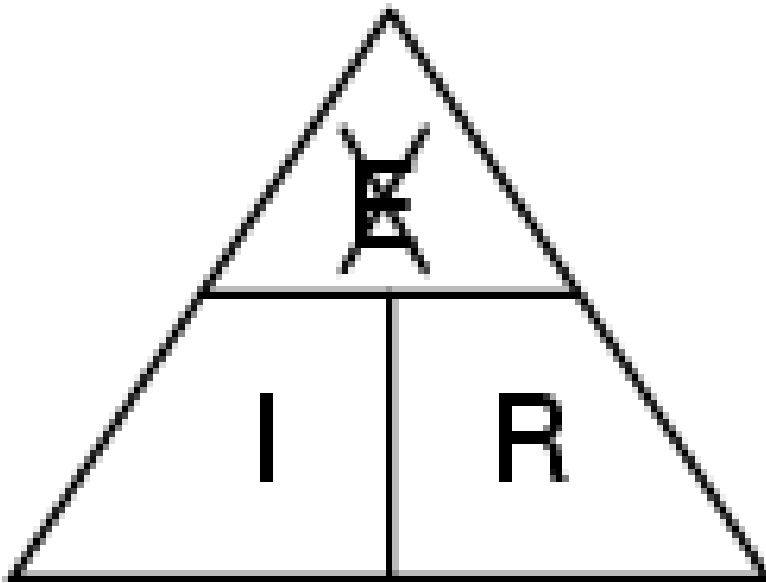
$$R = \frac{E}{I}$$

**If you know E and R, and wish to determine I,
eliminate I and see what's left:**



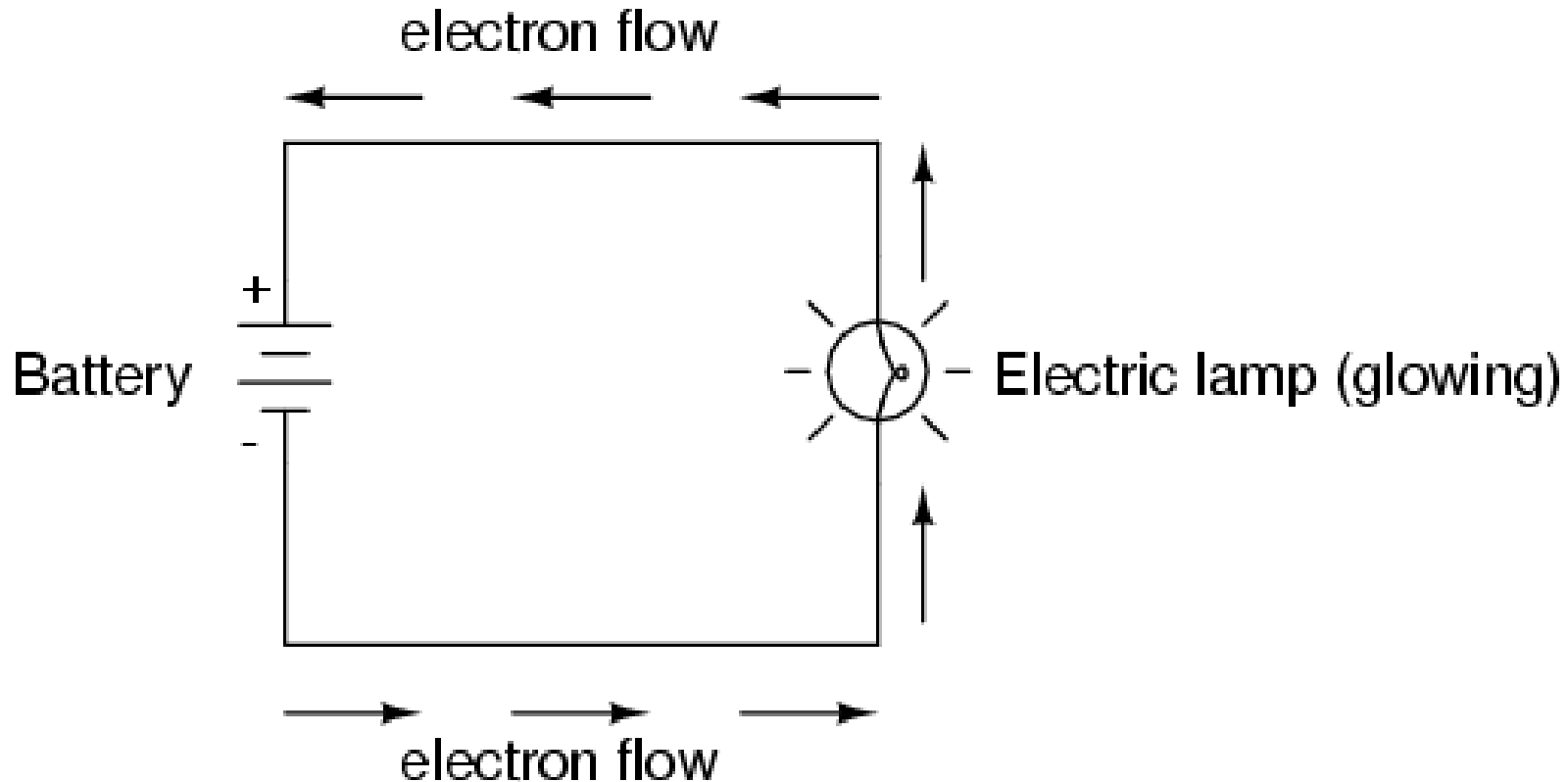
$$I = \frac{E}{R}$$

**if you know I and R, and wish to determine E,
eliminate E and see what's left:**



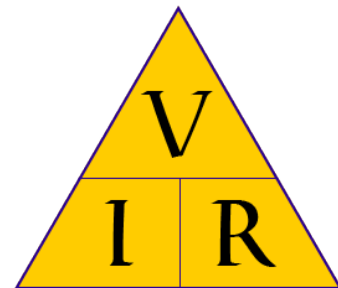
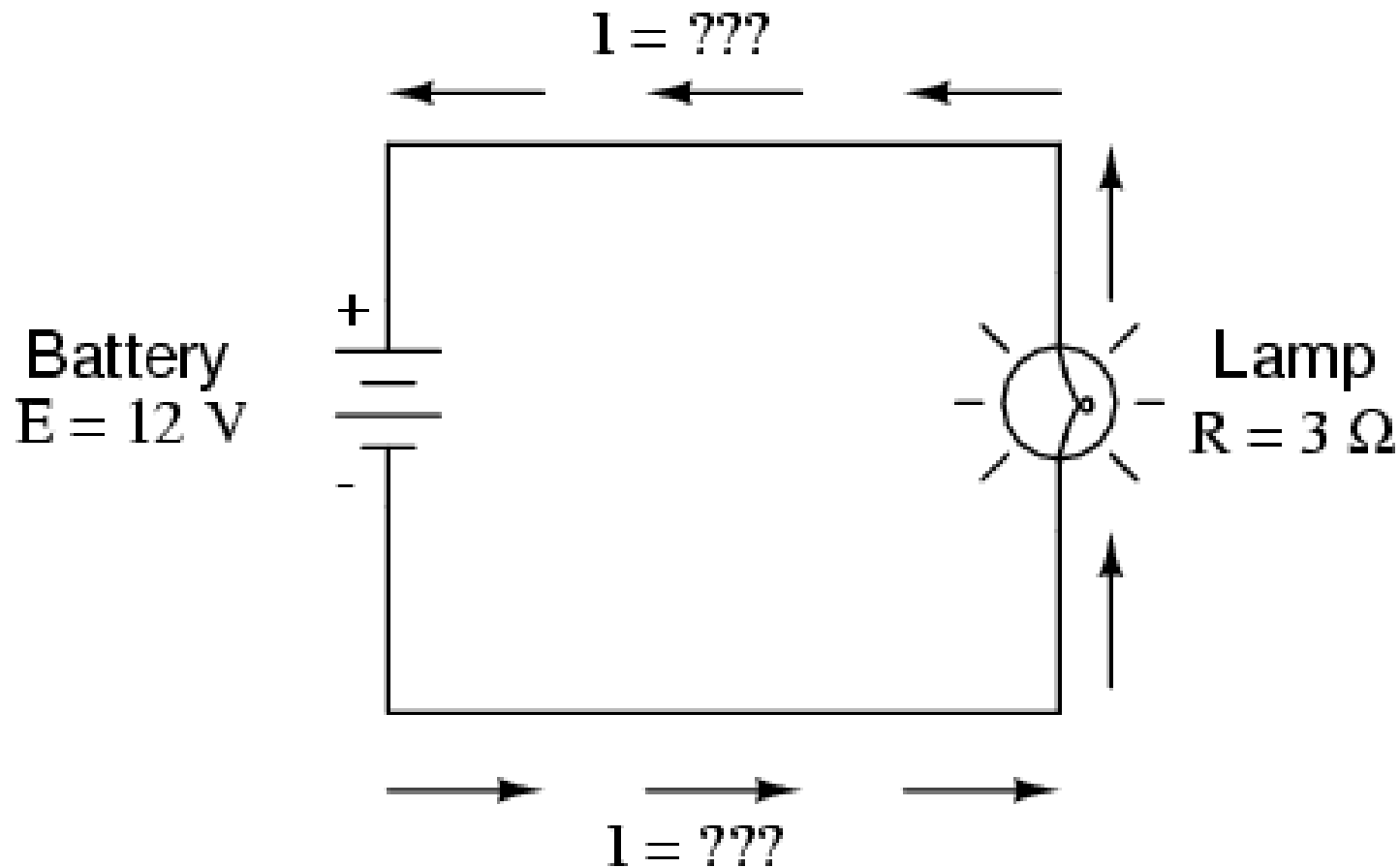
$$E = I R$$

Let's see how these equations might work to help us analyze simple circuits:

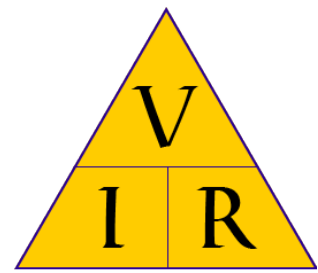
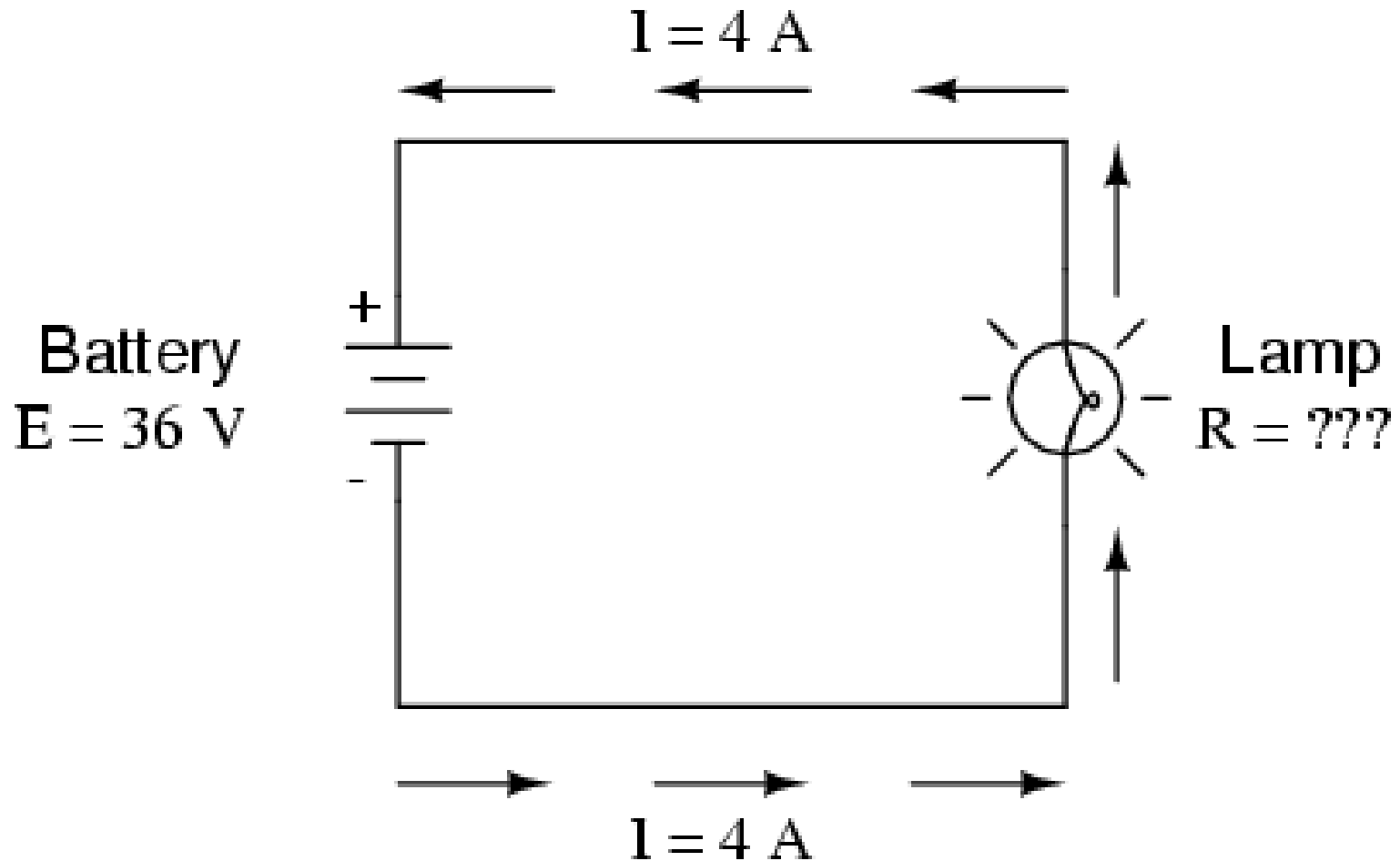


If we know the values of any two of the three quantities (voltage, current, and resistance) in this circuit, we can use Ohm's Law to determine the third.

calculate the amount of current (I) in a circuit, given values of voltage (E) and resistance (R):



**calculate the amount of resistance (R) in a circuit,
given values of voltage (E) and current (I):**



Example 1.14

A 100 V battery is connected across a resistor and causes a current of 5 mA to flow. Determine the resistance of the resistor. If the voltage is now reduced to 25 V, what will be the new value of the current flowing?

Solution

$$\begin{aligned}\text{Resistance } R &= \frac{V}{I} = \frac{100}{5 \times 10^{-3}} = \frac{100 \times 10^3}{5} \\ &= 20 \times 10^3 = \mathbf{20 \text{ k}\Omega}\end{aligned}$$

Current when voltage is reduced to 25 V,

$$I = \frac{V}{R} = \frac{25}{20 \times 10^3} = \frac{25}{20} \times 10^{-3} = \mathbf{1.25 \text{ mA}}$$

1.18 Electrical Power and Energy

1.18.1 Electrical Power

Power P in an electrical circuit is given by the product of potential difference V and current I . The unit of power is the *watt*, W . Hence,

$$P = V \times I \text{ watts}$$

From Ohm's law, $V = IR$.

Substituting for V in equation (1.1) gives:

$$P = (IR) \times I$$

i.e.,

$$P = I^2 R \text{ watts}$$

Also, from Ohm's law, $I = \frac{V}{R}$

Substituting for I in the equation above gives:

$$P = V \times \frac{V}{R}$$

i.e.,

$$P = \frac{V^2}{R} \text{ watts}$$

There are three possible formulas that may be used for calculating power

An electric kettle has a resistance of $30\ \Omega$. What current will flow when it is connected to a $240\ \text{V}$ supply? Find also the power rating of the kettle.

Example 1.19

An electric kettle has a resistance of $30\ \Omega$. What current will flow when it is connected to a 240 V supply? Find also the power rating of the kettle.

Solution

$$\text{Current, } I = \frac{V}{R} = \frac{240}{30} = 8\text{ A}$$

$$\begin{aligned}\text{Power, } P &= VI = 240 \times 8 = 1920\text{ W} \\ &= 1.95\text{ kW} \\ &= \text{power rating of kettle}\end{aligned}$$