Electric Current

Current

- There are two basic types of electric current:

  ➢ AC—(alternating current) an electric current that changes direction at regular intervals. For U.S. homes it is 120 V at 60 Hz (60 cycles per second).

  ➢ In AC the positive (+) terminal and the negative (-) terminals change, so there is no net movement of the charges they just vibrate back and forth.

  ➢ DC—(direct current) charges move in only one direction.

Current

- *Electric current* is the rate of charge flow past a given point in an electric circuit, measured in Coulombs/second which is named Amperes.

$$I = \frac{Q}{t} \quad \text{or} \quad Q = It$$

I = current (amps) A
Q = charge (Coulombs) C
t = time (s)

Sample

- A hair dryer draws 15 A. If it takes you 5 minutes to dry your hair how much charge passes a cross-sectional area of the circuit in this time?

I = 15 A
t = (5 min)(60 sec/min) =300s
Q = ?

Q = It

Q = (15A)(300s)

Q = 4500 *C*

Ohm's Law

- Details the relationship involving voltage, current and resistance.
- Resistance is the opposition to the motion of charge through a conductor.
  – It depends on length, cross sectional area, material, and temperature.

$$V = IR$$

V = voltage (V)
I = current (amperes) (A)
R = resistance (ohms) (Ω)

Sample

- A desktop computer in sleep mode draws about 0.05 A. What is the total resistance in the computer in sleep mode?

I = 0.05 A
V = 120 V
R = ?

V = IR

120 V = (0.05A)R

R = 2400 Ω

Power

- Power is the rate at which energy is transferred.
- P = E/t   P = VI   P = I²R   P = V²/R
  - ➢P = power (watt or J/s)
  - ➢E = energy (Joules)
  - ➢t= time (seconds)
  - ➢V = voltage (Volts or J/C)
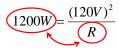 - ➢I = current (Amps or C/s)
  - ➢R = resistance (ohms)

Sample Problems

- If it takes you 5 minutes to dry your hair with a 1200 W hair dryer how much energy did you use?
- P = E/t

$$1200W = \frac{E}{(5\,\text{min})(60\,\text{sec}/\,\text{min})}$$

$$E = 360,000J = 360kJ$$

- What was the resistance in the circuit?
- P = V²/R

$$1200W = \frac{(120V)^2}{R}$$

$$R = 12\Omega$$

- How much current will run through a 500 watt coffee pot if it is plugged into a typical wall socket?
- P = VI

$$500W = (120V)(I)$$

$$\frac{500}{120} = I$$

$$I = 4.17\,A$$

Practice

You run a toaster oven that draws 8 A for 10 minutes. How much charge flows through the wire?

I = 8 A
t = 10 min = 600 s
Q = ?

Q = It

Q = (8 A)(600 s)

Q = 4800 C

Practice

If the above toaster is plugged into a typical American outlet, what is the total resistance of the toaster oven?

I = 8 A
V = 120 V
R = ?

V = IR

120 V = (8A)R

R = 15 Ω

Practice

An 1100 W microwave has a total resistance of 13.6 Ω. How much current is the microwave oven drawing?

P = 1100 W
R = 13.6 Ω
I = ?

$P = I^2 R$

1100 W = I^2(13.6 Ω)

R = 8.99 A