Power and Electricity

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Electric Power

- The rate at which charge carriers do work
- The rate at which electrical energy is used or converted to another form of energy, or for electrical power,

$$P = IV$$

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Watts

- SI Unit of Power
- Most commonly found on light bulbs and audio equipment.
- Tells us the amount of energy used each second
- Higher wattage = Higher energy use
  = Brighter bulb or
  = louder sound

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Sample Problem

- A hair dryer is rated at 1500 W. How much current does the hair dryer use while plugged into a 120 V outlet?

$P = IV$

$1500 = I(120)$

$I = \frac{1500}{120} = 12.5\,A$

Answer: 12.5 A

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Thermal Energy in Circuits

- All wires have resistance and therefore produce thermal energy
- The amount of thermal energy per second is usually found using:

$$V = IR \; and \; P = IV$$

- In transmitting energy this energy is considered waste.
- However, in certain applications (electric stoves, hair dryers, etc.) this thermal energy is the desired outcome.

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Sample Problem

- An electric space heater is connected across a 120V outlet. The heater dissipates 3400 W of power in the form electromagnetic radiation and heat. Calculate the resistance of the heater.

$P = IV$

$3400 = I(120)$

$I = \frac{3400}{120} = 28.3 \text{ A}$

$V = IR$

$120 = (28.3)R$

$R = \frac{120}{28.3} = 4.2 \, \Omega$

Answer: 4.2 Ω

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The Electric Company

- To reduce waste, the current carried along the wire is reduced
- Voltage is increased and current is decreased to transmit adequate power with less waste
- Transformers are set up to convert the high voltage low current power into higher current, lower voltage power.
- The kilowatt hour (kWh) is the amount of energy equal to 1000 Watts of power delivered for 3600 seconds or 3.6×10^6 J
- Price per kilowatt hour (kWh):
  - Power Company – from 5 to 20 cents
  - AA Battery – approximately 260 dollars

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Sample Problem

- How much does it cost to operate a 100.0 W light bulb for 24 hours if electrical energy costs 8 cents per kW•h?

① Convert to kW

$\frac{100}{1000} = .1\ kW$

② Multiply by time in hours

$(.1\ kW)(24\ Hours) = 2.4\ kW \cdot h$

③ Multiply by price

$(2.4\ kW \cdot h)(8¢) = 19.2¢$

Answer: 19.2 cents

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