Heating Effects of Electricity

Effect of Heat on Resistance

- Along with the factors we have already discussed, the temperature of a wire can effect the amount of resistance in a wire.

$$R = R_o(1 + a\Delta T)$$

Where R_o is the resistance of the material at $0\,^0C$ and α is the temperature coefficient of resistivity

Energy Conversion

- Electrical energy can be converted into light, mechanical motion, chemical action, and heat.
- During each conversion, some energy is converted to heat.

Electrical Energy

- As an electron moves around a circuit, the energy it loses can be found by:

$$U_E = q\Delta V$$

- To raise the potential of the charge, the voltage source must do the same amount of work on the charge

$$W = qV$$

Electric Power

- Power
  - The rate at which energy is used or converted to another form of energy, or the rate at which work is done
  - So for electrical power,

$$P = \frac{W}{t} = \frac{qV}{t} = IV$$ *Measured in Joules per second or Watts

$$Since I = \frac{q}{t}$$

Transmitting Energy

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

$$P = I^2R \quad or \quad P = \frac{V^2}{R}$$

- In transmitting energy this energy is considered waste. (called joule heat or I^2R loss)
- However, in certain applications (electric stoves, hair dryers, etc.) this thermal energy is the desired outcome.

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) the amount of energy equal to 1000 Watts of power deliver for 3600 seconds or 3×10^6 J
- Price per kilowatt hour (kWh):
  - Power Company - 18 cents
  - AA Battery - 260 dollars

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