PHYS 1444 – Section 004
Lecture #10

Wednesday, Feb. 21 2007

Dr. Andrew Brandt

- Resistivity
- Electric Power
- Alternating Current
- Microscopic View of Current

HW4 due Fri 2/23 at 8 pm;
HW5 will be due Fri Mar. 2;
Test Ch 21-25 Mon Mar. 5

Temperature Dependence of Resistivity

- Do you think the resistivity depends on temperature?
  - Yes
- Would it increase or decrease with the temperature?
  - Increase
  - Why?
  - Since the atoms are vibrating more rapidly as temperature increases and are arranged in a less orderly fashion. So?
    - They might interfere more with the flow of electrons.
- If the temperature change is not too large, the resistivity of metals usually increase nearly linearly w/ temperature

$$\rho_T = \rho_0 \left[1 + \alpha (T - T_0) \right]$$

  - α is the temperature coefficient of resistivity
  - α of some semiconductors can be negative due to the increased number of free electrons.

Electric Energy

- Why is electric energy useful?
  - It can be transform easily into different forms of energy:
    - Motors, pumps, etc, transform electric energy to mechanical energy
    - Heaters, dryers, cook-tops, etc., transform electricity to thermal energy
    - Light bulb filaments transform electric energy to light energy
      - Only about 10% of the energy turns to light with 90% lost via heat
      - Typical household light bulb and heating elements have resistance of order few ohms to few hundred of ohms
- How does electric energy transform to thermal energy?
  - Flowing electrons collide with the vibrating atoms of the wire.
  - In each collision, part of electron's kinetic energy is transferred to the atom it collides with.
  - The kinetic energy of wire's atoms increases, and thus the temperature of the wire increases.
  - The increased thermal energy can be transferred as heat through conduction and convection to the air in a heater or to food in a pan; it can also be radiated as light.