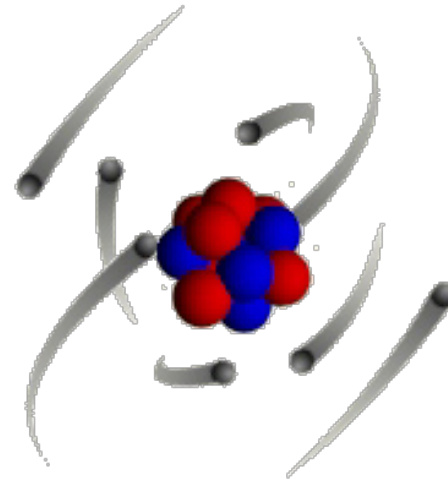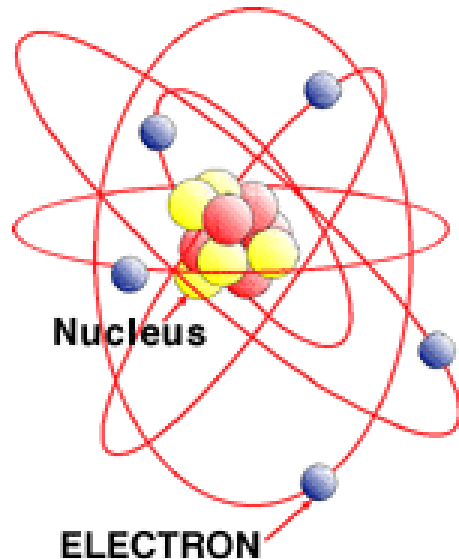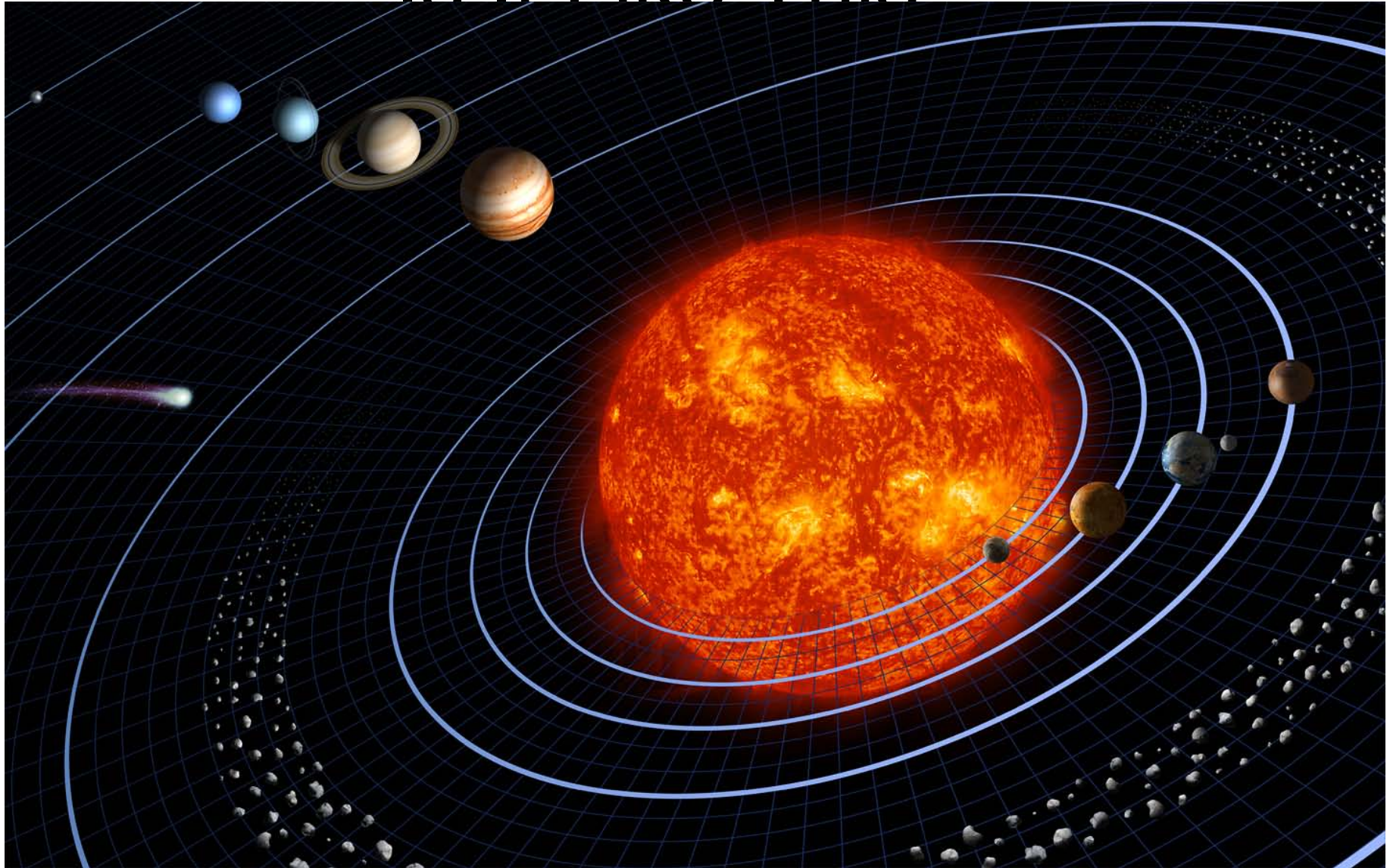# EE251 Lectures

Basic Concepts

Section 02

Electrons
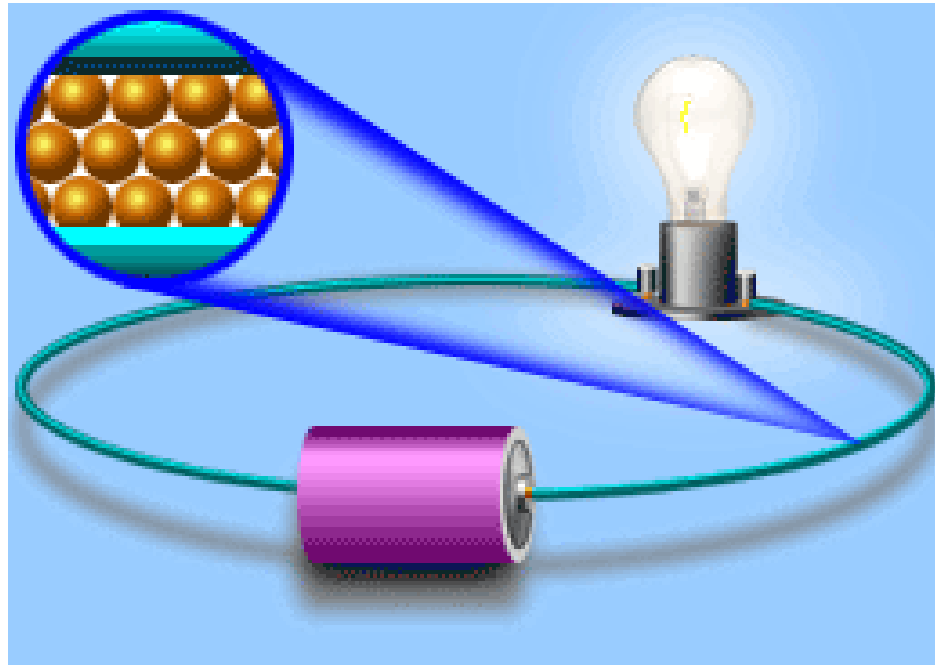
- Atoms and Electrons
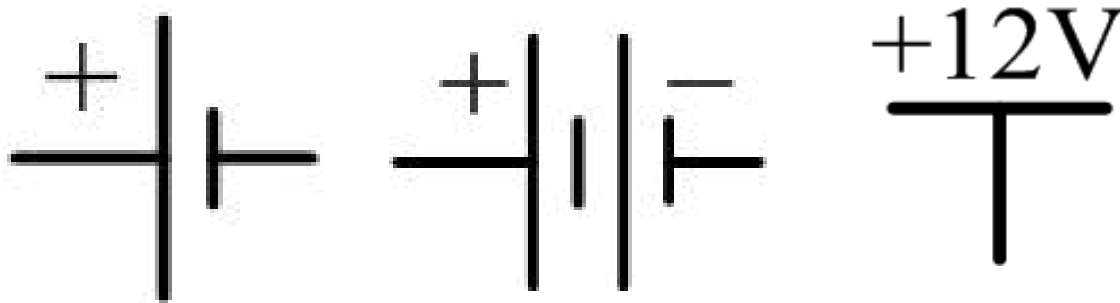- Heat and Free Electrons

Is It Like This?!

Electricity

- If electrons were pushed, they produce a current

Battery

- Source of pushing electrons
- Electrochemical reactions
- Look for types of batteries in Wikipedia!!

Volt

- Alexander Volta (first battery)
- Electromotive Force
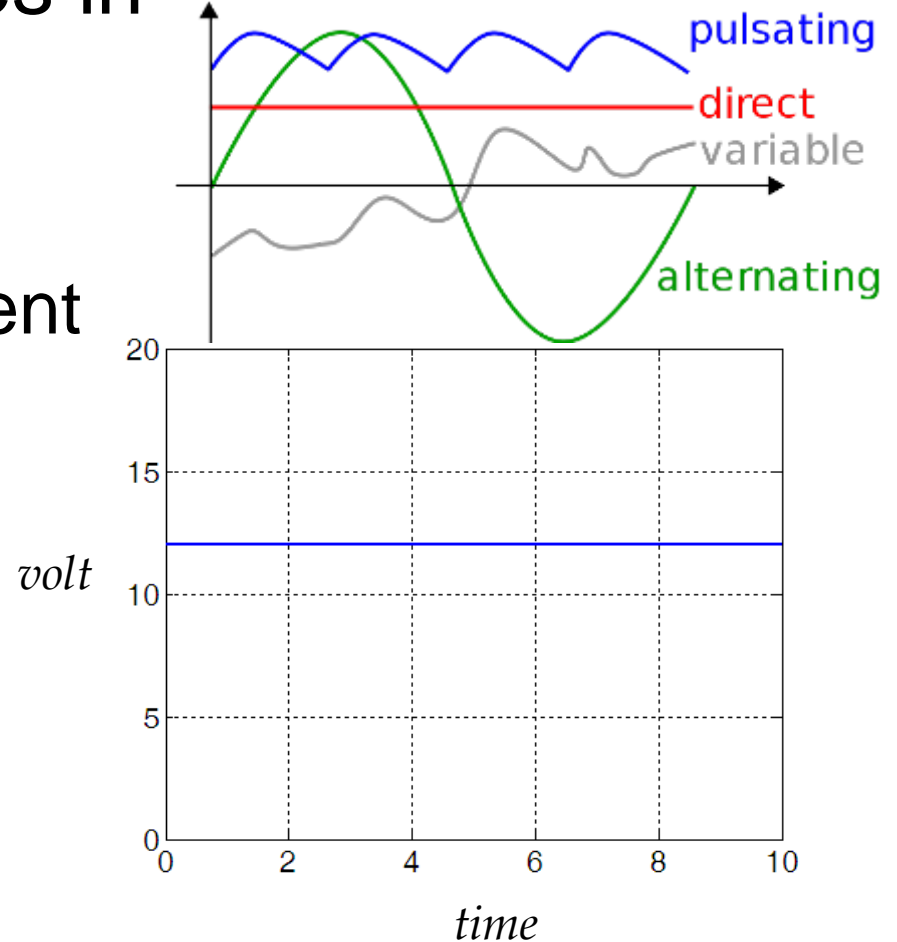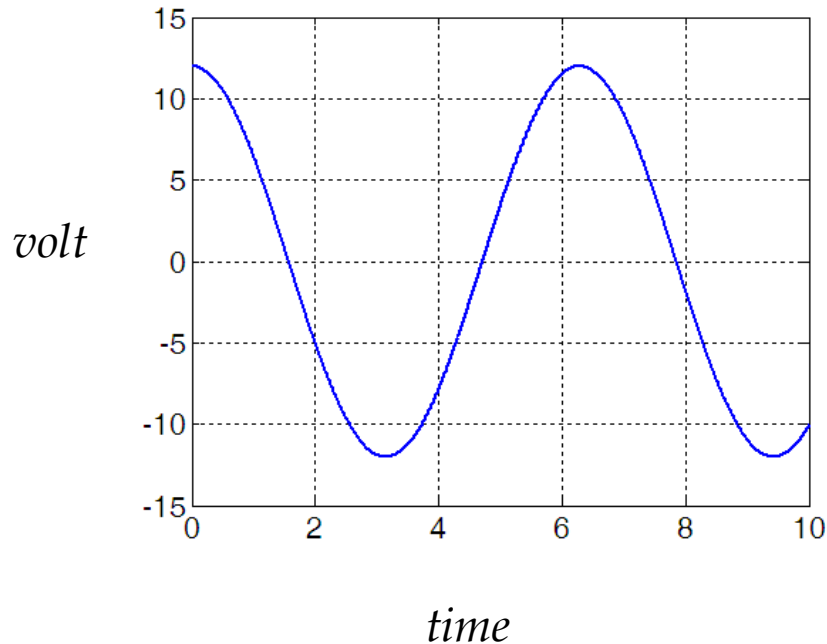 - 1.5V, 110V, 13.8kV

Model AMA-100

AC and DC Currents

- Cascade 73 batteries in series. Do they generate 110V?
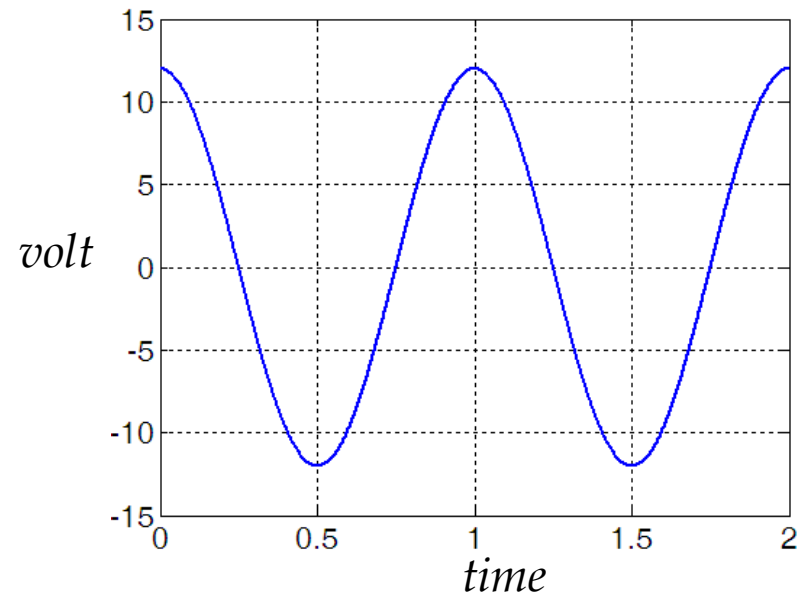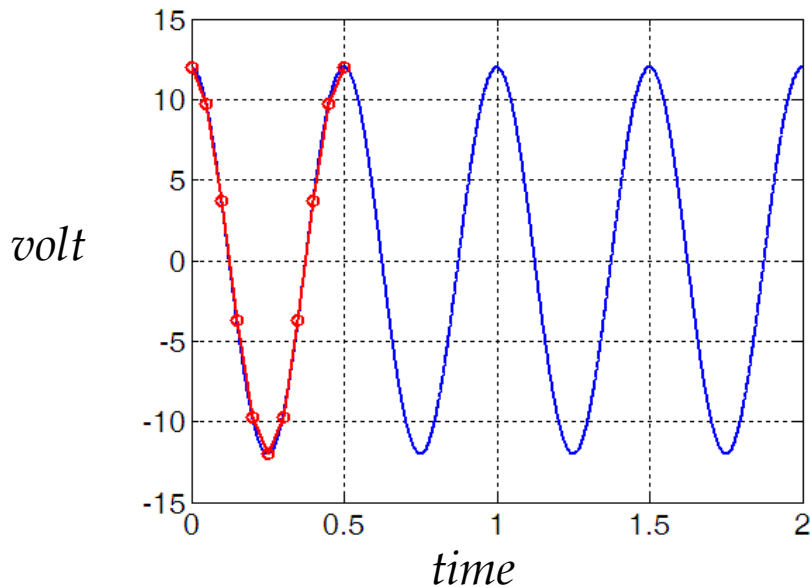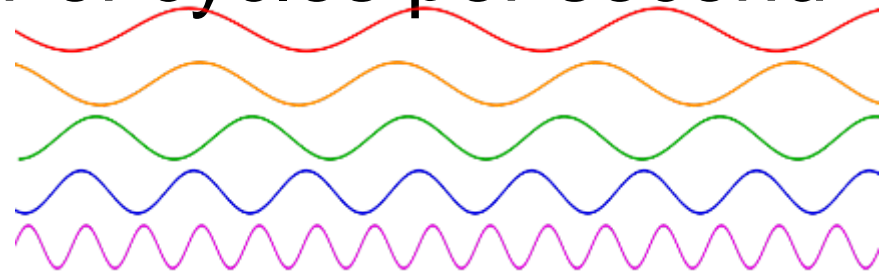 - DC: direct current
  - AC: alternating current

pulsating

direct

variable

alternating

volt

time

volt

time

Frequency of AC Signal

- Frequency = Number of cycles per second
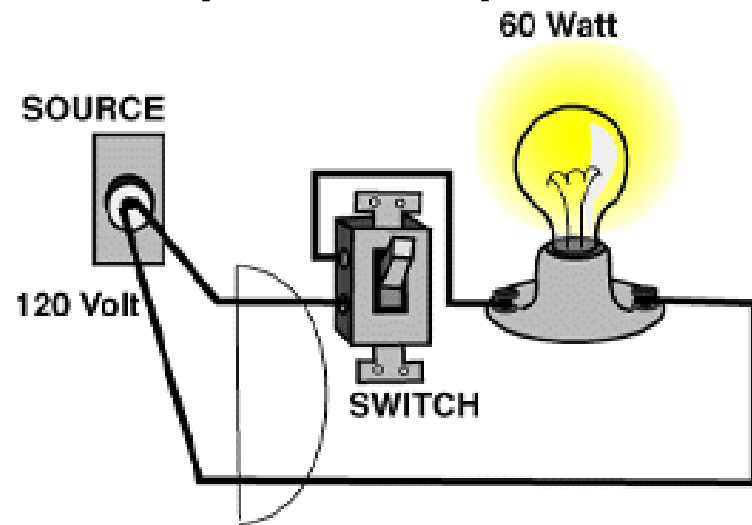
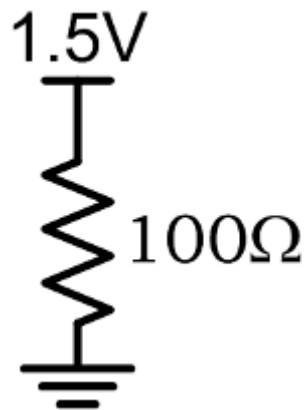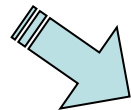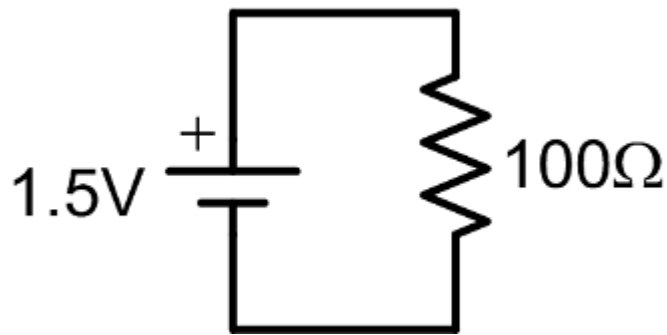$$f = \frac{1}{T}$$

Experiment!!

- What's the highest frequency your eyes can notice?
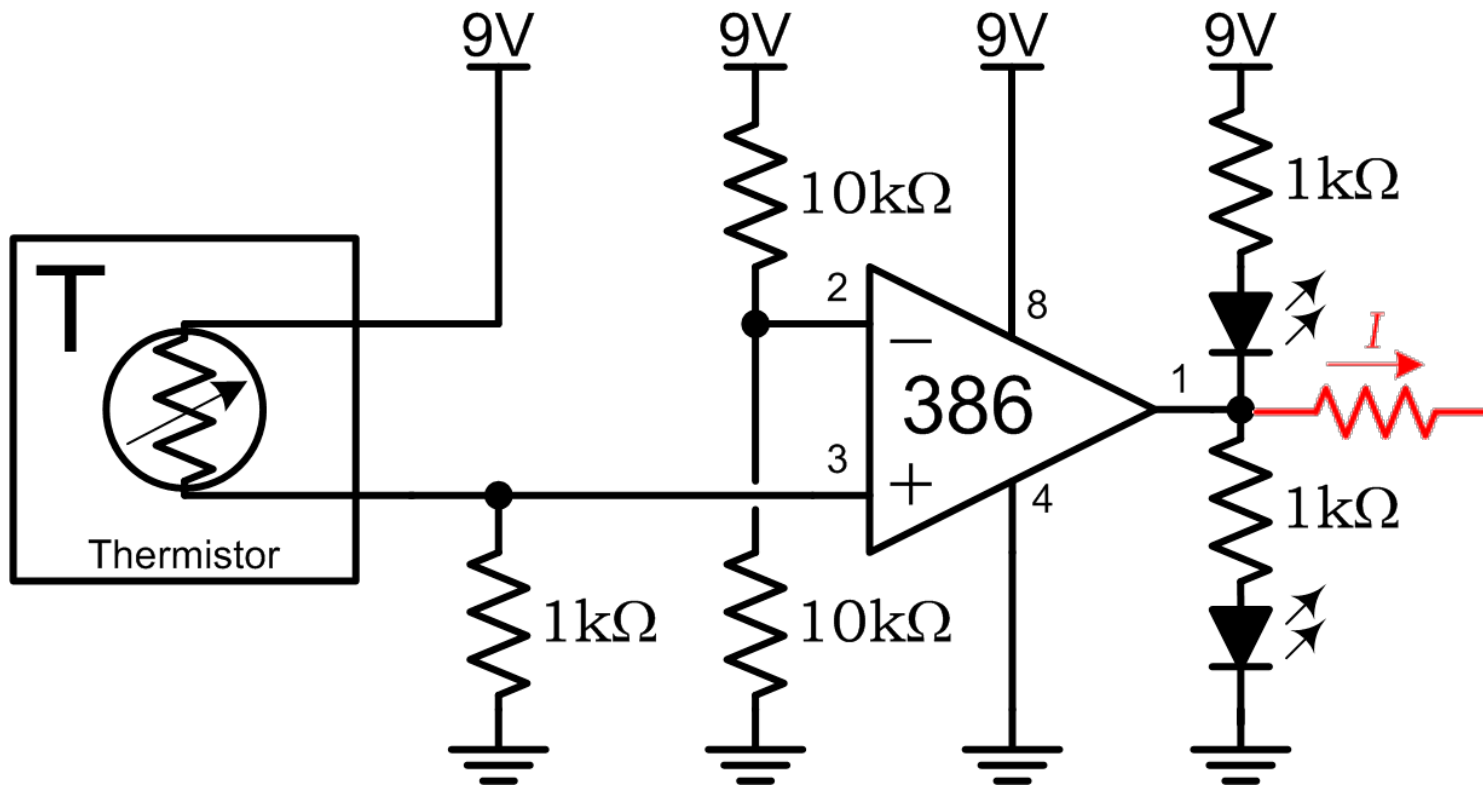 - *frequency vs. amplitude*

- What is the frequency of 110V battery?

Closed Loop Circuits

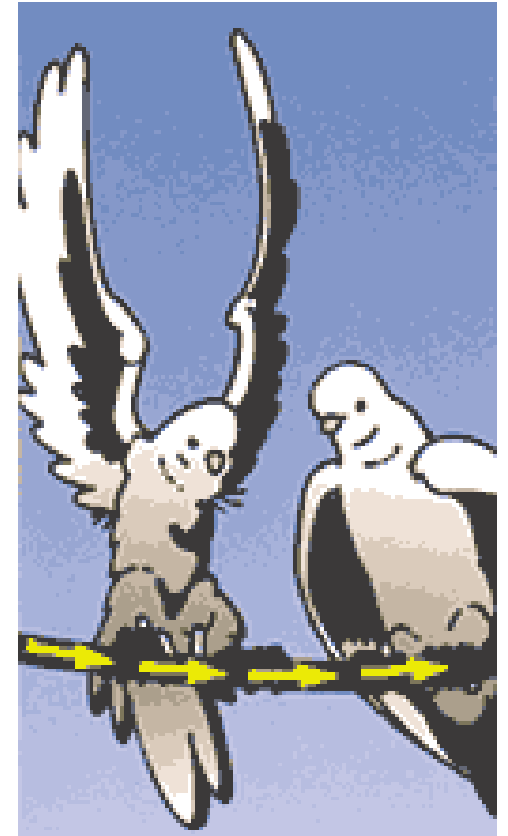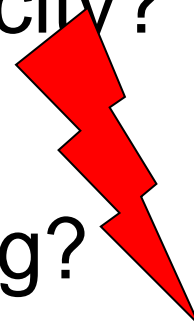- No current will flow in an open loop circuit..

Closed Loop Circuits

Ground Currents

1. Why birds do not get shocked by high voltage lines?

2. Can you safely touch one node of home electricity?
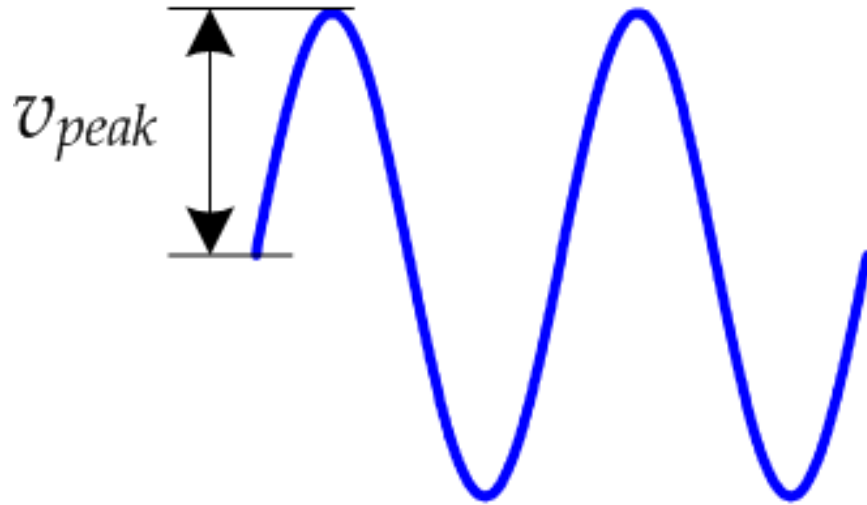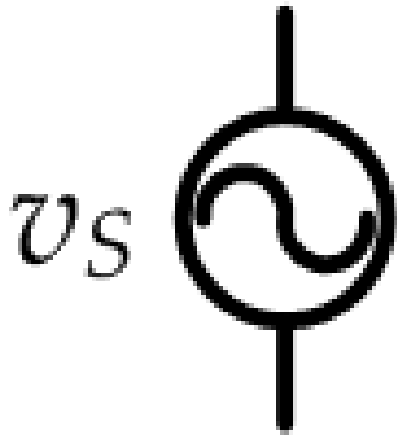
3. What about lightening?

Current

- Number of electrons passing every second
- Ampere (A) is a unit of current
  - 1 A = 6.28 x 10^{18} electrons/sec

- At home: 60A,100A (20A per phase)
- Electronics: 10mA

AC Source

- Generally produces sine wave

$$v_s = v_{peak} \times \sin(\omega \times t)$$

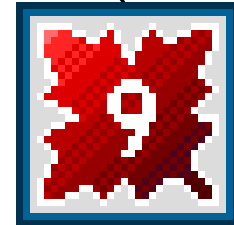$$v_s = v_{peak} \times \sin(2\pi \times f \times t)$$

RMS

- RMS: Root Mean Square
  - power is measured instead of peak voltage

$$RMS \equiv \sqrt{\frac{1}{T}\int_0^T v^2(t)\cdot dt}$$

  - for sine or cosine signals, $v(t) = A\cos(2\pi t/T)$

$$RMS = \frac{v_{peak}}{\sqrt{2}}$$

RMS

- If your meter reads $10V\sim$

  – then v_{peak} = 10*1.4 = 14V

- If your peak voltage is $154V_p$

  – then the meter reads RMS = 154*0.7 = 110V$\sim$