Circuits and Capacitors

I. Current, Power, Resistance
   - resistivity
   - internal resistance

II. Circuit Analysis
   - series and parallel
   - nodes, loops, switches

III. Capacitance
   - parallel plate capacitor
   - capacitors in circuits

	The student will be able to:	HW:
1	Define electric current and the ampere and solve problems relating current to charge and time and to power and voltage.	1 – 3
2	Define resistance, resistivity, and the ohm and Ohm's Law and solve related problems.	4 – 10
3	Define and apply the concepts of internal resistance and emf to solve related problems with the standard model of the terminal voltage of voltaic cells.	11 – 14
4	Determine resistance for series or parallel combinations of resistors, state and apply Kirchoff's node and loop rules and solve related problems, including analysis circuits with multiple batteries, resistors, and switches.	15 – 20
5	Define capacitance and relate to charge, voltage and energy to solve related problems involving capacitors in circuits at steady states of charge or discharge and qualitatively describe transitions of such states.	21 – 29
6	State the relation between capacitance, area, separation, and dielectric constant for parallel plate capacitors and solve related problems.	30 – 35

Electric current is defined as the rate at which charge passes through. (typically the rate of flow through a wire in a circuit)

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

where: Δq = amount of charge crossing an imaginary plane

Δt = amount of time for this to occur

Units of Electric Current

- The SI unit for electric current is the **ampere**.
- One ampere is equal to one coulomb of charge per one second:

$$1\ \text{A} = 1\ \text{C/s}$$

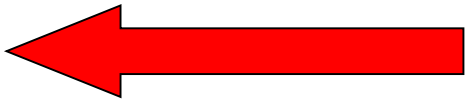
- Although current is not a vector, it is taken to be positive in the direction that positive charges flow (or *would* flow).

AC versus DC

There are two common types of current: AC and DC.

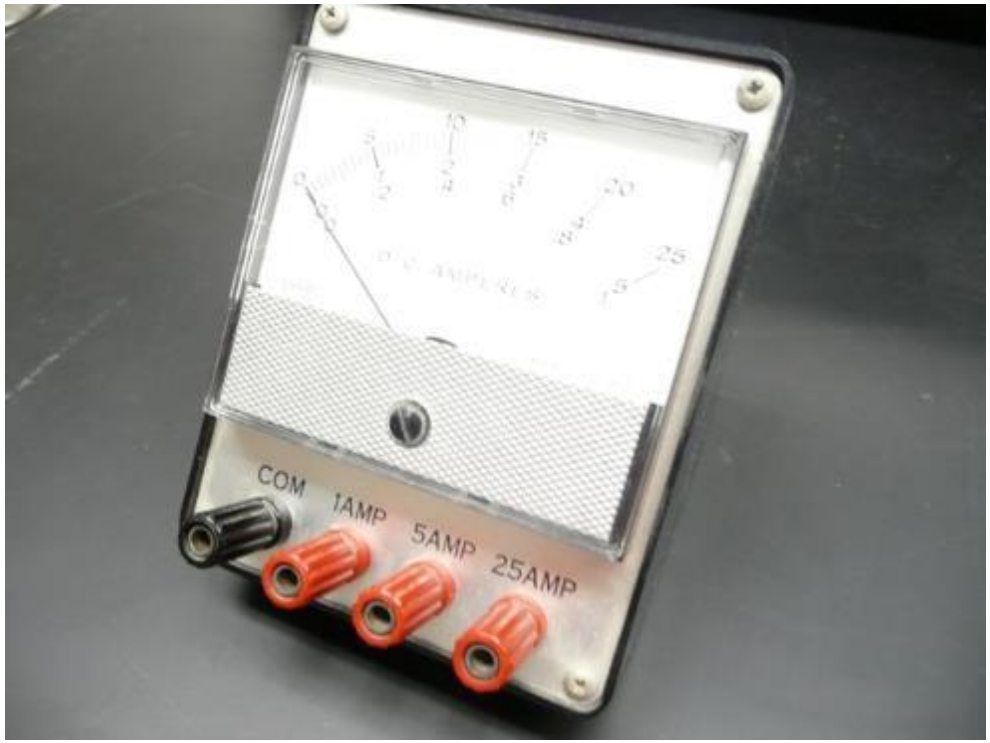
AC stands for **Alternating Current** and means that charge oscillates and travels in alternating directions.

DC stands for **Direct Current** and means that charge travels in only one direction.



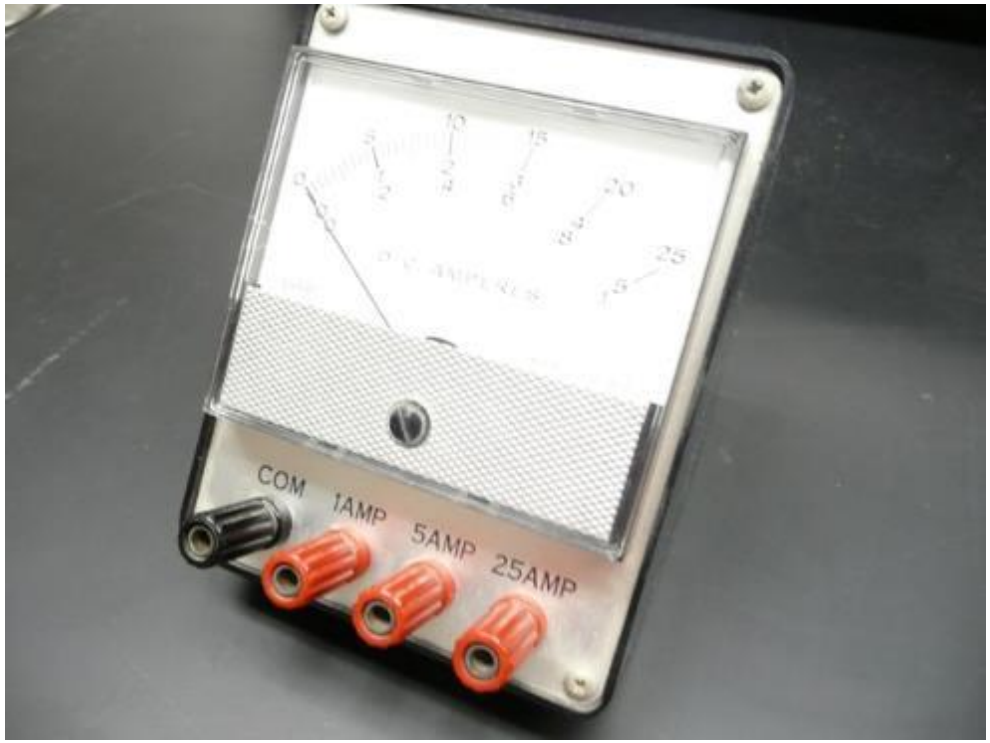
Measuring Electric Current

Digital Multimeter



Analog Ammeter

Either device can indicate the current that flows in one lead and out the other.



A **fuse** is an electrical device that is designed to limit current to a certain value. If too much current passes through it the fusable link will melt and break the circuit.

This is a 30-amp fuse. It will "blow" if the current passing through it exceeds 30 amperes.

Electric Power is the rate at which electric energy is transformed or transferred. This depends on electric potential and current:

$$P = VI$$

where: V = voltage *across* a device

I = current *through* the device