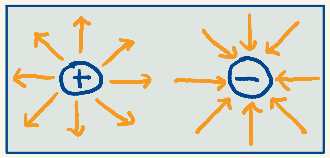
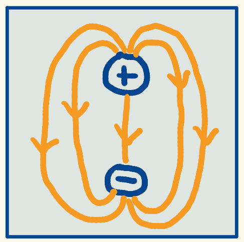
Point Charge

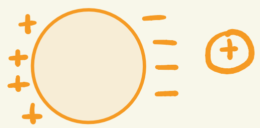
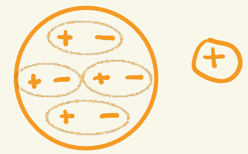
- Superposition — Electric fields add up
- Coulombic Forces
- Electric fields change @ the speed of light



Dipoles



- can be induced or permanent
- dipoles always net neutral charge
- dipole moment: $\vec{p} \equiv q\vec{s} = \alpha \vec{E}_{applied}$
- polarizability (α) is material specific
- A dipole under an applied electric field will have a torque

Conductors	Insulators
Have mobile charges: e^-s can move to find equilibrium	Charges are bound to nuclei of atoms
Entire object polarizes: 	Individual molecules polarize: 
For equilibrium, $\vec{E}_{inside} = 0$	For equilibrium, $\vec{E}_{inside} \neq 0$
Excess charge can only be on surface	Excess charge can be put on surface or throughout volume
Metals (like Cu, Au, Ag, etc.)*	Usually compounds (like plastic, glass, air, etc.)

* ions in liquids are also mobile charges and will conduct

- In conductors, e^- have average drift speed $\bar{v} = u E$

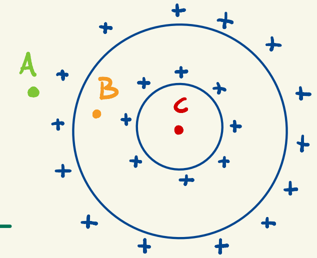
Units + Constants

- u = electron mobility
- $\alpha \left(\frac{C \cdot m^2}{V}\right)$ = polarizability
- $\vec{p}$ $(C \cdot m)$ = dipole moment

Objects of Charge

process: add up infinitesimal charges (integration!) over some volume

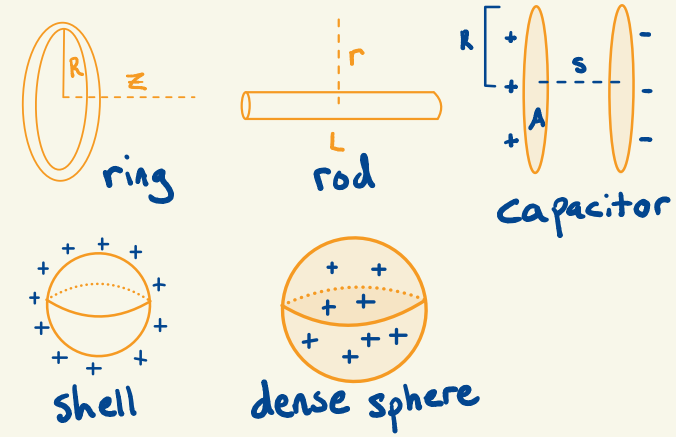
Concentric Shells:



$\vec{E}_C = 0$

$\vec{E}_B = \vec{E}_{inner\ shell}$

$\vec{E}_A = \vec{E}_{outer\ shell}$



Potential + Energy

- an object (with m or q) at a location in a field ($\vec{g}$ or $\vec{E}$) will have a potential energy. We can remove the object and just look at that location in the field and get a potential for that location. This is more useful in electricity, when there's different kinds of objects that could exist there (positive or negative q).

	Gravity	Electricity
force interacts with:	mass m	charge q
field:	earth $\vec{g}$	$\vec{E}$
force:	$m\vec{g}$	$q\vec{E}$
Potential energy:	mgy	qEy
Potential:	gy	$Ey = V$