The Big Ideas L9-18

Kirchoff's Rules

- Sum of voltages around a loop is zero
- Sum of currents into a node is zero
- Kirchoff's rules with capacitors and inductors
  - In RC and RL circuits: charge and current involve exponential functions with time constant: "charging and discharging"
  - E.g. $IR + \frac{Q}{C} = V$
- Capacitors and inductors store energy

Magnetic fields

- Generated by electric currents (no magnetic charges)
- Magnetic forces only on charges in motion $\vec{F}_{mag} = q\vec{v}x\vec{B}$
- Easiest to calculate with Ampere's Law $\oint \vec{B} \cdot d\vec{\ell} = \mu_0 I_{enclosed}$
- Changing magnetic fields can generate electric fields! FARADAY'S LAW

$$\int \vec{E} \cdot d\vec{\ell} = EMF = \Delta V = -\frac{d}{dt}\int B \cdot dA = -\frac{d\phi_{mag}}{dt}$$