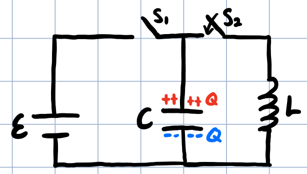
LC Circuit



After S_1 has been closed for a long time, open S_1 and close S_2; generates AC current

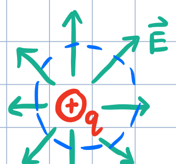
$-\frac{q}{C} - L\frac{dI}{dt} = 0 \rightarrow \frac{q}{C} + L\frac{d^2q}{dt^2} = 0 \rightarrow \frac{d^2q}{dt^2} = -\frac{1}{LC}q \rightarrow q_c = Q\cos(\omega x),\ \omega = \sqrt{\frac{1}{LC}}$

$I = \frac{dq}{dt} = -Q\omega\sin(\omega t)$

$U_c = \frac{1}{2} \times \frac{q^2}{C} = \frac{Q^2}{2C}\cos^2(\omega t),\ U_I = \frac{1}{2}LI^2 = \frac{LQ^2\omega^2}{2}\sin^2(\omega t) = \frac{Q^2}{2C}\sin^2(\omega t) \rightarrow U_{tot} = \frac{Q^2}{2C}$; energy conserved

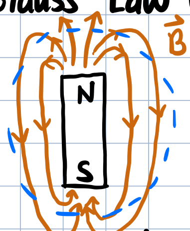
Maxwell's Equations

- "Consolidated E+M equations"
  - Gauss' Law for Electrostatics:



$\Phi_E = \oint \vec{E} \cdot d\vec{A} = \frac{Q_{encl}}{\varepsilon_0}$

  - Gauss' Law for Magnetism



$\Phi_M = \oint \vec{B} \cdot d\vec{A} = 0$

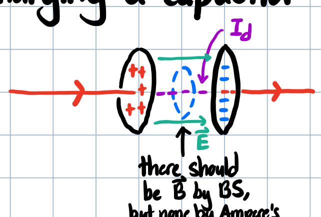
  - Faraday's Law of Induction

$\varepsilon = \int \vec{E} \cdot d\vec{s} = -\frac{d}{dt}\int \vec{B} \cdot d\vec{A}$

  - Ampere-Maxwell Law

Ampere's Law:  $\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{encl}$; doesn't work for everything

Charging a capacitor:



There's something "like a current"; displacement current I_d

$I_d = \frac{dq}{dt} = \frac{d}{dt}(\underbrace{C}_{\varepsilon_0 \frac{A}{d}}\varepsilon) = \frac{d}{dt}(\varepsilon_0 \frac{A}{d} Ed) = \frac{d}{dt}(\varepsilon_0 EA) = \frac{d}{dt}(\varepsilon_0 \times \int \vec{E} \cdot d\vec{A})$

Ampere-Maxwell: $\oint \vec{B} \cdot d\vec{s} = \mu_0 [I_{encl} + I_d] = \mu_0 [I_{encl} + \varepsilon_0 \frac{d}{dt}(\oint \vec{E} \cdot d\vec{A})]$