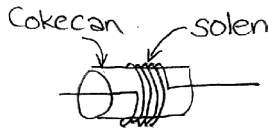
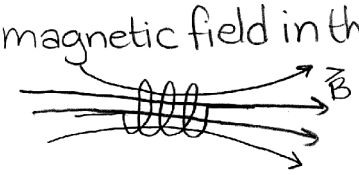
Analysis of the electromagnetic can crusher

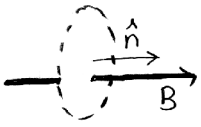




Faraday's law:

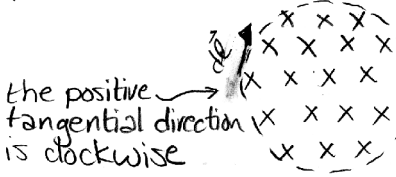
$$\oint \vec{E}\cdot d\vec{\ell} = -\frac{d}{dt}\int_S B_n\, dA = -\int \frac{\partial B_n}{\partial t}\, dA = -\frac{d\Phi_m}{dt}$$

To analyze $-\frac{d}{dt}\int_S B_n dA$ we analyze the magnetic field through a surface the slices through a cross sectional area of the coil



initially you get a rapidly rising current, thus a rapidly rising magnetic field through the coil $\frac{d\Phi_m}{dt} > 0$

looking at this from the end with $\vec{B}$ going in to the page



choose the normal to the surface $\hat{n}$ to be into the page, once $\hat{n}$ is chosen, $d\vec{\ell}$ is determined by the right hand rule

Since

$$\oint \vec{E}\cdot d\vec{\ell} = -\frac{d\Phi_m}{dt}$$

and $\frac{d\Phi}{dt} > 0$ then $\vec{E}$ must be antiparallel to $d\vec{\ell}$

$\vec{E}$ is counterclockwise

The poynting vector tells us the direction of the intensity

$$\vec{S} = \frac{\vec{E}\times\vec{B}}{\mu_0}$$

If $\vec{E}$ is counterclockwise and $\vec{B}$ is into the page $\vec{S}$ is everywhere pointed toward the center of the solenoid.