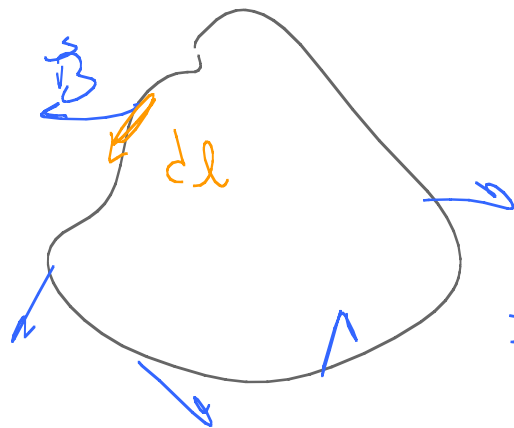


# Magnetism

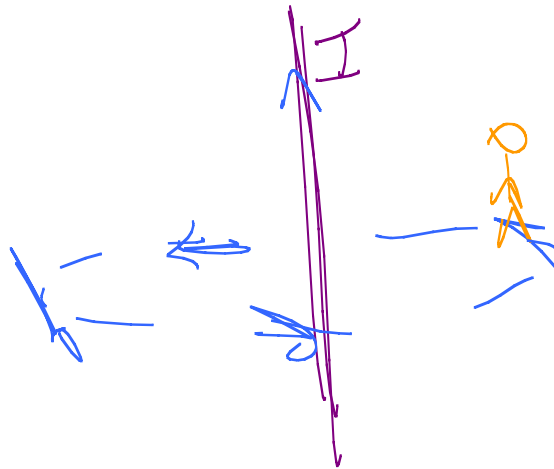


$$\vec{B} \cdot d\vec{l}$$

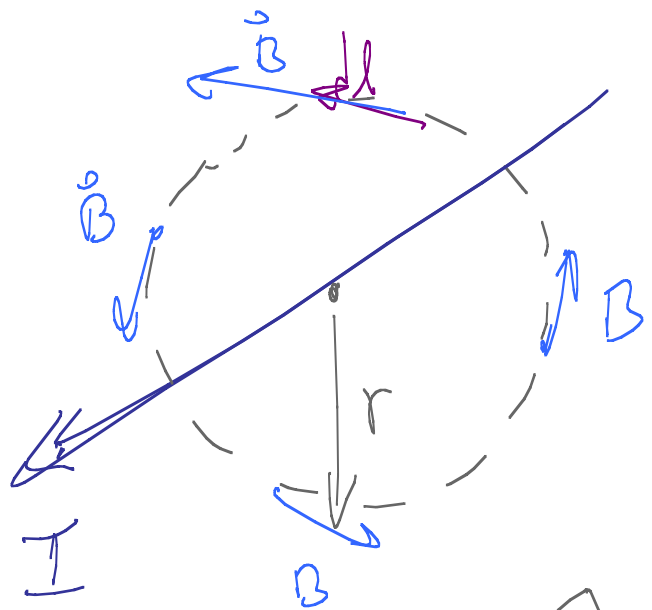


$$\oint \vec{B} \cdot d\vec{l}$$

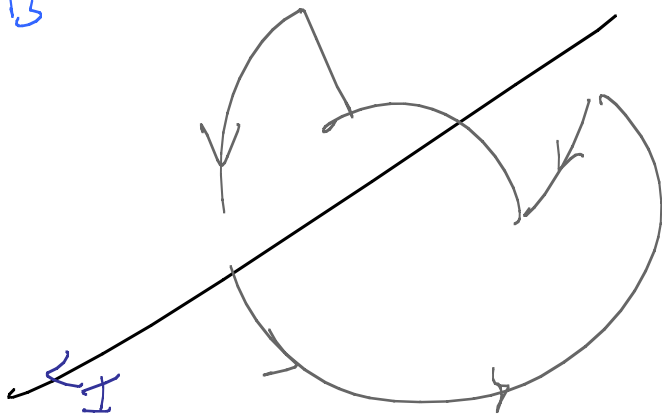
line integral  
of  $\vec{B}$  field



$$B = \frac{\mu_0 I}{2\pi r}$$



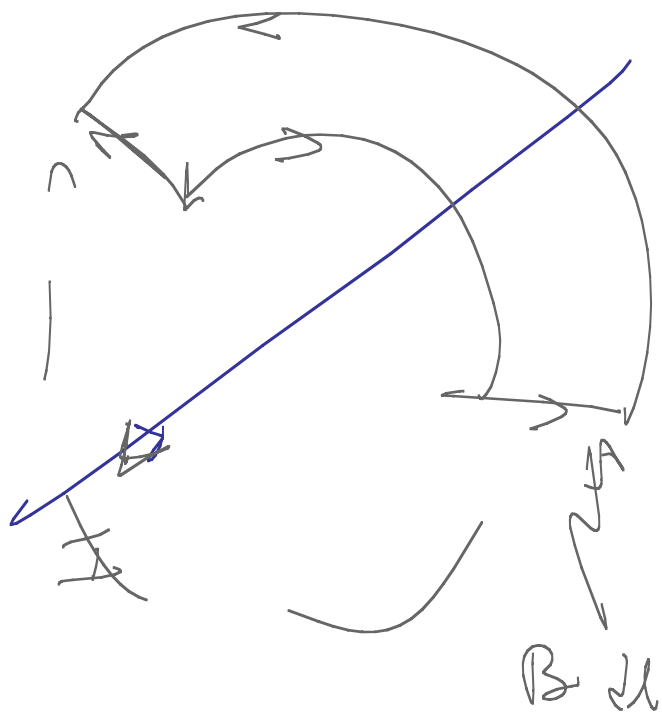
Try:



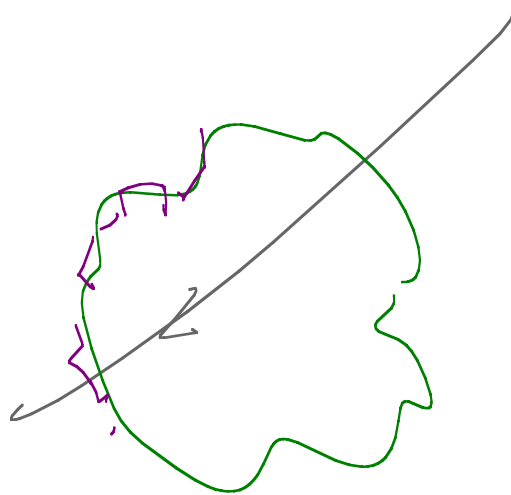
$$\oint \vec{B} \cdot d\vec{l} \quad \text{easy}$$

$$= \frac{\mu_0 I}{2\pi r} 2\pi r = \mu_0 I$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

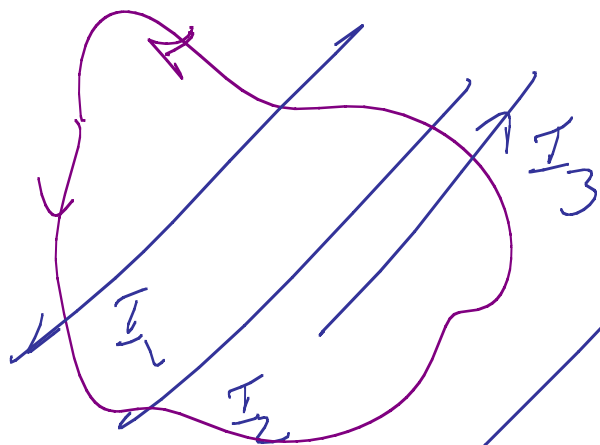


$$\oint \vec{B} \cdot d\vec{l} = 0$$



Wire,

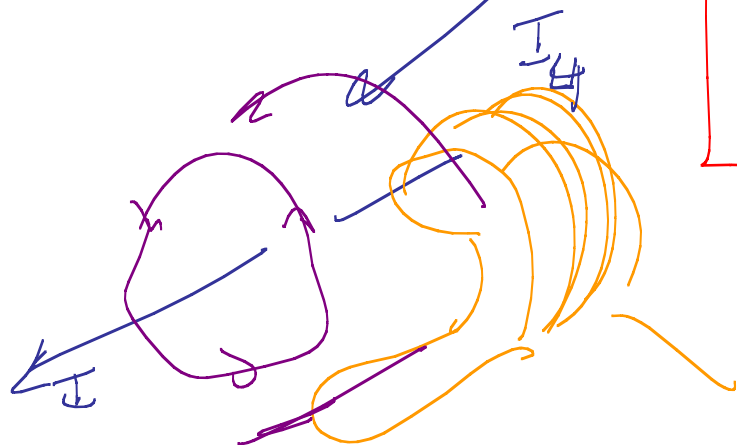
$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{\text{enc.}}$$



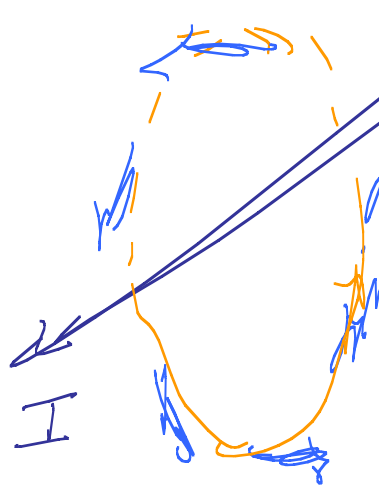
$$\oint \vec{B} \cdot d\vec{\ell} = \mu_0 I_{\text{enclosed Total}}$$

$$= \mu_0 (I_1 + I_2 - I_3)$$

$$\oint \vec{B} \cdot d\vec{\ell} = \mu_0 I_{\text{enclosed}}$$



## Ampere's Law

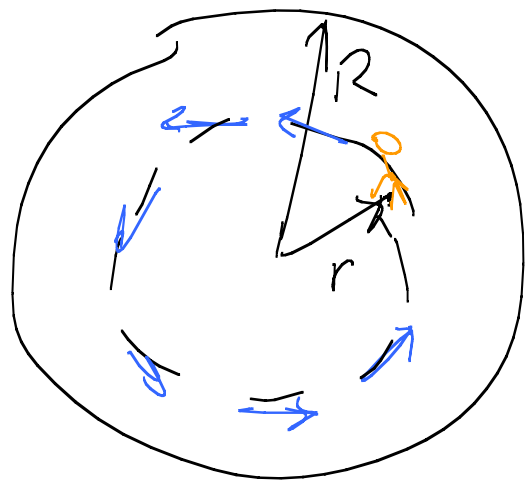


$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

$$B \cdot 2\pi r = \mu_0 I$$

$$B = \frac{\mu_0 I}{2\pi r}$$

# Magnetic Inside Fat Wire



$$r < R$$

$$\oint \vec{B} \cdot d\vec{l} = B(2\pi r)$$

$$= \mu_0 I_{\text{enc}} = \mu_0 \pi r^2 \left( \frac{I}{\pi R^2} \right) = \frac{\mu_0 r^2 I}{R^2}$$

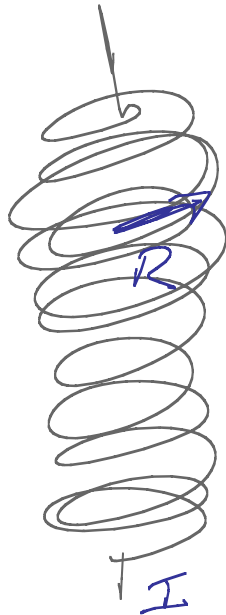


$$A = \pi R^2$$

$$J = \frac{I}{A} = \frac{I}{\pi R^2}$$

$$B = \frac{\mu_0 I r}{2\pi R}$$

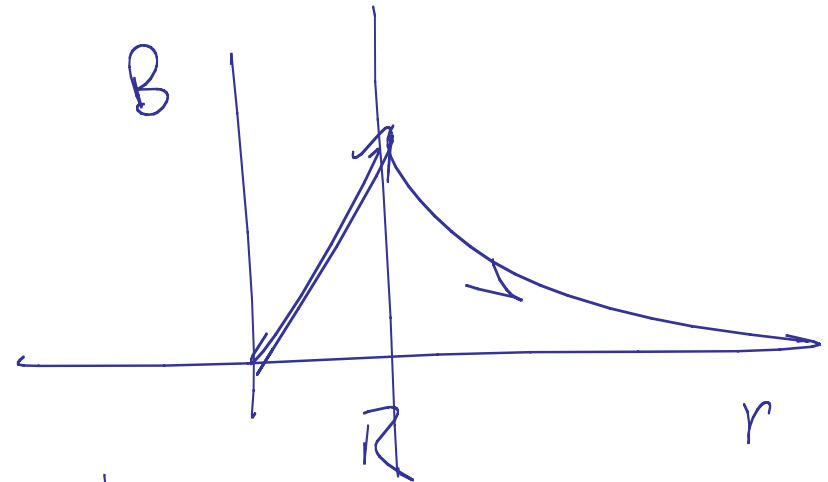
Solenoid



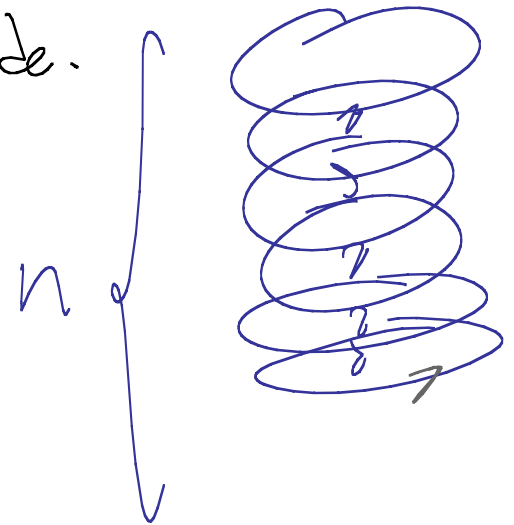
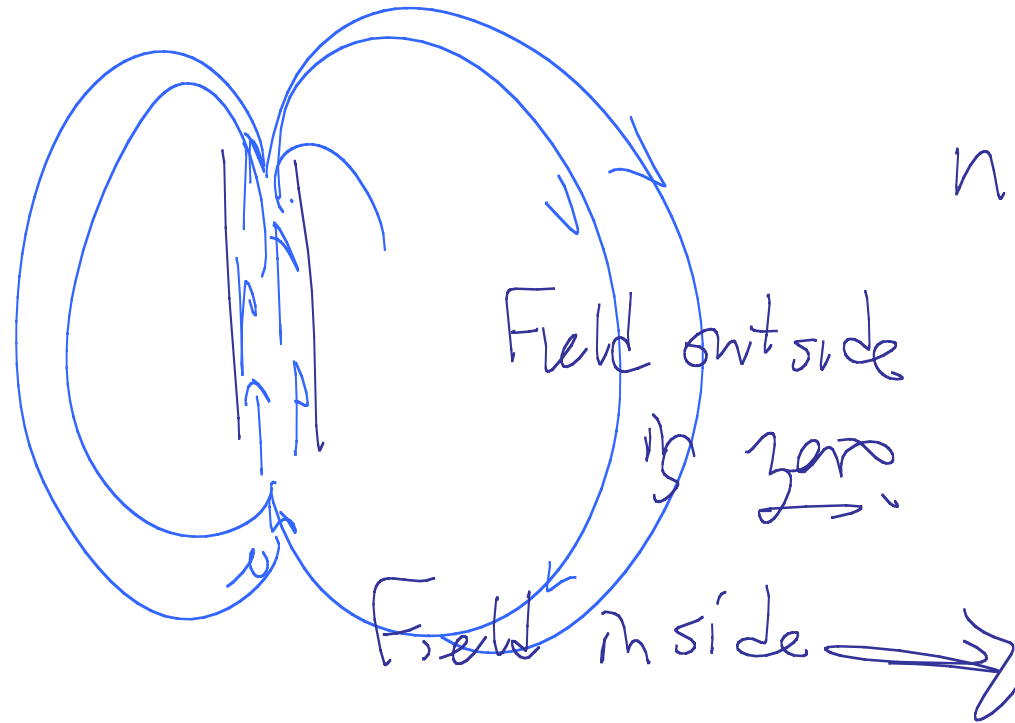
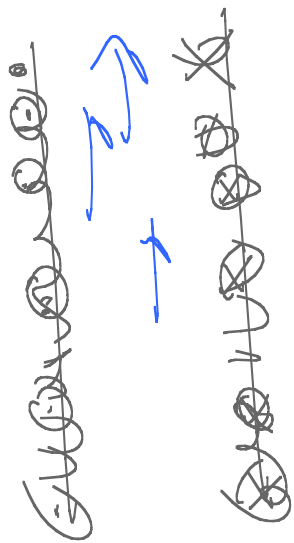
Length  
 $\gg$  radius  
 Infinite!

$$n = \frac{\# \text{ turns}}{\text{length}}$$

$$\left( \frac{1}{r} \right)$$



We want  $B$  inside  $B$  field outside.







$$\int \vec{B} \cdot d\vec{l} = \mu_0 I_{\text{enc}}$$

B field uniform on inside.

$$\int \vec{B} \cdot d\vec{\ell} = -B\ell = \mu_0 I_{\text{enc}}$$

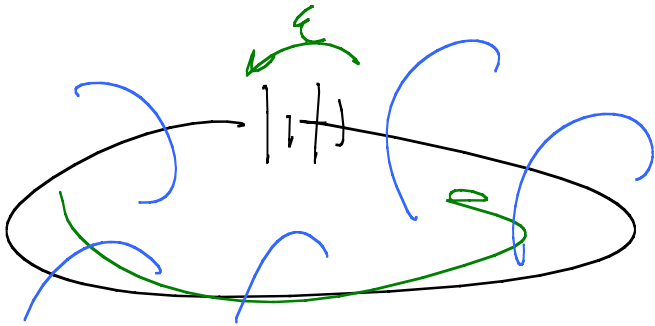
Qn 1

Into board

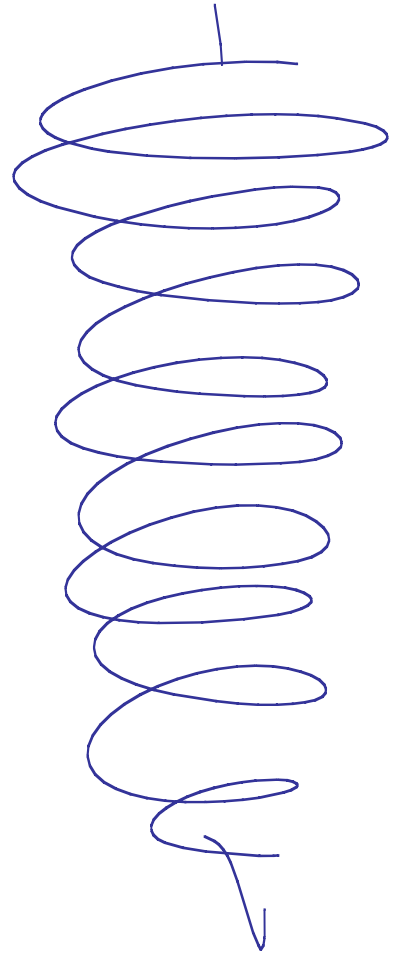
Equation  $B = \mu_0 n I$

Chap 27 EM Induction

Are  $\vec{E}$  &  $\vec{B}$  related?

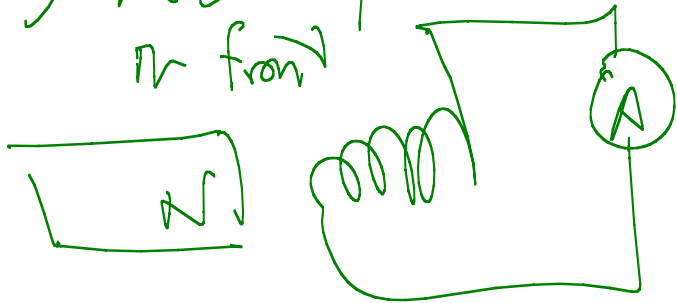


Yes in an  
abstract



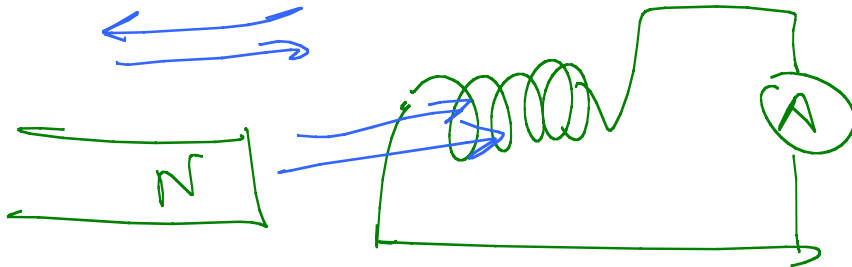
## Several expts

0) Hold magnet  
in front



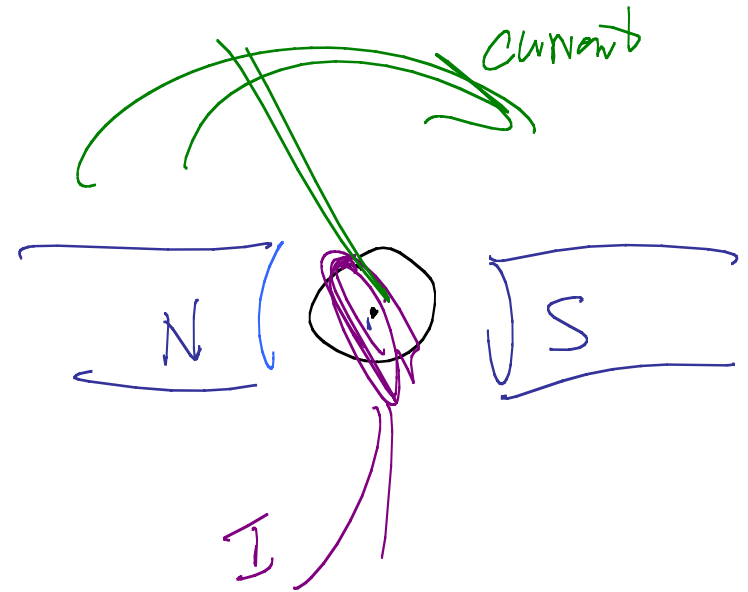
nothing happens.

1)

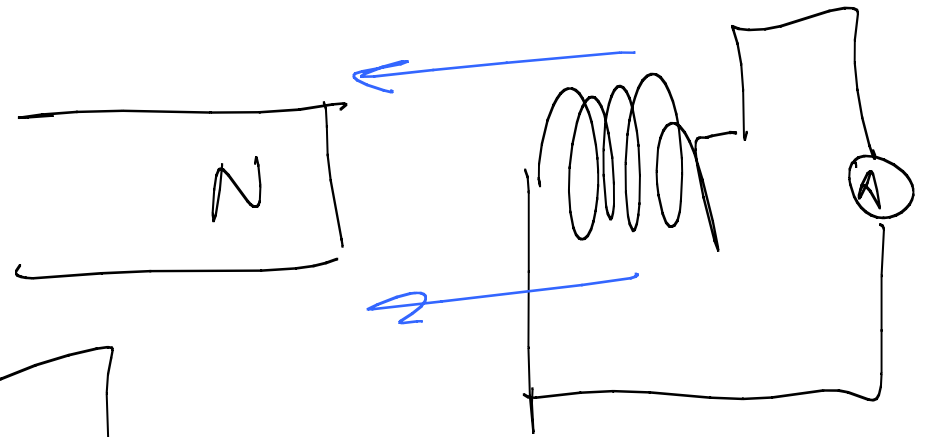


When magnet  
is in motion, current

## Galvanometer



2) Get current if coil is motion.



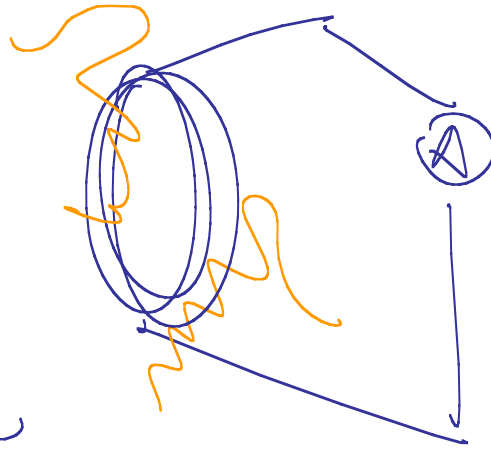
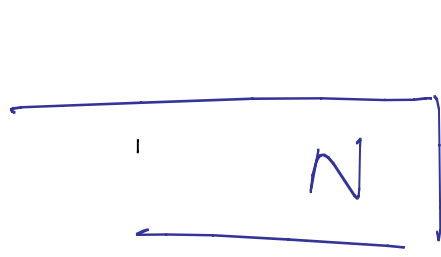
3)

A diagram showing two coils. The left coil is connected to a battery and a switch. The right coil is connected to an ammeter (A). Blue arrows show magnetic field lines passing from the left coil to the right coil. A green arrow above the left coil points to the right, indicating its motion.

EM Induction.

Throw switch,  
get current in second

Induced current



Change shape

→ Get current.

What do they have in common.

Changing  $\vec{B}$  field around 2<sup>nd</sup> coil  $\Rightarrow$  Induced current.

$$\Phi_B = \int_S \vec{B} \cdot d\vec{A}$$