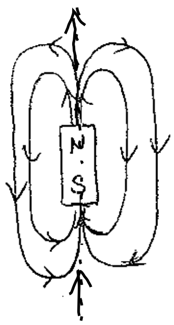
MAGNETISM SUMMARY

Magnetic fields produced by:

MAGNETS:

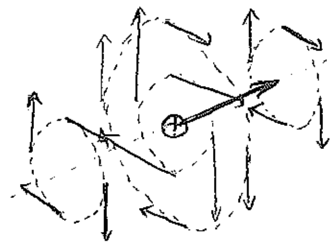


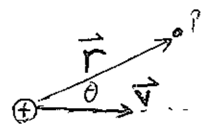
$$|\vec{B}| = \frac{\mu_0}{4\pi}\frac{2\mu}{r^3}$$

(μ ← magnetic moment)

on axis of magnet at distance $r >>$ size of magnet

MOVING CHARGES.





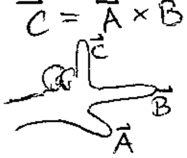
$$\vec{B}_p = \frac{\mu_0}{4\pi} q \frac{\vec{v}\times\vec{r}}{r^3}$$

↖ magnitude

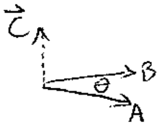
$$\frac{\mu_0}{4\pi}\frac{qv}{r^2}\sin\theta$$

ASIDE: cross product

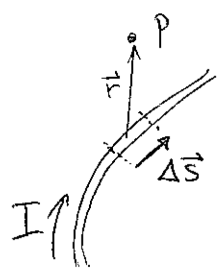
$\vec{C} = \vec{A}\times\vec{B}$ - perpendicular to $\vec{A}$ & $\vec{B}$



- magnitude $|\vec{A}||\vec{B}|\sin\theta$

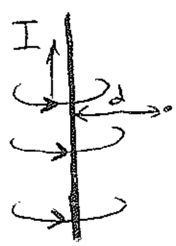


CURRENTS:



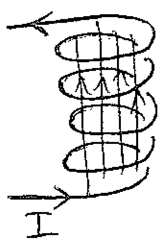
$\vec{B}$ from this segment at point p:

$$\vec{B} = \frac{\mu_0}{4\pi} I \frac{\Delta\vec{s}\times\vec{r}}{r^3}$$



$$|\vec{B}| = \frac{\mu_0}{2\pi}\frac{I}{d}$$

$$|\vec{B}|_{center} = \frac{\mu_0}{2}\frac{I}{R}$$

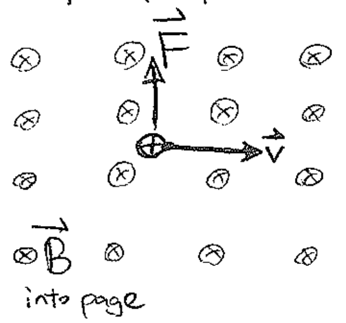


$\vec{B}$ constant inside

$$|\vec{B}| = \mu_0 \frac{N}{L} I$$

SUPERPOSITION PRINCIPLE: $\vec{B}$ at point p is the sum of $\vec{B}$ from each individual charge (or each individual segment of current-carrying wire)

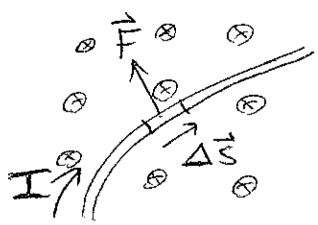
Magnetic field: results in forces/torques on magnets, moving charges/currents



Force on a moving charge:

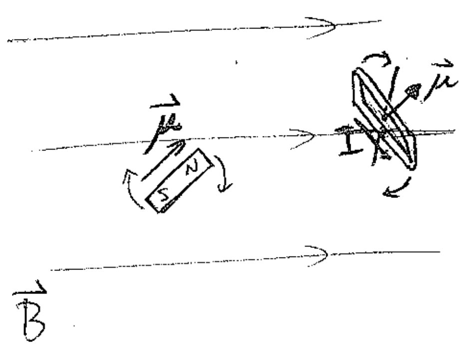
$$\vec{F} = q\vec{v} \times \vec{B}$$

Force on a segment of wire:



$$\vec{F} = I(\Delta\vec{s}) \times \vec{B}$$

Torque on a magnet or current loop:

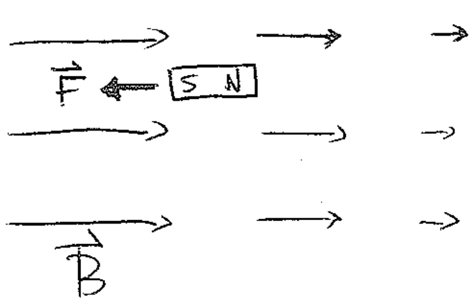


$$\vec{\tau} = \vec{\mu} \times \vec{B}$$

current loop: $|\vec{\mu}| = \text{Area} \times I$

$\vec{\mu}$ points from south pole to north pole

Force on magnet from non-constant magnetic field:



$$|\vec{F}| = \mu \frac{dB}{dx}$$