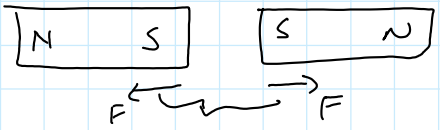
Phy 2B 2/9

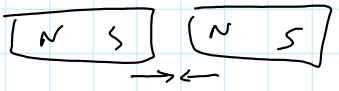
Monday, February 9, 2015 9:49 AM

Magnetic Fields and Forces (ch 22)

2 poles: North & South

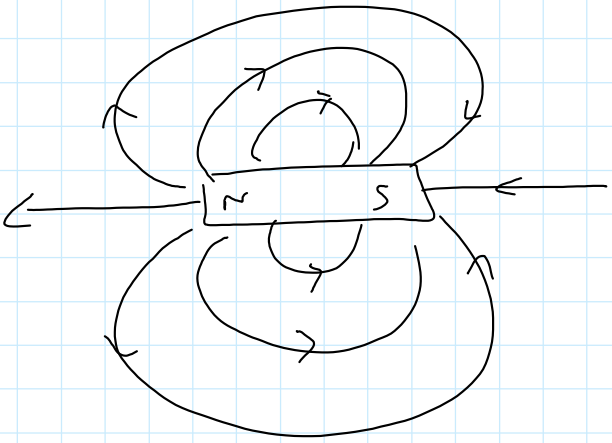


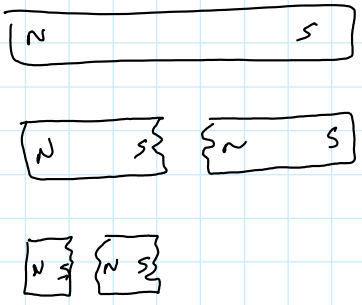
Like poles repel



opposite poles attract

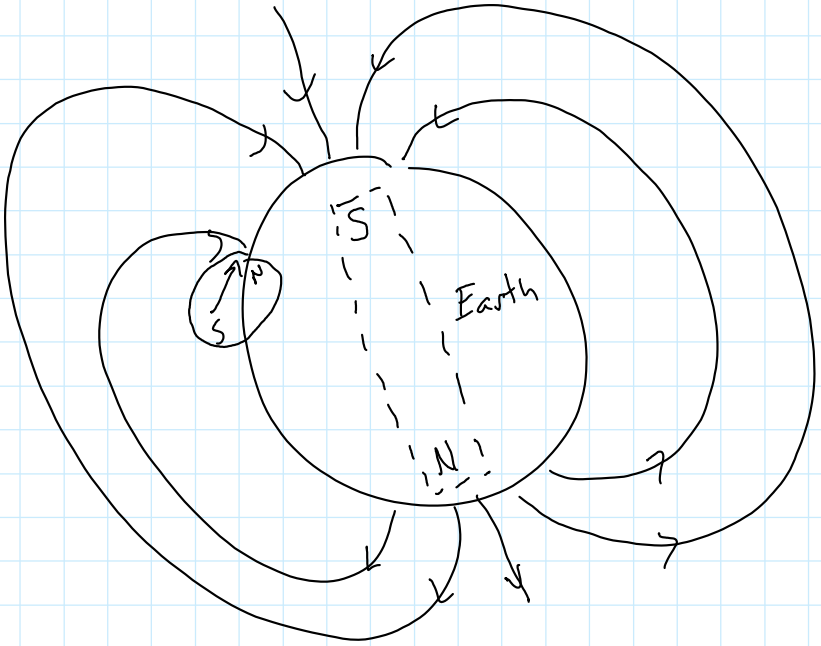
Field lines:



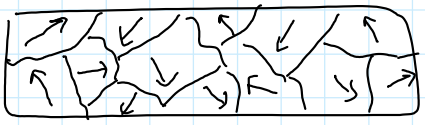


No magnetic monopoles

→ always get a N and S together



Iron

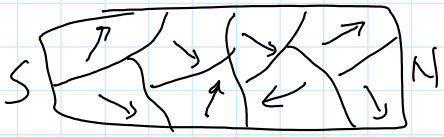


No Net magnetic moment

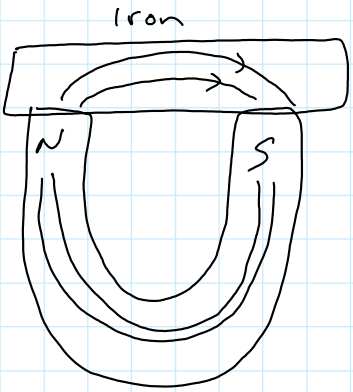
strong magnetic field

iron

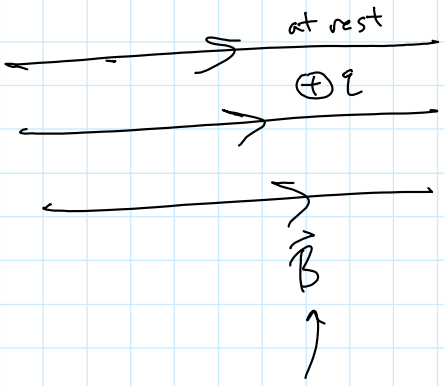
Remove external field



acts like a magnet



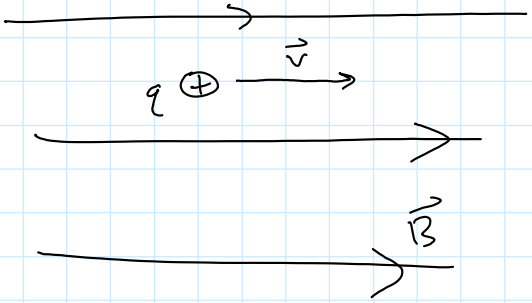
Magnetic Force



$F = 0$

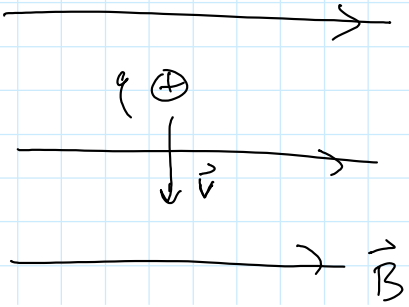
No force

use the symbol B for magnetic fields



$F = 0$

No force



$F \neq 0$

It feels a force due to the magnetic field

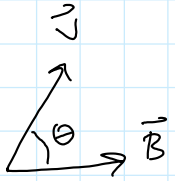
$\vec{B}$ due to the magnetic field

Force on a charged particle in a magnetic field:

$F_B \longrightarrow$ { q, B, v, orientation $\vec{v}$ and $\vec{B}$

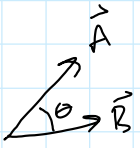
$$\vec{F}_B = q\,\vec{v} \times \vec{B}$$

$$|\vec{F}_B| = |q|\,|\vec{v}|\,|\vec{B}|\sin\theta$$



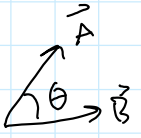
Dot Product:

$$C = \vec{A} \cdot \vec{B}$$
$$= |\vec{A}|\,|\vec{B}|\cos\theta$$



Cross Product:

$$\vec{C} = \vec{A} \times \vec{B}$$
$$|\vec{C}| = |\vec{A}|\,|\vec{B}|\sin\theta$$



$C = \vec{A} \times \vec{B}$

what is $\vec{B} \times \vec{A}$

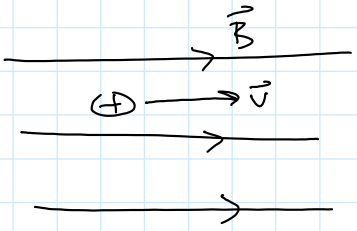
$\vec{B} \times \vec{A} = -\vec{A} \times \vec{B} = -\vec{C}$

$\bullet$ or $\odot$ out of page

$\times$ or $\otimes$ into page

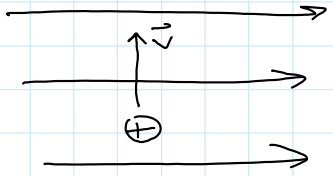
Examples of Right hand Rule

a)



$F = 0$

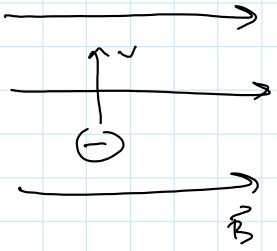
b)



$F = qvB\sin 90 = qvB$

Into Page

c)



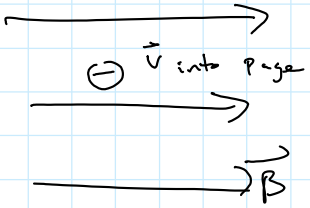
$\vec{v} \times \vec{B}$ is into page

$q\,\vec{v} \times \vec{B}$ is out of page

So, F is out of page

(since q is negative)

d)



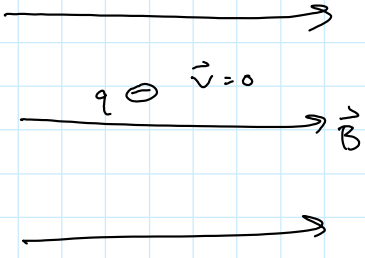
$\vec{v} \times \vec{B}$ is toward bottom of page

$q\,\vec{v} \times \vec{B}$ " " top " "

F " " " " "

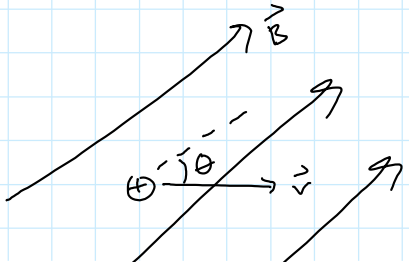
(since q is negative)

e)



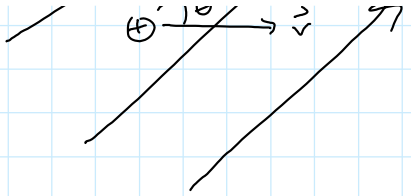
$F = 0$

f)

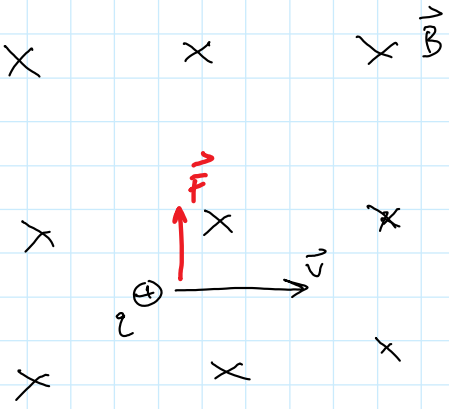


out of page

$F = qvB\sin\theta$



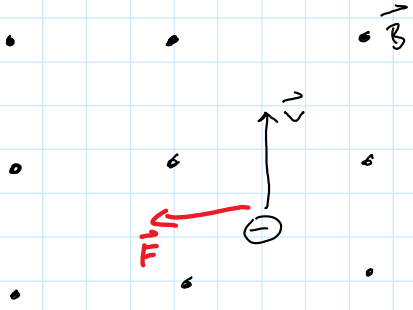
g)



$\vec{v} \times \vec{B}$ is toward top of page

q is positive, so F is also toward top of page

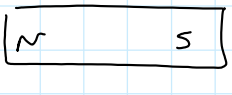
h)

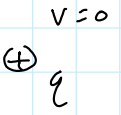


$\vec{v} \times \vec{B}$ is to the Right

q is Negative, so F is to the left

i)

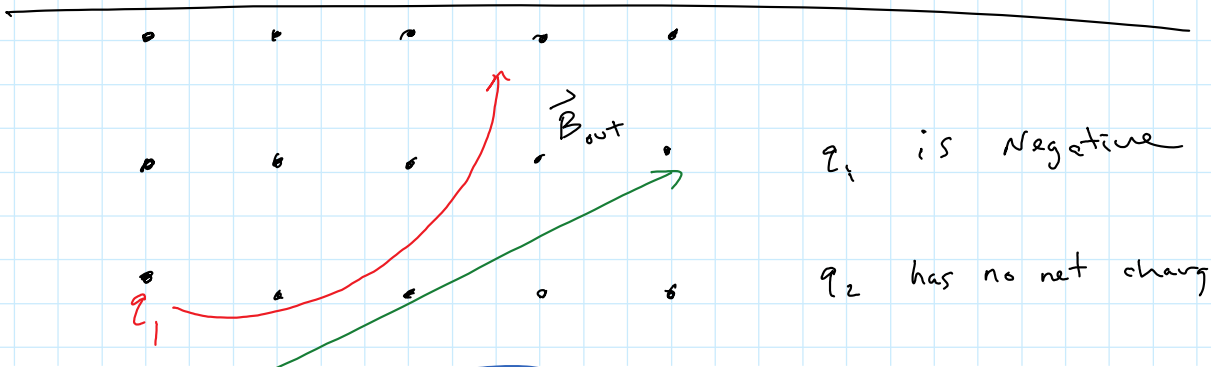




$F = 0$

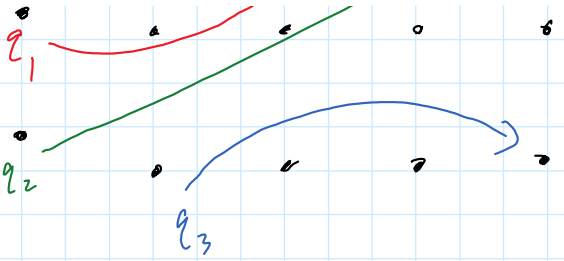
Magnetic field : B units are tesla T

$1\ T = 1 \frac{N}{Am}$



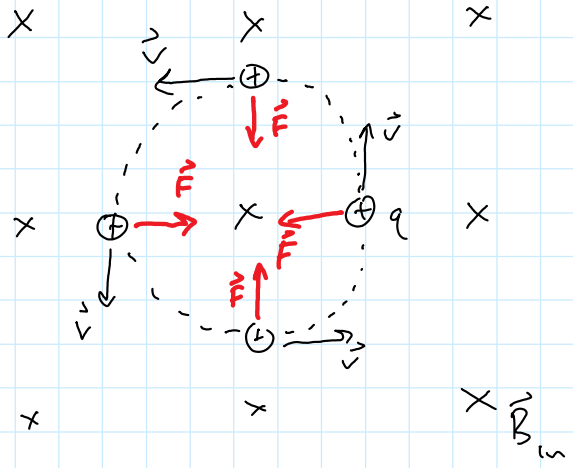
q_1 is Negative

q_2 has no net charge



q_2 has no net charge

q_3 is positive



Circular motion:

$$\Sigma \vec{F}_{radial} = m \vec{a}_{cp}$$

$$\Sigma F_{radial} = \frac{m v^2}{R}$$

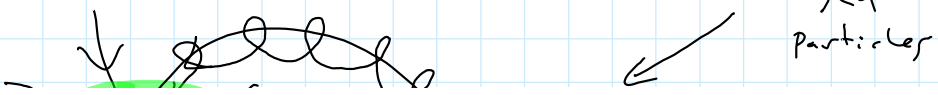
$$F_B = \frac{m v^2}{R}$$

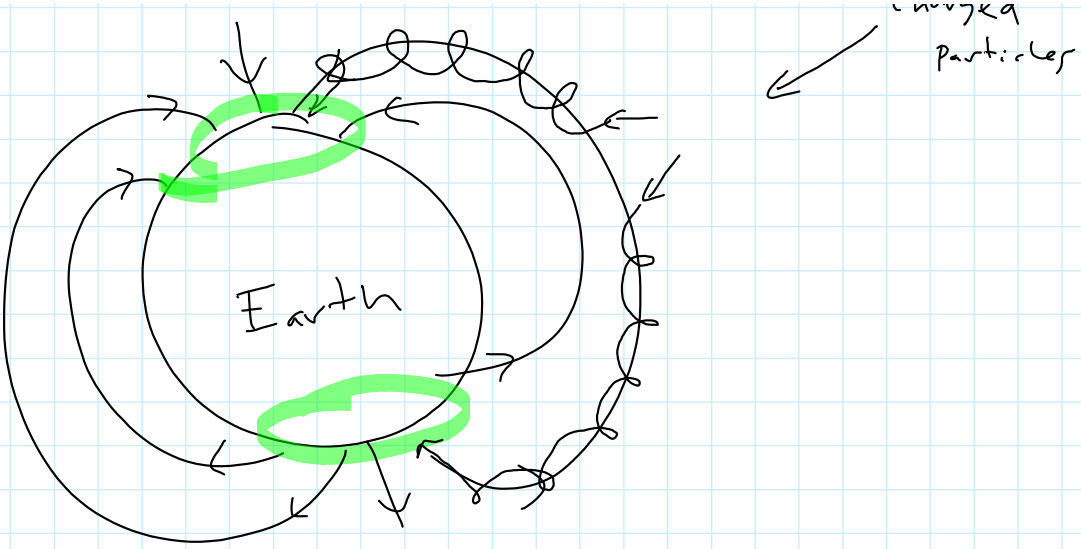
$$|q| v B = \frac{m v^2}{R}$$

$$R = \frac{m v}{|q| B}$$

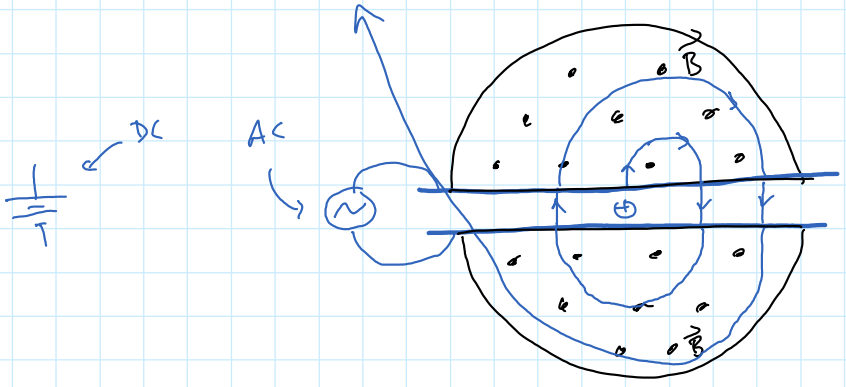
Applications:

1) Northern / Southern Lights : Aurora

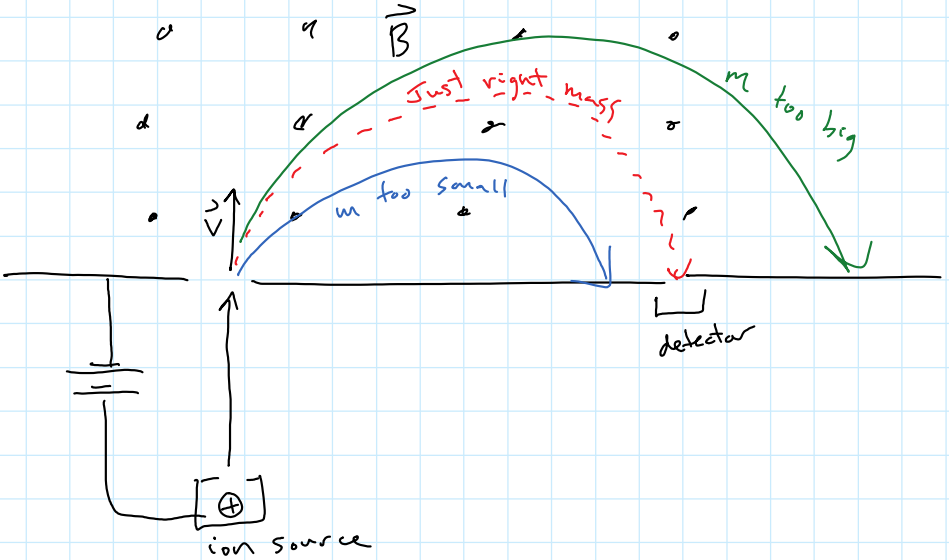




2) Cyclotron - particle accelerator



3) Mass Spec



Magnetic force on a current carrying wire:

$$F_B = I \vec{L} \times \vec{B}$$