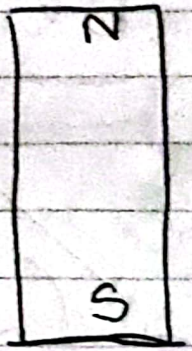
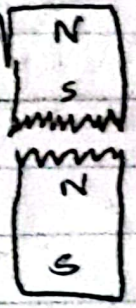
Magnetism

Bar magnet

full bar magnet

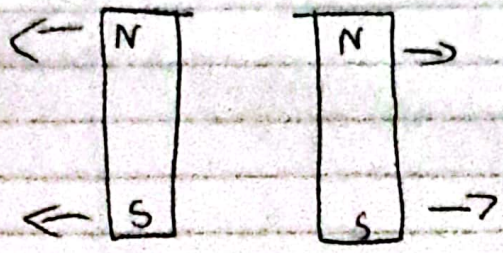


cut-half bar magnet

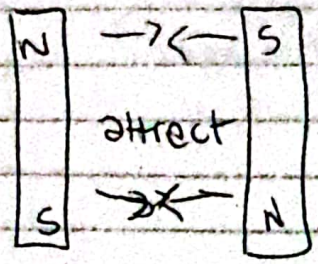


- When bar magnet cut in half, you still have two new bar magnets and so on.
  - ↳ until no magnetic monopoles
- [because you can't just have N OR S]
- north and south come together

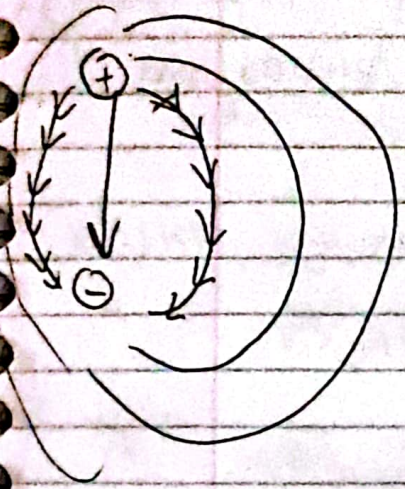
Bar magnet

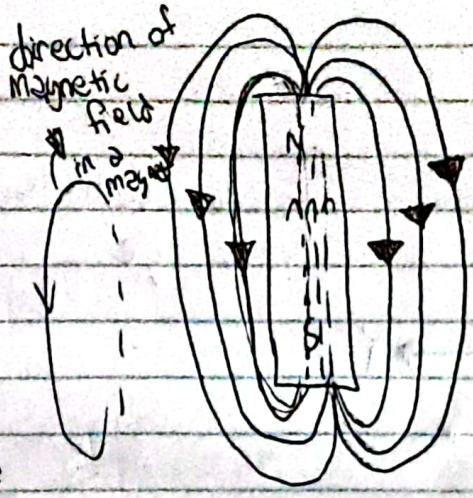


repels



likes repel
opposites attract





lines of $\vec{B}$ are continuous [magnetic field]

lines of $\vec{E}$ are not continuous [electric field]

for electric field are going down positive to negative

for magnetic field it goes up

— x — x — x — x — x — x — x — x — x —

Magnetic force

$F = qvB\sin(\theta)$

- F: magnetic force
- q: charge
- v: velocity
- B: magnetic field
- θ: angle between velocity and magnetic field

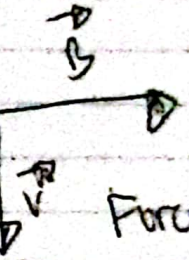
determining direction

Direction: Right hand rule

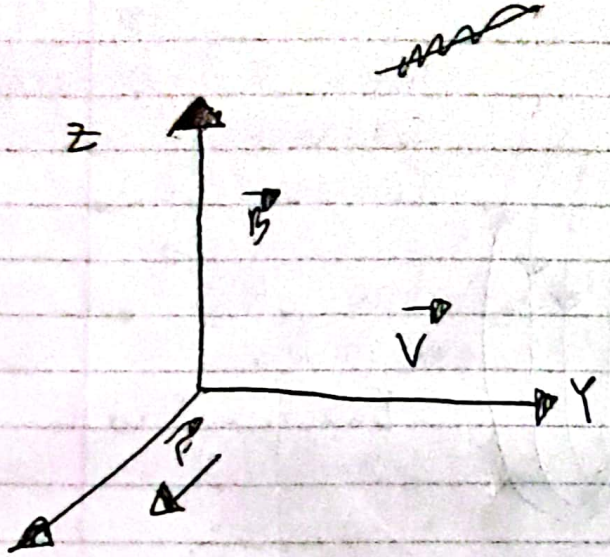
$F = qvB\sin(\theta)\,\hat{n}$ →

$F = qvB\sin(\theta)\,\hat{n}$

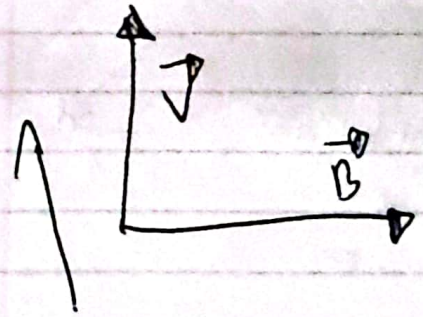
Thumb ⇒ (Finger) (Index finger)
Straight



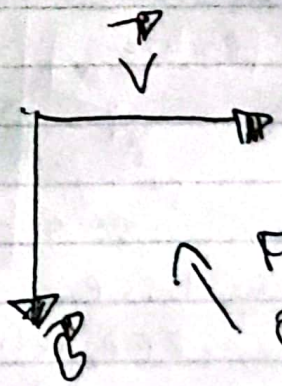
Force coming towards your eye



Force will be coming towards your eye

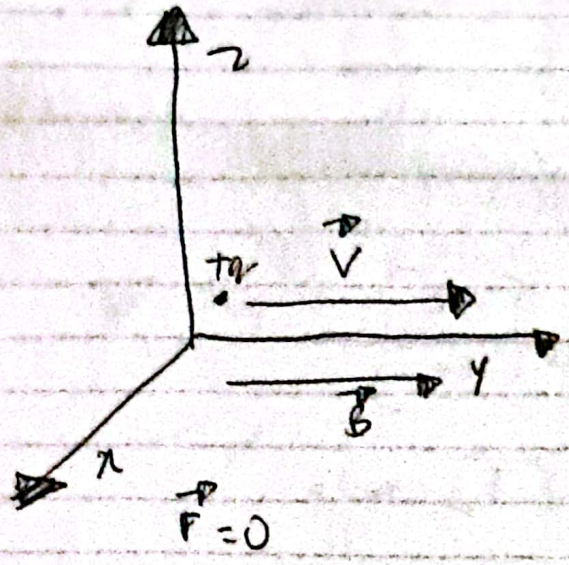


Force going away from your eyes



Force going away from your eyes

example



Decrease ~~do~~ its impossible to identify the velocity & B

Mathematical description

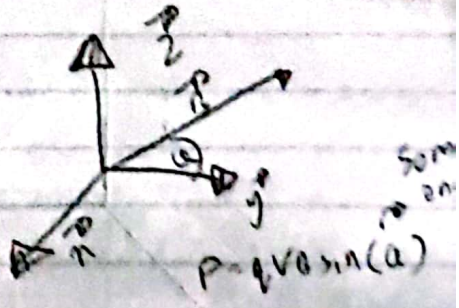
$\vec{F} = qVB\sin\theta(\hat{n})$

↳ Angle between $\vec{V}$ + $\vec{B}$

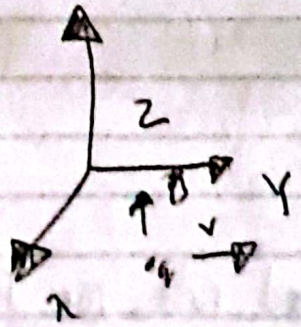
$F = qvB\sin(a)$

$= qv0\ 0$

$F = 0$



Force moves towards my eye



$F = qVB\sin(90)\hat{n}$

$F = qVB\sin(90)\hat{n}$

$F = qVB\ \hat{i}$

Units

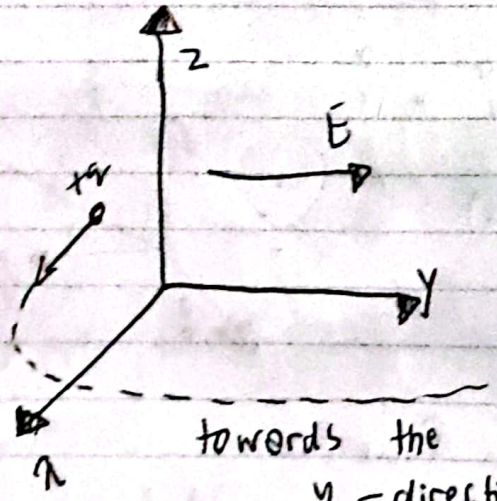
$F = qVB\sin(\theta)$

$\frac{F}{qV\sin(\theta)} = B$

$$\left[\frac{N}{C}\right]\left[\frac{m}{s}\right] = [T] = \left[\frac{N \cdot s}{Cm}\right]$$

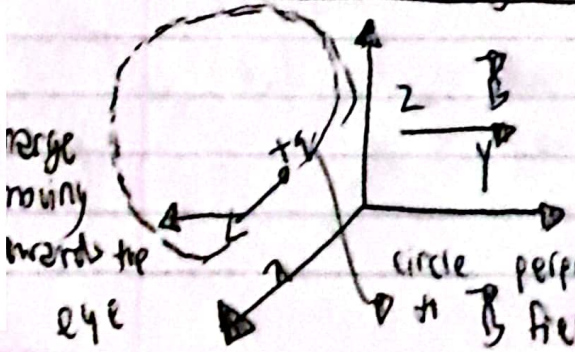
$= [T]$ tesla

Motion of q in electric field



Circle lies and rotates in the x-y plane

Motion for a magnetic field

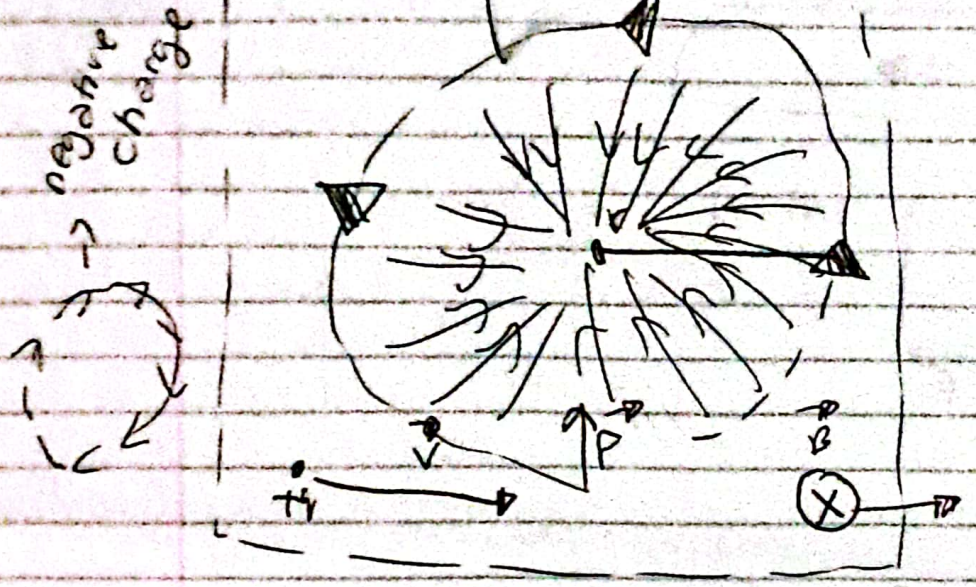


By right hand rule, the force will go up.

it will go up, feel a force towards the right and eventually moves in a spirel motion

magnetic field motion is in a spherical or circular motion

example



magnetic force

$F = qVB \sin(\theta)$

$= qVB \cdot (90)$

$= qVB$

up → Index finger pointing towards the screen

→ straight finger

straight finger

Note

If moving in a circle

cyclotron

Centripetal force

$F = \frac{mv^2}{r}$

$qVB = \frac{mv^2}{r}$

$qVBr = mv^2$

$qBr = mv$

$r = \frac{mv}{qB}$