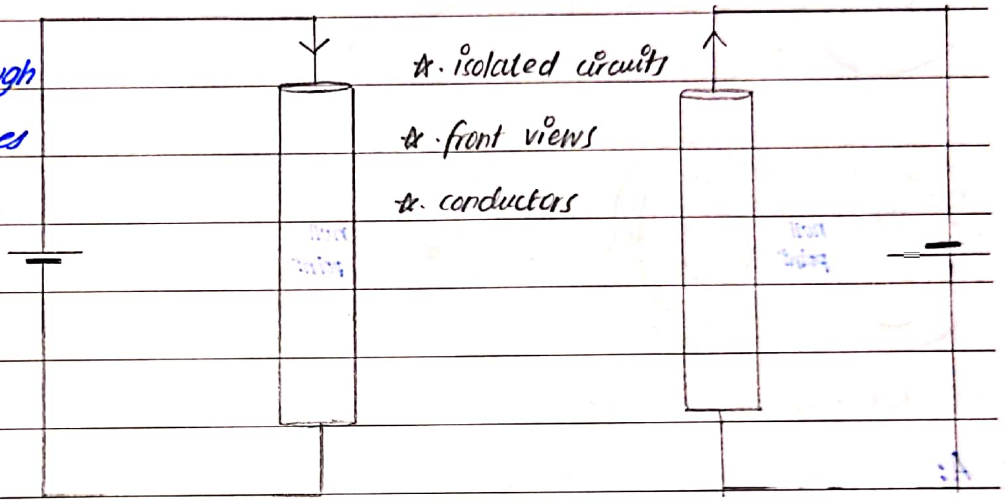
Date: 8/7/20

ELECTROMAGNETISM

→ a process in which conductor becomes magnet when current passes through it is called electromagnetism.

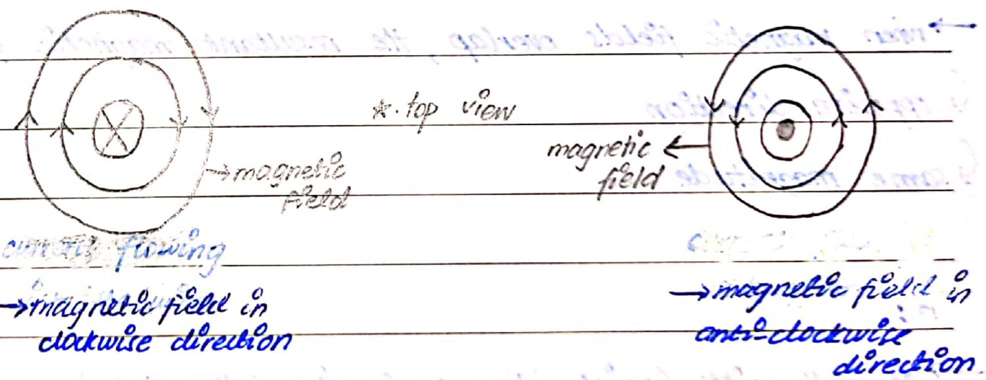
electromagnet : a conductor which becomes magnet when current passes through it

→ when current passes through the wire, the wire produces magnetic field in form of circles (conducting wire)



current flowing into the wire : ⊗

current flowing out of the wire : ⊙



→ right hand grip rule is used to find direction of magnetic field around the current carrying wire

1 → Hold the current carrying wire in the right hand

2 → point the thumb in the direction of current passing through the wire

3 → curl the fingers around the wire

4 → curled fingers direction will represent direction of magnetic field around the current carrying wire

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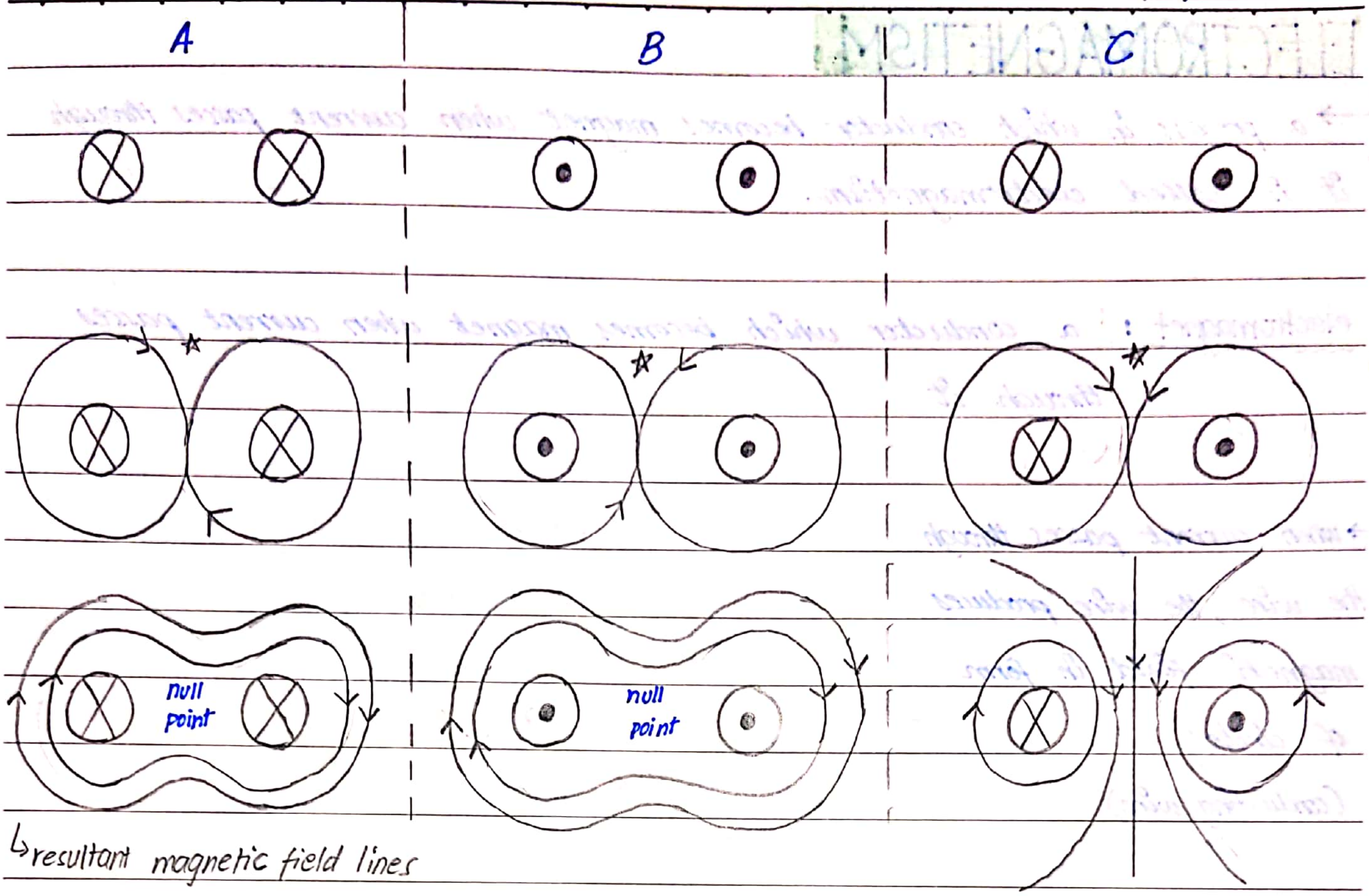

↳ resultant magnetic field lines

A:

→ when magnetic fields overlap, the resultant magnetic field becomes 0, at point ★

↳ opposite direction

↳ same magnitude

B:

→ at the ★ point where overlapping takes place, resultant magnetic field becomes 0

C:

→ at point ★ magnetic fields add up

↳ same direction

↳ different magnitudes.

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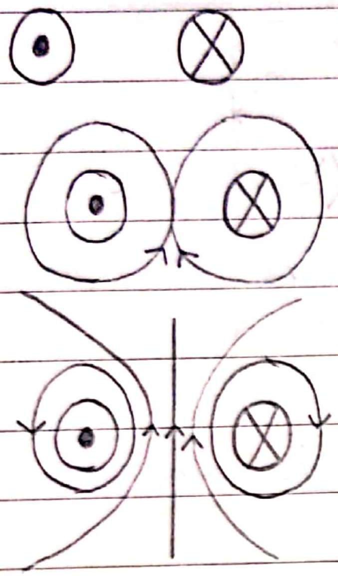
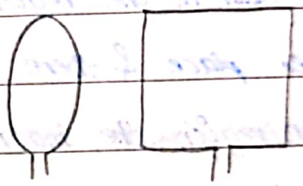
strong magnetic field : straight lines

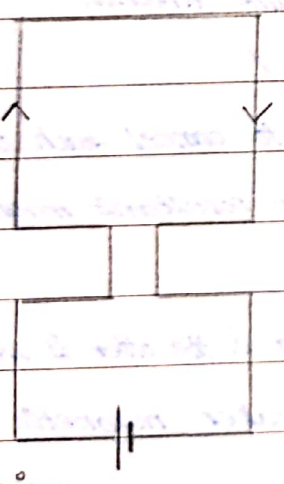
weak magnetic field : curved lines

D

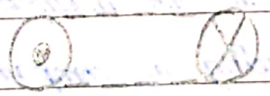


coil : a single loop of a wire





Front view



Top view

Resultant Magnetic Field : D

magnetic field pattern : representation of magnetic field using magnetic field lines

Date: 13/7/20

→ magnetic field lines are alway directed from N to S pole

→ uniform magnetic field is represented by straight, parallel line

non-uniform " " " " curved, circular lines

Factors on which magnetic field depends

1. Current

↑ current = stronger magnetic field

↳ reverse direction of current to reverse direction of magnetic field

2. Distance

↑ distance from wire = weaker magnetic field

Experiment to demonstrate the force on current carrying conductor

→ when a current carrying wire is placed in a magnetic field, then a magnetic force is exerted on the wire

→ place a stiff copper wire at right angles to the field, provided by a U-shaped magnet

→ when the switch is closed, the wire moves upwards indicating that an upward force acts on the wire.

Date: 13/7/20

Force on a current carrying conductor placed in a uniform magnetic field :

⇒ When a current carrying conductor is placed in a magnetic field, then the magnetic field exerts a force on the current carrying conductor

⇒ We can reverse direction of force by either reversing direction of magnetic field or direction of current passing through the conductor

→ to reverse direction of magnetic field, reverse position of poles

→ if both the directions are reversed, the direction of force remains unchanged

Factors effecting force :

1. strength of magnetic field

→ stronger magnetic field : stronger force is exerted by magnetic field on the wire

2. current passing through

→ more current : more force is exerted by magnetic field on the wire

3. length of wire

→ more length : more force is exerted by magnetic field on the wire lying inside the magnetic field

Fleming's Left Hand rule :

→ first finger : magnetic field direction

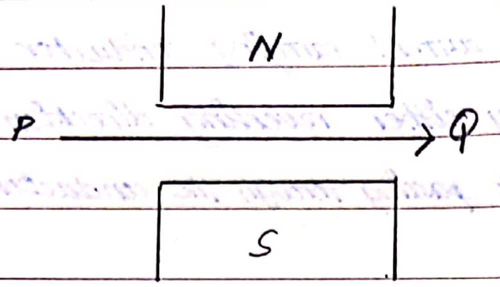
→ second finger : current direction

→ thumb : force direction

→ rule applies only

Date: 14/7/20

Q1. The diagram shows a wire PQ between the N-pole and S-pole of a magnet. There is a current in the wire in the direction of the arrow.



What is the direction of force on the wire PQ?

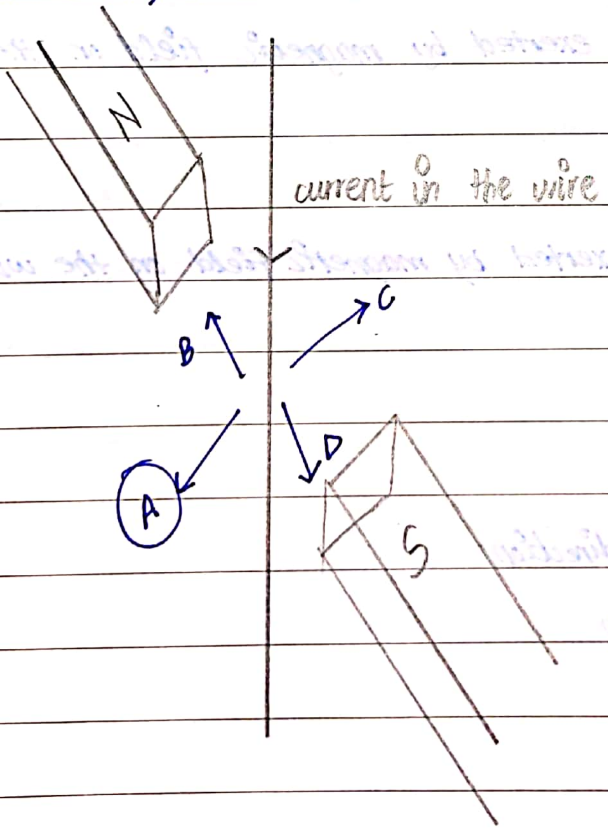
[✓ A.] into the page

B. out of the page

C. towards the N-pole

D. towards the S-pole

Q2. A wire hangs between the poles of a magnet. When there is a current in the wire, in which direction does the wire move?



(they exert a force on one another b/c they lie in each other's magnetic field)

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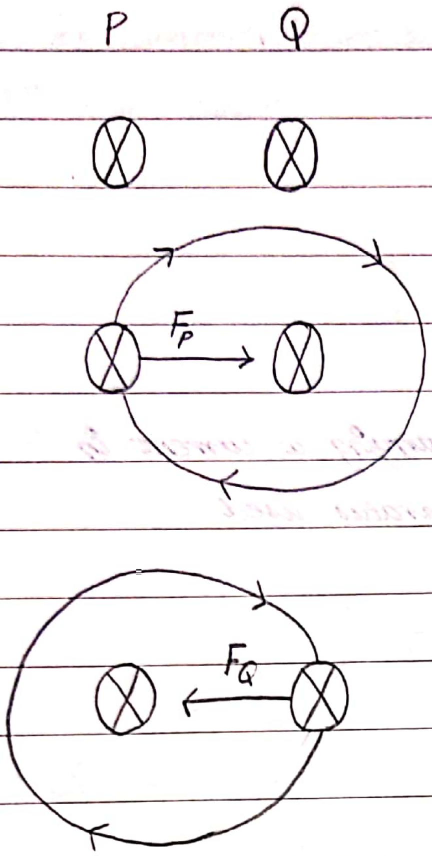
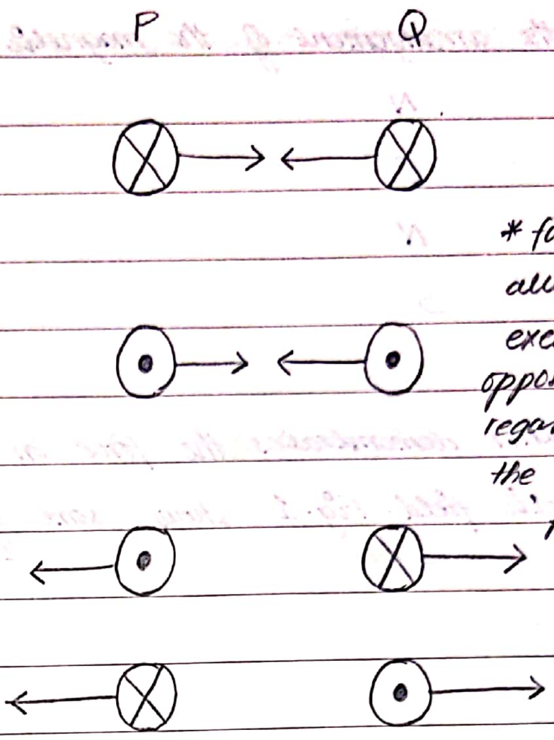




* force will always be exerted in opposite direction, regardless of the direction of flow

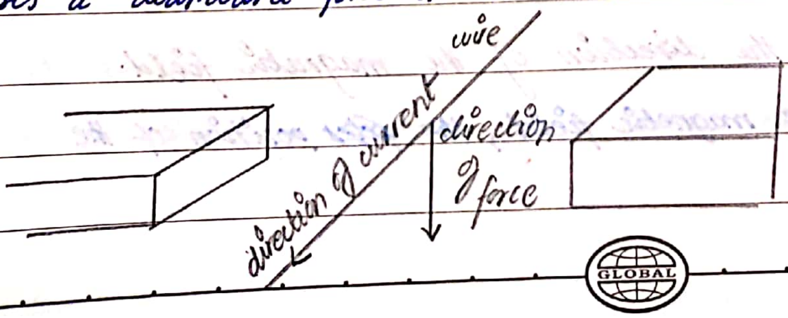
Force on two current-carrying wires placed near one another:

→ when two current-carrying wires are placed near one another, then they exert a force on each other

→ two current-carrying wires exert equal and opposite forces on each other

→ if current is flowing in the same direction through both the wires then the force will be attractive but if current is flowing in opposite direction in the both the wires then force will be repulsive

Q. The diagram shows a wire placed between two magnetic poles or equal strength current passes through the wire in the direction shown. The current causes a downward force on the wire



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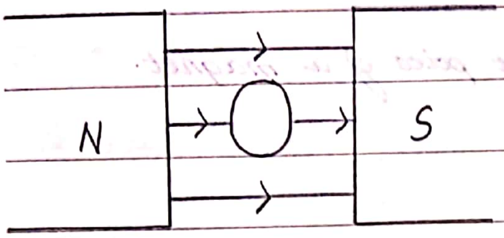
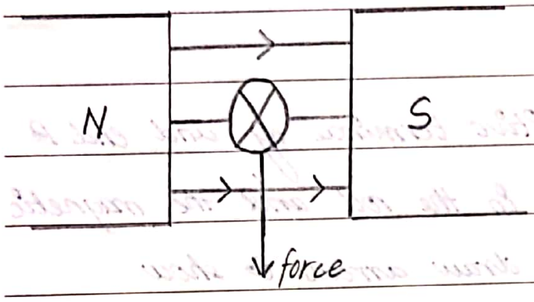
→

Force on a charge passing through a magnetic field



→ no force is exerted on this wire b/c no current is passing through the wire (switch off)



→ this means that the force is acting on the current in the wire (switch on)

→ & the current is moving charge

→ when charge passes through the magnetic field, then the magnetic field exerts a force on charge

→ force exerted by the magnetic field is perpendicular to both, the direction of motion of charged particles and direction of magnetic field

→ we can reverse the direction of force by either reversing direction of motion of charged particle or the direction of magnetic field

→ we can find direction of force by using Flemming's left Hand Rule

Flemming's left Hand Rule:

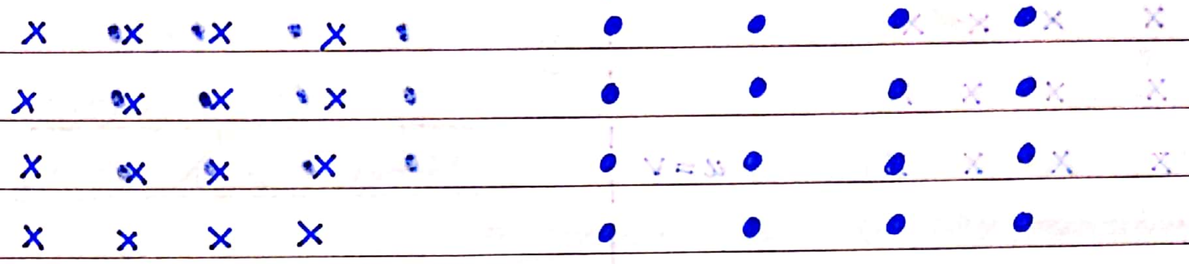
first finger : magnetic field

second /middle finger : motion of charge

thumb : force

Date: 16/7/20

→ direction of magnetic field can be shown using X or ●



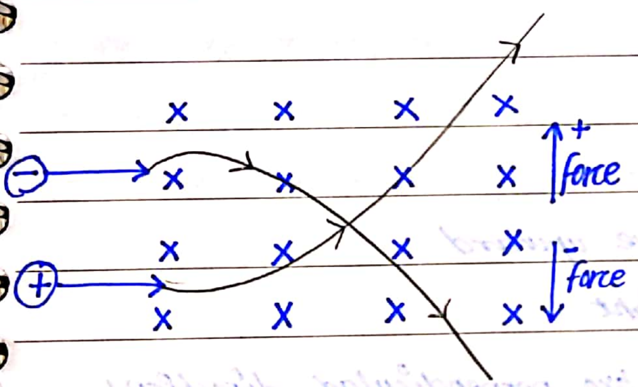
into the plane of page/board

out of the plane of board/page

(top of view)

↳ this means that the N-pole is on the upper surface & S-pole is on the downward surface

↳ this means that the S-pole is on the upper surface of the page & the N-pole of the down-ward surface



- for +ve charge, we point the finger in the direction of charge but for -ve charge we point the finger in opposite direction
- charged particle deflects in the direction of force

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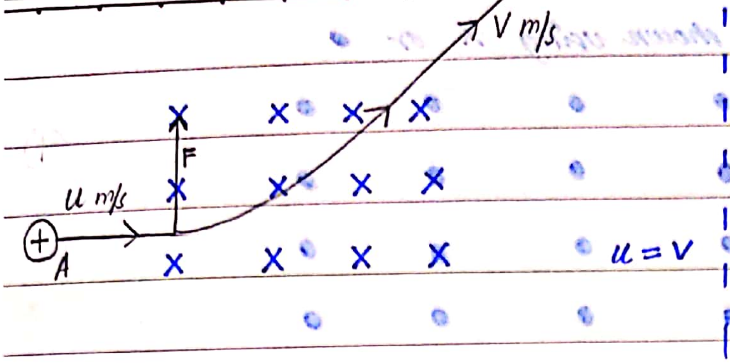
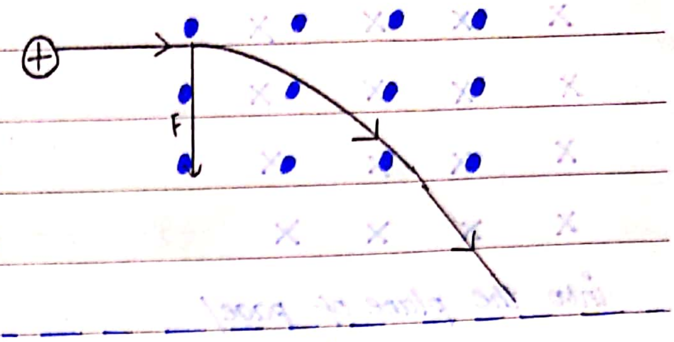
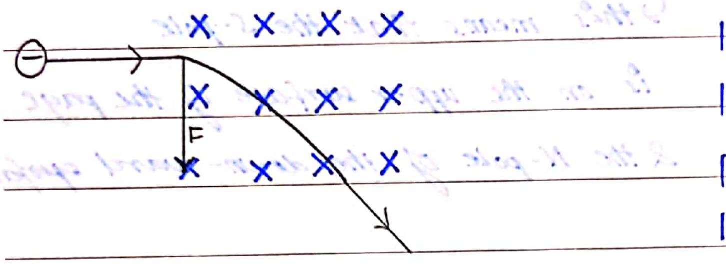
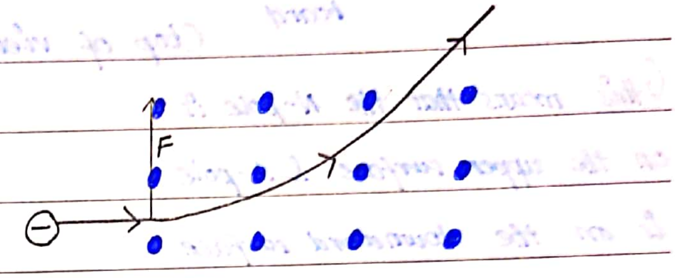








A. → magnetic field wants the charge to move upward

→ the particle wants to move towards right

↳ the charge particle is trying to move in two perpendicular directions simultaneously

↳ resultant motion is along a curved path

↳ force acts neither in same nor in opposite direction of force because of which the speed remains the same but velocity changes.

↳ although, force does change the direction at every instant.

➡ for speed to increase : force acts in same direction of motion

➡ " " decrease : force acts in opposite direction of motion

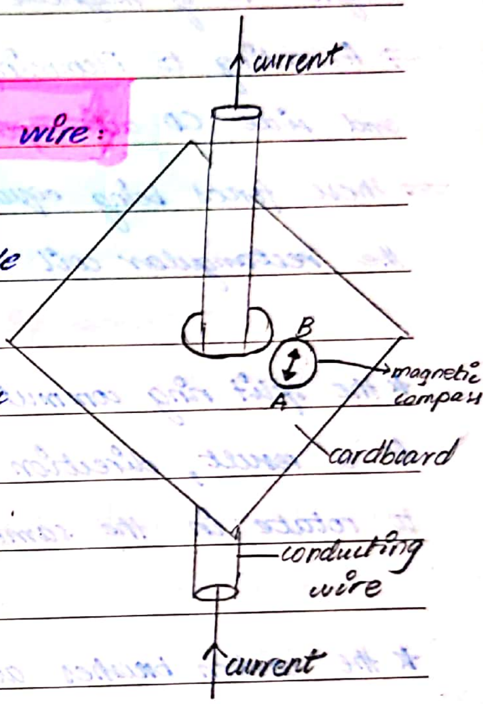
★. the charged particle goes in straight direction after coming out of magnetic field b/c no force is acting anymore

Date: 20/7/20

→ force exerted by the magnetic field on the charged particle depends upon 3 things :

1. Strength of magnetic field (directly proportional)
2. Speed of charged particle (directly proportional)
3. Magnitude of charge on the particle (directly proportional)

How to draw a magnetic field around a current carrying wire :



* as we move the compass around the wire, the needle of the compass deflects

→ using the deflection of the compass needle you can draw the magnetic field

Date:

D.C MOTORS

→ a device which converts electrical energy into mechanical energy

$\underbrace{\text{electrical energy}}_{\text{current provided}}$ into $\underbrace{\text{mechanical energy}}_{\text{rotation of coil}}$

⇒ When current is passed, the rectangular coil ABCD rotates b/w poles of magnet b/c of magnetic force

⇒ According to Flemming's left Hand Rule, side AB acts downwards and side CD acts upwards.

⇒ these forces being equal in magnitude but opposite in direction rotate the rectangular coil in an anti-clockwise direction

★ the split ring commutators reverse the direction of current in the coil As a result, direction of forces is also reversed and the coil continues to rotate in the same direction (after every half cycle)

★ the carbon brushes avoid friction between the split ring commutators and the circuit wires. Also, the circuit wires do not tangle over with the split ring commutators in the presence of carbon brushes

Factors increasing speed of coil

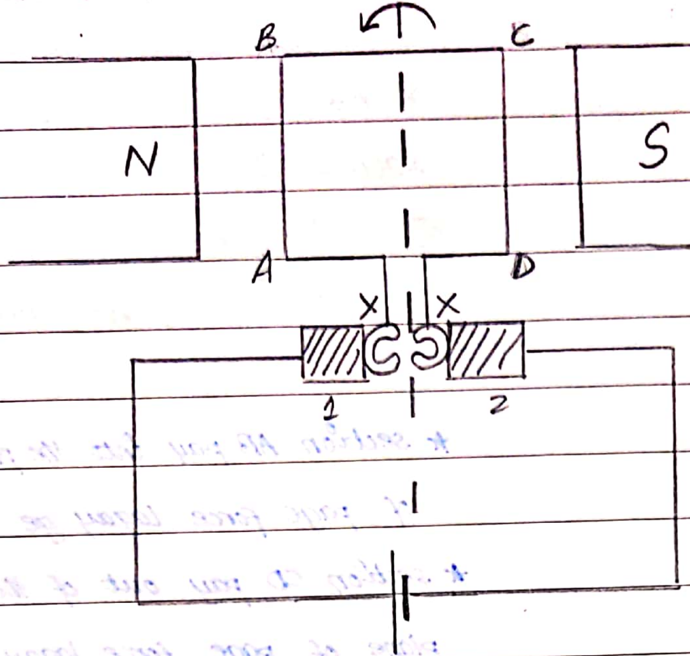
→ ↑ no. of turns of coil

→ increase current

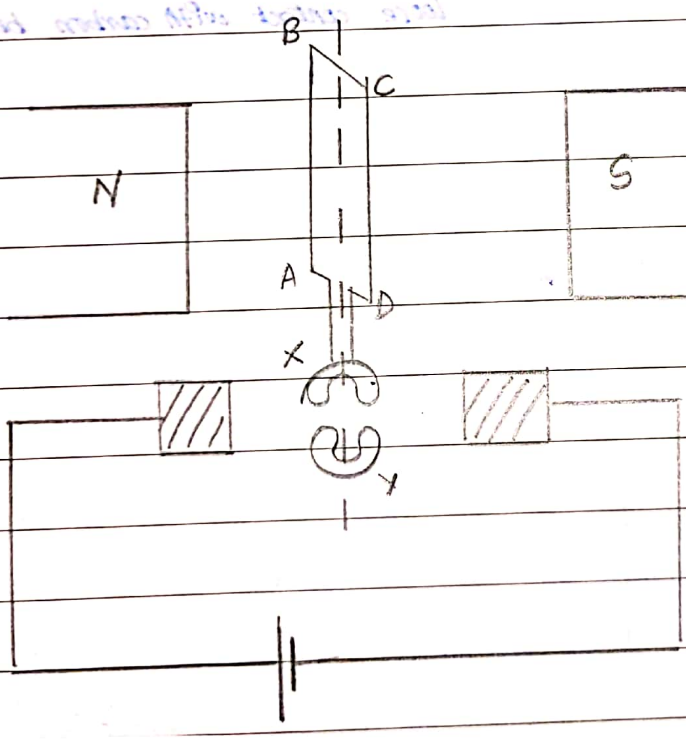
→ use a stronger magnet

→ use soft-iron inside the coil

①.



②.



DC motor consists of a rectangliar coil which is placed between the poles of a permanent magnet. The Rectangular coil is pivoted through a central axle. The ends of the coil are connected with split ring commutators which can rotate along with the coil. The two carbon brushes press gently against the split ring commutators and are connected with the cell through a switch. When the switch is closed, current passes through the coil and force acts on the parallel faces of the coil in opposite direction. Because of the force rotation will be produced in the coil and it will rotate about the central axle. We can increase rotation of coil by:

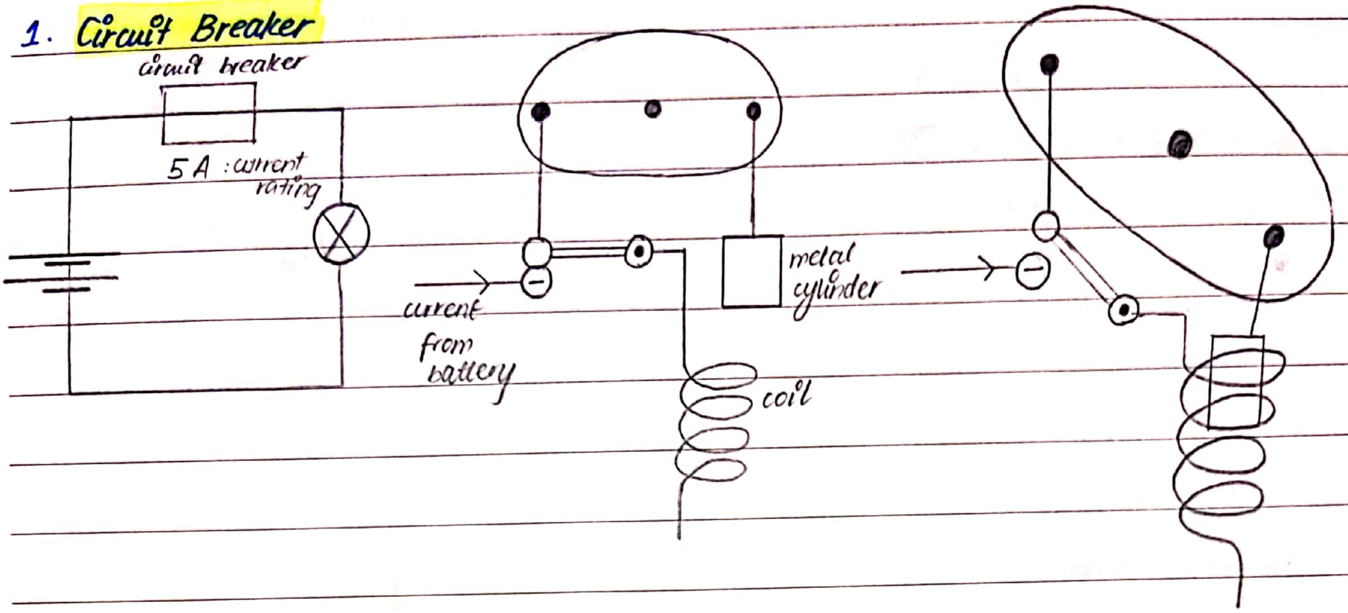
: (on following page)

★ No forces act on BC or AD b/c current and field directions are no longer perpendicular

Date: 22/7/30

USES OF ELECTROMAGNETS:

1. Circuit Breaker



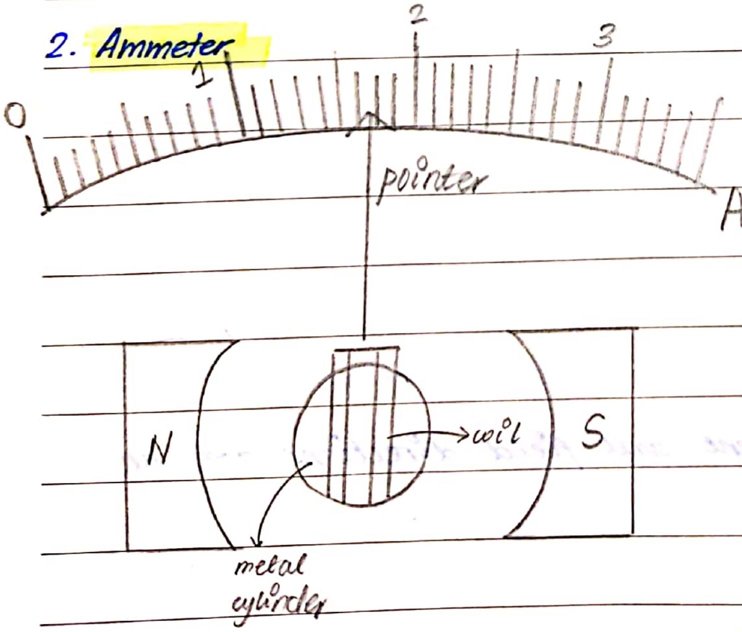
→ metal cylinder is pivoted at A

→ metal cylinder is pulled down by the coil in case current larger than 5 A is passed through the circuit (becomes highly magnetized and attracts metal cylinder which is pulled down)

→ as a result, the contact breaks and the current can not pass through the circuit to the bulb

→ by ~~t~~ turning the switch down, the circuit breaker will move back to its place

2. Ammeter



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→ a metal cylinder is placed b/w a permanent magnet

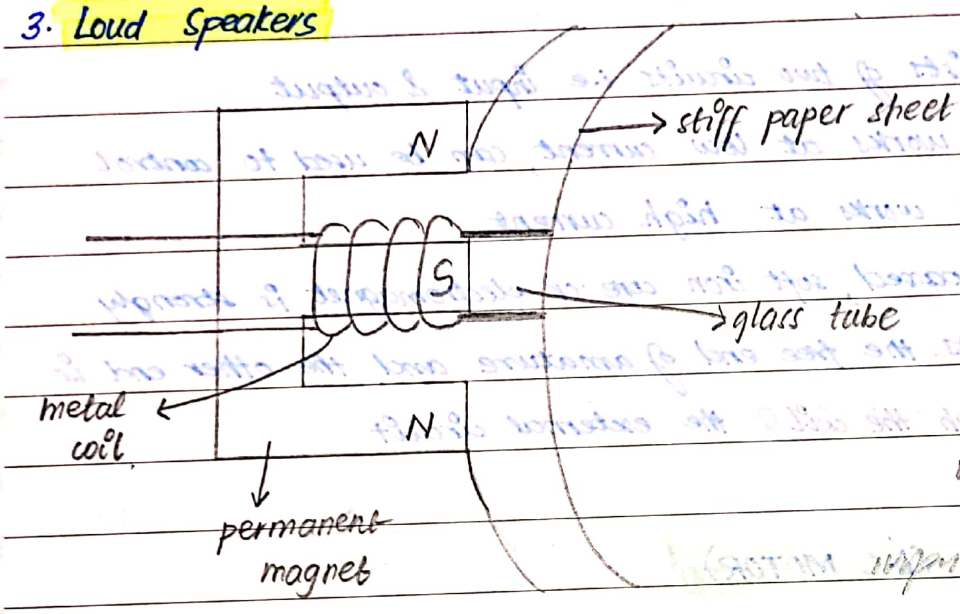
→ when current passes, coil becomes a magnet

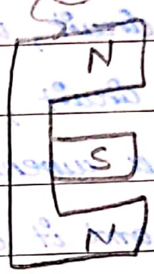
→ repulsion will take place (permanent magnet repels coil) (stronger with larger amounts of current)

→ coil rotates & as a result the pointer rotates

(north repels & south attracts)

3. **Loud Speakers**





ring shaped magnet - centre has opposite

current flows in wires, cuts m.f.l causing it to move forward backward

moves with the same frequency as input electric signal

→ a metal coil is attached to a permanent magnet and a glass tube

→ when alternating current passes through the metal coil then force is exerted by the magnetic field continuously (compress + stretch)

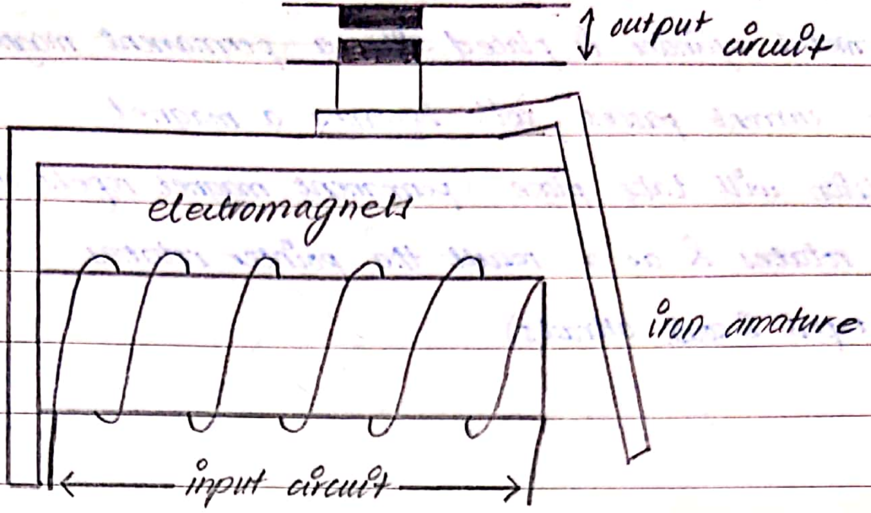
→ as a result, coil continuously oscillates in the magnetic field causing the glass tube to move back and forth which makes the paper sheet move (compressing & stretching in air) and hence, producing a loud sound

4. **Relay**

→ a device which uses an electromagnet to automatically switch on and switch off another device which is being operated using a large amount of current

Date: 23/7/20

(Magnetic Relay)



→ the magnetic relay consists of two circuits i.e input & output

→ the input circuit, which works at low current, can be used to control the output circuit, which works at high current

→ when small current is passed, soft iron core or electromagnet is strongly magnetized and it attracts. the free end of amature and the other end is pivoted upwards, joining the contacts of the external circuit