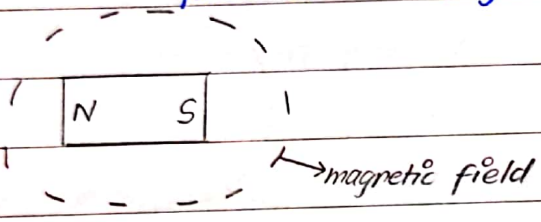
Date: 24/7/20

ELECTROMAGNETIC INDUCTION

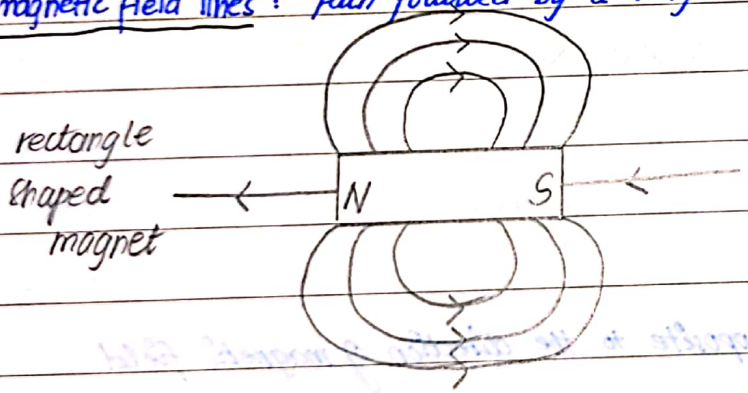
→ the process in which an emf and hence a current is induced in the coil due to cut of magnetic flux

induced emf : the driving force of electrons in the coil produced due to cut of magnetic flux

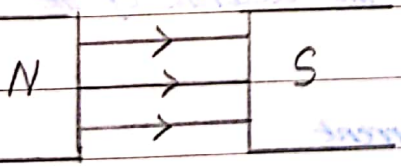
magnetic field : region around a magnet within which it can exert a force on a magnetic material



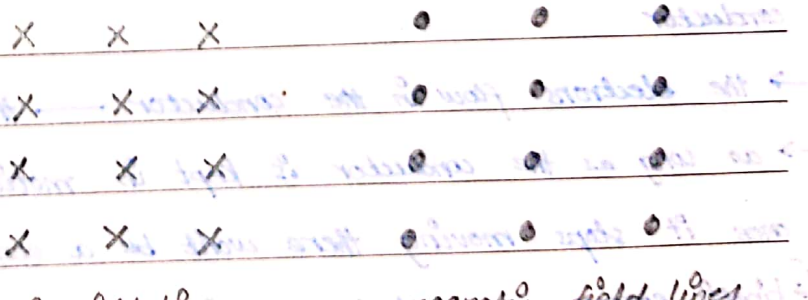
magnetic field lines : path followed by a magnetic material within the magnetic field



*whenever you are asked to draw a magnetic field, always draw representing magentic field lines. (do not draw a dotted region)



U-shaped magnet



• magnetic field lines into the plane of page

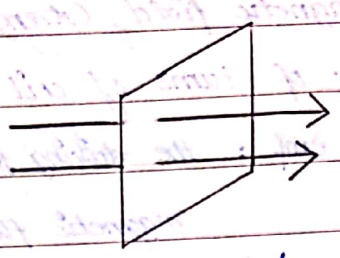
magnetic field lines out of the plane of page

Date: 27/7/20

magnetic flux : the number of magnetic field lines passing through the unit area of a conductor, held perpendicular to the magnetic field's direction.

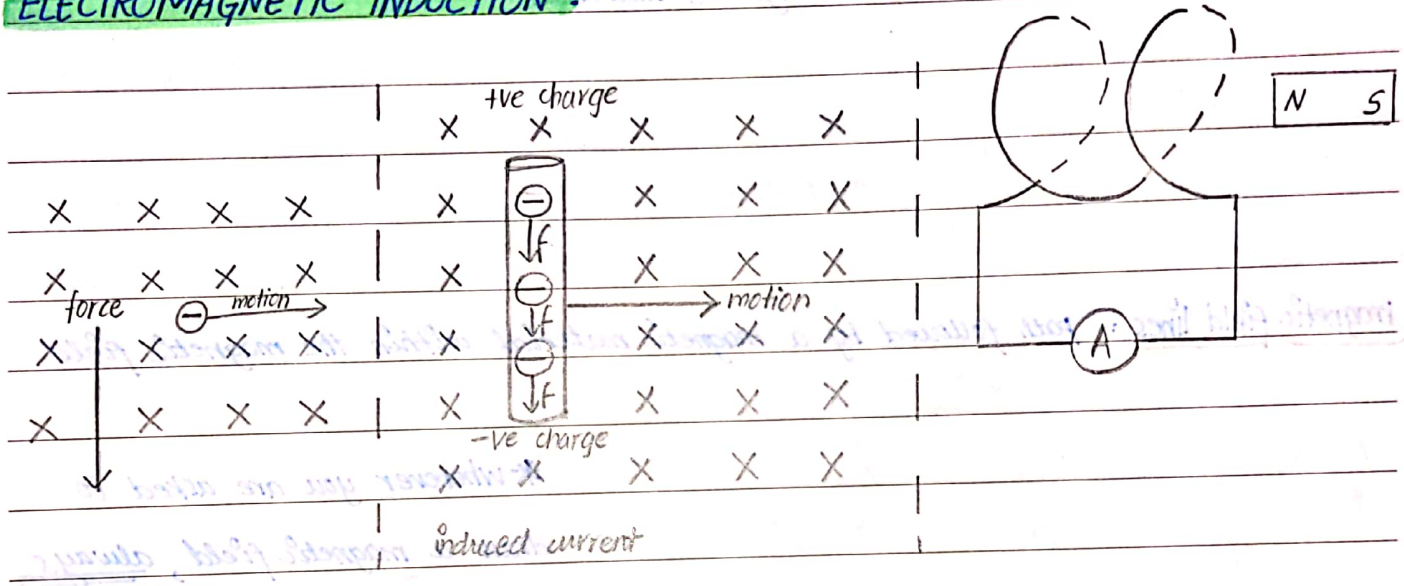
unit of magnetic flux :

weber ⟶ W_b



: 28/7/20

ELECTROMAGNETIC INDUCTION :



→ the conductor is moved in a direction opposite to the direction of magnetic field

→ but the magnetic field exerts a downward force on the electrons of the conductor

→ the electrons flow in the conductor ⟶ there is current

→ as long as the conductor is kept in motion, the current is produced but once it stops moving there won't be a current

↳ kinetic energy converted to electrical energy (law of conservation of energy)
(mechanical energy)

→ since all the electrons flow towards the end and potential difference (emf) is created across the ends of the conductor ⟹ induced emf

→ when a magnetic field is cutting the magnetic field lines of a current carrying wire

★ when flux passing through a c
produces current and generates emf, this process is called electromagnetic induction

current produced by the conductor is called the induced current

emf generated by the conductor is called induced emf

• Flux passing through conductor changes:

(i). by moving a conductor in a stationary magnetic field

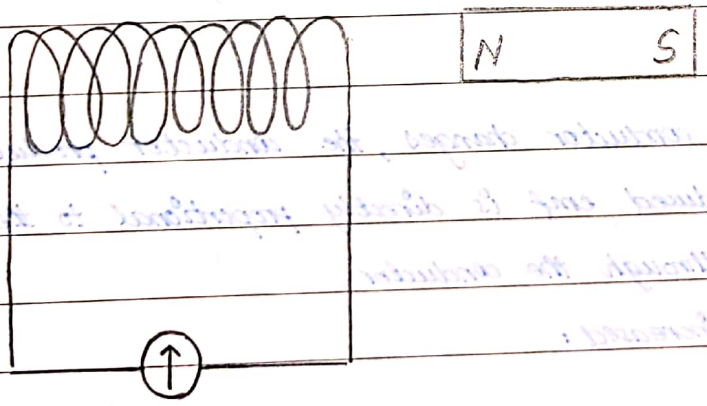
(ii). by moving magnetic field lines near a stationary conductor

Experiment to verify Electromagnetic Induction / Lenzy's Law

→ when a magnet is moved towards the coil, galvanometer deflects, showing presence of current in the coil

→ if magnet is moved away from the coil, galvanometer deflects in opposite direction showing current in the coil in the opposite direction

→ however, if magnet is stationary near the coil, galvanometer does not deflect



left hand ⇒ force

right hand ⇒ induced current

Date: 29/7/20

★ when flux passing through a conductor changes, then the conductor produces current and generates emf, this process is called electromagnetic induction

current produced by the conductor is called the induced current

emf generated by the conductor is called induced emf

• Flux passing through conductor changes:

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(ii). by moving magnetic field lines near a stationary conductor

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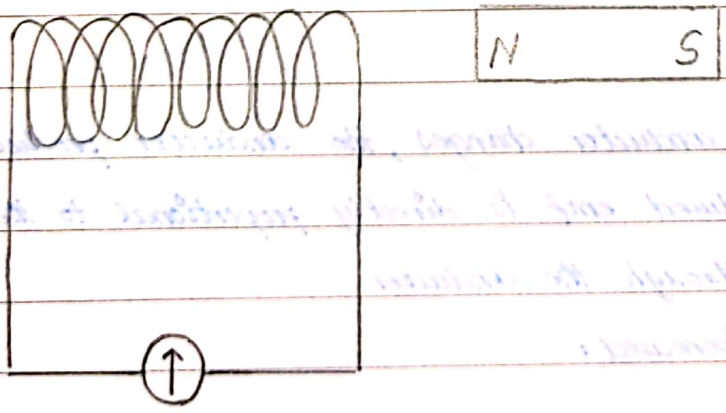


left hand ⇒ force

right hand ⇒ induced current

Date: 29/7/20

Factors affecting induced current:

→ length of wire (directly proportional)

→ strength of magnetic field (directly proportional)

→ speed of wire (directly proportional)

* to find direction of induced current use "FRHR"

1st finger : magnetic field * RIGHT HAND

2nd finger : induced current * HOLD THE FINGERS PERPENDICULAR

thumb : motion

→ the direction can be reversed by either reversing direction of magnetic field or direction of motion of conductor

→ induced emf ∝ speed

→ rate of change of flux ∝ speed

*induced current/emf directly depend on the rate of change of flux

Faraday's Law:

→ when flux passing through a conductor changes, the conductor produces induced emf such that induced emf is directly proportional to the rate of change of flux passing through the conductor

→ the induced emf can be increased:

↳ by using a stronger magnet

↳ increasing no. of turns in the coil

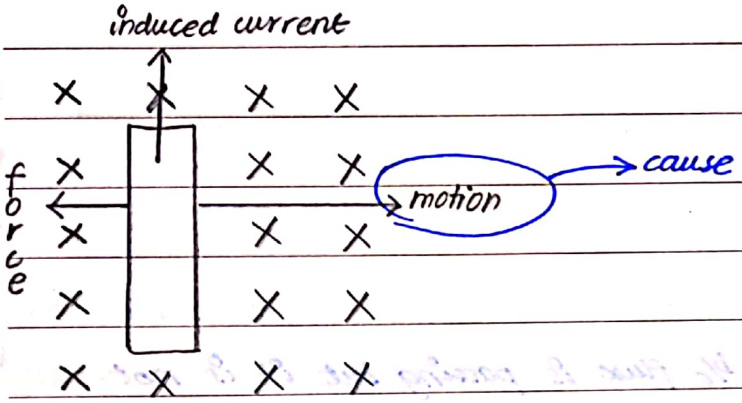
↳ using soft iron core in the coil

↳ moving the magnet faster

Date: 6/8/20

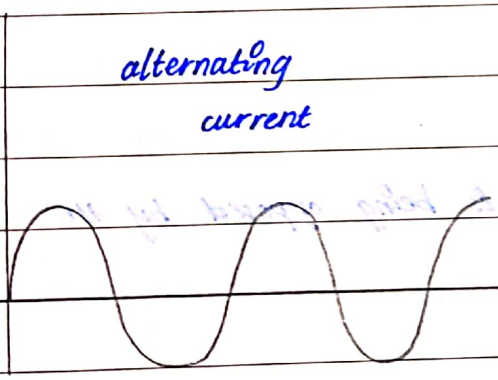
Lenzy's Law:

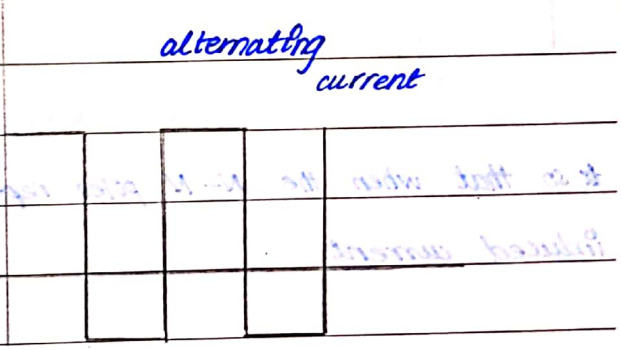
→ direction of induced current is always such that it always opposes its own cause

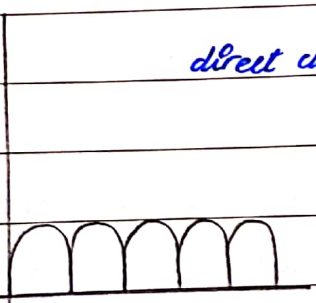


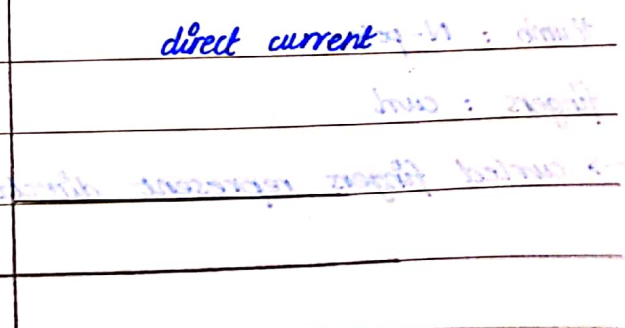
alternating current : current in which direction of flow reverces after every half cycle
(A.C)

direct current : current in which direction of flow remains unchanged
(D.C)





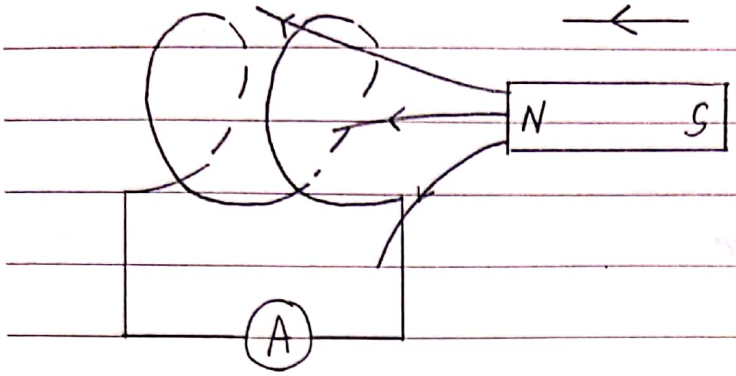




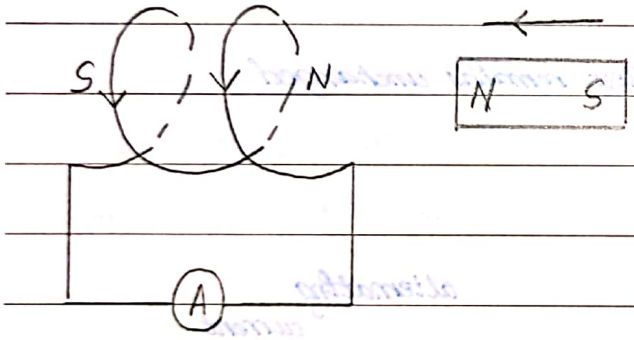
Date: 10/8/20

towards : some pole

away : opposite pole



* induced current is not bein produced b/c flux is passing but it is not changing
* when magnet is moved (A) to the left, induced current is produced
* and hence, the coil becomes a magnet



cause of induced current :
leftward motion of bar magnet

* so that when the N-N poles repel, the cause is being opposed by the induced current

to

* Right Hand Grip Rule :

thumb : N-pole

fingers : curl

→ curled fingers represent direction

→ the direction of the emf induced will always oppose the movement of the bar magnet

→ direction of emf induced = the north/south pole positioning in the coil

→ if the north pole of the bar magnet moves towards one end of the coil, a north pole will be induced at that end

→ opposition hogi, agar andar lay jayein gay tou push feel hoga, repulsive forces b/c of same pole

→ tau away karein gay tou pull hoga aur attractive force hogi

Date: 10/8/20

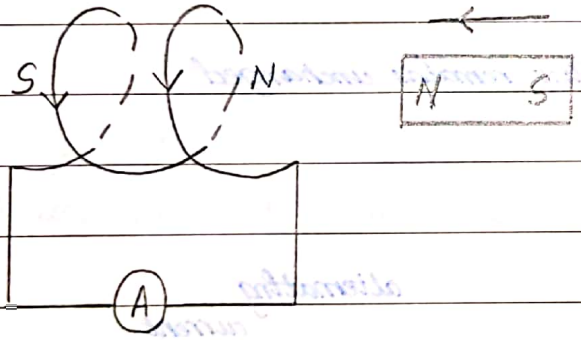
towards : same pole

away : opposite pole

* induced current is not bein produced b/c flux is passing but it is not changing

* when magnet is moved (A) to the left, induced current is produced

* and hence, the coil becomes a magnet



cause of induced current:
leftward motion of bar magnet

* so that when the N-N poles repel, the cause is being opposed by the induced current

∝

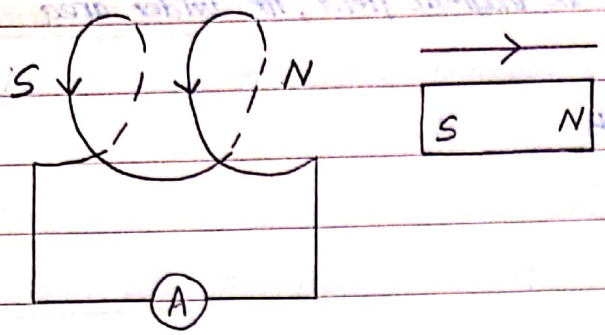
* Right Hand Grip Rule:

thumb : N-pole

fingers : curl

→ curled fingers represent direction

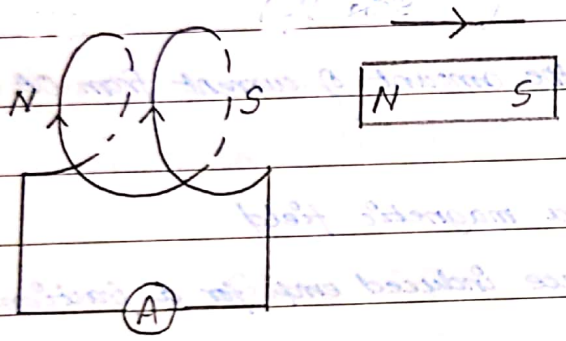
Date: 10/5/20

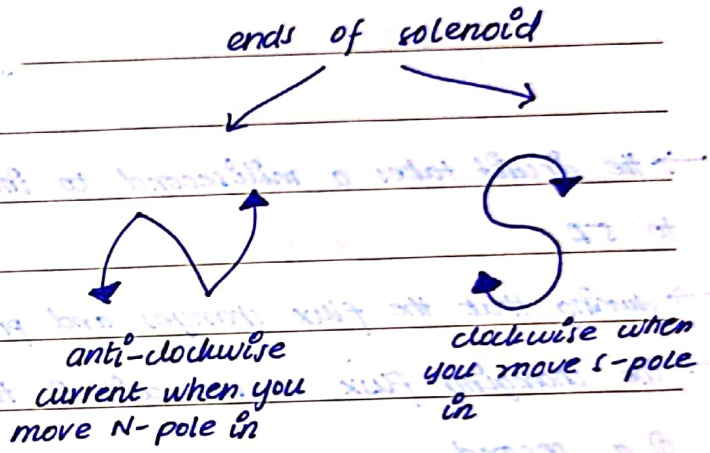


★ direction of induced current does not change

★ the magnet is moving towards the right but the poles have reversed as well

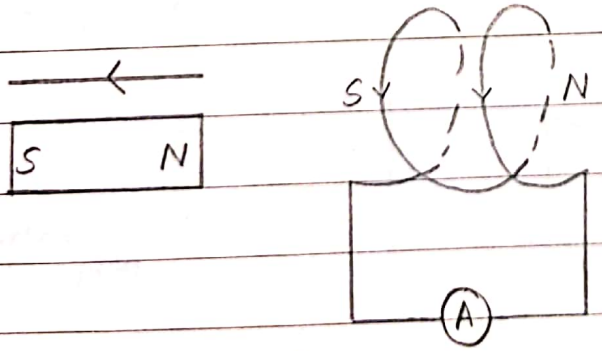
→ the N, S pole have their respective positions because in order to oppose the cause the N & S pole have to attract





→ Lenzy's law, to oppose the cause of induced current the S & N pole must attract

→ RHGR helps to determine direction of induced current



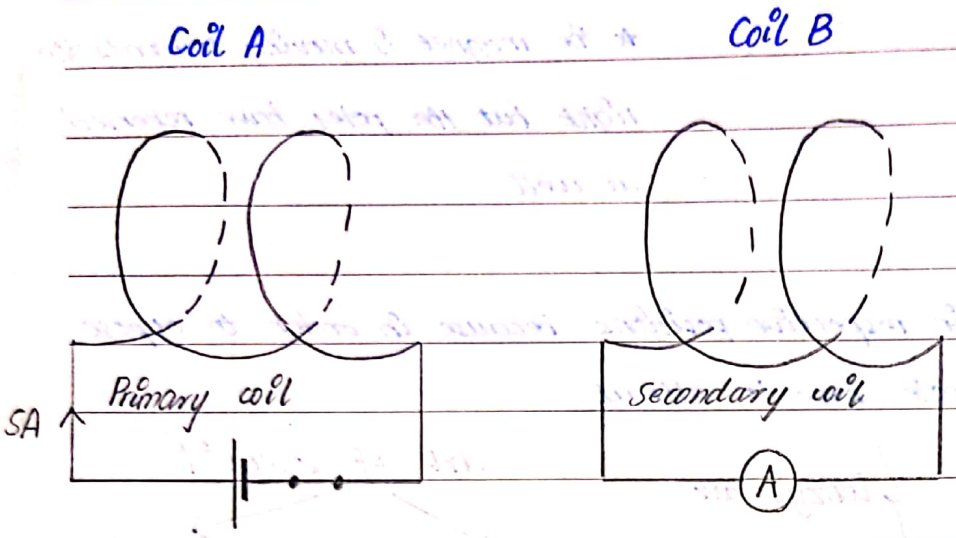
→ Lenzy's law, to oppose cause N & S must attract (hence, the positions)

→ RHGR for direction of induced current

Date: 12/8/20

TRANSFORMER:

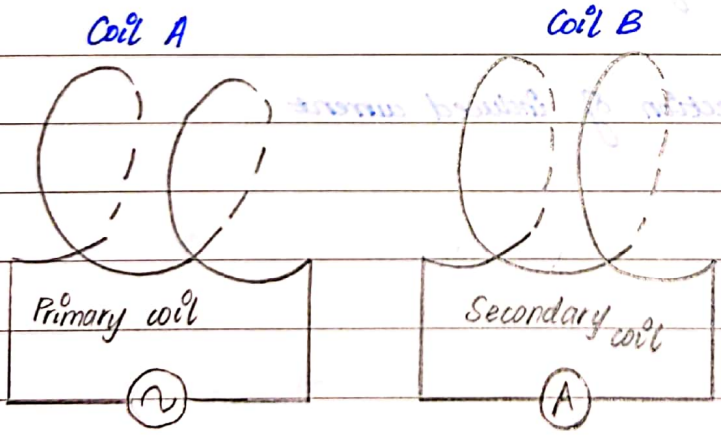
*the stronger the magnetic field, the wider area they cover



→ the circuit takes a milisecond to increase the amount of current from 0A to 5A (the mfl travel through soft iron core and cut the sec. coil ⇒ emf is induced)

→ during that the flux changes and produces a magnetic field

→ the changing flux causes coil B to produce induced emf for a fraction of a second



→ we replace the cell and [illegible] with a source of alternating current

if both ends of coil are joined = induced emf/current
" " " not = induced emf

Date: 12/8/20

mutual induction: a process in which changing flux of one coil produces induced emf in a nearby coil

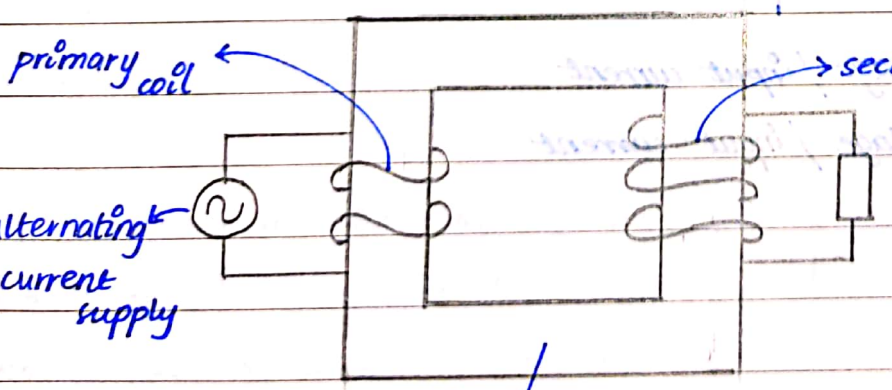
primary coil: coil producing changing flux

secondary coil: coil producing induced emf

- if both ends of the coil are joined: induced emf & induced current both are produced
- if the ends of the coil are not joined: only induced emf is produced

transformer: a device which is used to increase or decrease the magnitude of voltage (or to control voltage)

→ parts: (1). Primary Coil
(2). Secondary Coil
(3). Iron Core (rectangular frame of iron used in a transformer)



laminated so that it does not warm up

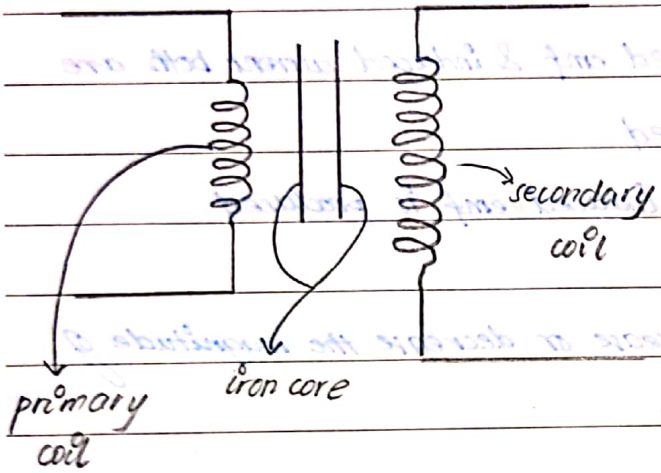
* soft iron core is easily magnetized & demagnetized so it facilitates when current is induced using an AC supply

Date: 12/8/20

→ iron core conducts the magnetic flux from primary coil to secondary coil

→ & minimizes the electricity loss by loosing minimum flux

→ without an iron core, the magnetic field lines towards left can not reach the secondary coil = loss of magnetic flux



	PRIMARY COIL	SECONDARY COIL
no of turns	N_p	N_s
current	I_p	I_s
voltage	V_p	V_s

→ primary coil : input voltage / input current

→ secondary coil : output voltage / output current

(1). $$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

ratio of input voltage & output voltage = ratio of turns of p.c & turns of s.c

Date: 13/8/20

assuming the power loss in the transformer is negligible

(2). $P_{in} = P_{out}$

$P = VI$

$P_{in} = V_p I_p \qquad P_{out} = V_s I_s$

$V_p I_p = V_s I_s$

$\therefore \quad \frac{V_s}{V_p} = \frac{I_p}{I_s}$

(3). $\frac{V_s}{V_p} = \frac{I_p}{I_s} \qquad \frac{V_s}{V_p} = \frac{N_s}{N_p}$

$\therefore \quad \frac{N_s}{N_p} = \frac{I_p}{I_s}$

$\Rightarrow$

TYPES OF TRANSFORMERS: (1). Step-up Transformer
(2). step-down Transformer

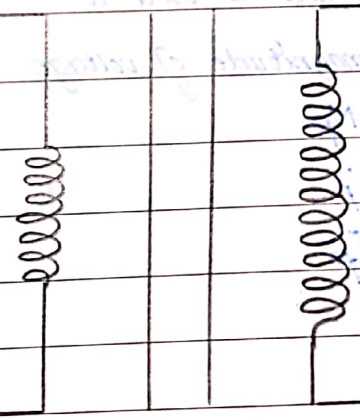
(1). Step-up Transformer

$N_s > N_p$

$V_s > V_p$

$I_s < I_p$

→ a transformer in which number of turns of secondary coil are greater than that of primary coil and is used to increase the magnitude of voltage



→ $I_s < I_p$ b/c $\frac{V_s}{V_p} = \frac{N_s}{N_p}$

$\frac{V_s}{V_p} = \frac{100}{10}$

Date: 14/8/20

$\frac{V_s}{V_p} = 10$

$V_s = 10(V_p)$

↳ clearly shows that the voltage in secondary coil will be more than that in primary coil

$P_{in} = P_{out}$ 100 watt

$V_p I_p = V_s I_s$

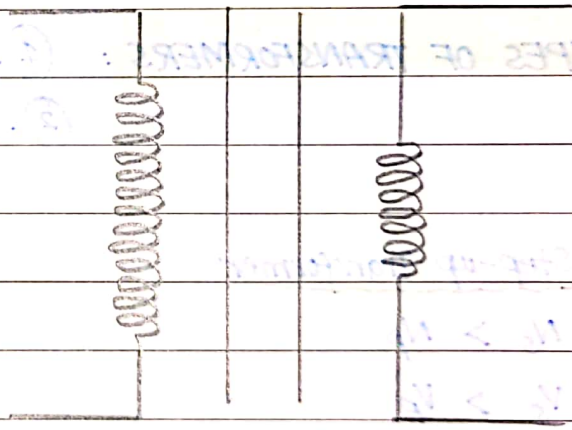
$10V \times 10A = 100V \times 1A$

↳ when voltage increases current decreases, exactly why $I_s < I_p$

→ ratio of turns of primary coil and turns of secondary coil is equal to ratio of voltage in primary coil and voltage in secondary coil

② Step-down transformer

→ a transformer in which no. of turns of secondary coil is less than that of primary coil and is used to decrease the magnitude of voltage



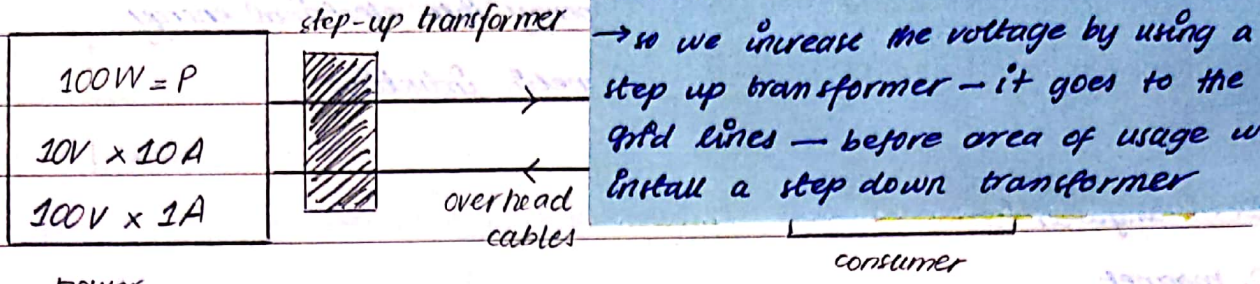
$N_s < N_p$

$V_s < V_p$

$I_s > I_p$

→ in transmission of electricity over national grid lines, there is loss of current b/c of loss in heat energy — the current has to travel over large distance
→ voltage is inversely proportional to current $P = VI$
→ so we increase the voltage by using a step up transformer — it goes to the grid lines — before area of usage we install a step down transformer

TRANSMISSION OF ELECTRICITY



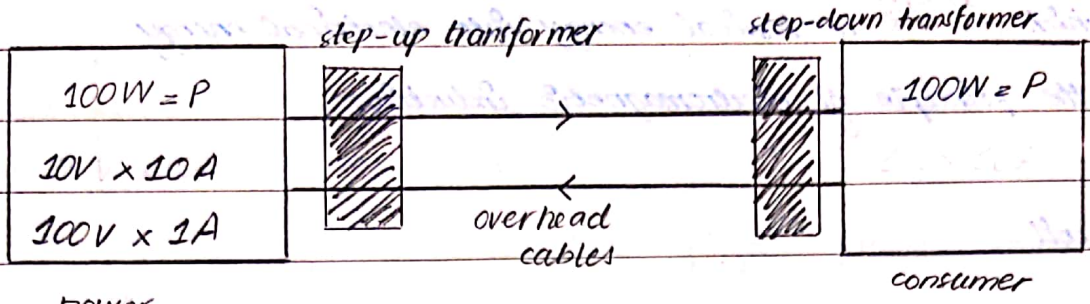
→ overhead cables as good conductors offer resistance to the current
→ b/c of this, there will be power loss and energy loss (to overcome the resistance energy/power is used)

Power loss = I^2R

To decrease power loss:
→ use a material for cable which offers minimum resistance e.g/ gold, copper, aluminium
→ decrease amount of current by passing electricity in 100V x 1A form, or transfer electricity in high voltage
↳ a step-up transformer will increase magnitude of voltage and decrease that of current
→ a step-down transformer is installed at the end b to increase magnitude of current and decrease voltage of voltage
↳ otherwise the electrical appliances of consumer will get damaged
→ use thick cables so that resistance is low (minimum power lost as heat)

Date: 14/8/20

TRANSMISSION OF ELECTRICITY



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→ a step-down transformer is installed at the end ↳ to increase magnitude of current and decrease voltage of voltage

↳ otherwise the electrical appliances of consumer will get damaged

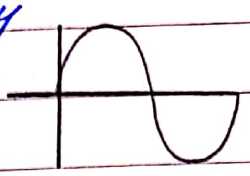
→ use thick cables so that resistance is low (minimum power lost as heat)

Date: 17/8/20

ALTERNATING CURRENT GENERATOR (A.C GENERATOR)

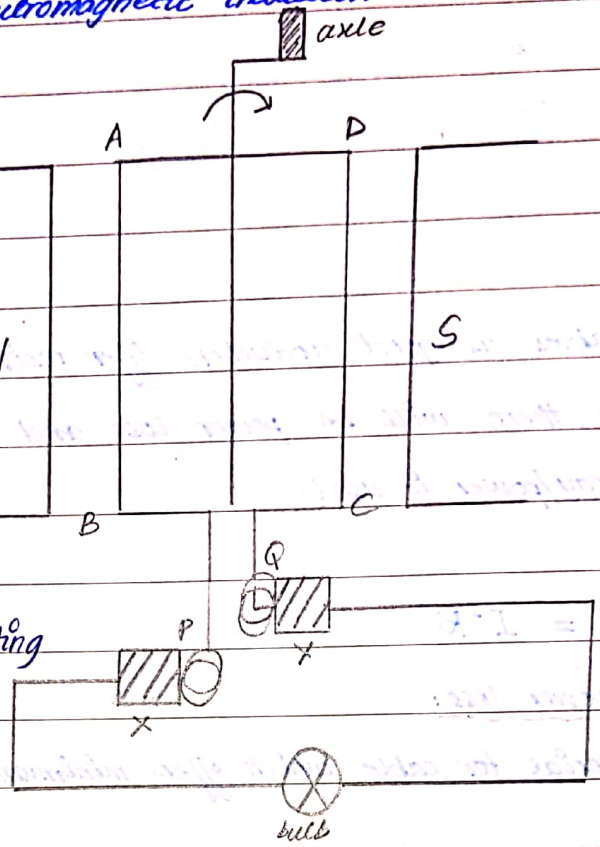
→ a device which converts mechanical energy into electrical energy

→ it works on the principle of electromagnetic induction



Parts:

1. rectangular coil
2. magnet
3. slip rings
4. carbon brushes
5. axle



*slip rings help in ~~[illegible]~~ providing/ ~~[illegible]~~ transporting ~~[illegible]~~ induced current to outer circuit

→ the coil is rotated through axle & the hand

→ induced current is produced inside the coil b/c of electromagnetic induction

Factors affecting alternating current

1. strength of magnetic field (amplitude doubles) (directly proportional)
2. rotation of coil — speed (amplitude + frequency) (directly proportional)
3. no. of turns of coil (amplitude doubles) (directly proportional)
4. magnetic material placed inside the coil (directly proportional)

↑ strength of magnetic field

*current wahan say flow karta hai jahan resistance kam ho.

Date: _____

→ when the coil is rotated b/w poles of magnet then due to cut of magnetic flux, an emf is induced in the coil

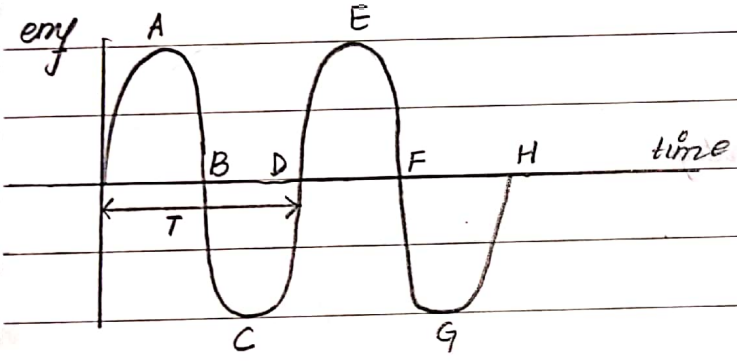
→ when the coil is in vertical position, cut of magnetic flux is zero and no emf is induced in the coil

→ when the coil is in horizontal position, cut of magnetic flux is maximum so maximum emf is induced in the coil

→ therefore, emf in the coil varies in magnitude as well as direction

⇒ slip rings act as a barrier bridge b/w the current induced in the coil coil and the output circuit

⇒ also help in reversing the direction of current after every half cycle

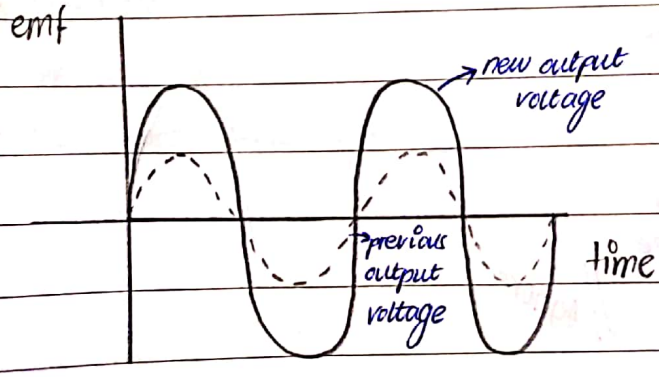


* at points O, B, D, F and H coil is in vertical position, because emf induced is zero

* at points A, C, E and G coil is in horizontal position, because emf induced is maximum

Graphical changes on induced current produced by A.C Generator

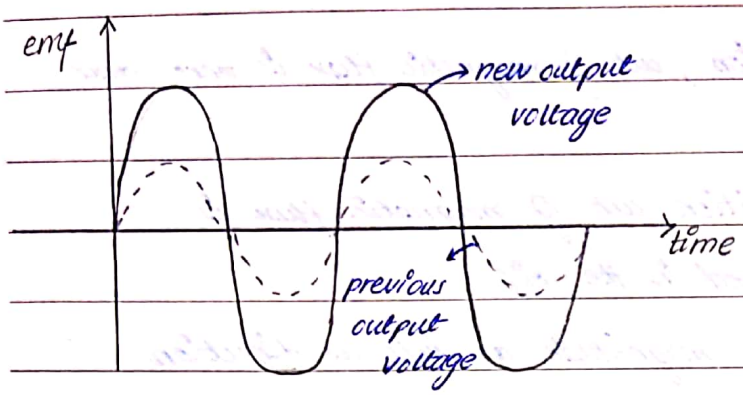
1. If no. of turns on the coil are doubled, the induced emf is also doubled



⇒ doubling the turns doubles the maximum output voltage

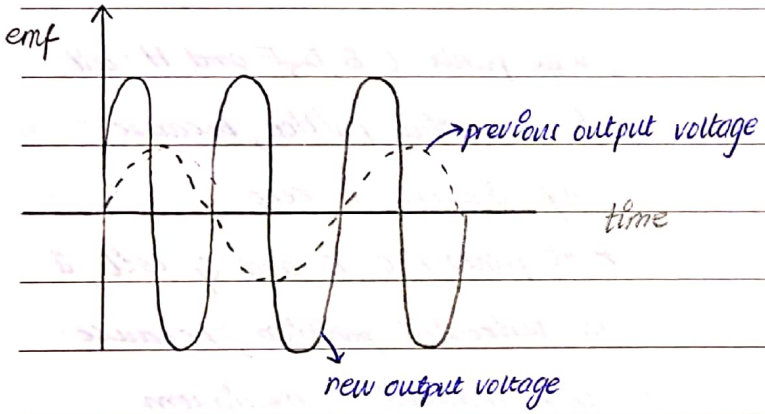
Date: _____

2. If magnet of double strength is used, the induced emf is also doubled.

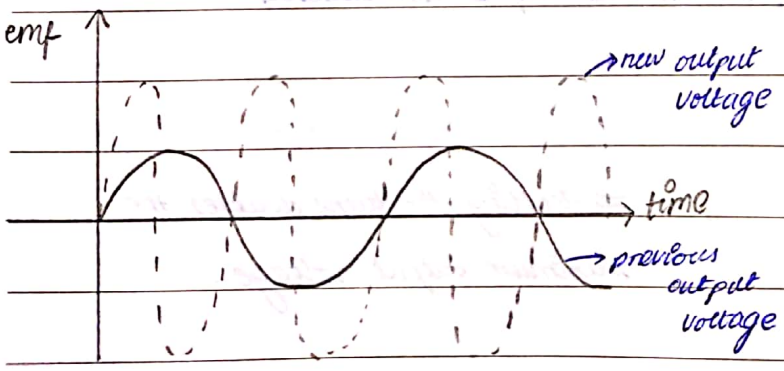


⇒ doubling the magnet strength, doubles the output voltage

3. If speed of coil is doubled, the induced emf as well as frequency of coil becomes double



4. If speed of coil is reduced to half of its original value, then emf induced as well as frequency of coil becomes half



// ignore

Date: _____

Advantages of A.C for Power Transmission

→ A.C transformers make it possible to change the voltage

→ D.C voltages can be changed but the process is relatively different and expensive

→ & ofcourse transformers do not work with DC

Advantages of high voltage Transmission

→

Environmental and cost implications of underground power transmission compared to overhead lines

→ overhead are easy to maintain (opposite for underground)

→ dangerous

→ environment ugly hota hai

→ do not heat up

Date: _____

Demagnetisation :-

→ provide it AC

→ the magnet has to be withdrawn without switching off the circuit.

OR → include a rheostat & gradually increase resistance — current decreases — demagnetizing the magnet.

Magnetization ⟼ D.C supply

Demagnetization ⟼ A.C supply