Q NO1 The emf induced in the coil of the motor due to change of magnetic flux in it, is called back emf.

→FACTORS EFFECTING BACKEMF:

(i) Rate of change of magnetic flux: Magnitude of back emf induced in a coil is directly proportional to the rate of change of magnetic flux **Mathematically:** $\mathcal{E} \propto \frac{\Delta\Phi}{\Delta t}$

(ii) Speed of motor: Increasing the speed of motor will increase the back emf and vice versa. The back emf produced in an armature of motor is given by the relation used for emf induced in generators **Mathematically:** $\mathcal{E} = NwAB\sin\omega t$, $\mathcal{E} \propto w$

(iii) Inductance (L): Higher inductance of coil leads to higher back emf **Mathematically:** $\mathcal{E} = \frac{L\Delta I}{\Delta t}$, $\mathcal{E} \propto L$

(iv) Resistance of circuit: Back emf in an inductive circuit is inversely proportional to resistance (R) of circuit.

Q NO2: →REASON: Rate of doing work increases as load to the motor is increased. Increased load decreases back emf.

→EXPLANATION:

- **Increase in moment of inertia of coil:** Connecting load with the armature of the coil increases moment of inertia of coil
- **decrease in rotational velocity:** Increasing moment of inertia decreases 'ω' **Mathematically:** $\text{Moment of inertia} \propto \frac{1}{\omega}$
- **effect on rate of change of flux and back emf:** Decreasing angular velocity decreases rate of change of flux. Thus Back emf also decreases.

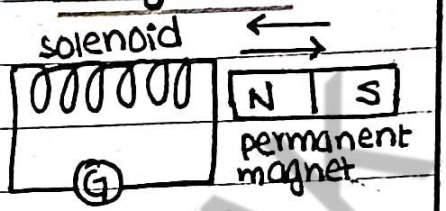
Mathematically: $\downarrow\mathcal{E} \propto \omega\downarrow$ $\downarrow\mathcal{E} \propto \frac{\Delta\Phi}{\Delta t}\downarrow$ (where ↓ indicates decrease)

QNO3: According to faraday's law of electromagnetic induction the induced emf is given by $\mathcal{E} = -N\Delta\Phi/\Delta t$

→ ADVANTAGE OF USING COIL WITH MANY TURNS:

Rate of change of magnetic flux will increase as number of turns increase and as a result larger amount of emf $\mathcal{E}$ is induced. This happens as surface area exposed to changing magnetic field increases.

Diagram:



▲ faradays solenoid experiment

→ CONCLUSION:

The whole procedure is advantageous for generating higher voltage and improving the effeeiency of devices like transformers, generators and inductors

---

QNO4: $\mathcal{E} = -\Delta\Phi/\Delta t$

L·H·S	R·H·S
Emf($\mathcal{E}$) = $\frac{\text{work done}}{\text{charge}}$	$\Delta\Phi/\Delta t = \frac{\Delta B \cdot A}{\Delta t} = \frac{(Nm^{-1}A^{-1})\,m^2}{s}$
Dimensions of work = $[ML^2T^{-2}]$	$= (Nm^{-1}A^{-1})m^2s^{-1}$
Dimensions of charge = $[AT]$	$= kgms^{-2}m^{-1}A^{-1}m^2s^{-1}$
Dimensions of emf = $\frac{[ML^2T^{-2}]}{[AT]}$	$= kgm^2s^{-3}A^{-1}$
$= [ML^2T^{-2}A^{-1}T^{-1}]$ (1)	Putting dimension units $= ML^2T^{-3}A^{-1}$ (2)

As (1) = (2) thus L·H·S = R·H·S

→ RESULT:

Given equation is dimensionally correct.

Cutting Line

Q NO 5 → MAGNETIC FLUX LINKAGE:

- **Definition:** "Magnetic flux linkage is the product of magnetic field and number of turns of coil."
- **Mathematically:**

Flux linkage = $N\Phi$

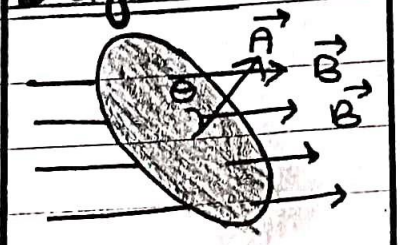
where $\Phi = B \cdot A \cos\theta$

Flux linkage = $NBA\cos\theta$ (i)

But we know that $\theta = \omega t$ thus equation (i) becomes

Flux linkage = $NBA\cos\omega t$ (ii)

Diagram:



magnetic flux linkage

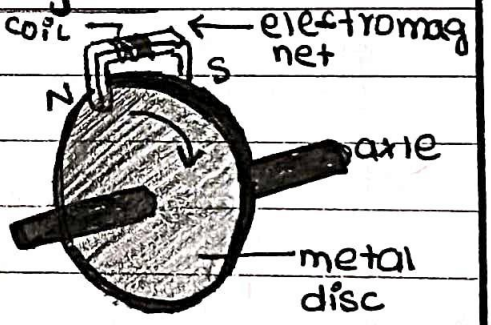
- **RESULT / CONCLUSION:**

Equation (ii) represents the flux linkage in terms of angular orientation ($\theta = \omega t$)

Q NO 6: → ELECTROMAGNETIC BREAK:

Refers to applying break using electric and magnetic power. These are also called as eddy current breaks

Diagram:



→ WORKING:

(i) Current through electromagnet: current is passed through electromagnet which produces its magnetic feild.

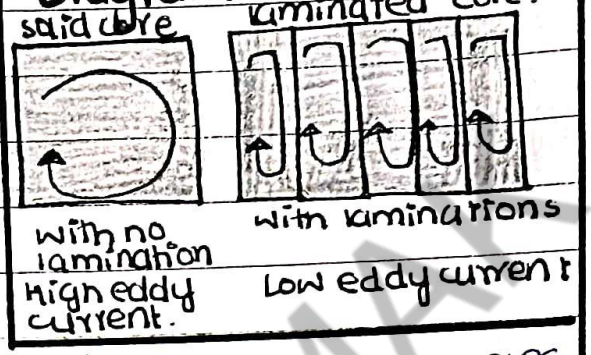
(ii) Magnetic feild through rotating disc: Magnetic field perpendicularly passes through rotating disc which causes change of magnetic flux through disc. This produces eddy currents

(iii) Interaction of eddy currents with magnetic feild: Eddy currents will produce their own magnetic field and according to Lenz's law it will interact with external m.f so as to oppose rotation.

Q NO7: → **EDDY CURRENTS:** "Eddy currents are loops of electrical current induced within conductors by changing magnetic field in the conductor"

→ **Disadvantage:** Eddy currents flow in closed loops within transformer core in planes perpendicular to the magnetic field and produce heat.

Diagram:



→ **MINIMIZATION:**

- **Using laminated core:** Using laminated soft iron cores consisting of many thin sheets pressed together but separated by thin insulating layers.
- **Increasing resistance of core:** This will decrease eddy current

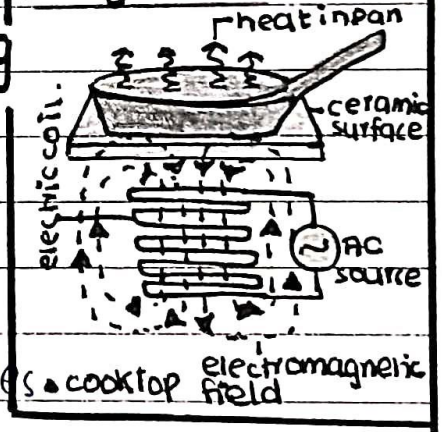
NET EFFECT: Reduced heating effects & limitation of eddy currents to small thickness.

Q NO8: → **COOK TOPS:** An electrical device used for cooking and heating the food through electromagnetic induction is called cook tops.

→ **WORKING:**

(i) **Production of rapidly oscillating magnetic field:** A coil attached to AC beneath stove top set up a rapidly oscillating magnetic field.

Diagram:



(ii) **Production of eddy currents:** Rapidly changing magnetic field produces eddy currents in base of metal pan.

(iii) **Production of heat:** Eddy currents produce heat energy and the food items absorb this heat energy. In this way food is cooked using a cooktop through electromagnet induction.

attempt the questions at specified spaces only.

000000

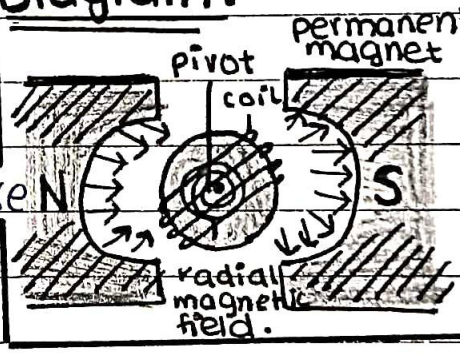
Q. NO 9 Page 4 → **BACK EMF OF MOTOR:** "When armature of the motor rotates in a magnetic field by applying potential difference V, then its magnetic flux changes and emf is induced in it which is called back emf."

- **Opposing Nature:** Induced emf opposes the potential difference running the motor, net effective voltage is given by: **Mathematically:** $\text{Effective voltage} = V - \mathcal{E}_{back}$
- **Relation with speed of rotation:** Back emf induced in the armature of motor is directly proportional to its speed of rotation. **Mathematically:** $\mathcal{E} \propto \omega$
- **As motor speeds up:** Back emf increases
- **As motor slows down:** Back emf decreases
- **As load increases:** Back emf decreases and if motor is prevented from rotating back emf becomes zero.

Q NO 10: → **ADVANTAGE FOR ARMATURE TO ROTATE IN RADIAL MAGNETIC FIELD:**

(i) More efficient induction: In a radial magnetic field, the changing magnetic flux across the coil is more uniform during rotation resulting in more efficient induction of emf.

Diagram:



(ii) Simpler construction: Radial magnetic field configurations often have simpler designs making them easier to implement in certain applications

(iii) Torque acting on coil: In a radial magnetic field, magnetic field and vector area of coil are perpendicular to each other and $\theta = 90°$. Therefore **maximum torque** acts on coil. **Mathematically:** $\tau_{max} = NIAB$ ($\because \sin 90 = 1$)

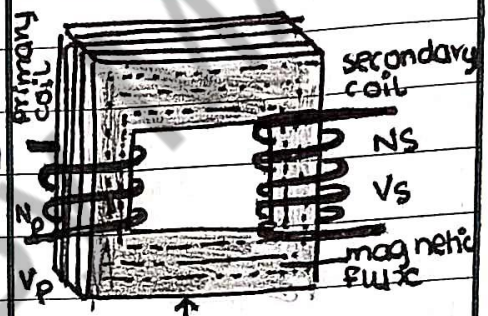
Q NO 11 vi (a) I would prefer laminated soft iron core

(b) → **REASON:**

(i) **Minimize Hysterisis Loss:** Soft iron core lessens the hysterisis loss and magnetization and demagnetization is made easier.

(ii) **Reduced Eddy Current:** Laminated core plays crucial role in offering resistance to induction of Eddy current.

Diagram:



▲ A transformer

(iii) **Focusing Magnetic Flux:** It can increase and focus the magnetic flux on the transformer coils.

→ **CONCLUSION:** overall energy loss, heat production is reduced. Aluminum can not fulfill these requirements and using only iron or soft iron isn't as beneficial without lamination.