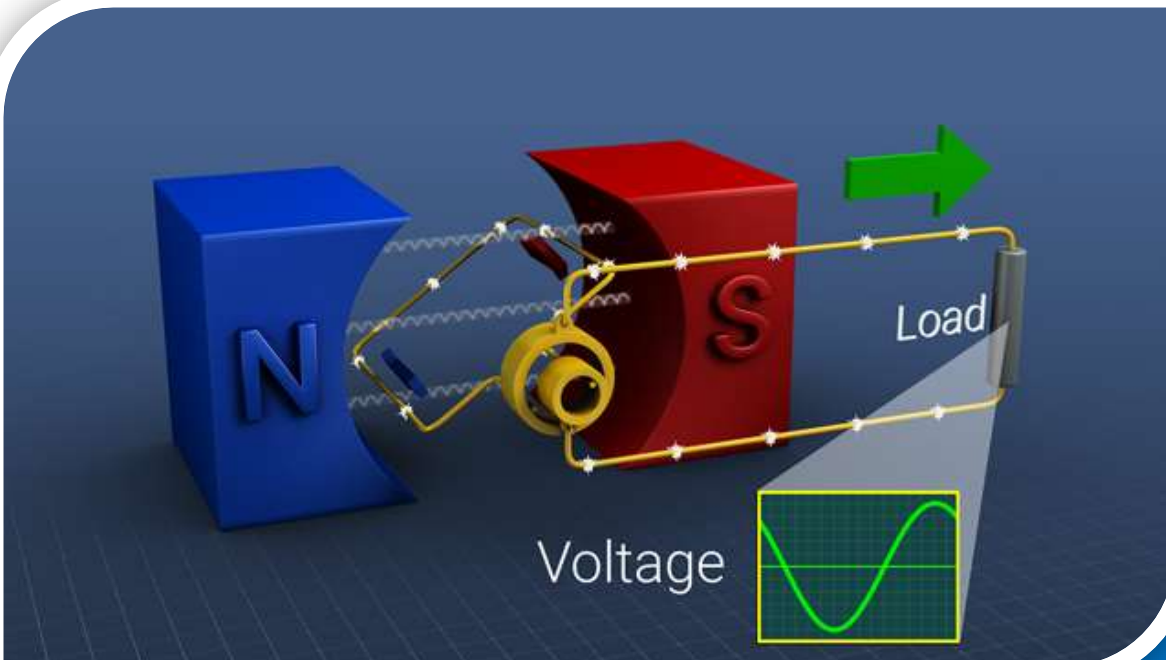
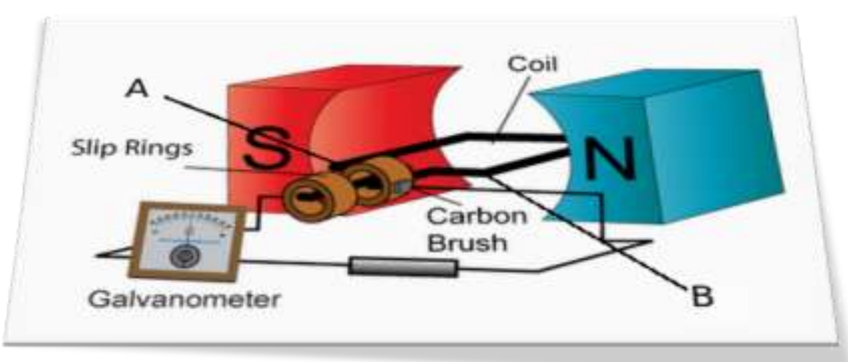
KNOWLEDGEBASE PHYSICS

2020

ELECTROMAGNETIC INDUCTION





TEACHERS OF PHYSICS

www.teachersofphysics.com

7/30/2020

1. State Faraday's law of Electromagnetic induction.

- ✓ *Faradays law of electromagnetic induction states that the magnitude of induced e.m.f is directly proportional to the rate of change of magnetic flux linkage.*

2. State Lenz's law of electromagnetic induction.

- ✓ It states that the direction of induced e.m.f is such that the induced current which it causes to flow produces a magnetic effect which opposes the change producing it.

3. Define the volt.

- ✓ Is the work done in moving a unit charge through a distance of 1m in an electrical conductor.

4. State <u>three</u> factors affecting the size of the induced voltage.

- ✓ The magnitude or strength of magnetic field.
- ✓ The nature of the core.
- ✓ The number of turns of coil/length of the conductor.
- ✓ The rate of change of flux linkage/rate of relative motion between the conductor and magnetic field.

5. State one source of mains electricity

- ✓ Water in high dams.
- ✓ Geothermal energy.
- ✓ Coal or diesel.
- ✓ Tidal waves in the seas.
- ✓ Nuclear energy.

COILS

1. An armature composed of turns of insulated copper wire wound on a laminated soft- iron core is rotated in a magnetic field to generate an e.m.f. Use this information to answer the following questions.

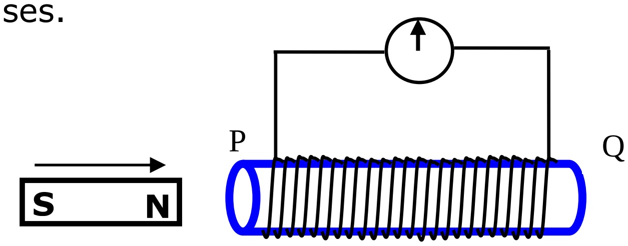
(a) State two factors other than the speed of rotation that affect the magnitude of the e.m.f generated.

- ✓ Strength of the magnetic field.
- ✓ Number of turns of the coil.

(b) State the reason why soft- iron is laminated.

- ✓ To minimize energy losses by reducing eddy currents

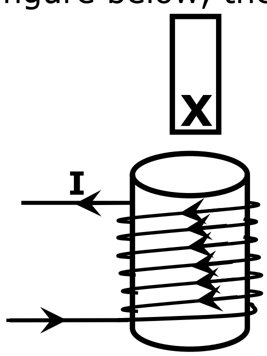
2. The free ends of a coil are connected to a galvanometer. When the north pole of a magnet is moved towards the coil, the pointer deflects towards the right as shown. State with reason the behaviour of the pointer in the following cases.



i) The north pole of the magnet is held stationary near p.
   ✓ No deflection of the pointer. No change in magnetic flux hence no current induced.

ii) The south pole of the magnet is made to approach the coil from Q.
   ✓ Pointer of the galvanometer deflected to the right. End Q acquires south polarity, hence current flows in clockwise direction at end Q.

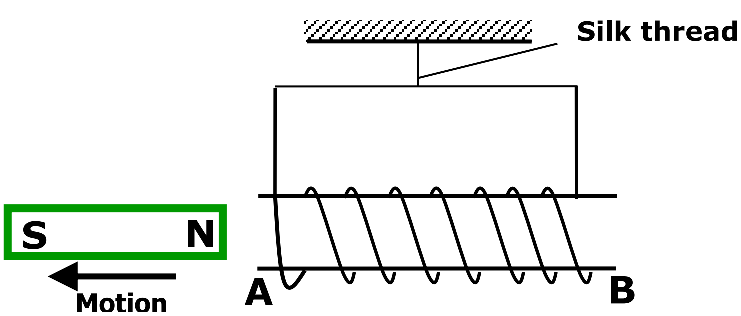
3. In the figure below, the bar magnet is moved out of the coil



(i) If the current, I is induced in the coil in the direction shown, what is the polarity of x of the magnet?
   ✓ North pole

(ii) Explain briefly the source of electrical energy in the circuit.
   ✓ Mechanical energy of the magnet converted to electrical energy.

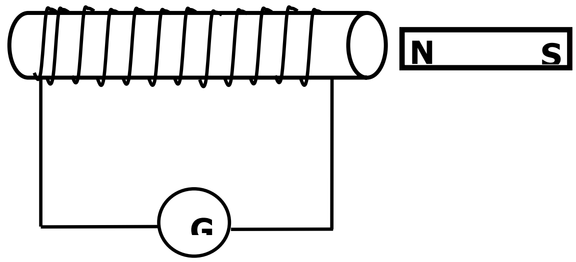
4. Figure below shows a rigid circuit ABCD suspended by a silk thread from a support. The coil AB is made of copper.



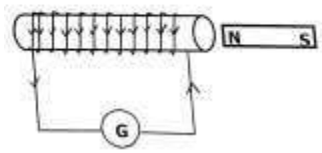
The magnet near A is suddenly pulled to the left. State and explain the observation on the circuit.

- ✓ Current flows in clockwise direction. South polarity formed at end A.

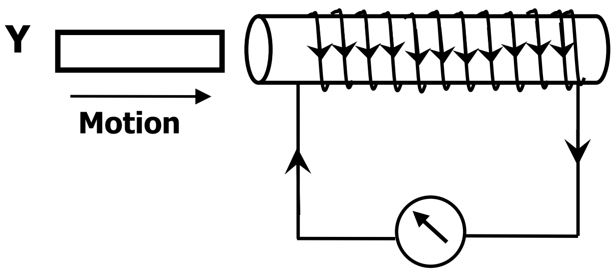
5. The figure below shows ends of a solenoid connected to a galvanometer as shown below and a magnet plunged into the coil.



Show the direction of induced current



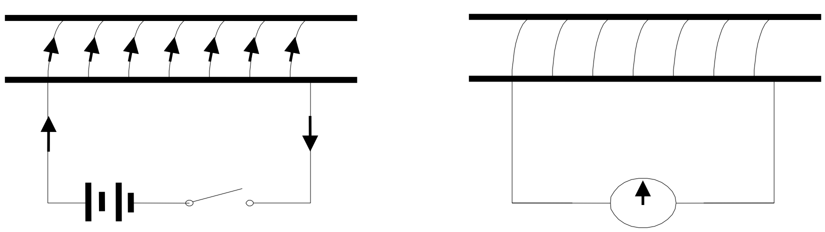
6. A coil x is moved quickly away from the end of a stationery Magnet Y and current flows as show n in



State the polarity of **Y**

- ✓ *North pole*

7. Figure shows two coils P and Q placed close to each other.

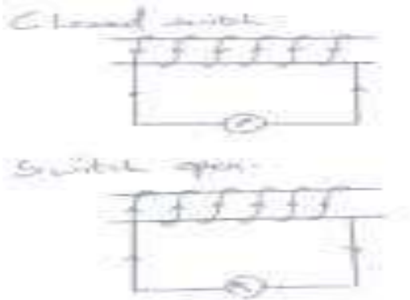


When the switch k is closed, an e.m.f is induced in coil Q. Similarly, an e.m.f is induced in coil Q when the switch K is opened.

(i) Explain why the induced current in coil Q is higher when the switch K in coil P is opened than when it is closed.

- ✓ *Time taken for current to die off is shorter than time taken for it to build*

(ii) With the help of diagrams, show the direction of the induced current in coil Q when the switch k is closed and when it is opened.



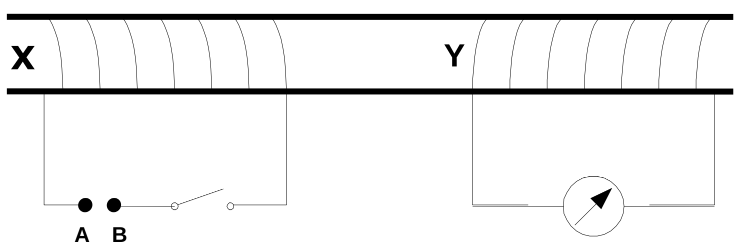
(iii) Which phenomenon is being demonstrated in this set up?

- ✓ *Mutual induction.*

(iv) Suggest a way in which the induced e.m.f in the secondary coil Q can be increased.

- ✓ *Increasing number of turns in coil Q*
- ✓ *Winding both coils P and Q on a soft iron ring.*

8. Figure shows two coils connected using a soft iron core.



When the switch is closed, the galvanometer deflected in the direction shown. Determine:

i) The magnetic poles X and Y

X→North pole
Y→South pole

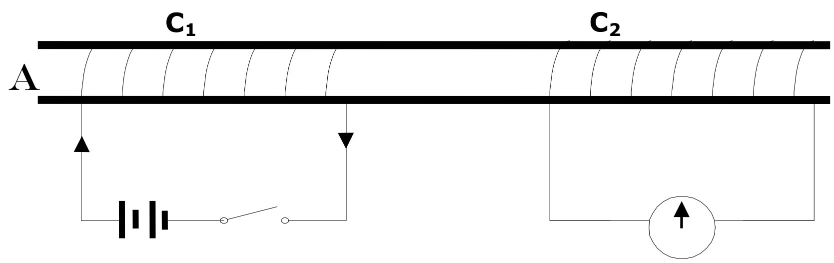
ii) The electric polarity A and B of the cell.

A→Negative
B→Positive

iii) Compare the deflection of the galvanometer when the switch is closed and when its opened.

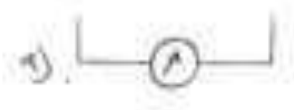
- ✓ *Greater deflection when switch is opened than when it is closed. Current takes shorter time to die off than to build up.*

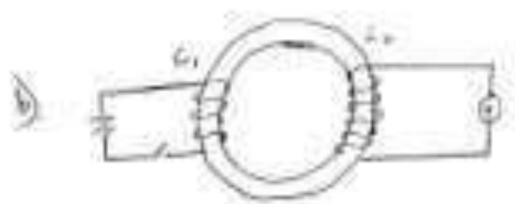
9. The figure below shows mutual induction



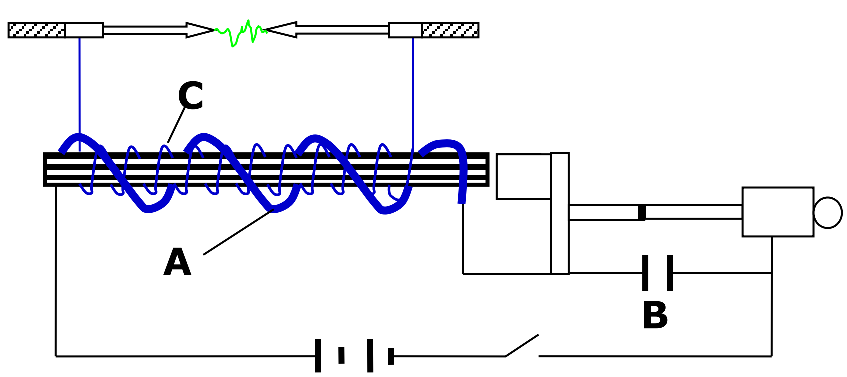
(a) Show the deflection in C_2 when the switch for C_1 is closed (1mk)

(b) Using a diagram illustrate one way of increasing the e.m.f induced with the same number of cells and coils. (2mks)





10. The diagram below shows an induction coil used to produce sparks.



(i) Name parts labeled **A, B** and **C** (3mks)

. A – primary coil

B – capacitor

C – secondary coil

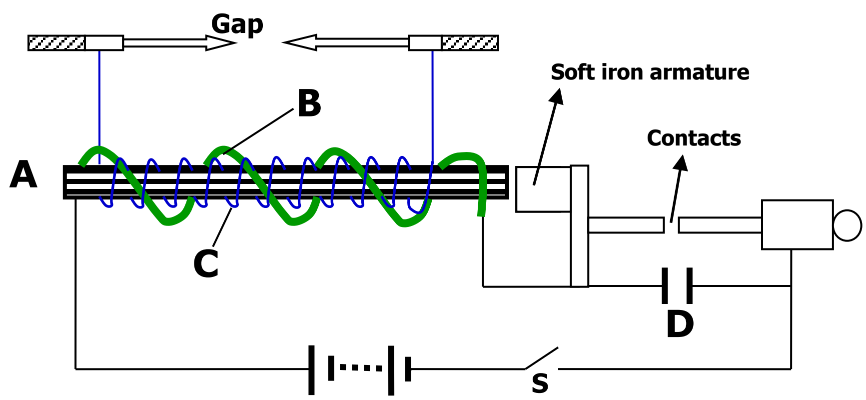
(ii) Briefly explain how the induction coil works. (4mks)

On closing the switch, current flows in the primary coil, soft iron rods get magnetized and attract the soft iron armature.

Contact is then broken, current stops flowing and magnetism reduced to zero. A large emf is induced in the secondary coil by mutual induction.

Spring pulls back the armature, contact is made again and process repeated.

11. Fig shows an induction coil.



i) Name the parts labelled A, B, C and D. (2mk)

A – soft iron rods
B – primary coil
C – secondary coil.
D - capacitor

ii) Briefly explain what happens from the time the switch'**s**' is closed onwards. (4mk)

When switch is closed, current flows in the primary coil, soft iron rods get magnetized and attract the soft iron armature.
Contact is then broken, current stops flowing and magnetism reduced to zero. A large emf is induced in the secondary coil by mutual induction.
Spring pulls back the armature, contact is made again and process repeated.

iii) State the purpose of the part labelled D in the circuit. (1mk)

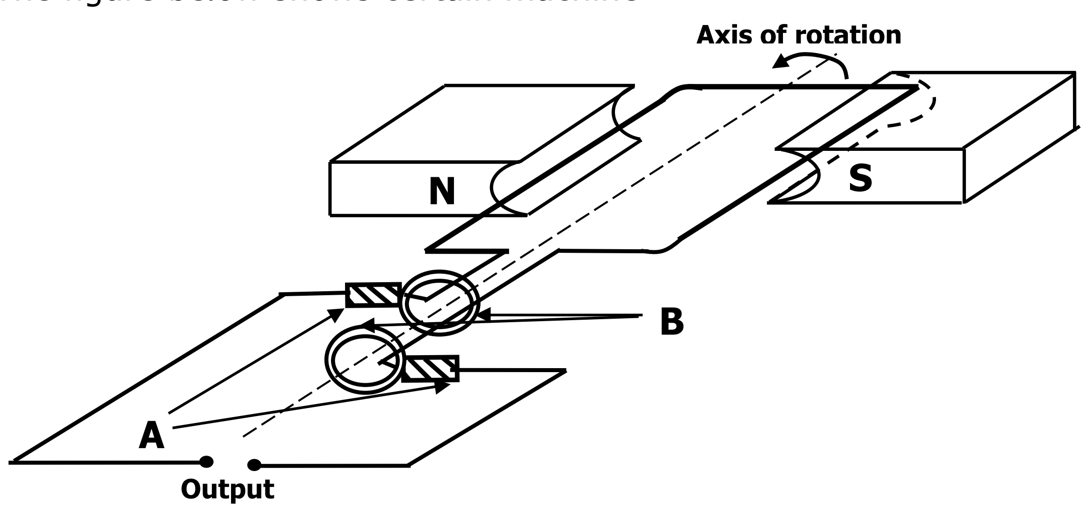
To prevent sparking across the contacts by reducing magnetic flux to zero.

GENERATOR

1. If a "boda boda" cyclist wants his head lamp to light more brightly what must he do?

Cycles at a higher speed.

2. The figure below shows certain machine



(i) State the name of the machine shown in the diagram above. (1mk)

AC generator

(ii) What are the names of the parts labeled A and B (2mk)

A- Brushes *B – Slip rings*

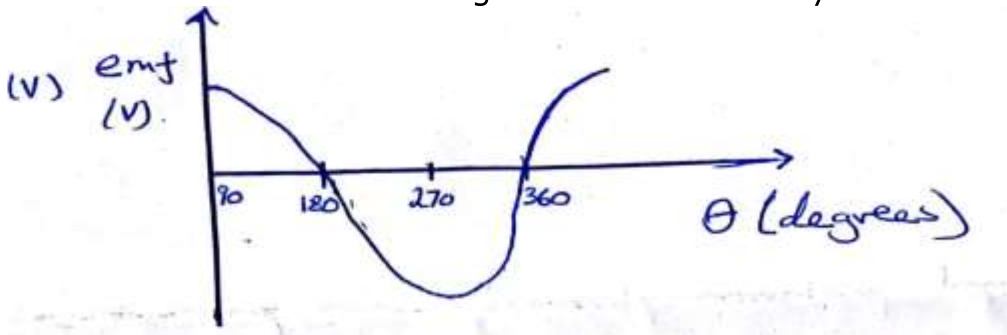
(iii) What would be the effect of doubling the number of turns on the coil if the speed of rotation remained uncharged? (1mk)

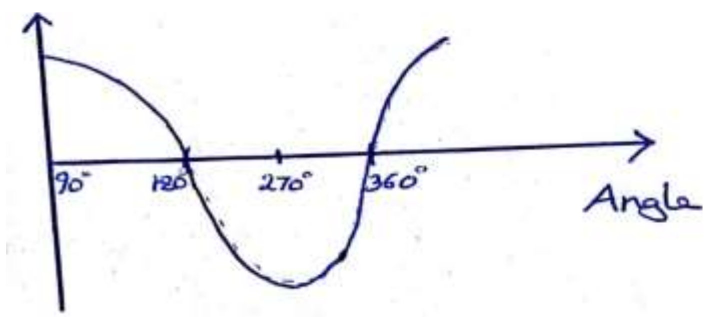
Doubles the current generated

(v) Which of the output terminals is positive at this instant if the coil is rotating in the direction shown in the diagram (anticlockwise)?(1 mk)

Left terminal

(v) On the axes below sketch a graph to show how potential difference across **R** varies with the inclination angle. The coil is initially horizontal. (1mk)

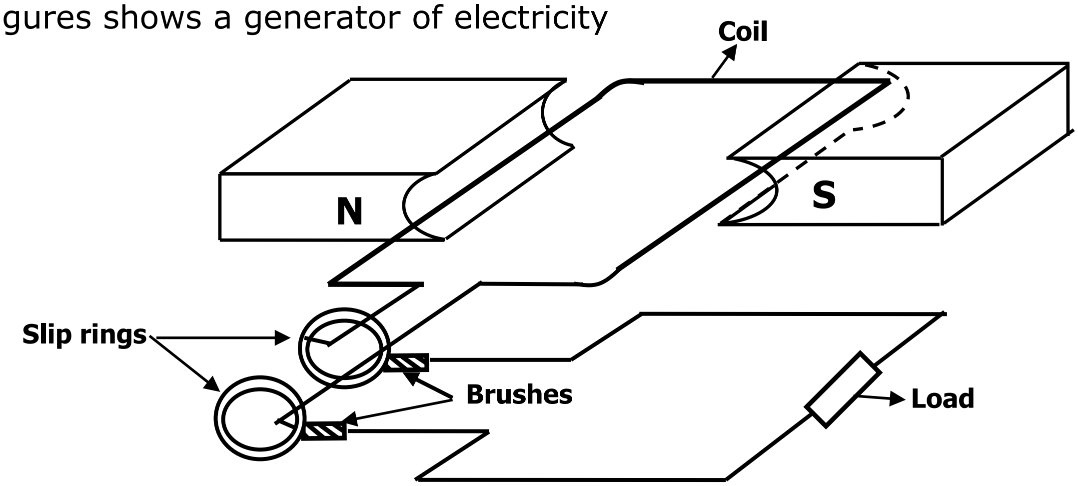


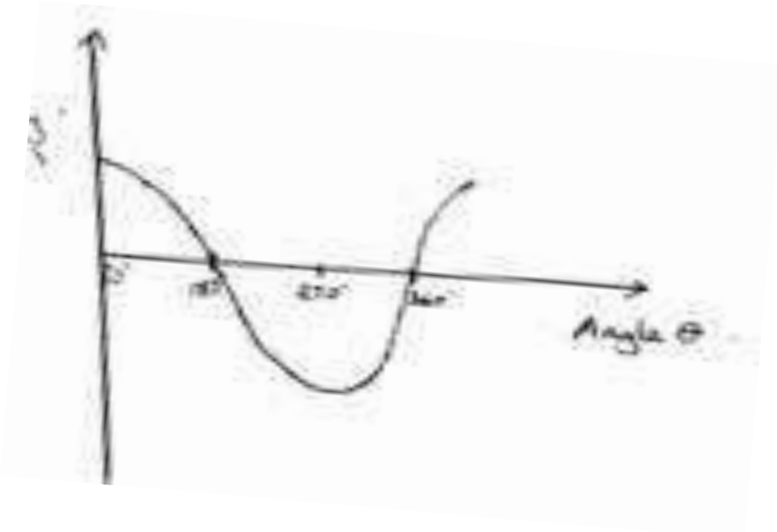


(vi) Give reasons for the changes in the emf as the coil rotates from 0^0 to 180^0 (3mk)

As the angle increases from 0^0, the flux linkage between the coil and the field increases hence increase in the induced emf. This happens between 0^0 and 90^0. Past 90^0, the flux linkage decreases hence reducing the emf induced. Emf is maximum at 90^0 and zero at 180^0 or 0^0

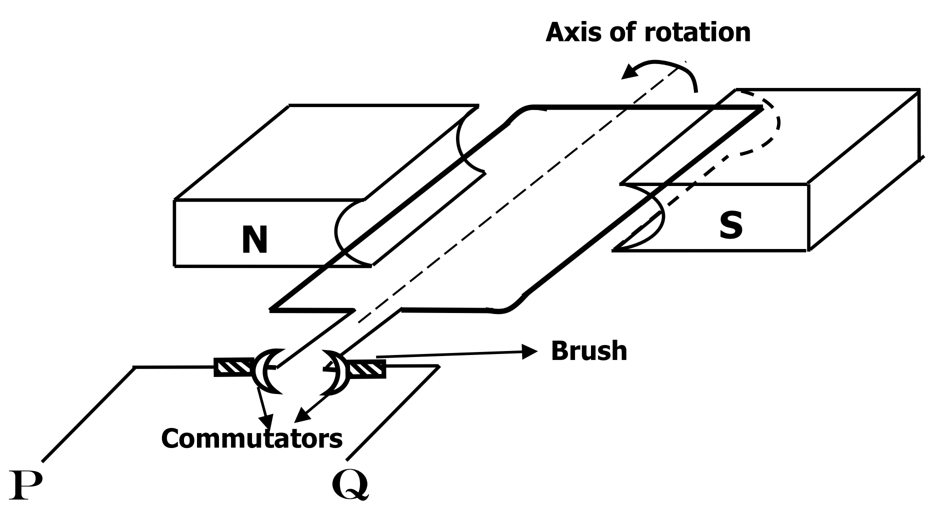
3. Figures shows a generator of electricity





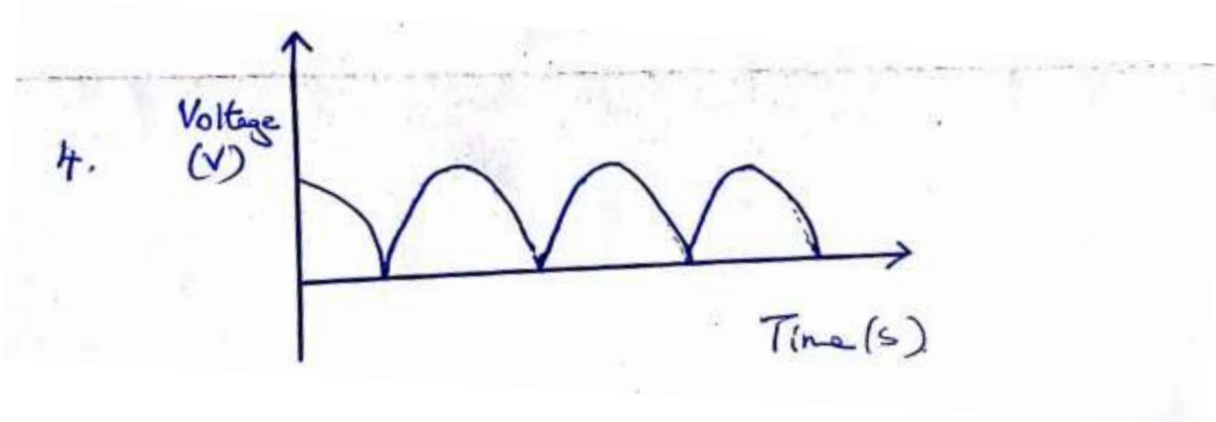
The coil rotates at a steady speed of 60 turns rotations per minute. An oscilloscope is connected a cross the load and adjusted to get on the screen a trace for one rotation of the coil. Sketch the trace for one rotation starting and finishing in the same position of the coil as shown in the figure. (3mk)

4. (i) Figure below shows an electric generator. The points P and Q are connected to a cathode Ray oscilloscope (C.R.O)

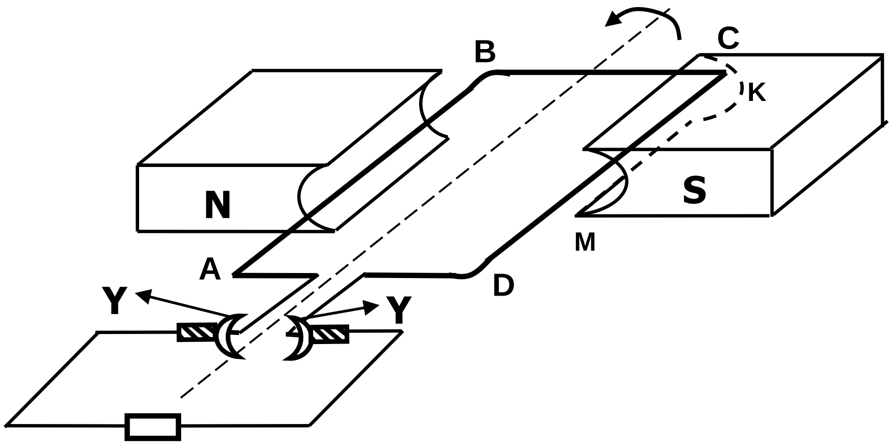


(ii) Sketch on the Axis provided the graph of the voltage output as seen on the C.R.O, given that when t= o, the coil is at the position shown in the figure 2mk

4.



5. The diagram below shows a simple d.c generator.



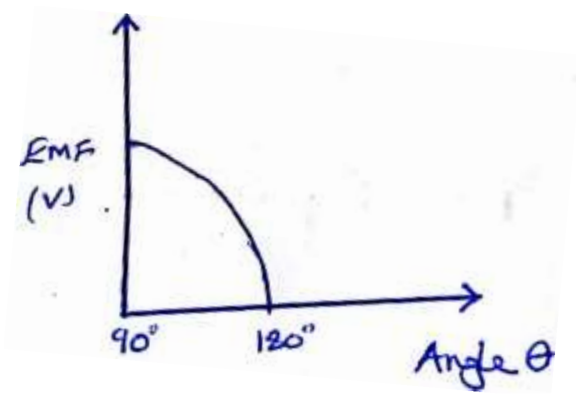
i) Name the part labeled X and Y (2mk)

Split ring

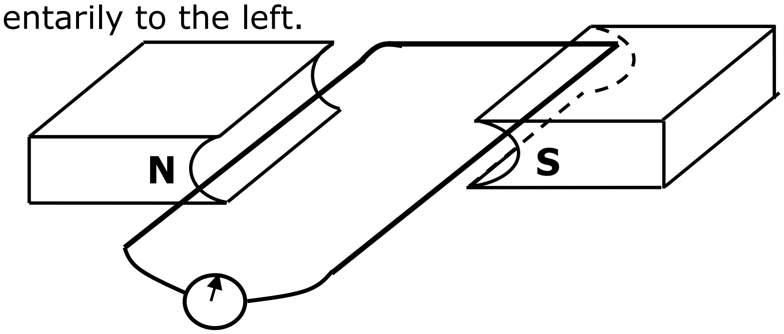
ii) The coil is rotated in Anticlockwise direction indicated using an arrow on the figure the direction of the induced current as the arm CD passes the position MK as shown. (1mk)

From D towards C

iii) Sketch on the axis below a graph of the e.m.f generated against the angle as arm CD rotates from 90^o to 180^o



6. A single coil of wire is held between the poles of a magnet as shown in figure below. The ends of the coil are connected to a sensitive centre-zero galvanometer. The coil is held out of the field of the magnet, the galvanometer deflects momentarily to the left.



(a) Explain why the galvanometer deflects (1mk)

Instantaneous motion of the coil in the magnetic field leads to instantaneous induction of current in the coil hence galvanometer deflects.

(c) Explain how the deflection would be made larger with the same apparatus(2mk)

By moving the coil at a higher speed.

(c) For each of the following cases, describe what is observed on the galvanometer giving reasons

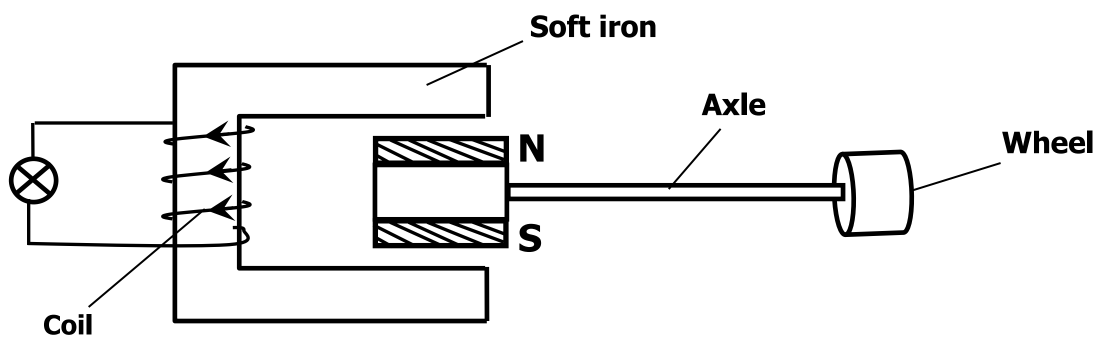
(i) Coil moved towards south pole without rotating (2mks)

i. No deflection. The coil and the field are parallel to each other hence no current induced.

(ii) Coil rotated through 90^0 in clockwise direction (2mks)

The deflection of the galvanometer will be from maximum to zero. There will be induced current due to the coil cutting the field in motion. Induced current decreases as the angle between the coil and the field decreases from 90^0 to 0^0.

7. Figure shows a cross –section of a bicycle dynamo. The wheel is connected by an axle to apermanent cylindrical magnet and is rotated by the bicycle tyre.



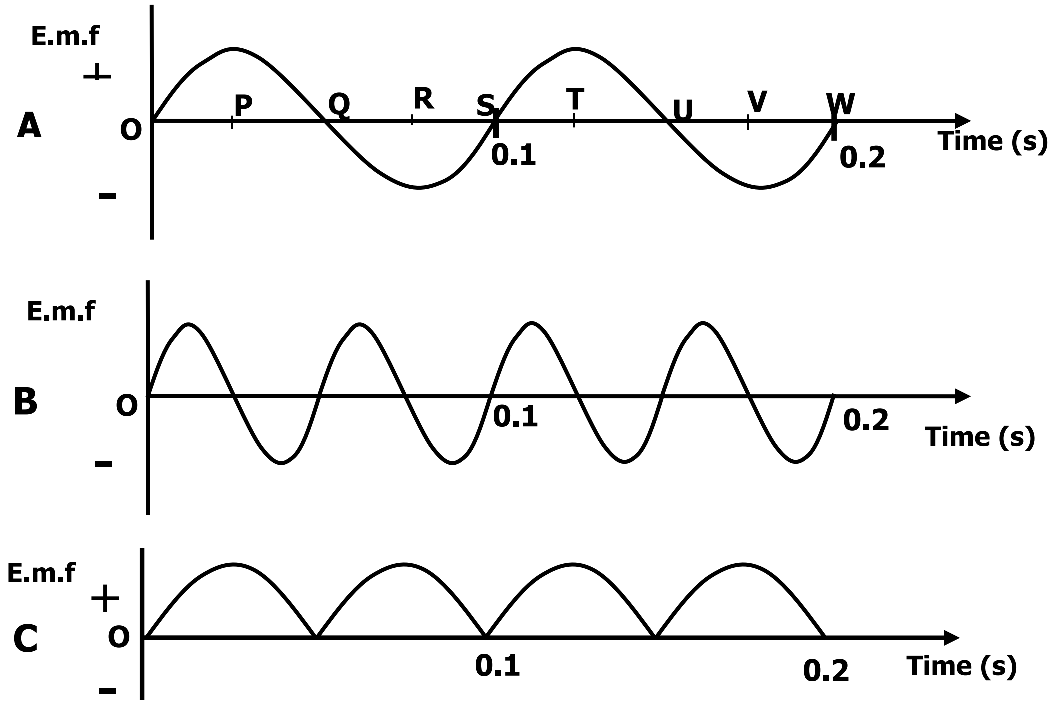
(i) Explain why the bulb lights (1mk)

There is induced current due to relative motion between magnetic field and the coil.

(ii) How can the bulb be made brighter?(1mk)

Rotating the wheel at higher speed.

8. Graph A below shows how the e.m.f produced by a simple dynamo varies with time. Graphs Band C show how the e.m.f produced by the same dynamo varies with time after certain alterations and modifications have been made



(i) What is the frequency of the alternating e.m.f as shown by graph A? (2 marks)
10 Hz

(ii) Which letters on graph A correspond to the plane of the coil of the dynamo being parallel to the magnetic field? (1 mark)
P, R, T, V

(iii) Explain why the e.m.f at Q is zero (3 marks)
The field is parallel to the coil hence no emf is induced.

(iv) What alterations has been made for the dynamo to produce the e.m.f represented by graph B? (1 mark)
Speed of rotation of the magnet has been increased.

(v) What modification has been made to the dynamo for it to produce the e.m.f represented by graph C? (1 mark)
Speed of rotation of the magnet has been increased.

(vi) A dynamo is driven by a 5kg mass which falls at a steady speed of 0.8m/s. the current produced is supplied to a 12W lamp which glows with normal brightness. Calculate the efficiency of this arrangement (2 marks)

1. $n = \frac{12}{40} x 100\%$
30%

TRANSFORMERS

1. State one difference between a transformer and an induction coil. (1 mk)

An induction coil is used to ignite petrol mixture in a car engine while a transformer is used to transfer electrical energy from one circuit to another by mutual induction.

2. Describe briefly the energy changes involved in the generation of electrical energy at a hydro-power station. (2mk)

PE $\longrightarrow$ KE $\longrightarrow$ Mechanical energy $\longrightarrow$ Electrical energy

3. Explain why the core of a transformer tends to get hot when in use.(2mk)

This is due to production of heat during magnetization and demagnetization of the core every time the current reverses.

4. In what form is energy lost in a cable during transmission. (1 mk)

Heat energy

5. Give any two (2) structural features in a transformer design which help in achieving high efficiency. (2mk)

Secondary coil is wound over the primary coil, coils are wound next to each other to reduce flux leakage.

By use of core made of soft magnetic material to minimize hysteresis loss.

Laminating the core to minimize heating effect.

6. What are eddy currents (1mk)

Loops of electrical currents induced within conductors by changing magnetic fields within conductors.

7. State the reason why soft iron it laminated in transformers. (1mk)

This is to reduce/minimize heating effects thus reducing energy loses through eddy currents in the core.

8. Explain why in a transformer, it is alternating current which is fed to the primary coil and not the direct current. (1 Mark)

This is because alternating current can easily be stepped up or down to a required voltage.

9. State the advantage of generating a.c rather than d.c voltage in a power station. (1mk)

It is because it can be stepped up and down unlike the dc.

10. Give the structural features in a transformer design which helps in achieving high efficiency. (3mk)

i) lamination of the core.

ii) Use of core made of soft magnetic material.

Iii) Winding secondary coil over primary coil or the coils are wound next to each other on a common core.

11. State one cause of energy losses in a transformer and explain how it can be minimized. (2mk)

Causes	*How to minimize.*
Eddy currents in the core.	*Lamination of the core.*
Hysteresis loss	*Use of a core made of soft magnetic material.*
Resistance of coils.	*Use of thick copper wire to reduce heating effect*
Flux leakage.	*Wound coils next to each other on a common core.*

12. State **one** way in which power is lost in a transformer. (1mk)

Through flux leakage.
Hysteresis loss.
Eddy currents.

13. The core of a transformer is made of soft iron which is a ferromagnetic material.

(i) Name one other ferromagnetic material. (1mk)

✓ *Cobalt, nickel.*

(ii) State two features of the soft iron core that helps to improve the efficiency of the transformer. (2mk)

✓ *Soft iron core magnetizes and demagnetizes easily.*

14. One of the factors that affect efficiency of a transformer is hysteresis losses. What is Hysteresis losses (1mk)

Energy lost in form of heat in magnetizing and demagnetizing the soft iron core every time the current reverses.

15. State two energy losses in a transformer (2mk)

(i) Hysteresis loss -This is due to the repeated magnetization and demagnetization of the iron core caused by the alternating input current. This can be minimized by using alloys like metal or silicon steel.

(iii) Eddy current loss - Varying magnetic flux produces eddy current in the core. This leads to wastage of energy in the form of heat. This can be minimized by using a laminated core made of stelloy; an alloy of steel.

16. What are the advantages of transmitting power at

(i) Very high voltages

Minimize power losses.

(ii) Alternating voltage

Can easily be stepped up and down.

17. How are the high voltages acquired during power transmission achieved? (1mk)

Stepping up the voltage by use of step up transformer.

18. Explain why the voltage of mains electricity has to be stepped up immediately after power generation

To minimize power loss during transmission.

19. In the design a step up transformer;

(i) Which coil would be made with thick conductors 1mk

Secondary coils

(ii) Explain your answer in c (i) 1mk

Reduce heating effect due to large currents in the secondary coil.

20. A large substation transformer is used to step down voltage from 11,000V to 450V.

i) Determine the ratio of the turns in the primary to secondary coils.

$$\frac{Vs}{Vp} = \frac{450}{11000}$$

0.04091

ii) How is the efficiency of this transformer ensured?

Eddy currents – lamination of the core

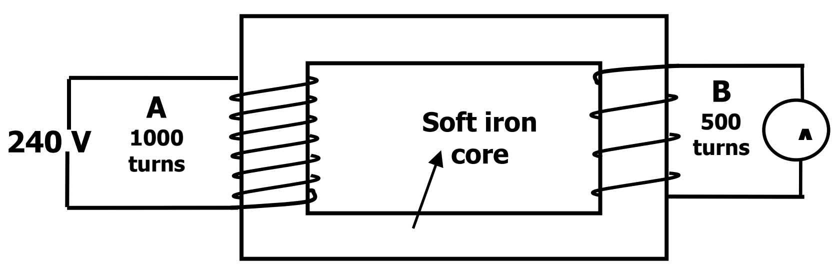
Hysteresis loss – use of soft magnetic materials

Resistance of coil – use of thick copper wires.

iii) State one function of the core in a transformer.

✓ *Acts as an electromagnet*

21. The diagram below shows two coils A and B wound on a soft iron core.



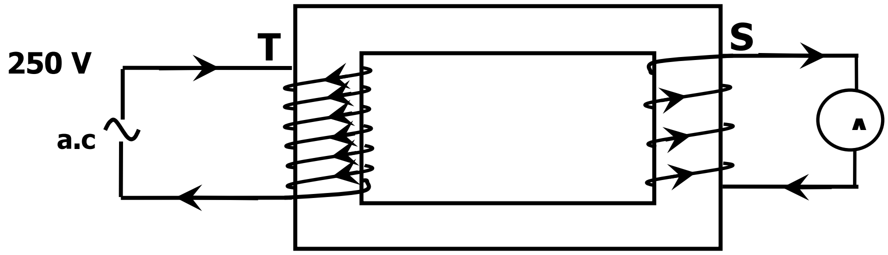
A has 1000 turns and B has 500 turns and a resistance of 100Ω. **Determine** the maximum current measured by the ammeter. (4mks)

1. $\frac{Ns}{Np} = \frac{Vs}{Vp}$

$$\frac{500}{1000} = \frac{I\ x\ 100}{240}$$

$I = 1.2A$

22. Two coils T and S are wound on a soft iron core as shown. T has 1000 turns while S has 600 turns and resistance of 100Ω



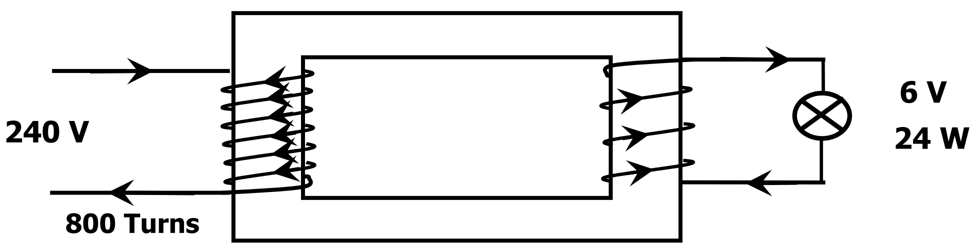
Calculate the maximum current measured by the ammeter.

1. $\frac{Ns}{Np} = \frac{Vs}{Vp}$

$$\frac{600}{1000} = \frac{I\ x\ 100}{240}$$

$I = 1.44A$

23. A 6v, 24w lamp shines at full brightness when it is connected to the output of this main transformer as shown in the figure.



Assuming the transformer is 100% efficient, **calculate**

(i) The number of turns in the secondary coil if the lamp is to work at its normal brightness (2mk)

(ii) $\frac{Ns}{Np} = \frac{Vs}{Vp}$

$$\frac{Ns}{800} = \frac{6}{240}$$

$Ns = 20\ turns$

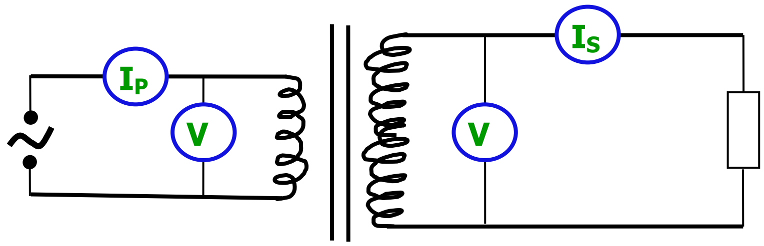
(iii) The current which flows in the main cables. (2mks)

$$IsVs\ = IpVp$$

$24\ = Ip\ x\ 240$

$$Ip\ = 0.1A$$

24. Figure below represents transformer connected to an a.c. source and a resistor R.

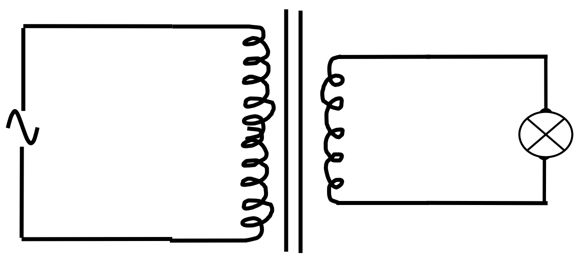


Compare the magnitude of:
(i) Voltage V_p and V_s (1mk)

$Vs > Vp$ *step up transformer*

(ii) Current I_p and I_s (1mk)
$Is > Ip$

25. Figure below shows a transformer which is 90% efficient.



(i) Determine the number of turns in secondary coil if the number of turns in the primary coil is 4000. (2mks)

1. $\frac{Ns}{Np} = \frac{Vs}{Vp}$

$$\frac{Ns}{4000} = \frac{12}{240}$$
$$Ns = 200 \; turns$$

(iii) Determine the current in the primary coil if the bulb is operating normally (3mks)

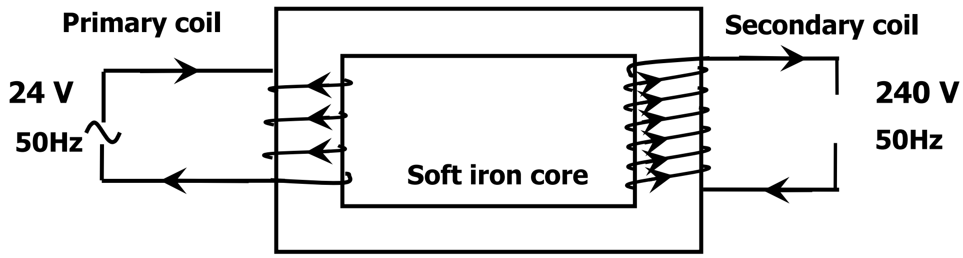
$$n = \frac{IsVs}{IpVp} \; x \; 100\%$$

$$0.9 = \frac{36}{240Ip}$$
$$Ip = 0.1667A$$

(iii) Explain why long distance power transmission is done at a very high voltage (2mks)

The higher the voltage, the lower the current. The lower the current, the lower the resistance losses in the conductors.

26. Figure below shows a single phase demonstration transformer intended to converted 24V, 50Hz as AC supply to 240V, 50Hz



(i) What is the purpose of the soft iron core? (1mk)

Acts as an electromagnet

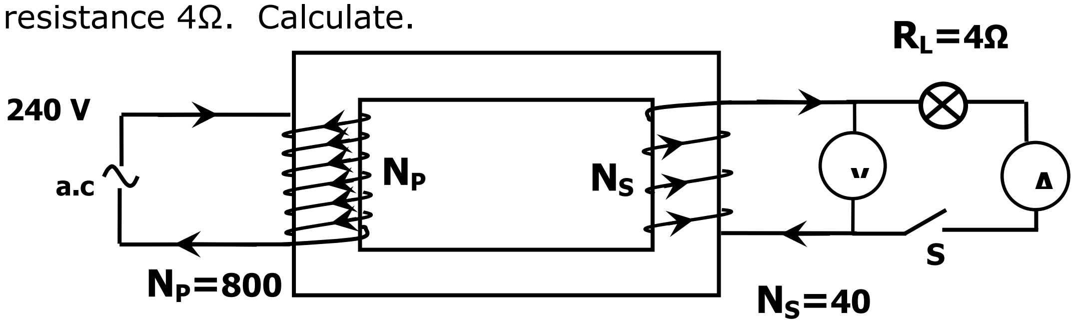
(ii) If the primary core has 50 turns of coil, how many turns of coils should the secondary have? (2mks)

$$\frac{Ns}{Np} = \frac{Vs}{Vp}$$

$$\frac{Ns}{50} = \frac{240}{24}$$

$$Ns = 500\ turns$$

27. The circuit below shows a step-down transformer used to light a lamp of resistance 4Ω. Calculate.



i) The reading of voltmeter, V, with ,S, open. (2mks)

1. $\frac{Ns}{Np} = \frac{Vs}{Vp}$

$$\frac{40}{800} = \frac{Vs}{240}$$

$$Vs = 12V$$

ii) The reading of the ammeter A with S closed (neglect the effective resistance of the secondary winding) (2mks)

$$V = IR$$

$I = \frac{12}{4} = 3A$

iii) The power dissipated in the lamp. (2mks)

$$P = IV = 3 \, x \, 12 = 36W$$

iv) The primary current if the transformer is 90% efficient. (3mks)

$$n = \frac{IsVs}{IpVp} \, x \, 100\%$$

$$0.9 = \frac{3 \, x \, 12}{Ip \, X \, 240}$$

$$Ip = 0.1667A$$

28. A transformer of 480 turns in the primary coil used to connect a 9-volt a.c. electric device to a 240V a.c. mains power supply. Calculate the number of turns in the secondary coil

$$\frac{Ns}{Np} = \frac{Vs}{Vp}$$

$$\frac{Ns}{480} = \frac{9}{240}$$

$$Ns = 18 turns$$

29. A transformer in a welding machine supplies 6 volts from a 240V mains supply. If the current used in the welding is 30A. Determine the current in the mains.

$$\frac{Vs}{Vp} = \frac{Ip}{Is}$$

$$\frac{6}{240} = \frac{Ip}{30}$$

$$Ip = 0.75AS$$

30. A generator produces 150KW at a voltage of 5 kV. The voltage is stepped up to 60kV and transmitted through cables of resistance 150Ω to a step – down transformer in a substation. If both transformers are 80% efficient,

Calculate the:-

(i) Current through the transmission cables. (3mks)

$$n = \frac{IsVs}{IpVp} x100\%$$

$n = \frac{Isx60}{150}$

$Is = 2A$

(ii) Power lost during transmission. (3mk)

$Powerlost = I^2R = 2^2x150 = 600W$

31. A transformer with 1200 turns in the primary circuit and 120 turns in the secondary circuit; it produces heat at the rate of 600w. Assuming 100% efficiency, determine the:

i) Voltage in the secondary circuit. (2mk)

32. A student designed a transformer to supply a current of 10A at a potential difference of 60V to a motor from an A.C mains supply of 240V. If the efficiency of the transformer is 80%, determine the;

a) Power supplied to the transformer

$\frac{\text{Power Output}}{\text{Power Input}} = n$

$\text{Power Input} = \frac{\text{Power Output}}{n}$

$= \frac{60 \times 10}{0.8}$

$= 750W$

b) Current in the primary coil.

Current in the primary circuit. (2mk)

✓ $\text{Power Input} = I_P \, V_P$

$750 = I_P \times 240$

$I_P = 3.125\ A$

33. An ideal transformer has 500 turns in the primary circuit and 2000 turns in the secondary circuit. When the primary circuit is connected to a 200V a.c. source, the power delivered to a resistor in the secondary circuit is formed to be 1000W.

$N_P = 500$ $V_P = 200\ V$

$N_S = 2000$ $P\ output = 1000\ w$

(i) Giving a reason compare the thickness of the wires used in the primary and secondary circuit. (2mk)

✓ *Secondary coils are thicker than primary coils. This is due to a high voltage in the secondary coil which helps to minimize power loss.*

(ii) Determine the current in the secondary circuit (3mk)

$\frac{NS}{NP} = \frac{VS}{VP}$

$\frac{2000}{500} = \frac{VS}{200}$

$V_S = 800\ V$

$V_S I_S = 1000\ W$

$I_S = \frac{1000}{800} = 1.25\ A$

(iii) Determine the current in the primary circuit. (3mk)

$I_S V_S = I_P V_P$

$I_P = \frac{1.25 \times 800}{200} = 5\ A$

34. A Transformer has 800 turns in the primary winding and 40 turns in the secondary winding. The alternating e.m.f connected to the primary is 240V and the current is 0.2 A.Find;

$N_P = 800$ $V_P = 240\ V$

$N_S = 40$ $I_P = 0.2\ A$

i) Secondary e.m.f

$\frac{NP}{NS} = \frac{VP}{VS}$

$\frac{800}{40} = \frac{240}{VS}$

$V_S = 12\ V$

ii) The power in the secondary if the transformer is 90% efficient.(3mk)

✓ $\eta = \frac{ISVSPoweroutput}{IPVPpowerinput}$

$0.9 = \frac{poweroutput}{0.2 \times 240}$

$=43.2W$

35. A hydro-electric power station produces 500KW at a voltage of 10KV. The voltage is then stepped up to 150KV and the power is transmitted through cables of resistance 200Ω to a step down transformer in a sub-station. Assuming that both transformers are 100% efficient. Calculate;

Power output= 500000W

V=10000V

Stepped up to 150000V

(i) The current produced by the generator (2mks)

✓ $P=IV$

$I=\frac{500000}{10000}$

$=50\ A$

(ii) The current that flows through the transmission cables(2mks)

✓ $\frac{VS}{VP} = \frac{IS}{IP} = \frac{150000}{10000} = \frac{50}{IP}$

$I_P = 3.333A$

(iii) The voltage drop across the transmission cables (2mks)

✓ $V= IR$

$V=3.333\times200$

$V=666.67V$

(iv) The power loss during transmission (2mks)

✓ $P=VI$

$=666.67\times3.333$

$=2222.01W$

(v) The power that reaches the sub-station (2mk)

5000002222.01

=497777.989W

36. A transformer is designed to supply a current of 12A at a p.d. of 80V. The inlet cable is to be connected to an a.c. mains of 240V. The efficiency of this transformer is 80%. Calculate:

(i) Current in the primary coil of the transformer (2mks)

$P=VI$

$I=\frac{1200}{240}$

$=5A$

(ii) The power supplied to the transformer (3mks)

$\eta=\frac{workoutput}{workinput} \times 100\%$

$0.8=\frac{80\times12}{\chi}$

$X=1200W$

(iii) Explain how energy losses in a transformer are reduced by having a soft iron core. (2mk

✓ *Soft iron core reduces magnetic flux leakage by ensuring all magnetic flux from the primary coil reaches secondary coil.*

37. A transformer is designed to supply a current of 5A at a potential difference of 50V to a motor from an a.c supply of 240V. If the efficiency of the transformer is 80%. Calculate

(i) The power supplied to the transformer (3mk)

$I_S= 5A$ $VP=240V$

$V_S =50\ V$ $\eta=80\%$

$\eta = \frac{Power output}{power input} \times 100\%$

$0.8 = \frac{5 \times 50}{x}$

$X = 312.5\ W$

(ii) The current in the primary coil (2mk)

$P = VI$

$I = \frac{312.5}{240}$

$= 1.30$

38. A transformer uses 240 V a.c supply to deliver 9.0A at 80.0V to a heating coil. If 10% of the energy taken from the supply is lost in the transformer itself, what is the current in the primary winding? (3mks)

$V_P = 240\ V.$

$I_S = 9.0A$

$V_S = 80V$

$\eta = 90\%$

$\eta = \frac{ISVS}{IPVP} \times 100\%$

$0.9 = \frac{9 \times 80}{IP \times 240}$

$I_P = 3.333A$

39. A transformer of 600 turns in the primary circuit and 9000 in the secondary circuit is connected to a240V mains supply. The current in the secondary circuit is 0.15A. What is the current in the primary circuit? (Assume 100% efficiency) (3mks)

$N_P = 600$ $V_P = 240\ V$

$N_S = 9000$ $I_S = 0.15A$

$\frac{NS}{NP} = \frac{VS}{VP} = \frac{IP}{IS}$

$\frac{NS}{NP} = \frac{IP}{IS}$

$\frac{9000}{600} = \frac{IP}{0.15}$

$I_P = 2.25A$

40. A transformer has 960 turns in its primary coil and n turns in its secondary coil and is connected to a 240V supply. Given that the transformer is 80% efficient and it is used to operate a 6V, 24W bulb. Find

$N_P = 960$ $V_P = 240$

$N_S = n$ $\eta = 80\%$

$V_S = 6V$ $24W$

(i) The number of turns in its secondary coil. (2mk)

✓ $\frac{NS}{NP} = \frac{VS}{VP}$

$\frac{n}{960} = \frac{6}{240}$

n= 24

(ii) The current flowing in the primary coil. (2mk)

✓ $n = \frac{Poweroutput}{Powerinput} \times 100\%$

$0.8 = \frac{24}{IP \times 240}$

$I_P = 0.125A$

41. A transformer was assigned to operate a 60W, 12V lamp when it is connected to a 240vmains supply. Calculate the current that would be drawn from the mains if it is 80% efficient. (4mk)

60W

12V

$V_P = 240$

$\eta = 80\%$

$\eta = \frac{ISVS}{IPVP} \times 100\%$

$0.8 = \frac{60}{IP \times 240}$

$I_P = 0.3125A$

42. A 240v mains transformer has 800 turns in the primary and N turns in the secondary. It is used to supply energy to a 12V, 21W lamp.

i) Calculate the number of turns in the secondary. (2mks)

$\frac{NS}{NP} = \frac{VS}{VP}$

$\frac{N}{800} = \frac{12}{240}$

N= 40

ii) What is the efficiency of the transformer if the current drawn from the 240V mains is 100 mA? (2mks)

$\eta = \frac{ISVS}{IPVP} \times 100\%$

43. A transformer has 10,000 turns on its secondary coil and 100 turns on its primary coil. An alternating current 5.0A flows in the primary circuit when it is connected to a 12v a.c supply.

i) State the type of transformer (1mk)

✓ *Step up transformer*

ii) Calculate the power input to the transformer (3mk

Power Input $= I_P V_P$

$= 5 \times 12$

$= 60W$

iii) Calculate the E.M.F across the secondary coil. (3mk)

$$\frac{NS}{NP} = \frac{VS}{VP}$$

$$\frac{10000}{100} = \frac{VS}{12}$$

$V_S = 1200V$

iv) Determine the maximum current that could flow in a circuit connected to the secondary coil if the

- ✓ *Assuming its 100% efficient*

$I_P V_P = I_S V_S$

$60 = I_S \times 1200$

$I_S = 0.05A$

v) In transmitting power why is it necessary to step it up before transmission. (1mk)

✓ *To minimize power losses.*

44. A transformer with primary coil of 400 turns and secondary coil 200 turns is connected to 240ac mains.

(i) Calculate the secondary voltage. (2mk)

$$\frac{NS}{NP} = \frac{VS}{VP}$$

$$\frac{200}{400} = \frac{VS}{240}$$

$V_S = 120V$

(ii) If the primary current is 3.0A and secondary is 5.0A. What is its efficiency? (2mk)

$$\eta = \frac{ISVS}{IPVP} \times 100\%$$

$$\frac{5 \times 120}{3 \times 240} \times 100\%$$

$= 83.33\%$

(iii) How is energy loss in transformer due to hysteresis minimized.(1 mk)

- ✓ *Using soft magnetic material.*
- ✓ *Winding secondary coil on top of primary coil on the same core*

(iv) Explain why electrical power is transmitted at very high voltages.(1mk)

- ✓ *Minimize power losses.*