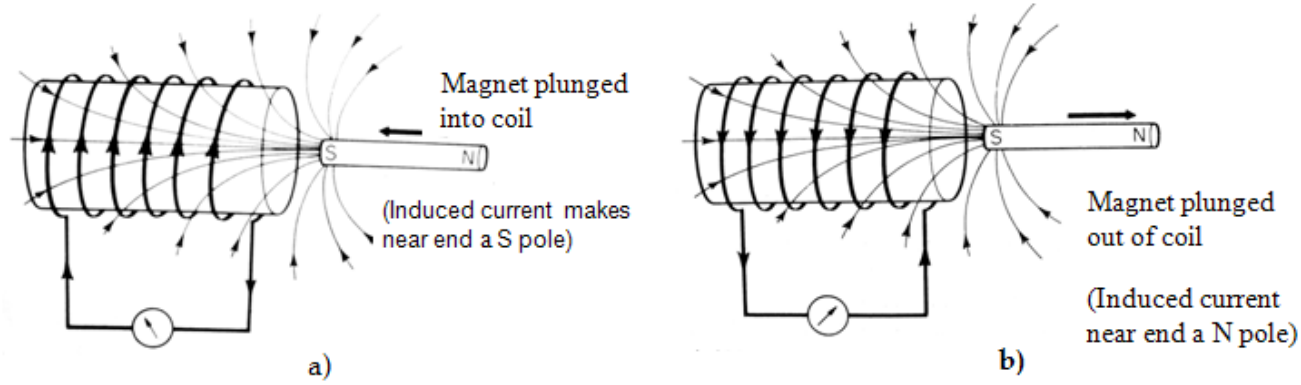
ELECTROMAGNETIC INDUCTION

This is the effect of producing electric current from magnetism. This principle of electromagnetic induction is demonstrated in the dynamo or electric generators.

Faraday's experiment on electromagnetic induction

- Ends of cylindrical coil are connected to the galvanometer and then a magnet is plunged into the coil.
- It is noticed that the galvanometer needle gives momentary deflection showing that a current has been induced in the coil.
- On removal of the magnet from the coil, the galvanometer gives another deflection but in an opposite direction as shown in the figure below. This effect is called electromagnetic induction.
- No current (deflection) is induced simply by allowing the magnet to remain at rest inside or outside the coil.
- Current is induced in the circuit as a result of the wire being cut by magnetic flux (magnetic field lines) when the magnet is removed.
- Alternatively, we say that the electromotive force is induced whenever there is change in the magnetic flux linked with the coil.



Induced current depends on:

1. The number of turns in the coil
2. The strength of the magnet
3. The speed with which the magnet is plunged into the coil.

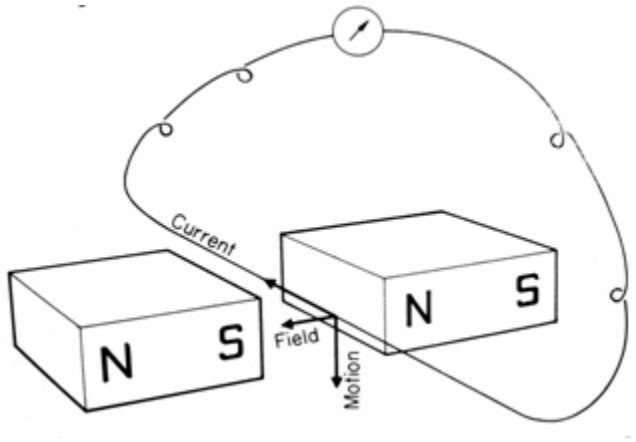
Faraday's law of electromagnetic induction

- **Whenever there is a change in the magnetic flux linked with a circuit, an electromotive force is induced, the strength of which is proportional to the rate of change of the flux linked with the circuit.**

Lenz's law of electromagnetic induction

- **The direction of the induced current is such as to oppose the change producing.**
- Figure above illustrates that application of this law in the case of a magnet plunged into a coil.
- When the S pole of the magnet is plunged into the coil the induced current must flow in such a direction as to give S polarity to the end of the coil facing the magnet.
- Thus, since like poles repel, the motion of the magnet is opposed by the induced current.
- On the other hand when the S pole of the magnet is pulled away from the coil the direction of the induced current is reserved. The near end of the coil becomes a N pole and, since unlike poles attract, the motion of the magnet is again opposed.

Direction of the induced current in a straight wire



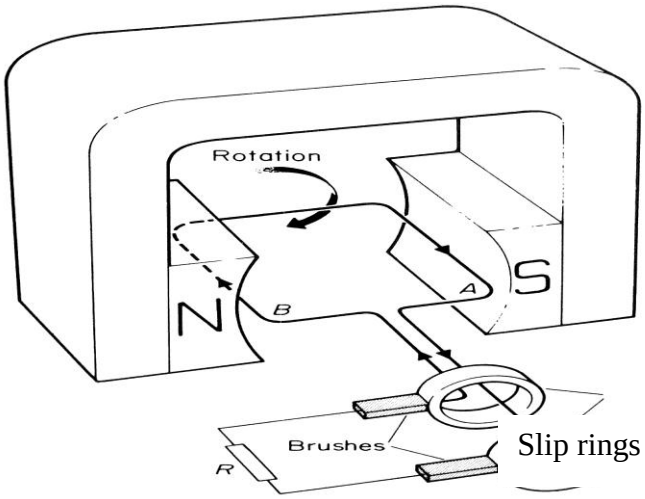
- A current is induced in a straight wire when it is moved at right angles to the magnetic flux near a bar magnet.
- If the wire is moved downwards, the galvanometer indicates that an induced current flows in the direction as shown in the figure above.
- When the wire is moved upwards, the induced current is reserved. This is shown by the direction of the galvanometer needle in the opposite direction.

Fleming's right hand rule (dynamo rule)

- Hold the thumb and the first two finger of the right hand at right angles to each other with the **F**irst finger pointing in the direction of the **F**ield and the thu**M**b in the direction of the **M**otion of the wire, then the se**C**ond finger points in the direction of the induced **C**urrent.

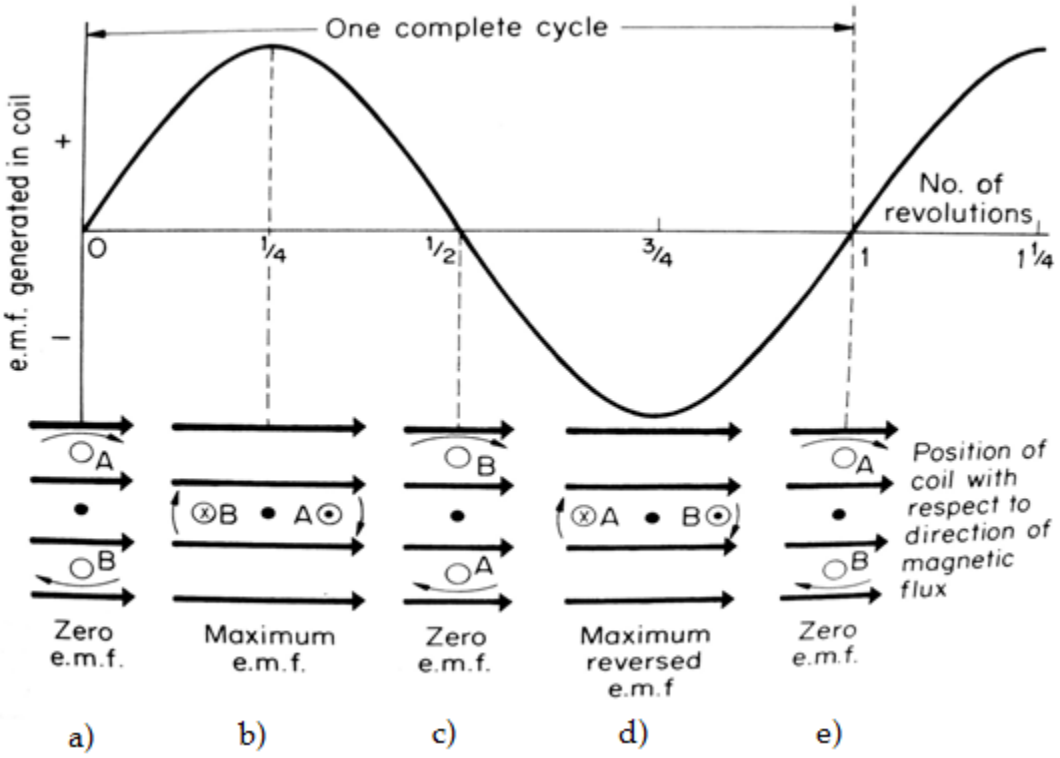
Aid to memory: 1. thu**M**b ⟶ **M**otion
2. **F**irst finger ⟶ **F**ield
3. se**C**ond finger⟶ **C**urrent

The simple alternating current (a.c) generator



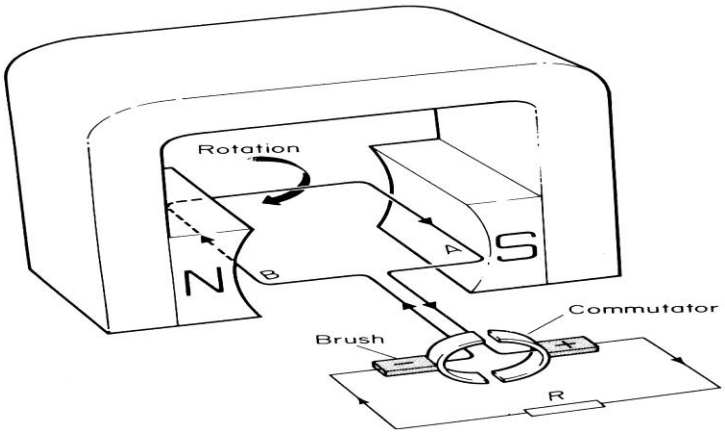
- An a.c generator has a rectangular coil of wire which is rotated in the magnetic field between the poles of the U-shaped permanent magnet. This magnet is called **field magnet.**
- The ends of the coil are connected to two slip rings mounted on the coil spindle. Current can be obtained from the coil through two carbon brushes which are made to press tightly against the slip rings.
- As the coil rotates its sides cut the magnetic flux, and therefore a current is induced in it.
- Application of Fleming's right hand rule indicates that the current flows from back to front along side A and from front to back along side B.
- When viewed from above the current therefore flows in a clockwise direction around the coil.

- ***The figure below shows how the e.m.f generated in the coil varies over a complete rotation:***



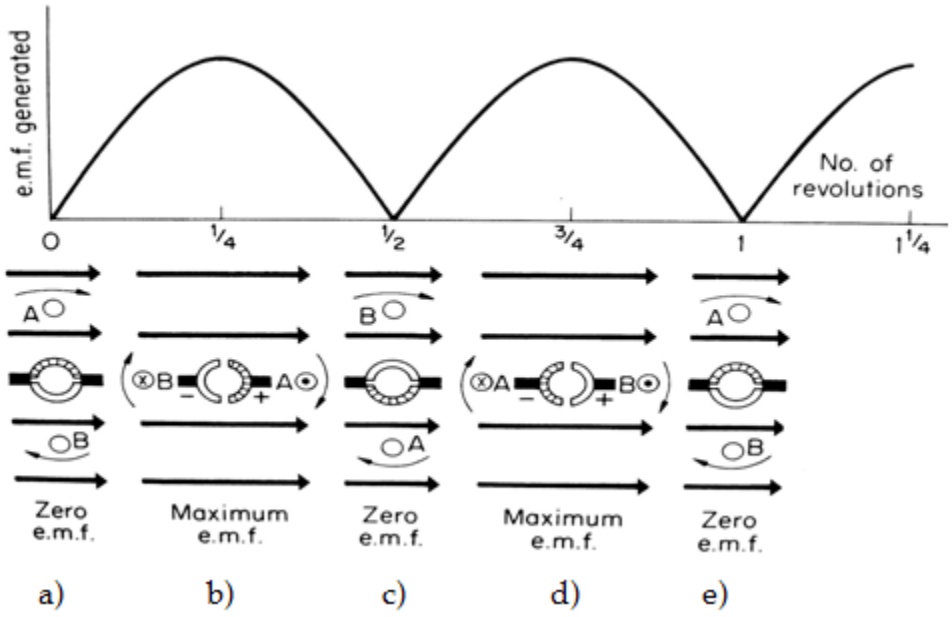
(a) zero emf coil vertical, side A: down, side B: up.
(b) maximum emf coil horizontal, side A: left, side B.
(c) zero emf coil vertiocal, side A: up, side B: down.
(d) maximum emf reversed coil horizontal, side A: right, side B: left,.
(e) zero emf coil again vertical, side A: down, side B: up.

The simple direct current (d.c) generator



- A direct current is obtained when the slip rings are replaced with a split ring commutator.
- The working of a d.c generator is similar to that o an a.c generator.
- The difference between the two is that the coil rotates about an axis, the two halves of the commutators change contact from one brush to the other and the direction of current is reversed in the coil itself when the coil reaches a vertical point.
- The change over between brushes and commutator halves ensures that the right hand brush remains positive and the left hand brush remains negative.
- Thus after change over, the e.m.f of the brushes remain identical with that before change over and the current through external resistor R continues flowing in the same direction.

- ***The emf generatated by the d.c generator is shown below:***



(a) the emf = zero, coil in vertical position. Side A; down, side B: up. a
(b) maximum emf, coil in horizontal position. Current flows through out side A
(c) zero emf, coil in vertical position. Side A up, side B down.
(d) maximum emf, coil in horizontal position,current flows throughout side B
(e) zero emf, coil in vertical position, side B up, side A down.

D.C. dynamo compared with an electric motor

- If a simple d.c. dynamo connected to a battery it will run as a motor. Conversely, if a simple electric motor is made to rotate it will behave as a dynamo and deliver current at the brushes.

- When, therefore, an electric motor is running it acts as a dynamo and so produces an e.m.f. in opposition to that applied to it. This is called a ***back e.m.f.***

How to increase the e.m.f. obtained from a simple dynamo

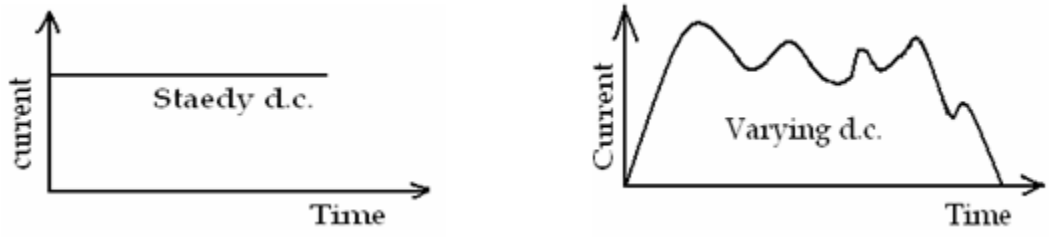
- Anything which increases the rate of cutting of magnetic flux in a dynamo will increase the e.m.f. obtained from it. Some ways are made:
  1. by increasing the number of turns in the coil.
  2. by winding the coil on the soft-iron armature so as to increase the magnetic flux through the coil.
  3. by increasing the speed of rotation.
  4. by making the field magnet as strong as possible.

ALTERNATING CURRENT

Difference between d.c and a.c

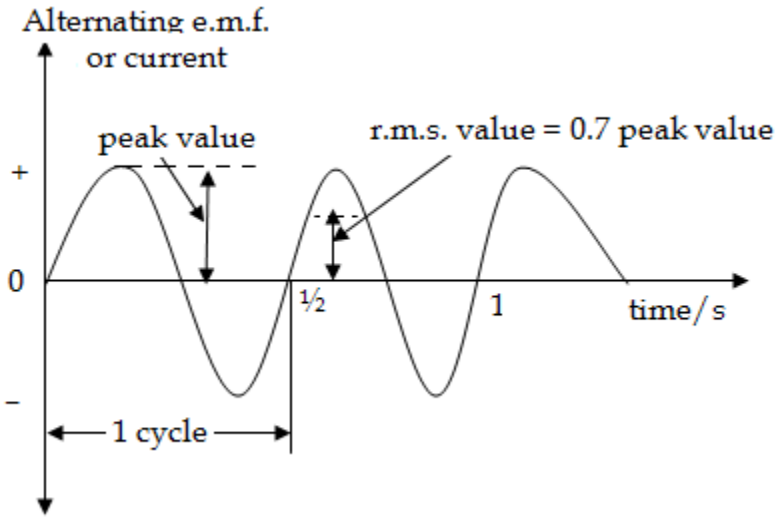
- In a direct current (d.c) the electrons flow in one direction only. Graphs for steady and varying direct currents are shown in figure (a) below.

a)



- In an a.c the direction of flow reverses regularly, fig. (b) below. The sign for a.c is ~

b)



Peak value:
Peak value *E_o of an e.m.f. is the maximum e.m.f. of the a.c.*
Peak voltage *is the maximum voltage produced by the a.c. generator.*

Frequency of an a.c. *is the number of cycles per second*. The unit is hertz. (Hz)

- Batteries give d.c.; generators can produce either d.c or a.c. The main supply is a.c.
- For heating and lighting a.c and d.c. are equally satisfactory but radio and television sets need d.c, as do processes such battery charging and electroplating.
- a.c. can be rectified to give d.c.

Root mean square (r.m.s.)

Its is defined as that direct current or steady current which produces the same heating effect per second in a given resistance.

- r.m.s value = 0.7 x peak value

Example: The r.m.s voltage of the mains supply is 240V;
The peak value is therefore

$$= \frac{240}{0.7} = 340V$$

TEST 11.1

SECTION A

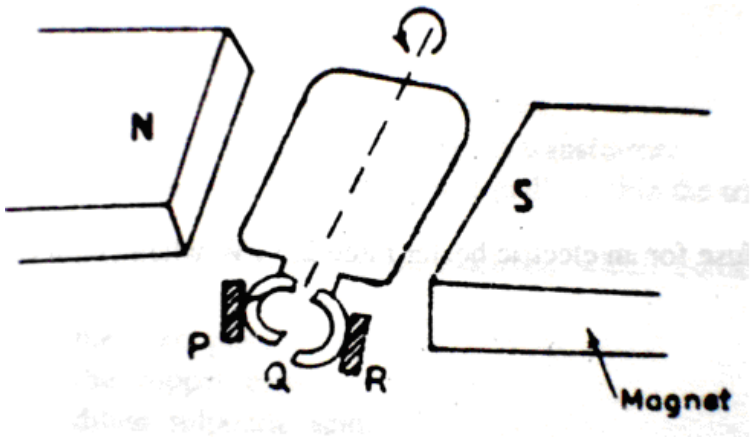
1. moving coil galvanometer can be used to

A. easure direct current.
B. onverting alternating current into direct current
C. onvert direct current to alternating current.
D. o measure the peak value of an alternating current.

2. he sensitivity of a moving coil galvanometer can be increased by using

(a) smaller coil (b) weaker magnet
(c) weaker hairspring (d) fewer turns of wire on the coil.

3. The diagram in the figure below shows a simple electric motor.

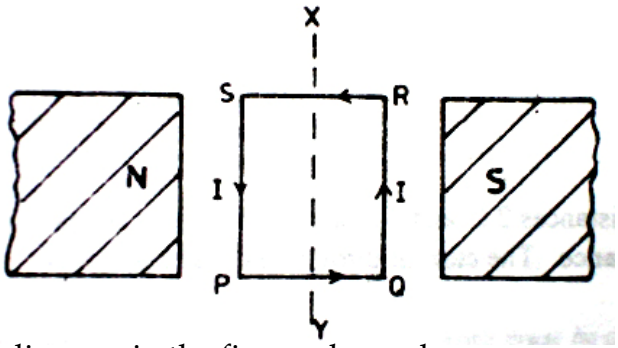


The coil continues to turn in the same direction because the commutator Q and brushes P and R

A. reverse current in the coil every half a revolution
B. reverse current in the coil every quarter of the revolution
C. reverse polarity of the field produced by the magnet

D. carry the coil past its vertical position every half a revolution

4.



The diagram in the figure above shows a current carrying coil PQRS pivoted at about XY between two magnets. Which of the statements are true about the coil?

(i) the sides PQ and QR shall experience force
(ii) as seen from X, the coil will rotate anticlockwise
(iii) the force on the coil can be increased by increasing the number of turns
(iv) the coil will come to rest with PQ at right angles to magnetic field.

a) (i), (ii) and (iii) b) (i) and (iii) only
c) (ii) and (iv) only d) (iv) only

5. A moving iron meter

(a) measures only direct current
(b) has a permanent magnet
(c) measures only alternating current
(d) has the pointer attached to the soft iron.

6. The magnitude of the force on the coil of a d.c motor depends on

1. the strength of the magnetic field
2. the number of turns on the coil
3. the current through the coil
4. the mass of the coil support

A. 1 only B. 1 & 2 only
C. 1,2 &3 only D. All

SECTION B

1. A galvanometer has resistance of 5Ω and a range of 0-40mA. Find the resistance of the resistor which must be connected in parallel with the galvanometer if a maximum current of 10 A is to be measured.

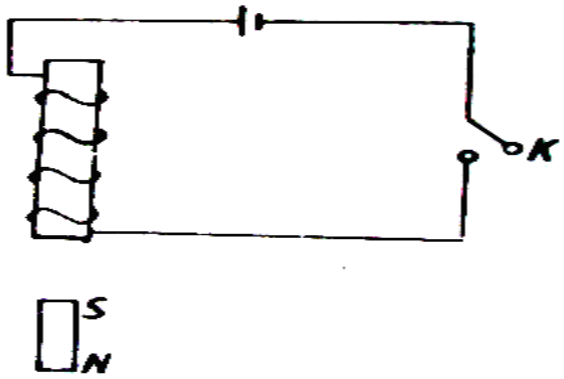
2. Sketch the magnetic field pattern around a straight conductor carrying a current in the plane of paper

3. (a) State three factors on which the magnitude of the force exerted on a wire carrying a current in a magnetic field depends.

(b) With the aid of a labelled diagram, describe the action of a moving coil loud speaker.

4. (a) State two factors which affect the strength of an electromagnet.

(b)



The diagram above shows a small magnet placed near an electromagnet. Describe what happens to it when the key K is closed.

5. A moving coil galvanometer has a coil of resistance 4Ω and gives a full scale deflection when a current of 25mA passes through it. Calculate the value of the resistance required to convert to an ammeter which reads 15A at full scale deflection

6. A milliammeter has an internal resistance of 4Ω and a full scale deflection of 0.015 A. calculate the value of the resistor that must be connected to the milliammeter so that a maximum current of 5A can be measured.

TEST 11.2

SECTION A

1. The induced current in a generator

(a) is a maximum when the coil is vertical
(b) is a minimum when the coil is horizontal
(c) changes direction when the coil is horizontal
(d) increases when the speed of rotation increases

2. The arrangement in figure 1 is used to produce an e.m.f. What causes the e.m.f.?

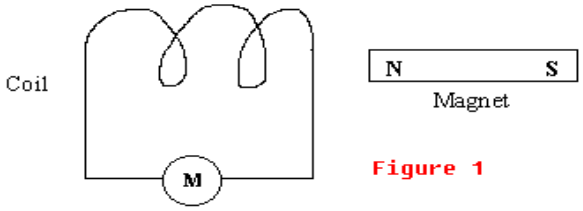


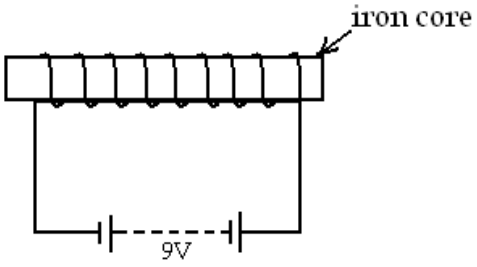
Figure 1

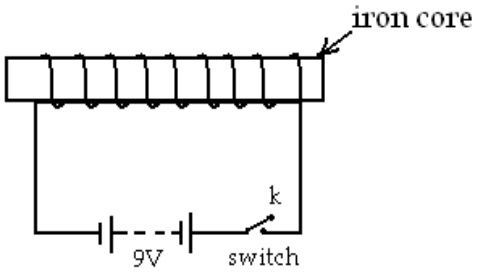
A. The attraction between the coil and magnet.
B. The magnetic field outside the coil.
C. The magnet placed close to the coil.
D. The variation of magnetic lines linking the coil.

3. Which of the following only works with a direct current?

A. Electric lamp.
B. Transformer.
C. Electroplating.
D. Electric bell.

4. In figure below, when switch K is closed, the two soft iron cores will





A. repel each other all the time.
B. attract each other all the time.
C. attract each other for just a brief moment.
D. have no force attraction or repulsion between them

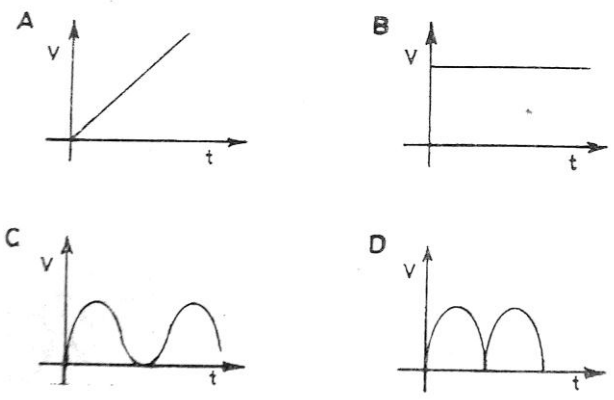
5. A rectifier is used to

A. step up an a.c voltage.
B. amplify an a.c current.
C. change an a.c voltage to a.d.c voltage.
D. change a.d.c. voltage to an a.c. voltage.

6. Which of the following will increase the force on a current carrying wire?
(i) Using a large current.
(ii) Using a stronger magnetic field.
(iii) Using a shorter length of wire in the field.

A. (i) only.
B. (i) and (ii) only.
C. (i) and (iii) only.
D. (ii) and (iii) only.

7. Which of the following graphs represents the output voltage from a d.c. dynamo?



8. An alternating current can be changed to a direct current by a

A. transformer
B. moving coil galvanometer
C. dynamo
D. diode

9.

A bar magnet is moved near a coil as shown in the above figure. Which of the following ways can be used to increase the size of the induced e.m.f in the coil?

(i) using a stronger magnet
(ii) moving the magnet at a higher speed
(iii) reducing the number of turns in the coil

A. (i) and (ii)
B. (i) and (iii) only
C. (ii) and (iii)
D. (i),(ii) and(iii)

10. The strength of the magnetic field between the poles of an electro- magnet remains the same if the

(i) current in the electro-magnetic windings is doubled
(ii) direction of the current in the electro-magnet winding are reserved.
(iii) The number of turns are halved.

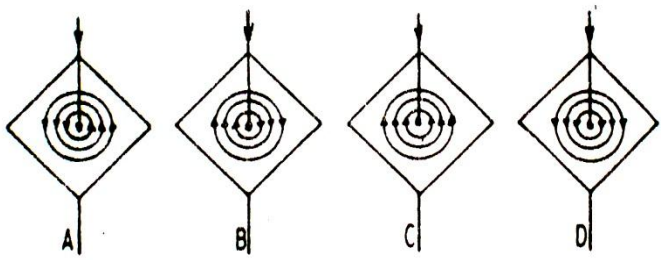
(a) (i) only
(b) (ii) only
(c) (i) and (ii) only
(d) (ii) and (iii) only.

11. Which of the following factors affect the strength of an electro magnet?

(i) change magnitude of the current
(ii) change direction of the current
(iii) double number of turns

(a) (ii) only
(b) (i) and (ii) only
(c) (i) and (iii) only
(d) (ii) and (iii) only

12. Which one of the following diagrams represents the correct magnetic field around a straight wire carrying a current?



SECTION B

1. (a) State one advantage of a.c over d.c in a mains supply.

(b) In the figure11 shows the variation of an a.c with time.

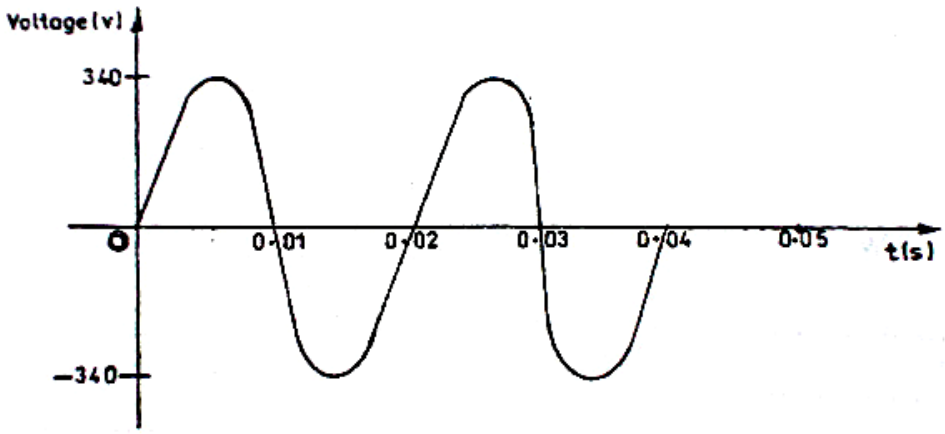


Fig. 11

Find (i) the peak value.

(ii) the frequency.

2. (a) State any two factors which determines the magnitude the e.m.f. induced in a coil rotating in a magnetic field.

(b) Explain why soft iron is preferred to steel in making electromagnets.

3. When the wire is moved vertically upwards out of the plane of the paper, the galvanometer deflects

(i) In which direction does the galvanometer deflect

(ii) Why does the galvanometer deflect

(iii) State one way by which the deflection of the galvanometer can be reversed?

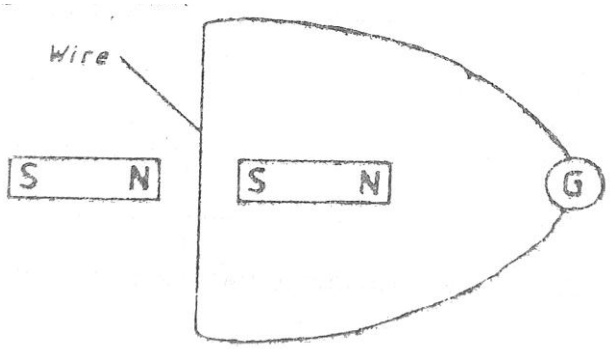
4. With the aid of a labeled diagram, explain how a simple a.c generator works

5. Draw the magnetic field pattern due to an electric current in;

(i) a circular coil.

(ii) a solenoid.

6. The diagram in the figure below shows a straight wire connected to the terminals of a centre zero galvanometer



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(i) In which direction does the galvanometer deflect

(ii) Why does the galvanometer deflect

(iii) State one way by which the deflection of the galvanometer can be reversed?

7. Sketch the magnetic field pattern around a straight conductor carrying a current in the plane of paper

8. State three factors on which the magnitude of the force exerted on a wire carrying a current in a magnetic field depends

9. (a) Describe using a labeled diagram how a telephone receiver works.

(b) State two ways by which the strength of an electro magnet can be increased.

10. With the aid of a labeled diagram, describe briefly the action of an electric bell.

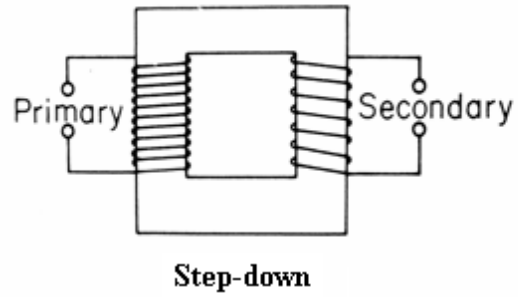
TRANSFORMER

Mutual induction

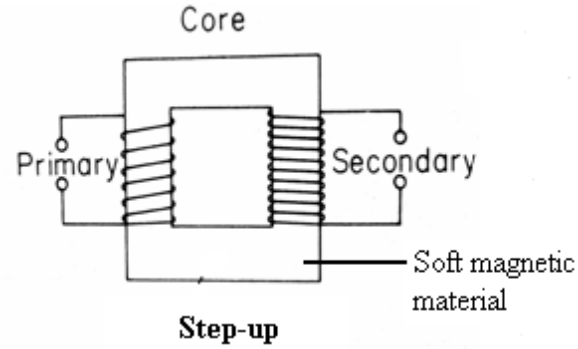
When the current in a coil is switched on or off or changed an e.m.f. and current are induced in a neighboring coil. The effect is called *mutual induction*.

Transformer

- A transformer is a device which steps up or down the voltage of an alternating current.
- It consists of two coils called the primary and the secondary coils, wound around the soft iron core that is made of soft iron pieces insulated from each other to reduce heat loses.
- Such a soft iron core is said to be laminated, see simple construction of transformer.



Step-down



Step-up

Action of a transformer

- When a.c is fed into the primary circuit, it steps up alternating flux in the soft iron core.
- This flux links up the secondary coil and it induces an emf in the secondary coil.

- The emf induced is proportional to:
  1. the number of turns on the secondary coil.
  2. the rate at which flux in the core changes.

- ***If the coils are closely wound so that all the flux from the primary links the secondary, then,***

$$\frac{secondary\ output\ voltage(Vs)}{primary\ input\ voltage(Vp)} = \frac{number\ of\ turns\ on\ secondary(Ns)}{number\ of\ turns\ on\ primary(Np)}$$

In symbols; $\frac{Vs}{Vp} = \frac{Ns}{Np}$

- It follows that if the transformer is 100% efficient, we can write:

$$\frac{Is}{Ip} = \frac{Ns}{Np}$$

Is: Current in the output or secondary circuit.
Ip: Current in the input or primary circuit.

- Under this condition power transferred in the transformer is a constant, that is;

Input power = output power or
$IpVp = IsVs$

- When a transformer has more turns in the secondary coil than in the primary, then output voltage is higher than input voltage. A transformer of this type is called a ***STEP-UP transformer*** as shown in the figure-a above.

- When the number of turns in the secondary coil are less than those in the primary, the output voltage is less than input voltage. The transformer is called a ***STEP-DOWN transformer*** as shown in figure-b above.

- Step-up transformers are used in power stations to increase the e.m.f. before it is fed into power transmission lines.

- Step-down transformers are used in reducing the higher voltage to a lower voltage that is usable in homes.

In practical transformers, energy loses usually occur in the following ways:

1. Resistance of windings (coils).
   Low resistance copper wires are used to reduce loses in windings.
2. Eddy currents induced in soft iron core.

The iron core is laminated to reduce loses due to eddy currents.

3. Leakage of field lines.
   The core should designed efficiently by avoiding air gaps to minimize leakage of field lines.

Advantages of a.c over d.c transmission

1. a.c. can be easily and cheaply changed from one voltage to another by a transformer with very little lose of energy.
2. Since the a.c. is transmitted at very high voltage, it follows that the cables carry small current. These thinner cables can be used with high voltage transmission.
3. a.c. is more suitable for heating than d.c.

TEST FIFTEEN

SECTION A

1. A 240 V mains transformer has 1000turns in the primary. The number in the secondary if it is used to supply a 12V, 24W lamp is

(a) 2.0×10^4 (b) 500. (c) 50 (d) 20

2. A transformer is used to step down an alternating voltage from 240V to 12V. Calculate the number of turns on the secondary coil if the primary coil has 1200 turns.

A. 3 B. 5 C.60 D.100

3. The transformer cores are laminated to

A. Reduce eddy currents
B. decreases the resistance of the coils.
C. determine the energy lost by the transformer
D. Distribute the voltage out put equally with in the transformer.

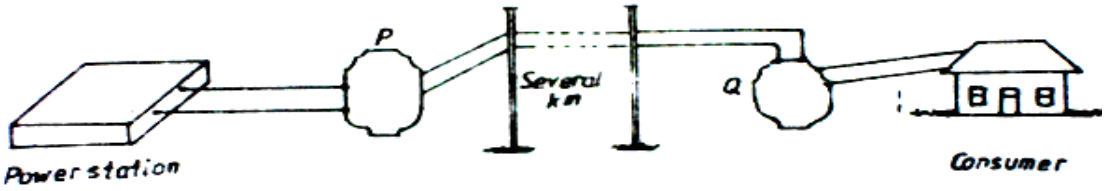
4. A transformer cannot function normally with d.c. because a d.c ….

(a) has extremely high heating effect
(b) reduces the efficiency of the transformer
(c) cannot produce a changing magnetic field
(d) cannot provide high voltage required for power transmission.

5. A transformer has twice as many turns in the secondary coil as in the primary coil. The a.c input to the primary is 4V. Find the output

(a) 2V (b) 4V (c) 8V (d) 16V

6. The figure below shows a transmission line from a power station to a consumer several kilometres away.



Which one of the following is the correct type of transformers at P and Q

	P	Q
A.	step-up	step-up
B.	step-down	step-down

C. step-up step-down

D. step-down step-up

7. Rectification of alternating current means

(a) stepping up alternating current by a transformer
(b) converting alternating current into direct current
(c) stepping down alternating current by a transformer
(d) generating alternating current from a dynamo

8. What device could be connected to the secondary of a transformer in order to get a d.c in the output?

(a) Diode (b) resistor
(c) Rheostat (d) Thermostat

9. Which one of the following is the most economical means of transmitting electricity over long distances?

(a) At a high voltage and a low current
(b) At a high voltage and a high current
(c) At a low voltage and a low current
(d) At a low voltage and a low current

10. When transmitting energy, electrical power over long distances, the voltage is stepped up in order to

(a) transmit it
(b) reduce power loss
(c) increase current for transmission
(d) prevent electric shocks

SECTION B

1. (a) Describe briefly the structure and action of an a.c transformer.

(b) (i) State any three causes of energy loss in a transformer
(ii) How are these losses reduced in a practical transformer.

2. **(**a) What is a transformer?

(b) A transformer whose efficiency is 80% has an output of 12W. Calculate the input current if the input voltage is 240V.

(c) Explain briefly why bulbs in a building are connected in parallel.

3.

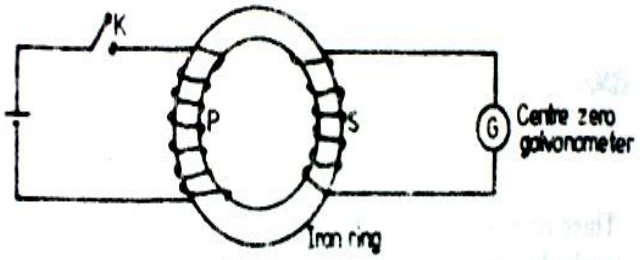


Fig.5

The diagram in the figure above shows a model of a transformer in which the primary coil, P is connected to d.c and the secondary coil, S is connected to a galvanometer.

i. What is observed just as the switch K is closed?
ii. What would be the effect of closing switch K very fast in (i) above?
iii. What is observed when the switch K is left closed?
iv. What is observed just as switch K is opened?
v. What would be observed if the d.c. source is replaced by an a.c. source of low frequency?

4. When two identical heating elements of a kettle are connected in series to a 240V supply, the power developed is 400W. Find;

(a) the resistance of the either element

(b) the power developed when the elements are connected in parallel to the same supply

5. The figure below shows a charging circuit.

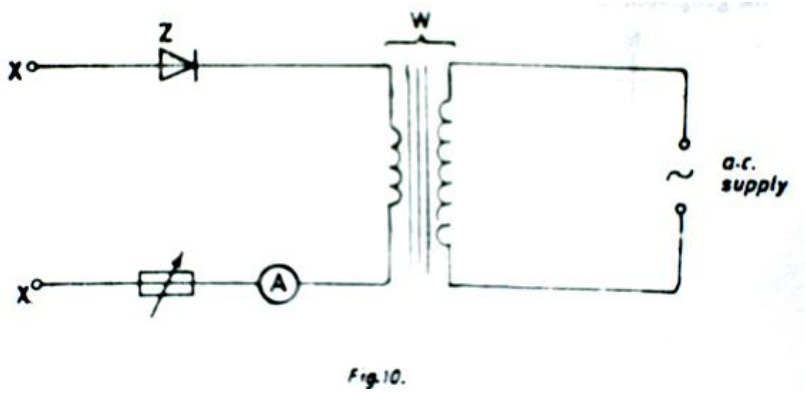
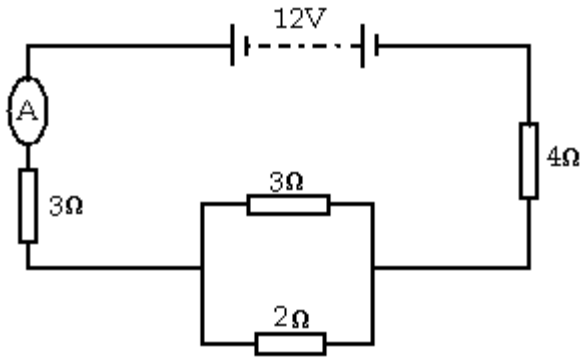


Fig. 10.

a) Name and state the use of each of the parts labelled
   i) W: ?
   ii) Z: ?

b) Sketch the waveform that is obtained from terminals XX.

6. Four resistors are connected across a 12V battery of negligible internal resistance as shown in the above figure. Determine



(i) the reading of the ammeter A

(ii) the p.d across the parallel combination of resistors

7. **(a)** State two sources of energy loss in a transformer.

(b) Explain why it is an advantage to transmit electrical power at high voltage.

8. Explain briefly how a calculator which operates on a 6.0 V d.c can draw power from a 240 volts main supply.

9. (a) State three sources of energy loss in a transformer.

(b) Electric power is generated at 11Kv. Transformers are used to raise the voltage to 440kv for transmission over large distances using cables. The out put of the transformers is 19.8 Mw and they are 90% efficient.

Find: (i) the input current to the transformer.

(ii) the output current to the cables.

10. A transformer of efficiency 80% is connected to 240V a.c. supply to operate a heater of resistance 240Ω. If the current flowing in the primary circuit is 5A,

(i) calculate the potential difference (p.d) across the heater.

(ii) If the transformer is cooled by oil of specific hest capacity 2100 J kg^{-1} K^{-1} and the temperature of the oil rises by 20^0 in 3 minutes, find the mass of the oil in the transformer

11. Explain briefly what is meant by mutual induction.

(i) mention the causes of energy loss by a transformer and state how the loss can be minimised

(ii) A transformer has 200 turns on the primary coil. Calculate the number of turns on the secondary coil if 240V is to be stepped to 415 V.

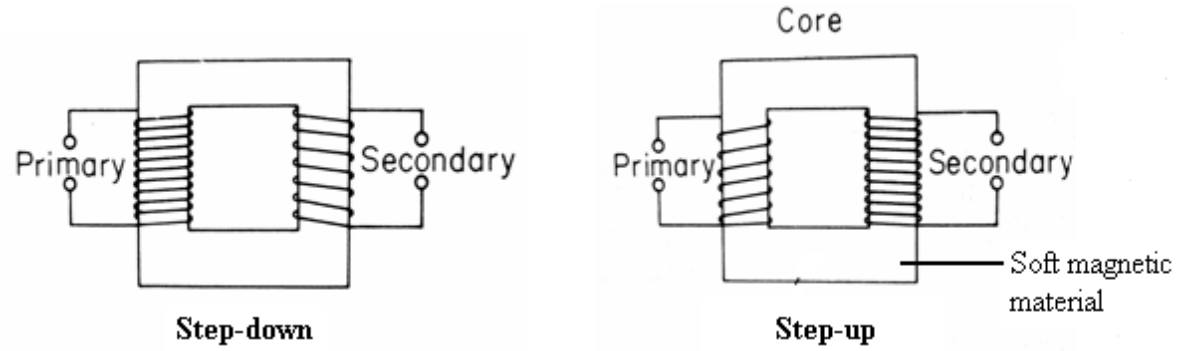
TRANSFORMER

Mutual induction

When the current in a coil is switched on or off or changed an e.m.f. and current are induced in a neighboring coil. The effect is called *mutual induction*.

Transformer

- A transformer is a device which steps up or down the voltage of an alternating current.
- It consists of two coils called the primary and the secondary coils, wound around the soft iron core that is made of soft iron pieces insulated from each other to reduce heat loses.
- Such a soft iron core is said to be laminated, see simple construction of transformer.



Action of a transformer

- When a.c is fed into the primary circuit, it steps up alternating flux in the soft iron core.
- This flux links up the secondary coil and it induces an emf in the secondary coil.

- The emf induced is proportional to:
  1. the number of turns on the secondary coil.
  2. the rate at which flux in the core changes.

- ***If the coils are closely wound so that all the flux from the primary links the secondary, then***

$$\frac{secondary\ output\ voltage(Vs)}{primary\ input\ voltage(Vp)} = \frac{number\ of\ turns\ on\ secondary(Ns)}{number\ of\ turns\ on\ primary(Np)}$$

In symbols; $\frac{Vs}{Vp} = \frac{Ns}{Np}$

It follows that if the transformer is 100% efficient, we can write:

$$\frac{Is}{Ip} = \frac{Ns}{Np}$$

Is: Current in the output or secondary circuit.
Ip: Current in the input or primary circuit.

- Under this condition power transferred in the transformer is a constant, that is;

  Input power = output power or
  $IpVp = IsVs$

- When a transformer has more turns in the secondary coil than in the primary, then output voltage is higher than input voltage. A transformer of this type is called a ***STEP-UP transformer*** as shown in the figure-a above.

- When the number of turns in the secondary coil are less than those in the primary, the output voltage is less than input voltage. The transformer is called a ***STEP-DOWN transformer*** as shown in figure-b above.

- Step-up transformers are used in power stations to increase the e.m.f. before it is fed into power transmission lines.

- Step-down transformers are used in reducing the higher voltage to a lower voltage that is usable in homes.

In practical transformers, energy loses usually occur in the following ways:

1. Resistance of windings (coils).
   Low resistance copper wires are used to reduce loses in windings.
2. Eddy currents induced in soft iron core.

The iron core is laminated to reduce loses due to eddy currents.

3. Leakage of field lines.
   The core should designed efficiently by avoiding air gaps to minimize leakage of field lines.

Advantages of a.c over d.c transmission

1. a.c. can be easily and cheaply changed from one voltage to another by a transformer with very little lose of energy.
2. Since the a.c. is transmitted at very high voltage, it follows that the cables carry small current. These thinner cables can be used with high voltage transmission.
3. a.c. is more suitable for heating than d.c.

Transmission of power from station to House

- Electricity is generated by power stations.
- It is stepped up by transformers, then fed into grid (high voltage over head power lines)
- It is stepped down into successive stages at substations.
- In neighborhood of homes, it is then stepped down further to 240V by transformers for domestic use.

TEST 11.4

SECTION A

1. A 240 V mains transformer has 1000turns in the primary. The number in the secondary if it is used to supply a 12V, 24W lamp is

(a) 2.0×10^4 (b) 500. (c) 50 (d) 20

2. A transformer is used to step down an alternating voltage from 240V to 12V. Calculate the number of turns on the secondary coil if the primary coil has 1200 turns.

A. 3 B. 5 C.60 D.100

3. The transformer cores are laminated to

A. Reduce eddy currents
B. decreases the resistance of the coils.
C. determine the energy lost by the transformer
D. Distribute the voltage output equally within the transformer.

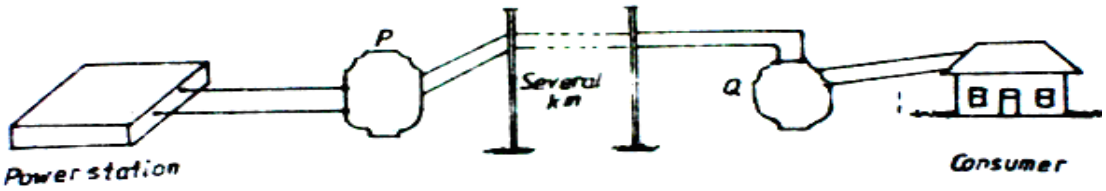
4. A transformer cannot function normally with d.c. because a d.c ….

(a) has extremely high heating effect
(b) reduces the efficiency of the transformer
(c) cannot produce a changing magnetic field
(d) cannot provide high voltage required for power transmission.

5. A transformer has twice as many turns in the secondary coil as in the primary coil. The a.c input to the primary is 4V. Find the output

(a) 2V (b) 4V (c) 8V (d) 16V

6. The figure below shows a transmission line from a power station to a consumer several kilometres away.



Which one of the following is the correct type of transformers at P and Q

	P	Q
A.	step-up	step-up
B.	step-down	step-down
C.	step-up	step-down
D.	step-down	step-up

7. Rectification of alternating current means

(a) stepping up alternating current by a transformer
(b) converting alternating current into direct current
(c) stepping down alternating current by a transformer
(d) generating alternating current from a dynamo

8. What device could be connected to the secondary of a transformer in order to get a d.c in the output?

(a) Diode (b) resistor
(c) Rheostat (d) Thermostat

9. Which one of the following is the most economical means of transmitting electricity over long distances?

(a) At a high voltage and a low current
(b) At a high voltage and a high current
(c) At a low voltage and a low current
(d) At a low voltage and a low current

10. When transmitting energy, electrical power over long distances, the voltage is stepped up in order to

(a) transmit it
(b) reduce power loss
(c) increase current for transmission
(d) prevent electric shocks

SECTION B

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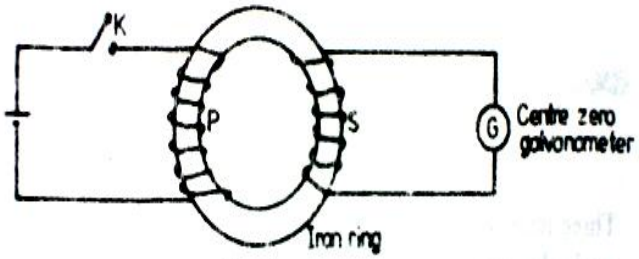

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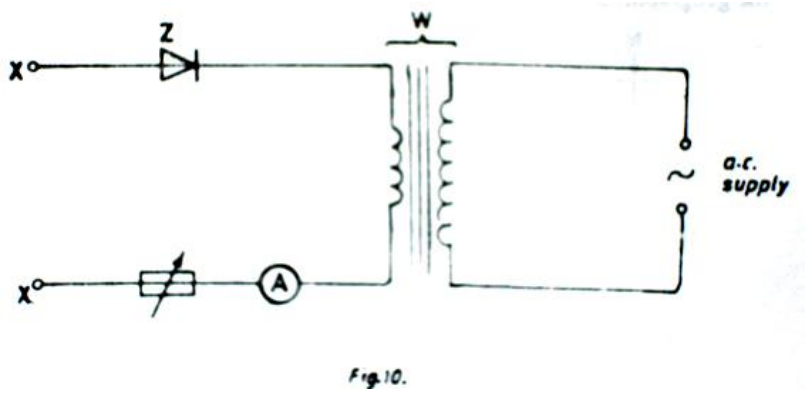

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TEST 11.1

1.A 2.C 3.A 4.C 5.D 6.C

TEST 11.2

1. D 2. D 3. C 4.B 5. C 6. B 7. D 8. D 9. A 10.B
11.C 12.B

TEST 11.3

1. C 2. C 3. A 4. C 5. C 6. C 7. B 8. A 9. A 10. B

TEST 11.4

1. C 2. C 3. A 4. C 5. C 6. C 7. B 8. A 9. A 10. B