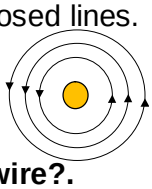
12. ELECTRO MAGNETISM

Questions and Answers

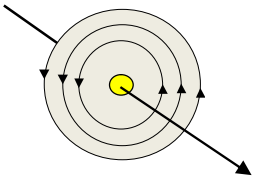
1. Are the magnetic field lines closed? Explain.

A. The magnetic lines of forces distributed from north pole to south pole in the magnetic field. And the magnetic lines of forces distributed from south pole to north pole inside the magnet.
No two magnetic lines of forces intersect each other. Hence, they are closed lines.

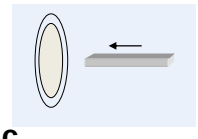
2. Observe the figure given. Magnetic lines are shown. What is the direction of the current flowing through the wire?.



A. In the given figure, the magnetic lines of forces are shown in anti clock wise direction. As per right hand thumb rule, the direction of flow of flow of current is vertically out ward direction from the page.

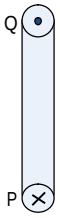


3. A bar magnet with North Pole facing towards a coil moves as shown in figure. What happens to the magnetic flux passing through the coil?.



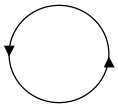
A. The magnetic flux passing through the coil increases. Current generated in the coil.

4. A coil is kept perpendicular to the page. At P, current flows into the page and at Q it comes out of the page as shown in figure. What is the direction of magnetic field due to the coil?



A. If current flows into the page in down ward direction, then the field lines are in clockwise direction at 'P'. The field lines are in anti clock wise direction at 'Q'.

5. The direction of current flowing in a coil is shown in figure. What type of magnetic pole is formed at the face that has flow of current as shown in figure?

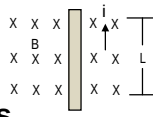


A. North Pole is forms at the face that has flow of current.

6. Why does the picture appear distorted when a bar magnet is brought close to the screen of a television? Explain.

A. Television works on the motion of electrons, charged particles. When a bar magnet is brought close to the screen of a television, magnetic field exerts a force on the moving charge. So the picture appears as distorted.

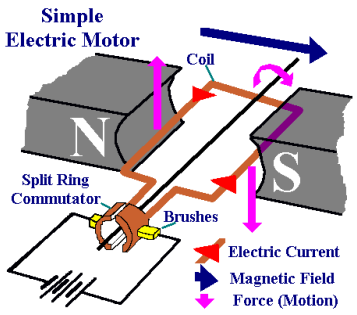
7. Symbol 'X' indicates the direction of a magnetic field into the page. A straight long wire carrying current along its length is kept perpendicular to the magnetic field. What is the magnitude of force experienced by the wire? In what direction does it act?



A. The magnitude of force experienced by the wire by the magnetic field is, F= iLB.
Here 'B' = Uniform magnetic field
i' = Current through the conductor
'L' = Length of the conductor.
The force that acts on the wire is perpendicular to the direction of the magnetic field induction.

8. Explain the working of electric motor with a neat diagram.

A. Electric motor : it is a device which converts the electrical energy into mechanical energy.
Principle: when a current carrying conductor placed perpendicular to the magnetic field experiences a force.



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Working: Consider a rectangular coil kept in a uniform magnetic field as shown in figure. This coil ABCD is called armature.

Switch on the circuit to allow the current flow through the rectangular coil. The angle made by AB and CD with magnetic field always right angles.

The force on AB is equal and opposite to the force on CD due to external magnetic field. Sum of these forces is zero; similarly the sum of the forces on sides BC and DA is also zero. So, net force on the coil is zero. But the rectangular coil comes into rotation in clockwise direction because of equal and opposite pair of forces acting on the two sides of the coil. It gets half rotation. Then due to its inertia it rotates further in clockwise direction. But now the sides of the coil experience forces which are in the opposite direction to the previous case. Hence these forces try to rotate it in anti clockwise direction. As a result, this coil comes to halt and rotates in anti clock wise direction.

The brushes are connected to the battery. The ends of the coil are connected to slip rings. After half rotation, the brushes come into contact with the other slip rings in such a way that the direction of current through the coil is reversed. This happens every half rotation. Thus the direction of rotation of the coil remains the same. In this way motor works.

9. Derive Faraday's law of induction from law of conservation of energy.

A. Faraday's law of induction: The induced e.m.f. generated in the closed loop is equal to the rate of change of magnetic flux passing through it.

When a bar magnet is pushed towards the coil with north pole facing then north pole of bar magnet repels by the north pole of the coil. Hence we need to do work to over come the force.

Work (W) = F . S

The work on the magnet converted to electricity.

W = BIl. S [since F = BIl]

As the decrease in flux is $\Delta\emptyset$, B is perpendicular to the area lS.

W = $\Delta\emptyset$. I [since $\Delta\emptyset$ = Bl S]

As per law of conservation of energy,

P = $\frac{W}{\Delta t} = \frac{\Delta\emptyset . I}{\Delta t}$

Induced e.m.f. X $I = \frac{\Delta\emptyset . I}{\Delta t}$ [since P = iV]

Induced e.m.f. = $\frac{\Delta\emptyset}{\Delta t}$

This is the equation for Faraday's law of induction.

10. The value of magnetic field induction which is uniform is 2T. What is the flux passing through a surface of area 1.5m^2 perpendicular to the field?

A. Magnetic field induction B = 2T

Surface area A = 1.5 m^2

Magnetic flux Φ = ?

Formula: B = $\frac{\emptyset}{A}$

$\emptyset$ = BA = 2 x 1.5 = 3 Weber

11. An 8N force acts on a rectangular conductor 20cm long placed perpendicular to a magnetic field. Determine the magnetic field induction if the current in the conductor is 40A.?

A. Force on conductor (F) = 8N

Length of conductor (l) = 20cm = 20 x 10^{-2} m

Current in the conductor (i) = 40 A

Magnetic field induction (B) = ?

Formula: F = B i l

B = $\frac{F}{i\,l} = \frac{8}{40\ X\ 20\ X\ 10^{-2}} = \frac{8\ X\ 10^2}{800} = \frac{800}{800}$ = 1 Tesla

12. Explain with the help of two activities that current carrying wire produces magnetic field.

A. Activity-1: Connect a copper wire to the battery and switch. Place one compass below the wire. Switch on the circuit. We observe the compass needle gets deflected. This indicates that the current carrying wire produces magnetic field.

Activity-2: Connect a copper coil to the battery and switch. Sprinkle iron dust near the coil. Switch on the circuit. We observe the iron fillings move towards the coil. This indicates that the current carrying coil produces magnetic field.

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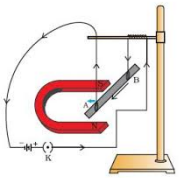
13. How do you verify experimentally that the current carrying conductor experiences a force when it is kept in magnetic field?

A. Arrange the devices as shown in the figure.

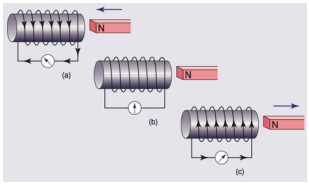


Bring a horse shoe magnet near the copper wire.

The wire is deflecting upwards due to some force acts on it. Repeat this by changing the direction of current in the circuit. We came to know that the direction of force is also changed.

14. Explain Faraday's law of induction with the help of activity.?

A. Connect the terminals of a coil to sensitive Galvanometer.



Push a bar magnet towards the coil whose north pole is facing towards the coil. Then the needle in the galvanometer deflects.

If the magnet is moved away from the coil, the needle in the galvanometer again deflects but in the opposite direction. If the south pole is facing towards the coil, then also the needle deflects.

Whenever there is a continuous change of magnetic flux linked with closed coil, the current is generated.

Thus Faraday stated the law of induction as - The induced e.m.f. generated in the closed loop is equal to the rate of change of magnetic flux passing through it.

15. Explain the working of AC electric generator with a neat diagram.

A. ** Diagram should be drawn**

Working of A.C. generator: Consider the rectangular coil is held between the poles of curve-shaped permanent magnet. The coil is at rest in vertical position with side A of coil at top position and side B at bottom position. No current will be induced in it.

When coil is rotated in clockwise direction current will be induced init and it flows from A to B.

If we continue the rotation of coil once again current becomes zero. The coil comes to vertical position with side B at top position and side A at bottom position. During second part of the rotation current generated follows the same pattern except that the direction of current is reversed. The current in this process changes its direction alternatively. Thus the current produced is A.C. current.

16. Explain the working of DC generator with a neat diagram.

A. A. ** Diagram should be drawn**

Working of D.C. generator: Consider the rectangular coil is held between the poles of curve-shaped permanent magnet. The coil is at rest in vertical position with side A of coil at top position and side B at bottom position. No current will be induced in it.

When coil is rotated in clockwise direction current will be induced init and it flows from A to B.

If we continue the rotation of coil once again current becomes zero. The coil comes to vertical position with side B at top position and side A at bottom position. During second part of the rotation current generated follows the same pattern except that the direction of current is reversed. The current in this process changes its direction alternatively. Thus the current produced is A.C. current.

If two half slip rings are connected to ends of the coil, then A.C. generator works as D.C. generator. It means current generated in the second half rotation of the coil is identical with that of first half rotation. In this way D.C. generator works.

17. Raj kumar said to you that the magnetic field lines are open and they start at north pole of bar magnet and end at south pole. What questions do you ask Raj kumar to correct him by saying "field lines are closed"?

A. I asked Raj kumar, the following.

(i) Are the magnetic field lines passing through bar magnet?

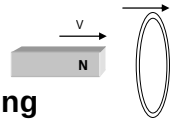
(ii) Why the direction of magnetic lines of forces shows from north pole?

(iii) What is the direction of magnetic lines of force within the magnet?

(iv) Why the magnetic field experienced around the magnet?

(v) Make a hole in the magnet. Keep a compass. Can it deflect?

18. As shown in figure , both coil and bar magnet moves in the same direction. Your friend is arguing that there is no change in flux. Do you agree with his statement? If not what doubts do you have?



Frame questions about the doubts you have regarding change in flux.?

A. No. I don't agree with my friend.

(i) Do they move with same speed in the same direction?

(ii) With out changing the flux, how can induced e.m.f. produced?

(iii) What are the factors that affected the magnetic flux?

19. What experiment do you suggest to understand Faraday's law? What items are required? What suggestions do you give to get good results of the experiment? Give precautions also.

A. Experiment to understand Faraday's law:

Connect the terminals of a coil to sensitive Galvanometer.

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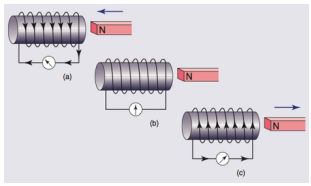


Push a bar magnet towards the coil whose north pole is facing towards the coil. Then the needle in the galvanometer deflects.

If the magnet is moved away from the coil, the needle in the galvanometer again deflects but in the opposite direction. If the south pole is facing towards the coil, then also the needle deflects.

Whenever there is a continuous change of magnetic flux linked with closed coil, the current is generated.

Thus Faraday stated the law of induction as - The induced e.m.f. generated in the closed loop is equal to the rate of change of magnetic flux passing through it.

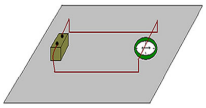
Material Required: Galvano meter , Bar magnet , Coil of wire.

Suggestions: If we want good results, we need (i) Strong magnet

Precautions : Observation should be taken carefully.

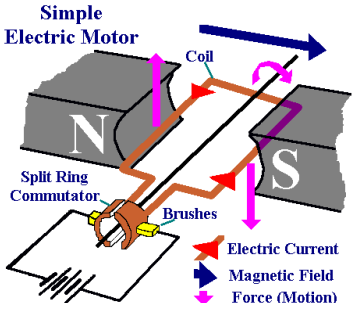
20. How can you verify that a current carrying wire produces a magnetic field with the help of an experiment?

A. Connect a copper wire to the battery and switch. Place one compass below the wire. Switch on the circuit. We observe the compass needle gets deflected. This indicates that the current carrying wire produces magnetic field.



24. Draw a neat diagram of electric motor. Name the parts.

A.



25. Draw a neat diagram of an AC generator.

A.

26. How do you appreciate Faraday's law, which is the consequence of conservation of energy?

A. When the bar magnet is moved towards the coil current is generated in the coil. Also when the bar magnet is moved away from the coil current generated in the coil. This means mechanical energy is converted into electrical energy. Hence, I appreciate the Faraday's law which is the consequence of conservation of energy.

27. How do you appreciate the relation between magnetic field and electricity that changed the life style of mankind?

A. There is relation between electricity and magnetism. Both are inter linked.

A current carrying wire produced magnetic field. By this principle calling bells, electric cranes, electric motors works. Due to relative motion of magnets and coil electricity is produced. By this principle generator works.

Hence the relation between electricity and magnetism leads to many inventions that changes our life style. So we appreciate the work of scientists in this regard.

28. Give a few applications of Faraday's law of induction in daily life.

A. Applications of Faraday's law of electromagnetic induction.

Electromagnetic induction is all around us.

(i) It is useful in electric bells.

(ii) It is useful in tape recorder which we use to listen to songs (or) record voices

(iii) It is useful in the case of using ATM card when its magnetic strip is swiped through a scanner.

(iv) An induction stove works on the principle of electromagnetic induction.

29. Which of the various methods of current generation protects nature well? Give examples to support your answer.

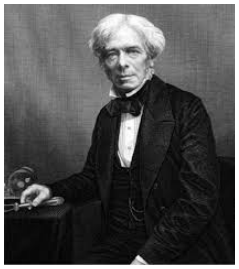
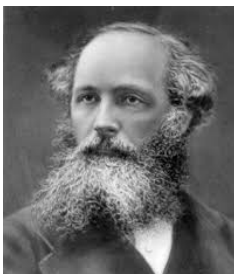
A. The various methods of current generation that protects the nature well are,

(i) When speedily moving wind falls on the blades of a wind mill, it produces the current and is known as "wind electricity".

(ii) Solar energy converted as electricity.

(iii) Geothermal energy converted as electricity.

(iv) Tidal energy and bio-mass energy are converted as electricity.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