12. Magnetic Effects of Electric Current - Board Exam Questions

2 Mark Questions

1) *A fuse in electric circuit is rated 4 A. Can it be used with an electric heater of rating 2 kW, 200 V? Explain your answer.*

I = P/V = 2000/200 = 10 A

No. The heater draws 10 A, much more than the fuse rating (4 A). The fuse will melt and break the circuit.

2) *How is an electromagnet made? Write any two ways by which the strength of electromagnet can be increased.*

An electromagnet is made by winding a coil of insulated copper wire around a soft iron core and passing current through it.

Its strength can be increased by (i) increasing the number of turns in the coil, and (ii) increasing the current.

3) *What are magnetic field lines. List two important properties of magnetic field lines.*

Magnetic field lines are lines that show the magnetic field around a magnet.

• No two field lines cross each other.

• Outside the magnet, they come out of the north pole and go into the south pole.

4) *(i) Two magnetic field lines do not intersect each other. Why? (ii) How is a uniform magnetic field in a given region represented? Draw a diagram in support of your answer.*

(i) If two lines crossed, a compass needle at that point would have to point in two directions at once, which is not possible.

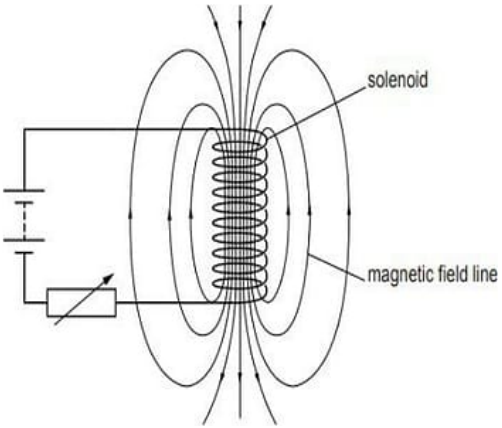
(ii) A uniform magnetic field is shown by parallel straight lines that are equally spaced, with arrows all in the same direction.

5) *Name the device used to magnetise a piece of magnetic material. Draw a labelled diagram to show the arrangement used for the magnetisation of a cylinder made of soft iron.*

A current-carrying solenoid.

Diagram: a soft iron rod placed inside a solenoid connected to a battery and a key (NCERT Fig. 12.11).

6) *Refer to the image below and state how the magnetic field pattern indicates regions where the magnetic field is stronger outside the magnet? What happens to the magnetic field when the current in the circuit is reversed?*



The field is stronger where the field lines are crowded together. So it is strongest near the poles and becomes weaker away from them.

If the current is reversed, the direction of the magnetic field is also reversed.

3 Mark Questions

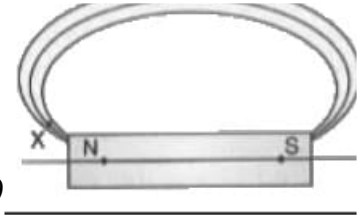
1) *A student fixes a white sheet of paper on a drawing board. He places a bar magnet in the centre and sprinkles some iron filings uniformly around the bar magnet. Then he taps gently and observes that iron filings arrange themselves in a certain pattern. (a) Why do iron filings arrange themselves in a particular pattern? (b) Which physical quantity is indicated by the pattern of field lines around the bar magnet? (c) State any two properties of magnetic field lines.*

(a) In the magnetic field, each iron filing acts like a tiny magnet. The magnetic force turns them so they line up along the field lines.

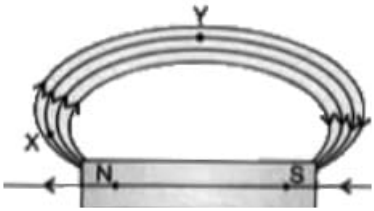
(b) The magnetic field of the bar magnet.
(c) Field lines never cross each other. Field lines are closed curves.

2) *A student fixes a sheet of white paper on a drawing board. He places a bar magnet in the centre of it. He sprinkles some iron filings uniformly around the bar magnet. Then he taps the drawing board gently and observes that the iron filings arrange themselves in a particular pattern. (a) Why do iron filings arrange in a particular pattern? (b) What does the crowding of iron filings at the ends of the magnet indicate? (c) What do the lines, along which the iron filings align, represent? (d) If the student places a cardboard horizontally in a current carrying solenoid and repeats the above activity, in what pattern would the iron filings arrange? State the conclusion drawn about the magnetic field based on the observed pattern of the lines.*
(a) Because there is a magnetic field around the bar magnet.
(b) The magnetic field is strongest near the poles.
(c) Magnetic field lines.
(d) In equally spaced parallel lines. So the magnetic field inside the solenoid is uniform (the same everywhere).

3) *Magnetic field lines are shown in the given diagram. A student makes a statement that the magnetic field at X is stronger than at Y. (i) Explain with reason if the student's claim is correct. (ii) Also redraw the diagram and mark the direction of magnetic field lines.*

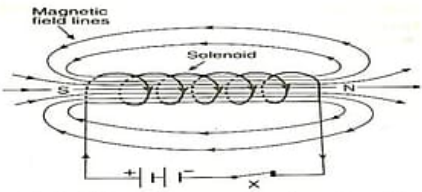


(i) Correct. The closer the field lines, the stronger the field. The lines are closer at X (near the pole) than at Y.
(ii) Outside the magnet, the arrows go from the north pole to the south pole.

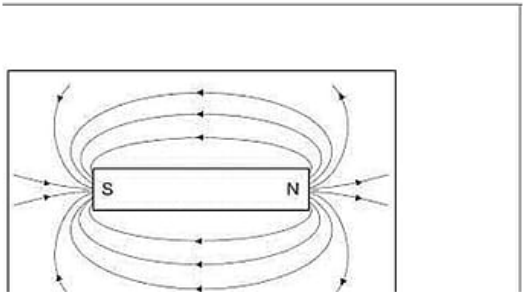


4) *(i) Draw the pattern of magnetic field lines of (1) a current carrying solenoid (2) a bar magnet (ii) List two distinguishing features between the two fields.*

(i)



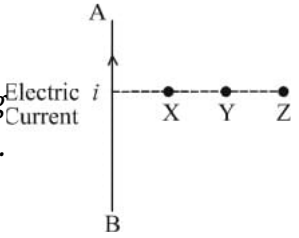
Magnetic field lines of a current carrying solenoid



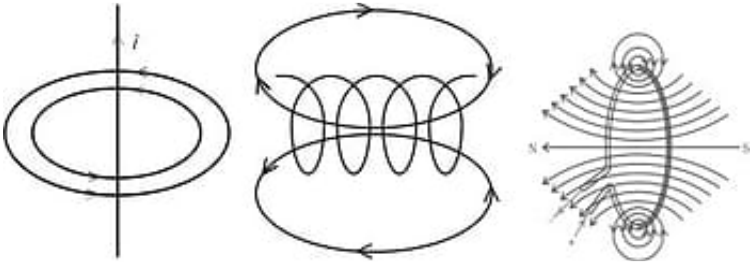
(ii)

Field of a solenoid	Field of a bar magnet
Its strength can be changed by changing the current.	Its strength cannot be changed.
Its direction can be reversed by reversing the current.	Its direction cannot be changed.

5) *(a) The pattern of magnetic field due to a current carrying wire depends upon the shape made by that wire. Justify. (b) A current carrying straight wire AB is shown in the given diagram. Out of X, Y and Z on which point will the strength of magnetic field be maximum and why?*

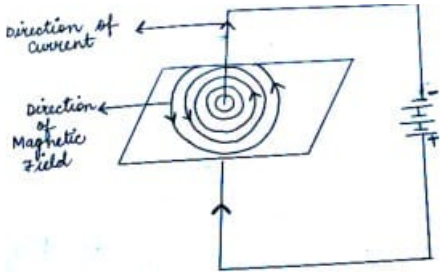


(a) The field patterns of a straight wire, a circular loop and a solenoid are all different:



(b) At X, because it is closest to the wire. The field becomes weaker as the distance from the wire increases.

6) *Draw a diagram to show the pattern of magnetic field lines on a horizontal sheet of paper due to a straight conductor passing through its centre and carrying current vertically upwards. Mark on it (i) the direction of current in the conductor and (ii) the corresponding magnetic field lines. State right hand thumb rule and check whether the directions marked by you are in accordance with this rule or not.*



The field lines are concentric circles around the wire. For current going upwards, they go anticlockwise (seen from above).

Right-hand thumb rule: Hold the wire in your right hand with the thumb pointing in the direction of current. Your fingers curl in the direction of the magnetic field lines. The directions marked agree with this rule.

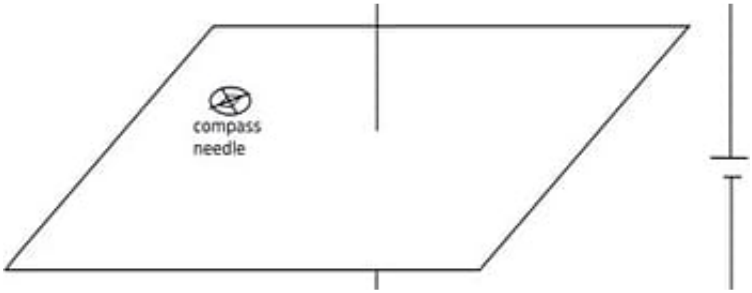
7) *A. State the Right-Hand Thumb Rule and describe how it helps determine the direction of magnetic field around a current-carrying conductor. B. Explain how the magnetic field changes with distance from the conductor.*

A. Hold a current-carrying straight wire in your right hand so that the thumb points in the direction of current. Your fingers then curl around the wire in the direction of the magnetic field lines.

So, if we know the direction of current (thumb), the curled fingers give the direction of the field.

B. The field becomes weaker as we move away from the wire. It is inversely proportional to the distance ($B \propto I/r$).

8) *Mona was doing an experiment with a magnetic compass and a straight current-carrying wire. She observed that as she moved the compass away from the current-carrying wire, the deflection of the compass needle reduced. A. Explain why the deflection of the compass needle reduced as Mona moved away the compass needle from the current carrying wire. B. Mention one thing that could have changed in the circuit of the wire that could increase the deflection of the needle. C. Explain with reason what will be the direction of the magnetic field associated with the wire for the case described by the above figure.*



A. The magnetic field becomes weaker as the distance from the wire increases. So the compass needle is deflected less.

B. Increase the current in the wire. The field is directly proportional to the current.

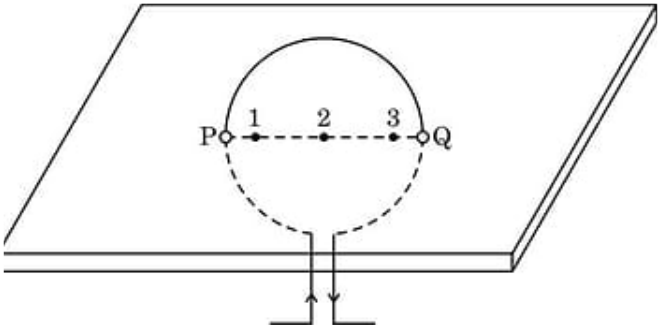
C. The current flows from the top to the bottom. By the right-hand thumb rule, the magnetic field is clockwise.

9) *A compass needle is placed near a current carrying wire. State your observations for the following cases and give reasons for the same in each case- (a) Magnitude of electric current in wire is increased. (b) The compass needle is displaced away from the wire.*

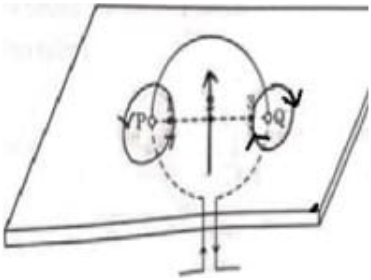
(a) The deflection increases, because the magnetic field is directly proportional to the current.

(b) The deflection decreases, because the magnetic field becomes weaker with distance from the wire.

10) *Consider a rectangular cardboard having two holes P and Q through which a current carrying circular loop has been inserted as shown in the diagram. (a) Make this diagram on your answer sheet and draw three magnetic field lines, one each passing through the points 1 (near P), 2 (at the centre of the loop) and 3 (near Q). (b) List two factors on which the intensity of the magnetic field produced at the centre of the loop depends. (c) Name the rule you will apply to determine the direction of magnetic field produced due to a current carrying straight conductor.*



(a)

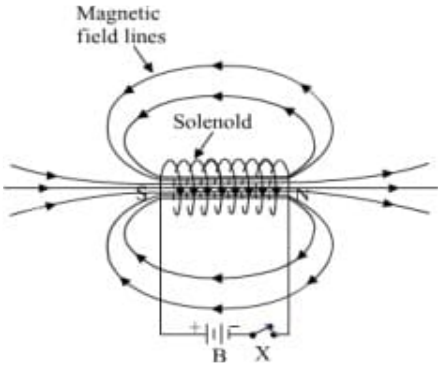


(b) The current in the loop, and the number of turns of the loop.
(c) Right-hand thumb rule

11) *What is a solenoid? When does a solenoid behave as a magnet? Draw the pattern of the magnetic field produced inside it showing the directions of the magnetic field lines.*

A solenoid is a coil of many turns of insulated copper wire wound closely in the shape of a cylinder.

It behaves as a magnet when an electric current passes through it.



12) *(a) What happens when a bundle of wires of soft iron is placed inside the coil of a solenoid carrying a steady current? Name the device obtained. Why is it called so? (b) Draw the magnetic field lines inside a current carrying solenoid. What does this pattern of magnetic field lines indicate?*

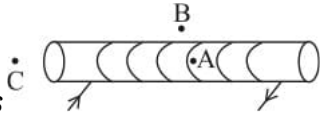
(a) The soft iron becomes magnetised. The device is an electromagnet. It is called so because it acts as a magnet only while current flows through the solenoid.

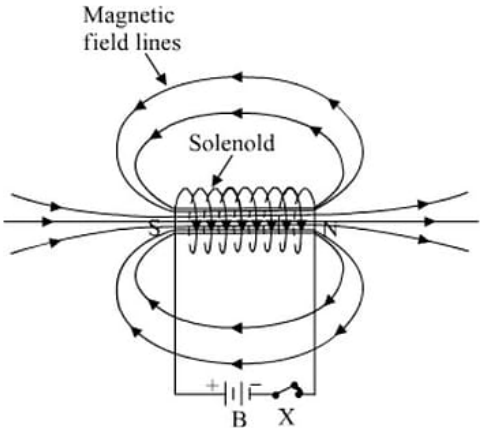
(b)



The lines inside are parallel, so the magnetic field inside the solenoid is uniform.

13) *For the current carrying solenoid as shown, draw magnetic field lines and give reason to explain that out of the three points A, B and C, at which point the field strength is maximum and at which point it is minimum?*





Maximum at A, because the field lines are crowded there.
Minimum at B, because the field lines are far apart there.

14) *Name and state the rule to determine the direction of a: (i) magnetic field produced around a current carrying straight conductor. (ii) force experienced by a current carrying straight conductor placed in a magnetic field which is perpendicular to it.*

(i) Right-hand thumb rule: Hold the wire in your right hand with the thumb pointing in the direction of current. Your fingers curl in the direction of the magnetic field lines.

(ii) Fleming's left-hand rule: Stretch the thumb, forefinger and middle finger of your left hand so that they are at right angles to each other. If the forefinger points along the magnetic field and the middle finger along the current, the thumb points in the direction of the force (motion) on the conductor.

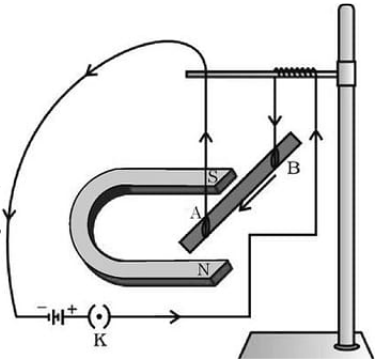
15) *(a) Describe an activity to show that a current carrying conductor, placed in an external magnetic field experiences a force. (b) Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally towards the front wall from the back wall, is deflected by a strong magnetic field to your right side. Find the direction of the magnetic field.*

(a) Hang a small aluminium rod AB horizontally from a stand with two wires. Place a strong horseshoe magnet so that the rod is between its poles, at right angles to the field. Connect the rod to a battery and a key, and switch on the current.

Observation: The rod moves (is displaced) when current flows. So it experiences a force.

(b) The magnetic field is vertically downwards.

16) *On the basis of the given circuit arrangement, answer the following questions: (a) What happens to the rod AB when the key K is closed and why? (b) Name and state the rule that determines this behaviour of the rod AB in the above situation.*



(a) The rod AB moves from its place, because a current-carrying conductor in a magnetic field experiences a force.

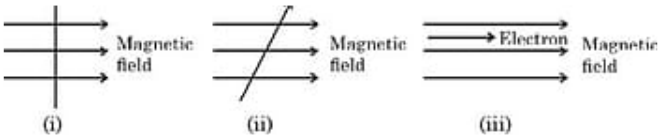
(b) Fleming's left-hand rule: Stretch the thumb, forefinger and middle finger of your left hand at right angles to each other. If the forefinger points along the field and the middle finger along the current, the thumb gives the direction of the force (motion).

17) *(i) A straight cylindrical conductor is suspended with its axis perpendicular to the magnetic field of a horse-shoe magnet. The conductor gets displaced towards left when a current is passed through it. What will happen to the displacement of the conductor if the (1) current through it is increased? (2) horse-shoe magnet is replaced by another stronger horse-shoe magnet? (3) direction of current through it is reversed? (ii) Name and state the rule for determining the direction of force on a current carrying conductor in a magnetic field.*

(i) (1) It increases. (2) It increases. (3) It is reversed (the conductor moves to the right).

(ii) Fleming's left-hand rule: Stretch the thumb, forefinger and middle finger of your left hand at right angles to each other. If the forefinger points along the field and the middle finger along the current, the thumb gives the direction of the force (motion).

18) *(i) State the rule used to find the force acting on a current carrying conductor placed in a magnetic field. (ii) Given below are three diagrams showing entry of an electron in a magnetic field. Identify the case in which the force will be (1) maximum and (2) minimum respectively. Give reason for your answer.*



(i) (refer 14th 3 mark question)

(ii) (1) Maximum in Fig (i), because the electron moves at right angles to the field.

(2) Minimum in Fig (iii), because the electron moves along the field.

19) *(a) "The third wire of earth connection is very important in domestic electric appliances." Justify this statement. (b) List two precautions to be taken to avoid the overloading of domestic electric circuits.*

(a) The earth wire is a safety measure. If current leaks to the metal body of an appliance, the earth wire carries it to the ground and keeps the body at zero (earth) potential. So the user does not get a severe shock.

(b) (i) Use a fuse of the proper rating. (ii) Do not connect too many appliances to one socket.

20) *Anannya responded to the question: Why do electrical appliances with metallic bodies are connected to the mains through a three pin*

plug, whereas an electric bulb can be connected with a two pin plug? She wrote: Three pin connections reduce heating of connecting wires. (i) Is her answer correct or incorrect? Justify. (ii) What is the function of a fuse in a domestic circuit?

(i) Her answer is wrong. Appliances with metal bodies need an earth wire. It gives an easy (low-resistance) path to the ground if current leaks to the metal body, so the user does not get a shock. A bulb has no metal body to touch, so it does not need earthing.

(ii) A fuse protects the circuit from too much current. Its wire melts and breaks the circuit when excess current flows.

21) *Explain the meaning of overloading of an electrical circuit. List two possible causes due to which overloading may occur in household circuits. Write one preventive measure that should be taken to avoid overloading of domestic circuits.*

Overloading means that too much current flows through the wires.

Causes: (i) the live and neutral wires touch each other (short-circuit); (ii) too many appliances are connected to one socket.

Prevention: use a fuse of the proper rating (and wires with good insulation).

22) *(i) Why is an alternating current (A.C.) considered to be advantageous over direct current (D.C.) for the long distance transmission of electric power? (ii) How is the type of current used in household supply different from the one given by a battery of dry cells? (iii) How does an electric fuse prevent the electric circuit and the appliances from a possible damage due to short circuiting or overloading.*

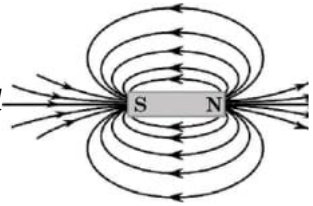
(i) AC can be sent over long distances without much loss of energy.

(ii) Household supply is alternating current (AC), which changes direction again and again. A battery gives direct current (DC), which flows in one direction only.

(iii) When the current becomes higher than its rating, the fuse wire melts and breaks the circuit, so no current flows.

4 Mark Questions (Case Study)

1) *In order to obtain magnetic field lines around a bar magnet, a student performed an experiment using a magnetic compass and a bar magnet. The magnet was placed on a sheet of white paper fixed on a drawing board. Using magnetic needle he obtained on the paper a pattern of magnetic field lines (as shown below) around the bar magnet.*



(a) By convention, the field lines emerge from north pole and merge at south pole. Why? Give reason. (1)

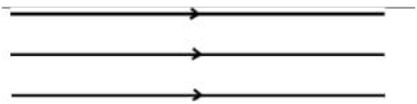
The direction of the field is taken as the direction in which the north pole of a compass needle moves.

(b) State the relationship between strength of the magnetic field and the degree of closeness of the field lines. (1)

The closer the field lines, the stronger the magnetic field.

(c) (A) (i) No two field lines can ever intersect each other. Give reason. (ii) The magnetic field in a given region is uniform. Draw a diagram to represent it. (2)

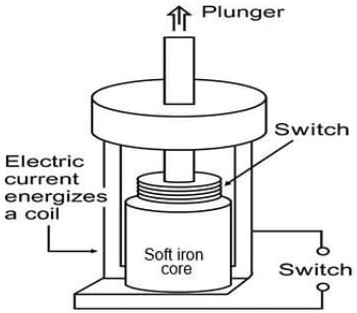
(refer 4th 2 mark question)



OR (c) (B) Draw the pattern of the magnetic field lines through and around a current carrying solenoid. What does the pattern of field lines inside the solenoid represent?

(refer 12th 3 mark question)

2) *A school has installed an automatic electromagnetic door-locking system at the main entrance. The locking mechanism uses a solenoid controlled by a switch at the security desk. When electricity flows through the solenoid, it creates a magnetic field strong enough to pull an iron bolt, unlocking the door. As soon as the switch is turned off, the magnetic field disappears, and a spring pushes the bolt back, locking the door.*



Attempt either subpart (C) or (D).

A. Why is an iron core kept inside the solenoid in this locking mechanism? (1)

The iron core makes the magnetic field much stronger, so the bolt is pulled harder.

B. How can we determine the magnetic poles in this solenoid? (1)

Use the right-hand thumb rule: curl the fingers of your right hand in the direction of the current. The thumb points towards the north pole.

C. If the current in the solenoid is increased from 1 A to 2 A, explain how the magnetic effect changes and its effect on unlocking the door. (2)

The magnetic field becomes stronger, because it is directly proportional to the current.

The stronger pull unlocks the door more easily.

OR D. If the source of the current is fixed, how can we increase the magnetic field in the solenoid?

• Increase the number of turns in the coil.

• Put a soft iron core inside it.

3) *In our homes, we receive the supply of electric power through a main supply also called mains, either supported through overhead electric poles or by underground cables. In our country the potential difference between the two wires (live wire and neutral wire) of this supply is 220 V.*
(a) Write the colours of the insulation covers of the line wires through which supply comes to our homes. (1)

Live wire: red. Neutral wire: black.

(b) What should be the current rating of the electric circuit (220 V) so that an electric iron of 1 kW power rating can be operated? (1)

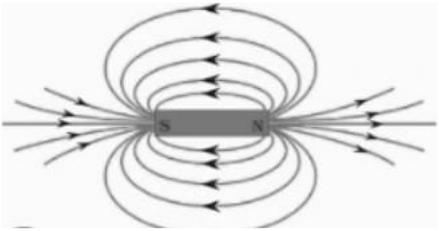
I = P/V = 1000/220 = 4.54 A, so the circuit should be rated 5 A.

(c) (i) What is the function of the earth wire? State the advantage of the earth wire in domestic electric appliances such as electric iron. (2)
(refer 19th 3 mark question)
OR (c) (ii) List two precautions to be taken to avoid electrical accidents. State how these precautions prevent possible damage to the circuit/appliance.

• Use a fuse: it melts and breaks the circuit when too much current flows (overloading).
• Use an earth wire: it carries leaked current to the ground and prevents electric shock.

5 Mark Questions

1) *(i) Draw a diagram showing the magnetic field lines around a bar magnet. Write any two characteristics of magnetic field lines.*
(ii) Write the statement of Right hand thumb rule.
(iii) The concentric circles representing the magnetic field around a current carrying straight wire become larger and larger as we move away from the wire. How does magnetic field change on these concentric circles?
(i)



• Outside the magnet, field lines go from the north pole to the south pole, and inside from south to north. So they are closed curves.
• The closer the lines, the stronger the field.
(ii) (refer 14th 3 mark question)
(iii) The magnetic field becomes weaker as the circles become larger (farther from the wire).

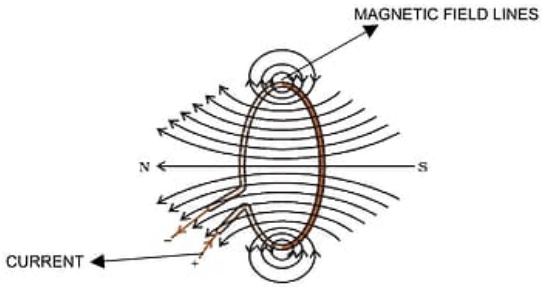
2) *Why can't two magnetic field lines cross each other? Draw magnetic field lines showing the direction of the magnetic field due to a current carrying long straight solenoid. State the conclusion which can be drawn from the pattern of magnetic field lines inside the solenoid. Name any two factors on which the magnitude of the magnetic field due to this solenoid depends.*

Crossing: (refer 4th 2 mark question)
Field lines and the conclusion: (refer 12th 3 mark question)
Factors: the number of turns, and the current in the solenoid.

3) *What are magnetic field lines? How is the direction of magnetic field at a point determined? Draw the pattern of magnetic field lines of the magnetic field produced by a current carrying circular loop. Mark on it the direction of (i) current and (ii) magnetic field lines. Name the two factors on which the magnitude of the magnetic field due to a current carrying coil depends.*

Magnetic field lines are imaginary lines that show the magnetic field around a magnet.

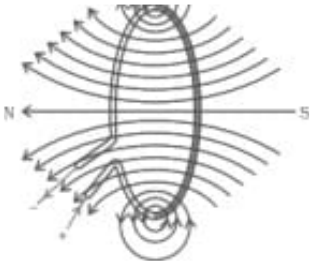
The direction at a point is found by placing a small compass there: its north pole points along the field.



Factors: (refer 10th 3 mark question)

4) *(i) Draw the pattern of magnetic field lines through and around a current-carrying circular loop.*
(ii) State the rule to find out the direction of the magnetic field inside and around the circular loop.
(iii) Give reasons: (I) Why should a burnt-out fuse be replaced by another fuse of identical rating only, in an electric circuit? (II) Why is soft iron-core used in making an electromagnet?

(i)

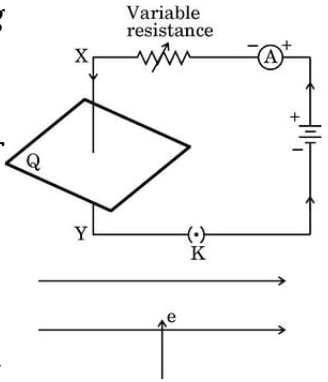


(ii) Right-hand thumb rule: (refer 14th 3 mark question)

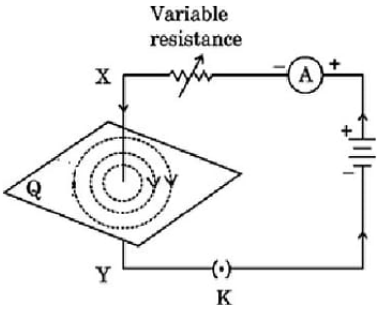
(iii) (I) A fuse of higher rating will not melt when too much current flows, so it will not protect the circuit.

(II) Soft iron becomes a magnet easily when current flows and loses its magnetism quickly when the current stops.

5) *The given figure shows the current passing through the straight conductor XY.*
(i) Copy the diagram and draw the magnetic field lines when current flows from conductor X to Y.
(ii) Name and state the rule used in determining the direction of the magnetic field lines in the situation given above.
(iii) State Fleming's left hand rule. Using this rule, determine the direction of force applied on an electron entering a uniform magnetic field as shown in the figure.

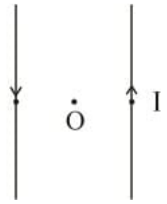


(i)



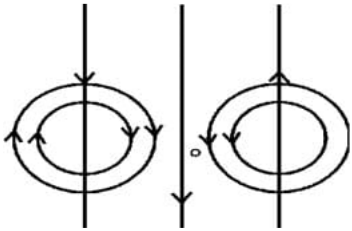
(ii) (refer 14th 3 mark question)
(iii) Fleming's left-hand rule: (refer 14th 3 mark question)
The force on the electron is out of the plane of the paper.

6) *(i) Draw the pattern of the magnetic field lines for the two parallel straight conductors carrying current of same magnitude 'I' in opposite directions as shown. Show the direction of magnetic field at a point O which is equidistant from the two conductors. (Consider that the conductors are inserted normal to the plane of a rectangular cardboard.)*



(ii) In our houses we receive A.C. electric power of 220 V. In electric iron or electric heater cables having three wires with insulation of three different colours – red, black and green are used to draw current from the mains. (a) What are these three different wires called? Name them colourwise. (b) What is the potential difference between the red wire and the black wire? (c) What is the role of the wire with green insulation in case of accidental leakage of electric current to the metallic body of an electrical appliance?

(i)



(ii) (a) Red: live wire. Black: neutral wire. Green: earth wire.

(b) 220 V

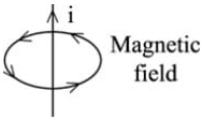
(c) (refer 19th 3 mark question)

7) *(i) What is a solenoid? Draw a diagram showing the magnetic field pattern due to a current-carrying solenoid (inside and outside).*
(ii) Name any two factors on which the magnitude of the magnetic field due to a current-carrying solenoid depends.
(iii) A current-carrying solenoid is stretched and converted into a straight wire carrying current. Draw a diagram showing the magnetic field pattern around it and mark the direction of the magnetic field.

(i) (refer 11th 3 mark question)

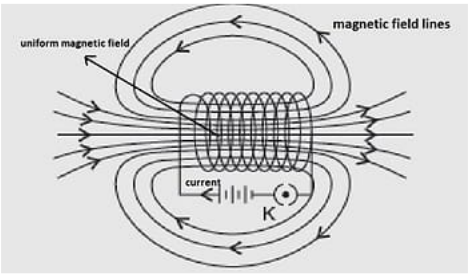
(ii) The current through the solenoid, and the number of turns of the coil.

(iii) The field lines become concentric circles around the wire:



8) *(i) Define the term solenoid. Draw the pattern of the magnetic field lines in and around a current carrying straight solenoid. Mark on the pattern the (i) direction of current, (ii) direction of field lines near the ends of the solenoid, and (iii) region where the magnetic field is uniform.*
(ii) How would you make an electromagnet using a current carrying solenoid?

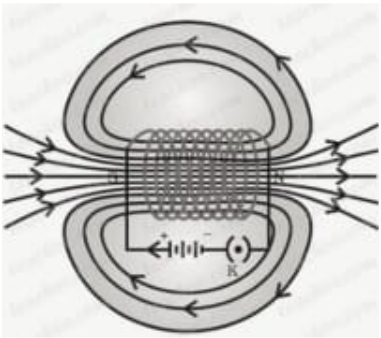
(i) A solenoid is a coil of many turns of insulated copper wire wound closely in the shape of a cylinder.



(ii) Put a piece of soft iron inside the current-carrying solenoid.

9) *(i) Draw a diagram, showing the magnetic field lines in and around the current carrying solenoid. Write any two salient features of these lines.*
(ii) What is an electromagnet and how is it made?

(i)

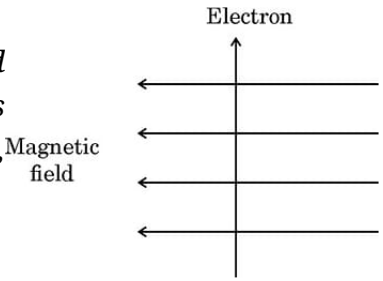


• The pattern is like that of a bar magnet.
• Inside the solenoid, the lines are parallel straight lines (uniform field).

(ii) An electromagnet is a magnetic material that acts as a magnet only while current flows.

How it is made: (refer 2nd 2 mark question)

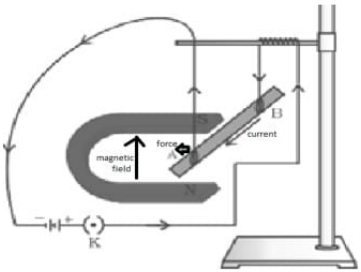
10) *(i) With the help of a diagram, show that a current-carrying conductor placed in an external magnetic field, experiences a force. Indicate the direction of the field, current and force clearly.*



(ii) The diagram given below shows an electron moving in a uniform magnetic field.

(I) What will be the direction of the force acting on the electron? (II) What will happen to the direction of the force acting on the electron, if the direction of the magnetic field as well as the direction of motion of the electron, both are reversed?

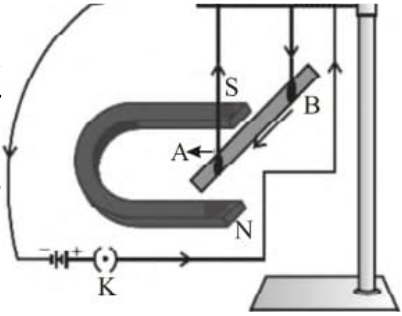
(i) (refer 15th 3 mark question)



(ii) (I) Into the plane of the paper.

(II) The force stays in the same direction (reversing both cancels out).

11) *(i) By using the given experimental set-up. How can it be shown that: (a) a force is exerted on the current-carrying conductor AB when it is placed in a magnetic field. (b) the direction of force can be reversed in two ways.*



(ii) When will the magnitude of the force be highest?

(iii) State Fleming's left hand rule.

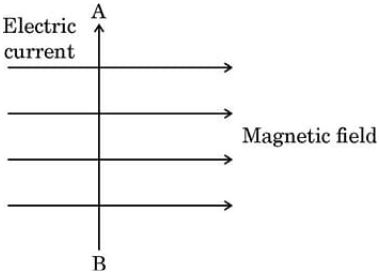
(i) (a) When current flows, the conductor AB moves (is displaced).

(b) By reversing the direction of the current, or by reversing the direction of the magnetic field.

(ii) When the current is at right angles to the magnetic field.

(iii) (refer 14th 3 mark question)

12) *(i) State the rule which gives the direction of force acting on a current-carrying conductor placed in a magnetic field.*



(ii) What is a fuse? Why is it called a safety device?

(iii) Why are electrical appliances with metallic bodies connected to the mains through a three-pin plug, whereas an electric bulb is connected with a two-pin plug?

(iv) What will be the direction of force experienced by the conductor AB due to the magnetic field, when current flows in the direction shown? Name the law you applied to find the direction.

(i) (refer 14th 3 mark question)

(ii) and (iii) (refer 20th 3 mark question)

(iv) Into the page, by Fleming's left-hand rule.