Magnetic Effects of Electricity Curren

Previous Years' CBSE Board Questions

12.1 Magnetic Field and Field Lines

VSA (1 mark)

1. Why do two magnetic field lines not intersect each other? (2021C)

SAI (2 marks)

2. (a) Name the poles P, Q, R and S of the magnets in the following figures 'a' and 'b':

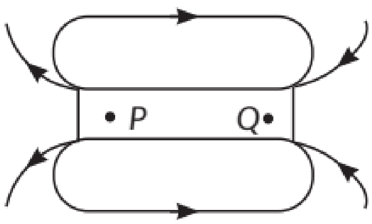


Figure 'a'

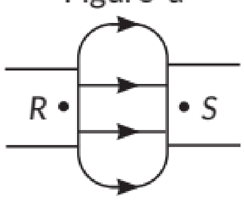


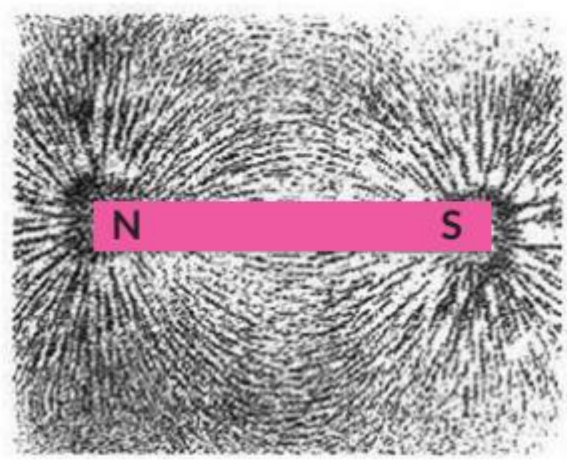
Figure 'b'

(b) State the inference drawn about the direction of the magnetic field lines on the basis of these diagrams. (Term II, 2021-22)

3. Draw magnetic field lines around a bar magnet. Name the device which is used to draw magnetic field lines. (Board Term 1, 2015)

SA II (3 marks)

4. Study the diagram given below and answer the questions that follow:



(a) Why do the iron filings arrange in such a pattern?
(b) What does this pattern demonstrate?
(c) Why do the iron filings near the bar magnet seem to align in the shape of closed curves? (2020C)

5. Design an activity to demonstrate that a bar magnet has a magnetic field around it. (Board Term 1, 2017)

6. What are magnetic field lines? Justify the following statements:
(a) Two magnetic field lines never intersect each other.
(b) Magnetic field are closed curves. (Board Term 1, 2016)

LA (4/5 marks)

7. A student fixes a sheet of white paper on a drawing board using some adhesive materials. She places a bar magnet in the centre of it and sprinkles some iron filings uniformly around the bar magnet using a salt-sprinkler. On tapping the board gently, she observes that the iron filings have arranged themselves in a particular pattern.
(a) Draw a diagram to show this pattern of iron filings.
(b) What does this pattern of iron filings demonstrate?
(c) (i) How is the direction of magnetic field at a point determined using the field lines? Why do two magnetic field lines not cross each other?

OR

(ii) How are the magnetic field lines of a bar magnet drawn using a small compass needle? Draw one magnetic field line each on both sides of the magnet. (Term II, 2021-22)

12.2 Magnetic Field Due to a Current-Carrying Conductor

Magnetic Field due to Current through a Straight Conductor

MCQ

8. Assertion (A): The magnetic field lines around a current carrying straight wire do not intersect each other.
Reason (R): The magnitude of the magnetic field produced at a given point increases as the current through the wire increases.
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A)
(c) Assertion (A) is true, but Reason (R) is False.
(d) Assertion (A) is false, but Reason (R) is true. (2023)

VSA (1 mark)

9. Name the instrument used to detect the presence of a current in a circuit. (2021C)

SAI (2 marks)

10. List two factors on which the strength of magnetic field at a point due to a current carrying straight conductor depends. State the rule that determines the direction of magnetic field produced in this case. (Term II, 2021-22C)

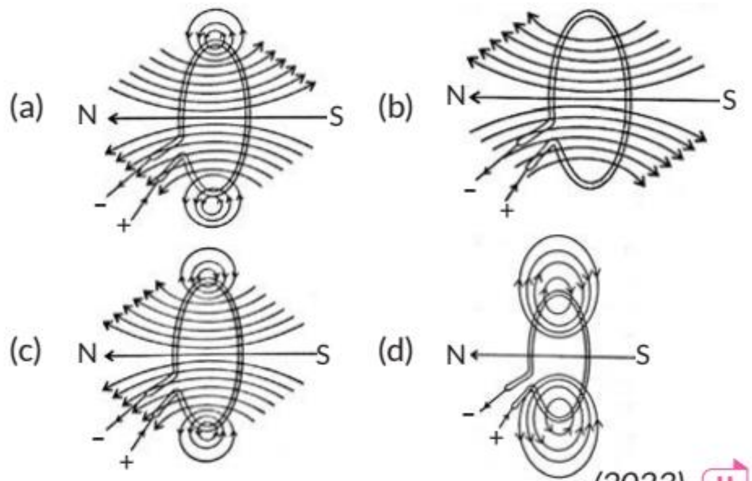
11. A compass needle is placed near a current carrying straight conductor. State your observation for the following cases and give reasons for the same in each case.
(a) Magnitude of electric current is increased. conductor.
(b) The compass needle is displaced away from the (Al 2019)

12. State how the magnetic field produced by a straight current carrying conductor at a point depends on
(a) current through the conductor (b) distance of point from conductor. (Board Term I, 2014)

Right Hand Thumb Rule

MCQ

13. The correct pattern of magnetic field lines of the field produced by a current carrying circular loop is



(2023)

SA I (2 marks)

14. (i) A magnetic compass shows a deflection when placed near a current carrying wire. How will the deflection of the compass get affected if the current in the wire is increased? What does it indicate?
(ii) State Right Hand Thumb rule. (Term II, 2021-22C)

SA II (3 marks)

15. Draw the pattern of the magnetic field produced around a vertical current carrying straight conductor passing through a horizontal cardboard. Mark the direction of current and the magnetic field lines. Name and state the rule which is used to determine the direction of magnetic field associated with a current carrying conductor. (2023)

16. (a) State Right Hand Thumb rule to find the direction of the magnetic field around a current carrying straight conductor.
(b) How will the magnetic field be affected on:
(i) increasing the current through the conductor
(ii) reversing the direction of flow of current in the conductor? (Board Term 1, 2015)

Magnetic Field due to Current through a Circular Loop and Solenoid

MCQ

17. For a current in a long straight solenoid, N and S poles are created at the two ends. Among the following statements, the incorrect statement is :
(a) the magnetic field lines inside the solenoid are in the form of straight lines, which indicates that the magnetic field is uniform at all points inside the solenoid.
(b) the strong magnetic field produced inside the solenoid can magnetize the soft iron placed inside it.
(c) the pattern of the magnetic field associated with a current carrying solenoid is different from the pattern of the magnetic field around a bar magnet.
(d) The N and S poles exchange positions when the direction of current through the solenoid is reversed. (2023)

VSA (1 mark)

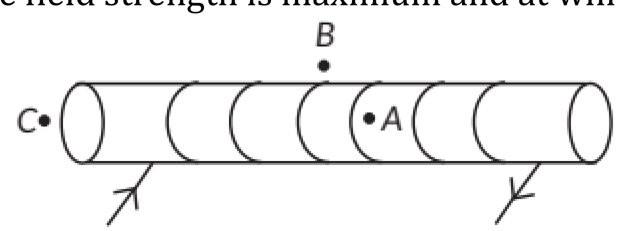
18. What is an electromagnet? (2021C)

SAI (2 marks)

19. (i) What is a solenoid?
(ii) Draw the pattern of magnetic field lines of the magnetic field produced by a solenoid through which a steady current flows. (Term II, 2021-22) Ap

SA II (3 marks)

20. 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?



(2023)

21. What is a solenoid? Draw the pattern of the magnetic field lines around a current carrying solenoid. Mark on the pattern the region where the magnetic field is uniform. (Term II, 2021-22)

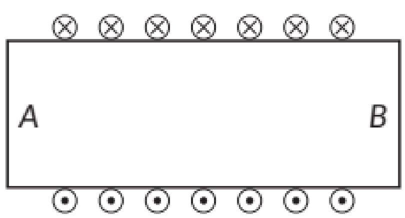
22. Give reason for the following
(i) There is either a convergence or a divergence of magnetic field lines near

the ends of a current carrying straight solenoid.
(ii) The current carrying solenoid when suspended freely rests along a particular direction. (2/3, 2020)

23. Find the direction of magnetic field due to a current carrying circular coil held:
(i) vertically in North-South plane and an observer looking it from east sees the current to flow in anticlockwise direction,
(ii) vertically in East - West plane and an observer looking it from south sees the current to flow in anticlockwise direction,
(iii) horizontally and an observer looking at it from below sees current to flow in clockwise direction. (Board Term 1, 2017)

24. (a) State three factors on which the strength of magnetic field produced by a current carrying solenoid depends.
(b) Draw circuit diagram of a solenoid to prepare an electromagnet. (Board Term 1, 2016)

25. Diagram shows the lengthwise section of a current carrying solenoid. ® indicates current entering into the page, indicates current emerging out of the page. Decide which end of the solenoid A or B, will behave as north pole. Give reason for your answer. Also draw field lines inside the solenoid.



(Board Term I, 2014)

LA (5 marks)

26. (a) What is an electromagnet? List any two uses.
(b) Draw a labelled diagram to show how an electromagnet is made.
(c) State the purpose of soft iron core used in making an electromagnet.
(d) List two ways of increasing the strength of an electromagnet if the material of the electromagnet is fixed. (2020) R

27. What is solenoid? Draw the pattern of magnetic field lines of
(i) a current carrying solenoid and

(ii) a bar magnet.
List two distinguishing features between the two fields. (Delhi 2019)

28. What are magnetic field lines? List three characteristics of these lines. Describe in brief an activity to study the magnetic field lines due to a current carrying circular coil. (Board Term I, 2017, 2016)

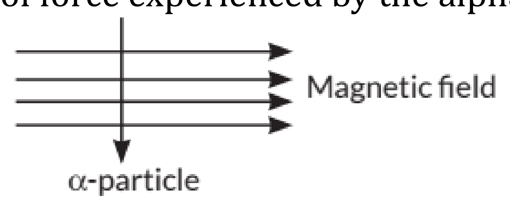
29. Draw the magnetic field lines through and around a single loop of wire carrying electric current. (2/5, Board Term 1, 2016)

30. What is a solenoid? Draw a diagram to show field lines of the magnetic field through and around a current carrying solenoid. State the use of magnetic field produced inside a solenoid. List two properties of magnetic lines of force. (Board Term 1, 2015)

12.3 Force on a Current-Carrying Conductor in a Magnetic Field

MCQ

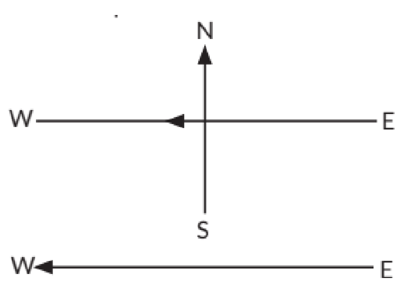
31. An alpha particle enters a uniform magnetic field as shown. The direction of force experienced by the alpha particle is



(2023)

(a) towards right
(b) towards left
(c) into the page
(d) out of the page

32. A constant current flows in a horizontal wire in the plane of the paper from east to west as shown in the figure. The direction of the magnetic field will be north to south at a point



(a) directly above the wire
(b) directly below the wire
(c) located in the plane of the paper on the north side of the wire
(d) located in the plane of the paper on the south side of the wire (2023)

33. Assertion: A current carrying straight conductor experiences a force when placed perpendicular to the direction of magnetic field. Reason: The net charge on a current carrying conductor is always zero.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true. (2023)

34. Hans Christian Oersted (1777-1851) observed that a compass needle suffers a deflection when placed near a metal wire carrying an electric current. This discovery gave the first evidence of a connection between electric and magnetic phenomena. Andre Ampere (1775 - 1836) grasped the significance of Oersted's discovery. He carried out a large series of experiments to explore the relationship between current electricity and magnetism. On the basis of experiments, he hypothesised that all magnetic phenomena are due to circulated electric currents. Later on many devices such as electromagnets, electric motors, microphones, electric generators, etc. were developed on the basis of magnetic phenomena.
(i) A magnetic needle is a/an :
(a) isolated north pole pivoted at its centre of mass.
(b) isolated south pole pivoted at its centre of mass.
(c) ordinary needle made of soft iron and pivoted at its centre of mass.
(d) small bar magnet pivoted at its centre of mass.
(ii) A freely suspended magnet always rests in geographically north and south direction because:
(a) the Earth has two poles.
(b) the Earth behaves as a huge magnet.
(c) the magnetic north pole of the Earth's magnet is located very close to its south pole.
(d) the magnetic south pole of the Earth's magnet is located very close to its south pole.

(iii) When a current flows through a straight conductor, a magnetic field is produced around it. Consider the following statements about this field:
I. The direction of the magnetic field of a current carrying straight conductor is determined by right-hand thumb rule.
II. A charged body placed in this field experiences a force whose direction is given by Fleming's left- hand rule.
III. The magnetic field lines around a current carrying straight conductor are in the form of concentric circles with the conductor as the centre. The correct statement(s) is/are:
(a) I only
(c) I and II
(b) III only
(d) I and III
(iv) The strength of magnetic field of a current carrying solenoid is
(a) minimum at its ends
(b) uniform inside it at all points
(c) maximum at its centre
(d) zero at its centre
(v) Which one of the following particles would not experience a force while moving perpendicular to a uniform magnetic field?
(a) A neutron
(c) An electron
(b) An alpha particle
(d) A proton (2021 C)

VSA (1 mark)

35. State the effect of a magnetic field on the path of a moving charged particle. (Board Term 1, 2014)

SA I (2 marks)

36. When is the force experienced by a current - carrying straight conductor placed in a uniform magnetic field
(i) Maximum;
(ii) Minimum? (Term II, 2021-22)

37. (i) Name and state the rule to determine the direction of force experienced by a current carrying straight conductor placed in a uniform magnetic field

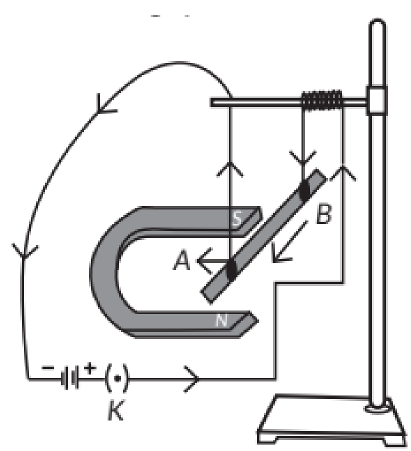
which is perpendicular to it.
(ii) An alpha particle while passing through a magnetic field gets projected towards north. In which direction will an electron project when it passes through the same magnetic field? (Term II, 2021-22)

SA II (3 marks)

38. (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. (2023)

LA (4/5 marks)

39. A student was asked to perform an experiment to study the force on a current carrying conductor in a magnetic field. He took a small aluminium rod AB, a strong horseshoe magnet, some connecting wires, a battery and a switch and connected them as shown. He observed that on passing current, the rod gets displaced. On reversing the direction of current, the direction of displacement also gets reversed. On the basis of your understanding of this phenomenon, answer the following questions:



(a) Why does the rod get displaced on passing current through it?
(b) State the rule that determines the direction of the force on the conductor

AB.
(c) If the U shaped magnet is held vertically and the aluminium rod is suspended horizontally with its end B towards due north, then on passing current through the rod B to A as shown, in which direction will the rod be displaced?

OR

Draw the pattern of magnetic field lines produced around a current-carrying straight conductor held vertically on a horizontal cardboard. Indicate the direction of the field lines as well as the direction of current flowing through the conductor. (Term II, 2021-22)

40. A current carrying conductor is placed in a magnetic field. Now answer the following.
(i) List the factors on which the magnitude of force experienced by conductor depends.
(ii) When is the magnitude of this force maximum?
(iii) State the rule which helps in finding the direction of motion of conductor.
(iv) If initially this force was acting from right to left, how will the direction of force change if:
(a) direction of magnetic field is reversed?
(b) direction of current is reversed? (Board Term I, 2017)

41. State whether an alpha particle will experience any force in a magnetic field if (alpha particles are positively charged particles)
(i) it is placed in the field at rest.
(ii) it moves in the magnetic field parallel to field lines.
(iii) it moves in the magnetic field perpendicular to field lines. Justify your answer in each case. (Board Term 1, 2016)

42. Describe an activity with labelled diagram to show that a force acts on current carrying conductor placed in a magnetic field and its direction of current through conductor. Name the rule which determines the direction of this force. (Board Term 1, 2016)
Electric Generator* (A.C and D.C)

SAI (2 marks)

43. Write the frequency of alternating current (AC) in India. How many times per second it changes its direction? (Board Term 1, 2015)

44. How is the type of current that we receive in domestic circuit different from the one that runs a clock? (Board Term 1, 2014)

SA II (3 marks)

45. (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 the possible damage due to short circuiting or overloading. (2023)

46. Define alternating current and direct current. Explain why alternating current is preferred over direct current for transmission over long distances. (Board Term 1, 2014)

12.4 Domestic Electric Circuits

MCQ

47. At the time of short circuit, the electric current in the circuit
(a) vary continuously
(b) does not change
(c) reduces substantially
(d) increases heavily. (2020)

SA II (3 marks)

48. Give reason for the following: The burnt out fuse should be replaced by another fuse of identical rating. (1/3, 2020)

49. Justify the following statements:
(a) Tungsten is used exclusively for filaments of electric lamps.
(b) Series arrangement is not used for domestic circuits.
(c) Copper and aluminium wires are usually employed for electricity transmission. (2019C)

50. Give reasons for the following:
(a) It is dangerous to touch the live wire of the main supply rather than

neutral wire.
(b) In household circuit, parallel combination of resistances is used.
(c) Using fuse in a household electric circuit is important. (Board Term 1, 2017)

51. (a) Fuse acts like a watchman in an electric circuit. Justify this statement.
(b) Mention the usual current rating of the fuse wire in the line to (i) lights and fans
(ii) appliance of 2 kW or more power. (Board Term 1, 2014)

LA (5 marks)

52. (a) State Fleming's Left-hand rule.
(b) List three characteristic features of the electric current used in our homes.
(c) What is a fuse? Why is it called a safety device?
(d) Why is it necessary to earth metallic electric appliances? (2020)

53. (a) Name two safety measures commonly used in an electric circuit and appliances.

(b) What precaution should be taken to avoid the overloading of domestic electric circuits? (Board Term 1, 2017)

54. (a) Draw a schematic diagram of a common domestic circuit showing provision of
(i) Earth wire.
(ii) Main fuse
(iii) Electricity meter and
(iv) Distribution box.
(b) Distinguish between short circuiting and overloading (Board Term 1, 2015)

CBSE Sample Questions

12.1 Magnetic Field and Field Lines

SA II (3 marks)

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. (2022-23)

12.2 Magnetic Field Due to a Current-Carrying Conductor

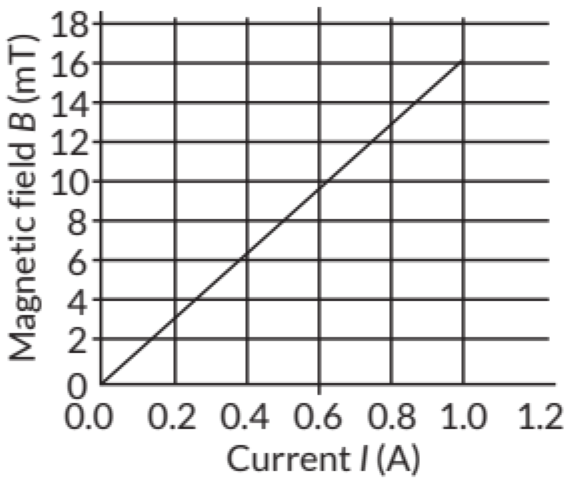
MCQ

Which of the following pattern correctly describes the magnetic field around a long straight wire carrying current?
(a) straight lines perpendicular to the wire.
(b) straight lines parallel to the wire.
(c) radial lines originating from the wire.
(d) concentric circles centred around the wire. (2022-23)

3. Assertion: On freely suspending a current - carrying solenoid, it comes to rest in Geographical N-S direction.
Reason : One end of current carrying straight solenoid behaves as a North pole and the other end as a South pole, just like a bar magnet.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true. (2022-23)

Read the following and answer any four questions from 4(i) to 4(v).

4. A solenoid is a long helical coil of wire through which a current is run in order to create a magnetic field. The magnetic field of the solenoid is the superposition of the field due to the current through each coil. It is nearly uniform inside the solenoid and close to zero outside and is similar to the field of a bar magnet having a north pole at one end and a south pole at the other depending upon the direction of current flow. The magnetic field produced in the solenoid is dependent on a few factors such as, the current in the coil, number of turns per unit length etc. The following graph is obtained by a researcher while doing an experiment to see the variation of the magnetic field with respect to the current in the solenoid.



The unit of magnetic field as given in the graph attached is in milli-Tesla (mT) and the current is given in Ampere.

(i) What type of energy conversion is observed in a linear solenoid?
(a) Mechanical to magnetic
(b) Electrical to magnetic
(c) Electrical to mechanical
(d) Magnetic to mechanical

(ii) What will happen if a soft iron bar is placed inside the solenoid?
(a) The bar will be electrocuted resulting in short- circuit.
(b) The bar will be magnetised as long as there is current in the circuit.
(c) The bar will be magnetised permanently.
(d) The bar will not be affected by any means.

(iii) The magnetic field lines produced inside the solenoid are similar to that of
(a) a bar magnet
(b) a straight current carrying conductor
(c) a circular current carrying loop
(d) electromagnet of any shape

(iv) After analysing the graph a student writes the following statements.
I. The magnetic field produced by the solenoid is inversely proportional to the current.
II. The magnetic field produced by the solenoid is directly proportional to the current.
III. The magnetic field produced by the solenoid is directly proportional to square of the current.

IV. The magnetic field produced by the solenoid is independent of the current.
Choose from the following which of the following would be the correct statement(s).
(a) Only IV
(b) I and III and IV
(c) I and II
(d) Only II

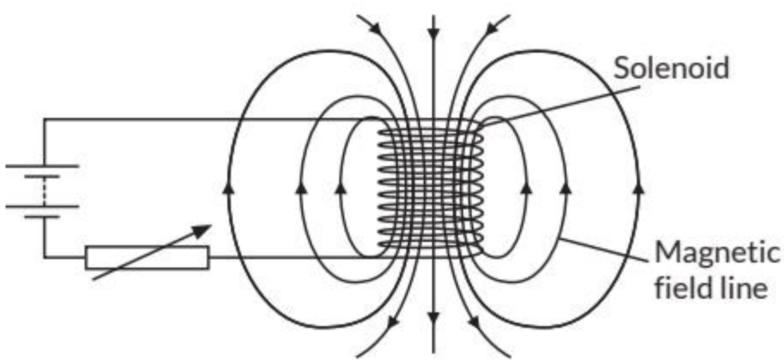
(v) From the graph, deduce which of the following statements is correct.
(a) For a current of 0.8 A, the magnetic field is 13 mT.
(b) For larger currents, the magnetic field increases non-linearly.
(c) For a current of 0.8 A, the magnetic field is 1.3 mT.
(d) There is not enough information to find the magnetic field corresponding to 0.8 A current. (2020-21)

VSA (1 mark)

5. Draw the magnetic field lines around a straight current carrying conductor.(2020-2021)

SAI (2 marks)

6. A circuit contains a battery, a variable resistor and a solenoid. The figure below shows the magnetic field pattern produced by the current in the solenoid.



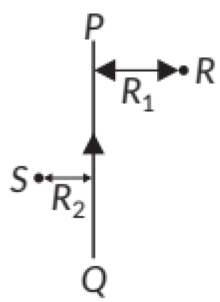
State how the magnetic field pattern indicates regions where the magnetic field is stronger.
(b) What happens to the magnetic field when the current in the circuit is reversed? (Term II, 2021-22)

SA II (3 marks)

7. 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. (2022-23)

LA (5 marks)

8. PQ is a current carrying conductor in the plane of the paper as shown in the figure here.

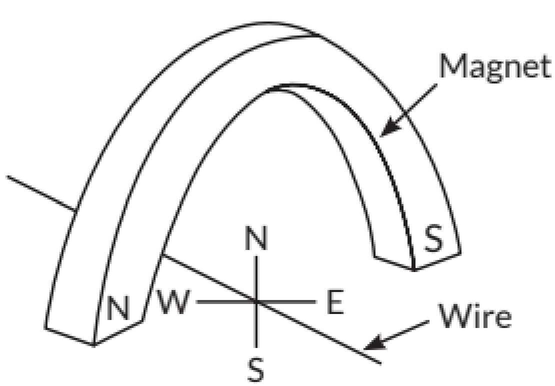


(i) Find the directions of the magnetic fields produced by it at points R and S.
(ii) Given $R_1 > R2$, where will the strength of the magnetic field be larger? Give reasons.
(iii) If the polarity of the battery connected to the wire reversed, how would the direction of the magnetic field be changed?
(iv) Explain the rule that is used to find the direction of the magnetic field for a straight current conductor. (2020-21)

12.3 Force on a Current-Carrying Conductor in a Magnetic Field

MCQ

9. A copper wire is held between the poles of a magnet.

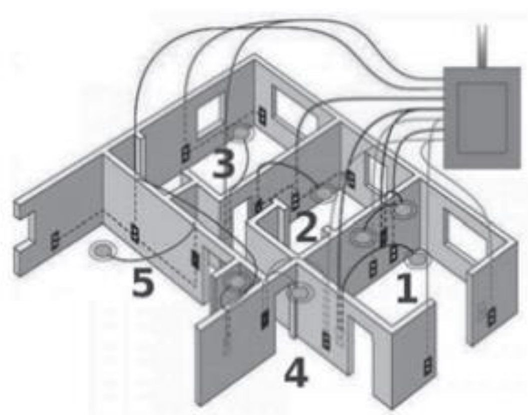


The current in the wire can be reversed. The pole of the magnet can also be changed over. In how many of the four directions shown can the force act on the wire?
(a) 1
(b) 2
(c) 3
(d) 4 (2022-23)

12.4 Domestic Electric Circuits

SA II (3 marks)

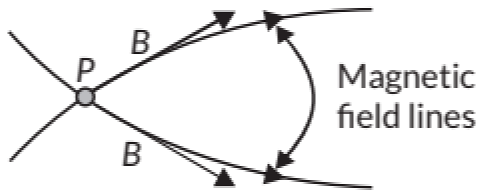
10. The diagram below is a schematic diagram of a household circuit. The house shown in the above diagram has 5 usable spaces where electrical connections are made. For this house, the mains have a voltage of 220 V and the net current coming from the mains is 22 A.



(a) What is the mode of connection to all the spaces in the house from the mains?
(b) The spaces 5 and 4 have the same resistance and spaces 3 and 2 have respective resistances of
20Ω and 30Ω. Space 1 has a resistance double that of space 5. What is the net resistance for space 5?
(c) What is the current in space 3?
(d) What should be placed between the main connection and the rest of the house's electrical appliances to save them from accidental high electric current? (2022-23)

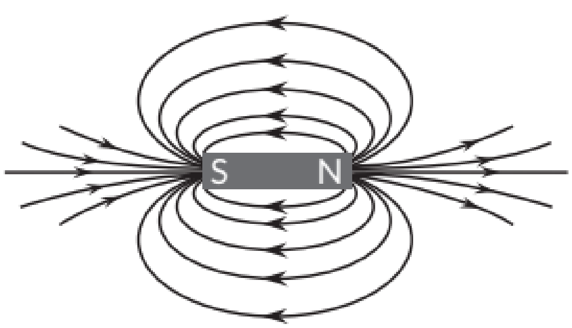
SOLUTIONS

1. The direction of magnetic field (B) at any point is obtained by drawing a tangent to the magnetic field line at that point. In case, two magnetic field lines intersect each other at the point P as shown in figure, magnetic field at P will have two directions, shown by two arrows, one drawn to each magnetic field line at P, which is not possible.



2. (a) Infigure'a', poles P and Qof the magnet represents north pole and south pole respectively. In figure 'b', poles R and S of the magnet also represents north pole and south pole respectively.
(b) Magnetic field lines are closed continuous curves directed from north pole to south pole outside the magnet but from south pole to north pole inside the magnet.

3.

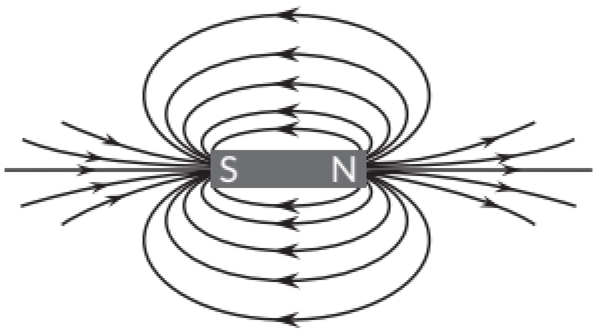


Magnetic field lines around a bar magnet Compass needle is used to draw magnetic field lines.

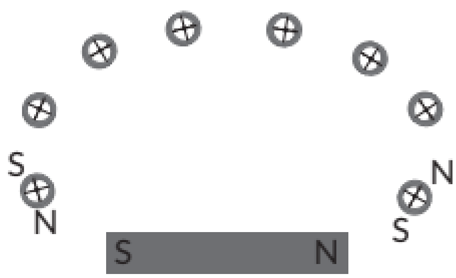
4. (a) The lines along which the iron filings align themselves represent the magnetic field lines of the bar- magnet.
(b) This pattern of iron filings demonstrate that the
magnet exerts its influence in the region surrounding it. Therefore, the iron filings experience a force.
(c) It is taken by convention that the field lines emerges from north pole and

merge at the south pole. Inside the magnet, the direction of field lines is from its south pole to its north pole. Thus, the magnetic field lines are closed curves.

5. One can easily demonstrate the presence of field lines around a bar magnet using compass needles. Place the magnet on a white sheet and mark its boundaries on sheet. Place the compass near the north pole of magnet and mark the position of needle. Now move the compass such that its south pole occupies the position previously occupied by its north pole. Repeat this step several times and you will have pattern as shown in the figure.



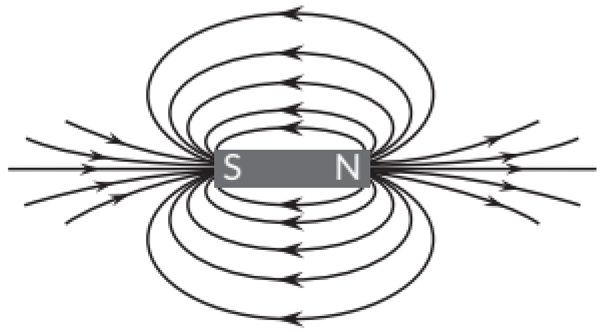
Magnetic field lines around a bar magnet



Drawing a magnetic field lines with the help of a compass needle

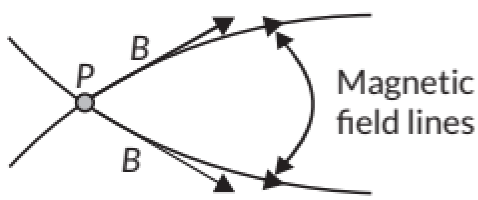
Repeat the above procedure and draw as many lines as you can. These lines represent the magnetic field around the magnet. These are known as magnetic field lines.

6. Imaginary continuous closed curves used to represent the magnetic field in a region is known as magnetic field lines. It is directed from north pole to south pole outside the magnet and south pole to north pole inside the magnet.



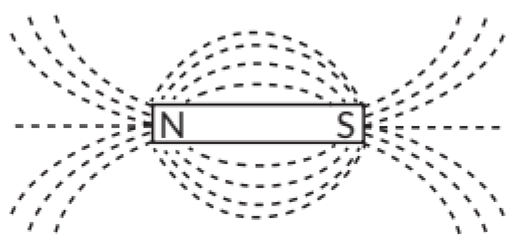
Magnetic field lines around a bar magnet

(a) The direction of magnetic field (B) at any point is obtained by drawing a tangent to the magnetic field line at that point. In case, two magnetic field lines intersect each other at the point P as shown in figure, magnetic field at P will have two directions, shown by two arrows, one drawn to each magnetic field line at P, which is not possible.



(b) It is taken by convention that the field lines emerges from north pole and merge at the south pole. Inside the magnet, the direction of field lines is from its south pole to its north pole. Thus, the magnetic field lines are closed curves.

7. (a) The pattern of iron filings is shown below.



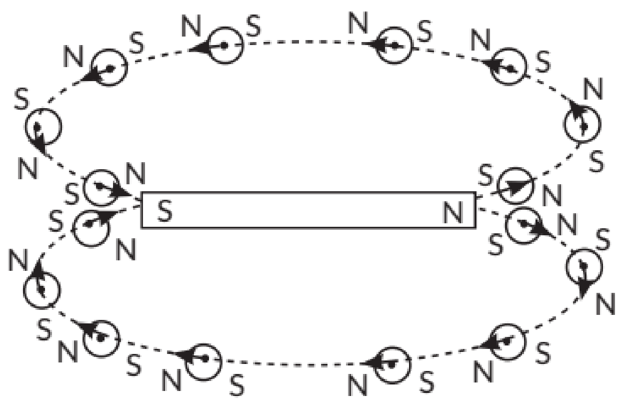
(b) This pattern of iron filings demonstrate that the magnet exerts its influence in the region surrounding it. Therefore, the iron filings experience a force. The lines along which the iron filings align themselves represent magnetic field lines.

(c) (i) 1. The direction of magnetic field is determined by placing a small

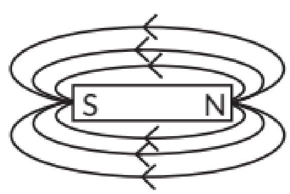
compass needle in the magnetic field. The N-pole of the compass indicates the direction of magnetic field at that point.
2. Magnetic field lines never intersect each other because it is not possible to have two directions of magnetic field at the same point.

OR

(ii) Place the plotting compass near the magnet on a piece of paper. Mark the direction the compass needle points. Move the plotting compass to many different positions in the magnetic field, marking the needle direction each time. Join the points to show the field lines. Drawing a magnetic field line with the help of a compass needle.



Field lines around a bar magnet.

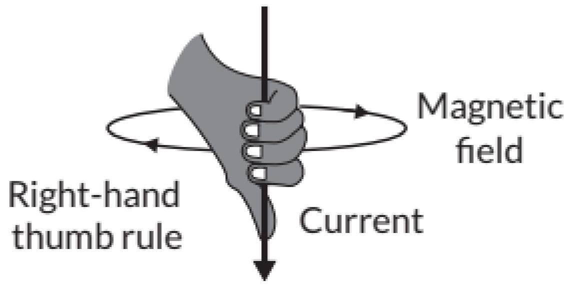


8. (b): Assertion is true and reason is also true, but reason is not the correct explanation of assertion. Magnetic field lines around a current carrying straight wire do not intersect each other because at the point of intersection there will be two directions which is not possible. Also, the strength of magnetic field increased by increasing the magnitude of the current in the wire.

9. Galvanometer is used to detect the current in a circuit.

10. (i) Strength of magnetic field produced by a straight current-carrying wire at a given point is

directly proportional to the current passing through it.
- inversely proportional to the distance of that point from the wire.
(ii) Right-hand thumb rule: The straight thumb of right hand points in the direction of electric current. The direction of the curl of fingers represents the direction of magnetic field.



11. (a) As the amount of magnetic field strength is directly proportional to the amount of current, so the deflection of compass needle increases.
(b) Since magnetic field strength at a point is inversely proportional to the distance from the wire. Hence deflection of compass decreases when it is displaced away from the conductor.

12. Strength of magnetic field produced by a straight current-carrying wire at a given point is
(a) directly proportional to the current passing through it.
(b) inversely proportional to the distance of that point from the wire.

$$i.e., \ B \propto \frac{I}{r} \begin{cases} B \rightarrow \text{magnetic field} \\ I \rightarrow \text{current} \\ r \rightarrow \text{distance between wire and} \\ \quad \text{point of observation} \end{cases}$$

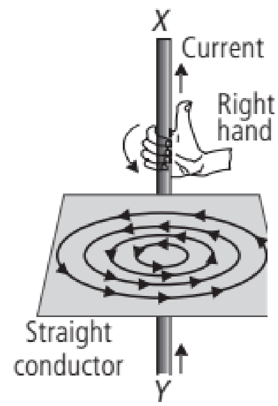
13. (c): By the use of Maxwell's Right hand rule, the correct field lines are shown by option (c).

14. (i) As the amount of magnetic field strength is directly proportional to the amount of current, so the deflection of compass needle increases. It indicate that stronger the current, stronger the magnetic force acting on the needle of the compass.
(ii) It states that you are holding a current carrying straight conductor in your right hand such that the thumb points towards the direction of current. Then

your finger will wrap around the conductor in the direction of the field lines of the magnetic field.

15. The pattern of magnetic field produced around a vertical current carrying straight conductor passing through a horizontal cardboard is shown in figure. The magnitude of magnetic field produced is

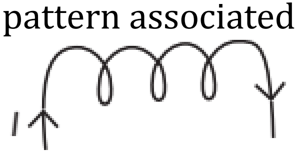
(i) $\propto I$ (ii) $\propto \frac{1}{r}$



Right hand thumb rule is used to determine the direction of magnetic field associated with a current carrying conductor. It states that you are holding a current carrying straight conductor in your right hand such that the thumb points towards the direction of current. Then your finger will wrap around the conductor in the direction of the field lines of the magnetic field.

16. (a) It states that you are holding a current carrying straight conductor in your right hand such that the thumb points towards the direction of current. Then your finger will wrap around the conductor in the direction of the field lines of the magnetic field.
(b) (i) If the current is increased, the magnetic field strength also increases.
(ii) If the direction of current is reversed, the direction of magnetic field also get reversed.

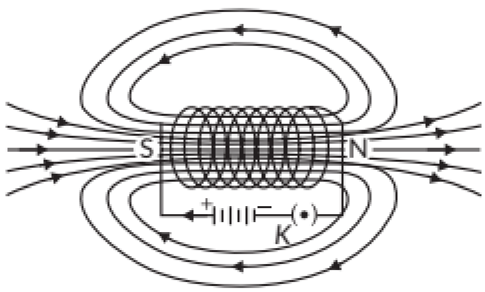
17. (c) A solenoid works similarly to a bar magnet. Hence, the magnetic field pattern associated with the solenoid is same as bar magnet.



18. An electromagnet is a current-carrying solenoid coil which is used to magnetise steel rod inside it.

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

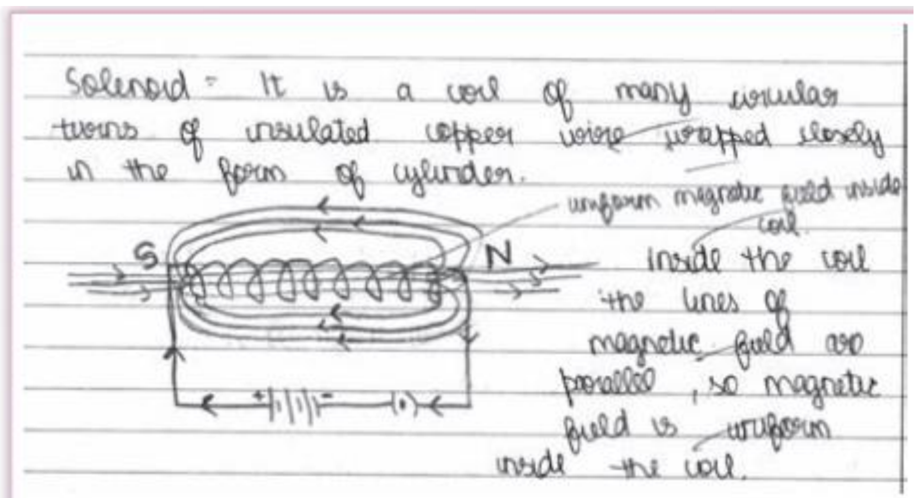
20.



Field lines of the magnetic field through and around a current-carrying solenoid

The magnetic field is maximum at a point which is well inside the solenoid because the maximum number of field lines passes through there. So, point A has maximum field strength and point B has minimum field strength.

21.

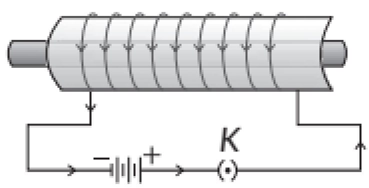


[Topper's Answer, 2022]

22. (i) There is either a convergence or a divergence of magnetic field lines near the ends of a current carrying straight solenoid because it behaves similar to that of a bar magnet and has a magnetic field line pattern similar to that of a bar magnet. Thus the ends of the straight solenoid behaves like poles of the magnet, where the converging end is the south pole and the diverging end is the north pole.
(ii) The current carrying solenoid behaves similar to that of a bar magnet and when freely suspended aligns itself in the north-south direction.

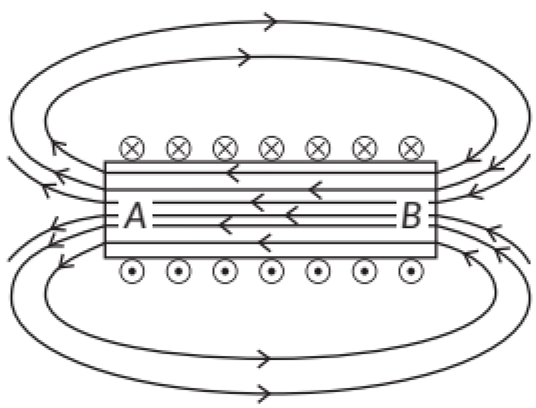
23. According to right hand rule, the direction of magnetic field is
(i) west to east
(iii) into the paper.
(ii) north to south

24. (a) Strength of magnetic field produced by a current carrying solenoid depends upon the following factors:
(i) number of turns in the coil
(ii) amount of current flowing through it
(iii) radius of coil
(iv) material of core of the solenoid.
(b) A strong magnetic field produced inside a solenoid can be used to magnetise a piece of magnetic material, like soft iron, when placed inside the coil. The magnet so formed is called an electromagnet.



An electromagnet is a current-carrying solendoid coil which is used to magnetise steel rod inside it.

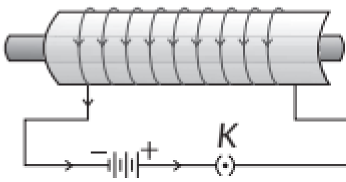
25.



Using right hand thumb rule, we can draw the magnetic field lines around the conductor as shown. From figure, end A of solenoid act as north pole and end B will act as south pole. Inside the solenoid field lines are in the form of parallel straight lines.

26. (a) An electromagnet is a current-carrying solenoid coil which is used to magnetise steel rod inside it. Electromagnets are used in electric bells and buzzers, loudspeakers and headphones etc.

(b) A strong magnetic field produced inside a solenoid can be used to magnetise a piece of magnetic material, like soft iron, when placed inside the coil. The magnet so formed is called an electromagnet.



An electromagnet is a current-carrying solendoid coil which is used to magnetise steel rod inside it.

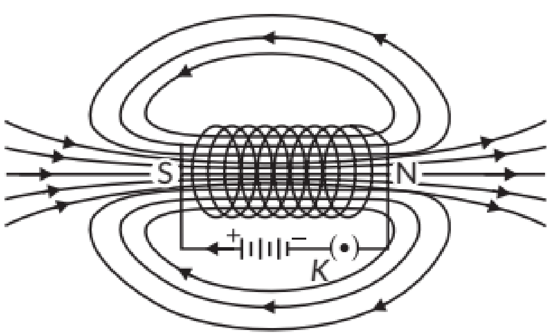
(c) The soft iron core placed in an electromagnet increases the strength of the magnetic field produced. Thus increasing the strength of electromagnet.

(d) The strength of electromagnet can be increased by

(i) Increasing the current passing through the coil.

(ii) Increasing the number of turns in the coil.

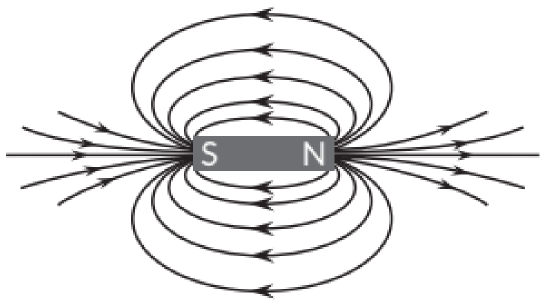
27. (i) Solenoid: A coil of many circular turns of insulated copper wire wrapped in the shape of cylinder is called solenoid.



Field lines of the magnetic field through and around a current-carrying solenoid

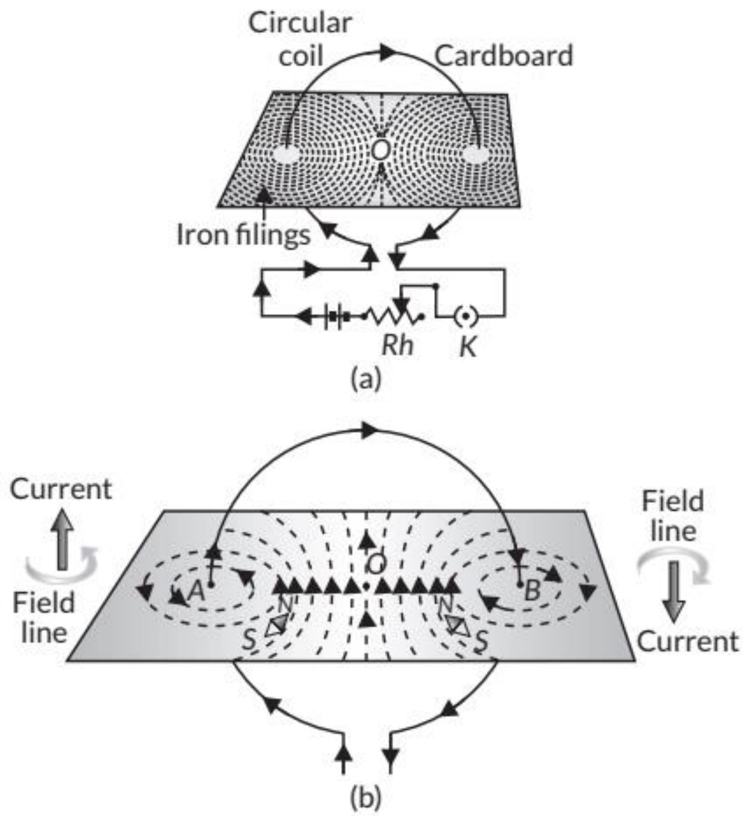
The pattern of magnetic field lines inside the solenoid indicates that the magnetic field is the same at all points inside the solenoid. That is, the field is uniform inside the solenoid.

(ii) Magnetic field lines around a bar magnet.



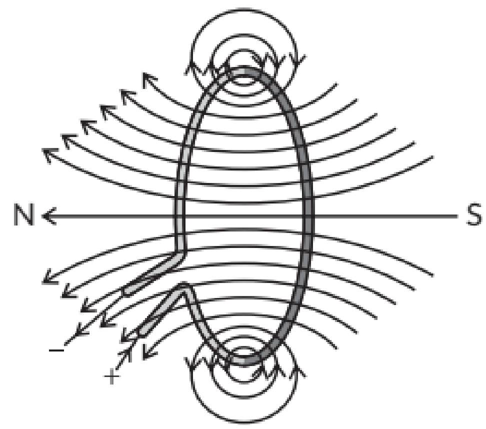
Following are the distinguishing features between the two fields.
(a) A bar magnet is a permanent magnet whereas solenoid is an electromagnet, therefore field produced by solenoid is temporary and stay till current flows through it.
(b) Magnetic field produced by solenoid is more stronger than magnetic field of a bar magnet.

28. Magnetic field lines: These are the imaginary close curves which are used to represent the magnetic field around the magnet. The properties of the magnetic field lines are listed below:
(a) Magnetic field lines start at the north pole and end at the south pole.
(b) Magnetic field lines do not intersect each other, because there can't be two directions of the magnetic field at any one point.
(c) The degree of closeness of the field lines depends upon the strength of the magnetic field. Stronger the field, closer are the field lines. In order to find the magnetic field due to a coil, it is held in a vertical plane and is made to pass through a smooth cardboard in such a way that the centre (O) of the coil lies at the cardboard. A current is passed through the coil and iron filings are sprinkled on the cardboard. These iron filings arrange themselves in a pattern similar to one shown in the figure. This pattern represents the magnetic field lines due to the coil. In order to find the direction of magnetic field lines, we plot the magnetic field with the help of a compass needle. The pattern of magnetic field lines so obtained is shown in figure (b). From this pattern, the following important conclusion have been drawn.



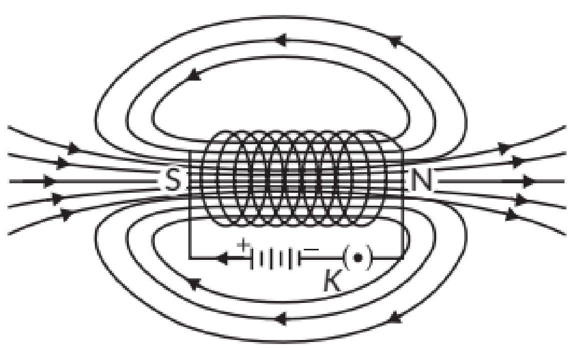
(i) The magnetic field lines near the coil are nearly circular and concentric. This is due to the reason that the segments of the coil in contact with the board at the points A and B are almost like straight conductors. The direction
of the field lines can also be found by applying right-hand thumb rule.
(ii) The field lines are in the same direction in the space enclosed by the coil.
(iii) Near the centre of the coil, the field lines are nearly straight and parallel. As such the magnetic field at the centre of the coil can be taken to be uniform.
(iv) The direction of the magnetic field at the centre is perpendicular to the plane of the coil.
(v) As we move towards the centre of the coil, the strength of magnetic field increases. Magnetic field is maximum at its centre. This is due to the reason that the two magnetic field (one due to the semicircular segment of the coil through A and the other due to the semicircular segment through B) assist each other. The magnitude of the magnetic field at the centre of the coil is directly proportional to the current flowing through it and total number of turns and inversely proportional to the radius of the coil. This is due to the reason that the current in all the circular turns of the coil is in the same direction. As such, the resultant magnetic field due to the coil is equal to the sum of the field due to all these turns.

29.



Magnetic field lines of the field produced by a current-carrying circular loop.

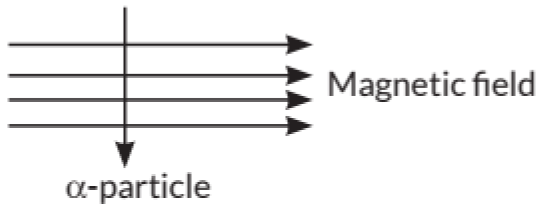
30. Solenoid: A coil of many circular turns of insulated copper wire wrapped in the shape of cylinder is called solenoid.



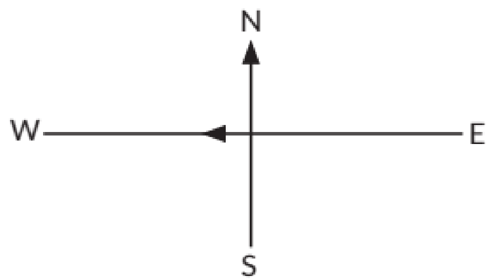
Field lines of the magnetic field through and around a current-carrying solenoid

The pattern of magnetic field lines inside the solenoid indicates that the magnetic field is the same at all points inside the solenoid. That is, the field is uniform inside the solenoid. Solenoid is used to form strong but temporary magnet called electromagnets. These electromagnets are used in wide variety of instruments and used to lift heavy iron objects. Properties of magnetic field lines:
(a) Magnetic field lines start at the north pole and end at the south pole.
(b) Magnetic field lines do not intersect each other, because there can't be two directions of the magnetic field at any one point.

31. (d): According to the Fleming's left hand rule, the direction of force is out of the page.



32. (a): According to right hand thumb rule, the point is at the direction above the wire.



33. (b): Magnetic force, F = qvBsine In current carrying wire, net charge is zero because of equal number of electrons and protons present in the wire, but only electrons are moving.

34. (i) (d): A magnetic needle is a small bar magnet pivoted at its center of mass.
(ii) (d): A freely suspended magnet always rest in north- south direction because the north-pole of the magnet lies in the geographic north direction and the south pole of the magnet lies in the geographic south direction.
(iii) (d): Right hand thumb rule says that straight thumb of right hand points in the direction of electric current and direction of curled finger represents the direction of magnetic flied in a straight conductor. Flemming left hand rule gives direction of force experienced by current carrying conductor in magnetic field. The magnetic field
due to straight conductor is in the form of concentric magnetic lines.
(iv) (b) The strength of magnetic field of a current carrying solenoid is uniform inside it at all points.
(v) (a): Neutron does not experience force while moving perpendicular in uniform magnetic field as neutron has no charge.

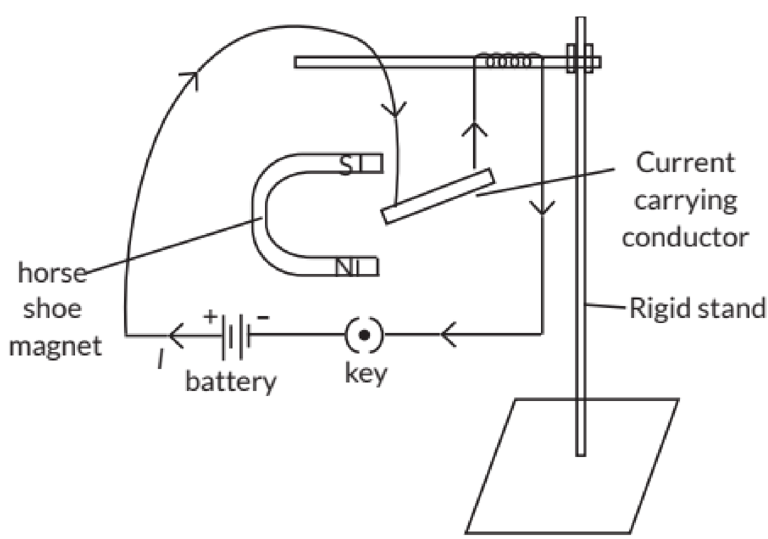
35. A charged particle moving in a magnetic field may experience a force in the direction perpendicular to direction of magnetic field and direction of motion of particle. This force deflects the charged particle from its path.

36. The magnitude of force experienced by a current carrying conductor placed in a uniform magnetic field is

(i) maximum when the conductor is placed perpendicular to the magnetic field. (ii) minimum when the conductor is placed parallel to the magnetic field.

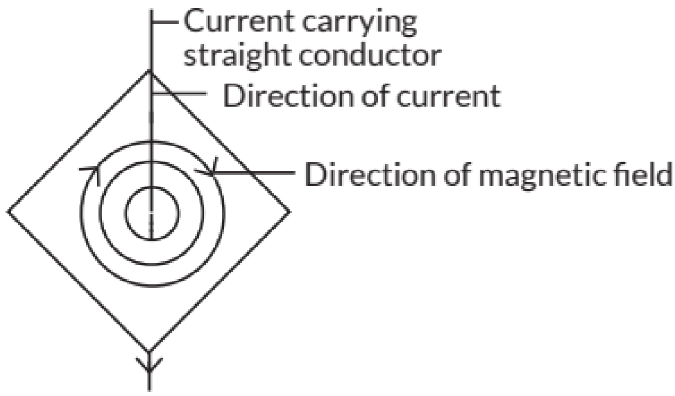
37. (i) Fleming's left-hand rule is used to determine the direction of magnetic force experienced by a current carrying straight conductor placed perpendicularly in a uniform magnetic field. Fleming's left-hand rule, states that when left hand's thumb, forefinger and centre finger are held mutually perpendicular to one another and adjusted in such a way that the forefinger points in the direction of magnetic field, and the centre finger points in the direction of the current, then the direction in which thumb points, gives the direction of force acting on the conductor.
(ii) As we know that, an alpha particle is positively charged. It is given that an alpha particle while passing through a magnetic field gets deflected (projected) towards north. Since an electron is negatively charged, it will deflect in opposite direction i.e., south.
(iii) GM crops increases efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil).

38. (i) (1) If the current through the conductor is increased, the magnitude of the force applied will increase and more displacement of the conductor will be observed.
(2) If the magnet is replaced by another horse-shoe magnet then more force will be applied on the conductor resulting an increase in the displacement of the conductor.
(3) If the direction of current is reversed, the direction of force applied will also reverse and the direction of displacement of the conductor will be reversed.
(ii) For determining the direction of force on a current carrying conductor, Fleming's left hand rule is used.



39. (a) On passing current, the rod gets displaced because of a magnetic force exerted on the rod when it is placed in the magnetic field.
(b) Fleming's left hand rule is used to determine the direction of magnetic force exerted on the conductor AB.
(c) The rod will be displaced towards left according to Fleming's left-hand rule.

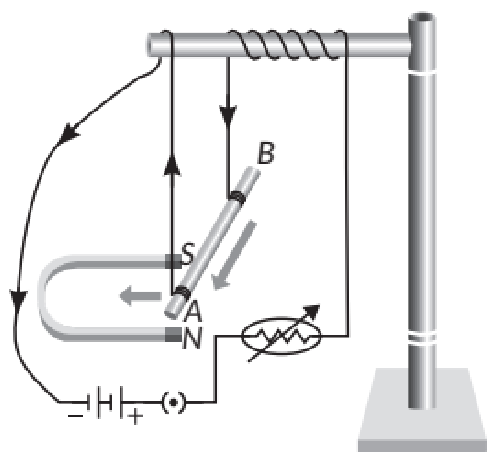
OR



40. (i) When a current carrying wire is placed in a magnetic field, it experiences a magnetic force that depends on
(a) current flowing in the conductor
(b) strength of magnetic field
(c) length of the conductor
(d) angle between the element of length and the magnetic field.
(ii) Force experienced by a current carrying conductor placed in a magnetic field is largest when the direction of current is perpendicular to the direction of magnetic field.
(iii) The rule used in finding the direction of motion of the conductor placed in a magnetic field is Fleming's left hand rule. Fleming's left hand rule is as follows: Stretch out the thumb, the forefinger, and the second (middle) finger of the left hand so that these are at right angles to each other. If the forefinger gives the direction of the magnetic field (N to S), the second (middle) finger gives the direction of current then the thumb gives the direction of the force acting on the conductor.
(iv) (a) Direction of force will be reversed when direction of magnetic field is reversed, i.e., now force on conductor will act from left to right.
(b) Direction of force will be reversed, if the direction of current is reversed, i.e., the force on the conductor will act from left to right.

41. (i) No, alpha particle will not experience any force if it is at rest, because only moving charge particle can experience force when placed in a magnetic field.
(ii) No, alpha particle will not experience any force if it moves in the magnetic field parallel to field lines because charge particle experiences force only when it moves at an angle other than 0° with magnetic field.
(iii) Alpha particle will experience a force in the direction perpendicular to the direction of magnetic field and direction of motion of alpha particle.

42. A small aluminium rod suspended horizontally from a stand using two connecting wires. Place a strong horseshoe magnet in such a way that the rod lies between the two poles with the magnetic field directed upwards. For this, put the north pole of the magnet vertically below and south pole vertically above the aluminium rod.



Connect the aluminium rod in series with a battery, a key and a rheostat. Pass a current through the aluminium rod from one end to other (B to A). The rod is displaced towards left. When the direction of current flowing through the rod is reversed, the displacement of rod will be towards right. Direction of force on a current carrying conductor is determined by Fleming's left hand rule.

43. The frequency of A.C. in India is 50 Hz and it changes direction twice in each cycle. Therefore, it changes direction 2 × 50 = 100 times in one second.

44. The current that we receive from domestic circuit is alternating current (A.C.) and the current that is use to run clock is direct current (D.C.). Direct current always flow in one direction whereas the alternating current reverses its direction periodically.

45. (i) It is because that over a long distance to a distant places, the loss of electric power is very less in case of A.C. as compared to D.C.

(ii) The current used in household supply is alternating in nature while the current given by battery is direct in nature.
(iii) Electric fuse protects circuits and appliances by stopping the flow of any unduly high electric current. It consists of a piece of wire made of a metal or an alloy of appropriate melting point, for example aluminium, copper, iron, lead etc. If a current larger than the specified value flows through the circuit, the temperature of the fuse wire increases. This melts the fuse wire and breaks the circuit.

46. Alternating current (A.C.): An electric current whose magnitude changes with time and direction reverses periodically is called alternating current. Direct current (D.C.): An electric current whose magnitude is either constant or variable but the direction of flow in a conductor remains the same is called direct current. A.C. can be transmitted to distant places without much loss of electric power than D.C. That is why A.C. is preferred over D.C. for transmission of current over a long distances.

47. (d): At the time of short circuit, the live and neutral wire come in direct contact, thus increasing the current in the circuit abruptly.

48. A burnt out fuse should be replaced with identical rating because it helps in protecting the circuit from overloading and short circuiting. If a fuse of higher rating is used then it may not melt and cut off the supply during overloading. Similarly a fuse of lower rating may melt frequently even for a normal flow of current. This results in decreasing the efficiency of the circuit.

49. (a) Tungsten is used because it has high melting point and resistivity
(b) Series arrangement is not used for domestic circuit as each resistor does not same potential from the source. We cannot use separate on/off switches with each appliance. Also in case if any one resistor fails then the circuit will break. So, it is not safe and convenient to connect household circuit in series combination of resistors.
(c) Copper and aluminium are good conductor of electricity and have low resistivity.

50. (a) Live wire is at 220 V and neutral wire is at zero volt since the electric current flows from higher potential to lower potential, we can get an electric shock by touching live wire but that is not the case with neutral wire.
(b) In parallel combination, each resistor gets same potential from the source. We can use separate on/off switches with each appliance. Also in case if any one resistor fails then the circuit will not break. So, it is safe and convenient to connect

household circuit in parallel combination of resistors.
(c) Fuse is an important safety device. It is used in series with any electrical appliance and protects it from short-

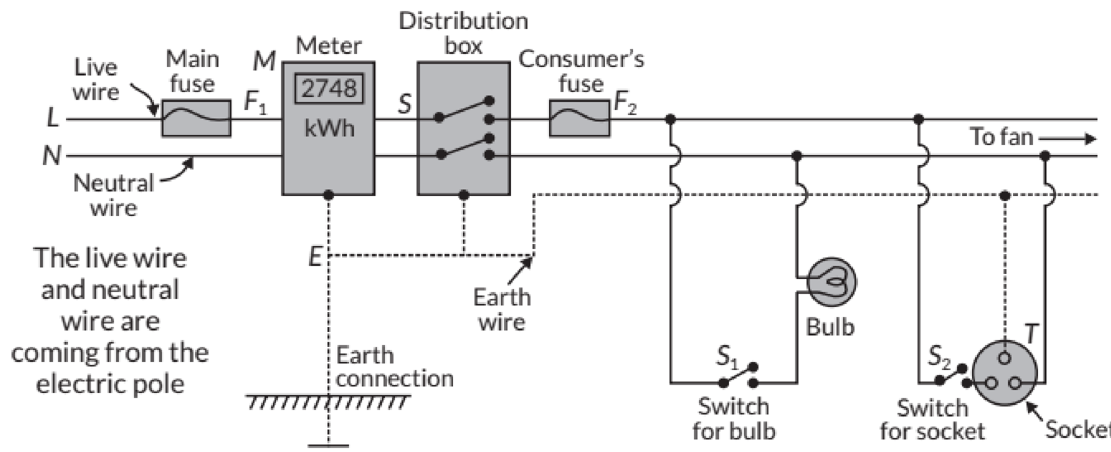
51. (a) When an unduly high electric current flows through the circuit, the fuse wire melts due to joule heating effect and breaks the circuit. Hence, it keeps an eye on the amount of current flowing and also stops the current if exceeds the maximum value. So, fuse acts like a watchman in an electric circuit.
(b) (i) A fuse of rating 5A is usually used for lights and fans.
(ii) A fuse of rating 15 A is usually used for appliance of 2 kW or more power.

52. (a) Fleming's left hand rule is as follows: Stretch out the thumb, the forefinger, and the second (middle) finger of the left hand so that these are at right angles to each other. If the forefinger gives the direction of the magnetic field (N to S), the second (middle) finger the direction of current then the thumb gives the direction of the force acting on the conductor.
(b) (i) The electric current which we receive in our homes are alternating current with a frequency of 50 Hz.
(ii) There are mainly two wires used in the power supply provided to us. The one usually with a red insulation is called the live wire (or positive wire) and the one with black insulation is called the neutral wire (or negative wire). The potential difference between these wires is 220 V.
(iii) Often, there are two separate circuits used in our homes, one of 15 A current rating for appliances with higher power rating and the other circuit of 5 A rating for appliances such as fans, bulbs, etc.
(c) A fuse is safety device use to limit the current in an electric circuit. When an unduly high electric current flows through the circuit, the fuse wire melts due to joule heating effect and breaks the circuit. Hence, it keeps an eye on the amount of current flowing and also stops the current if exceeds the maximum value. So, fuse acts like a watchman in an electric circuit.
(d) Many electric appliances of daily use like electric
press, heater, toaster, refrigerator, table fan etc., have a metallic body. If the insulation of any of these appliances melts and makes contact with the metallic casing, the person touching it is likely to receive a severe electric shock. This is due to the reason that the metallic casing will be at the same potential as the applied one. Obviously, the electric current will flow through the body of the person who touches the appliance. To avoid such serious accidents, the metal casing of the electric appliance is earthed. Since the earth does not offer any

resistance, the current flows to the earth through the earth wire instead of flowing through the body of the person.

53. (a) Fuse and the connection of earthing wire are the two safety measure commonly used in electric circuit and appliances.
(b) Provide fuses/MCBS of proper rating.

54.
(a)



Domestic electric wiring from electric pole to a room

(b) Overloading: The condition in which a high current flows through the circuit and at the same time too many appliances are switched on then the total current drawn through the circuit may exceed its rated value. Short circuiting: The condition when the live wire comes in direct contact with the neutral wire, due to which a high current flows in the circuit.

CBSE Sample Questions

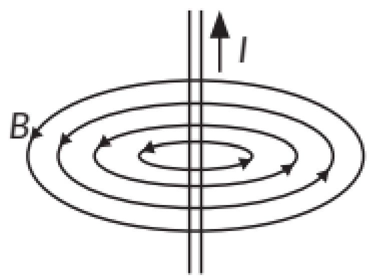
1. (a) When iron filings are placed in a magnetic field around a bar magnet, they behave like tiny magnets. The magnetic force experienced by these tiny magnets make them rotate and align themselves along the direction of field lines. (1)
(b) The physical property indicated by this arrangement is the magnetic field produced by the bar magnet. (1)
(c) (i) Magnetic field lines never intersect. (1)
(ii) Magnetic field lines are closed curves.

2. (d): The field consists of concentric circles centred around the wire. (1)

3. (a): A current-carrying solenoid behaves libe a bar magnet, when it is suspended freely, it interacts with the Earth's magnetic field and aligns itself along the north-south direction. (1)

4. (i) (c): A linear solenoid converts electrical energy into a mechanical pushing or pulling force. So, option (c) is correct. (1)
(ii) (b): The bar will be magnetised as long as there is current in the circuit. (1)
(iii) (a) Magnetic field inside a solenoid is same as that of a bar magnet. (1)
(iv) (d): From the given graph, we see magnetic field is varying linearly with current. (1)
(v) (a): For a current of 0.8 A, the magnetic field is 13 mT. (1)

5. The field consists of concentric circles centred on the wire. The direction of field lines is given by right hand thumb rule. (1)



6. (a) Relative closeness of magnetic field lines indicates the strength of magnetic field. Since field lines are crowded around the ends of the solenoid, hence these are the regions of strong magnetic field. (1)
(b) The direction of the magnetic field will be reversed on reversing the direction of electric current. (1)

7. (a) The deflection in the compass needle increases as magnetic field of the current carrying conductor is directly proportional to current flowing through it.
(b) The deflection in the needle decreases as the magnetic field is inversely proportional to the perpendicular distance from the wire. (3)

8. (i) The magnetic field lines produced is into the plane of the paper at R and out of it at S. (1)
(ii) Field at S > Field at R
Magnetic field strength for a straight current carrying conductor is inversely proportional to the distance from the wire. (2)
(iii) The current will be going from top to bottom in the wire shown and the direction of magnetic field at S will be into the plane and at R will be out of the

plane. (1)
(iv) Right hand thumb rule. If the thumb of right hand is aligned to the direction of the current and the direction in which the fingers are wrapped around the wire will give the direction of the magnetic field. (1)

9. (b):2 (From Fleming's left hand rule, the force acting on the wire would be, either in north direction or in south direction). (1)

10. (a) All spaces are connected in parallel.
(b) Letresistance of space 5 and 4 be Rohms respectively.
Resistance of space 1 = 2 Rohms
Resistance of space 2 = 30 ohms
Resistance of space 3 = 20 ohms
Current = 22 A; V= 220 V; Total resistance = V/I

$$\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}+\frac{1}{R_4}+\frac{1}{R_5}=\frac{1}{R_{eq}}$$

$$\frac{1}{2R}+\frac{1}{30}+\frac{1}{20}+\frac{1}{R}+\frac{1}{R}=\frac{1}{R_{eq}} \Rightarrow R = 150\,\Omega$$

(c) Current in space 3, $I_3 = \frac{220}{\text{[illegible]}} = 11\,A$

(d) A fuse wire should be placed between the main connection and rest of the house's electrical appliances to save them from accidental high electric current. (3)