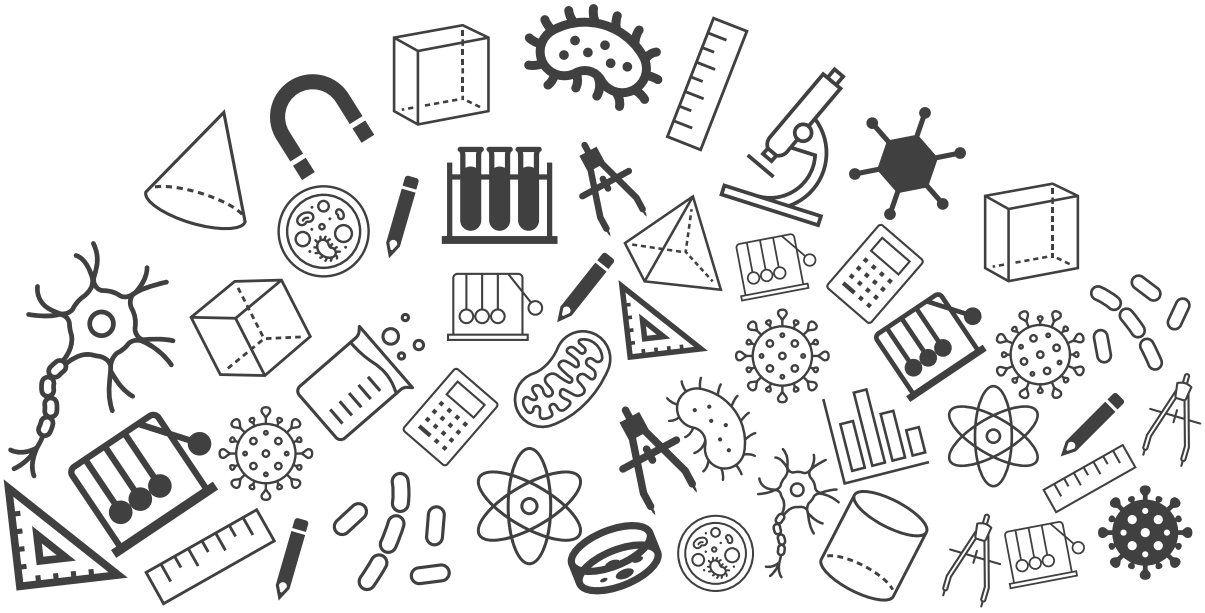
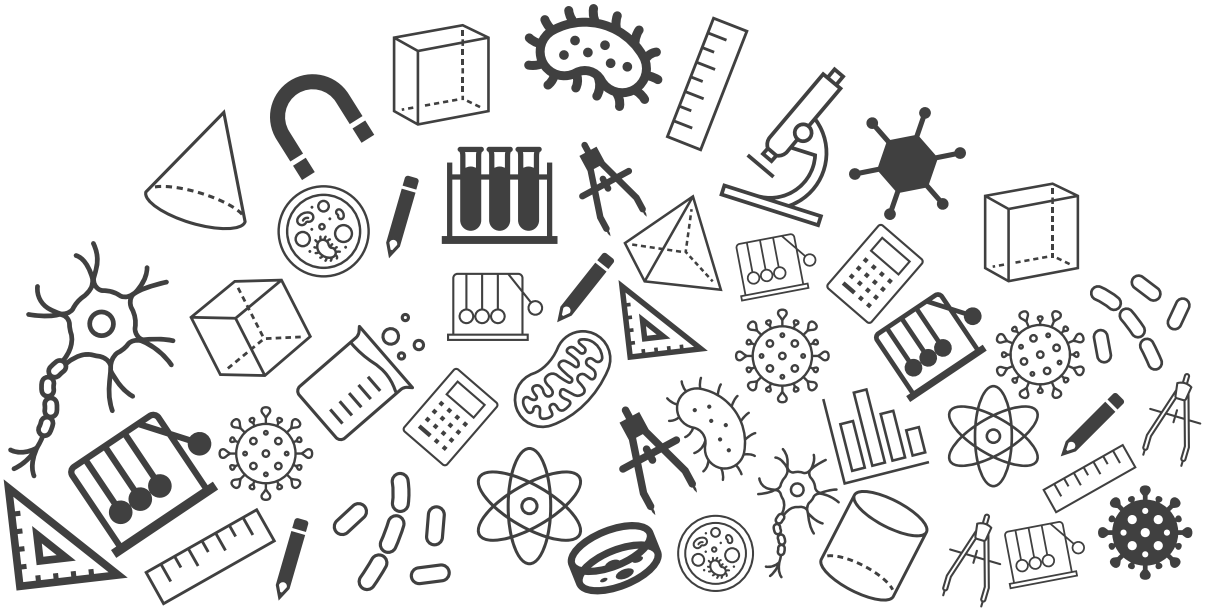
Grade 10: Science
Exam Important Questions



Magnetic Effects of Electric Current



1. 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.
   (b) The compass needle is displaced away from the conductor.

   [2 Marks]
   [CBSE - 2019]
   [Oersted's Experiment]

   Solution:
   (a) As the amount of magnetic field strength is directly proportional to the amount of current, so the deflection of compass needle increases. [1 Mark]
   (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. [1 Mark]

2. How is the magnetic field due to a straight current carrying wire affected if current in the wire is:
   (a) Decreased
   (b) Reversed

   [2 Marks]
   [Magnetic Field Due to a Straight Current Carrying Conductor]

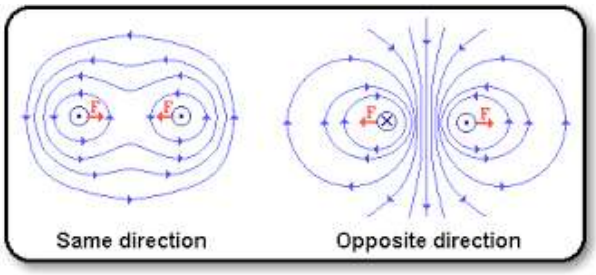
   Solution:
   (a) On decreasing current, the magnetic field becomes weaker.
   [1 Mark]

   (b) The direction of the magnetic field gets reversed on reversing the current. This can be easily confirmed with the thumb rule.
   [1 Mark]

Magnetic Effect of Electric Current : Magnetic field due to current

3. Draw magnetic field lines for parallel current carrying wires when:
   A. Direction of currents is same
   B. Direction of currents is opposite
   [4 Marks]
   [Magnetic Field Due to a Straight Current Carrying Conductor]

Solution:

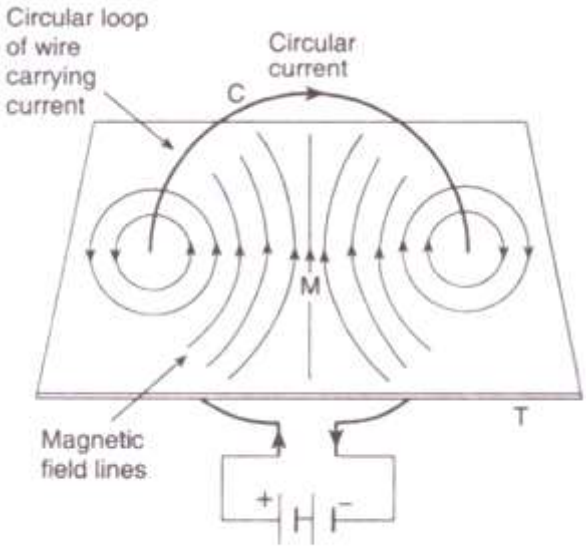


[2 Marks per diagram]

4. Draw the magnetic field lines through and around a single loop of wire carrying electric current.

   [2 Marks]
   [CBSE Board Term I, 2016]
   [Magnetic Field Due to a CircularCurrent Carrying Conductor]

Solution:



Magnetic lines of force due to a circular wire carrying current

[2 Marks]

5. Describe in brief an activity to study the magnetic field lines due to a current carrying circular coil.

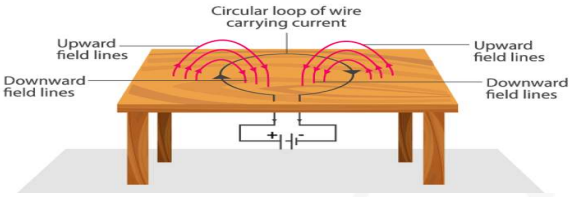
[5 Marks]
[CBSE Board Term I, 2017, 2016]
[Magnetic Field Due to a Circular Current Carrying Conductor]

Magnetic Effect of Electric Current : Magnetic field due to current

Solution:

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 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. [1 Mark]

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. From this pattern, the following important conclusion have been drawn.



[1 Mark]

- 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.
- The field lines are in the same direction in the space enclosed by the coil.
- 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.
- The direction of the magnetic field at the centre is perpendicular to the plane of the coil.
- 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. [2 Marks]

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. [1 Mark]

Magnetic Effect of Electric Current : Magnetic field due to current

6. Draw the magnetic field lines representing the uniform magnetic field.

[1 Mark]

[Solenoid: An Electromagnet]

Solution:
For a uniform magnetic field:

- Strength of magnetic field does not change.
- Direction of mangetic field is the same.

Hence, equidistant parallel straight lines represent uniform magnetic field as shown below:

[1 Mark]

7. What is the way to detect the polarity of a current carrying solenoid without using any other element?

[2 Marks]

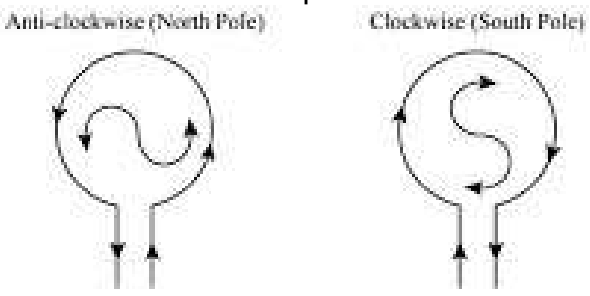
[Solenoid: An Electromagnet]

Solution:
The polarity can be detected using right hand thumb rule.

- If the current in the coil facing you is flowing in clockwise direction, then field is entering the coil. This means that this face is the south pole.
- Similarly, if the current is flowing in anti-clockwise direction, then the field is exiting from the coil. This means that this face is the north pole.

[1 Mark per point]

A shortcut to find the poles is shown below:



Magnetic Effect of Electric Current : Magnetic field due to current

8. 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.

[3 Marks]
[CBSE - 2020]
[Solenoid: An Electromagnet]

Solution:

(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. [1.5 Marks]

(ii) The current carrying solenoid behaves similar to that of a bar magnet and when freely suspended aligns itself in the north-south direction. [1.5 Marks]