Chap 12: Magnetic Effects of Electric Current

1. What is a magnetic field? What are its characteristics?

A magnetic field is the region around a magnet or a current-carrying conductor in which its magnetic force can be detected. It has both magnitude and direction.

Magnetic field lines are closed continuous curves.

Outside the magnet they run from the North pole to the South pole, and inside the magnet from South to North.

No two field lines intersect each other.

The closer the lines, the stronger the field. They are most crowded at the poles.

2. Why do two magnetic field lines never intersect each other?

A field line at any point shows the direction in which a compass needle points. If two lines crossed, the compass kept at that point would have to point two ways at once, which is not possible. So field lines never intersect.

3. Write about the discovery of magnetic field due to electric current.

Oersted accidentally discovered the magnetic effect of electric current.

When a compass needle was placed near a wire carrying current, the needle deflected.

When current was switched off, the needle returned to its original position.

When the direction of current was reversed, the needle deflected in the opposite direction.

It proved that a current-carrying wire produces a magnetic field around it.

Electricity and magnetism are linked to each other. (Electromagnetism)

4. What is the shape of the magnetic field lines around a straight current-carrying conductor?

The magnetic field around a straight current-carrying conductor forms concentric circles centred on the wire. The circles are closer together (stronger field) near the wire and spread out farther away.

5. State the right-hand thumb rule.

Hold the current-carrying wire in the right hand with the thumb pointing in the direction of current. The curling fingers show the direction of the magnetic field.

6. What is a solenoid?

A solenoid is a long coil of insulated wire wound in the shape of a cylinder.

Inside the solenoid, a strong and uniform magnetic field is produced when current is passed.

Solenoid behaves like a bar magnet. The magnetic field pattern, inside and outside a solenoid is similar to that of a bar magnet.

One end of the solenoid behaves as the North pole, and the other end behaves like the South pole. Poles are determined using the right-hand thumb rule and the direction of current.

7. What are the factors affecting the magnetic field at the centre of a current carrying circular loop?

The magnetic field at the centre of a circular loop

- increases if the current through the loop is increased.
- decreases if the radius of the loop is increased.
- increases if the number of turns in the coil is increased.

8. Why does the magnetic field at the centre of a current-carrying circular coil increase when the number of turns in the coil is increased?

The current in every turn of the coil flows in the same direction and has the same magnitude.

So the magnetic field produced at the centre by each turn points in the same direction, and the fields due to all the turns simply add up.

For n turns, the field at the centre becomes n times that of a single turn.

9. How is an electromagnet made?

Electromagnets are made by winding a large number of turns of insulated copper wire closely around a soft iron core, and passing current through the coil.

The strength of the magnetic field is proportional to the current and the number of turns.

10. Why is a soft iron core used in making an electromagnet?

Soft iron is magnetised strongly and very quickly when current flows, which makes the electromagnet powerful.

Soft iron loses almost all its magnetism the moment the current is switched off. This is essential for a crane releasing its load, an electric bell or a relay.

Steel would retain its magnetism and cannot be switched off, so it is used for making permanent magnets.

11. State Fleming's left-hand rule.

Stretch the thumb, forefinger and middle finger of the left hand, so that they are mutually perpendicular.

• Middle finger points in the direction of the current.
• Forefinger points in the direction of the magnetic field.
• Thumb points in the direction of the force acting on the conductor.

12. Why are electrical appliances with a metallic body connected to the mains through a three-pin plug, whereas an electric bulb is connected with a two-pin plug?

An appliance with a metallic body (electric iron, refrigerator, toaster) can become live if its insulation fails. The third thicker pin connects the body to the earth wire, so any leakage current is carried safely to the ground and the user is protected. Hence a three-pin plug.

An electric bulb has no exposed metal body that a user can touch, so a two-pin plug is sufficient.

13. What is the function of the earth wire?

The earth wire is connected to a metal plate buried deep in the earth and provides a low-resistance path for current to flow to the ground.