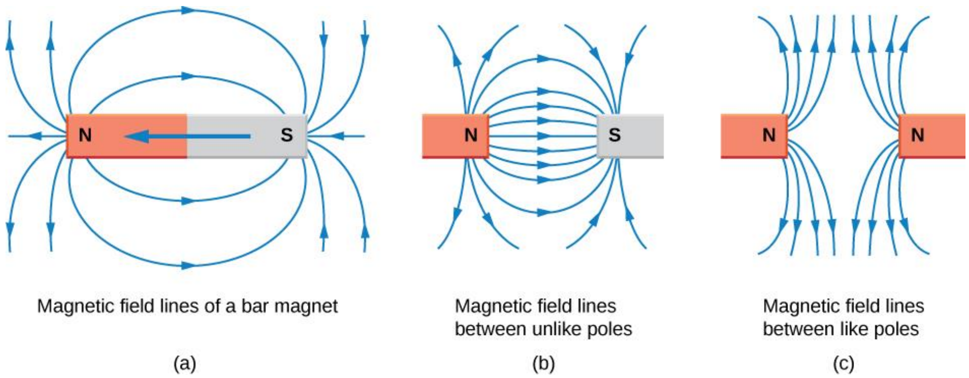
What is a magnetic field?

A magnetic field is a vector field that describes the magnetic influence on moving electric charges, electric currents, and magnetic materials. A moving charge in a magnetic field experiences a force perpendicular to its own velocity and to the magnetic field.



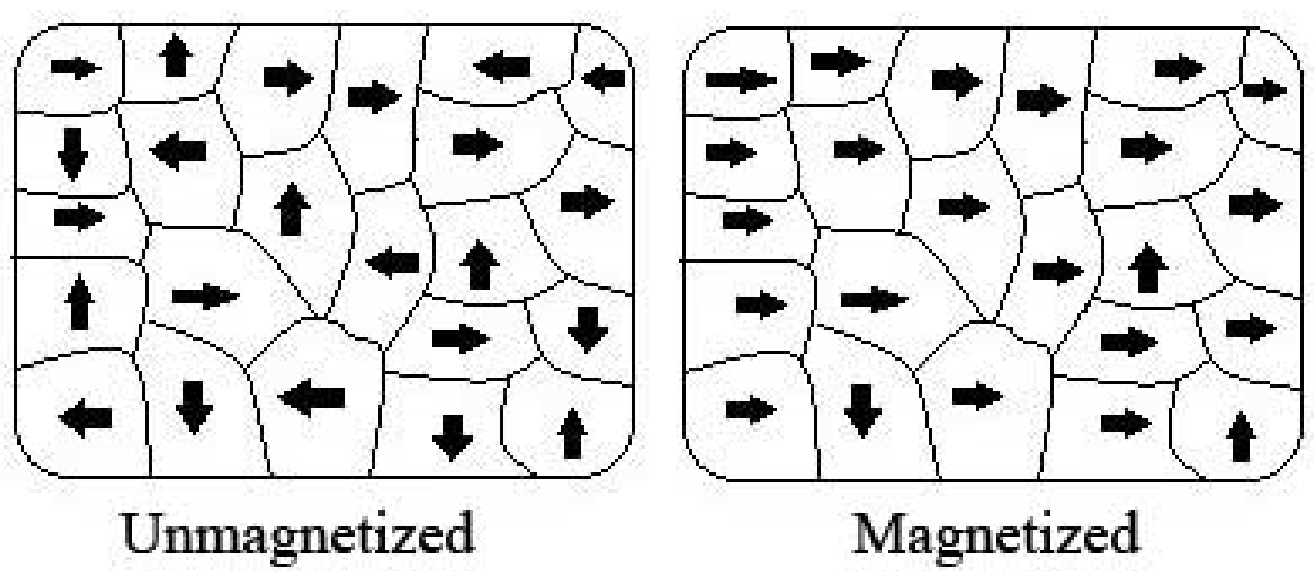
Things to note:

1. The magnetic field lines never intersect.
2. The closer they are, the stronger the magnetic field.
3. The region in between the like pole repulsion is known as the null region.

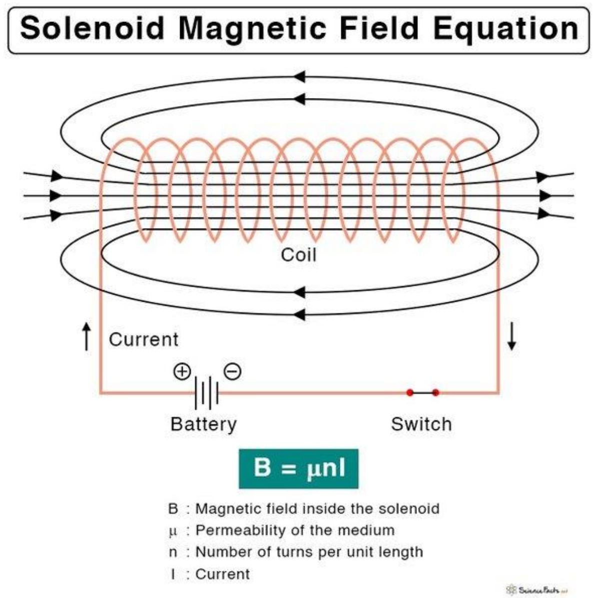
The flow of electric current occurs because we have a high potential of electrons gathered at the positive terminal and a low potential of electrons at the negative terminal.

Magnetic Domain

Magnetic domain is similar to a cell in the magnet, it is a region where the magnetization is in a uniform direction.



Electro-magnetization



The process above is known as magnetization:

Induce temporary magnetism: When a ferromagnetic material, like iron or steel, is placed inside a solenoid's active region (the area where the magnetic field is strong), the material becomes temporarily magnetized. This happens because the magnetic field aligns the tiny magnetic domains within the material, making them all point in the same direction.

The current flowing through a solenoid possesses a magnetic field, therefore, when a ferromagnetic material is placed inside solenoid, it becomes a temporary magnet.

This can also be known as Δø, or change in magnetic flux, magnetic flux is defined as the number of field lines passing through a given surface.

Number of turns per unit length can also be represented as N/L, which is total turns/ length of solenoid.

Permeability:

In magnetism, permeability refers to the ease with which a material allows magnetic fields to pass through it. It essentially describes how well a material responds to an applied magnetic field.

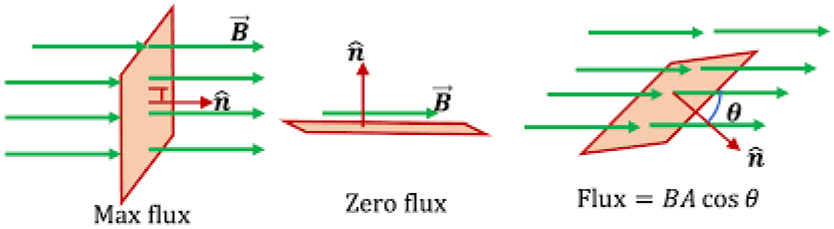
What happens when an iron core passes through free space in a magnetic interaction?

The iron becomes a permanent magnet with the poles aligned as shown: Its south pole is adjacent to the north pole of the original magnet, and its north pole is adjacent to the south pole of the original magnet.

Permeability is represented with the value of 4π * 10^-7, when no object is passing through the solenoid.

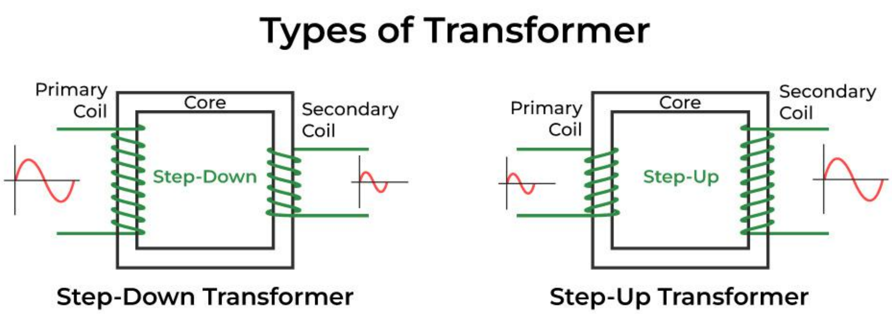
The permeability of pure iron is 6.3*10^-3, when the permeability increases the magnetic field increases.

If there is an iron core, they will tell you the permeability of the solid.



Transformers

Transformers are used worldwide to help with the distribution of power.



A transformer works by using magnetic induction. When an AC voltage is applied to one coil of wire, it creates a magnetic field that induces a magnetic field on the iron core which further induces a voltage in a second coil of wire. The voltage in the second coil is proportional to the number of turns in the coil.

Inductions is known as the change of magnetic flux which will change the current in a coil, $\phi \propto I$, when the number of turns is increased, it will be a step-up transformation.

If the examiner asks you to calculate the number of turns, remember that the voltage and turns are a ratio of proportionality.

1. Voltage Ratio:

- **Vs/Vp = Ns/Np**
- Vs: voltage across the secondary coil
- Vp: voltage across the primary coil
- Ns: number of turns in the secondary coil
- Np: number of turns in the primary coil

2. Current Ratio:

- **Is/Ip = Ns/Np**
- Is: current in the secondary coil
- Ip: current in the primary coil
- Ns: number of turns in the secondary coil
- Np: number of turns in the primary coil

3. Power (Ideal Transformer):

- **Ps = Pp**
- Ps: power in the secondary coil
- Pp: power in the primary coil

4. **Turn Ratio**

- K=N(p)/N(s)
- Ns: number of turns in the secondary coil
- Np: number of turns in the primary coil
- K: Turns constant

5. Transformer Efficiency:

- Efficiency = (Output Power)/(Input Power) * 100%

6. Voltage and Turn constant:

- **Vs=Vp*K**
- Vs: voltage across the secondary coil
- Vp: voltage across the primary coil
- K: Turns constant