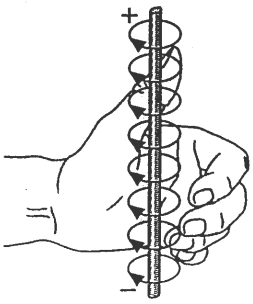
Electric currents and magnetic fields

Magnetic fields of electric currents

An electric current produces a magnetic field. The field lines are in the form of circles around the wire with the wire at their center.
The direction of the field lines can be remembered with the following “left-hand rule” (see picture):

If you grasp the wire with your left hand so that your thumb points in the direction of the electron motion (opposite to the direction of the current); then your fingers will encircle the wire in the direction of the magnetic field.



Tasks

Draw the magnetic fields produced by the currents as arrows. For a current perpendicular to the paper plane we use the following symbols:

⊗ electrons moving away from you (into the paper)

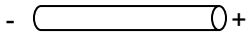
⊙ electrons moving towards you (out of the paper)

Magnetic field of a current in a straight wire

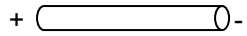
a) top view

b) top view

c) front view

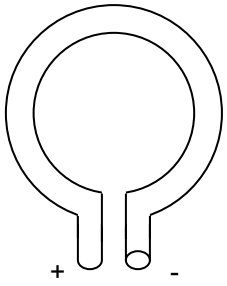


d) front view

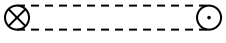


Magnetic field of a current in a loop of wire

a) front view



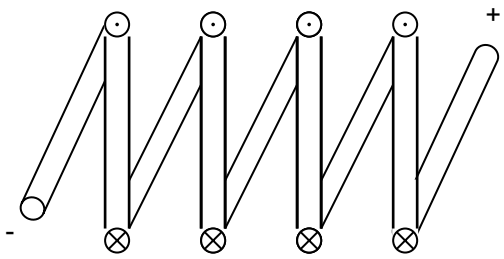
b) top view



Magnetic field of a current in a solenoid

A long coil of wire consisting of many loops (or turns) of wire is called a solenoid.

a) Draw the representation of the magnetic field as arrows.
b) The magnetic field of a solenoid resembles the field of a bar magnet.
If placed at the point x, how would a little magnet align in the magnetic field of the solenoid? Draw it in the picture.

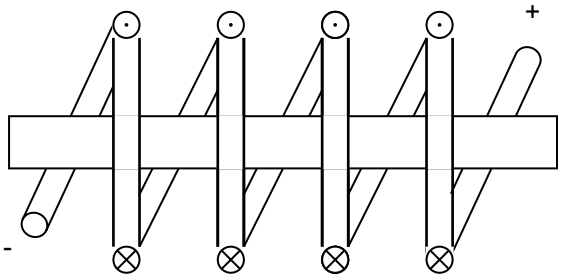


x

Electromagnets

A solenoid with in ircon-core is an electromagnet.

a) How do the magnetic domains in the iron-core align? Draw little arrows in the iron-core showing the direction of the north poles of the magnetic domains.
b) If an iron-core is placed inside the solenoid, does the magnetic field increase, decrease, or does it not change at all? Give reasons for your answer.
c) Name three differences between permanent magnets and electromagnets.



Applications of electromagnets