

Homework 10.

Magnetism

We started discussing magnetism. Even long time ago people knew the property of some natural magnetic materials. In our everyday life natural and artificial magnets have numerous applications. What are the basic properties of a magnet we can learn from simplest experiments with two magnetic bars?

- a) We can check that the ends of a magnetic bar (we will call them *poles*) have different properties: when you try to get two poles belonging to different bars together you will feel that some poles are attract each other while another pole combination produce repelling force. We can mark them by the characters “N”(north) and “S”(south) in such a way that the attracting poles will be marked by different characters while repelling poles will bear same mark.



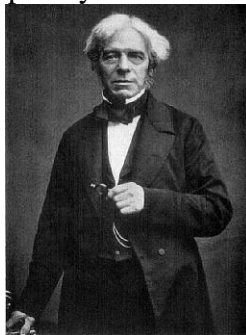
- b) Magnetic bars can attract some materials (for example, iron) which are not magnets.
- c) If you cut the bar in the middle you will not obtain two separate poles. Instead, you will have two magnets with both north and south poles.

The scientist who established experimentally that electrical and magnetic phenomena are closely related was Danish physicist and chemist Hans Christian Oersted.



Hans Christian Oersted (1777-1851)

He noticed that a compass needle is deflected near a current carrying wire. The experimental work of Oersted was developed by two famous physicists: Michael Faraday and Andre-Mari Ampere.



Michael Faraday(1791-1867).



Andre-Mari Ampere (1775-1836).

It was established that the “**magnetic force**” is **produced by moving charges**. We can introduce magnetic field similarly to how we introduced electric field: as long as in a certain point of space there is a force exerted on a moving charge and there is no force applied to an identical charge at rest we can say that there is magnetic field in this point.

Important note:

*When I mention moving charge I mean “moving with respect to the source of the magnetic field”. If we try to choose the inertial reference of frame which moves together with the charge, the velocity of the charge and the magnetic force will become zero. But in this reference frame the source of the magnetic field has nonzero velocity. As we will learn later, in this case the electric field will appear and exert the force on our charge. This compensates for the lack of the magnetic force, so the total force applied to our charge does not depend on our choice of inertial frame of reference. Later we will learn that both electric and magnetic fields are two “sides” of one electromagnetic field which has electrical and magnetic components. The magnitudes of these components generally depend on your choice of the inertial reference frame, but all the **forces stay the same**. So again, the real physical processes involving electromagnetic interaction do not depend on our choice of inertial reference frame.*

Questions:

1. Suggest a way to make magnetic field “visible”
2. If you bring a magnet close to the screen of old electron beam monitor or TV you will see that the picture on the screen is distorted. Try to explain the effect.
3. You have two rods. One is a magnet; the other made of iron and is not magnetized. You do not know which rod is a magnet. Can you suggest “one touch” experiment which will allow you to determine the magnet rod?