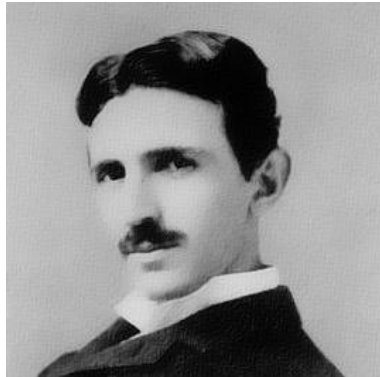Homework 20

Magnetic force (Lorentz force)

As we remember the magnetic field applies the force to moving charges. As a charge particle which is moving perpendicularly to the magnetic field vector Bat a velocity V,the magnitude of the magnetic force applied to the particle is

$$F_m = qVB \quad (1)$$

where q is the charge of the particle, V is the particle's velocity, B is the parameter which is characterized the "strength" of the magnetic field. It is called magnetic induction. Magnetic induction is measured in teslas (international system of units). If the force applied to a charged particle with 1C of charge which is moving in a magnetic field at a velocity of 1m/s is 1N, then the magnetic induction is 1T (tesla). This unit is named after a famous Serbian inventor and physicist Nicola Tesla.
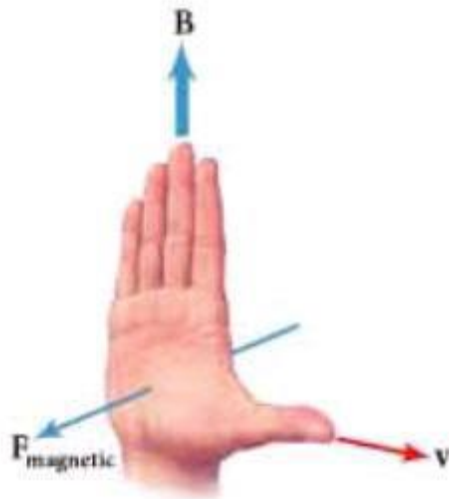

Tesla Nikola Tesla (1856-1943)

Magnetic force, described by formula 1, is also called Lorentz force. This name is given after a Dutch physicist Hendrik Antoon Lorentz..

Hendrik Antoon Lorentz (1853-1928)

Magnetic force is directed ***perpendicularly*** to both the magnetic field and the velocity of the particle. The direction of the force can be found using "right hand rule".

Please remember that the picture above is for a positive charge. For a negative charge the direction of the force will be opposite.

Problems:

1. An electron enters the area with magnetic field; the velocity of the electron is perpendicular to the magnetic field lines. Do the speed and the velocity of the electron change as it enters into the magnetic field?

2. The wire made from nonmagnetic material can be attracted to or repelled from the magnet as there is the electrical current in the wire. Could you explain the effect?

3. Give an example of a physical situation where the force exerted on the object is perpendicular to the object's displacement.