Force on a Moving Charge in Uniform Magnetic and Electric Field

The Lorentz force (or electromagnetic force) is indeed the outcome of electromagnetic fields combining electric and magnetic forces on a point charge. In an electric field E and a magnetic field B, a charge q particle travelling with a velocity v experiences a force of. The electromagnetic force on a charge q is described as a combination of a force in the direction of the electric field E, proportional to the magnitude of field and the quantity of charge, as well as a force at right angles to the magnetic field B and the charge's velocity v, proportional to the magnitude of the field, the charge, and the velocity. The magnetic force on the current-carrying wire (often termed as the Laplace force), the electromotive force in a sterile loop travelling through a magnetic field, and also the force on a moving charged particle are all described by variations on this basic formula.

E and B are defined by the Lorentz force law.

The electromagnetic force F on a test charge at a given position and time is a function of its charge q and velocity v, that can be quantified in the functional form by exactly two vectors E and B:

F = q (E + v * B)

Even for particles close to the speed of light (that is, the magnitude of v, |v| c), this holds true. As a result, the two vector fields E and B are defined in space and time, and they are referred to as the "electric field" and "magnetic field," respectively. Irrespective of whether a charge is accessible to experience the force, the fields are specified everywhere in space and time in terms of what force a test charge might receive.

Since a real particle (as distinguished to a hypothetical "test charge" with infinitesimally minuscule mass and charge) would create its own finite E and B fields, altering the electromagnetic force it experiences, the Lorentz force is just a theoretical definition.

What does a magnetic field causes in terms of force?

Magnetic fields can only exert a force on a moving electric charge, as a moving charge generates a magnetic field. With a rise in charge and magnetic force strength, this force increases. Furthermore, when charges have higher velocities, the force is stronger.

However, the magnetic force is always transverse to the velocity. As a result, this force could never produce stuff on the charge or transfer kinetic energy to it. The magnetic field is defined as

Fm= q v × B

Q = charge

V = velocity

B = Magnetic field

It's worth noting that the cross product implies that the force is always perpendicular to the velocity and magnetic field. As a result, it always acts outside of the plane and contributes nothing to the charge's work. It can only modify the velocity's direction; it can't change the magnitude. Using Fleming's Right-hand Rule, you may quickly calculate the force's direction.

Parallel to the electric fields axis If is 0, the particle has no magnetic force and will continue to flow along the field lines undeflected. When v and B are at right angles, charged particle accelerators like cyclotrons exploit the fact that particles move in a circular orbit. A perfectly timed electric field provides the particles greater kinetic energy with each round, causing them to move in increasingly bigger circles. When the particles once attained the necessary energy, they are collected and used in a variety of applications, ranging from subatomic particle research to cancer treatment.

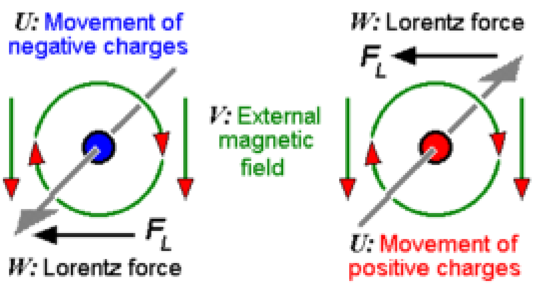
The symbol of the charge carriers in a conductor is disclosed by the magnetic force on a moving charge. Positive charge carriers going from right to leave, negative charge carriers moving from left side to right side, or some mix of the two can cause a current to flow from right to left in a conductor.

What is the electric field's force?

The electric field's force on a charge is integrated into its definition. It always functions in either parallel or anti-parallel to an electric field, regardless of the charge's velocity. This indicates that it can work and provide energy to the charge.

Fe = q E

The magnetic force along both types of excitons is in the same direction when a conductor is put in a B field perpendicular to the current. This force causes a tiny potential difference between the conductor's sides. When an electric field is coordinated with the direction of the magnetic force, this phenomenon is known as the Hall effect. The Hall effect demonstrates that electrons dominate copper's conductance. Conduction in zinc, on the other hand, is dominated by the movement of positive charge transporters. When electrons in zinc are stimulated from the valence band, they leave holes, which act as positive charge carriers. The majority of the electrical conduction in zinc is due to the mobility of these holes.



Force on a Moving Charge in Magnetic and Electric Fields

Lorentz force is the force that is exerted on the charged particles moving in a magnetic field and an electric field. The modern formula of Lorentz force was derived by the Dutch physicist Hendrik Lorentz in 1895.

Suppose a positively charged particle is moving in an electric and magnetic field. The sum of the magnitude of the electric force and magnetic force equals the total force acting on the particle. This total force is called the Lorentz force. It can be given by the following expression:

$$\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$$

In this formula, the first term indicates the electric field while the second indicates the magnetic field. It can also be expressed by the following formula.

$$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$$

This equation gives the magnitude of the force acting on a moving charge in a magnetic and an electric field. This force is applied in Cyclotrons and other particle generators. The concept of this force is also seen in Cathode Ray Tube television to deviate the charged electrons in a linear path to land them on particular spots on the screen.

Difference Between Force on a Moving Charge in a Magnetic Field and an Electric field

S. No.	**Magnetic Force**	**Electric Force**
1	The magnetic force acts only when the charged particles are in the moving position in a magnetic field as it depends on the velocity of the particles.	The electric force acts on a charged particle in both rest or motion in an electric field as it does not depend on the velocity.

2	The force on a moving charge in a magnetic field is low compared to the electric field.	The force on a moving charge in an electric field is high compared to the magnetic field.
3	This force never acts centrally.	Electric force may or may not be central.
4	Electric force does not work on the charged particles in a magnetic field as it functions normal to the direction of motion.	Electric force works on the charged particles in an electric field.
5	The magnitude of the magnetic force is measured with the following formula. $F=qvB$	The magnitude of the electric force is measured with the following formula. $F=qE$

Summary

Electric fields are generated from electric charges and varying magnetic fields, while the magnetic fields generated from permanent magnets and the electric charge which is in motion.

Force on a moving charge in magnetic and electric fields is the sum of the magnetic force and an electric force that acts on the charge in the respective fields, known as Lorentz force.