MAGNETIC FORCES

Force On A Moving Charge

In electric field, force on a charged

particle is $F=QE$

Force is in the same direction as the electric field intensity(positive charge)

A charged particle in motion in a magnetic field force magnitude is proportional to the product of magnitudes of the charge Q, its velocity V and the flux density B and to the sineof the angle between the vectors V and B.

The direction of force is perpendicular to both V and B and is given by a unit vector in thedirection of V x B.

The force may therefore be

expressed as $F=QV \times B$

Force on a moving particle due to combined electric and magnetic fields is obtained bysuperposition.

$$F=Q\,(E + V \times B)$$

This equation is known as Lorentz force equation.

Force On A Differential Current Element:

The force on a charged particle moving through a steady magnetic field may be written asthe differential; force exerted on a differential element of charge.

Convection current density in terms of the velocity of the volume charge

density Differential element of charge may also be expressed in terms of

volume charge density.

The magnitude of the force is given by the familiar equation

$$F=BILsin\theta$$

Force on a current-carrying conductor

Charges confined to wires can also experience a force in a magnetic field. A current (I) in a magnetic field (**B**) experiences a force (**F**) given by the equation **F** = I **l** × **B** or F = IlB sin θ, where **l** is the length of the wire, represented by a vector pointing in the direction of the current. The direction of the force may be found by a right-hand rule similar. In this case, point your thumb in the direction of the current—the direction of motion of positive charges. The current will experience no force if it is parallel to the magnetic field.

Force and Torque on a current loop

A loop of current in a magnetic field can experience a torque if it is free to turn. Figure 4.1 (a) depicts a square loop of wire in a magnetic field directed to the right. Imagine in Figure 4.1 (b) thatthe axis of the wire is turned to an angle (θ) with the magnetic field and that the view is lookingdown on the top of the loop. The *x* in a circle depicts the current traveling into the page away from the viewer, and the dot in a circle depicts the current out of the page toward the viewer.

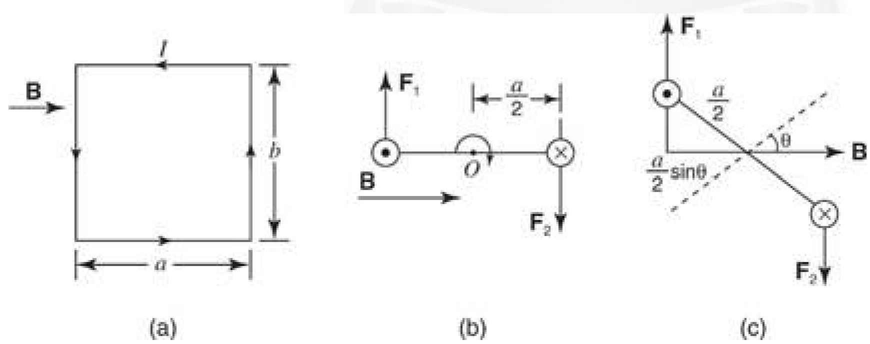

Figure 4.1
(a) Square current loop in a magnetic field **B**. (b) View from the top of the current loop. (c) If the loop is tilted with respect to **B**, a torque results.

(www.brainkart.com/subject/Electromagnetic-Theory_206/)