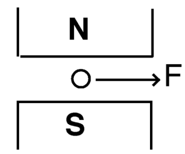
PhyzGuide: Magnetic Force

MAGNETIC FORCE ON A CURRENT-CARRYING WIRE

When a current carrying wire is placed in a magnetic field, it is acted upon by a force due to magnetism. Remember that a current-carrying wire is surrounded by its own magnetic field—a field that could interact with the magnetic field of a permanent magnet or that of another current-carrying wire.

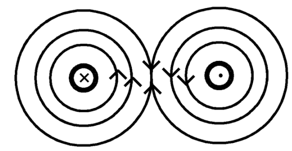


Vector: $\mathbf{F} = \mathbf{I}L\times\mathbf{B}$

Scalar: $F = ILB\sin\varphi$

when $\mathbf{I} \perp \mathbf{B}$: $F = ILB$

F is the force due to magnetism
I is the current through wire that force F is acting upon
L is the length of wire immersed in the magnetic field
B is the external magnetic field that the wire is in
ϕ is the angle between direction of current and direction of magnetic field



Will they attract or repel

MAGNETIC FORCE ON A MOVING CHARGED PARTICLE

This equation can be rewritten to determine the magnetic force on a single moving charge:

Current in terms of charge and time is

$I = q/t$

And since the speed of the particle is

$v = d/t$ (d = a distance equal to length L)

We can write length

$L = vt$

So with the substitutions, $F = ILB$ becomes $F = (q/t)(vt)B$ or

Vector: $\mathbf{F} = q\mathbf{v}\times\mathbf{B}$

Scalar: $F = qvB sin\varphi$

when $\mathbf{v} \perp \mathbf{B}$: $F = qvB$

F is the magnetic force acting on the charged particle
q is the charge on the charged particle
v is the velocity of the charged particle
B is the external magnetic field through which the charged particle passes
ϕ is the angle between velocity vector and magnetic field direction