Lesson 7.2- Magnetic Force on a Current

Unit 7: Magnetism

https://youtu.be/hFAOXdXZ5TM?si=CChAqbuJvGLqYtEc

Magnetic Force on a Current in a Wire:

A current carrying wire has a **magnetic** field. When this current carrying wire is placed in another **external magnetic field**, the wire will experience a **force** due to the interactions of the two magnetic fields.

$$\vec{F} = \vec{B}_\perp I \ell$$

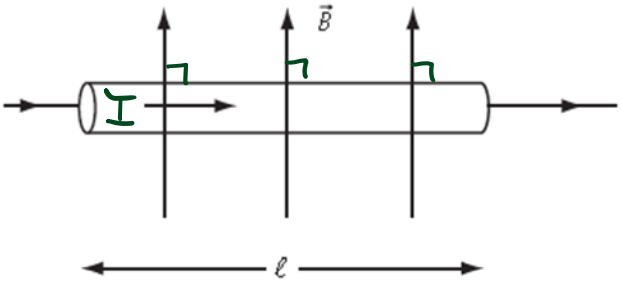
$\vec{F}$ = Force on the wire (N)

$\vec{B}$ = Magnetic field intensity (T) ⊥ to the wire

I = Current (A)

ℓ = length of the wire inside the external magnetic field (m)

* If $\vec{B}$ and I are parallel, no force!



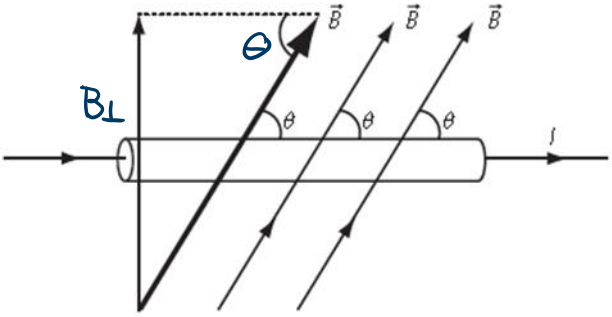
* Force is perpendicular to both $\vec{B}$ and I.

What happens when the B field and current flow are not perpendicular?

$$\sin\theta = \frac{\vec{B}_\perp}{\vec{B}}$$

$$\vec{B}_\perp = \vec{B}\sin\theta$$

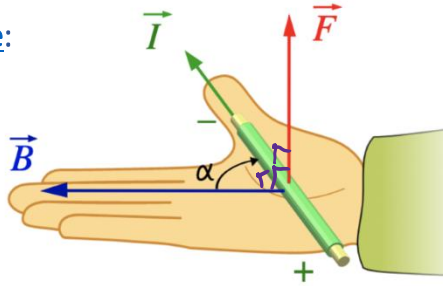
$$\therefore \vec{F} = \vec{B} I \ell \sin\theta$$



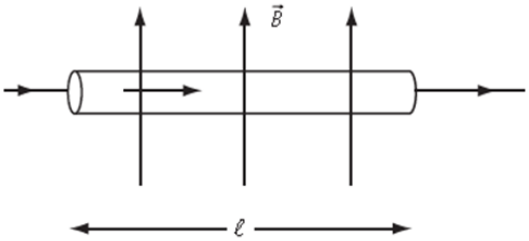
Second Right-Hand Rule to determine the direction of Force:

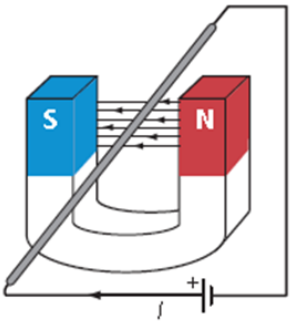
* Thumb follows conventional current
* Fingers extend in direction of magnetic field
* Palm "pushes" the direction of force

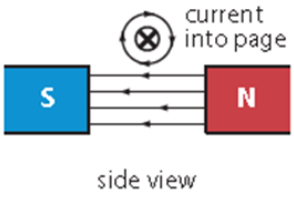
} all ⊥ to each other.



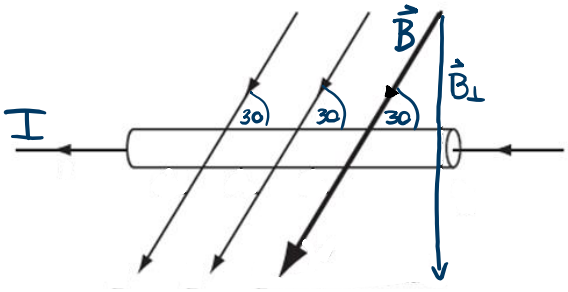
Example 1: Use the right-hand rule to label the direction of force on the wires in the magnetic fields.







Example 2: A wire 20 cm long carrying 3.0 A is in a magnetic field of 0.20 T at 30°. Find the magnitude and direction of force on the wire.

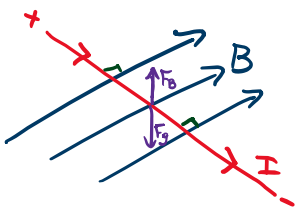


$\vec{F} = \vec{B} I \ell \sin\theta$

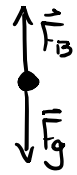
$= (0.20\,T)(3.0\,A)(0.2\,m)\sin 30$

$= 0.060\,N$ ⊙ "out of the page."

Example 3: A 6.0 g wire is placed in a 4.3 x 10^{-2}T field that is 23 cm long. What current is needed to make the wire hover in the field?



FBD:



$\sum \vec{F}_y = 0$

$F_B = F_g$

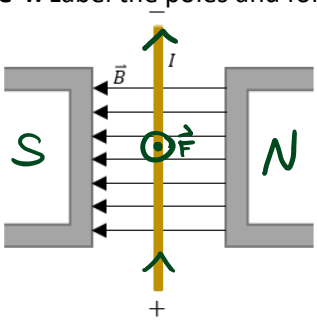
$BI\ell = mg$

$I = \frac{mg}{B\ell}$

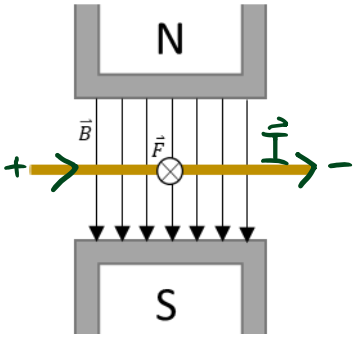
$\frac{0.0060\,kg(9.8\,m/s^2)}{(4.3\times10^{-2}\,T)(0.23\,m)}$

$= 6.0\,A$

Example 4: Label the poles and force:



Example 5: Label the direction of current:



Assignment: BC Physics 12 Pg. 232-233 #'s 2-5, 7-10