Electromagnetic Force

IB PHYSICS | FORCE FIELDS

Remember the Right Hand Rule?

Thumb points in direction of the current

Fingers point in direction of the **field lines**







Right Hand Rule #2



Thumb points in direction of the current

Fingers point in direction of the field lines

Palm points in direction of the force

How do you represent a direction that's perpendicular to the paper?

Into the paper

Out of the paper

Right Hand Rule #2

A current-carrying wire is placed in a magnetic field and the magnetic field exerts a force on the wire



Designing a Motor

When electric current is passed through a magnetic field, you get _____



Motors vs Generators

Electric Motors convert



Electric Generators convert



Examples





Speakers







Definition of the Ampere



**One ampere is defined as the current that would cause a force of 2×10^{-7} N per meter between two long parallel conductors separated by 1 m in a vacuum

Fields



Electric Field

$$E = \frac{F}{q} = \frac{[N]}{[C]}$$

Magnetic Flux

The magnetic field strength is sometimes referred to as magnetic flux and depends on how perpendicular the current is in relation to the field direction



Magnetic field Strength



used in the calculation

Fields

F $F = BIL sin\theta$ В IL sinθ

F	Magnetic force <i>Newtons [N]</i>	I,	Length of conductor in
В	Magnetic field strength <i>Tesla [T]</i>		Angle between
Ι	Current <i>Amperes [A]</i>	θ	magnetic field and current

IB Physics Data Booklet

Sub-topic 5.1 – Electric fields	Sub-topic 5.2 – Heating effect of electric currents	
$I = \frac{\Delta q}{\Delta t}$	Kirchhoff's circuit laws:	
Δt , $q_1 q_2$	$\Sigma V = 0$ (loop)	
$F = k \frac{1}{r^2}$	$\Sigma I = 0$ (junction)	
$k = \frac{1}{4\pi\varepsilon_0}$	$R = \frac{V}{I}$	
$V = \frac{W}{q}$	$P = VI = I^2 R = \frac{V^2}{R}$	
$F = \frac{F}{F}$	$R_{\rm total} = R_1 + R_2 + \cdots$	
$L = \frac{1}{q}$	$\frac{1}{R} = \frac{1}{R} + \frac{1}{R} + \cdots$	
I = nAvq	$R_{\text{total}} = R_1 = R_2$	
	$\rho = \frac{RA}{L}$	
Sub-topic 5.3 – Electric cells	Sub-topic 5.4 – Magnetic effects of electric currents	
$\varepsilon = I(R+r)$	$F = qvB\sin\theta$	
	$F = BIL \sin \theta$	



A current of 3.8 A in a long wire experiences a force of 5.7×10^{-3} N when it flows through a magnetic field of strength 25 mT. If the length of wire in the field is 10 cm, what is the angle between the field and current?

$F = BIL sin\theta$

Force on a Charged Particle

When there is a magnetic force on a current carrying wire, the force is really on the moving charges inside of the conductor.

Single charged particles can also experience a magnetic force when moving through a magnetic field...

$F = BIL sin\theta$



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$F = \frac{F}{F}$	$R_{\rm total} = R_1 + R_2 + \cdots$	
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Try This...

What is the magnetic force acting on a proton (+1.6 × 10^{-19} C) moving at an angle of 32° across a magnetic field of 5.3 × 10^{-3} T at a speed of 3.4 × 10^{5} m s⁻¹?

$F = qvB \sin\theta$

Particles Moving Across Fields

