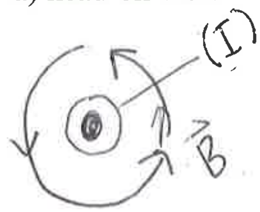
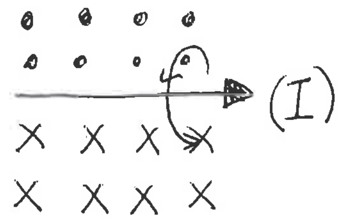
(X) into paper (•) out of paper

Draw the magnetic field lines around a current bearing wire:

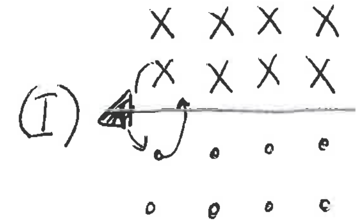
a) head-on view



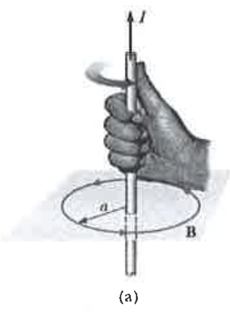
b) side view



c) side view



Right Hand Rule: Magnetic Field around a Wire

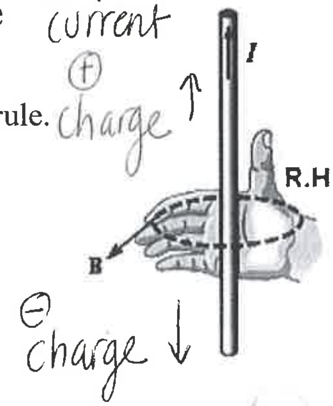


(a)

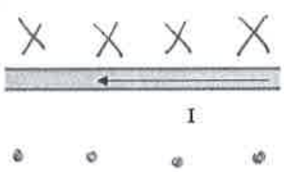
The direction of the curl of these field lines (clockwise or counterclockwise) can be determined by a **Curled Hand** right hand rule.

Thumb: direction of conventional current

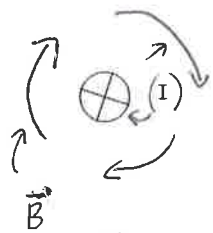
Fingertips: direction of magnetic field



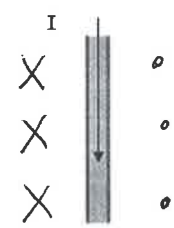
1. Draw the magnetic field around the wire in each case below. Use the Right Hand Rule for Fields to determine its direction.



(a)

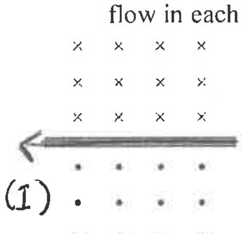


(b)

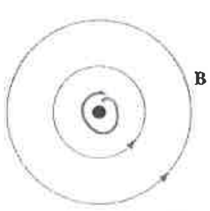


(c)

2. The magnetic field produced by the current is shown in each case. Use the Right Hand Rule for Fields to determine the direction of the current flow in each wire shown below.

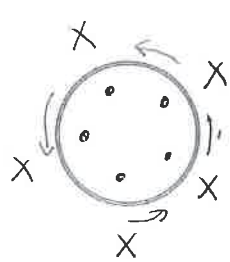


(a)

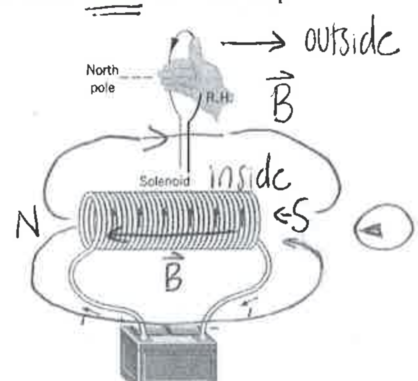


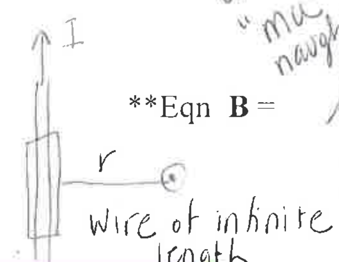
(b) (I) is out of page

3. What is the direction of the magnetic field inside the wire loop shown below? The Solenoid?



Show loop as demo





constant "mu" naught

**Eqn $B = \frac{\mu_0 I}{2\pi r}$

does not vary by r^2 because not a 2 pt. source for field strength

~~B~~ $\frac{\vec{F}}{I\ell}$ Show doc cam visual ~~B~~ $\frac{\vec{F}}{q\vec{v}}$

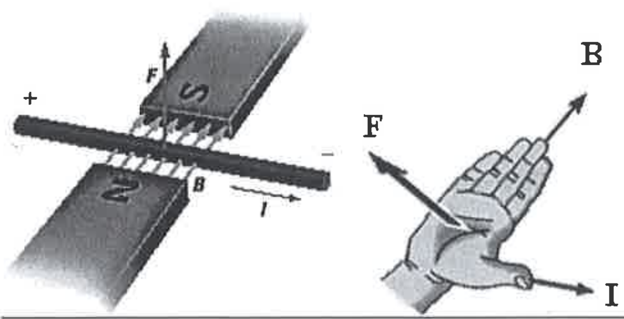
From N-S 4 outside from S-N inside

Force on a Wire

If a wire with current flowing through it is placed in an external magnetic field, it will experience a force. Why? Two magnetic fields around a wire form an external magnet that either attracts or repels.

Right Hand Rule: Magnetic Force on a Wire

The direction of the force exerted on a wire bearing current when placed in an external magnetic field can be determined by a **Flat Hand** right hand rule.



Flat Hand: Thumb ⊥ fingers

Fingers: $\vec{B}$ external magnetic field

Thumb: I current

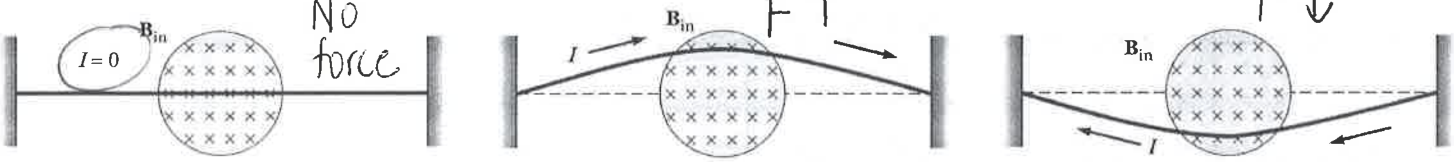
Palm: $\vec{F}$ magnetic force

Maximum force occurs when: $\vec{B} \perp I$ (or ℓ, length of wire)

No force occurs when: $\vec{B} \parallel I$ (or ℓ)

Use the right hand rule for forces to confirm the direction of the force in each case.

No force — $\vec{F}$ ↑ — $\vec{F}$ ↓



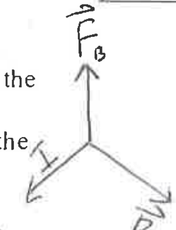
Magnitude of the force on a wire:

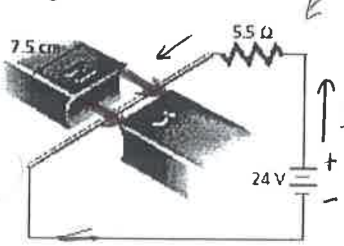
$\vec{F} = \vec{B} \times I \times \ell$

$\vec{B} = \dfrac{\vec{F}}{I\ell}$

Variable:	$\vec{F}_B$	$\vec{B}$	I	ℓ
Quantity:	magnetic force	magnetic field strength	current	length
Units:	N	$[T] = \frac{N}{A \cdot m}$	A	m
Type:	vector	vector	(treat as vectors)	

1. Find the magnitude and direction of the force on the wire when the switch is closed. The strength of the magnetic field is 1.9 T.





$\vec{F}_B = (1.9T)\left(\frac{24V}{5.5\Omega}\right)(0.075m) = \boxed{0.62N}$ up

Magnetic Force between Two Wires

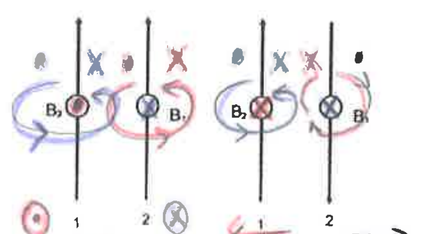
2. Why do two wires carrying current attract or repel each other?

One wire's magnetic field is affecting the other.

General Rule:

If current in 2 wires is in opposite direction, they will repel.

If current is in same direction, wires will attract



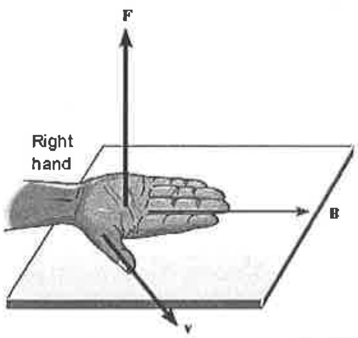
$F_{2 on 1}$ $F_{1 on 2}$ $F_{2 on 1}$ $F_{1 on 2}$

current- electrons being pushed by magnetic force

Magnetic Force on a Moving Charged Particle

Why is there a magnetic force on a charged particle as it moves through a magnetic field? Moving charged particles create their own magnetic field which interacts with other magnetic fields.

Right Hand Rule: Magnetic Force on a Charged Particle



Flat Hand: thumb ⊥ to fingers

Right Hand: ⊕ charged particle

Left Hand: ⊖ negative charges

Maximum force occurs when: $\vec{B} \perp \vec{v}$

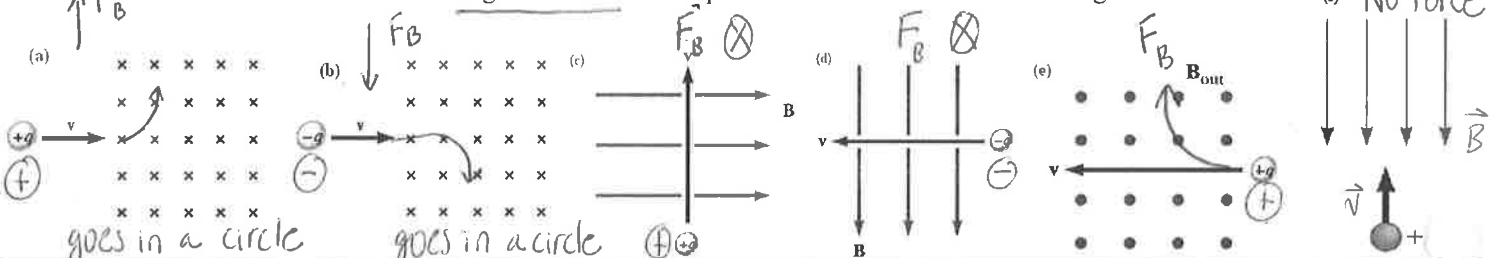
No force occurs when: $\vec{B}$ ∥ to $\vec{v}$

Fingers: run N → S in direction of magnetic field $\vec{B}$

Thumb: velocity of charge

Palm: direction of magnetic force

Find the direction of the magnetic force on each particle below as each enters the magnetic field shown.



Magnetic Force on a Moving Charged Particle:

$\vec{F} = q\vec{v}\vec{B}$ $C \cdot \frac{m}{s} \cdot \frac{N}{C \cdot \frac{m}{s}}$

or $q\vec{v}\sin\theta\vec{B}$

same as

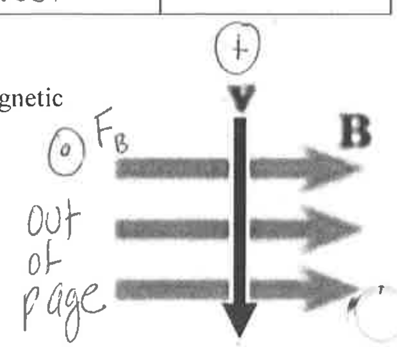
$\vec{F} = \vec{B}I\ell$ $\frac{N}{C \frac{m}{s}} \cdot \frac{C}{s} \cdot m$

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

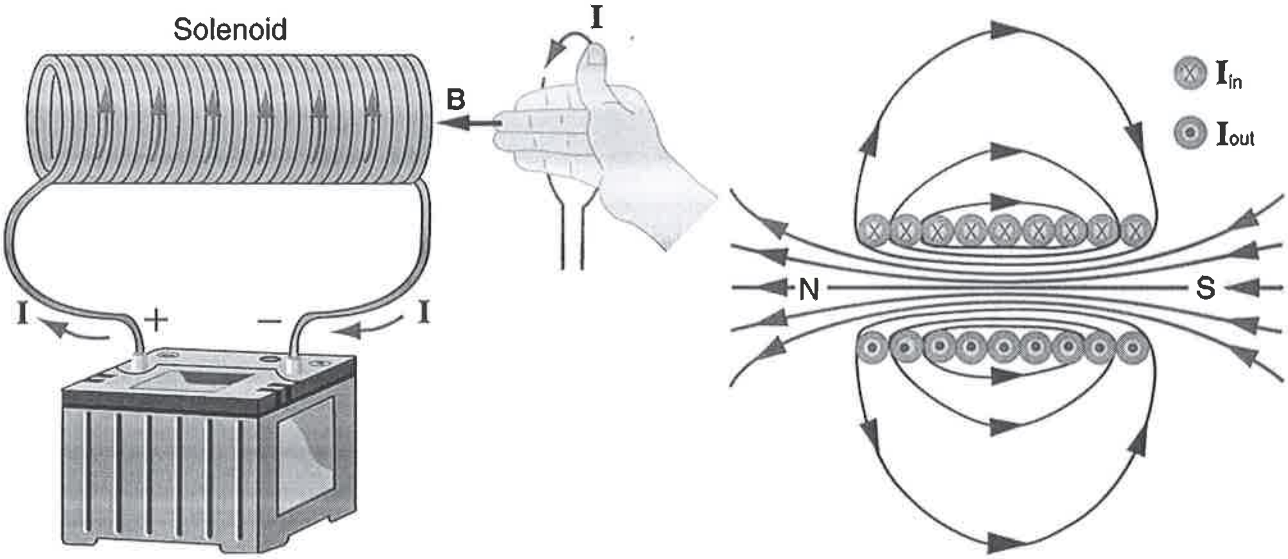
Variable:	$\vec{F}$	q	$\vec{v}$	$\vec{B}$
Quantity:	magnetic force	charge	velocity	magnetic field strength
Units:	[N]	[C]	$\left[\frac{m}{s}\right]$	$[T] = \left[\frac{N}{C\, m/s}\right]$
Type:	vector	scalar	vector	vector

1. a) Find the magnitude and direction of the magnetic force on a proton as it travels through a magnetic field whose strength is 2.0 T at a speed of 3.0×10^7 m/s.

$\vec{F} = q\vec{v}\vec{B} = (1.6\times10^{-19}C)(3.0\times10^{7}\frac{m}{s})(2.0T) = 9.6\times10^{-12}N$

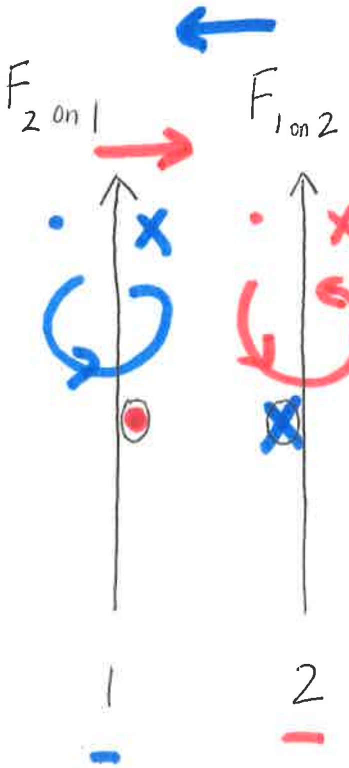


b) What would change if the particle were an electron? F_B ⊗ into page

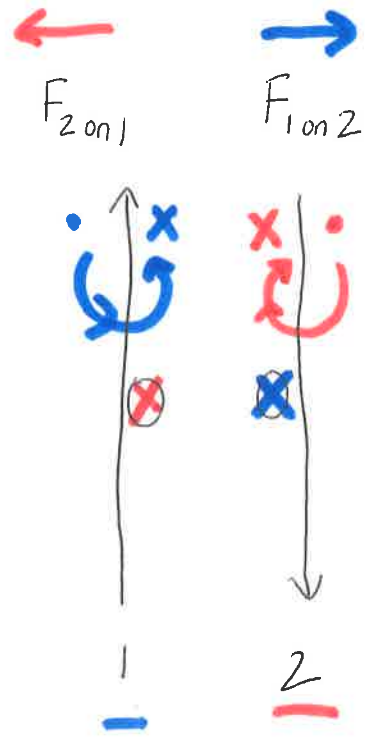


Solenoid
B
I
I
+
−
I
I_{in}
I_{out}
N
S

(a) (b)



$F_{2 \text{ on } 1}$
$F_{1 \text{ on } 2}$
1
2



$F_{2 \text{ on } 1}$
$F_{1 \text{ on } 2}$
1
2