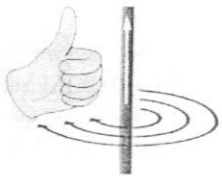
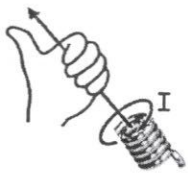
SPH 3U – Electricity & Magnetism Directions

Note: The rules below assume we are looking at the direction of the flow of electrons (negative to positive). Many textbooks will use "conventional current" which is current flow from positive to negative, in which case the right hand rule is used. When electricity was discovered there was no way to know *what* was actually moving and in what direction, and Benjamin Franklin guessed wrong.

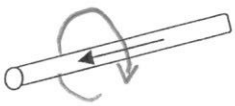
LHR (for straight conductors)
Using your left hand, point your thumb in the direction of the electron current and the fingers curl in the direction of the magnetic field.



LHR (for coiled conductors – solenoids)
Curve fingers of left hand point in the direction of electron current and the thumb points in the direction of the magnetic field inside the coil



1) Draw the magnetic fields around the following objects. The arrows indicate the direction of electron current flow.



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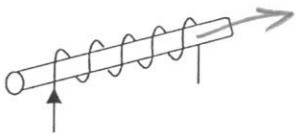
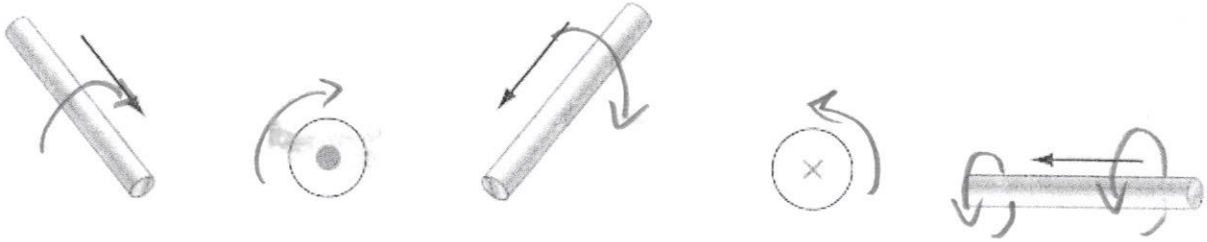
Into the page

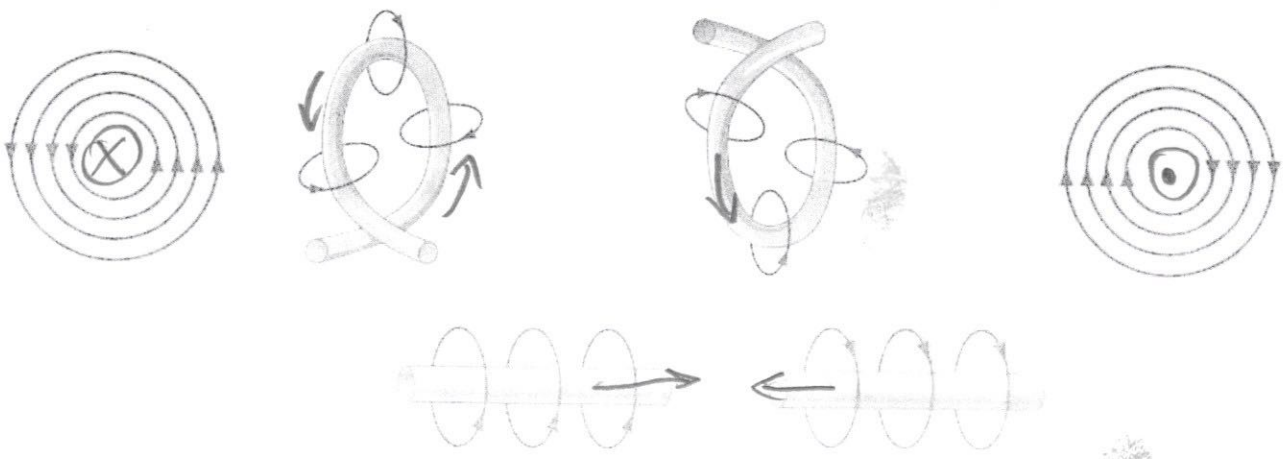


Magnetic fields in coiled conductors
- The magnetic field inside the solenoid is uniform (same strength and same direction)
- Magnetic field *B* can be adjusted depending on the current (double the current → double the magnetic field)
- Magnetic field can be adjusted depending on the number of turns (if you double the number of turns, you double the magnetic field)

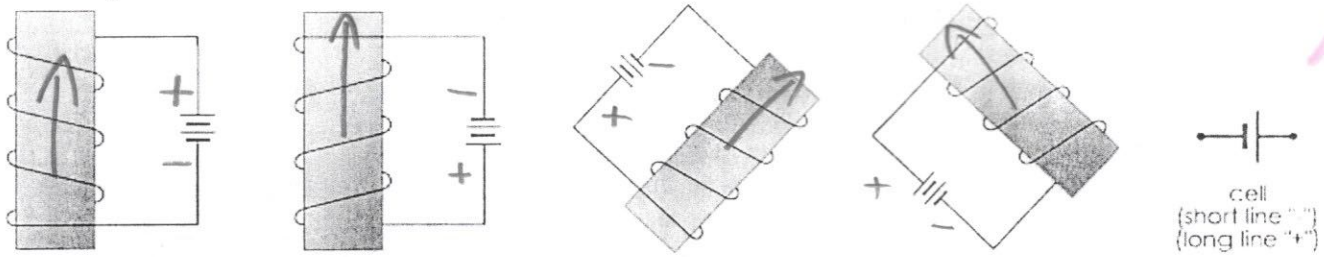
1. For each current-carrying conductor, sketch a view of the magnetic field, based on the direction of the current shown (current represents electron flow)



2. For each current-carrying conductor, show the direction of current (electron flow), based on the magnetic field shown.



3. For each current-carrying solenoid (an electromagnetic coil), sketch a view of the magnetic field around the coil, based on the direction of current flow shown. On each, label the polarity (north and south) of the electromagnet.



* more variety

4. For each coil, show the direction of current (electron flow) that would cause the labelled magnetic polarity.

* field lines point to the south

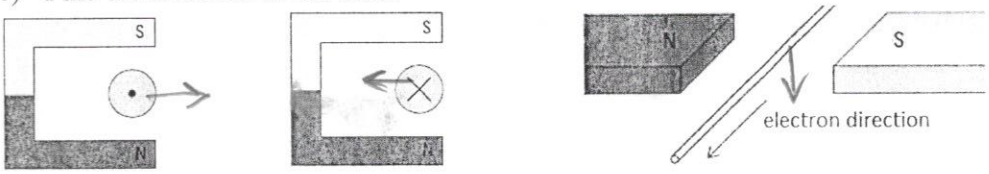
SPH 3U – Electricity & Magnetism – Motor Principle Name: _____

The motor principle: A current-carrying conductor experiences a force when it is placed in an external magnetic field. The force exerted is perpendicular to the direction of current and the external magnetic field.

LHR (for the motor principle)
On the left hand, the fingers point in the direction of the magnetic field, the thumb points in the direction of the electron current flow. The palm points in the direction of the force produced.

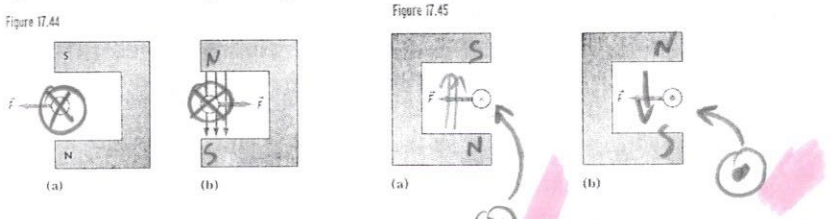
Examples

1) Find the direction of the force



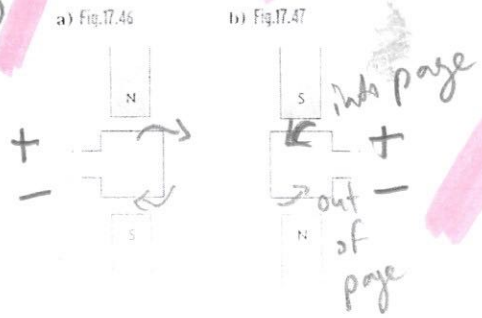
Recall: Magnetic poles are drawn from north to south

2) Label the magnetic poles, the magnetic field and the direction of electron current



bigger

3) Show which way the loops will turn



SPH 3U – Electricity & Magnetism – Summary Name: _____

1) Complete the following statements:

Kirchhoff's Voltage Law (KVL): In a complete circuit loop, the total of all electric potential increases is equal to …
the electric potential decreases

Kirchhoff's Current Law (KCL): At any junction point in an electric circuit, the total electric current into a junction point is equal to … the electric current out

Ohm's Law: $V = IR$ or $I = \frac{V}{R}$ or $R = \frac{V}{I}$

Oersted's Principle: Current moving through a conductor produces (or induces) …
a magnetic field

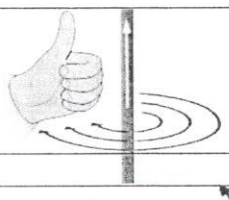
Faraday's Law: A magnetic field that is moving or changing intensity near a conductor causes (or induces) …
an electric current

Lenz's Law: The direction of the induced current creates an induced magnetic field that opposes the motion of the inducing magnetic field.

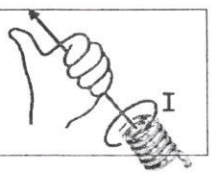
The Motor Principle: A current-carrying conductor experiences a force when it is placed in an external magnetic field. This is because the conductor creates is own magnetic field as well.

Magnetic Fields: Magnetic field lines come out of the N pole and go into the S pole. They are 3D, and do not cross.

***LHR* #1 straight conductors:** Grasp a conductor with the *left* hand.
The thumb points in the direction of … current
and the curved fingers point in the direction of … magnetic field



***LHR* #2 coiled conductors: Grasp a conductor with the *left* hand.**
The curved fingers point in the direction of … current
and the thumb point in the direction of … magnetic field



***LHR* #3 the motor principle**: Open the *left* hand,
the fingers point in the direction of the … magnetic field
the thumb points in the direction of … current
and the palm points in the direction of the … force.