Name: ______________________________ Phys 12

6.4 Magnetic Fields

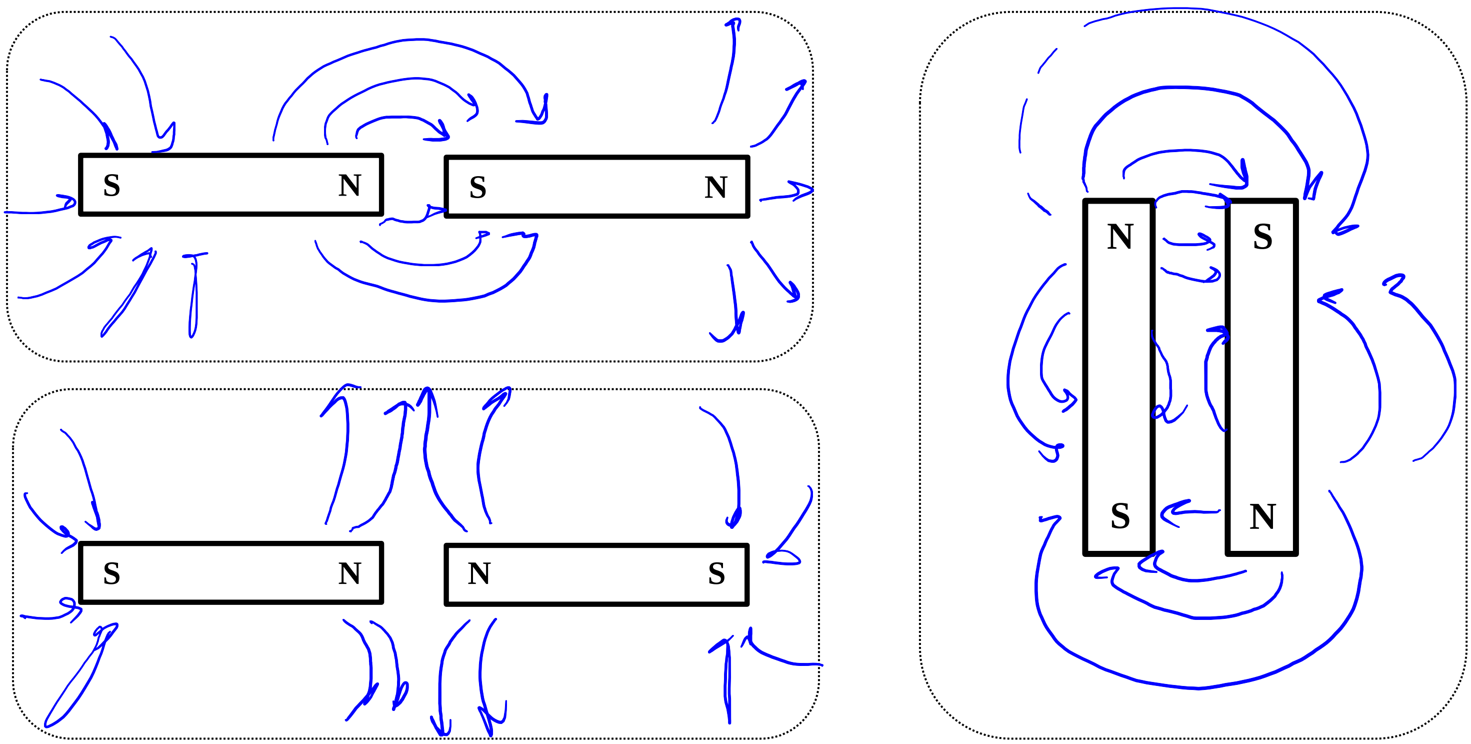
Magnets have 2 poles, the __north__ (N) and the __South__ (S) pole.

The attraction between __opposite__ poles and the repulsion between __same__ poles suggest that there is a magnetic __field__ between these 2 poles.

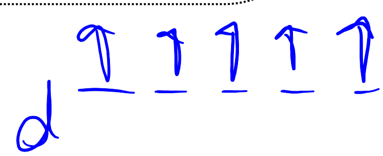
The stronger the field, the __closer__ the lines are together, the larger the __magnetic flux__.

Magnetic flux is the magnetic field through a defined __surface area__. Using calculus language, it is __integration of__ the magnetic field across a particular surface.

Use the provided magnets and iron fillings to draw the magnetic fields on the examples below. The arrows that you'd draw for magnetic fields should start from the __north__ pole and end at the __South__ pole.



Try putting compasses around the magnets and see what you get.

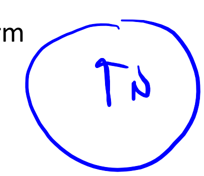


What did you notice when you put compasses around your magnet?

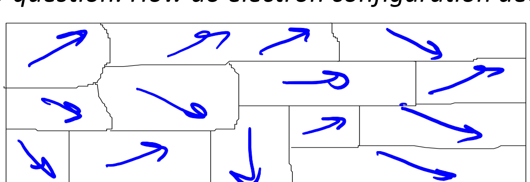
Would you say magnetic fields are vectors or scalars?

While using your compass while camping, the compass arrow lines up with the Earth's magnetic field lines, which means our geographic north pole is actually the __magnetic south pole__

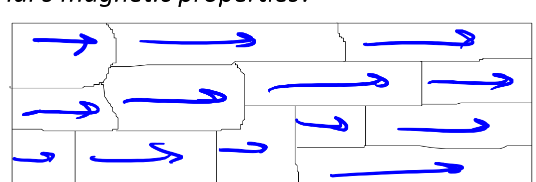
Domains in a material are parts in that material where the magnetic moments of atoms are pointing in a uniform direction. Electron spin determines the magnetic moments.



Inquiry question: How do electron configuration determine a material's magnetic properties?



Paramagnetic materials



Ferromagnetic materials

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Scavenger Hunt -> take a compass and find a power cord in the classroom that will cause a deflection on the compass.

What does that mean?

What is the direction of this magnetic field?

We use the **1st Right Hand Rule** to determine the magnetic field based on the direction of the current.

Thumb: current direction

Fingers: magnetic field direction

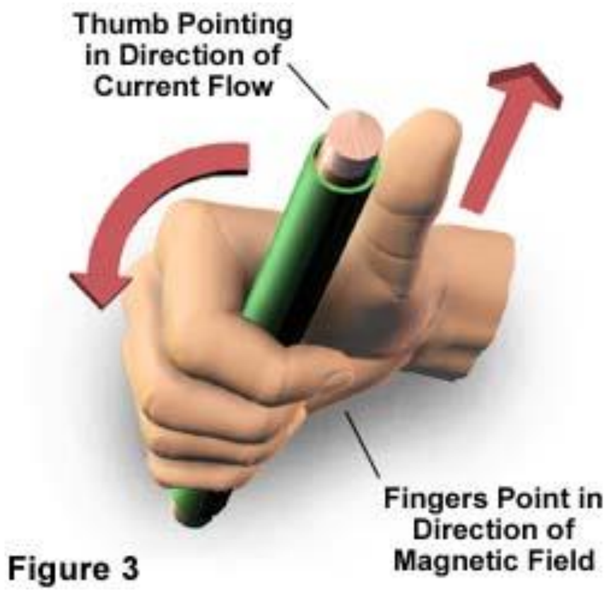
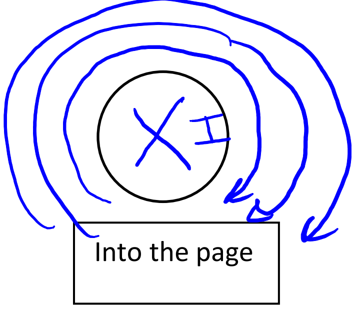
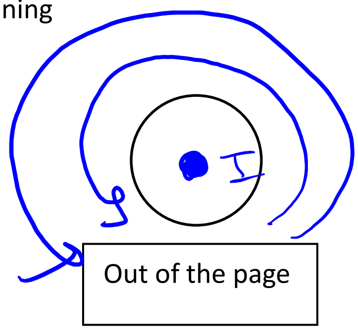


Figure 3

Sometimes we need to draw arrows in and out of the page. For example, if we have a current running



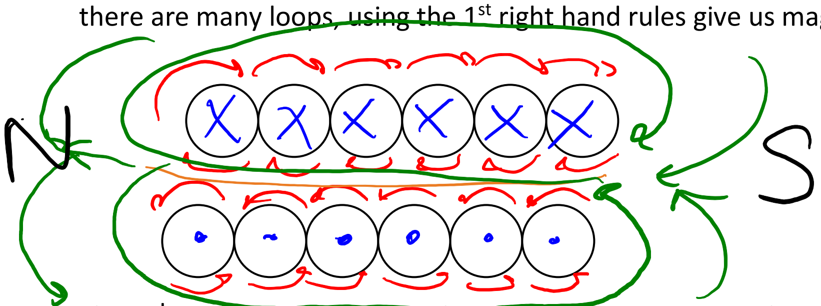


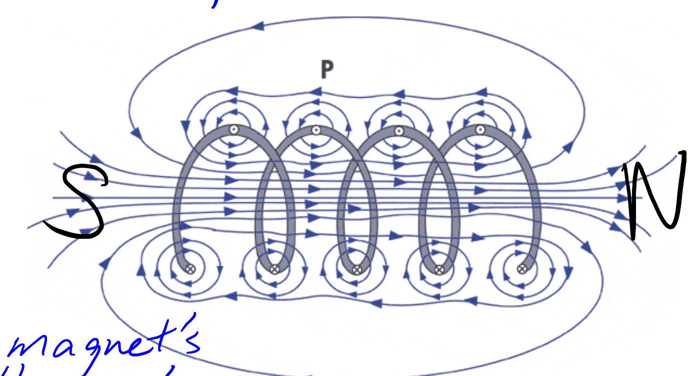
It's kind of like shooting an arrow or seeing an arrow come towards you.

Draw in the magnetic field on your current carrying wires above.

While some magnets are permanent and some temporary, we can make a kind of temporary magnet called an **electromagnet** using a current.

A solenoid is an electromagnet with current running through many loops of wires or a coil of wires. Since there are many loops, using the 1st right hand rules give us magnetic fields that reinforce inside the solenoid.





The **2nd Right Hand Rule** for solenoids help us determine the polarity of our solenoid based on the direction of the current.

Fingers: Current

Thumb: electromagnet's north pole

In a uniform magnetic field INSIDE a solenoid we can calculate the strength of the field using:

$$B = n I \mu_0$$

or

$$B = \frac{N}{l} I \mu_0$$

Where :

B = magnetic field (T, Tesla)

μ_o = permeability of free space ($4\pi \times 10^{-7}$ mkg/(s^{2}A^2))

I = Current (A)

n = loops per unit length

= Total loops (N)/length of solenoid (m)

HW: Worksheet 6.4 ALL