Magnetic Fields from Wires

A wire with current flowing through it will create a magnetic field around it, to remember the direction of this field we use the

First Right Hand Rule:

Thumb: Points in direction of conventional cullent (+ → −)

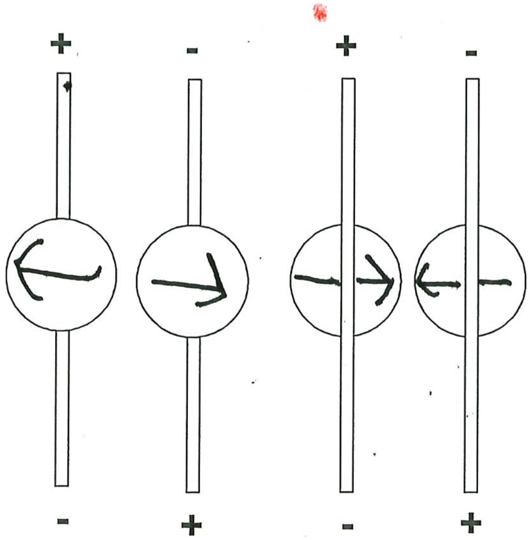
Fingers Direction of magnetic field

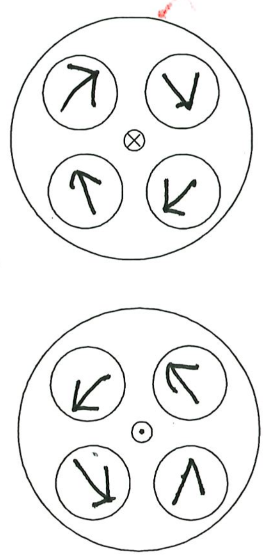
Often we will represent a current carrying wire as though you were looking at it end on. In this case we simply draw it as a circle. To indicate the direction of current flow we draw a X if it is in to the page and a • if it is out of the page.

out of page

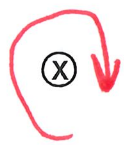
into page

Fill in the following with the direction of the magnetic field

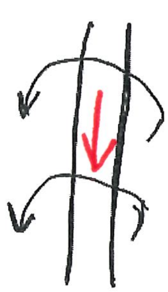




Example: Fill in the following with the direction of the magnetic field

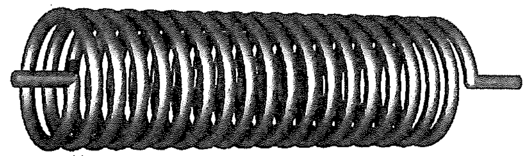
a) current flowing through wire into paper	b) curved wire
	 side view top down view

Example: Determine the direction current is flowing in the following wires given the magnetic field generated by them.



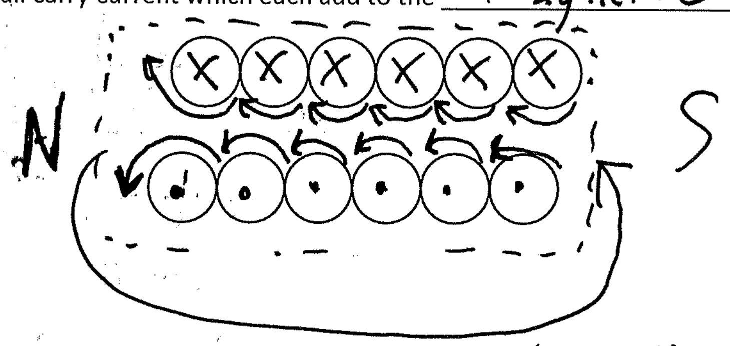
Solenoids: electromagnet

A solenoid is simply a coil of wires



https://commons.wikimedia.org/wiki/File:Solenoid-coreless.jpg

The many loops all carry current which each add to the magnetic field



Just as with a bar magnet a solenoid has North and South poles

The 2[nd] Right Hand Rule:

Fingers: direction of current in Solenoid

Thumb: North pole

The magnetic field outside of a solenoid is Weak and non-uniform

However the magnetic field inside the solenoid is strong and fairly uniform.

Inside a solenoid we can approximate the strength of the field using the following equation. It is only perfectly true if the length of the solenoid is much greater than its width, but is an acceptable approximation otherwise:

$$B = \mu_0 I n$$

Where : B = Magnetic Field strength

μ_0 = permiability of free space $= 4\pi \times 10^{-7}$

I = Current

n = loops per metre $= \frac{\# \text{ loops}}{\text{length}} = \frac{N}{\ell}$

0.25m

Example: A hollow solenoid is 25 cm long and has 1000 loops. If the solenoid has a current of 9.0 A what is the magnetic field in the solenoid?

$$B = \mu_0 I n = \mu_0 I \frac{N}{\ell} = (4\pi \times 10^{-7})(9.0)\left(\frac{1000}{0.25}\right)$$

$$= 0.045 \text{ T}$$