Magnetism

Magnetic Poles

- The poles are where the magnetic forces are produced.
- We call these poles north and south.
- Like poles repel, unlike attract.
- Magnetic poles cannot be isolated like electrical charges can.
- You cannot have a north without a south no matter how small the object is even down to the single atom.
- Atoms therefore are magnets.

Magnetic Fields

- The space around the magnet where force is exerted is the field.
- Magnetic field lines are formed and spread from the north pole to the south.
- Where the lines are closer together the field is stronger.
- Magnetic fields are byproducts of electric fields.
- Any moving electrical charge (current) creates a magnetic field.

Electrons role

- Each electron is spinning and revolving.
- That means their charge is in motion which creates the magnetic field.
- This spinning field is greater than their orbital field in most materials.
- More electrons spinning the same way creates a larger field.
- Line up a cluster of atoms and you get a magnetic domain.

Magnetic Domains

- Each domain is made up of billions of aligned atoms
- There are many domains in each crystal of iron.
- Usually the domain’s direction are randomized, and there is no net field.
- If the domains are all aligned, then the metal is magnetic.
- To align the domains the metals are placed in a strong magnetic field.
- If a magnet is dropped or heated, then the domains randomize.

Electric Currents and Magnetic Fields

- Many charges in motion in an electric current produces a magnetic field.
- Compass direction can be changed when brought near a current carrying wire.
- Magnetic field strength can be increased by increasing the number of loops in an electric wire.
- A wire in multiple loops creating a strong magnetic field is an electromagnet.
- Placing iron in the coil aligns the domains increasing the power of the magnet.
- Superconducting electromagnets.

Forces on moving charged particles

- A static magnetic field will not act on a charged particle at rest, only when moving.
- The force is greatest when the particle is moving perpendicular to the field lines, and goes to zero when moving parallel to field lines.
- The force acts in the direction perpendicular to both the magnetic field and the direction of the moving particle.
- This can bend and move a wire or other objects as well. (Right Hand Rule)

Magnetic Field Calculations

- Magnetic Field is measured in Teslas (T) or Newton per Amp x meter
- $B = F/qv$ or $B = F/IL$
- B = magnetic field (T)
- F = force (N)
- q = charge (C)
- v = velocity (m/s)
- I = current (amp)
- L = length of wire (m)

Galvanometer

- A magnetic object can be deflected by a current in a wire, so looping wire can cause a noticeable deflection.
- The more deflection, the more current, so you can then measure the current.
- More loops of wire creates a more sensitive meter to a maximum of ½ turn.
- If a modification is made where the current switches direction after a half turn, then you can keep it turning. That is an electric motor.