UNIT-II

Magnetic susceptibility:

(Magnetic susceptibility is a dimensionless proportinality constant of the degree of magnetization of a material in response to applied magnetic field) (It caused by interactions of elections and neulei with the externally applied magnetic field)

Definition:

* In electromagnetism magnetic susceptibility is defined as
  * The massuses of how much a material will be magnetized in an applied magnetic field. It is denoted by χ. χ k_i magnetic susceptibility

Formula:

The mathematically definition of magnetic susceptibility is the ratio of magnetization to applied magnetzing field intensity. This is a dimensionless quanlity.

$$\chi = M/H$$

where,

χ = magnetic susceptibility.

M = magnetization

H = field intensity.

Magnetic moment:

Magnetic moment also known as magnetic dipole moment is the measure of (the objects tendency to align with a magnetic field)

Magnetic moment is degined as magnetic strength and orientation of a magnet or other object that produces a magnetic field.

The magnetic moment is a vector quantity. The objects have a tendency to place themselves in such a way that the magnetic moment vector becomes parllel to the magnetic field lines. The direction of the magnetic moment points from the south to the north pole of a magnet the (magnetic field created by a magnetic is directly proportional to the magnetic moment.)

Method to produced magnetic moment

Magnetic moment is produced by the following two methods.

* The motion of electric charge
* Spin angular moment.

Measurement of magnetic moment:

(Magnetic moments are ~~typically~~ measured by instruments known as magnetometers). (But not all magneto meters are aligned to measure. the magnetic moment directly) (some of these devices measure magnetic fields only from the measured magnetic field, the magnetic moment is measured.)

Formula:

The magnetic moment is a vector relating torque of an objects to the magnetic field. This is mathematically represented as:

$$\tau = M \times B$$

where τ = The torque acting on the dipole
M = magnetic moment
B = external magnetic field.

Unit:

In the diffinition for the current (loop (the magnetic moment is the product of the current flowing and the area $M = IA$)

* So the unit conferring to this difinitions is articulated by Ampm2

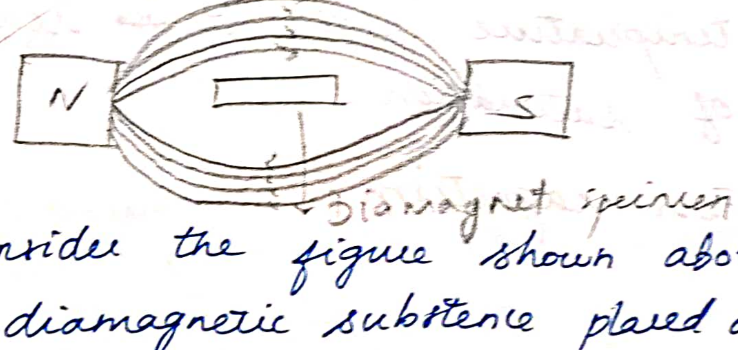
* It can also be suggested in terms of torque and moment conferring to that the forque is measured in joules (J) and the magnetic field is measured in Tesla (T) and thus the unit is JT^{-1}

* So these two units are equivalent to each other and are provides by (Amp-m2 = JT^{-1})

Magnetic moment Amp m2 JT^{-1}

Diamagnetism:

Diamagnetism substences have a tendency to move from stronger part to the weaker part of ~~two~~ the external magnetic field. We can also say that the diamagnetic substence get repelled by a magnet



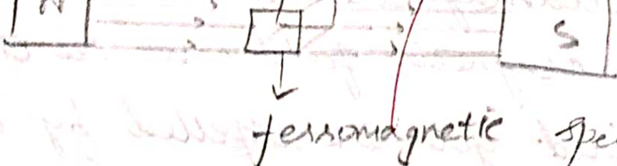
Consider the figure shown above. we have a diamagnetic substence placed in an external magnetic field. We see that the field lines get ~~ex~~ expelled by the material is reduced. If we place this substence in a non uniform magnetic field. it is tends to move from the point of a high electric to that of low electric field.

para magnetism:

para magnetic substence are those substences that get weakly magnetized in the presence of an external magnetic field. In the presence of an external magnetic field those substences tend to move from a region of a weak to a strong magnetic field.

In other terms, we can say that these substence tend to get weakly attracted to a paramagnetic magnet. In a paramagnetic material, the individual atom possess a dipole moment which when placed in a magnetic field intract with one another and get sponteniously aligned in a common direction, which results in its magnetism. As per the curies law, the magnetism of a paramagnetic substence is inversly propoertional to the absolute temperature untill it reaches a state of saturation.

Ferromagnetism:



Ferromagnetic substence are those substence that when it placed in an external magnetic field get strongly magnetized. Also they tend to move from a region of

~~strong~~ weak magnetic ~~fi~~ to the strong magnetic field and get strongly attracted to a magnetic field the atoms interact with one another and get sporteniously aligned in a common direction. The direction is common ever a macroscopic volume which we term as a domain. The domain has a net magnetization and each domain directs itself, which results in it strong magnetization.

Applications of magnetic properties in solving structural problems:

* The magnetic property of a material is the atomic (or) subatomic response of a material to an applied magnetic field. where in the election spin and charge create a dipole moment and a magnetic field.

* Sometimes magnetic properties constitute supplementary information to support other data such as ~~micro~~ micro analysis.

i) metalloenzymes:

nearly half the important enzymes containe one or more transition materials at the active site. Because of the large molecular weight it is frequently impossible to determine how many metal atoms there are from simple chemical analysis.

* Knowledge of number of ion, atoms present is important in understanding the function and machanism of enzymes. If there were two iron atom the magnetism would be twice as great than if only one iron were present.

* The enzyme urease was found to contain a dimeric nickel(II) centre based only on its magnetic properties in large proteins such as ferritin strong coupling is seen in a -o- phosphate center, rather like a small piece of rust enclosed in a protein sheath.

* Individual metal atoms reveal their presence and bonding environment in their magnetic field T. dependent magnetic properties deviation from curie weiss.

* The magnetic susceptibility of copper(II) acetate deviates dramatically from the curie law. It was analysed as a binuclear rather than monomeric structure long before, x-ray crystallography confirmed This.

Determination of magnetic susceptibility by Guoy's method:

The application of a magnetic field to a (paramagnetic substence causes magnetic dipoles to be lined up in the field) directions with (diamagnetic material the effects is one of polarization of the election change cloud) In both cases a magnetic flux density. B is set up and is given by

$B = \mu H$ where,
μ= permeability of the medium and
H = Applied field strength.

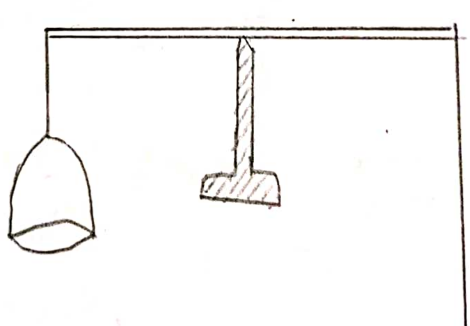
The magnetic susceptibility (χ) is defined as

$\chi = \mu_r - 1 \equiv M/H$

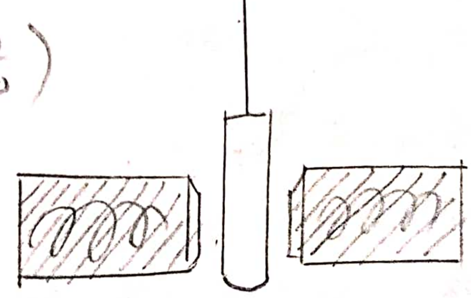
$\chi = \mu_r - 1$

where μ_r = relative permeability of material

The Guoy's method ~~p~~ measures the effect of an ~~is~~ inhomogeneous magnetic field upon the speciman. (which is suspended from the arm of a sensitive ~~bla~~ balance by a fine silver chain) The speciman is in the form of a rod of uniform cross sectional area (A) (where each end of the rod is in a region of uniform magnet (H0) and that at the centre of the magnetic field (H) The magnetic susceptibilities of the speciman is obtained from the relationship.



$F = \frac{1}{2}\mu_0 A \chi (H^2 - H_0^2)$



Gouy apparatus for the measurement of magnetic susceptibility.

The specimen, which may be crystalline or liquid is contained in a flat bottomed "Gouy" tube constructed of glass about 10-15 cm in length and of uniform cross sectional diameters (3-10 mm) The tube itself being a hollow. specimen experiences a force when the sample is weighed in the field. The measurements are also made in air, which has an appreciable susceptibility account must be taken of the volume of the air displaced on taking these into consideration we get. $\chi_0 - \chi_a$

$$F = \frac{1}{2} \mu_0 A (\chi_0 - \chi_a) (H^2 - b^2) + \delta$$

where, χ_0 is the magnetic susceptibility of air

δ is the tube correction factor.