Origin of Magnetic Properties :-

Dia-magnetism – The substances which when placed in a magnetic field decrease the intensity of magnetic field than in vacumm are called diamagnetic substances and these properties are called "diamagnetism".

The magnetic lines of force tend to avoid such substances and as such these are repelled by the magnetic field.

Origin :- If two electrons with opposite spin are paired in the same orbital, the magnetic field produced by one electron is cancelled by the other because each of them has equal and opposite magnetic moment. Thus the substances having only paired electrons give 'zero' resultant magnetic moment and hence they are diamagnetic.

It is temprature independent and is shown by all types of substances such as H_2, N_2, H_2O, NaCl, KCl, $MgCl_2$ i.e. almost all non-transition metal compounds. These substances have small and (–ve) χ_g values in the order of 10^{-6} cgs units.

Paramagnetism :- The substances which when placed in a magnetic field, allow the magnetic lines of force to pass through them rather than through vacumm are called paramagnetic substances and these properties are called "Paramagnetism".

Here $B > H$ or $P > 1$

i.e. χ_g will be (+ve) having values

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in the range of $(10-1000) \times 10^{-6}$ cgs unit. It is temparature dependent and field independent.

Origin:- Paramagnetism of a substance consisting of atoms, ions ~~and~~ or molecules is caused by the presence of unpaired electrons. The greater the number of unpaired electrons, the greater will be the paramagnetism.

This is actually caused by orbi-tal and spin motion of unpaired electrons. Examples are - $[Ni(H_2O)_6]Cl_2$, $[CoCl_4]^{2-}$, O_2, NO_2, NO etc.

In such substances, the magnetic field is produced due to the orbital and spin motions of the unpaired electrons. But ~~so the~~ the fields are not mutually cancelled and thus some definite and permanent resultant magnetic moment is obtained which interacts with the applied magnetic field showing paramagnetism.

Paramagnetic molecules are free to orient themselves ideally in gas or liquid phase but this is not possible in solid state. Thus two other types of magnetism arise —

Ferromagnetism:- When in a solid lattice the magnetic moments caused by individual electron are aligned in parallel way, thus re-inforcing each other, the substance possesses a very large and (+ve) X_g value and those are called ferromagnetic.

They possess a characteristic temparature called curie temparature (T_c). Below T_c magnetic susceptibility of ferromagnetic substances is many times greater than that of a paramagnetic substance. As temparature is lowered below T_c, susceptibility sharply increases, reaching the highest value at $T = 0$.

Again as temparature is raised parallel spin arrangement tends to becomes partially antiparallel. Above T_c, the all parallel spin orientation breaks down and the substance behaves as a normal paramagnetic one.

Ferromagnetism is observed in substances havings atoms / ions with incomplete d or f subshells e.g. ~~mettal~~ metallic iron, Co, Ni, Gd, Mn-Cu alloy

Antiferromagnetism:- Antiferromagnetism arises when two lattices of particles have spins antiparallel to the spins of one lattice of the other lattice. They have very small and (+ve) X_g values in the order of $[(0.12 \times 10^2) \times 10^{-6}]$ cgs unit.

They are characterised by a certain temparature T_N (Neel temparature) below which the electron spins of the paramagnetic centres orient themselves as antiparallel, thus lowering the susceptibility. As the temparature is lowered below T_N, susceptibility continues to fall and may even show diamagnetism near absolute zero ($T = 0$). On raising the temparature, the antiparallel orientation is disturbed due to thermal agitation and on passing T_N, the substance behaves again as a paramagnet.

Antiferromagnetism is commonly observed among transition metal complexes in which the metal atoms are bound to or brided by electronegative X atoms (mainly O and F) as MXM. e.g.→ $KNiF_3$ and many dimeric complexes of Cu(II) and oxovanadium (IV).

Magnetic Susceptibility:- It is the magnetic moment per unit volume per unit magnetic field, and is known as the volume magnetic susceptibility (K) of the body. It is the characteristic property of a compound.

$$K = \frac{I}{H}$$