

- 1) Discuss the origin of orbital and spin magnetic moments in magnetic materials and explain the term Bohr magneton.

A) Orbital moments in magnetic materials:-

When an electron revolves around the nucleus, its motion is analogous to an electric current in a loop. The current (I) is

$$I = \frac{e}{T}$$

e is charge of e^-

T is time period of one complete revolution of e^-

The current gives rise to magnetic moment μ_{orb} is $\mu_{orb} = IA = eA/T = m\vec{v}$

Where A is area of loop

$$\therefore \mu_{orb} = m_l \mu_B$$

m_l is magnetic quantum number

μ_B is Bohr magneton.

$$\therefore \mu_B = \frac{eh}{4\pi m} = 9.27 \times 10^{-24} \text{ Am}^2$$

Spin Magnetic moment:-

In addition to orbital motion, the electrons also possess spin motion spin moment. The spinning e^- behaves like a spinning tiny magnet

$$\text{Then } \mu_s = 2e/2m\mu_B$$

The spin angular momentum P_s is given by $P_s = \hbar/2\pi$

$$\therefore \mu_s = 2e \hbar / 4\pi m \quad \text{sh}(\pi) = 2\pi \quad \text{sh}(\pi) = e \hbar / 4\pi m \quad (s = 1/2)$$

$$\mu_s = e \hbar$$

Thus the magnetic moment due to electron spin is equal to one Bohr magneton.

Bohr magneton :-

The Bohr magneton is a physical constant used as a unit for the magnetic moment of an electron due to its orbital or spin motion

for orbital motion $\mu_B = \frac{e \hbar}{4\pi m_e}$

for spin motion $\mu_B = \frac{e \hbar}{4\pi m}$

2) Differentiate hard & soft magnetic materials with examples

Hard magnetic materials

soft magnetic materials

- 1) The magnetism of hard magnetic materials is constant
- 2) For hard magnetic materials, the area of hysteresis loop is large
- 3) Hard magnetic materials cannot be magnetized easily
- 4) The coercivity of hard material is high

Ex:- electro magnets

- 1) The magnetic of soft magnetic materials is temporary
- 2) For soft magnetic, area of hysteresis loop is small
- 3) Soft magnetic materials can be easily magnetized.
- 4) Soft magnetic materials have small value of retentivity

Ex:- Aluminium.