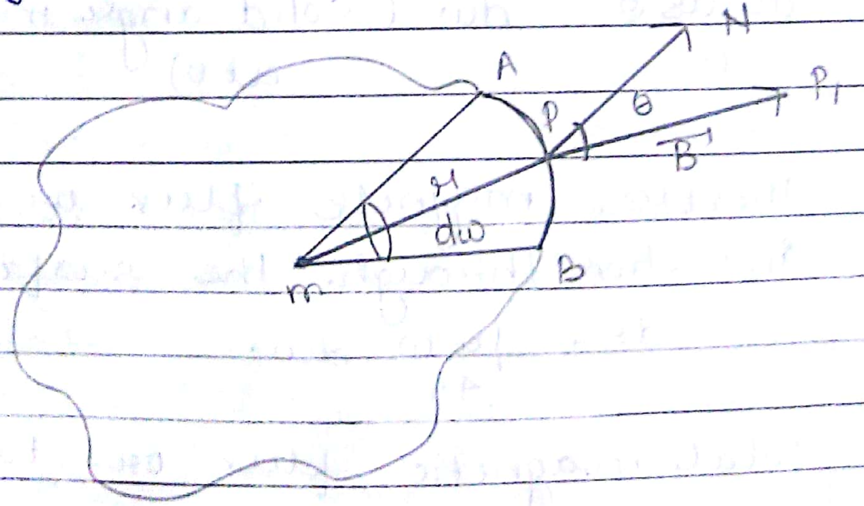
Paul sir
4/8/18

→ **Gausses law in Magnetism :—** Total normal magnetic induction of magnetic flux through a surface represent the no. of lines of force crossing the surface in a direction normal to the surface. It is defined as the dot product of magnetic field vector ($\vec{B}$) and area vector ($\vec{A}$). Area vector represent the area of a surface in a dirⁿ normal to the surface. Magnetic flux is denoted by ϕ and it is a scalar quality. Unit of magnetic flux in SI system is Waber (Wb). i.e.,

$$\phi = \vec{B} \cdot \vec{A}.$$

→ **Gauss thm in Magnetism**

Statement :- Gausses thm states that total normal magnetic induction or magnetic flux over a closed surface is equal to μ_0 times in algebric sum of the pole strength inside the closed surface.



consider a closed surface S inside which a pole of strength 'm' is placed. AB is small surface of surface area ds on the closed surface S. P is a point on AB. Pole is placed at O. Let OP = r. PN is normal on AB.

Magnitude of magnetic field (B) at P due to pole strength 'm' at O is given by

$$B = \frac{\mu_0}{4\pi} \frac{m}{r^2} \quad (\text{along } PP_1)$$

θ = Angle between magnetic field $\vec{B}$ and normal PN.

Resolve component of $\vec{B}$ along PN = $B\cos\theta$

induction through the surface AB of area ds = $B\cos\theta \cdot ds$

$$= \frac{\mu_0}{4\pi} \frac{m}{r^2} \cos\theta \cdot ds$$

$$= \frac{\mu_0 m}{4\pi} \frac{ds\cos\theta}{r^2}$$

$\frac{ds\cos\theta}{r^2} = d\omega$ (solid angle made by surface AB at O)

therefore magnetic flux or normal magnetic induction through the surface AB of area

$$ds = \frac{\mu_0 m}{4\pi} d\omega.$$

total magnetic flux or total normal magnetic induction through the closed

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surface. $S = \frac{\mu_0 m}{4\pi} \oint d\omega$

$\because \oint d\omega = 4\pi$ = Total solid angle made by closed surface S at O.

$\therefore$ Total magnetic flux through the closed surface $= \frac{\mu_0 m}{4\pi} \times 4\pi$

$= \mu_0 m$ proved

If the pole strength is outside the closed surface. Then total magnetic flux through the closed surface is 0.

→ For objective ques:—

$\because$ isolated poles is not possible and magnetic lines of force from the closed loop therefore there are as many as magnetic field lines outside the closed surface as their inside the closed surface.

$\therefore$ Total magnetic flux over the closed surface is 0.

i.e., $\oint \vec{B} \cdot \vec{ds} = 0$

These integral is called surface integral of magnetic field. A result something different from the gauss's thm of electrostatic.

14/08/2018

Wave particle duality of radiations.

– The phenomenon of interference, the interaction and polarisation of light can only be explained by considering the light travel in the form of wave. i.e., it is an electromagnetic radiation but after the invention of photoelectric effect and compton effect is has been established that electromagnetic radiation exhibits corpuscular nature or particle nature. i.e., E.M.W we have as particles also it means that ~~someth~~ sometimes it behaves as wave and sometimes it behaves as particle. it is called wave particle duality. or dual nature of electromagnetic radiation.

Photo electric effect is experimental evidence of corpuscular nature of electromagnetic radiation. A/c to photo-electric effect when electromagnetic radiation of particular wavelength and frequency incident on a particular metal surface then electrons are emitted from the metal surface. The emitted electrons are called photoelectrons. The minimum frequency at which electrons are emitted from the metal surface is called thersold frequency (V_0) and energy corresponding to thersold frequency is called work function (ϕ_0).

If ν_0 = thersold frequency then thersold energy or work function (ϕ_0) $= h\nu_0$

Work function is the characteristics of metal surface.

The nature of photoelectric effect couldn't be explained by classical theory. It was explained by einstein in 1905 on basis of quantum theory given by Max Blancks. According to Max theory ~~electromag~~ electro-magnetic radiation doesn't act like a wave only, but consist of quanta or photons of energy ($h\nu$) where h is planks constant. Photons behave as particle having rest mass 0 and it moves with velocity equal to velocity of light (c). Photons has energy equal to $h\nu$. The concept of max Blanks proves the wave particle duality. i.e., electromagnetic radiation behave as wave as well as particles in the form of photons of quanta of energy ($h\nu$)

Let ν = frequency of incident wave

ν_0 = Thersold frequency

energy of incident wave $= h\nu$

Thershold energy $= h\nu_0$

$\nu > \nu_0$

m = mass of ejected electrons

v = velocity of ejected electrons.

K.E of ejected electrons $= \frac{1}{2} mv^2$.

from the law of conservation of energy

$$h\nu = h\nu_0 + \frac{1}{2} mv^2$$

or $\frac{1}{2} mv^2 = h(\nu - \nu_0)$ — (1)

This eqn (1) is called eienstein photo-electric eqn.

from eqn (1) it is clear that

1) Energy of ejected electron depends upon the frequency of the incident wave.

2) The no. of electrons emmitted from the metal surface depends upon the intensity of incident wave.

3) The energy of ejected electron doesn't depend upon the intensity of incident wave and the no. of electrons emmitted from metal surface doesn't depend upon the frequency of incident wave.

21/08/18

→ Wave Particle duality of Matter :-

We know that electromagnetic radiation behaves as wave as well as particle i.e., it posses dual nature. In 1924 De-broglie put forward a bold hypothesis that matter should also posses dual nature. i.e., it behave as particle as well as wave.

→ The following observation led him that matter should also posses dual nature.

1) The whole energy in this universe is due to radiation and matter.

2) Nature love symmetry.

3) When radiation possess dual nature then matter should also possess dual nature.

a/c to de-broglie every moving material particle associated with a wave of wavelength -

$$\lambda = \frac{h}{p} \quad \text{—— (1)}$$

where h is planks constant. and p is momentum of particle. these wavelength is called de-broglie wavelength and the wave is called de-broglie wave or matter wave.

If 'm' is the mass of the particle and 'v' is the velocity of the particle.
then $p = mv$

$$\boxed{\lambda = \frac{h}{mv}} \quad \text{--- (2)}$$

eqn (1) relates momentum which is the characteristics of particle with wavelength which is the characteristics of wave.

1) Lighter the particle greater is the de-broglie wavelength.
2) Higher is the velocity of the particle smaller is the de-broglie wavelength.
3) De-broglie wavelength is independent of nature and charge of the particle.
4) De-broglie wave is ~~differ fr~~ different from that of electromagnetic wave. Electromagnetic wave are produced by accelerated charged particle.

Eqn (2) is called De-broglie eqn.

• De-Broglie wavelength of electrons :-

Let m = mass of the electron
e = charge of the electron
V = applied potential difference to accelerate the electron
E = energy acquired by the electron
$E = eV$
v = velocity of the electron

$$E = \frac{1}{2} m v^2$$

$$v^2 = \frac{2E}{m}, \quad v = \sqrt{\frac{2E}{m}}$$

We know that,

$$\lambda = \frac{h}{mv}$$

$$\text{or } \lambda = \frac{h}{m\sqrt{\frac{2E}{m}}}$$

$$\text{or } \lambda = \frac{h}{\sqrt{2mE}}$$

$$\text{finally } \lambda = \frac{h}{\sqrt{2meV}} \quad \text{--- (1)}$$

We know that

$m = 9.1 \times 10^{-31}$ Kg
$h = 6.62 \times 10^{-34}$ Js
$e = 1.6 \times 10^{-19}$ couble

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$$\lambda = \frac{6.62 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19}}} \qquad \propto \frac{1}{\sqrt{V}}$$

$$= \frac{12.27 \times 10^{-10}}{\sqrt{V}} \text{ meter}$$

$$\lambda = \frac{12.27}{\sqrt{V}} \ A^{\circ}$$

If the electrons are accelerated by a potential difference 100 volt.

$\lambda = 1.227 \ A^{\circ}$ (which is same as the wavelength of x-rays)

But both are quite different from each other in nature.

28-08-18

★ Uncertanity Principle

→ Heisenberg's uncertanity principle.

Uncertanity Principle is the direct consequence of the dual nature of matter. According to classical mechanics a moving particle has a definite momentum and occupies definite positions in space. and it is possible to determine both its position and momentum (velocity). The above view for symultaneous determination of position and velocity is applicable for object of appreciable size but does not holdwould for the particles of atomic dimensions.

In quantum mechanism a particle is described by a wave packet, which represents all about particle and moves with the group velocity. The particle may be found any where within the wave packet. This means that position of the particle is uncertain within the limit of the wave packets. The another fact of wave packet is that it has a velocity spread and hence there is uncertanity about the velocity or momentum of the particle. from the above logic it is clear that it is impossible to know where within the wave packet the particle it is and what it is exact velocity or momentum. In conclusion we can say that it is impossible to determine simultaneously both the position and momentum or velocity of particle.

Heisenberg's uncertanity principle state that product of uncertanity is determaining the position and momentum of the particle. is approximately equal to a number of the order of $\hbar$.

$\hbar$, where $\hbar = \frac{h}{2\pi}$ — (1)

i.e., $\Delta p . \Delta q \simeq \hbar$

Δp = Uncertanity in determaining the momentum.

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Δq = uncertanity in determaining the position of the particle.

Thus the smaller the value of Δq larger the value of Δp i.e., More certain the position. i.e., larger the value of Δp. i.e., less certain about the position of momentum or vice versa.

This relation shows that both the position and momentum of the particle accurately. This relation hold could for all cannonically conjugate physical quantities like position and momentum, energy and time, angular momentum and angle etc. whose product has unit of joule second.

Thus if ΔE uncertanity in determining the energy.

Δt uncertanity in determining the time

ΔJ Uncertanity in determining the angular momentum.

$\Delta \theta$ uncertanity in determining the angle.

Then we must have,

$$\Delta E \cdot \Delta t \simeq \hbar$$

$$\Delta J \cdot \Delta \theta \simeq \hbar$$

The uncertanity principle can also be started as follows:-

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The product of the uncertainities in determining the position and momentum of the particle can never be smaller than the number of the order of $\frac{\hbar}{2}$.

Hence eqn (1) can also be written as

$$\Delta p \cdot \Delta q \geq \frac{\hbar}{2}.$$

similarly $\Delta E \cdot \Delta t \geq \frac{\hbar}{2}$. and $\Delta J \cdot \Delta \theta \geq \frac{\hbar}{2}$

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4/09/18

Elementary idea of dia- para and ferro Magnetic Substances and their Comprative Study :-

1) Dia - magnetic material :- Dia - magnetic substances are those which are repelled by magnet and when placed in non-uniform magnetic field moved from stronger to weaker part of field.

Eg :- Bi, Au, Cu, H_2, Sb, H_2O, P, etc.

2). Para - magnetic material :- para - magnetic substances are those which are attracted by magnet & when place in a non- uniform magnetic field move from weaker to stronger part of field.

Eg :- Mn, pt, Na, O_2 etc.

3). Ferro magnetic Substances : Ferro magnetic substances are those which are attracted by magnets and can be also magnetised.

Eg: Co, Fe, Ni etc.

* Ferro-magnetic material show all the properties of para-magnetic material to much greater degree.

Comperative Study b/w dia- para and Ferro magnetic materials :-

1) Dia-magnetic materials:-

a). There is no permanent atomic magnetic dipole moment, these materials are repelled by magnetic field.

b). Induced dipole moment always oppose the applied field & susceptibility.

c). k_m ($\chi < 0$) is practically independent of temp (T) and magnetic field.

d). Magnetization (I) varies linearly with external magnetic field.

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2). Para - magnetic :-

a). These material causes permanent atomic dipole.

b). In the absence of external field the dipoles are randomly oriented and there is no net magnetization. The presence of external field causes allignment of dipole and hence magnetization.

c). (χ) is positive fraction. (χ) varies inversally with Temp (T). but independent (H) magnetizing force.

d). Magnetization varies with external field

3). Ferro - magnetic :-

a). It contains permanent atomic dipoles which interact strongly with each-other and make cause spontaneous magnetization with in a single part even in the absence of external field. They are strongly attracted by magnetic field.

b). A strong external field can cause large magnetization.

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c) $\chi >> 1$ and depends on temp (T) and according to curie Wiess law $\chi \propto \frac{1}{T-\theta}$.
Here (χ) is function of (H) and
θ is curie temp.

d) For each ferro-magnetic material there is a particular temp called curie temp(θ). There is spontaneous magnetization for $T < \theta$. If $T > \theta$ ferromagnetic material becomes paramagnetic.

* Some definition :-

i) Intensity of magnetization (I) : The ratio b/w pole strength and cross-sectional area of magnet is called Intensity of magnetization.

i.e;
$$I = \frac{m}{a} = \frac{2lm}{2la}$$

{ $2l$ = magnetic length.

$$I = \frac{M \text{ (magnetic moment)}}{V \text{ (volume)}}$$

Hence magnetic moment per unit volume of the magnet is also called Intensity of magnetization

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2) Permiability (μ) :-
The ratio b/w magnetic induction to the magnetizing force (H). is called permiabbility.

$$\mu = \frac{B}{H}$$

$$B = \mu H$$

$$B = \mu_r \mu_0 H$$

$\mu = \mu_r \mu_0$
for air
$\mu_r = 1$
$\mu_{air} = \mu_0$

unit of (μ) permiability in S.I system is henry/m

3). Susceptibility (χ) : The ratio b/w intensity of magnetization (I) to the magnetizing force (H). is called susceptibility. The susceptibility of substances show the ability of a substance has to how easily and how much more magnetization it can hold.

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

* Soft iron is more susceptible than steel.
* It has no unit. Since it is the ratio of two similar Quantities.

END

11/09/18

Hysterisis :-

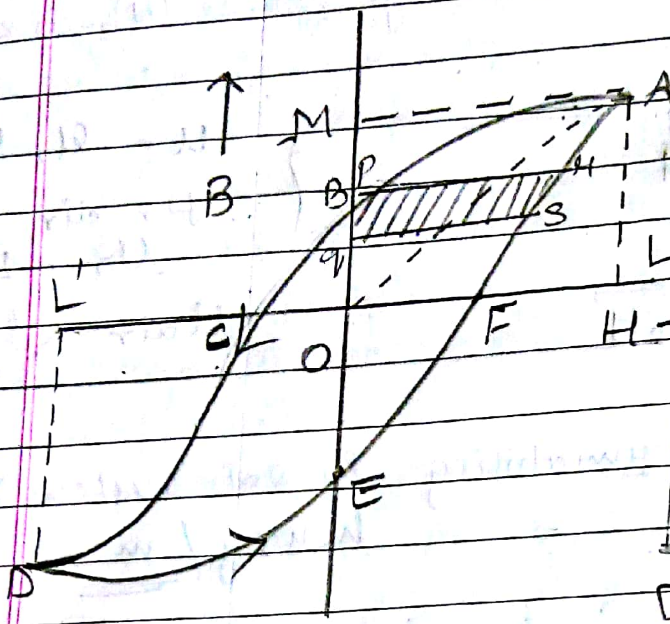

Fig (1)

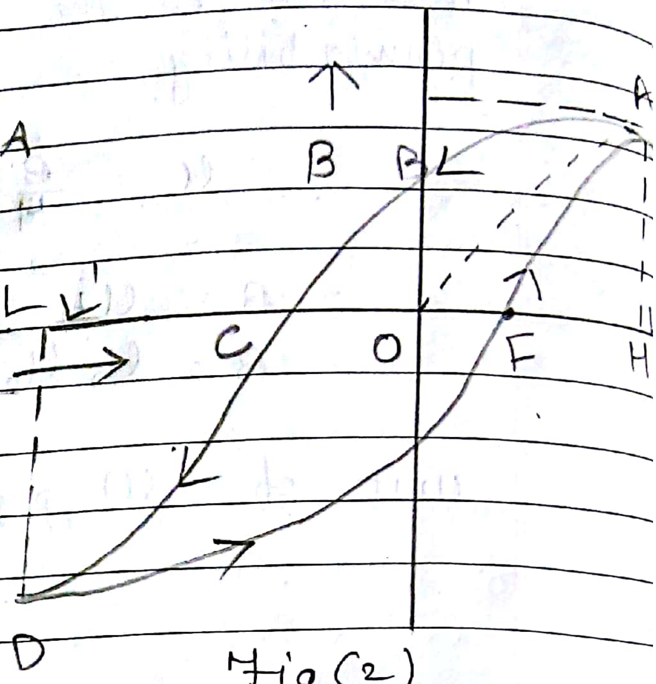

Fig (2)

A Specimen of iron (ferromagnetic material) be magnetised by passing an electric current through it. If the value of current increase the magnitude of the magnetising 'H' increased and the magnetic induction B also increases. The graph between B and H is shown below fig (1). The analysis of graph indicate various informations between the B and H values and all the diagram (1).

Hysterisis:— The lagging of magnitude induction behind the magnetising force producing it when a specimen of iron is taken through a cycle of magnetisation is called Hysterisis.

Hysterisis loop —: The variation of B with H from 0 to a max^m value in one dir^n and then back through zero. to a max^m value in the opposite dir^n and finally back again through zero to the first maximum value is called Hysterisis loop.

loss of energy per cycle in (B–H)

consider a graph between B along Y-axis and H along x-axis is similar to the nature of graph between I along Y-axis and H along x-axis as shown in fig(–2). Let ABCDEFA is a complete cycle of magnitisation. Let PQ be the small step in the process of magnetisation in which B increases by a small amount dB.

∴ So work done per unit volume = HdB.

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$HdB =$ area PQRS.

(1) When the magnetising force H increases from O to OA, B changes from OE to OM.

$\therefore$ workdone on the specimen for unit volume in increasing B from OE to OM

$= \int_E^M HdB =$ area EFAMBOE.

(2) When H increases from OL to zero, B decreases from OM to OB.

$\therefore$ Workdone by ~~H~~ the specimen per unit volume $= \int_M^B HdB =$ area AMBA