(Section B)

Short Question

Question 2

Part No V

Ohm's Law :—

Statement

Ohm's law states that when a voltage is applied across a conductor, the current will flows through the conductor when the temperature is kept constant.

Mathematical

$V \propto I$

$V = \frac{I}{R}$

Constant

where 'R' is constant which is known as resistance of the conductor

Difference between Ohmic or non Ohmic Conductor :-

Ohmic Substance

The substances which have constant or straight $\frac{I}{V}$ graph or the substances for which the ohm's law is valid are known as ohmic substances

Examples

Metals are examples of ohmic substances.

Non - Ohmic Substances :-

The substances for which the the I-V graph is not straight but it is curved or do not obey ohm's law are non-ohmic substances.

Example :-

Filament of tungsten wire, diode etc.

Part (i)

Given data :-

$r = 30 cm$

$= 30 \times 10^{-2} m$

point charge $= q = 3 \mu C$

$= 3 \times 10^{-6} C$

value of $k = 9 \times 10^{9} Nmc^{-2}$

Required :-

$E = ?$

Solution :-

$$E = k \frac{q}{r^2}$$

$$E = 9\times10^{9}\,Nmc^{-2} \times \frac{3\times10^{-6}\,C}{(30\times10^{-3}\,m)^2}$$

$$E = 9\times10^{9}\,Nmc^{-2} \times \frac{3\times10^{-6}\,C}{9\times10^{-4}\,m^2}$$

$$E = 9\times10^{9}\,Nmc^{-2} \times 3.33\times10^{-3}$$

$$E = 3\times10^{5}\,NC^{-1}$$

Part (viii)

Statement :-

Yes, doubling the frequency affect the reactance of inductor or capacitance.

doubling Frequency doubles Inductance

The formula for reactance of an inductor is ;

$$X_L = 2\pi f$$

Now if we doubles the frequency i.e $f = 2f'$

$$X_L' = 2\pi f$$
$$X_L' = 2\pi(2f') \quad \because f = 2f'$$
$$X_L' = 2(2\pi f')$$
$$X_L' = 2X_L$$

So this proves that doubling frequency doubles the reactance of inductance

Doubling frequency halFs capacitance

The formula for capacitance is :

$$X_c = \frac{1}{2\pi f}$$

IF we doubles the frequency

$f' = 2f$

$$X_c' = \frac{1}{2\pi(2f)} \quad \because f = 2f$$

$$X_c' = \frac{1}{2(2\pi f)}$$

$$X_c' = \frac{1}{2X_c}$$

So doubling frequency half the capacitive reactance.

Conclusion

It is concluded that doubling frequency doubles inductive reactance but decrease capacitive reactance.

Part (iv)

Volts :—

volts are unit of potential difference. One volt of potential differenc occure when one coloumb charge moves from higher to lower potential.

Electron Volts

Electron volts are units of kinetic energy. 1ev of kinetic energy is done when electron gain or lose energy when covers a distance of one volt of potential difference.

Relation :-

1 electron volt is the energy between one volt potential difference and energy in elementary units.

$$E_{(ev)} = P.D_{(v)} \times Q_{(e)}$$

So 1 ev is :-

$$1ev = 1V \times 1.6 \times 10^{-19} C$$

$$1 ev = 1.6 \times 10^{-19} J$$

$$Volt = \frac{W}{q}$$

Difference

Volt is the quantity related to potential difference between 2 points in electric field but electron volt is related to energy of particle placed in that magnetic field.

Part (vii)

Explanation

The magnetic field of current carrying coil or conductor behave like a bar magnet That's why current carrying coil behaves like a bar magnet.

Bar Magnet

Bar magnet is a permanent magnet which have north and South poles. The magnetic field originate from north pole and ends in a south pole.

Current Carrying Coil :-

When a conductor carrying current is placed in a magnetic field we can find by right hand rule that streche your hands (right) in a direction of magnetic field thumb will be in a direction of north pole and other side will be in direction of south pole which are alike so hence current carrying coil behaves like a bar magnet.

Part (ix)

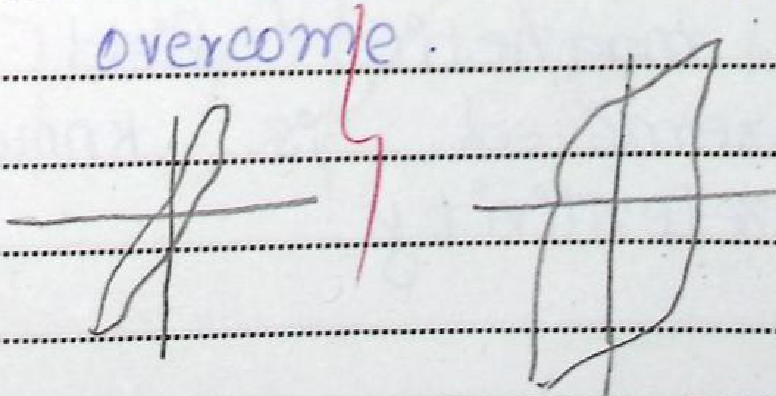
Soft magnetic material

The materials which have narrow hysteris loop or can easily magnetized or demagnetize are called soft magnetic materials.

These materials have low residual value & less coercive force is required for over-coming. The work is done to fill the area of loop, So due to small area less energy is dissipated in form of heat.

Hard Magnetic material

The materials which have wide hysterisis loop and difficult to magnetize or demagnetize or remain magnetized once it is magnetized. These are called Hard magnetic materials. The work done for area is large. So very much energy is disscipated in form of heat. They have residual value & large coercive force is required to overcome.



Hard material

Part (x)

Coercive Force

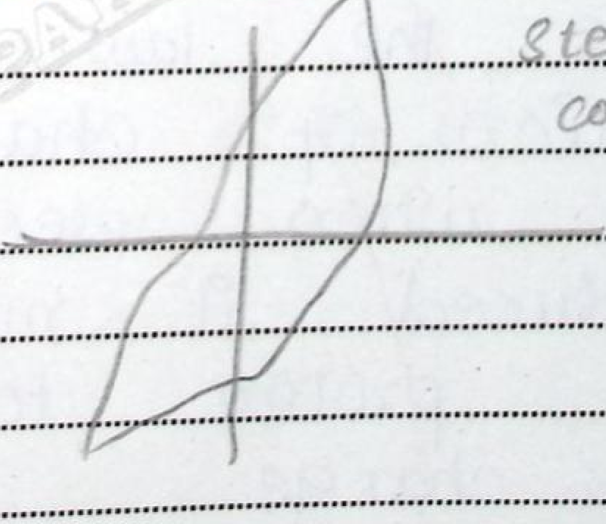
The ability of a material to demagnetize the magnetic field of a material to 0 is known as coercive force.

Retentivity :

The capacity of a material to retain magnetization after magnetic field has been removed is know as retentivity.

Coercive Force of Steel

The coercive force of steel is higher than iron or retentivity of steel is less than iron. So materials with large coercive force are used to make permanent magnets. That's why steel is used to make permanent magnets.



steel coercive force is higher

Part (xiii)

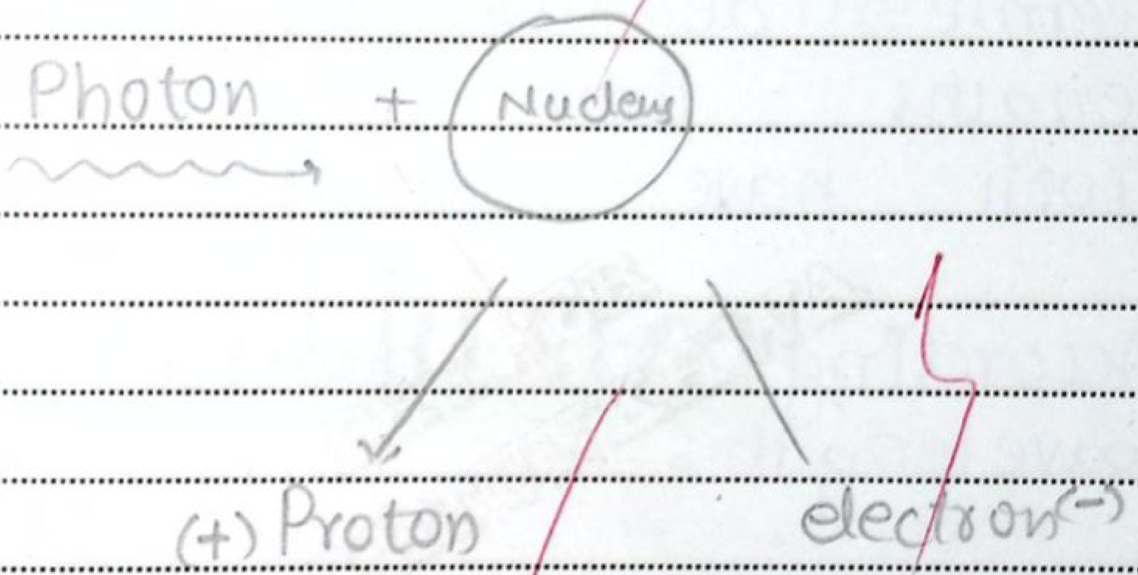
Pair Production

The production of electron or positron due to interaction of photon with heavy mass nuclei.

$\rightsquigarrow$ + Nucleus $\rightarrow$ $\ominus$ elec
Photon $\searrow$ $\oplus$ positron

There is the law of conservation of charge because when electron is produced it must produce proton to conserve law of charge.

There is also law of conservation of momentum because for carrying such a high energy photon massive nucleus with large momentum is required.



$$\lambda \longrightarrow e^{+} + e^{-}$$

Part (xii)

Statement

electron and proton has same de Broglei wave lengths than electron will have greater speed

According to debroglie-wavelengths ;

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

$$\lambda \propto \frac{1}{m}$$

From the above equa the speed in inversely proportional to mass.

As mass of electron is less than proton so electron will have larger speed when wavelengths are same.

Conclusion

The speed of electron is greater than proton because of its less mass.

proton is 1836 times heavier than electron.

Part (ii)

Show $E = -\dfrac{\Delta V}{\Delta r}$

Derivation :

$$W = F \cdot d$$

$$E = \frac{F}{q}$$

$$F = qE$$

$$W = qE \cdot d$$

$$V = \frac{W}{q}$$

$$W = \frac{V}{q}$$

$$\cancel{q} E \cdot d = V \cancel{q}$$

$$E = -\frac{\Delta V}{\Delta r} \qquad \because d = \Delta r$$

Long Question

AC Generator

Definition :-

AC means Alternating Current.
It convert mechanical energy to electrical energy.

Principle :

AC generator works on the principal of electromagnetic induction.

Construction

Ac generator consist of the following parts. It has permanent magnets pole & split rings. The coil is place between permanent magnent. It is Connected to load when it generate current it is provided to load and load becomes started. Ac generator also contain carbon brushes.

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Working :-

When the current flow through the coil The coil moves in different directions First the coil and magnetic field are in direction in which angle between is 0, 90, 180, 270 and 360.
So the coil moves in diff directions.

At position 1

The angle between magnetic field and coil is zero.

At Position 2:

The angle b/w magnetic field and coil is 90°.

At Posi 3

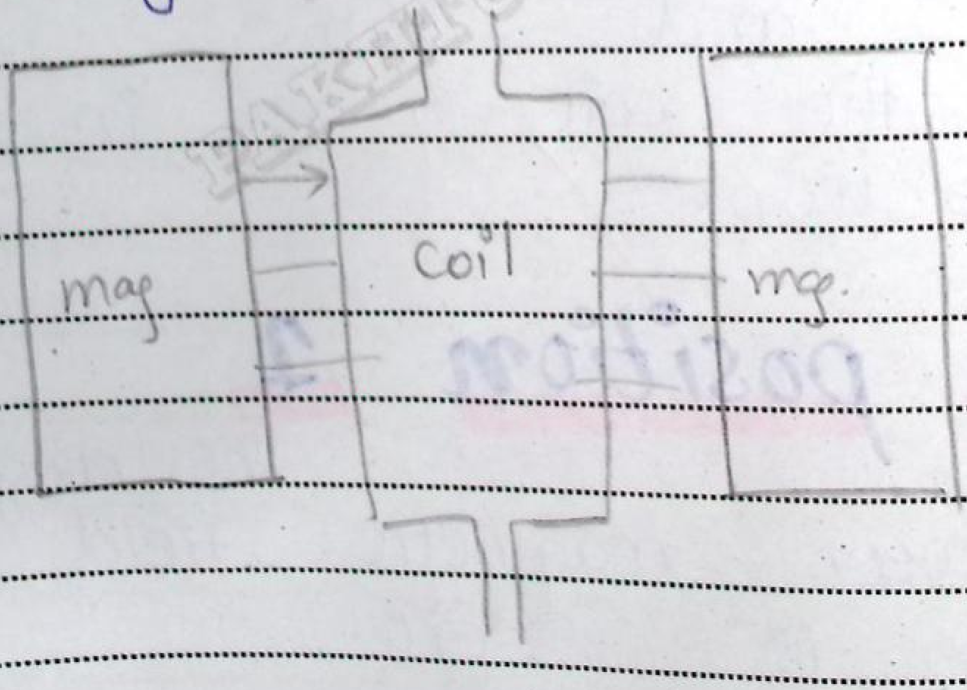
The angle will be 180°

At Posi 4

The angle will be 270.

At Posi 5

The angle will be 360°.



Part B

Given :-

current = I_1 = 0A

current = I_2 = 5A

Time = t = 0.1s

emf = $\mathcal{E}$ = 200V

Required :-

Self inductance = L = ?

Solution :-

We know that

$$L = \frac{\mathcal{E}\,\Delta t}{\Delta I}$$

By putting values

$$L = \frac{20\text{V} \times 0.1\text{S}}{5\text{A} - 0\text{A}}$$

$$L = \frac{20}{5}$$

$$L = 4\text{H}$$

Question 4

Part (a)

Bohr postulates

After Rutherford atomic model who says that electrons are concentrated at very small area around nucleus.

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But Bohr explained that revolving of electrons around the nucleus is just like planetary system. As earth rotates around sun.

→ The Bohr said electrons are revolving around the nucleus in fixed circular orbits.

Classical physics explain that as electrons revolve around nucleus radiate energy continously and move towards nucleus in spiral motion.

But actually elec revolving around nucleus are in specific stationary states called energy levels.

The revolving of electron is provided by centripetal force and which is

$$F_e = F_c$$

$$\frac{mv^2}{r} = \frac{ke^2}{r^2}$$

→ The orbitals in which electrons are revolving have angular momentum which is integral multiple of $\frac{h}{2\pi}$.

$$L = \frac{h}{2\pi}$$

$$mvr = \frac{h}{2\pi}$$

→ The electrons energy level is 3rd postulate
The electron will jump from higher energy level to lower energy and radiate energy.

$$E = E_2 - E_1$$

Radii of electron Orbit :-

The electron revolving around nucleus has the orbit whose radius is quantized. The small bohr radius will be the one from which other radii will be founded.

$$F_c = F_e$$

$$\frac{mv^2}{r} = \frac{ke^2}{r}$$

$$\frac{mv^2}{\cancel{r}} = \frac{ke^2}{\cancel{r} \cdot r}$$

$$mv^2 = \frac{ke^2}{r}$$

$$r = \frac{ke^2}{mv^2} \quad (1)$$

From second postulate:

$$mvr = \frac{nh}{2\pi}$$

$$mv = \frac{nh}{2\pi r}$$

Put mv in eq (1)

$$r = \frac{ke^2}{mv^2}$$

$$v = \frac{nh}{m2\pi r}$$

Put value of v in eq 1

$$r = \frac{ke^2}{m\left(\frac{nh}{2\pi r}\right)^2}$$

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$$r = \frac{n^2h^2 \div ke^2}{m^2\, 4\pi r^2 m}$$

$$r = ke^2 \div \left(\frac{nh}{2\pi m r}\right)^2$$

$$= \frac{ke^2}{m} \times \frac{4\pi^2 m^2 r^2}{n^2h^2}$$

$$r = \frac{ke^2\, 4\pi^2 m r^2}{n^2h^2}$$

$$r = \frac{ke^2\, 4\pi^2 m r^2}{n^2h^2}$$

$$\frac{n^2h^2}{ke^2\, 4\pi^2 m} = r$$

$$r = \frac{n^2h^2}{ke^2\, 4\pi^2 m}$$

$$r = n^2\left(\frac{h^2}{ke^2 4\pi^2 m}\right)$$

$$r = n^2\left(0.532 \times 10^{-10}\right)$$

$$\frac{h^2}{ke^2 4\pi^2 m} = \text{constt}$$

$$r = n^2 r_0$$

Given :-

n shell $= n = 4$

p shell $= p = 1$

Rydberg const $= 1.097 \times 10^{-7}$

Required

wavelength $= \lambda = ?$

Solution

$$\frac{1}{\lambda} = \frac{1}{R}\left(\frac{1}{n^2} - \frac{1}{p^2}\right)$$

$$\frac{1}{\lambda} = \frac{1}{1.097 \times 10^{7}}\left[\frac{1}{(4)^2} - \frac{1}{(1)^2}\right]$$

$$\frac{1}{\lambda} = \frac{1}{1.097 \times 10^{7}}\left[\frac{1}{16} - \frac{1}{1}\right]$$

$$\frac{1}{\lambda} = \frac{1}{1.097\times10^{-7}}\left(1 - 0.06\right)$$

$$\frac{1}{\lambda} = 8.5 \times 10^{6}\ m$$

$$\lambda = \frac{1}{8.5\times10^{6}\ m}$$

$$\lambda = 1.16 \times 10^{-7}\ m$$

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Question 6

Part (A)

Capacitance of Parallel plate Capacitor

The ability of capacitor to store charges is called capacitance of capacitor.

Mathematical

Consider a parallel plate capacitor in which applied voltage is V.

$$E = -\frac{\Delta V}{\Delta r}$$

once plate is at V_1 & other is at V_2

$$E = -\frac{(V_2 - V_1)}{\Delta r}$$

$$E = \frac{V_1 - V_2}{r}$$

$$E = \frac{V}{r} \quad \text{— eq i}$$

As

$$E = \frac{\sigma}{\varepsilon_0}$$

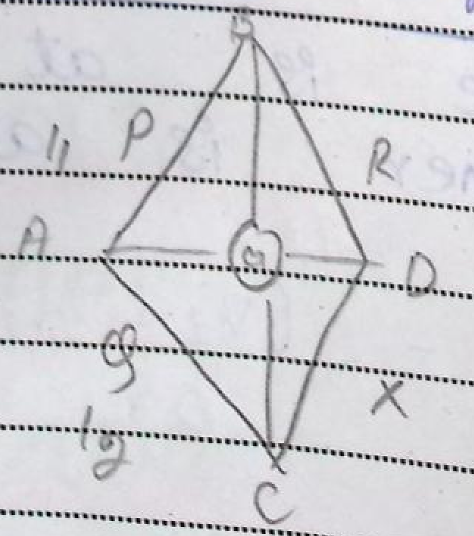
$$E = \frac{q}{A\varepsilon_0} \quad \text{— eq ii} \quad \because \sigma = \frac{q}{A}$$

From eq i & ii

$$\frac{V}{r} = \frac{q}{A\varepsilon_0}$$

$$\frac{q}{V} = \frac{A\varepsilon_0}{r}$$

$$\boxed{C = \frac{A\varepsilon_0}{r}} \quad \text{——} \; (*)$$



weatstone bridge.

Wheat stone Bridge :-

It is a device which is used to detect the unknown resistance with the help of known resistance.

Construction

Whetstone Bridge consist of 4 Resistances P, Q, R, x The P, Q are fixed resistances while R is variable resistance while x has to be known. The Galvanometer is attached across AB, AD and the key is attached to AC.

Working:

When the key is closed the current divides b/w the AB and AD and the Resistor R is varied until the galvanometer reads zero The wheatstone bridge is said to be balanced when the B and D are at same potentials and AB, AD are at same potential differences.

Potential diff across AB = AD or potential diff across AD, AC are also at same potential diff :

$$P I_1 = Q I_2$$

$$R I_1 = X I_2$$

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$$\frac{P}{Q} = \frac{R}{x}$$

$$X = \frac{P}{Q} R$$

So in this way the unknown Resistance cane be found by known resistance.

B.I.S.E THE END KOHAT