SECTION 'B'

QUESTION 2:

—: (i) :—

ANSWER:

GIVEN DATA:

Distance = r = 30 cm

= 30×10^{-2} m

Charge = q = 3 μC

= 3×10^{-6} C

Coloumb's constant = $k = 9 \times 10^{-9} C^2 N^{-1} m^{-2}$

REQUIRED DATA:

Electric field = E = ?

SOLUTION:

By applying formula.

$$E = \frac{kq}{r^2}$$

Putting the values, we get

$$E = \frac{(9 \times 10^{-9})\ (3 \times 10^{-6})}{(30 \times 10^{-2})^2}$$

$$E = \frac{27000}{0.09}$$

$$E = 300,000$$

$$E = 3 \times 10^{-5}$$

$$E = 0.3 \times 10^{-6}\ C$$

$$E = 0.3\ \mu C$$

—:(ii):—

ANSWER:

VOLT:

Volt is the unit of potential difference and 1 volt is the potential difference when 1 joule of work is done in moving 1 Coloumb charge between two points in electric field.

ELECTRON VOLT:

Electron volt is the unit of kinetic energy and 1 ev is the energy of electron when it moves through potential difference of 1 volt.

RELATION:

The energy in electron volt is equal to the voltage in volt times and electric charge in elementary units.

$$E_{(eV)} = V_{(x)} \times Q_{(e)}$$

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

$$1\,eV = 1.6 \times 10^{-19} J \qquad V \times C = J$$

DIFFERENCE:

Volt and electron volt are two different physical quantities. Electric potential is the property associated with the field while energy is associated with the particle you place into the field and

it depends upon the particle.

—:(V):—

ANSWER:

OHM'S LAW:

This law was presented by German scientist George Simon ohm in 1886.

STATEMENT:

The magnitude of current in a conductor is directly propotional to applied voltage as long as temperature of conductor is kept constant

MATHEMATICAL FORM:

$$V = IR$$

whereas 'V' is the voltage 'I' is the current and 'R' is the resistance.

OHMIC SUBSTANCES:

The substances which strictly obey's Ohm's law are called ohmic substances.

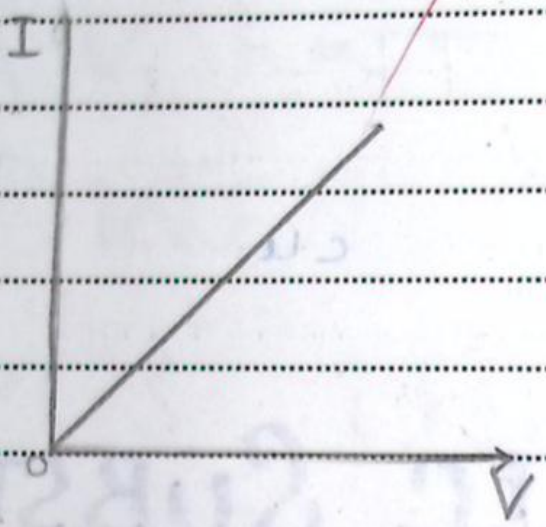
EXAMPLES:

- Metals are ohmic in characteristics.

GRAPH:

For ohmic

substances current verses voltage graph is a straight line.



NON-OHMIC SUBSTANCES:

The substances which donot obey ohm's law are called non-ohmic substances.

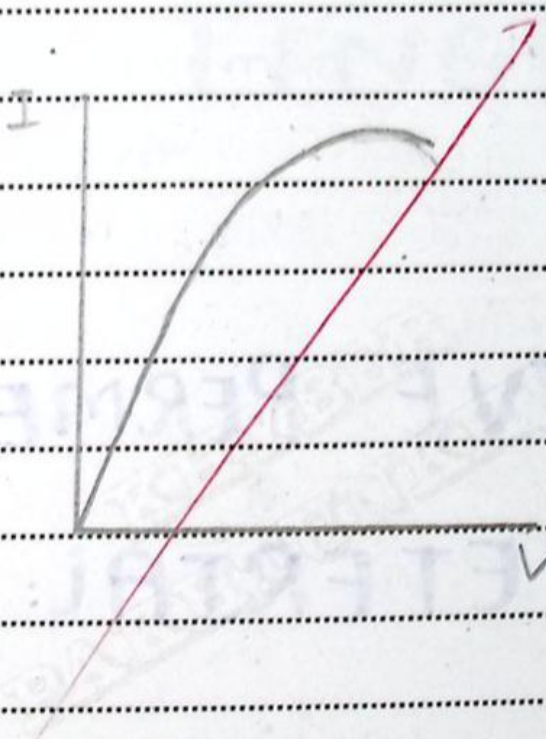
EXAMPLES:

Thermistor, semiconductor

diode , tungsten filament

GRAPH:

For non-ohmic substances current versus voltages is curved (not linear)



—:(vi):—

ANSWER:

FACTORS AFFECTING

INDUCTANCE:

1. NUMER OF TURNS:

If the number of turns in the coil is more then greater the inductance and if the number of turns is fewer then lesser will be the inductance.

2) RELATIVE PERMEABILITY OF METERIAL:

If the relative permeability of core material which the coil is wrapped around is greater then greater will be the inductance.

3 COIL AREA:

Coil area is directly propotion to inductane. Greater the area of coil greater will be the inductance.

4- COIL LENGTH:

Coil length is inversely propotional to length. If the length of the coil is more then inductance will be greater.

—: (vii) :—

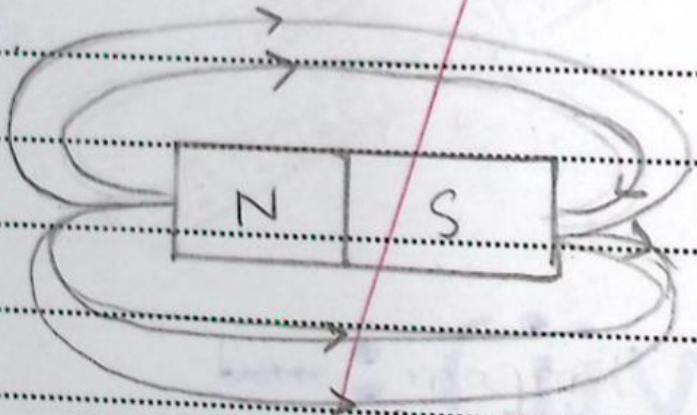
ANSWER:

The magnetic field of a current carrying

coil resembles a bar magnet. That's why current carrying coil behaves like a bar magnet.

EXPLANATION:

→ Consider a bar magnet which have North and South poles. Magnetic field lines originate from North pole and ends on South pole.



Bar magnet

→ Consider a coil having N number of turns. when

current is passing through coil. Magnetic field is set up around coil. The direction of magnetic field lines can be determined through Right Hand Rule which states that

"grab the current carrying conductor in your right hand and curl the fingers around the coil in the direction of current the extented thumb will give direction of North pole of a magnet and other point behaves like south pole"

By comparing both the fields it is clear that both magnetic fields are similar to each other. That's why current carrying coil behaves like bar magnet

—:(xiii):—

ANSWER:

PAIR PRODUCTION:

DEFINITION:

The creation of an elementary particle and it's antiparticle. when photon strikes the nucleus the electron and it's antiparticle positron may be created is called pair production

MATHEMATICALLY:

$\gamma = e^- + e^+$

EXPLANATION:

Pair production is the process in which photon is converted into photon in accordance with Einstein mass energy equation $E = mc^2$. A photon when pass near the nucleus it disintegrates the nucleus into electron and positron. A positron has the same mass as electron but opposite charge.

PRODUCTION OF POSITRON:

A photon cannot create electron alone because this would voilate law of conservation of charge.

Thus to conserve charge positron is created.

PRESENCE OF NUCLEUS:

Presence of nucleus is necessary because it conserve momentum.

ENERGY OF PHOTON:

For electron and positron pair a minimal of $2m_0c^2$ energy is needed the surplus energy is taken by electron and positron as their kinetic energy.

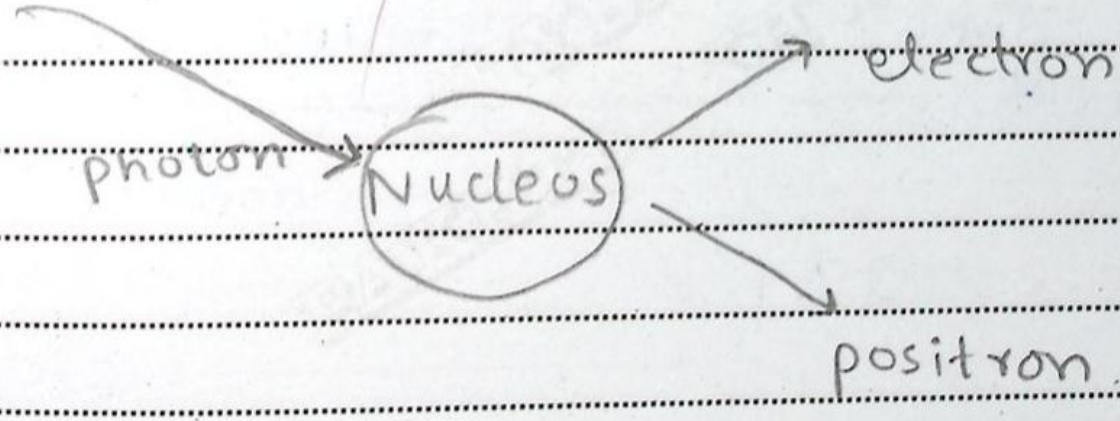
$$hf = 2m_0c^2 + (K.E)_{-e} + (K.E)_{+e}$$

MINIMUM ENERGY OF PHOTON:

For minimum energy, electron and positron cannot take kinetic energy. Thus minimum energy is

$hf = 2m_0c^2$

and value of $2m_0c^2$ is 1.02 MeV



—:(viii):—

ANSWER:

Doubling the frequency doubles the inductive reactance

EXPLANATION:

As inductive reactance is given by the following equation.

$$X_L = 2\pi f L$$

By Doubling the frequency the new reactance is.

$$X_L' = 2\pi f' L$$

$$= 2\pi (2f) L$$

$$X_L' = 2(2\pi f L)$$

$X_L' = 2X_L$ $\quad \therefore X_L = 2\pi f L$

Thus by doubling the frequency the inductance will double.

b) Capacitive Reactance Becomes Half when frequency is Double

EXPLANATION:

As capacitive reactance is given by the following equation

$$X_C = \frac{1}{2\pi f C}$$

By doubling the frequency, the new reactance is given by

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

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

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

$$X_c' = \frac{1}{2X_c} \qquad \therefore X_c = \frac{1}{2\pi fC}$$

Thus capacitive reactance becomes half when frequency is double

-:(xii):-

ANSWER:

Speed of electron will

be greater than speed of proton.

EXPLANATION:

According to De-Broglie hypothesis the wavelength is

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

$$v = \frac{h}{m\lambda}$$

Since De-broglie wavelength is same for both particles therefore above equation becomes

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

From the above expression it is clear that velocity is inversely proportional to mass

Smaller the mass of particle, greater will be the speed. And hence electron will have lesser mass the proton therefore speed of electron is greater for same de-broglie wavelength.

—: (ii) :—

ANSWER:

POTENTIAL GRADIENT:

The rate of change of electric potential with respect to displacement is called potential gradient.

MATHEMATICALLY:

Potential Gradient = $\frac{\Delta V}{\Delta r}$

RELATION BETWEEN ELECTRIC FIELD INTENSITY AND POTENTIAL GRADIENT

Consider uniform electric field for which the lines of force are parallel and equidistance from each other. Let A and B be two points in electric field which is very close to each other and potential is almost

constant. The work done of charge for point A to B is given by

$$W = W_{AB}$$

$$= \vec{F} \cdot \Delta\vec{r}$$

$$= F \Delta r \cos\theta$$

As $F = -Eq_0$

$$W = -Eq_0 \Delta r \cos\theta$$

$\theta = 0°$ and $\cos 0° = 1$

$$W = -Eq_0 \Delta r$$

$$\frac{W}{q_0} = -E\Delta r \qquad \Delta V = \frac{W}{q_0}$$

$$\Delta V = -E\Delta r$$

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

Thus electric field intensity

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is the negative of potential gradient.

—:(ix):—

ANSWER:

SOFT MAGNETIC MATERIALS	HARD MAGNETIC MATERIALS:
1. Soft magnetic material have narrow hysteresis loop.	Hard magnetic materials have thick hysteresis loop.

SECTION 'C'

QUESTION 3:

—: (a) :—

ANSWER:

AC GENERATOR:

DEFINITION:

An AC (alternating current) generator is device which converts mechanical energy into electrical energy of the form in which flow of electric charges periodically reverses direction.

WORKING PRINCIPLE:

It works on the principle of Faraday's law of electromagnetic induction. The emf generated by generator is dynamically induced emf.

CONSTRUCTION:

AC Generator consists of coil CDEF, two carbon brushes and two slip rings. ~~The~~ The coil rotates between the poles of magnet, as a result induced emf will be produced in the coil. Due to this induced emf electric current flow through coil. The side EF is connected with A, and side CD is attach with

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area A_2 . A_1 is always in contact with brush B_1 . And A_2 is connect with brush B_2

WORKING:

When coil CD moves upward, Fleming's right hand rule shows current flow from C to D and E to F. Thus current enters the circuit at B_1 and leaves at B_2. Half a revolution later the side EF will be in a position previously occupied by CD and thus current direction is reversed i-e from F to E and D to C. The current now enters the

enters the circuit at B_2 and leaves at B_1. The direction of current and electromotive force changes every half a revolution.

EXPRESSION FOR INDUCED EMF:

Suppose a coil is rotating with angular velocity 'ω' in time interval 't'. 'θ' be the angle which the coil makes with field. If 'N' is the number of turns in the coil and A is the area then magnetic flux through Area is

$$\phi_B = BA\cos\theta$$

$$\phi_B = BA\cos(\omega t) \quad \because \theta = \omega t$$

According to Faraday's law:

$$\mathcal{E} = -N \frac{\Delta \phi}{\Delta t}$$

Putting the value of ϕ

$$\mathcal{E} = -N \frac{(BA \cos \omega t)}{\Delta t}$$

$$\mathcal{E} = -NAB \frac{\cos(\omega t)}{\Delta t}$$

If we take time interval very small $\Delta t \to 0$

$$\mathcal{E} = -NAB \lim_{\Delta t \to 0} \frac{\cos(\omega t)}{\Delta t}$$

$$\mathcal{E} = -NAB(-\omega \sin \omega t)$$

$$\mathcal{E} = NAB\, \omega \sin \omega t$$

$\lim_{\Delta t \to 0} \frac{\cos \omega t}{\Delta t} \downarrow -\omega \sin \omega t$

For $\mathcal{E}_{max}$ $\sin \omega t = 1$

$$\mathcal{E}_{max} = NAB\, \omega\, (1)$$

$$\mathcal{E}_{max} = NAB\, \omega$$

—:(b):—

GIVEN DATA:

Initial current = $I_i = 5A$

Final current = $I_f = 0A$

$\Delta I = 0 - 5 = -5A$

Time = $t = 0.1s$

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

REQUIRED DATA:

Self inductance = $L = ?$

SOLUTION:

we know that

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

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

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Putting the values:

$$L = \frac{(200)(0.1)}{5A}$$

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

$$L = 4H$$

5

QUESTION 6:

-: (a) :-

9

ANSWER:

Capacitance Of Parallel Plate Capacitor In Vacuum.

Capacitor is connected to battary The current starts flowing. And capacitor starts charging let one plate gets positive charge and other plate get's negative charge let $+Q$ is at potential V_1 and $-Q$ is on potential V_2 thus electric field strength between plates are

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

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

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

$$E = \frac{\Delta V}{d} = \frac{V}{d} \quad (1)$$

The strength of electric field also depend on the charge on plates. Therefore surface charge density is defined as charge per unit area of the plate

$$\sigma = \frac{Q}{A} \quad \text{---} (2)$$

By using Gauss's law, electric field intensity between two parallel plates is

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

Putting value of 'σ' from eq (2)

$$E = \frac{Q}{A\varepsilon_0} \quad \text{---} (3)$$

By comparing eq (1) and eq (3)

$$E = \frac{V}{d} = \frac{Q}{A\varepsilon_0}$$

$$\frac{Q}{V} = \frac{A\varepsilon_0}{d} \qquad \frac{Q}{V} = A\varepsilon_0$$

$$C = \frac{A\varepsilon_0}{d}$$

Capacitance Of Parallel Plate Capacitor In Dielectric:

When we placed insulator (dielectric) inside the plates of the capacitor then capacitance is

$$C_{med} = \frac{A\varepsilon}{d}$$

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As we know that

$$\varepsilon_r = \frac{\varepsilon}{\varepsilon_o}$$

$$\varepsilon = \varepsilon_r \varepsilon_o$$

Putting the value of 'ε' in above equation.

$$C_{med} = \frac{A \varepsilon_r \varepsilon_o}{d}$$

—:(b):—

ANSWER:

WHEATSTONE BRIDGE:

DEFINITION:

A simple circuit which is used to determine an unknown resistance precisely and accurately is called wheatstone bridge.

CONSTRUCTION:

Four resistors are arranged in such a way that they form closed loop ABCD. A single emf source is connected between point A

and C through a key. The galvanometer is connected as a bridge between two points.

Working Principle:

The wheatstone bridge is based on balancing of bridge. The resistances are connected in such a way that galvanometer deflection is zero.

Working:

The resistance of P and Q are fixed whereas 'R' can be varied by changing unknown resistance X when the key closed the current is divided between branch AB and AD And galvanometer shows deflection

The value of variable resistance is changed such the galvanometer deflection is zero. Under such condition bridge is said to balance.

Because potential at B and D is same. Under balanced condition potential across AB and AD is equal thus.

$I_1 P = I_2 R$ —— (1)

And similarly potential across BC and DC is equal therefore

$I_1 Q = I_2 X$ —— (2)

Divide eq (2) by eq (1)

$$\frac{I_1 Q}{I_1 P} = \frac{I_2 X}{I_2 R}$$

B.I.S.E THE END KOHAT.

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

$$X = \frac{QR}{P}$$

QUESTION 4:

—: (a) :—

BOHR'S POSTULATES ABOUT HYDROGEN ATOM:

1) The electron waves with the force F_c and F

$$\frac{mv^2}{r} = \frac{k \cdot q}{r^2}$$

2) Momentum of the atom is quantized which is integral multiple $nh/2\pi$

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

3) Electron has specific energy in each shell which also quantized

$$E = E_p - E_n$$

4) As electron jump from high energy level to low energy level they lose energy and when jump from low

energy level to high energy level it absorbs energy.

$$E = hf$$

EXPRESSION FOR RADII:

1st postulate

$$\frac{mv^2}{r} = \frac{kq}{r^2} \quad \text{(i)}$$

2nd postulate

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

$$v = \frac{nh}{2\pi mr}$$

Put this value of v in eq (i)

$V^2 = \frac{Kq}{r}$

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

$\frac{n^2h^2}{4\pi^2 mkq} = r$

$n^2 \times \text{constant} = r$

$n^2 \times r_o = r$

where $r_o = 0.59 A^o$

So $n^2 \times 0.529 A^o$

—:(b):—

Answer.

Energy level $= 4$

Rydberg constant $= 1.0974 \times 10^7$

$\lambda = ?$

$\frac{1}{\lambda_n} = R_H \left[\frac{1}{p^2} - \frac{1}{n^2}\right]$

$\frac{1}{\lambda_n} = 1.0974 \times 10^7 \left[\frac{1}{1^2} - \frac{1}{4^2}\right]$

$= \left[\frac{1 \times 16}{1 \times 16} \times \frac{1}{16 \times}\right]$

$\left[\frac{16-1}{16}\right]$

$\frac{1}{\lambda_n} = 1.0974 \times 10^7 \left[\frac{15}{16}\right]$

$\frac{1}{\lambda_n}$ 1.0974×10^7 (0.

$\frac{1}{\lambda_n} = 1.028 \times$

$\lambda_n = 1.16$