SECTION : B

QUESTION ANSWERS

QUESTION: 1

ANSWER:

GIVEN:

Distance = 30cm

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

value of charge = q = 3μC

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

value of constant = $k = 9 \times 10^{9} N m^{2} C^{-2}$

REQUIRED:

Electric field: $\vec{E}$ = ?

FORMULA:

$$\vec{E} = \frac{Kq}{r^2}$$

SOLUTION:

Putting values in given formula

$$= \frac{9 \times 10^9 \, Nm^2 C^{-2} \times 3 \times 10^{-6} C}{(30 \times 10^{-2} m)^2}$$

$$= \frac{27000 \, N m^2 C^{-1}}{0.09 \, m^2}$$

ANSWER:

$$\vec{E} = 3 \times 10^5 \, NC^{-1}$$

QUESTION: 2.

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

ANSWER:

Consider a charge is displaced in electric field from one point to other. Potential energy is stored in charge by work done.

$W = F \cdot \Delta r$

$W = Eq \cdot \Delta r$ eq(i) $\because F = Eq$

Futther more the potential difference is equal to.

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

Potential Gradient:

Rate of change of E with displacement is

called potential gradient.

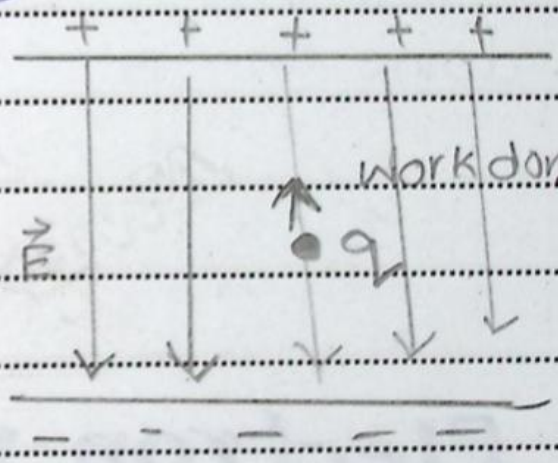
$W = -\Delta V q$ eq (ii)

Since negative sign is inserted in equation because work is done aggaist the direction of field

Left hand side is equal so comparing R.H.S

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

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



Negative sign shows that potential is increasing in opposite direction of electric field. This relationship is anlogous to earth's gravitational field.

QUESTION: 4

Volt:

Volt is the unit of potential difference.
Potential is said to be 1 volt is work of 1J is done on a charge of q = 1C.

$$1V = \frac{1J \text{ work}}{1 \text{ coloumb}}$$

Electron Volt

Electron volt is unit of energy at atomic level.
It is energy gained or lost by charge equal to 1 electron and moved thro

potential difference of 1 V.

1 eV = charge of (e) x 1 volt.

1 eV = 1.6×10^{-19} J.

RELATED AND DIFFERENCE.

volt is the different physical quantity related to field.

Howeven electron volt is accociated with energy of charge.

$1\ eV = q \times \Delta V$

1 eV is the elementry charge times potential differce.

QUESTION: 5

INTRODUCTION:

Gregor Simon Ohm relates three fundamental quantities in a law known as ohm's law.

Ohm's Law:

"The current flowing through conductor is directly related to potential differce applied if temperature remains constant."

$$I \propto V$$

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

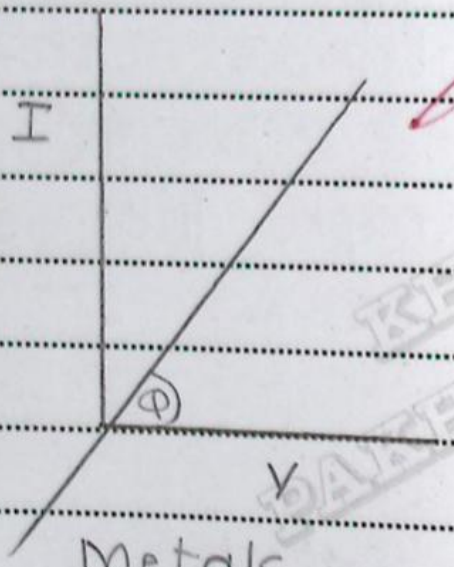
R is constant which called resistance of material.

Ohmic Substances	Non Ohmic Substances
• Ohmic substances are those current verses voltage graph is a stright line	Non-ohmic substances current verses voltage has a graph that is not linear.
• Resistance of ohmic conductors is very small.	Resistance of non ohmic conduct Varies.
• Metals seems to obey ohm's law.	Beside metals, semiconductors and non metals

are also non ohmic.

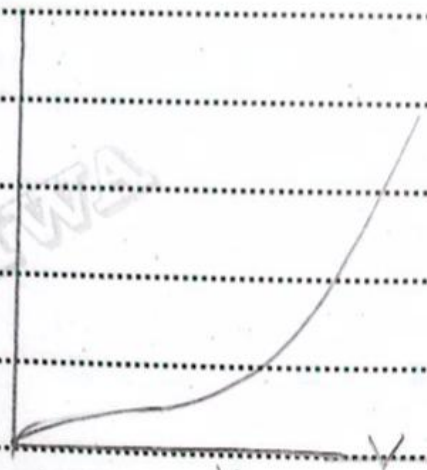
- Current increases linearly with increase of potential applied

Current donot increase linearly because of resistance of material

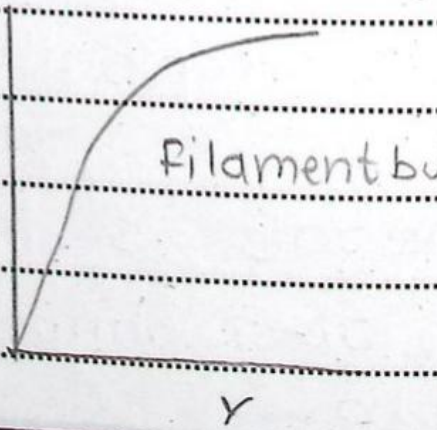


Metals

slope = $\frac{1}{R} = G$



Thermistor



filament bulb

QUESTION: 3

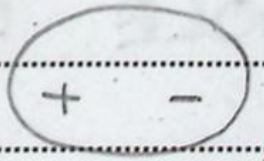
(i) DIELECTRIC:

Dielectric is any insulator when placed in electric field this substance is know called direlectric.

EXAMPLES OF DIELECTRIC:

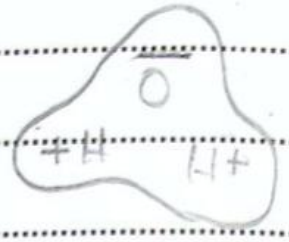
Air direlectric value -(0.0005)
Water dielectric (78.5)
Benzene, glass, mica etc.

(ii) Dipole:



The system that have equal magnitude but of opposite charge

is called dipole.



Permanant Dipole:

Water is permanent dipole molecule having charge separation but wholly a neutral molecule.

TEMPERY DIPOLE:

Nitroge(N_2) molecule is no dipole in absence of electric field. But in field it become dipole

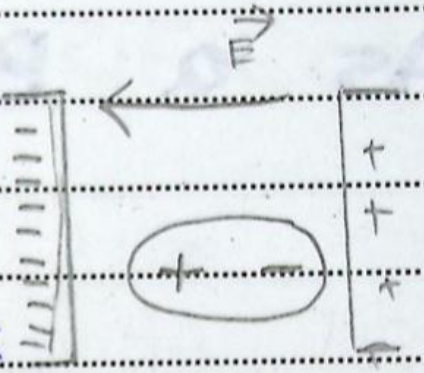
DIPOLE MOMENT:

Dipole moment is measure of polarity of a molecule. It is a vector quantity denoted by $\vec{p}$.

MATHEMATICALLY:

Dipole moment is equal to charge time distance between charge.

$$\vec{P} = |Q \times r|$$

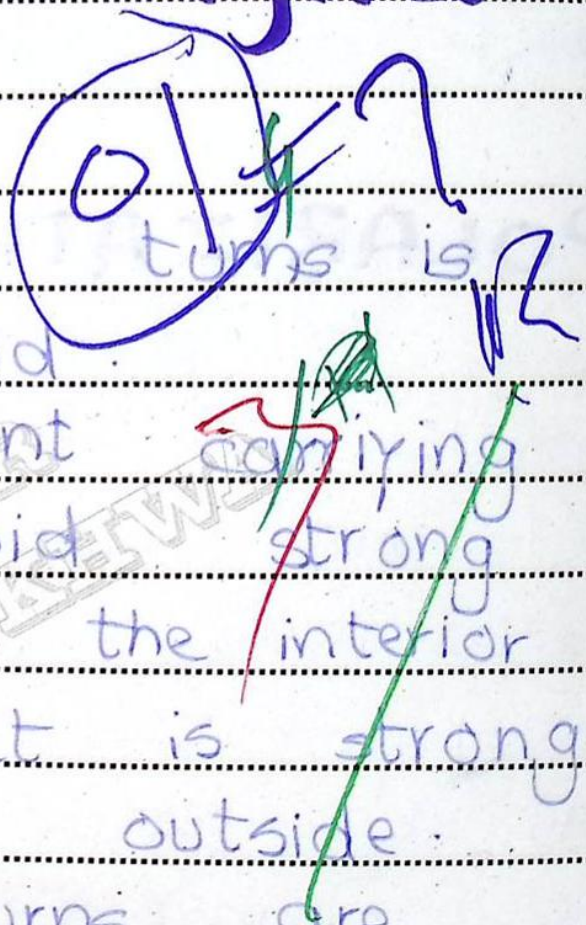


(iv) POLARIZATION:

When a molecule is placed in electric field a slight separation of charge occurs with in molecule. As a result one side of charge become positive while other become negative. This separation of charge is called polarization

QUESTION: 7

Current carriying coil As a Bar Magnet:



coil of many turns is called solenoid. When in a current carrying coil or solenoid strong current passes the interior field of magnet is strong while weaker outside. When the turns are closely packed and length of coil is much larger as campare to diameter of coil the coil has

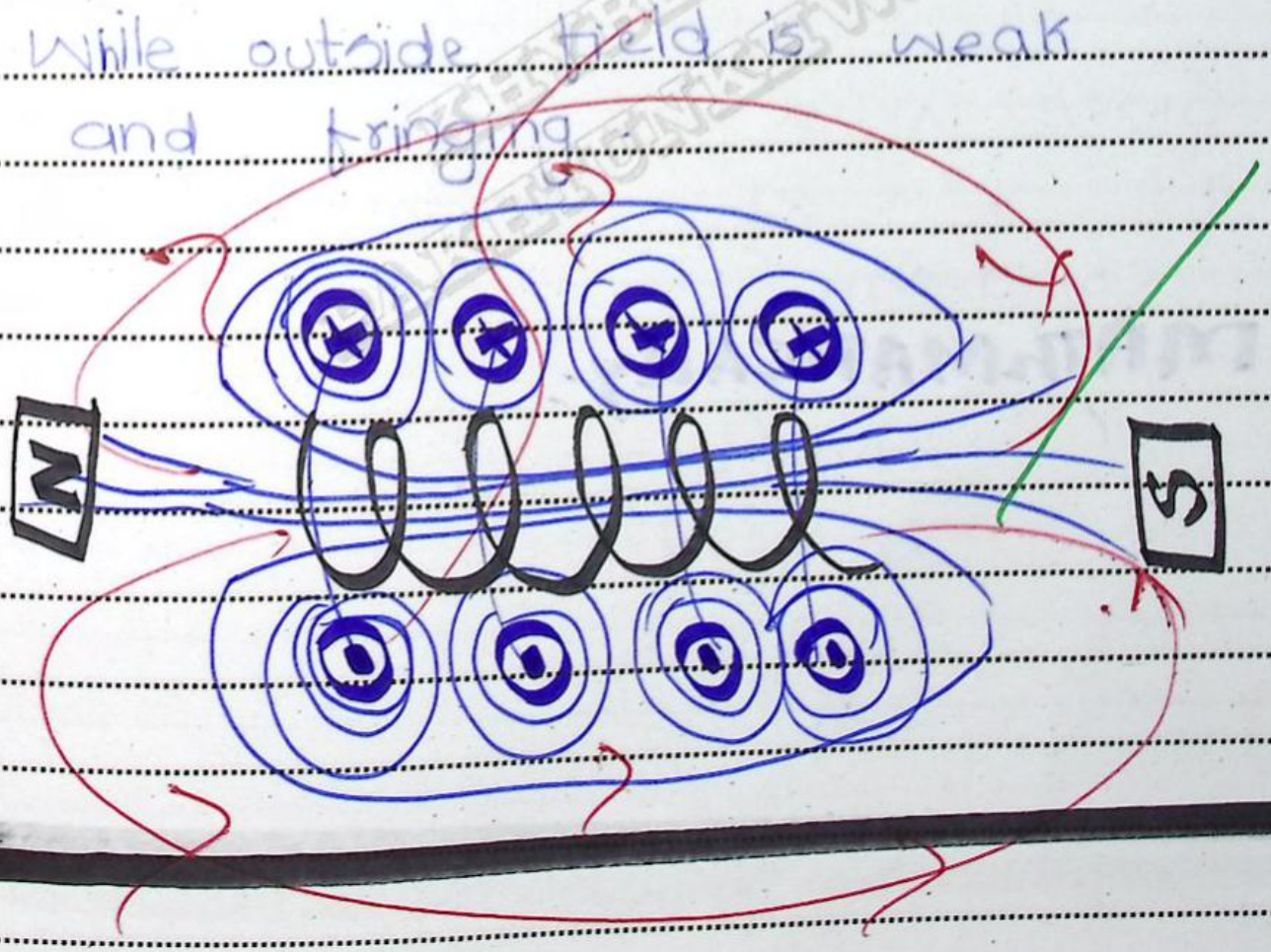
effitive north and south pole. and it behave like a bar magnet.

INTERIOR FIELD OF Coil:

The interior field becomes strong and field lines are parrallel equidistant.

Exterior FIELD OF Coil:

While outside field is weak and fringing



QUESTION: 8

Effect of Doubling Frequency ON capicitor and inductor reactance.

Effect on Inductive Reactance (XL)

$X_L = \omega L$

$X_L = 2\pi f L$

Since $X_L \propto f$

if $f' = 2f$ according to condition.

MATHMATICALLY.

$X_L' = 2\pi f' L$

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

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

$X_L' = 2X_L$

RESULT:

Inductive reactance will be doubled be doubling frequency.

Effect on Capacite Reactance (X_C):

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

If $f' = 2f$

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

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

$\because X_L = 1/2\pi f C$

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

So capative reactance wille

RESULT:

half of orginal capacitance if frequency is doubled.

QUESTION: 12

DE-BROGLI WAVE EQ:

From de-brogli wave equation

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

$$\lambda = \frac{h}{mv} \quad \because P = mv$$

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

Relation shows greater the mass smaller will be

its velocity and vice versa.

Since proton is (1836) heavier than electron mass = (0.0072754) so electron having less mass (0.0005485) will have greter speed and vice versa.

CONCLUSION:

Speed of electron will be more than proton if having same wavelength.

QUESTION: 11

Prove

$$\beta = \frac{\alpha}{1+\alpha}$$

ALPHA FACTOR:

Alph factor is ratio of collector current to emitter current

$$\alpha = \frac{I_C}{I_E}$$

$\because I_E \approx I_C$

$\alpha \approx 1$

BETA FACTOR:

Beta factor or current gain is the ratio of

collector current to base current.

$$\beta = \frac{I_C}{I_B}$$

RELASIONSHIP BETWEEN α and β

Since $I_E = I_C + I_B$

So $I_B = I_E - I_C$

$$\beta = \frac{I_C}{I_E - I_C}$$

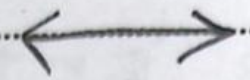
Dividing numerator and denominator with I_E

$$= \frac{I_C / I_E}{I_E/I_E - I_C/I_E}$$

$$\therefore I_C/I_E = \alpha$$

$$\beta = \frac{\alpha}{1-\alpha}$$

Hence proved



QUESTION : 13

Pair Production:

The production of particle and its antiparticle when a photon (or neutral boson) interacts with nucleus. The photo disapears and two particles are created.

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

MINIMUM ENEGY

$E = 2m_0c^2$

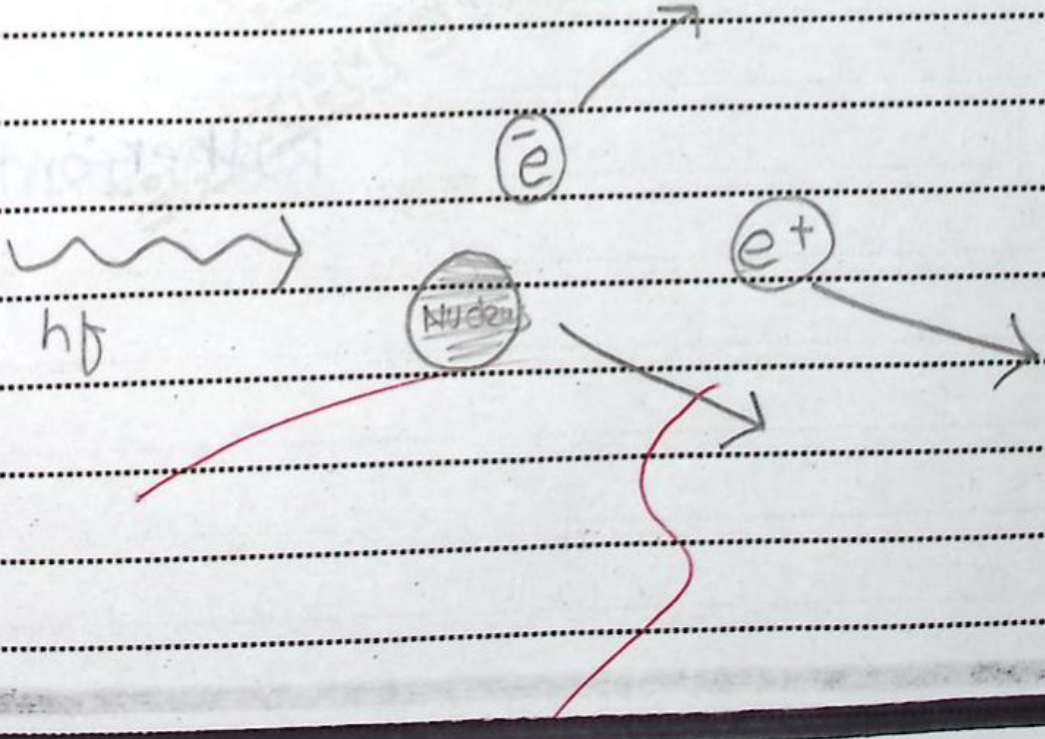
$hf = 2m_0c^2$

$= 2(9.1\times10^{-31})(3\times10^{8})^2$

$= 1.02\times10^{6}\ eV$

$= \boxed{1.02\ MeV}$

A minimum of 1.02MeV energy is needed for pair production.



SECTION: C

QUESTION: 4(a)

Bohr's Postulates ABOUT HYDROGEN:

Niel Bohr Present a model of hydrogen atom to overcome draw backs of Rutherford model.

Niel Bohr postulated that electron revolving around

nucleus is just like planets revolving aroun sun.

POSTULATES:

(1) Electron is revolving around nucleus. This centripetal force is provided by columbic force between nucleus and electron.

$$F_c = F_e$$

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

(2) Electron is revolving in fixed orbit for which angular momentum is integral multiple of $\hbar/2\pi$

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

where $n = 1, 2, 3 \ldots$

(3) Electron revolving in a fixed orbit don't absorb or emit energy.
When electron jump from higher energy level to lower it emits energy.
When jumps from lower orbit to higher it emits energy.

$$\Delta E = hf$$

The energy of radiation emitted is equal to energy difference of two shells.

Calculation of Radius from Bohr's Asumptions:

From 1st postulate.

$$F_c = F_e$$

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

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

From 2nd postulate:

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

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

Putting value of v in eq(i)

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

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

$$r = \frac{n^2h^2}{4\pi^2mke^2} \quad eq(ii)$$

if $n = 1$

$h = 6.62 \times 10^{-36}$ J.s

$\pi = 3.14$

$m = 9.1 \times 10^{-31}$ kg

$K = 9 \times 10^{9}$ Nm^2C^{-2}

$e = 1.6 \times 10^{-19}C$

Putting values in equation (ii)

$$r = \frac{(1)^2 (6.62 \times 10^{-36})^2}{4(3.14)^2 (9.1 \times 10^{-31})(9 \times 10^9)(1.6 \times 10^{-19})^2}$$

$$r = 0.52 \times 10^{-10} m$$

$$r_o = \boxed{0.53 A^\circ m}$$ Bohr orbit

This orbit is called bohr's orbit.

Successive orbits can be calculated as.

$$\boxed{r_n = n^2 r_o}$$

$$r_1 = (1)^2 r_o = 0.52 A^\circ$$

$$r_2 = (2)^2 r_o = 2.11 A^\circ$$

Part: B

Numerical:

GIVEN DATA:

$n = 4$

$m = 9.1 \times 10^{-31} kg$

Wave length is Required:

$\lambda = ?$

Solution:

From bohr's postulate..

$L = nh/2\pi$

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

$P = mv = \frac{nh}{2\pi r}$ eq (i)

From de-broglie wave equation

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

Putting in equation

$$\frac{h}{\lambda} = \frac{nk}{2\pi r} \quad \text{eq(ii)}$$

$$r = n^2 r_0$$

putting in above equation

$$\frac{1}{\lambda} = \frac{n}{2\pi n^2 r_0}$$

$$\lambda_n = 2\pi r_0 n^2$$

$$\lambda = 2\pi r_0 n$$

$$= 2 \times 3.14 \times (0.529 \times 10^{-10}) 4$$

$$\lambda = 1.32 \times 10^{-11} \text{ m}$$

Conclusion: 1.32×10^{-11} m.

QUESTION: 6

(a)

Parrallel Plates Capacitor:-

Consider parrallel plates capacitor when it is connected to potential difference applied charge starts to build.

From electric field as a potential gradient.

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

$$E = \frac{V}{d} \quad \text{equation: 1}$$

CONTINUATION SHEET

Fic. No.

(صرف بورڈ کے استعمال کیلئے) اُمیدوار یہاں کچھ نہ لکھیں

(3)

In this way when armature rotates emf is enduced.

$\Phi_E = BA$

Maximum torques acts on the coil at 2 position in cycle.

$\tau = -NIAB$

$\varepsilon = \frac{-N\Delta\Phi}{\Delta t} = \frac{NAB\cos\theta}{\Delta t}$

$= \frac{-NAB\cos\omega t}{\Delta t}$ $\quad \frac{-\cos\omega t = \sin\omega t}{\Delta t}$

$= NAB\omega\sin\omega t$

$= N\omega AB\sin\theta$

QUESTION: 3

(B)

GIVEN:

Curren change

$\Delta I = 5A \rightarrow 0$.

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

time = 0.1s

Average emf = 200V

REQUIRED:

FORMULA:

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

Arranging formula:

Putting vales in above eqution

Arranging given equation

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

Now putting values.

$$= -\frac{(200V)(0.1s)}{-5A}$$

$$= \frac{200 \times 0.1}{5}$$

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

ANSWER:

$L = 4$ Henry.

Inductance will be
4 henry.

CONTINUATION SHEET

Fic. No. 20

(صرف بورڈ کے استعمال کیلئے) امیدوار یہاں کچھ نہ لکھیں

(3)

From application of guass's law.

Electric field between two opposite charges is equal

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

$$\sigma = \frac{\Phi}{A}$$

$$E = \frac{\Phi}{\varepsilon_0 A} \quad \text{equation (iii)}$$

comparing both eqs

$$\frac{\Phi}{\varepsilon_0 A} = \frac{V}{d} \quad \text{eq (iii)}$$

Since

$$\Phi = CV$$

Replacing in eq (iii)

$$\frac{CV}{\varepsilon_0 A} = \frac{V}{d}$$

$$C_{vac} = \frac{A\varepsilon_0}{d}$$

Capacitance of medium (ε)

If any material is inserted then:

$$C_{vacc} = \frac{A\varepsilon}{d} \quad \because \varepsilon_r = \frac{\varepsilon}{\varepsilon_0}$$

$$C_{vac} = \frac{A\varepsilon_0\varepsilon_r}{d} \quad \therefore C_{vac} = C_{med}\varepsilon_r$$

Capacitance will be ε_r times C_{vacc}.

(B)

NUCLEAR FISSION:

The process in which a heavy nucleus after absorbing a neutron breaks in to parts.

REACTION:

$$^{235}_{92}U + n \longrightarrow ^{236}_{92}U^{*} \longrightarrow X + Y + \Phi$$

EXPLAINATION:

X and Y are fission fragments there are many posibilites of x and y possibile.

NEUTRONS PRODUCTION:

This reaction also result in neutrons normally 2 to 3 neutrons are produced per reaction.

HEAT PRODUCTION (Q)

This neuclear fission also result in large amount of heat.
1 single event result in 200 Mev energy which is equal to 1/millionth times 1 molecule of octance.

REACTION OF Uranium

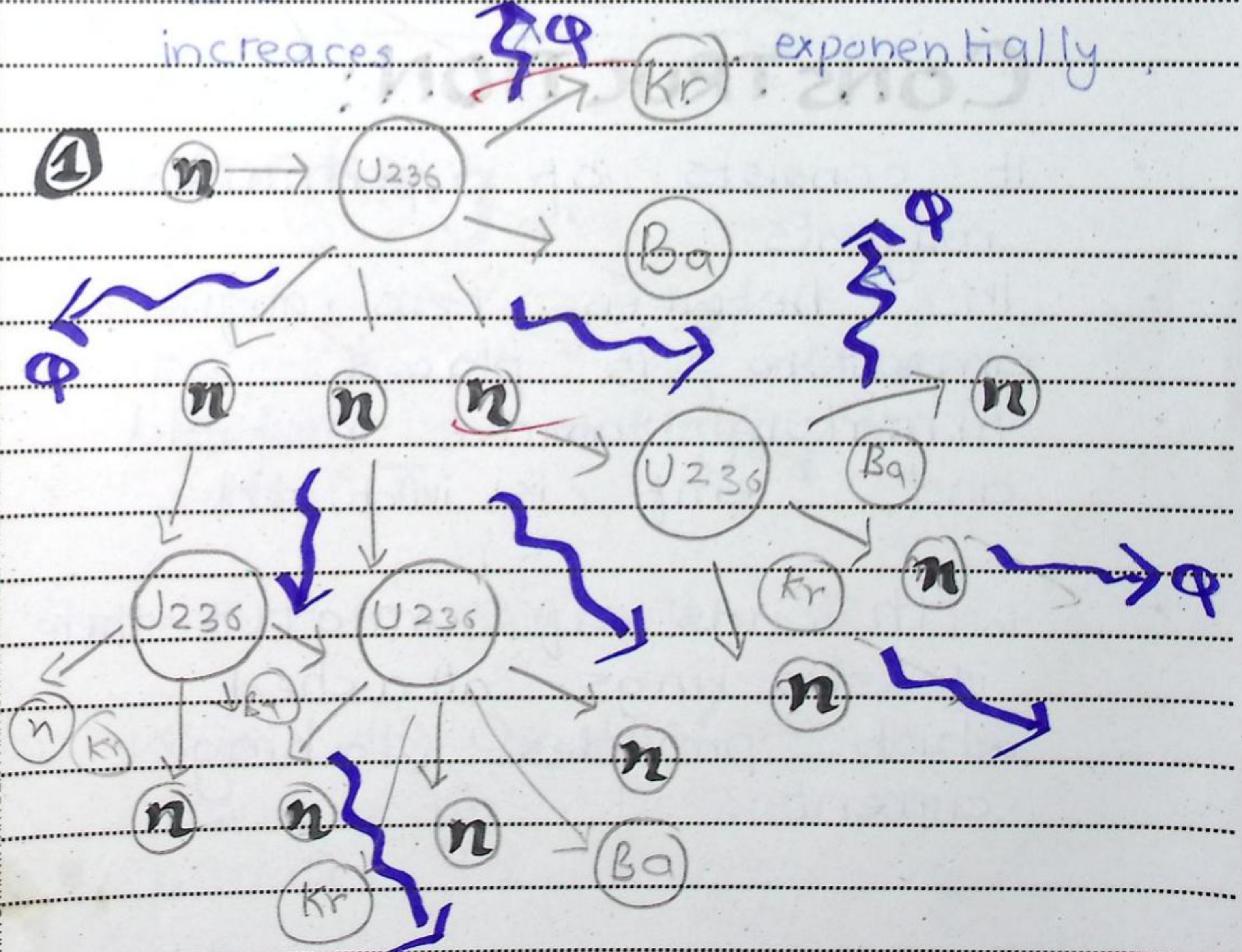
$$^{236}_{92}U^{*} \longrightarrow {}^{92}_{36}Kr + {}^{141}_{56}Ba + 3n + \Phi$$

FISSION CHAIN Rxn.

When a single fission process release neutron it proceeds reaction further still producing more neutrons. In This way self propagation reaction occurs releasing

4

still more neutrons On each event if no of neutrons is more than one than reaction increaces exponentially.



QUESTION: 3

(a)

AC GENERATOR:

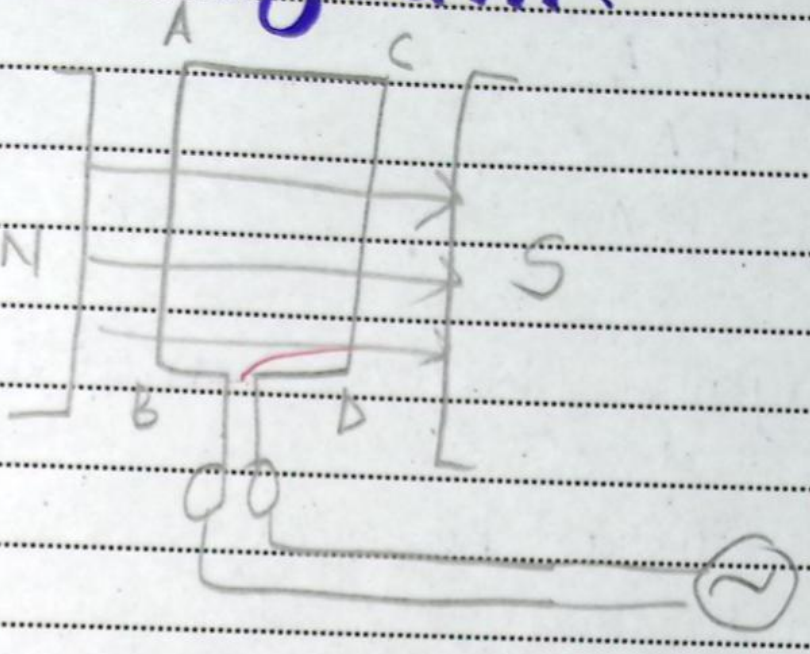
The device which converts mechanical energy in to electrical energy.

CONSTRUCTION:

- It consists of permanent magents.
- In between two magnents armature is placed.
- Armature move in field and emf is induced.

* with ends of armature there is slip rings attached which provides working current.

Diagram:



Working:

At $\theta = 0°$.

1) When the armature is perpendicular to $\vec{B}$ Area vector is making 90° with $\vec{B}$

$\phi_m = B \cdot A = BA\cos\theta = 0$.

2) When the armature turns area vector becomes parrallel to $\vec{B}$ so.

$\Phi_m = \vec{B} \cdot \vec{A}$

$= BA \cos 0$

$= BA$.

Now again when armature is at 180°

vector area becomes perpendicular to $\vec{B}$

$\Phi = BA - BA\cos 0$

$\Phi_M = 0$

When armature is again rotated at 270 the area vector is perpendicular to field

so

$\Phi_M = BA \cos 0$

$= BA$.