1) $f = R\left(1 - \frac{\sec\theta}{2}\right)$

2) $m = \frac{h_i}{h_o} = \frac{-v}{u} = \frac{f}{f-u} = \frac{f-v}{f}$, $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

3) $\frac{H_{final\ Image}}{H_{first\ object}} = m_1 \times m_2 \times m_3 \ldots$

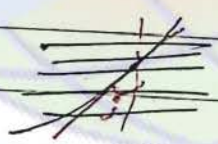
4) $\vec{V}_{Im(x)} = -m^2 \vec{V}_{om(x)}$

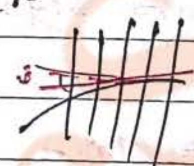
5) $\vec{V}_{Im(y)} = m\vec{V}_{om(y)} + \frac{V_{om} f}{(f-u)^2}\left(\frac{du}{dt}\right)$

6) $\mu_1 \sin i = \mu_2 \sin r$

7) $\frac{\text{Real depth}}{\text{app depth}} = \underset{\text{observe}}{\frac{\mu_D}{\mu_R}} = \frac{\mu_R}{\underset{\text{observer}}{\mu_R}}$

8) $\frac{dy}{dx} = \cot i$, $\frac{dy}{dx} = \tan i$





$\mu \sin\theta = \text{Constant}$

9) $\text{Normal shift} = t\left(1 - \frac{1}{\mu}\right)$

10) $\text{Lateral shift} = \frac{t}{\cos r}\sin(i - r)$

11) App. depth from top surface:-

$$\frac{t_1}{\mu_1}+\frac{t_2}{\mu_2}+\frac{t_3}{\mu_3}+\cdots$$

12.) $i_c = \sin^{-1}\left[\frac{\mu_R}{\mu_D}\right]$

13.) $\angle A = \angle r_1 + \angle r_2$; $\delta_{net} = i + e - A$

$\delta_{min} = 2i - A$ $\qquad$ $\delta_{max} = \pi/2 + e - A$

14.) $$\mu = \frac{\sin\left(\frac{A+\delta_{min}}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$ for all prism

15.) $A = 2i_c$

16.) $\delta = (\mu - 1)A$

→ for thin prism angle of deviation.

17.) Angular dispersion:-

$\theta = \delta_V - \delta_R$

$\boxed{\theta = (\mu_V - \mu_R)A}$ → for thin prism

18.) mean deviation → (δ_{mean})

$$\delta_{mean} = \frac{\delta_v + \delta_R}{2}$$

$$\boxed{\delta_{mean} = \left(\frac{\mu_v + \mu_R}{2} - 1\right)A}$$ → for thin Prism

or

$$\boxed{\delta_{mean} = (\mu_y - 1)A}$$

$$\because \boxed{\mu_y = \frac{\mu_v + \mu_R}{2}}$$

19.) Dispersive power (ω)

$$\omega = \frac{\theta}{\delta_{mean}}$$

$$\boxed{\omega = \frac{\mu_v - \mu_R}{\left(\frac{\mu_v + \mu_R}{2} - 1\right)} = \frac{\mu_v - \mu_R}{\mu_y - 1}}$$

महत्वपूर्ण

$$\because \mu_y = \frac{\mu_v + \mu_R}{2}$$

20.) $$A' = \frac{(\mu_y - 1)}{(\mu_y' - 1)} A$$

$$\theta_{net} = \delta_1 [\omega - \omega']$$

Dispersion without deviation

Here
δ_1 → mean deviation produced by 1st prism

21) $$A' = \left(\frac{\mu_V - \mu_R}{\mu_V' - \mu_R'}\right) \cdot A$$

$$\delta_{net} = \delta_1 \left[1 - \frac{\omega}{\omega'}\right]$$

Deviation without dispersion (Achromatism)

22) $$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$ (Relation b/w u and v)

23) $$m = \frac{h_i}{h_o} = \frac{\mu_1}{\mu_2}\left(\frac{v}{u}\right)$$

24) $$\frac{1}{f} = \left(\frac{\mu_2}{\mu_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$ → Lense maker formula (when both side having same R.I)

25) $$\frac{1}{f} = \frac{\mu_2 - \mu_1}{\mu_3 R_1} + \frac{\mu_3 - \mu_2}{\mu_3 R_2}$$ (" " diffe R.I " ")

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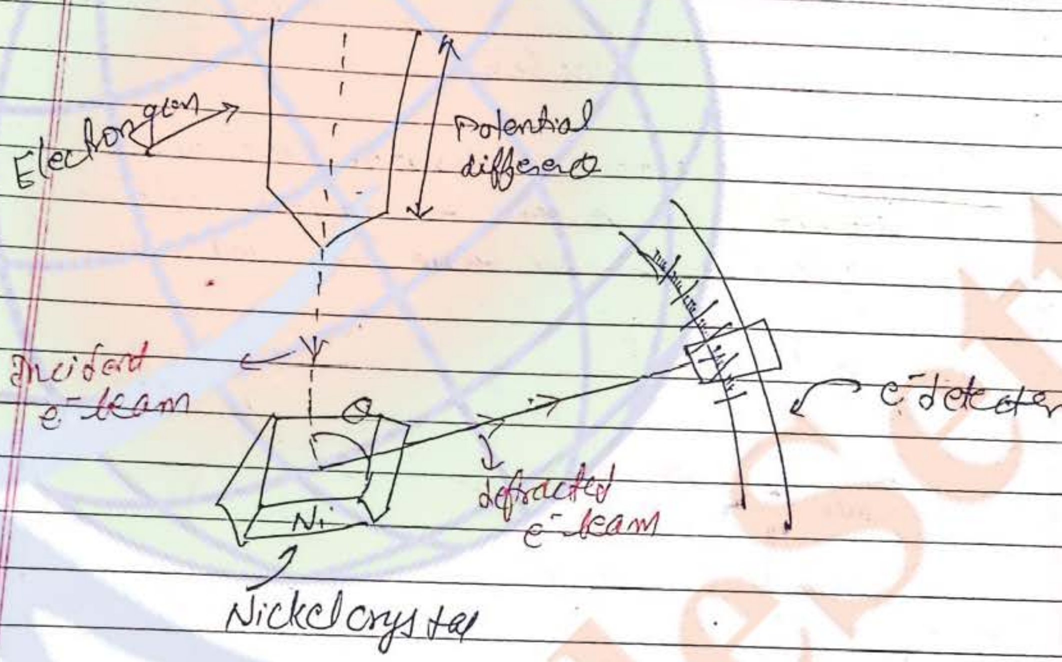
DAVISSON and Germer experiment

It proves the wave nature of particle.

There are three main parts —
i) Electron gun
ii) Nickel Crystal
iii) electron detector



i) e⁻ gun → it's work is to produce e⁻ beam of desired energy.

ii) Nickel crystal → it's work is to defract the e⁻ beam.

iii) e⁻ detector → it's work is to count the e⁻ defracted by Ni crystal at diff angles.

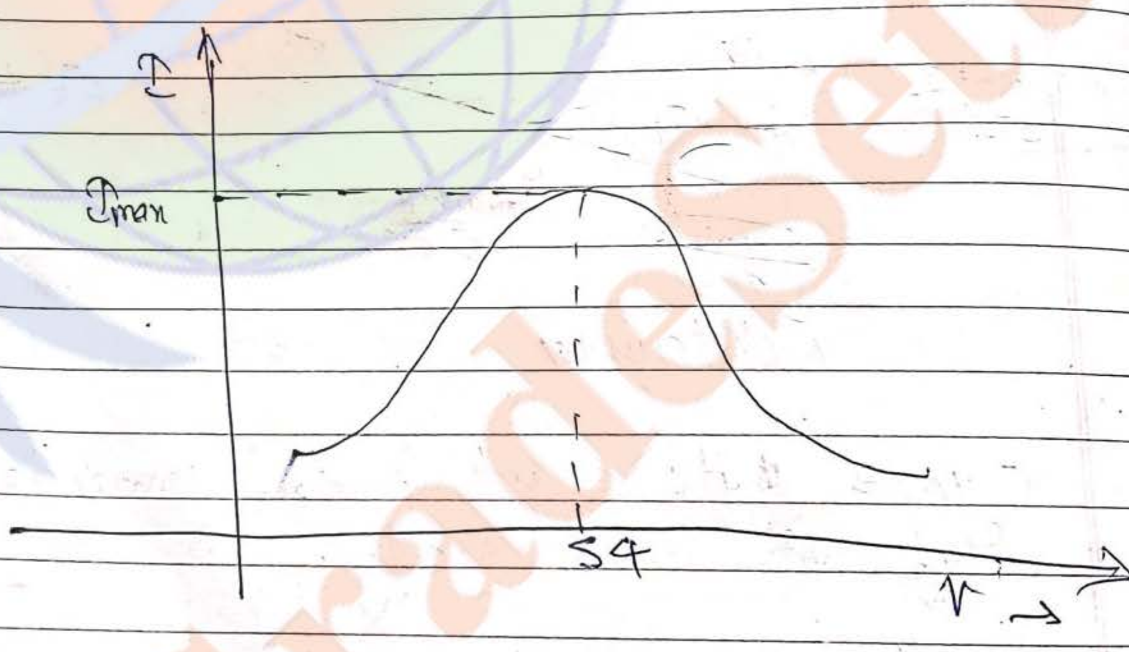
Observation/working → it's a two step process :-

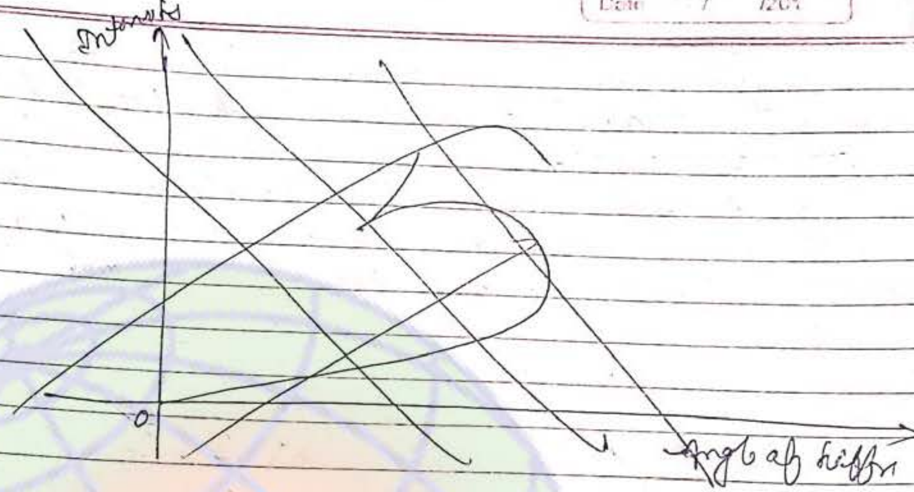
Step 1st → p.d is kept fixed and deflection angle (θ) get changed and no. of e⁻ are counted by the detector.

Here we will see at which deflection angle max. e⁻ are detected

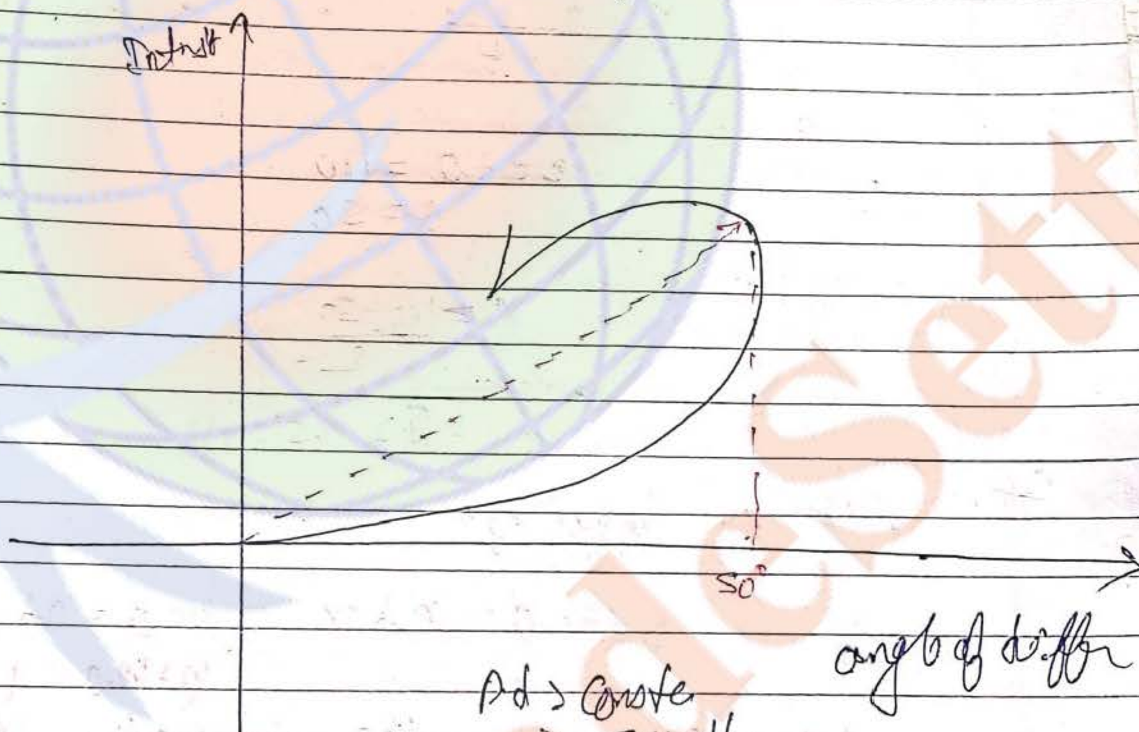
Step 2nd → Now diffra. angle is fixed and p.d is changed (40 to 68 volt) then again we will find at which p.d max. e⁻ are collected

Result → A/c to observation we will see that at 54 volt p.d and 50° angle of diffraction Intensity of e⁻ beam is maximum



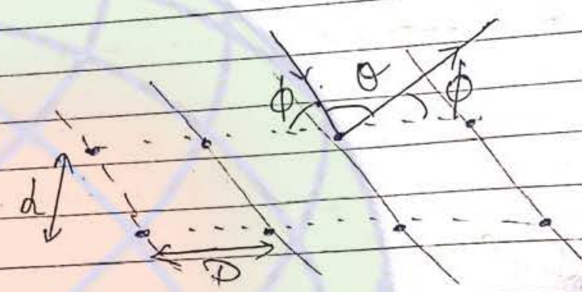


Pd is fixed = 54 volt



Pd = Const
= 54 volt.

explanation ⇒ max. Intensity at accelerating voltage 54 volt and diffraction angle 50° is due to the constructive Interference of e⁻ scattered from different atomic planes of the Nickel crystal which are regularly spaced with respect to each other.



$$2\alpha + \theta = 180$$
$$\theta = 50$$

$$\phi = \frac{180 - 50}{2}$$

$$(\phi = 65°)$$

A/c to Bragg's eqⁿ

$$2d\sin\phi = n\lambda \text{ or } D\sin\theta = n\lambda$$

$(n = 1, 2, \ldots)$

d ⇒ stand for the separation b/w two atomic planes

D ⇒ The distance b/w two atoms in a layer of atomic plan

n ⇒ order of diffraction.

λ ⇒ wavelength of Incident light

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For ~~M~~ first maxima, -

$$n=1$$

$$2d\sin\phi = \lambda$$

माप की जरूरत होता है

Note θ और ϕ पर ध्यान दें

$$d = 0.91\,A^\circ \text{ (for Nickel crystal)}$$

fixed है

$$\lambda = 2\times 0.91\,A^\circ \sin 65^\circ$$

$$= 1.66\,A^\circ \quad \text{---(i)} \rightarrow \text{theoretical value}$$

↳ यह value भी याद रखें

This is the wavelength calculated experimentally

Now

Acc to de broglie, the wavelength associated with the e^- is given by

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

$$\lambda_e = \frac{12.27}{\sqrt{54}}\,A^\circ$$

ये दोनों value भी याद रखना होता है

$$\lambda_e = \frac{12.27}{\sqrt{54}}\,A^\circ$$

$$= 1.67\,A \quad \text{---(ii) (experimental value)}$$

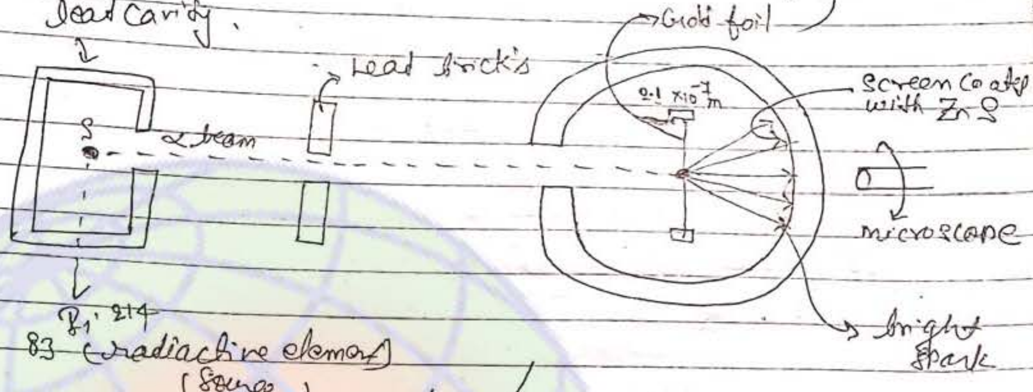
~~1.65 A°~~

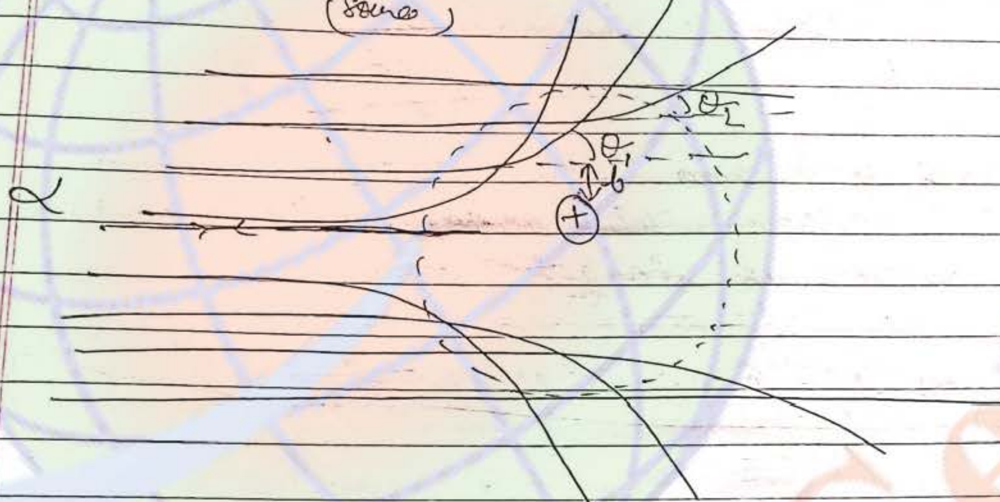
As this two data are approximately same. (from eq(i) and (ii))

So, it proves ~~the~~ or conform the wave nature of particle.

Rutherford atomic model ⇒

1) α- scattering experiment (19th century)





Result ⇒

1) majority of α-particles passes undeviated through the gold foil, and few of them with different angles (0 to 180°)

obtuse angle of deviation (>90°) is only possible when most part of the charge of atom is confined in a very small radius. and remaining part of the atom remains hollow.

10^{-15} m की Range की होती है

i) The no. of α-particle and angle of deflection are related by

$$\boxed{\text{No of } \alpha\text{-particle}(N) \propto \frac{1}{\sin^4\left(\frac{\theta}{2}\right)}}$$

ii) and the no. of α-particle also depend's on K.E as

$$\boxed{\text{No of } \alpha\text{-particle}(N) \propto \frac{1}{K.E^2}}$$

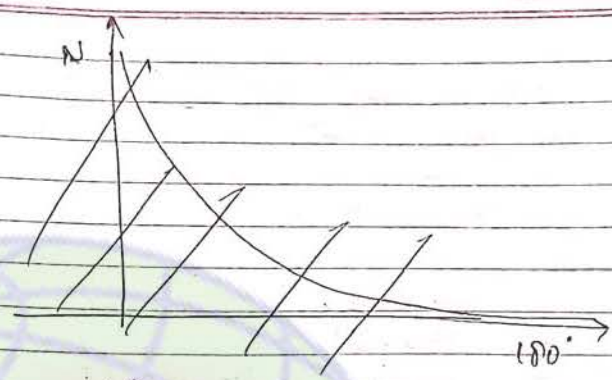
iii) No. of α-particle at a particle angle of deviation also depends on the atomic number of target atom

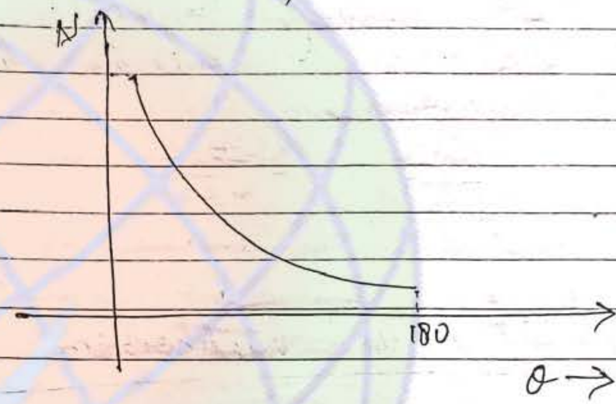
$$\boxed{\text{No. of } \alpha\text{-particle}(N) \propto Z^2}$$

Impact Parameter ⇒ (b)

The ⊥r distance of α-particle from nucleus is known as Impact parameter and it is given by

(Impact parameter) ← $$\boxed{b = \frac{KZe^2 \cot\left(\frac{\theta}{2}\right)}{(K.E)}}$$





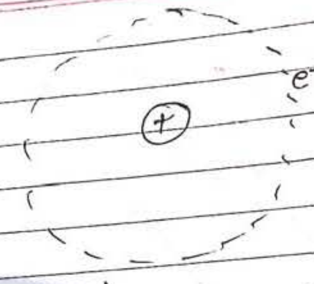
Rutherford model

1) The ~~at~~ most part and the charge of atom (excluding the mass of -ve particles) is confined into a very small space called ~~radius of the~~ nucleus.

and the same no. of -ve charge particle are revolving around the nucleus.

i.e. atom is electrically neutral

$$\Sigma +ve \text{ charge} = \Sigma -ve \text{ charge}$$



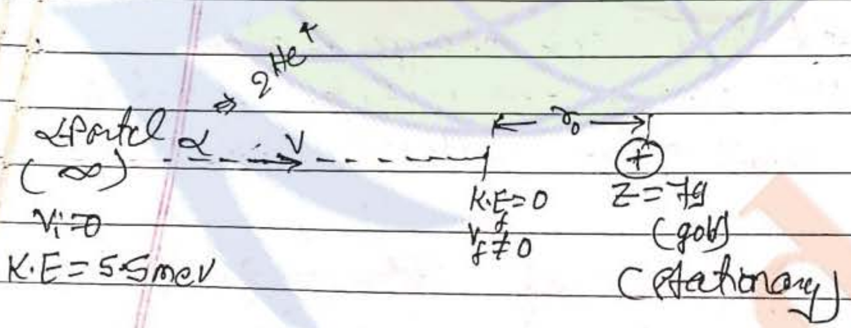
ii) e^- are revolving around the nucleus in circular path for the circular motion of e^- necessary centripetal force is provided by the coulomb force of attraction.

that is

$$\frac{mv^2}{r} = \frac{k(Ze)e}{r^2}$$

Application of Rutherford

i) Distance of closest approach →



A/q to conservation of mechanical energy

$$K.E_i + \cancel{PE_i}^{\,0} = K.E_f + PE_f$$

$$\frac{1}{2}mv^2 = 0 + \frac{k(Ze)(2e)}{r_0}$$

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$$r_0 = \frac{2kZe^2}{K.E} = \frac{9\times10^9 \times 2\times79\times(1.6\times10^{-19})^2}{5.5\times10^{-6}\ e}$$

$$= 41.2\times10^{-15}\ m$$

$$= 41.2\ \text{fermi}\ (fm)$$

A/c to conservation of M.E when α-particle with some K.E start moving towards the stationary nucleus due to the repulsion from nucleus it's vel. decreases continously.

and at ~~co~~ closest approach it's K.E becomes zero which is converted into P.E of the system.

on the behalf of this Rutherford said that the radius of ~~a~~ nucleus is ~~ab~~ around 10^{-15} m

Reason of failure

i) He could not explain the line spectrum of H-atom

~~Line spectrum ⇒~~

Notes: As He assume that e^- is revolving in a circular path ~~is so~~ which is basically as a accelerated motion and according to electromagnetic theory every accelerated particle radiated electromagnetic waves

so it's spectrum should be continous
but H-spectrum is a line spectrum (discreate)
(discreate)
that's why they fail.

ii) It can not explain the stability of atom.

As e⁻ revolving around the nucleus continous radiate electromagnetic wave so its energy should decrease. So radius of circular path will also decrease and finally it will fall in the nucleus.

matter wave

Bohr's model

Bohr postulate →

i) e^- could revolve in certain stable orbit's without the emission of radiation energy.

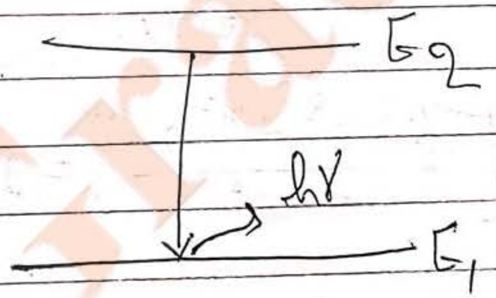
ii) e^- revolve's only in those orbit in which it's angular momentum is Integral multiple of "$\frac{h}{2\pi}$".

$$\underbrace{mvr}_{\text{angular moment}} = \frac{nh}{2\pi}$$

$n = 1, 2, 3, 4, \dots$

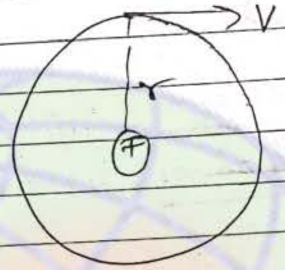
n = orbit number

iii) An e^- might make a transition from one of it's specified non-radiating orbit to another of lower energy. whenever when it do so a photon is emitted having energy equal's to the difference of energy b/w Initial and final state.



$$\boxed{h\nu = E_2 - E_1}$$

Radius of the Path



$$\boxed{F_c = F_e}$$

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

$$\boxed{r = \frac{kZe^2}{mv^2}}$$

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

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

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

$$r\left[\frac{kZe^2 4\pi^2 m}{n^2h^2}\right] = 1$$

$$r = \frac{n^2 h^2 \cancel{4\pi}\varepsilon_0}{Ze^2 \cancel{4\pi}^2 m}$$

$$r = \frac{n^2 \varepsilon_0}{e^2 \pi m} \times \frac{h^2}{Z}$$

$$\boxed{r = 0.529 \frac{n^2}{Z} A^\circ}$$

2.) orbital velocity

$$v = \frac{\cancel{K}\cancel{h}e^2 \cancel{\pi}\cancel{m} Z}{2\cancel{\pi}\cancel{m} h^2 \varepsilon_0 n^2}$$

$$v = \frac{e^2 Z}{2h\varepsilon_0 n}$$

$$\boxed{v = 2.18 \times 10^6 \frac{Z}{n} \text{ m/sec}}$$

3) Energy of e^-

(i) $\boxed{K.E = \frac{1}{2} m v^2}$

as

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

(i) $\boxed{K.E = \frac{1}{2}mv^2 = \frac{kZe^2}{2r}}$

(ii) $P.E = qV$

$\boxed{P.E = \frac{kZe^2}{r}}$

iii) $T.E = K.E + P.E$

$= \frac{kZe^2}{2r} - \frac{kZe^2}{r}$

$\boxed{T.E = -\frac{kZe^2}{2r}}$

$\boxed{T.E = -13.6\left(\frac{Z}{n^2}\right) eV}$

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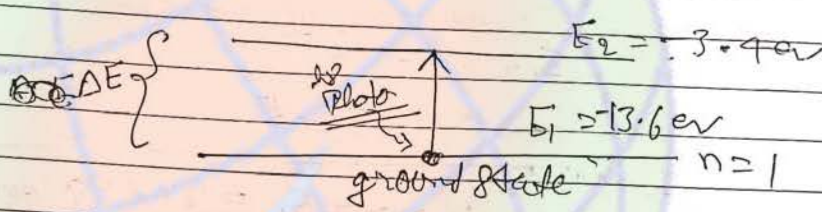
Ionisation energy and excitation energy

(i) Excitation energy →

The min. energy required to excite an atom from a particular state is called excitation energy and the corresponding potential is called excitation potential



for H-atom →

$$E_1 + \Delta E = E_2$$

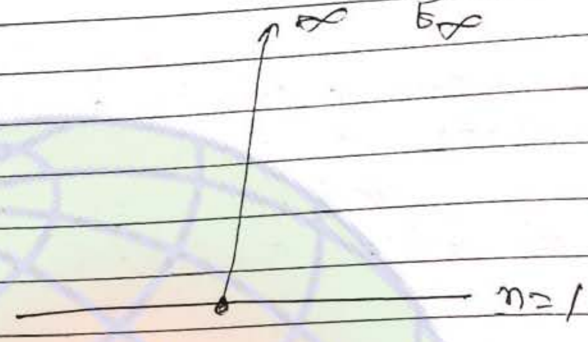
$$\Delta E = E_2 - E_1$$

$$= -3.4\,ev - (-13.6)$$

$$= 10.2\,ev$$

(ii) Ionisation energy / →

The min. energy required to remove an e^- from Hydrogen or Hydrogen like atom is called Ionisation energy and corresponding potential is called Ionisation Potential and the ionisation energy is just equal's to the binding energy of the e^-.



$$E_1 + \Delta E = E_\infty$$

excitation energy $\Delta E = E_\infty - E_1$

$$\boxed{\Delta E = -E_1 = \text{Binding energy}}$$

for H-atom $= 13.6\ \text{ev}$

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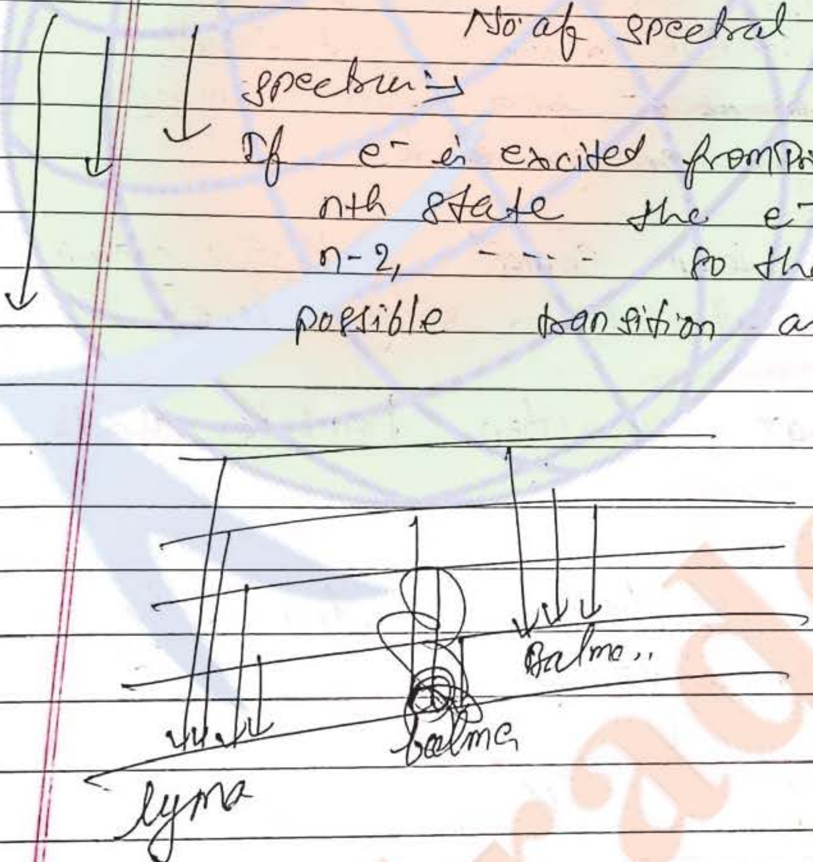
Types af spectra

1) Emmision line spectrum → when an atomic gas or vapour and pressure less than atmospheric pressure is excited by passing electric discharge the emitted radiation has a spectrum which contains certain specific bright lines only. which constitute ~~emi~~ emmision spectrum.

These are obtained when e^- jump's from higher energy state to lower.

No. af spectral line in emmision spectrum →

If e^- is excited from the quantum no. n to nth state the e^- may go to $n-1$, $n-2$, ---- so that total no. af possible transition are $n \times \left(\frac{n-1}{2}\right)$



ii) absorption spectr

When ~~a~~ white light is pass through a gas the gas is found to absorb light of certain wavelength.

The bright background on the photographic plate is then crossed by dark lines that corresponds to those wavelength which are absorbed by the gas atom.

The absorption spectrum consist of dark lines ~~of~~ on bright background.

These spectral line is due to absorption of certain photons and result into transition of e^- from lower energy state to higher energy state.

At ordinary temp almost all the atom's remain in its lower energy level ie $n=1$.

So that absorption transition starts from $n=1$.

So that in absorption spectrum only lyman series is formed

* The absorption spectra of sun has balmer series also due to high temp few H-atom are already in excited state.

Note

Lyman series is found in U.V region

Balmer → visible region
Paschen → Infrared
Brack
P.f

Explanation of 2nd Postulate by de-broglie

why angular momentum (mvr) is Integral multiple of $\frac{h}{2\pi}$

Sol (i) A/q to de-broglie waves are associated with the particle

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

and A/q to "Schrondinger" there are stationary waves whose wavelength is Integral multiple of circumference

$$2\pi r = n\lambda$$

(याद रखें :- circumference = $n\lambda$)

from eq (i) & (ii)

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

γ

24.) $e^+ + {}^{A}_{Z}X \longrightarrow {}^{A}_{Z-1}Y + \gamma$

Sol^n for β^+ emmission

$$\boxed{{}_{Z}X^{A} \longrightarrow {}_{Z-1}Y^{A} + {}_{1}e^{0} + \gamma + Q_1}$$

Δmc^2

$$Q_1 = [\,M_N[{}_{Z}X^{A}] - m_n(y) - m(\beta^+)]c^2$$

$$= [M[x] - Z(e) - \{m[y] - (Z-1)(e)\} - m\,]c^2$$

$$= [m(x) - m(y) - Z(e) + (Z-1)e - e]c^2$$

$$Q_1 = (m(x) - m(y) - 2e)c^2$$

In reverse Process.

$$Q_2 = (m_x - Ze + e - m_y + (Z-1)e)c^2$$

$$Q_2 = (m_x - m_y)c^2$$

$$Q_2 > Q_1$$

So,

21.)

$$e = \frac{m}{V}$$

$${}_{Z}X^{A} = \frac{mA}{\frac{4}{3}\pi R^3}$$

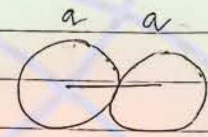
$$R = R_0 A^{1/3}$$

$$e = \frac{mA}{4/3\,\pi\,(R_0 A^{1/3})^3}$$

$$e = \frac{m\cancel{A}}{4/3\,\pi R_0^3 \cancel{A}}$$

$\underline{e = \text{constant}}$

90.)



$r = 2\,fm$

centre to centre distance

$d = 4\,fm = 4\times10^{-15}\,m$

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

$$= \frac{9\times10^9 \times e^2}{4\times10^{-15}}$$

2.000

$$= \frac{9\times10^9 \times 1.6\times10^{-19}\,eV}{4\times10^{-15}}$$

$= 360\,keV$

Q.100

2 atom $\rightarrow$ 3.27 MeV

no of atom's in 2kg duteion

$$= \frac{m}{M_w} \times N_A$$

$= 6\times0.29\times10^{26}$

36×1.7

Total energy released $= \frac{6.023\times10^{26}}{2} \times 3.27\times10^{6} \times 1.6\times10^{-19}$ J

$= 15.75\times10^{13}$ J

$P = \frac{E}{t}$

$t = \frac{E}{P} = 15.75\times10^{11}$ sec

$P = 100$ watt

18)

1000 MW

(Every nucleus of $_{92}U$, 200 MeV energy released)

(1 nucleus → 200 MeV)

5 year 80% → 4 year

Total energy produced →

$E_T = 4\times365\times24\times60\times60\times1000\times10^6$

$= \frac{4\times86400\times365\times10^9}{1.6\times10^{-19}}$ eV

no. of atom consumed to produced this energy

$N = \frac{4\times86400\times365\times10^9}{1.6\times10^{-19}\times200\times10^6}$

Now

in 1 kg $_{92}U^{235}$ no of atoms $= \frac{1 \times 10^3}{235} \times 6.023 \times 10^{23}$

mass of $_{92}U^{235}$ unit

$$= \frac{4 \times 8.6400 \times 365 \times 10^9 \times 235}{1.6 \times 10^{-15} \times 200 \times 10^6 \times 6.023 \times 10^{26}}$$

so,

the total fuel available at starting

$= 2 \times$ consumed

$= 3078$

15) If Q is -ve reac' will be endothermic and if Q is +ve exothermic process,

$m_1 + m_2 > m_3 + m_4$

$(m_1 + m_2 - m_3 - m_4) \times 931$ mev

$Q = -ve$

$Q = +ve$

14.) (mass of ne - mass of sodium) $\times 931$ mev

13)

$\Delta E =$

12.

$_{88}Ra$

Q

11)

13)

$$\Delta E = \left(m_N ({}_6C^{11}) - m_N ({}_5B^{11}) - m_e \right) \times 931\,meV$$

$$= \left[m({}_6C^{11}) - 6e - m\,{}_5B^{11} + 5e - e \right] \times 931$$

$$= \left[m({}_6C^{11}) - m({}_5B^{11}) - 2e \right) \times 931\ mev$$

12.

$${}_{88}Ra^{226} \longrightarrow {}_{86}Ra^{222} + {}_2He^4$$

$Q =$

11)

$$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2} \right)^{1/3}$$

Semiconductor

C → Diamond → Insulator

Se → graphite → conductor

Ge → Coal → Conductor.

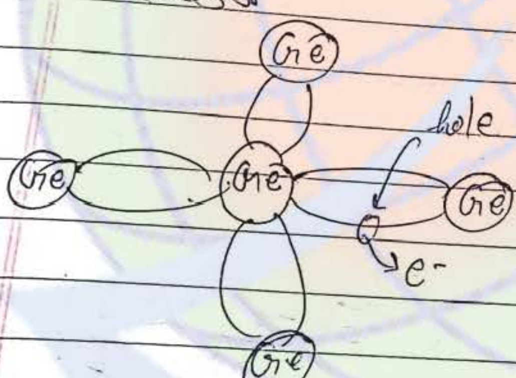
Sn

Pb

Semi conductor

Pure form or (Intrinsic semiconduct)

Impure form (Extrinsic semiconductor)



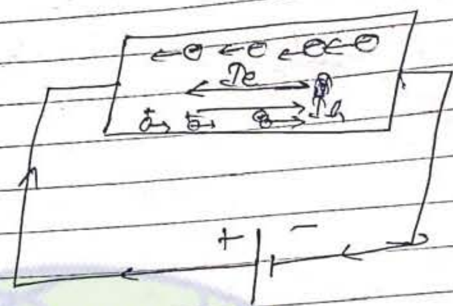
no. of e^- = no. of hole

$n_e = n_h$

$$\boxed{n_e = n_h = AT^{3/2} e^{-\frac{\Delta E_g}{2kT}}}$$

ΔE_g → forbidden energy gap. (वर्जित)

T → "absolute temperature"



$\therefore v_d = \mu_e$ mobility

$I_{net} = I_e + I_h$

$= [n_e e A v_e + n_h e A v_h]$

$= n A e [v_e + v_h]$

$I = nAe [\mu_e + \mu_h] E$

$\frac{I}{E} = nAe [\mu_e + \mu_h]$

$\frac{IL}{V} = nAe [\mu_e + \mu_h]$

$\frac{\cancel{I}L}{\cancel{I}R} = neA [\mu_e + \mu_h]$ $\left\{ E = \frac{-dV}{dr} = \frac{V}{L} \right\}$

$\frac{L\cancel{A}}{\rho L} = ne\cancel{A} [\mu_e + \mu_h]$

$\boxed{\frac{1}{\rho} = ne [\mu_e + \mu_h]}$

Resistivity ρ

$\boxed{\text{Conductivity } (\sigma) = ne [\mu_e + \mu_h]}$

$\mu_e > \mu_h$

Extrinsic s...

1) N-type

1) N-type →

amount
it will

4.

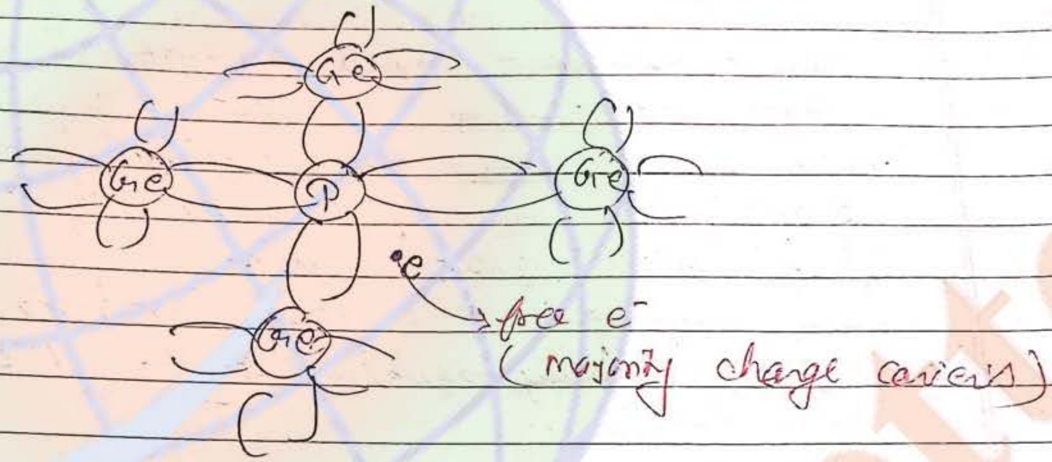
whi...

Extrinsic semiconductor

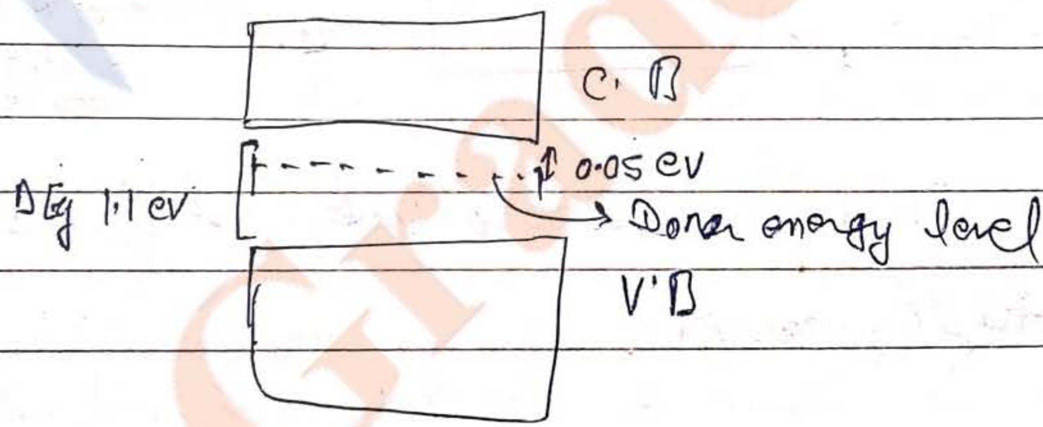
1) N-type ② P-type.

1) N-type → If a pentavalent impurities of small amount is mixed in pure semiconductor than it will becomes N-type semiconductor

NPASBISB



4-e⁻ of impurity atom will form the bond with neighbour atom of base material and 5th e⁻ which is free will form a seperate energy level near the conduction band.



which require very less energy to become free and this much energy is available at normal temp.

So in N-type semiconductors e⁻ are majority charge carriers.

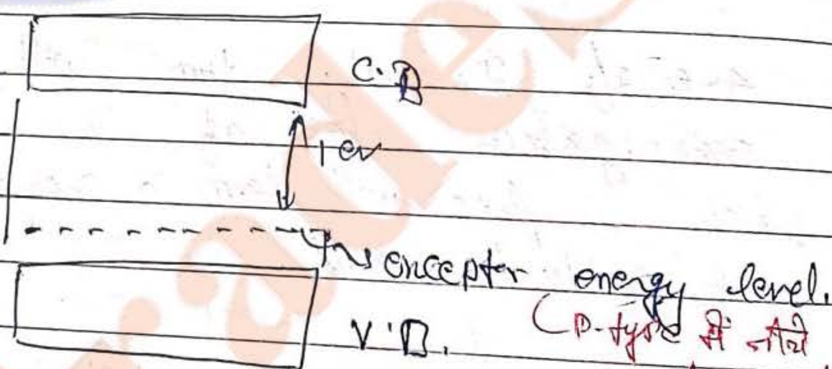
iii) P-type

If trivalent Impurities (element of 3rd group)

B, Al, Ga, In, Tl

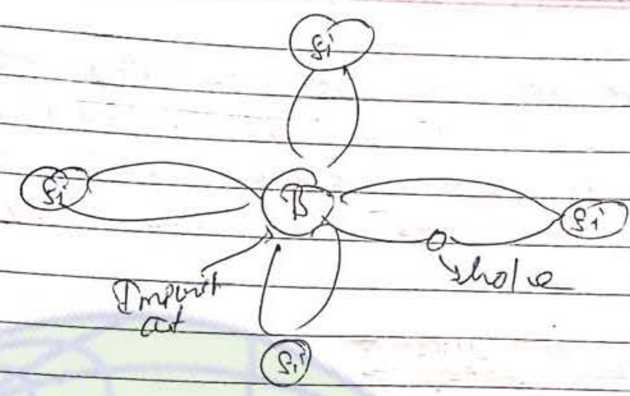
are mixed in very small amount in a semiconductor then the 3e⁻'s of Impurities atom will combine the neighbour base atom & and their will be a vacancies of one e⁻ which will produce a hole.

and these holes produce an acceptor energy level near to V.B.



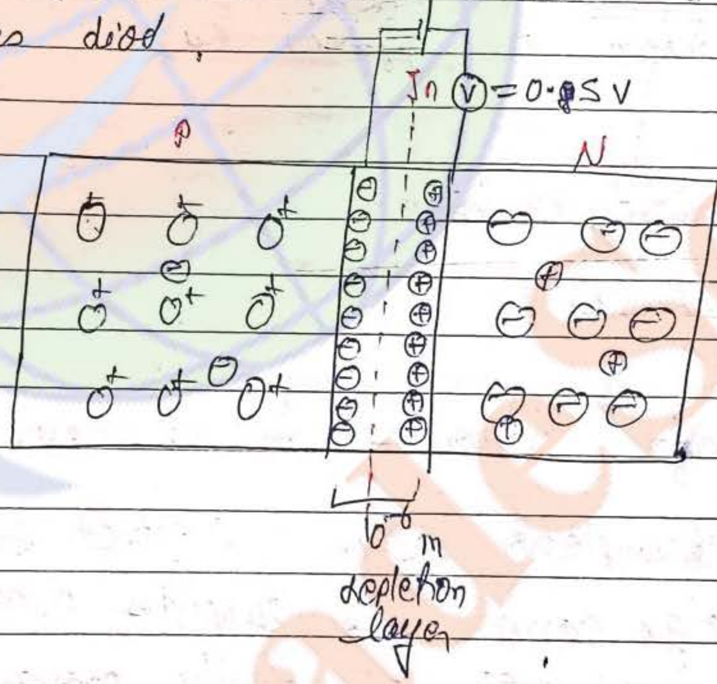
(P-type में नीचे except energy level आता है ध्यान दे।)

In P-type semiconductor holes are majority charge carrier.



Diod

If a semiconduct is doped in two ways one side with trivalent and other side with Pentavalent Impurities. then it results into a P-n junction known as diod.



$$E = \frac{V}{L} = \frac{0.5}{10^{-6}} = 5\times10^{5}\ V/m$$

D.L: If few e^- of N-type region reaches to P-type and diffuses hole's their hence the region produces in which no free e^- or hole

are Present this region is called depletion layer (10^{-6} m) and a P.d of 0.5 v.
So, that a electric field exist from N-type to P-type of a range 5×10^{5} v/m

Drift current ~~Diffusion current~~ →

~~electric field in depletion layer restrict the majority charge carries. but support's the minority charge carrier's. So that few e⁻'s of high K.E will cross the region and can reach to other side. So that e⁻ is from n-type and due to this flow of e⁻ the current is known as Drift ~~diffusion~~ Current.~~

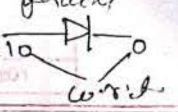
~~Drift Current~~

~~Diffusion Cu~~

1) Drift current → (due to minority charge carriers)

Depletion layer restrict the majority charge carries and supports minority charge e⁻ any free e⁻ easily moves from P type to N-type and current flow from N- to P type is known as drift current

P.E → forward Bias
↳ w.r.t. से ही पता चलेगा

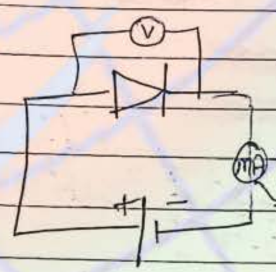


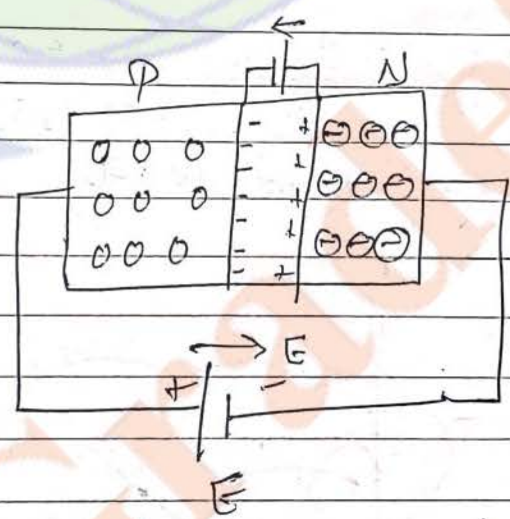
1) Diffusion currents

As depletion layer restrict the majority charge carriers but few e^-'s of high K.E crosses the potential barrier and reaches from N to P so that current flows from P to N is known as Diffusion current.

Baising of Diod

1) Forward Bais →





If ~~P-type~~ P-side is connecte with the terminal of batte and N-side with -ve ter. of battery this is called F.B.

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Note
In this situation E.F of battery decreases the E.F of depletion layer.
So this diffusion current Increase
on further Increase of applied voltage at the certain potential (knee voltage
At which E.F of battery is equals to the E.F of depletion layer that is Enet is Zero.)

Now if we further rise the E.F we support majority charge carries and movement of e⁻ Increases Rapidly.

Note

In F.B current is diffusion curr
knee voltage of some metal
Ge ⇒ 0.3
Si ⇒ 0.7 (max.)

Notes The resistance is low in F.B
(app. 10Ω to 100Ω)
Ideally it should be zero.

ii) Reversed

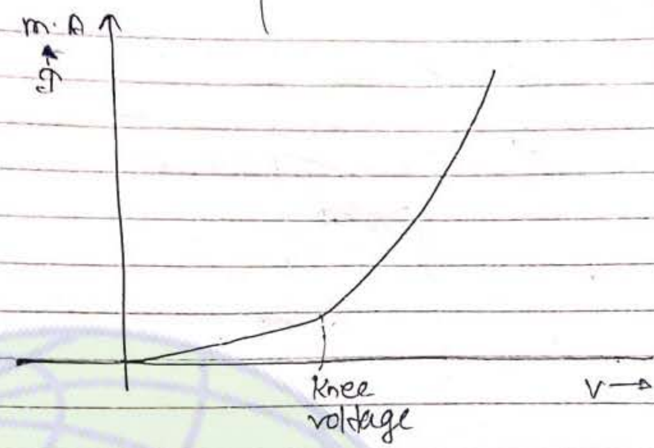
If p-
battery c
is called

the E.

opp. fer

drifting
very

100



II) Reversed biased

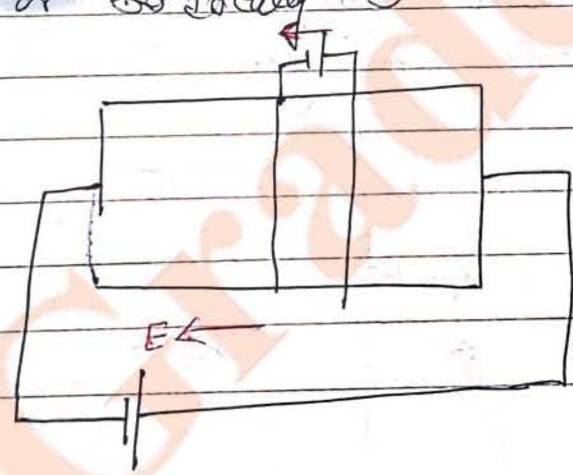
If P-type is connected with -ve terminal of battery and N-type with the terminal then diod is called reversed biased.

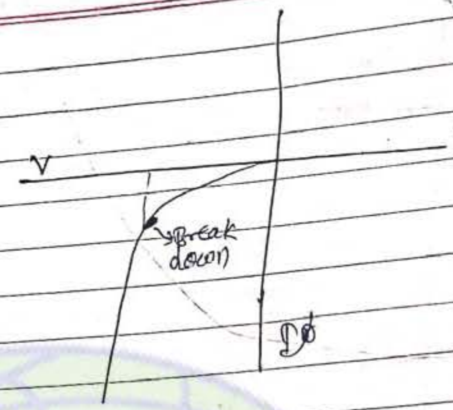
In this situation E.F of battery Increase the E.F of depletion layer.

So the majority e^- can not reach the opp. terminals Hence diffusion current decreases.

Here current is only due to drifting of minority charge carriers which is very less (in micro A)

and Resistance of ~~Ri~~ Base is very high 1000kΩ or Ideally ∞





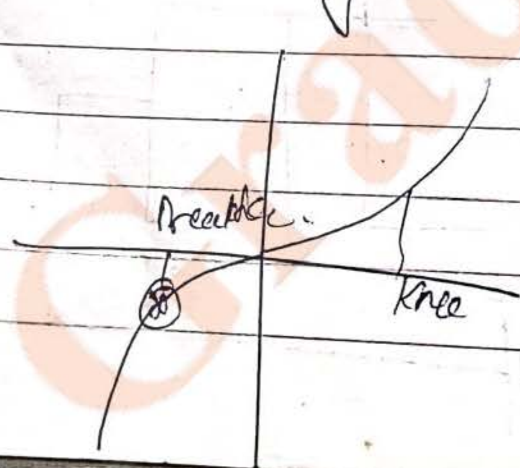
If ↑se the Potential in R.B to extent two events ~~may~~ are be possible.

1) Avalance of Breakdown

In R.B mode at high Potential free e^- gain very high speed due to K.E and if their free e^-'s colloid with the orbital e^-'s of the atom then orbital e^-'s ~~atoms~~ becomes free in this way orbital e^-'s Increase the Current

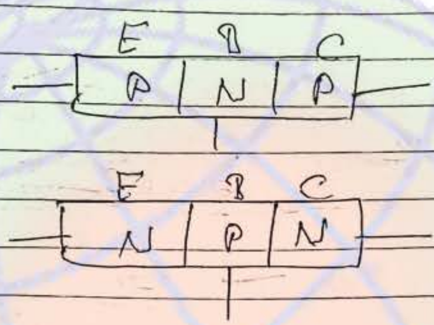
ii) Zener breakdown

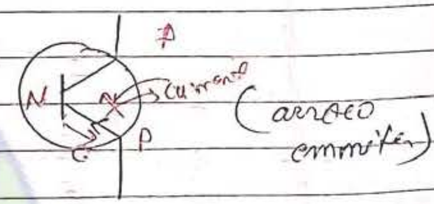
In R.B mode if Potential is ↑se the orbital e^-'s gains the K.E so they will be free and due to this free e^-'s current Increases suddenly..



→ Led and
Solar cell

Transistor

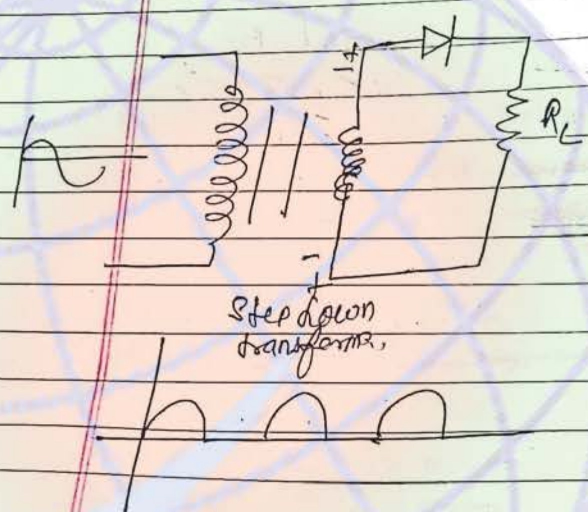


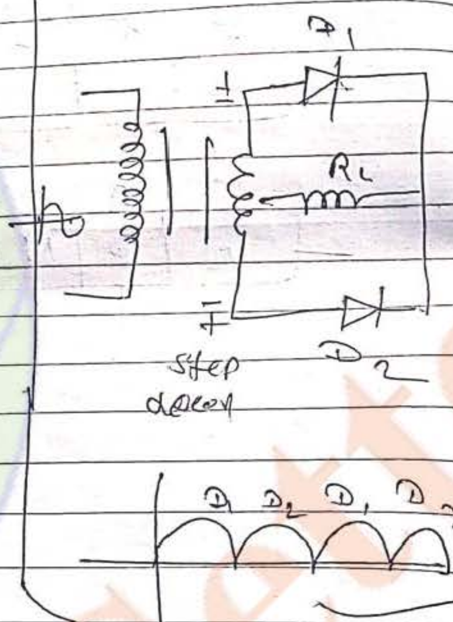


Diode as Rectifier

↳ A C ⟶ D. C

half wave rectifier | full wave rectifier





$\boxed{\text{* Input frequency = output frequency}}$

Input (A.C)	output (D.C)
$I_{rms} = \frac{I_0}{\sqrt{2}}$	$= \frac{I_0}{2}$
$I_{avg} = \frac{2 I_0}{\pi}$	$= \frac{I_0}{\pi}$
for mufa $= \frac{\pi}{2\sqrt{2}}$	$\frac{\pi}{\sqrt{2}}$

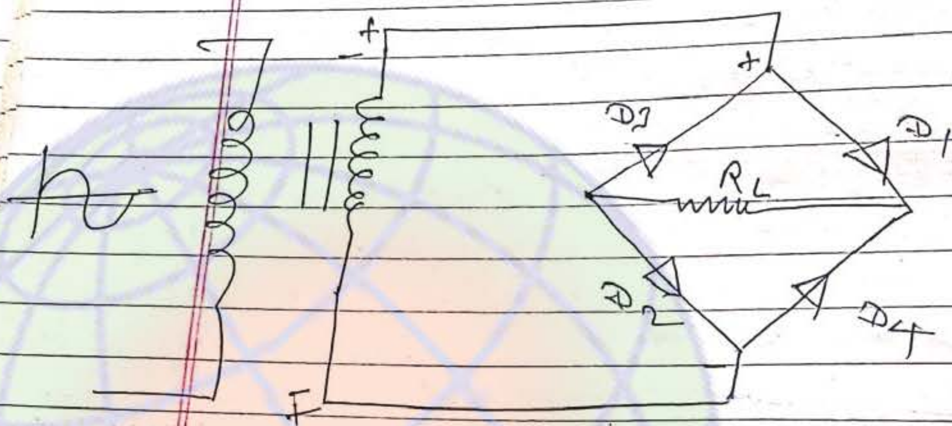
ripple

ripple factor $r = \sqrt{f^2 - 1}$	$r = \sqrt{f^2 - 1}$

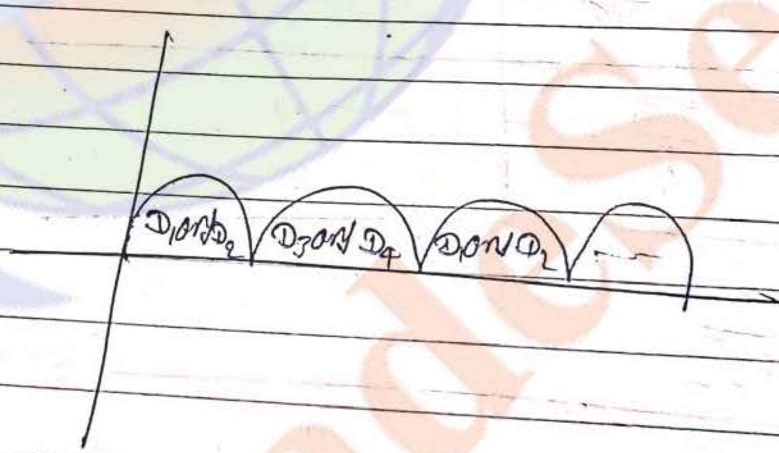
Input frequency $= f$ than output frequency $= 2f$

I/P	O.P
$I_{rms} = \frac{I_0}{\sqrt{2}}$	"
$I_{avg} = \frac{2I_0}{\pi}$	"
$F.F = \frac{\pi}{2\sqrt{2}}$	"
$r = \sqrt{f^2 - 1}$	"

Bridge rectifier



I/P → diff
O/P → same



Transistor

1) Are of two type

   i) N-P-N

   ii) P-N-P → B (N) P/C, E P → उलटा सीधा लो current के उलटा में e^- flow करेगा।

   E B C

ii) Transistor are made by doping

Imp. Point

i) Thickness ⇒

$$C > E > B$$

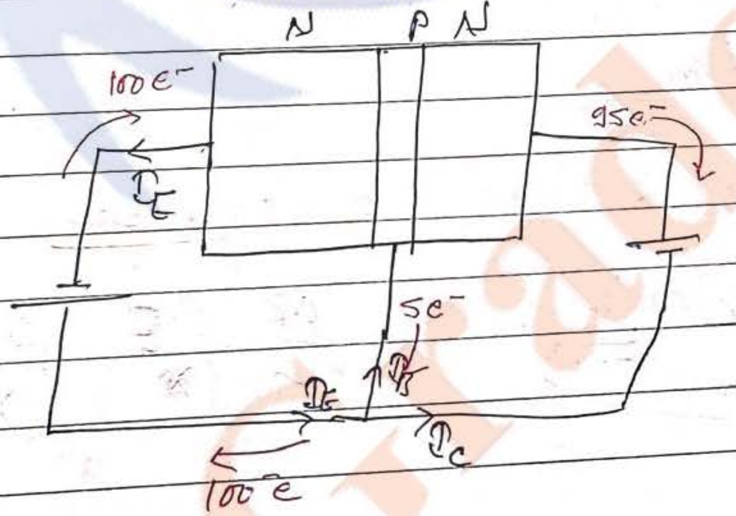
ii) Resistance ⇒

$$\cancel{R_{...}} \quad R_{EC} > R_{BC} > R_{BE}$$

iii) working

EB → forward bias

CB → reversed bias



$$I_E = I_B + I_C$$

Free e⁻ of ~~emmiter~~ emmiter region start moving forwards the base due to E.F of base emmiter. few e⁻'s passes through the base(base से नीचे या जाना (down)) while remaining crosses the base region due to its small thickness boost and reaches in the collector region. these e⁻ completes the circuit in the Influence of E.F b/w C and B.

$$\boxed{I_E = I_B + I_C}$$

Note

NPN is better transistor than PNP bcz in NPN current conduction is due to the e⁻ (maj. charge carrier) while in PNP current conduction is due to holes and we know the mobility of e⁻ is greater than holes.

Application

1) ~~As~~ a transistor as a Amplifier

Common means earthing करना

C.B. (⌐) C.E (X) C.C (X)

1) Co

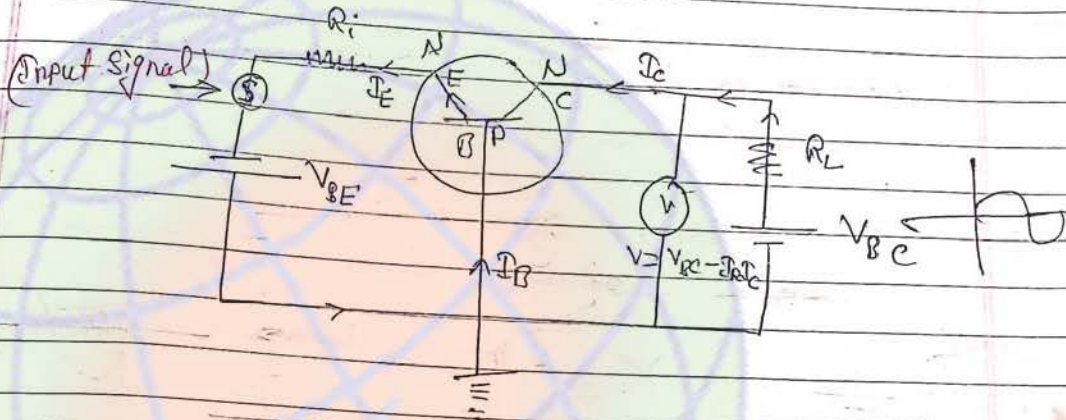
Input sig

1) (

2)

1) Common base Amplifier or Amplifier as a Common base

N-P-N वाला



C B	C E	C C
α	β	γ
$\frac{I_C}{I}$	$\frac{I_C}{I_B}$	$\frac{I_E}{I_B}$

1) Current gain

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

2) Resistance gain

$$A_R = \frac{R_L}{R_i}$$

3) voltage gain

$$A_V = \alpha \times \frac{R_L}{R_i}$$

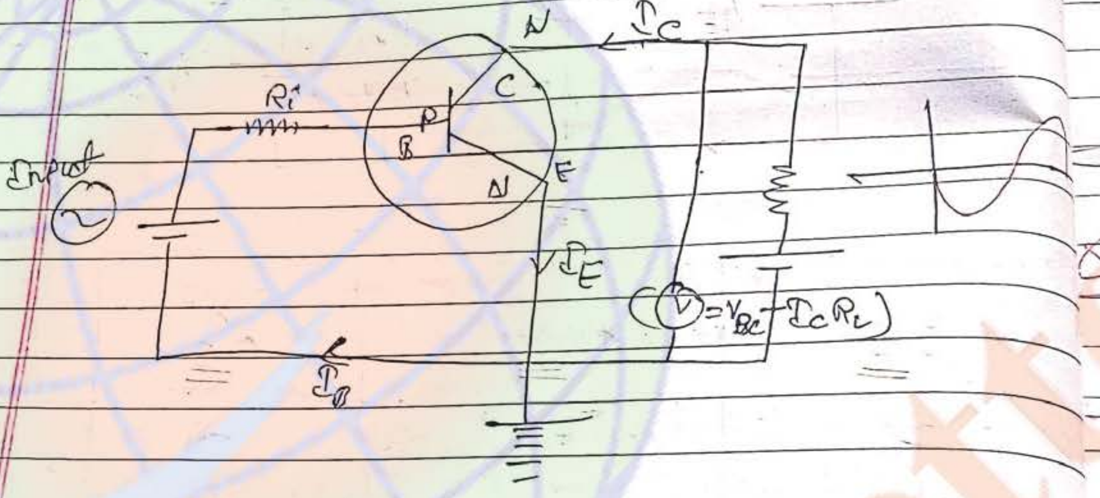
4) Power gain

$$A_P = \alpha^2 \frac{R_L}{R_i}$$

Note

There is no phase difference b/w Input and output.

2) Amplifier as a common emitter mode



$$I_E = I_B + I_C$$

C.B	C.E	C.C
α	β	γ
$\frac{I_C}{I_E}$	$\frac{I_C}{I_B}$	$\frac{I_E}{I_B}$

1.) Current gain $A_I = \beta = \frac{I_C}{I_B}$	3.) voltage gain $A_V = \beta \times \frac{R_L}{R_i}$
2.) Resistance gain $A_R = \frac{R_L}{R_i}$	4.) Power gain $A_P = \beta^2 \frac{R_L}{R_i}$

Note

There is a phase difference b/w Input and output of "π"

Logic gate

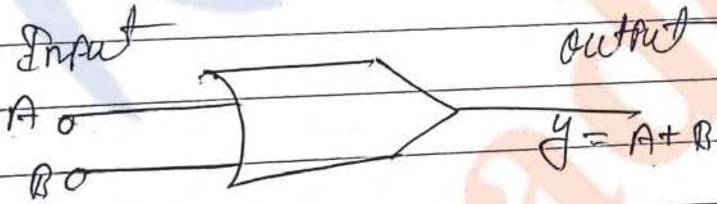
1) ~~"OR" Gate~~ add function → add mode (addition)

OR → जोड़ (+)	
AND → गुणा (×)	
NOT → उल्टा (1/1)	

$y = A \; OR \; B$

$$\boxed{Y = A + B}$$

ii) OR logic gate

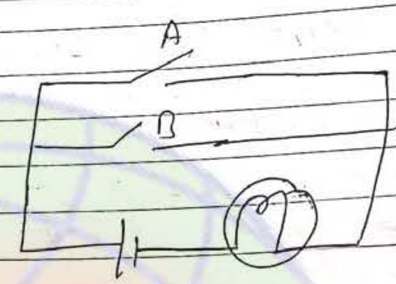


iii) Truth table ⇒

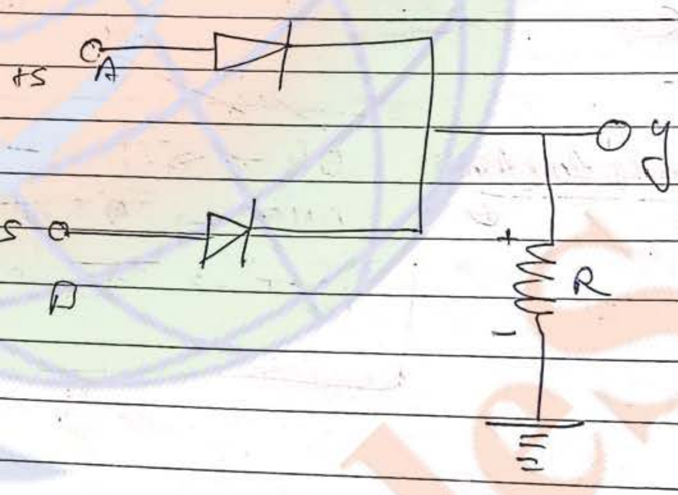
A	B	Y
0	0	0
1	0	1
0	1	1
1	1	1

H.W
Electronic

iv) Realisation



v) Diod OR gate



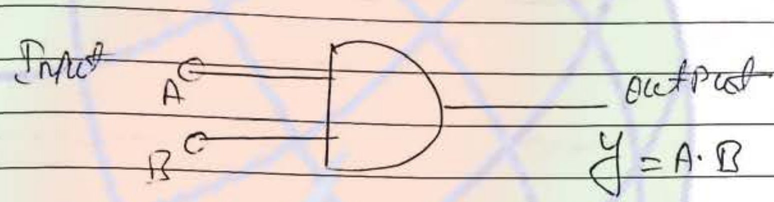
2) AND Gate

i) AND function

$$y = A \text{ AND } B$$

$$\boxed{y = A \cdot B}$$

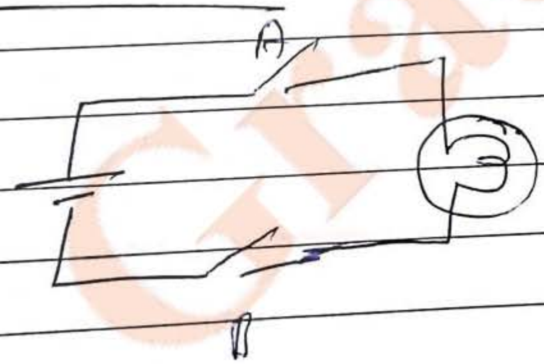
ii) AND logic gate



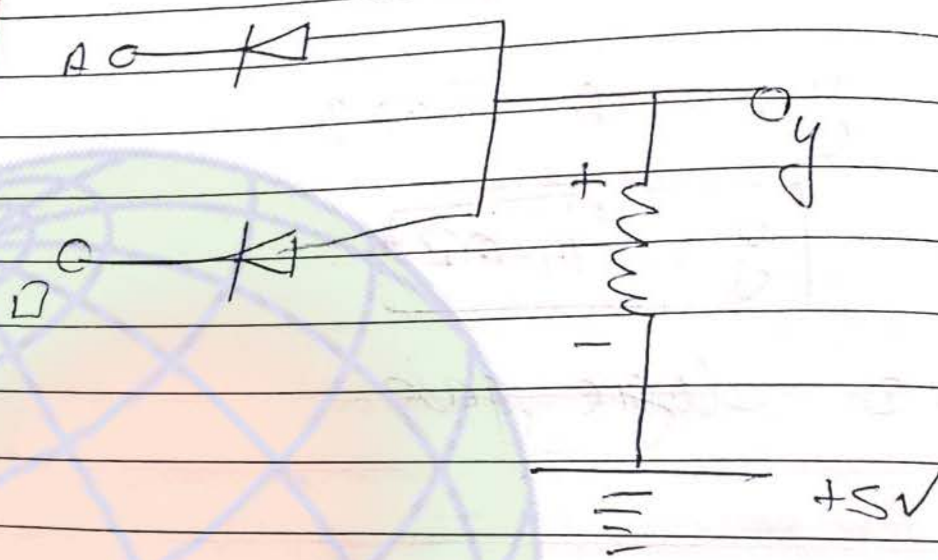
iii) truth table

A	B	y
0	0	0
1	0	0
0	1	0
1	1	1

iv) Realisation



v) Diod ~~or~~ AND gate



3.) NOT Gate (एक Input एक Out put)

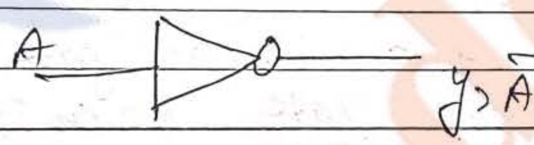
i) NOT function

$\boxed{y = \bar{A}}$

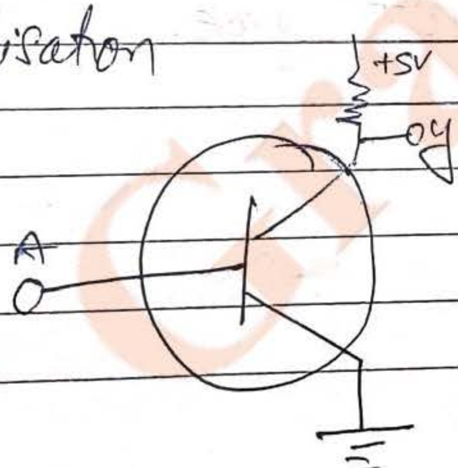
ii) NOT logic gate

A	$y = \bar{A}$
1	0
0	1

iii) Symbolic Representation



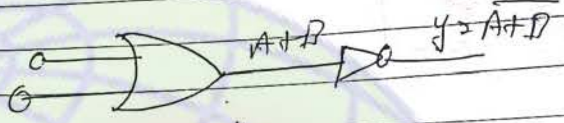
iv) Relisation



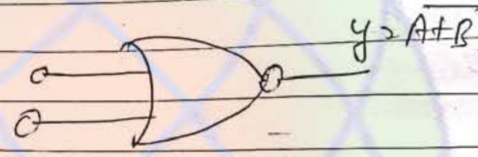
4 NOR gate

⇓

$y = NOT(A \ OR \ B) \Rightarrow \overline{A+B}$



⇓



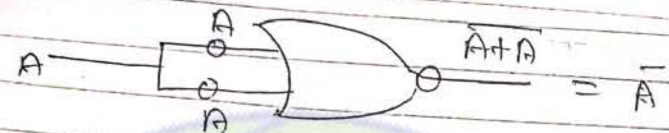
T.T.

A	B	y
0	0	1
1	0	0
0	1	0
1	1	0

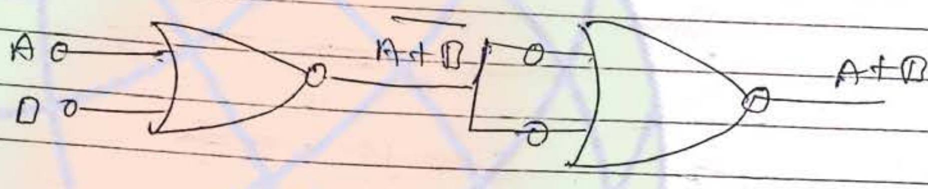
Note

NOR gate is a useful gate by the help of NOR gate we can produce AND, OR, NOT gate.

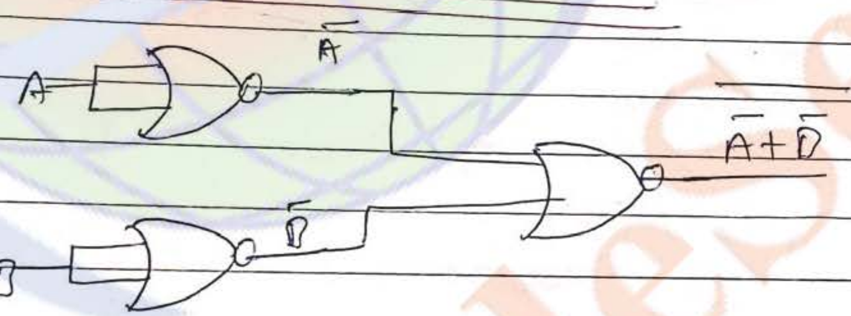
(i) NOR as NOT gate



(ii) NOR as OR gate



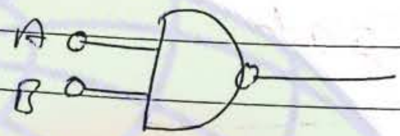
(iii) NOR as AND gate



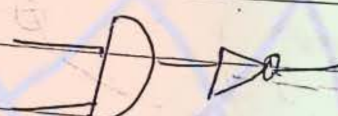
De Morgan theorem $\Rightarrow$ $\overline{\bar{A}+\bar{B}} = A \cdot B$

v) NAND Gate

$\underbrace{AND}$ + $\underbrace{NOT}$



$y = \cancel{A+B}\ \overline{A \cdot B}$



A	B	y
1	1	0
0	1	1
1	0	1
0	0	1

- → Software engineering.
- → Electrical engineering.

Wave Nature of Light : Interference

(1.)(C) Amplitude of resulting wave at the point.

$$= \sqrt{(A)^2+(2A)^2+2(A)(2A)\cos 60^\circ}$$

$$\therefore A_0 = \sqrt{7A^2}$$

Hence, as intensity $\propto$ (amplitude)^2.

$$\propto A_0^2$$

$$\propto 7A^2.$$

(2)(C) $I_{max} = (\sqrt{I_1}+\sqrt{I_2})^2$, $I_{min} = (\sqrt{I_1}-\sqrt{I_2})^2$.

$$\therefore \frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}}\right)^2 = 25.$$

$$\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}} = 5 \Rightarrow \frac{\sqrt{\frac{I_1}{I_2}}+1}{\sqrt{\frac{I_1}{I_2}}-1}.$$

$$\sqrt{\frac{I_1}{I_2}}+1 = 5\sqrt{\frac{I_1}{I_2}}-5$$

$$6 = 4\sqrt{\frac{I_1}{I_2}} \Rightarrow \sqrt{\frac{I_1}{I_2}} = \frac{3}{2}$$

$$\frac{I_1}{I_2} = \frac{9}{4}$$

(3) B, D For stationary interference pattern sources must be coherent, i.e. they must have no phase difference and should have same frequency and wavelength.

(4) (A) For interference frequency must be equal and have constant phase difference.

(5) (C)

Fringe width $= \beta = \frac{\lambda D}{d}$

$$\beta \propto \lambda$$

Hence, $\frac{\beta_1}{\beta_2} = \frac{\lambda_1}{\lambda_2} \Rightarrow \frac{1}{\beta_2} = \frac{5000}{6000}$

$\beta_2 = \frac{6}{5} = 1.2$ mm.

(6) (A) While in air, fringe width $= \beta = \frac{\lambda D}{d} = 0.4$ mm.

When immersed in liquid, fringe width.

$$\beta = \frac{\lambda D}{d} = \frac{\lambda D}{\mu d} = \frac{1}{\mu}\left(\frac{\lambda D}{d}\right)$$

$$= \frac{1}{(4/3)}(0.4) = 3(0.1) = 0.3 \text{ mm}.$$

Page No.
Date

(7)(c) $\lambda = 5\times10^{-7} m$ $d = 10^{-3}$, $D = 2m$
separation of bright lines = fringe width
$= \frac{\lambda D}{d}$

$= \frac{5\times10^{-7}\times2}{10^{-3}} = 10\times10^{-4} m.$

$= 10^{-3} m = 1 mm$

(8)(A) Fringe width $= \frac{\lambda D}{d}$.

In water wavelength λ decreases and D and d remain unaltered. Hence, fringe width decreases

(9)(A) Shift in fringes pattern $= \frac{4\lambda D}{d}$

Also shift due to glass plate $= \frac{(\mu-1)tD}{d}$

$\frac{4\lambda D}{d} = \frac{(\mu-1)tD}{d}$

$t = \frac{4\lambda}{\mu-1} = \frac{4\times6000\times10^{-10}}{1.5-1} m.$

$= 8\times6\times10^{-7} m = 4.8 \mu m.$

(10)(A) for 10th bright fringe in liquid.
$2\mu_l t = n\lambda$
$2\mu_l t = 10\lambda$ ....(1)
for 6th dark fringes in vacuum

$2\mu_v t = \frac{(2n-1)\lambda}{2}$

for vacuum. $\mu_v = 1$

So $$2t = \frac{(2\times 6 - 1)\lambda}{2}$$

$$2t = \frac{11\lambda}{2} \quad \ldots\ldots (2)$$

from equation (1) and (2)

$$\mu_l \times \frac{11\lambda}{2} = 10\lambda$$

$$\mu_l = \frac{20}{11}$$

$$\mu_l = 1.8$$

So refractive index of liquid $\mu_l = 1.8$.

(11)(A) separation between the slit $d = 3\lambda$

So fringe width $\beta = \frac{\lambda D}{d} = \frac{\lambda D}{3\lambda} = \frac{D}{3}$.

when a thin film of thickness 3λ and refractive index 2 has been placed in ~~fro~~ front of the upper slit

then distance of the central maxima on the screen from O is, $x = \frac{D}{\lambda}(\mu - 1)t$.

here $\beta = \frac{D}{3}$, $t = 3\lambda$ and $\mu = 2$.

So distance $x = \frac{D}{3\lambda}(2-1)\times 3\lambda$

$$x = D.$$

(12) False.
Fringe width will not increase.

(13) The path difference of $\frac{\lambda}{2}$ is introducted on reflection at the mirror.
$\therefore$ Net path difference.
$$= \frac{5\lambda}{2} + \frac{\lambda}{2} = 3\lambda$$
$\therefore$ Net phase difference at P.
$$= \frac{2\pi}{\lambda}(3\lambda)$$
$$\phi = 6\pi = 2(3\pi)$$
Hence P is a point of maxima and intensity at $p = \boxed{4I}$

(14) Angle between interfering wave train
$$= \frac{\lambda}{\beta} = \frac{6\times10^{-7}}{0.12\times10^{-3}} = \boxed{5\times10^{-3}\text{ rad}}$$

(15) In first case, source are coherent, so interference takes place.
Hence at mid-point of screen being maxima.
Intensity $= 4I$.
as $I \propto A^2 \Rightarrow I = KA^2$.
$\therefore$ Intensity $= I_1 = 4KA^2$
In Second case, sources being incoherent, So interference phenomena does not take place.
Hence at mid point of screen.
Intensity $= I + I = 2I = 2KA^2 = I_1$.

$$\therefore \frac{I_1}{I_1} = \frac{4KA^2}{2KA^2} = 2.$$

Electrostatics

1.(c)

$+40\mu C$ $+10\mu C$ $-10\mu C$ q_0

(2.)

Force on B due to A (+x) $f_{AB} = \frac{K q_A q_B}{r^2_{AB}}$

$$= \frac{9\times10^9 \times 40\times10^{-6} \times 10\times10^{-6}}{(40\times10^{-2})^2} = \frac{90}{4} = 22.5N$$

Force B due to C (+x) $f_{CB} = \frac{K q_C q_B}{r^2_{BC}}$

(3.)

$$= \frac{9\times10^9 \times 10\times10^{-6} \times 10\times10}{(20\times10^{-2})^2}$$

$$= \frac{90}{4} = 22.5N$$

Force on B due to D (−x) $= \frac{K q_B q_D}{r^2_{BD}}$

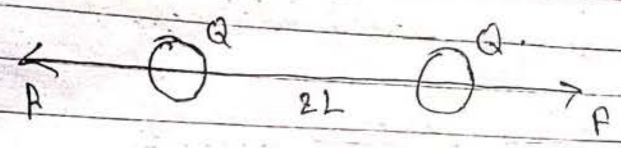
$$= \frac{9\times10^9 \times 10\times10^{-6} \times 10}{(40\times10^{-2})^2} = \frac{9}{16}\times10^6 q_0$$

$$= \frac{45\times16}{9\times10^6} = q_0$$

$q_0 = +80\times10^{-6}$

$q_0 = +80\mu C$

(2)

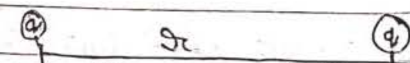


Due to similar charge, replusive force acts and angle between them $= \pi$

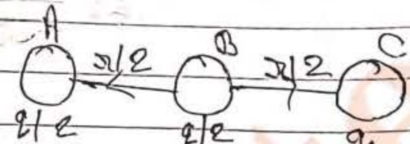
Tension $= T = F = \frac{KQ^2}{(2L)^2}$.

or $T = \left(\frac{KQ^2}{4L^2}\right)$

(3.)(B)



After touching similar uncharged ball one of them



$F_C = \frac{K\frac{q}{2}q}{(r/2)^2}(-x)$

$F_A = \frac{K\frac{q}{2}\frac{q}{2}}{(r/2)}(+x)$

$F_B = F_C - F_A \quad (F_C > F_A)$

$F_B = F_C - F_A \quad (F_C > F_A)$

$= Kq^2\left(\frac{2}{r^2} - \frac{1}{r^2}\right) = \frac{Kq^2}{r^2}$.

$F_B = F$.

(4)(ii) Force when charge placed in air.

$$F = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2} \quad \ldots\ldots (1)$$

when charge placed in a medium at dielectric constant K=16 they experience force 4 F

$$4F = \frac{1}{4\pi\varepsilon_0 \times 16} \frac{q_1 q_2}{R^2} \quad \ldots\ldots (2)$$

value of F put in equation (2) from equation (1)

$$4 \times \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$$

$$= \frac{1}{4\pi\varepsilon_0 \times 16} \frac{q_1 q_2}{R^2}$$

$$\frac{4}{r^2} = \frac{1}{16 R^2}$$

$$R^2 = \frac{r^2}{64} ; R = \frac{r}{8}$$

(5.)

Force between +4 q and q.

$$f_1 = \frac{K \times 4q \times q}{l^2} = \frac{4Kq^2}{l^2}$$

Force between Q and q.

$$f_2 = \frac{K \times Q \times q}{(l/2)^2} = \frac{4KQq}{l^2}$$

net force on q is zero.

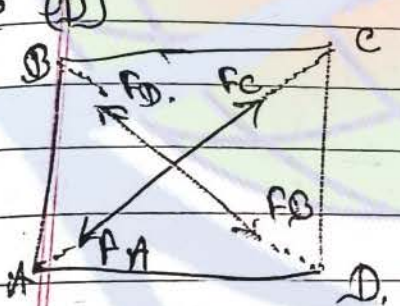
So $\quad F_1 + F_2 = 0$

$$F_1 = -F_2$$

$$\frac{4Kq^2}{l^2} = \frac{-KQq}{l^2}$$

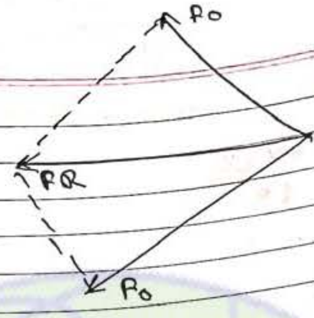
$$Q = -q$$

16 (D)



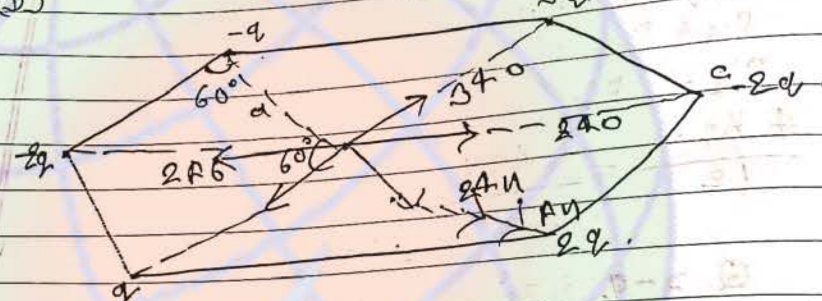
$$|F_C| = |F_B| = \frac{2q^2}{4\pi\epsilon_0 a^2} = F_0$$

$$|F_A| = |F_D| = \frac{4q^2}{4\pi\epsilon_0 a^2} = 2F_0.$$

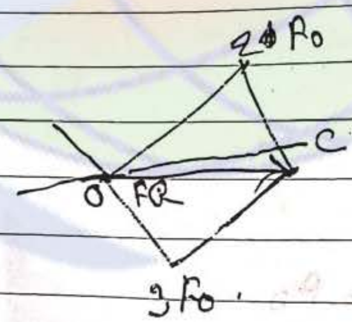


$\Rightarrow F_R = 2\sqrt{2}\, F_0$ and Perpendicular to AB.

(7.)(D)



$$F_0 = \frac{Qq}{4\pi\epsilon_0 a^2}.$$



It's below OC line so answer is (D) None of these

(8.)(B) The

(9.)(A)

(10.)(B)

Elec

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(8)(B) The magnitudes of the forces will be equal.

(9)(A)

$$F = qE$$

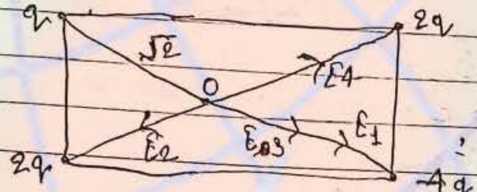
$$Mg = qE. \quad (F = mg.)$$

$$(M = V\rho)$$

$$\frac{4}{3}\pi r^3 \rho g = qE \quad (M = \frac{4}{3}\pi r^3 \rho)$$

$$E = \frac{4\pi r^3 \rho g}{3q}.$$

(10)(B)



Electric field due to charge q is

$$E_1 = \frac{Kq}{(b/\sqrt{2})^2}.$$

$$E_1 = \frac{2Kq}{b^2} \text{ (away from charge)}$$

Electric field due to charge 2q is.

$$E_2 = \frac{K(2q)}{(b/\sqrt{2})^2}.$$

$$= \frac{4Kq}{b^2} \text{ (away from charge.}$$

(11)(B)

Electric field due to charge ~~...~~ $-4q$ is

$$E_3 = \frac{k(4q)}{(b/\sqrt{2})^2}$$

$$E_3 = \frac{8kq}{(b/\sqrt{2})^2} = \frac{4kq}{b^2} \text{ (away from charge)}$$

Net field

$$E = \sqrt{(E_4 - E_2)^2 + (E_1 + E_3)^2}$$

but we know that $E_2 = E_3$:
So $E = E_1 + E_3$.

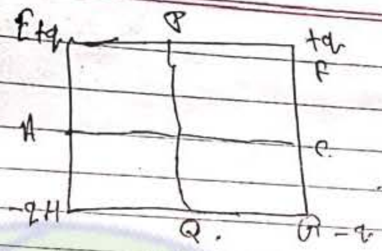
$$E = \frac{2kq}{b^2} + \frac{8kq}{b^2}$$

$$= \frac{10q}{4\pi\epsilon_0 b^2}.$$

$$E = \frac{5q}{2\pi\epsilon_0 b^2}.$$

from $+q$ to $-4q$.

(11) (B)



Potential at A = VE + VH

$= \frac{Kq}{r} - \frac{Kq}{r}$

$= 0.$

Potential at B = VE + VF + VG + VH

$= \frac{Kq}{r} + \frac{Kq}{r} - \frac{Kq}{r} - \frac{Kq}{r}.$

$= 0$

Potential at C = VF + VG

$= \frac{Kq}{r} + \frac{Kq}{r} = \frac{2Kq}{r}.$

Potential at P = VE + VF.

$= \frac{Kq}{r} + \frac{Kq}{r} = \frac{2Kq}{r}$

Potential at Q = VH + VG

$= \frac{-Kq}{r} + \frac{Kq}{r} = \frac{2Kq}{r}.$

So potential will be zero at point A, B and C, therefore correct option is (B)

(12)(A) $E = \frac{V}{d}$

$d = \frac{V}{E}$.

Here $E = 500\,V/m$, $V = 3000\,V$.

$d = \frac{3000}{500} = 6\,m$.

(13)(A) Given $q = 3$ coulomb, $F = 300$ Newton, Distance $(d) = 1cm$

Potential difference $= V_{AB} = \frac{W}{q} = \frac{Fd}{q}$.

$= \frac{3000 \times 0.01}{3}$

$= V_{AB} = 10$ Volt.

(14)(A) Given $W = 12J$

$q = 0.01C$.

Potential difference to take a charge of 0.01C from A

is $V_{AB} = V_A - V_B = (V_B - V_A) = \frac{W}{q}$.

$= \frac{12}{0.01} = 1200V$.

(15)(B)

(16)(

(17)

(18)

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(15)(B) $U_{in} = U_f + K$.

or $\frac{Kq_1q_2}{r} = \frac{Kq_1q_2}{R} + \frac{1}{2}mv^2$.

or $\frac{9\times10^9\times10^{-6}\times10^{-3}}{1}$

$= \frac{9\times10^9\times10^{-6}\times10^{-3}}{10} + \frac{1}{2} + 2\times10^{-3}v^2$.

or $9 = 0.9 + 10^{-3}v^2$

or $10^{-3}v^2 = 9 - 0.9$

$v^2 = \frac{8.1}{10^{-3}}$

$v = 90\ m/s$.

(16)(B) $E = \frac{q}{4\pi\epsilon_0 r^2}$; $V = \frac{q(n-1)}{4\pi\epsilon_0 r}$

$\Rightarrow \frac{V}{E} = r(n-1)$

(17)(B) $U = -eV$

$\Rightarrow$ Point must have minimum potential

$\Rightarrow$ At point B

(18)(A)

$\partial V = V - V_0$ or $V = V_0 + \partial V$

$\partial V = -(E_x\hat{i} + E_y\hat{j}).(x\hat{i} + y\hat{j})$

$\partial V = -[xE_x + yE_y]$.

$\therefore \; V = V_0 - xE_x - yE_y$.

(19)(B) Since $\vec{E} = \frac{\partial V}{\partial x}\hat{i}$

$\vec{E} = \frac{\partial}{\partial x}(1000x^{-1} + 1500x^{-2} + 500x^{-3})\hat{i}$

$= (-1000(-1)x^{-2} - 1500(-2)x^{-3} - 500(-3)x^{-4})\hat{i}$

$= \left(\frac{1000}{x^2} + \frac{3000}{x^3} + \frac{1500}{x^4}\right)\hat{i}$

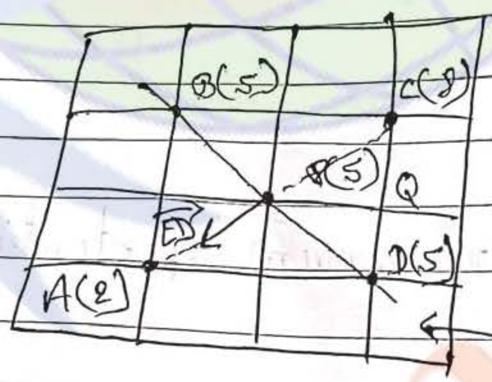
For $x = 1\,m$, $\vec{E} = (1000 + 3000 + 1500)\hat{i}$

or $\vec{E} = 5500\,\hat{i}\ V/m$.

(20)(B) $E_x = \frac{-\partial V}{\partial x} = -\frac{(2-4)}{(2-4)\times 10^{-2}} = -100\ V/m$

$E_y = \frac{\partial V}{\partial y} = \frac{(4-2)}{(0-1)\times 10^{-2}} = +200\ V/m$

(21)(B)



Equipotential Line

$\vec{E_P} = \frac{V_P - V_A}{AP}$.

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$$= \frac{(5-2)}{0.1\sqrt{2}} = 15\sqrt{2}\,V/m \text{ Along } VA$$

(22) (D) $y = 2x$ $m_1 = 2$.

$\vec{E} \perp$ equipotential line

$\Rightarrow m_1 \cdot m_2 = -1$ [where m_2 is slope of $\vec{E}$]

(A) $m_2 = \frac{3}{4}$ (C) $m_2 = \frac{4}{8} = \frac{1}{2}$

(C) $m_2 = \frac{8}{4} = 2$ (D) $m_2 = -\frac{8}{4} = \frac{1}{2}$.

$\Rightarrow$ (D) As $m_1 \cdot m_2 = -1$.

(23) (D) Since $\vec{E_A} = \frac{\lambda}{2\pi\varepsilon_0 (3a)}$

$\therefore E = -\frac{\partial V}{\partial r}$.

or $V = V = -\int \vec{E} \cdot \vec{\partial r}$.

$$VA = -\int \frac{\lambda}{2\pi\varepsilon_0} \frac{da}{(3a}$$

$$= \frac{-\lambda}{3\pi\varepsilon_0} \log(3a)$$

and $V_B = V_C = -\frac{\lambda}{2\pi\varepsilon_0} \log(2a)$

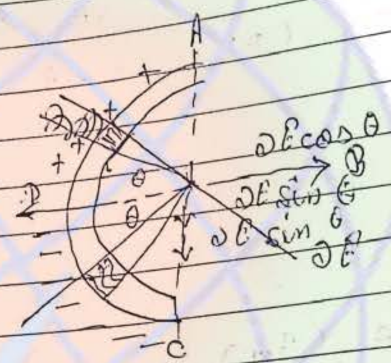
work done $w = q_0 (V_B - V_A)$

$$w = q_0 \left[\frac{\lambda}{2\pi\varepsilon_0} \log_e(2a) + \left(\frac{\lambda}{2\pi\varepsilon_0}\right) \log_e(3a) \right]$$

or $$w = \frac{q_0 \lambda}{2\pi\varepsilon_0} \log_e\left(\frac{3}{2}\right)$$

(2.5)(D)

(2.4)(C)



(2.6)

Take OB as the x-axis and OA as the y-axis. Consider two elements EF and E'F' of width $d\theta$ at angular distance θ above and below OB respectively. The magnitude of the field at O due to either element is

$$dE = \frac{1}{4\pi\varepsilon_0} \frac{r\,d\theta \times \frac{Q}{\pi r/2}}{r^2}$$

$$= \frac{Q}{2\pi^2 \varepsilon_0 r^2} d\theta$$

Resolving the fields, we that the components along OB and OD are equal and opposite so cancel each other, hence, The resultant field is along OC so correct option is C.

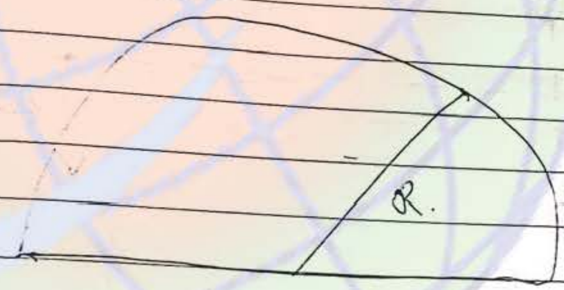
(25)(D) $\partial V = -\vec{E_z} \cdot \vec{\partial_z}$

$$\partial V = -\left(\frac{\sigma}{2\varepsilon_0}\hat{k}\right) \cdot (z\hat{k})$$

$$\partial V = -\frac{\sigma z}{2\varepsilon_0}$$

and $V = V_0 + \partial V = \left(V_0 - \frac{\sigma z}{2\varepsilon_0}\right)$

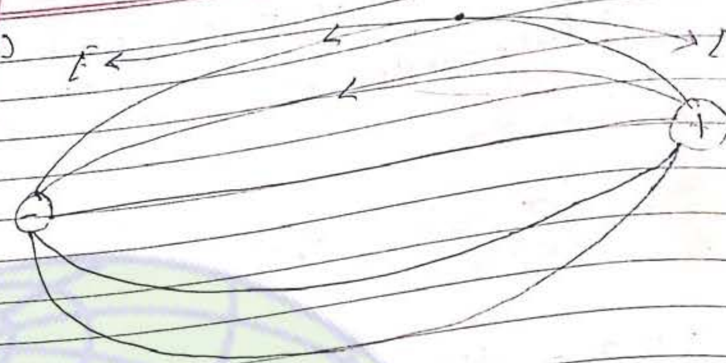
(26)(D)



$$V = \frac{q}{4\pi\epsilon_0 R} = \frac{\lambda(\pi R)}{4\pi\epsilon_0 R}$$

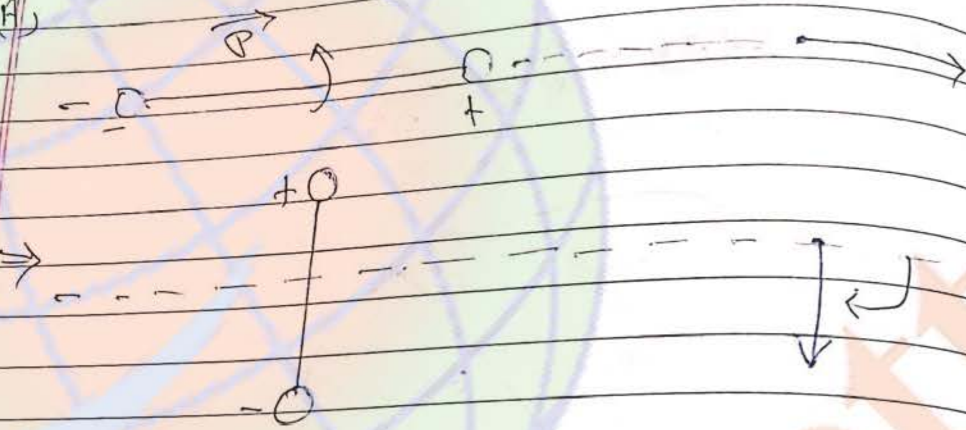
$$= \frac{\lambda}{4\varepsilon_0} = \frac{1}{4}\lambda\pi$$

(27)(B)



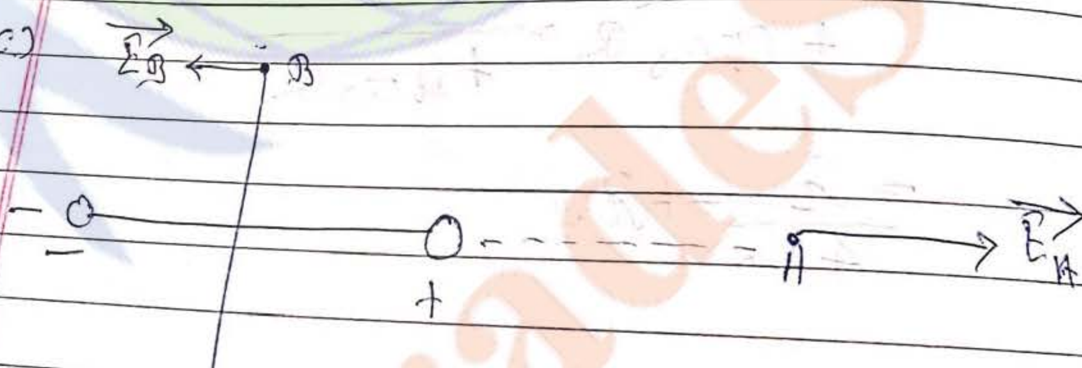
(30)(B)

(28)(A)



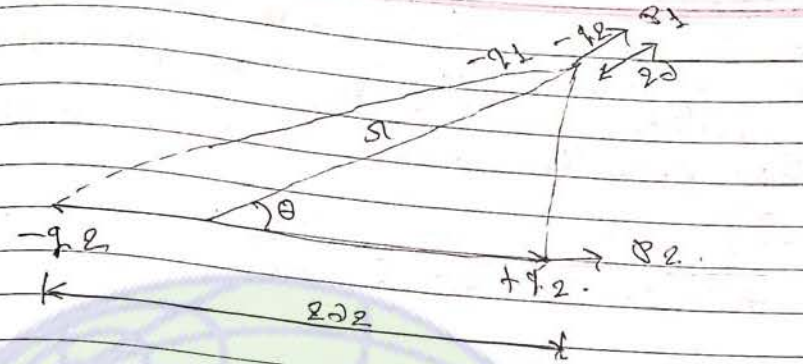
90° clock wise.

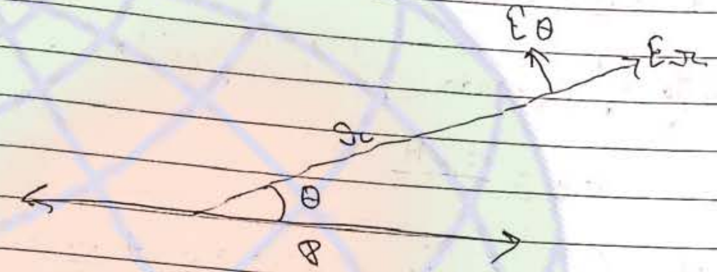
(29)(C)



$|E_A| = 2|E_B| \rightarrow \vec{E_A} = -2\vec{E_B}$

(30 Q3)





$$U = \sum \frac{q_i q_j}{r_{ij}} = -\vec{P}\cdot\vec{E}$$

$$= -P_1 \cdot E_r = -P_1 \left[\frac{+2KP_2\cos\theta}{r^3} \right]$$

$$= \frac{-2KP_1 P_2}{r^3}\cos\theta$$

Capacitance

1. (D) when the spheres are connected there will be loss of energy due to flow of charge from higher potential to lower potential. If their potential are same, There is no flow of charge

$$\frac{1}{4\pi\varepsilon_0}\frac{Q_1}{R_1} = \frac{1}{4\pi\varepsilon_0}\frac{Q_2}{R_2}.$$

or $Q_1 R_2 = Q_2 . R_1$.

(2) A) Capacity of circular plate capacitor.

$$C_1 = \frac{\varepsilon_0 A}{d}$$

Capacity of a metallic sphere $C_2 = 4\pi\varepsilon_0 r$ as per.

Q. $C_1 = C_2$

$$\frac{\varepsilon_0 A}{d} = 4\pi\varepsilon_0 r.$$

$$d = \frac{A}{4\pi r} = \frac{\pi r_1^2}{4\pi r}$$

Here $r_1 = 20\ mm = 20\times10^{-3}\ m$,

$r = 1\ m$.

So $d = \frac{(20\times10^{-3})^2}{4\times1} = \frac{400\times10^{-6}}{4}$.

$d = 10^{-4} = 0.1\ mm$.

(3.)(b.) Spheres put in contact will have same potential

$$\frac{Q_1}{C_1} = \frac{Q_2}{C_2}$$

or $$\frac{Q_1}{Q_2} = \frac{C_1}{C_2}$$

(4.A) capacity of a parallel plate capacitor.

$$C = \frac{\varepsilon_0 A}{d - t\left(1 - \frac{1}{K}\right)}$$

For mica sheet.

$$C_1 = \frac{\varepsilon_0 A}{d - 10^{-4}\left(1 - \frac{1}{5.4}\right)}$$

$$C_1 = \frac{\varepsilon_0 A}{d - 0.0008}$$

For glass sheet.

$$C_2 = \frac{\varepsilon_0 A}{d - 2\times10^{-4}\left(1 - \frac{1}{7}\right)}$$

$$= \frac{\varepsilon_0 A}{d - 00017}$$

For paraffin slab.

$$C_3 = \frac{\varepsilon_0 A}{d - 10^{-2}\left(1 - \frac{1}{2}\right)}$$

$$C_3 = \frac{\varepsilon_0 A}{d - 005}$$

as per see C_1, C_2 and C_3 lower portion of C_1 is lowest in these three force C_1 is highest in these three sheets.

(6)(A)

(5) (a) capacity of a parallel plate condenser is.

$$C_0 = \frac{\varepsilon_0 A}{d}$$

$$C = \frac{\varepsilon_0 A}{d - t\left(1 - \frac{1}{k}\right)}$$

here $K = \varepsilon_r$

$\cancel{d - t\left(1 - \frac{1}{k}\right)}$ $t = d/4$

then $C = \dfrac{\varepsilon_0 A}{d - \frac{d}{4} + \frac{d}{4\varepsilon_r}}$

$$C = \frac{\varepsilon_0 A}{\frac{3d}{4} + \frac{d}{4\varepsilon_r}} = \frac{4\varepsilon_r \varepsilon_0 A}{d(3\varepsilon_r + 1)}$$

(7)(A)

then $\dfrac{C}{C_0} = \dfrac{\dfrac{4\varepsilon_r \varepsilon_0 A}{d(3\varepsilon_r + 1)}}{\dfrac{\varepsilon_0 A}{d}}$

$$\frac{C}{C_0} = \frac{4\varepsilon_r}{3\varepsilon_r + 1}$$

(6)(A) $C_1 = \frac{\varepsilon_0 A}{d}$

When a metal plate of thickness d/2 and of same area is inserted completely between the plates.

Then

$$C = \frac{\varepsilon_0 A}{d-t} = \frac{\varepsilon_0 A}{d-d/2}.$$

$$C = \frac{2\varepsilon_0 A}{d}$$

So ratio $\frac{C}{C_1} = \frac{\frac{2\varepsilon_0 A}{d}}{\frac{\varepsilon_0 A}{d}} = 2:1.$

(7)(A) Initial capacitance of capacitor.

$$C_1 = \frac{K\varepsilon_0 A}{d}.$$

here, $K = 4$, $d = 3$ mm.

$$C_1 = \frac{4\varepsilon_0 A}{3\times10^{-3}}$$

After placing second sheet the space between the plates is filled completely with two dielectrics of thickness $t_1 = 3$ mm and $t_2 = 5$ mm having dielectric constants 4 and ε_r.

So the new capacitance

$$C_2 = \frac{\varepsilon_0 A}{\frac{t_1}{K_1} + \frac{t_2}{K_2}}$$

$$= \frac{\varepsilon_0 A}{\frac{3\times10^{-3}}{4} + \frac{5\times10^{-3}}{\varepsilon_r}}$$

Given that $C_2 = \frac{C_1}{2}$.

$$\frac{\varepsilon_0 A}{\frac{3\times10^{-3}}{4} + \frac{5\times10^{-3}}{\varepsilon_r}} = \frac{1}{2}\left(\frac{4\varepsilon_0 A}{3\times10^{-3}}\right)$$

(5)

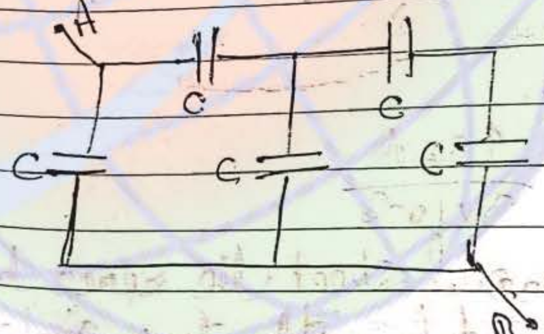
$$\frac{4\varepsilon_r \varepsilon_0 A}{3\varepsilon_r\times10^{-3} + 20\times10^{-3}} = \frac{4\varepsilon_0 A}{6\times10^{-3}}$$

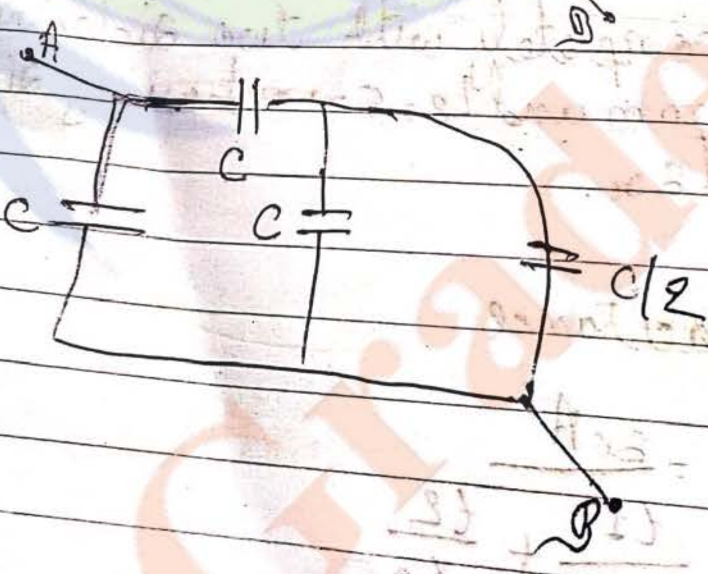
$$6\times10^{-3}\varepsilon_r = 3\varepsilon_r\times10^{-3} + 20\times10^{-3}.$$

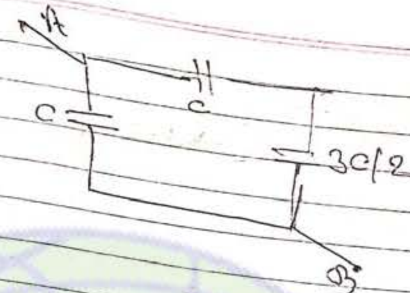
$$3\times10^{-3}\varepsilon_r = 20\times10^{-3}$$

$$\varepsilon_r = \frac{20}{3}.$$

(8)(B)

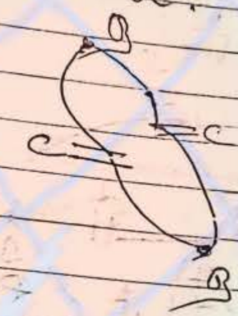






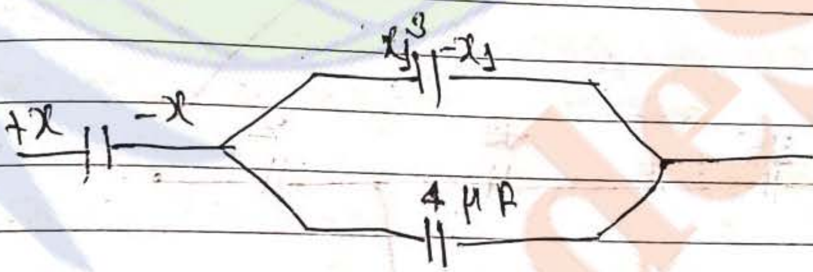
$$\frac{1}{C'} = \frac{1}{C} + \frac{2}{3C}$$

$$C' = 0.6C.$$



$$C_{eq} = C + C'$$
$$= C + 0.6C = 1.6C$$

9) (A)



$$x_1 = \frac{3}{3+4} \times x$$

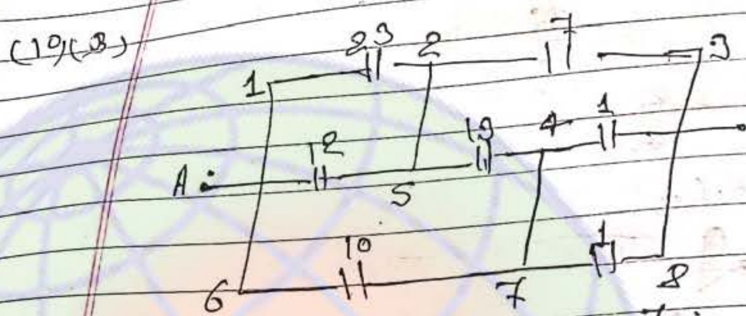
$$x_1 = \frac{3}{7}x \Rightarrow \frac{3}{7} \times (-20)$$

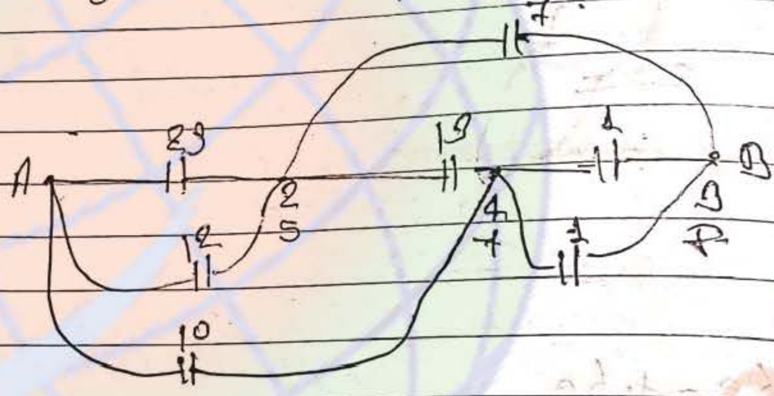
[$x = -20$ is given].

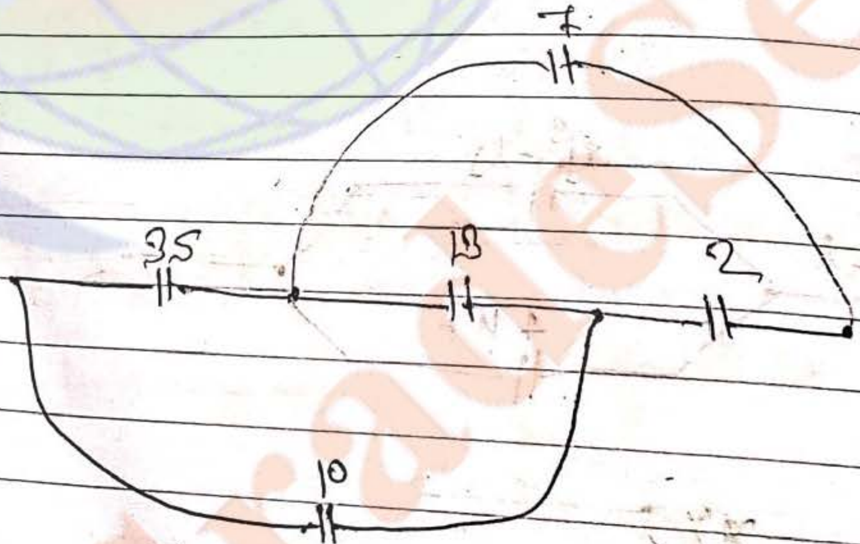
$\Rightarrow \frac{-60}{7} = 8.57$

charge of Right plate $= -x_1 \Rightarrow 8.57\ \mu C$.

(10)(B)

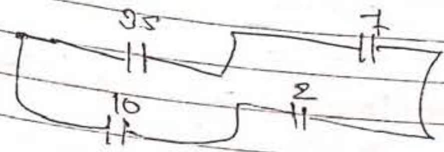






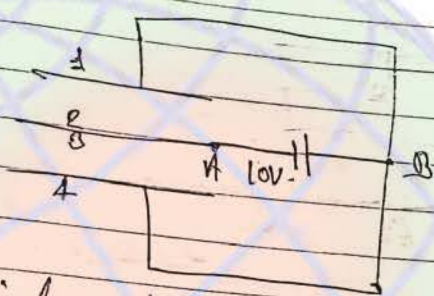
wheat stone balance bridge

$$\frac{35}{10} = \frac{7}{2}$$

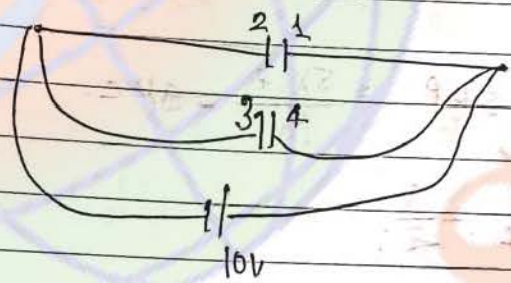


$C_{eq} = 15/2$ Ans(B)

(11) (B)



using point potential technique.

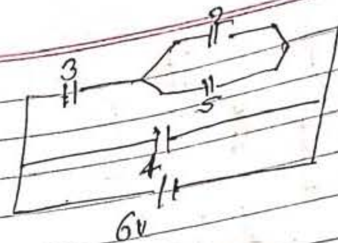


$U_{stored} = \frac{1}{2} C_{eq} \times 10^{-2} = \frac{1}{2} \times 2C \times 10^{2}$.

$\Rightarrow C \times 10^{2} \Rightarrow \frac{\epsilon_0 A}{d} \times 10^{2}$.

$= \frac{\epsilon_0 \times 0.1 \times 10^{2}}{0.885 \times 10^{-3}} \Rightarrow 10^{-1}\ \mu J$.

(12)(C)



charge on $4\mu F = 6\times 4 = 24\mu C$.

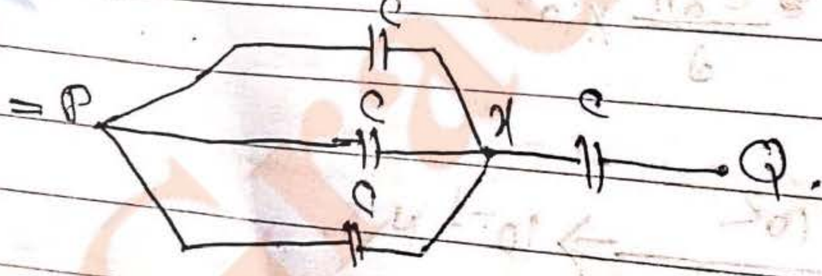
(5

$$v_2 = \frac{\frac{1}{7}}{\frac{1}{3}+\frac{1}{7}} \times 6 = \frac{1\times 3}{10} = \frac{18}{10}$$

charge on $5\mu F = \frac{5\times 18}{10} = 9\mu C$.

Ratio $= \frac{9}{24} = \frac{3}{8}$.

(13)(D)

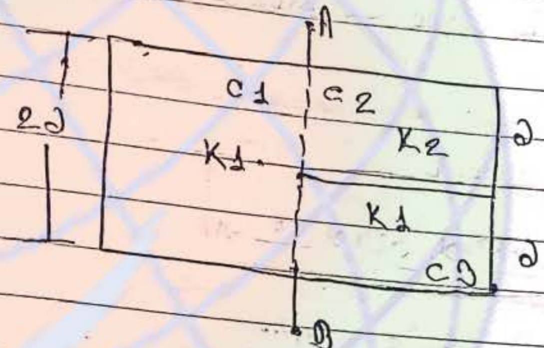


$$C_{eq} = \frac{3C^2}{4C} = \frac{3}{4}C.$$

(14)(B) 200 PF

(15)(C) $C_2 = \frac{K_2 \varepsilon_0 A}{2d}$

and $C_3 = \frac{K_1 \varepsilon_0 A}{2d}$



C_2 and C_3 in series

$$\frac{1}{C} = \frac{2d}{K_2 \varepsilon_0 A} + \frac{2d}{K_1 \varepsilon_0 A} = \frac{2d}{\varepsilon_0 A}\left[\frac{1}{K_1} + \frac{1}{K_2}\right]$$

$$\frac{1}{C} = \frac{2d}{\varepsilon_0 A}\left[\frac{K_1 + K_2}{K_1 K_2}\right] \text{ or } \frac{\varepsilon_0 A K_1 K_2}{2d(K_1 + K_2)}$$

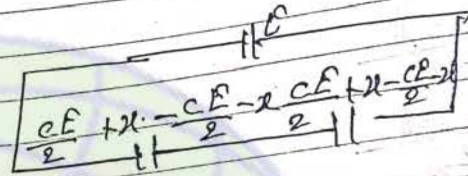
And $C_1 = \frac{K_1 \varepsilon_0 A}{4d}.$

Now C_1 and C are in parallel.

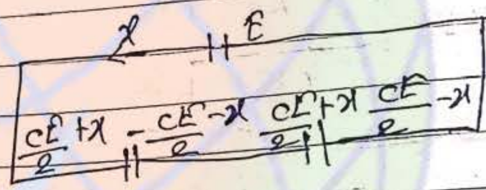
$$C = \frac{K_1 \varepsilon_0 A}{4d} + \frac{\varepsilon_0 A K_1 K_2}{2d(K_1+K_2)}$$

$$= \frac{\varepsilon_0 A}{4d} \frac{K_1(K_1+3K_2)}{K_1+K_2}$$

(16)(D)



Now dielectric k is inserted between the plate of one capacitor.



KVL:

$$-E + \frac{\frac{CE}{2}+x}{C} + \frac{\frac{CE}{2}+x}{KC} = 0.$$

$$-E + \frac{E}{2} + \frac{x}{C} + \frac{E}{2K} + \frac{x}{KC} = 0.$$

$$\frac{x}{C}\left[1+\frac{1}{k}\right] = \frac{E}{2}\left[1-\frac{1}{k}\right].$$

$$x = \frac{CE}{2}\frac{[K-1]}{(K+1)} \quad \text{Ans.}$$

(11)(c) $\Delta V = Ed$

$= 200 \times 5$

$= 1000$ volt.

$q = C \times 10$

when $C = \frac{\epsilon_0 A}{d} \Rightarrow C = \frac{\epsilon_0 A}{5}$.

on inserting metal plate.

$$C' = \frac{\epsilon_0 A}{(d-t)} = \frac{\epsilon_0 A}{(5-2)} = \frac{\epsilon_0 A}{3}$$

$$\frac{C}{C'} = \frac{3}{5}.$$

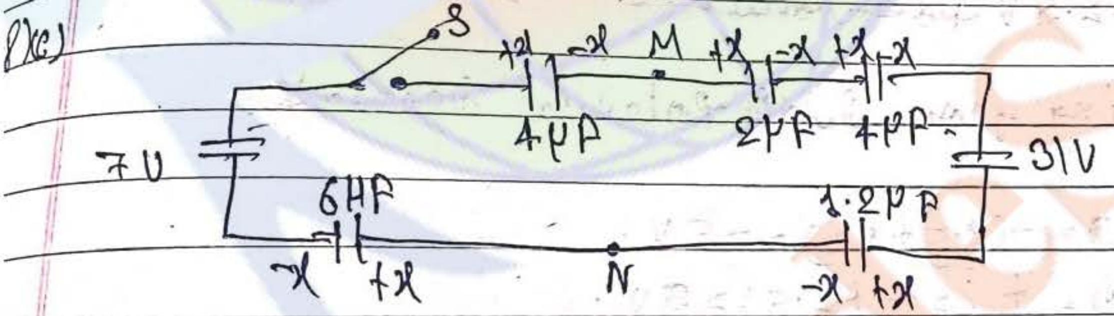
charge remain same.

$$C'V' = CV$$

$$V' = \frac{C}{C'} \times V$$

$$= \frac{3}{5} \times 1000 = 600\,V.$$

8(c)



KVL

$$\frac{x}{4} + \frac{x}{2} + \frac{x}{4} + 31 + \frac{x}{1.2} + \frac{x}{6} - 7 = 0$$

$0.3x + 0.6x + 0.3x + x + 0.2x = -24 \times 1.2$.

$2.4x = -24 \times 1.2$.

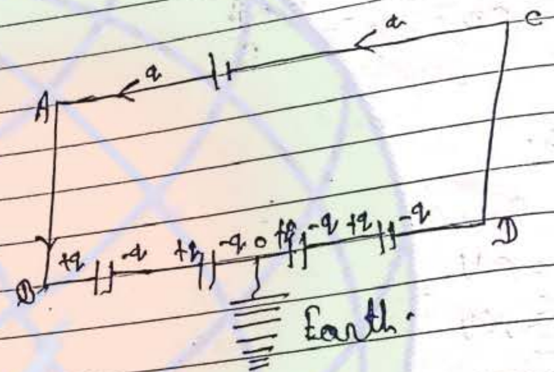
$x = -12\mu C$.

$V_m - V_n = \frac{-x}{4} + 7 - \frac{x}{6} = \frac{12}{4} + 7 + \frac{12}{6}$

$= 12$ volt.

$\Rightarrow 3 + 7 + 2 = 12$ volt.

(19)(B)



All capacitor are in series and their c are same.

$\therefore$ Potential drop across each c is same.

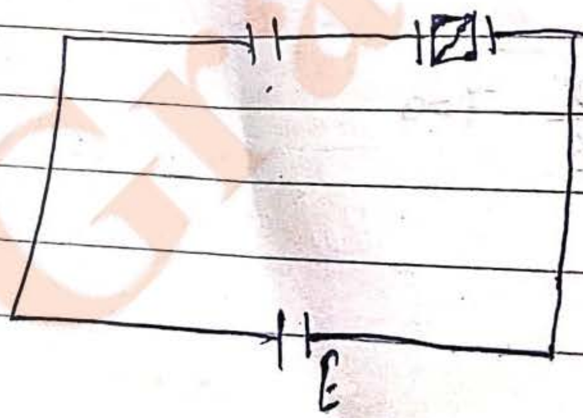
$= \frac{10}{4} = 2.5$ V potential at E = 0.

on going from B to D potential decreases

$\therefore$ V at D $= -(2.5 + 2.5) = -5$ V.

V to B $= +(2.5 + 2.5) = 5$ V.

(20)(C)



charge on each capacitor.

$Q1 = Q2 = \frac{KCE}{K+1}$.

on removing slab redistribution of charge take place and finally new charge on each

$Q_1 = Q_2 = \frac{CE}{Q2} = \frac{K}{2(K+1)}$

(21)(a) charge on 15μF = 15×100
= 1500μC

charge on 1μF = 100μC.

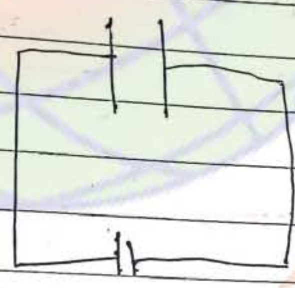
Now both are disconnected from battery and dielectric of K=15 is removed.

∴ capacitance of 15μF become 1μF.

$$V = \frac{Q1+Q2}{C1+C2} = \frac{1500+100}{1+1}$$

= 800 volt.

(22)(c)



As capacitor is connected to battery, its potential remains constant. when separation between plate is halfed c become double.

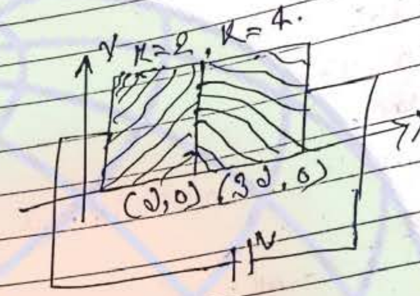
∴ $q = CV$.

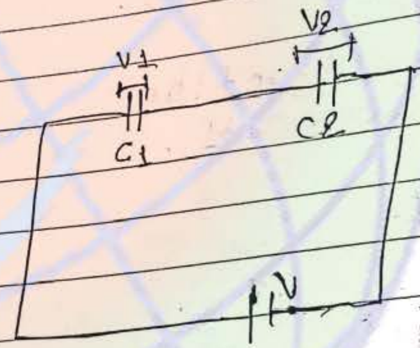
q charge become double.

$F = \frac{q^2}{2A\epsilon_0}$

∴ Force become 4 times

(28)(A)





$$C_1 = \frac{2\epsilon_0 A}{d}$$

$$C_2 = \frac{4\epsilon_0 A}{2d} = \frac{2\epsilon_0 A}{d}$$

∴ $V_1 = V_2$ as $C_1 = C_2$

$$E_1 = \frac{V_1}{d} \quad E_2 = \frac{V_2}{2d}$$

$E_2 < E_1$.

and E is uniform.

(24)(c) when dielectric is inserted c increases.
In isolated charged capacitor charge remain constant.

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

if c increases then V decreases.

$E = \frac{q}{KA\epsilon_0}$; it decreases.

Energy stored $U = \frac{q^2}{2CK}$; U decreases

(25)(A) when Air is filled between the plates.

$$C_1 = \frac{\epsilon_0 A}{d}$$

So $q_1 = C_1 V$

$$q_1 = \frac{\epsilon_0 A}{d} V \quad \ldots\ldots(1)$$

when dielectric is filled between the plates.

$$C_2 = \frac{K\epsilon_0 A}{d}$$

So $q_2 = C_2 V$

$$= \frac{K\epsilon_0 A}{d} V \quad \ldots\ldots(2)$$

As see equation (1) and (2) $q_2 > q_1$ because K have some values.

(26)(B) In conductor $E = 0$ ∴ slope of V v/s x graph is zero or we can say potential remain same in conductor. In dielectric E decreases. ∴ slope of V v/s x graph decreases because

$$|E| = \frac{\partial V}{\partial x}$$

On moving from +ve charged plate to negatively charge plate potential decreases.

ntial
cases.

changed

Laws of motion

1.(A) To reduced the impact of impulse.

(2)(B) Ball moves under the effect of two motions so it move like ~~ba~~ horizontal projectile and fall away of is brothers hand.

(3)(B) Given: m = kg, v = 330 m/s $\Delta t = 0.01$ sec.

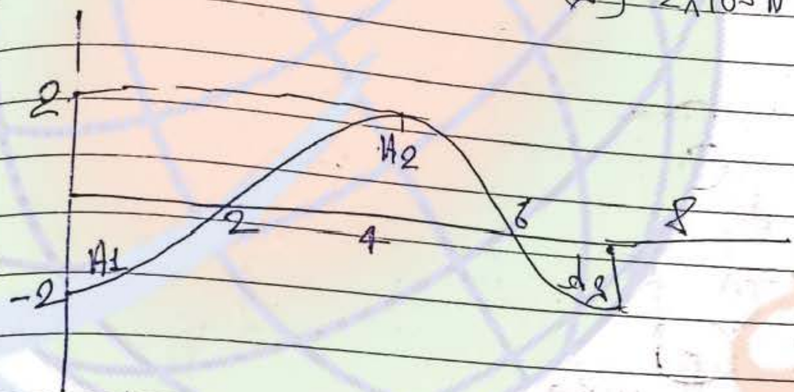
$F \cdot \Delta T = \Delta P = m \Delta V = 5 kg \times 330 m/S$

$\Delta P = 1650$ kg m/s

$F = \frac{\Delta P}{\Delta t} = \frac{1650}{0.01} = 1650 \times 100 = 1.65 \times 10^5 N$

so applied force should be greater than calculated value. So correct option will be (B) $2 \times 10^5 N$

(4)(A)



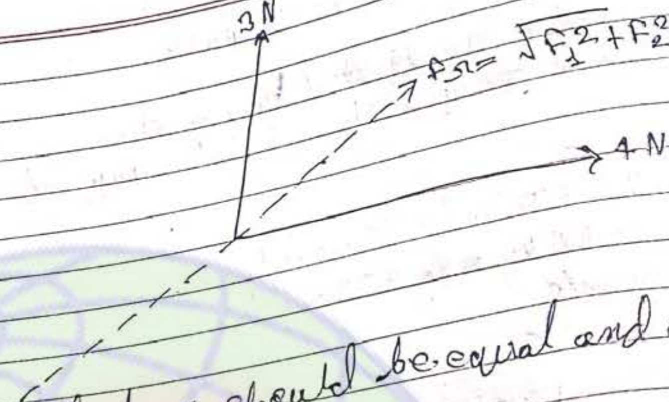
$A_1 \rightarrow$ Area-1
$A_2 \rightarrow$ " -2
$A_3 \rightarrow$ " -3

$A_1 = A_3$; $A_2 = A_1 + A_3$.

So net Area $= A_2 - (A_1 + A_3) = 0$

$F \Delta T = \Delta P = 0$ so charge in linear momentum.

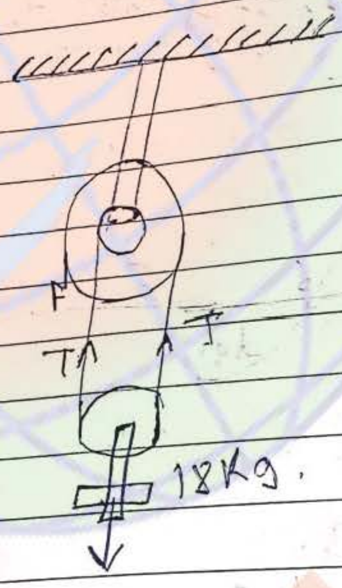
(5) (B)



$f_R = \sqrt{f_1^2 + f_2^2} = \sqrt{3^2+4^2} = 5N$

so third force should be equal and opposite of f_R.
third force will be 5N

(6) (B)



$w = 18g$.

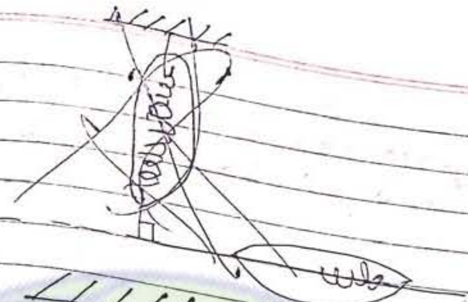
from figure

$2T = 18g$; $2T = 180$;

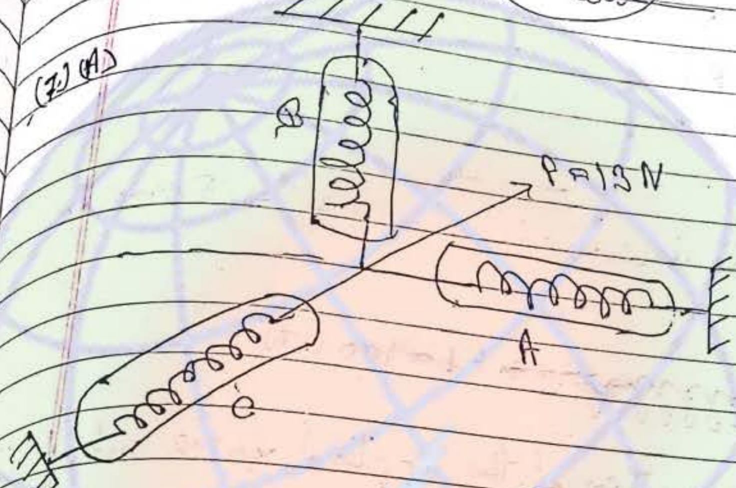
$T = 90$ Newton

For equilibrium

$F = T = 90N$



(7) (A)



Reading of A = 5N
Reading of B = 12N
So total force due to A and B.

$$F = \sqrt{F_A^2 + F_B^2 + 2F_A F_B \cos}.$$

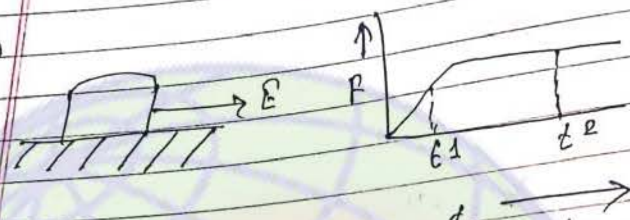
where $F_A = 5N$
$F_B = 12N$
$\theta = 90°$

$\therefore F = \sqrt{5^2 + 12^2 + 0}$ $\quad \cos 90 = 0$
$F = 13N$

$\tan\theta = \frac{F_B}{F_A} = \frac{12}{5}$

$\theta = 67.4°50$.
Hence Reading of balance cris ⊗ 13N at angle of 67.4°
From. Horizontal axis as shown in fig.

(8) (C)



At t_1 force ~~is~~ is increasing but at t_2. Force is constant.

(9) (C) $F_2 = 1000$ N —ꝏꝏꝏ→ $F_1 = 1000$ N.

Reading shows reaction of the applied force which will be same of exert force i.e. $\simeq 1000$ N

(10) (D)

Circular motion (L-1)

Q1)

$\to$ acc^n ?
$v = at$ //, $a = 0.5\, m/sec^2$

Angle described by the point $= \frac{\pi}{10}$

Now

$v = at$

we know that,

Tangential acc^n $= a_t = \frac{dv}{dt} = a = 0.5$

$\therefore$ $\boxed{\text{Angular Acc}^n = \alpha = \frac{a_t}{R}} = \frac{0.5}{R}$ $\to$ $\boxed{a_t = r\alpha}$

Now

Initially at time, $t = 0$, $v = a(0) = 0$

$\therefore$ $v = R\omega = 0 \Rightarrow \omega = 0$

using $\omega^2 = \omega_0^2 + 2\alpha.\theta$

$\omega^2 = 0 + 2\left(\frac{0.5}{R}\right)\left(\frac{\pi}{10}\right)$

$\omega^2 = \frac{\pi}{10R}$ —(i)

Now using, $\omega = \omega_0 + \alpha t$

$\omega = 0 + \frac{0.5}{R}.t$

$= \frac{0.5t}{R}$ —(ii)

Now from eq (i) and (ii)

$\left(\frac{0.5t}{R}\right)^2 = \frac{\pi}{10R}$ $\therefore$ $t = \sqrt{\frac{2\pi R}{5}}$

~~$t = \sqrt{\frac{2\pi R}{5}}$~~ S. Pr

$\therefore v = a\sqrt{\frac{2\pi R}{5}} = 0.5\sqrt{\frac{2\pi R}{5}} = \sqrt{\frac{\pi R}{5}}$

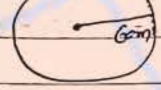
$\therefore$ At this time

Normal Acc^n $= \frac{v^2}{R} = \frac{\pi R}{5R} = \frac{\pi}{5}$

So Net Acc^n $= \sqrt{a_N^2 + a_t^2} = \sqrt{\frac{\pi^2}{25} + (0.25)}$

$= 0.8\ m/s^2$

Q2.)



$r = 60m$

$\theta = 10 - 5t + 4t^2$ rad

Avg. Ang. speed b/w 1s to 3s is -

$\omega = ?$

$\frac{d\theta}{dt} = \omega = -5 + 8t$

So at $t = 1s$

$\omega_1 = -5 + 8 = 3$ rad/sec

at $t = 3$ sec

$\omega_2 = -5 + 24 = 19$ rad/sec

we know that

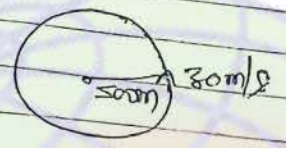
~~Average Angular speed~~ $\cancel{= \frac{\Delta\omega}{\Delta t} = \frac{\vec{\omega_f} - \vec{\omega_i}}{\Delta t}}$

$\cancel{= \frac{19 - 3}{2} = \frac{16}{}}$

(Q) Average Angular speed $= \dfrac{\omega_1+\omega_2}{t_2-t_1} = \dfrac{\text{total distance}}{\text{total time taken}}$

$$\theta_{avg} = \frac{\omega_1+\omega_2}{t_2-t_1} = \frac{19+3}{2} = \frac{22}{2} = 11 \text{ rad/sec}$$

Q.3



$r = 500m$

$\omega = 30 m/sec$

$\alpha = 2 m/sec^2$

$acc_{net} = ?$

→ circle पर acc^n हो रहा है वह tangentially acc^n हो रहा है इसलिए यह a_t है

so $a_t = 2 m/sec^2$

$$a_t = 2 m/sec^2$$

$$a_c = \frac{v^2}{r} = \frac{\omega^2}{r} = \frac{30\times30}{500} = \frac{9}{5} m/s^2$$

so

$$acc_{net} = \sqrt{a_t^2 + a_c^2} = \sqrt{(2)^2+\left(\frac{9}{5}\right)^2}$$

$$= \sqrt{4+\frac{81}{25}}$$

$12\times12 = 144$
$13\times13 = 169$
$14\times14 = 196$ } value taken in approx

$$= \sqrt{\frac{100+81}{25}} = \frac{\sqrt{181}}{5} = \frac{13.4}{5}$$

$= 2.$[illegible]