No. J/S 147535

इन्टरमीडिएट परीक्षा, 2016

आई०एससी० (I.Sc.)

28 पृष्ठों की उत्तरपुस्तिका

Sujata S. Bilung 25.2.16
वीक्षक का हस्ताक्षर

केन्द्राधीक्षक का हस्ताक्षर
गोरखनाथ हाई स्कूल, एवं मुहर
झारखण्ड इन्टरमीडिएट +2 परीक्षा।

[हाशिया (Margin) छोड़कर पन्नों के दोनों पृष्ठों पर लिखें]

रोल कोड (Roll Code)	क्रमांक (Roll No.)	पंजीयन संख्या Registration No. — No.	वर्ष (Year)	विषय (Subject)	लिपि (Script)	तिथि (Date)
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लब्धांक (MARKS OBTAINED)

Question Number	1	2	3	4	5	6	7	8	9	10	TOTAL
Marks Obtained	14	2	2	2	2	2	2	2	2	3	33
Question Number	11	12	13	14	15	16	17	18	19	20	TOTAL
Marks Obtained	3	3	3	2	2	2	3	5	4	5	32
Question Number	21	22	23	24	25	26	27	28	29	30	TOTAL
Marks Obtained											—
Question Number	31	32	33	34	35	36	37	38	39	40	TOTAL
Marks Obtained											
Grand Total	(In Words)	Sixty ~~Four~~ Five								(In Figure)	65

परीक्षार्थी हेतु निर्देश

1. परीक्षार्थी ध्यान दें कि केवल एक ही उत्तर-पुस्तिका में पूरे प्रश्नों का उत्तर सीमित करना है। अतिरिक्त उत्तर-पुस्तिका नहीं दी जायेगी।
2. उत्तर लिखना शुरू करने के पहले प्रत्येक परीक्षार्थी के लिए अपनी उत्तर-पुस्तिका के आवरण पृष्ठ पर अपना रोल कोड, रोल नं., पंजीयन संख्या एवं वर्ष, विषय, लिपि तथा तिथि लिखना अनिवार्य है। परन्तु परीक्षार्थी को अपना अथवा अपने कॉलेज का नाम कदापि नहीं लिखना है। परीक्षार्थियों को चेतावनी दी जाती है कि जिस उत्तर-पुस्तिका पर रोल कोड, क्रमांक और सूचीकरण संख्या स्पष्ट रूप से अंकित न होगी, उसे जाँची नहीं जायेगी।
3. यदि कोई परीक्षार्थी परीक्षा में दूसरे को सहायता करता या किसी प्रकार से अवैध सहायता लेने की चेष्टा करता हुआ अथवा परीक्षा में अनुचित लाभ उठाने के लिए किसी दूसरे अवैध उपाय का अवलम्बन करता हुआ पाया जायेगा तो उसे परीक्षा से निष्कासित कर दिया जायेगा। परीक्षा में परीक्षार्थियों को परस्पर किसी प्रकार से विचार विनिमय का अधिकार न होगा। परिषद् द्वारा दिये गए प्रवेश पत्र, उत्तर-पुस्तिका, प्रश्न-पत्र तथा नियमानुकूल निर्दिष्ट उपकरणों के अतिरिक्त परीक्षार्थियों को अपने साथ परीक्षा कक्ष में मोबाईल, कैलकुलेटर, छाता, पुस्तक, किसी प्रकार का पत्र, पॉकेट बुक, नोट आदि या किसी भी प्रकार का कागज रखना वर्जित है, भले ही उसका सम्बन्ध उस समय की परीक्षा के विषय से हो या न हो। इसका उल्लंघन करने वाले परीक्षार्थियों को परीक्षा से निष्कासित कर दिया जायेगा।
4. लिखने का सम्पूर्ण काम उत्तर-पुस्तिका पर ही किया जाय और उसका कोई भी पृष्ठ फाड़ा न जाए। परीक्षा खत्म होने के बाद उत्तर-पुस्तिका वापस लौटा देना आवश्यक है। इस उत्तर-पुस्तिका के बदले दूसरी उत्तर-पुस्तिका नहीं दी जा सकती। जो लिखावट काटी हुई रहेगी उसकी जाँच नहीं होगी। उत्तर-पुस्तिका में यदि कोई फटा पृष्ठ मिले तो उसे निकाल नहीं देना चाहिए बल्कि वीक्षक को दिखाकर उसे मोड़ देना चाहिए।
5. प्रश्न-पत्र पर कोई उत्तर या कोई भी दूसरी बात लिखना वर्जित है।
6. प्रश्न-पत्र वितरण के बाद एक घंटे तक कोई भी परीक्षार्थी अपनी उत्तर-पुस्तिका वापस नहीं कर सकते हैं।

परीक्षक का पूर्ण हस्ताक्षर एवं मुहर
(Full Signature of Examiner with Seal)

Prof. A. K. Mandal
Dept. of Physics
S.B.S.S.P.S.J. Inter College
Pathargama (Godda)

नोट - प्रत्येक पृष्ठों में अंकित दोनों हाशिया (Margin) के बीच में प्रश्नों का उत्तर लिखें।

(1)

(i) (c) $C^2N^{-1}m^{-2}$

(2)

(ii) (a) zero

(3)

(iii) (a) 0.625×10^3

(4)

(iv) (b) increases

(5) (v) (a) zero

(vii) (c) $\frac{1}{\sqrt{\mu_0 \epsilon_0}}$

(6)

(vi) (a) $1/\sqrt{2}$

(8)

(viii) (b) Frequency

(x) (c) α-particle

(xi) (a) $\frac{h}{2\pi}$

(ix) (b) $[ML^2T^{-1}]$

14

(xii) (b) decreases

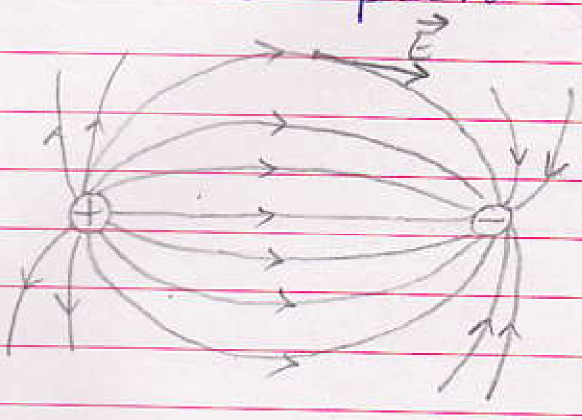
(xiii) (a) A + B = Y

(xiv) (a) Ionosphere

(xv) (c) 750 MHz

② <u>Electric field lines</u>

Electric field lines are those imaginary lines such that tangent at any point gives the direction of electric field at that point.



<u>Properties of electric field lines</u>

(a) It originates from +ve charge and terminates at −ve charge.
In case of single charge, it terminates at infinity (in case of +ve charge) and it originates from infinity (in case of −ve charge).

(b) It does not form closed loop.

(3) emf of a cell

emf of a cell is defined as maximum potential difference between the two terminals of a cell when the cell is in the open circuit.

2

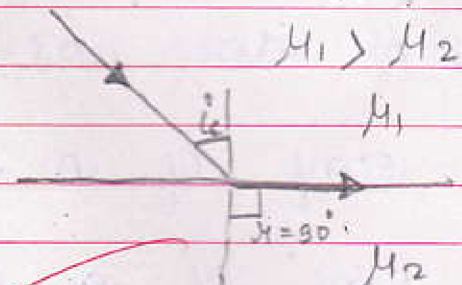
emf of a cell	terminal potential difference.
(a) It is the potential difference between two terminals of a cell when it is in the open circuit.	(a) It is the potential difference between the two points of a circuit which should be closed.
(b) It is always higher than terminal potential difference of circuit.	(b) It is always lower than emf of a cell.

(4) Critical Angle

2 Critical angle is the angle of incidence at which angle of refraction is 90°. It is denoted by ic.

From the figure,

$$\frac{\sin i_c}{\sin r} = \frac{\mu_2}{\mu_1}$$



or, $$\frac{\sin i_c}{\sin 90°} = \frac{\mu_2}{\mu_1}$$

or, $$\sin i_c = \mu_{21}$$

or, $$\boxed{i_c = \sin^{-1} \mu_{21}}$$

μ_{21} is the refractive index of 2^{nd} medium w.r.t. 1st medium.

Condition for total internal reflection

(a) Light should travel from denser medium to rarer medium.

(b) Angle of incidence should be greater than critical angle.

(8)

Mass defect

The difference between sum of masses of neutrons and protons forming a nucleus and mass of nucleus is called mass defect.

$$\text{Mass defect} = [(M_n + M_p) - M]$$

Here M = Mass of nucleus
Mn = Mass of neutrons (total)
Mp = total mass of protons

Nuclear binding energy

The amount of energy required to dissociate a nucleus into its constituent ~~to~~ nucleons is called nuclear binding energy.

(6) Co-efficient of self-induction

We know that,

$$\phi \propto I$$
$$\phi = LI$$

If $I = 1A$ L = coefficient of self induction

Then, $\boxed{\phi = L}$

Therefore, Co-efficient of self induction is defined as the amount of magnetic flux linked with the coil when unit current flows through it.

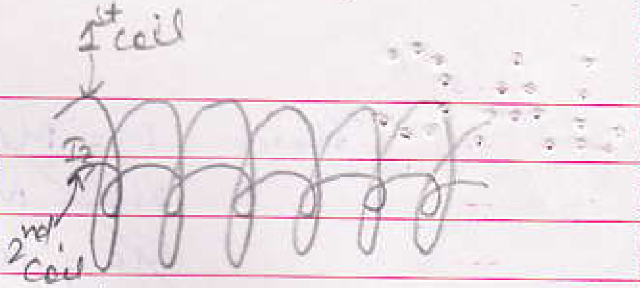
Co-efficient of Mutual induction

We know that,

$$\phi_1 \propto I_2$$
$$\phi_1 = M_{12} I_2$$

If $I_2 = 1A$

Then, $M_{12} = \phi_1$



M_{12} is the coefficent of mutual induction of first coil w.r.t. other (2nd coil)

ϕ_1 = magnetic flux through 1st coil

I_2 = current through 2nd coil

Therefore, Co-efficient of mutual induction is defined as magnetic flux linked with one coil when unit current flows through another coil.

(7)

Rutherford's Nuclear Model of Atom.

(a) Electron revolves around the nucleus in circular orbit just like planet revolves around the nucleus.

(b) The centripetal force for revolution of electron is provided by electrostatic force between electron and nucleus.

(c) The centre of nucleus is +vely charged

(d) The entire mass of an atom is concentrated in the nucleus.

(e) Most of the space of an atom is empty.

(f) The size of nucleus is about 10^{-15} m or 1 fermi.

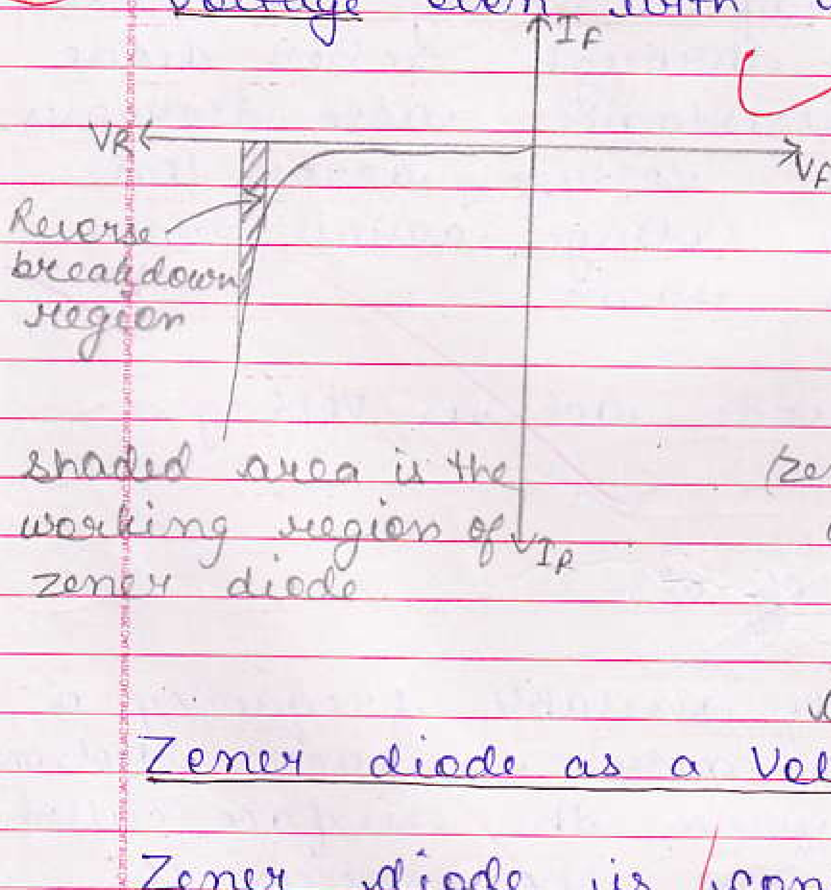
(16)

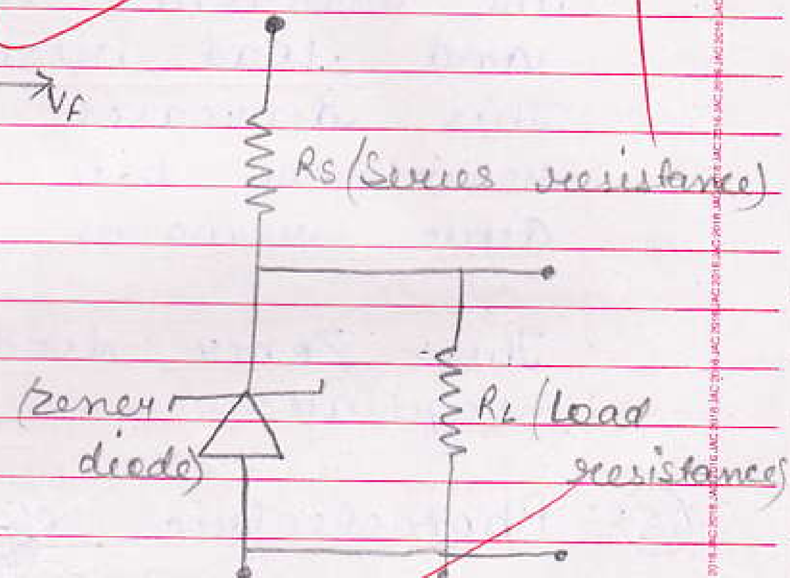
Zener diode

Zener diode is a Silicon p-n junction diode which is designed to operate in a reverse breakdown region.

2

The key feature of zener diode is that it maintains nearly constant voltage even with change in current.





Circuit diagram for zener diode

Zener diode as a Voltage regulator

Zener diode is connected with input source through a series resistance Rs such that it is reverse biased. A load resistance R_L is connected parallely with the zener diode for output.

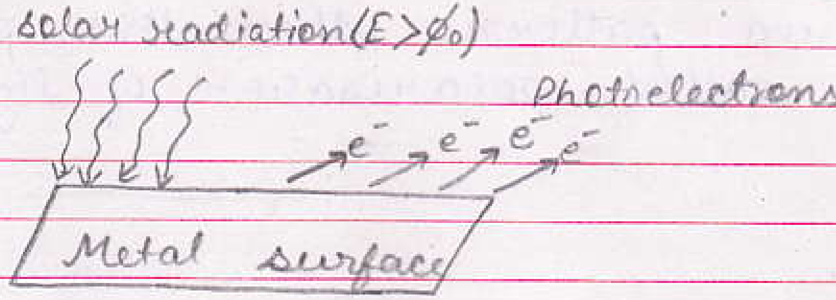
When input voltage increases, the current through zener diode and load resistance also increases. This increases voltage across R_L but voltage across zener diode remains constant.

When input voltage decreases, the current through zener diode and load resistance also decreases. This decreases voltage across load resistance but voltage across zener diode remains same.

Thus Zener diode act as voltage regulator.

(15). Photoelectric effect.

When light of suitable frequency is incident on metal surface, electrons are emitted from the surface (called photoelectrons). This phenomena of emission of electron from metal surface is called photoelectric effect.



Einstein's equation for photoelectric effect

When light of frequency ν and energy $E(=h\nu)$ is incident on metal surface where energy is greater than work function of metal, then electrons are emitted from the surface with some kinetic energy.

$$\boxed{K.E. = h\nu - \phi_0} \quad \text{——— (1)}$$

Eqⁿ (1) is known as Einstein's equation for photoelectric effect.

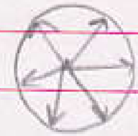
h = Plank's constant
ϕ_0 = work function of metal
K.E. = Kinetic energy of emitted electron.
ν = frequency of incident light

(13)

Polarisation of light

3

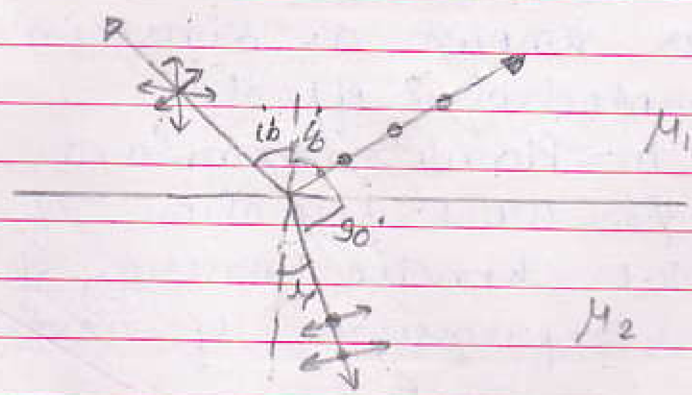
When the direction of electric field vector of light varies at a point according to a fixed pattern, then this phenomena is called polarisation of light.



Circular polarised light

Brewster's law.

According to Brewster's law,
"When unpolarised light falls on air-water interface at Brewster's angle, then the reflected light is completely polarised perpendicular to the plane of incidence. At that time, the direction of reflected ray is perpendicular to the direction of refracted ray."



When unpolarised light falls on a medium of refractive index μ_2 at angle of incidence i_b then, from the figure,

$$i_p + 90^\circ + r = 180^\circ$$

or, $i_p + r = 90^\circ$

or, $r = 90 - i_p$

From Snell's law, $\frac{\sin i_b}{\sin(90 - i_b)} = \frac{\mu_2}{\mu_1}$

$$\frac{\sin i_b}{\cos i_b} = \frac{\mu_2}{\mu_1}$$

2

or, $\tan i_b = \mu_{21}$

or, $\boxed{i_b = \tan^{-1}\mu_{21}}$

Hence, "Tangent of Brewster's angle is equal to refractive index of 2nd medium w.r.t. 1st medium".

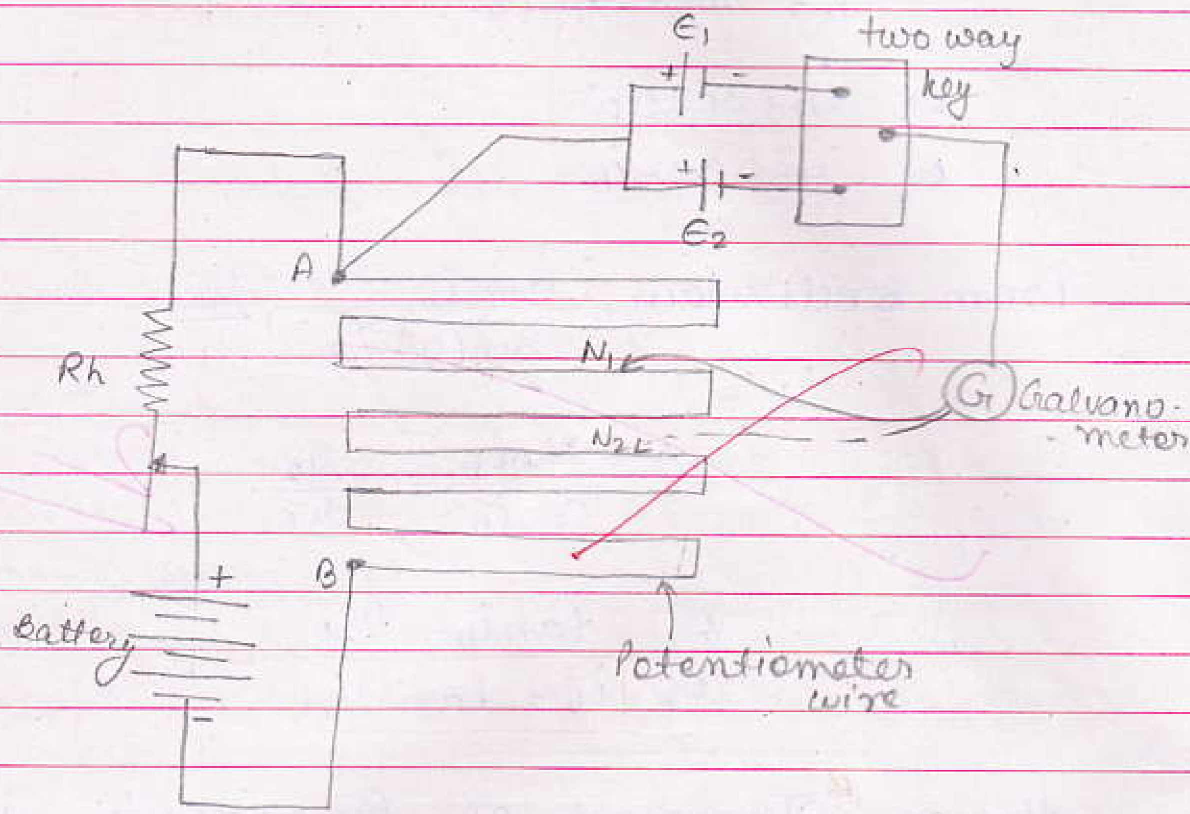
(10) Principle of potentiometer

3

It works on a principle that when potential difference is applied in opposite direction, they tends to cancel each other.

P.T.O.

Comparison of emf of two cells.



Circuit diagram

When cell E_1 is closed, null point is found at point N_1 of potentiometer.

If $AN_1 = l_1$

Then, $E_1 = \phi l_1$ —— (1)

Here ϕ = ~~resistence~~ potential per unit length.

When cell E_2 is closed, null point is found at point N_2.

If $AN_2 = l_2$

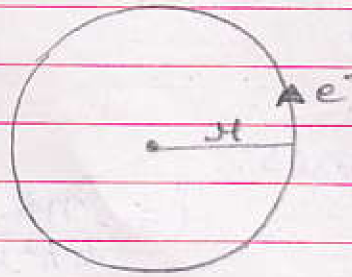
Then, $E_2 = \phi l_2$ —— (11)

Diving eq^n (I) by (II)

$$\boxed{\frac{\epsilon_1}{\epsilon_2} = \frac{l_1}{l_2}}$$

2

(11)



(B)

Suppose an electron of charge e is moving in an orbit of radius r around nucleus with velocity v.

Current due to motion of electron at time t is

$$i = \frac{e}{t}$$

But $t = \frac{2\pi r}{V}$

$$\therefore \; i = \frac{eV}{2\pi r} \quad \text{—— (1)}$$

3

Let m = mass of electron.
Multiplying by m in numerator & denominator of eq^n (1),

$$i = \frac{meV}{2\pi r m}$$

But $mev = l$ l = angular momentum of electron.

$\therefore$ $i = \frac{l}{2\pi r m}$ —— (II)

From Bohr 2nd postulate,

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

$\therefore$ Eqn (II) becomes,

$$i = \frac{nh}{4\pi^2 r m} \quad \text{—— (III)}$$

Dipole moment

$$\mu_l = Ai$$
$$= \pi r^2 \times \frac{nh}{4\pi^2 r m} \quad \text{[from eq}^n\text{ (III)]}$$

$$\boxed{\mu_l = \frac{nhr}{4\pi m}} \quad \text{—— (IV)}$$

where n = no. of orbit in which electron revolves
$= 1, 2, 3, \ldots$

Eqn (IV) gives magnetic dipole moment of revolving electron.

If $n = 1$
then,

$$\boxed{\mu_l = 9.27 \times 10^{-24}\ A\,m^2}$$

(12) Given that,

$N = 100$, $r = 8 \times 10^{-2} m$, $I = 0.4 A$

We know that,

$B = \frac{\mu_0}{4\pi} \frac{I \times 2\pi r}{r^2}$

$B = \frac{\mu_0}{4\pi} \frac{I\, 2\pi}{r}$

$B = 10^{-7} \times \frac{0.4 \times 2 \times 3.14}{8 \times 10^{-2} \times 1000}$

$= 0.314 \times 10^{-5}$

$B = 3.14 \times 10^{-6} T$

$B = \frac{\mu_0}{4\pi} \frac{I \, 2\pi r}{r^2}$

$= \frac{\mu_0 I}{2}$

3

3

(17) Modulation

The process of superposition of low frequency wave (base band signal) onto a high frequency wave is called modulation.

1

3

Necessity of modulation

(a) Size of Antenna

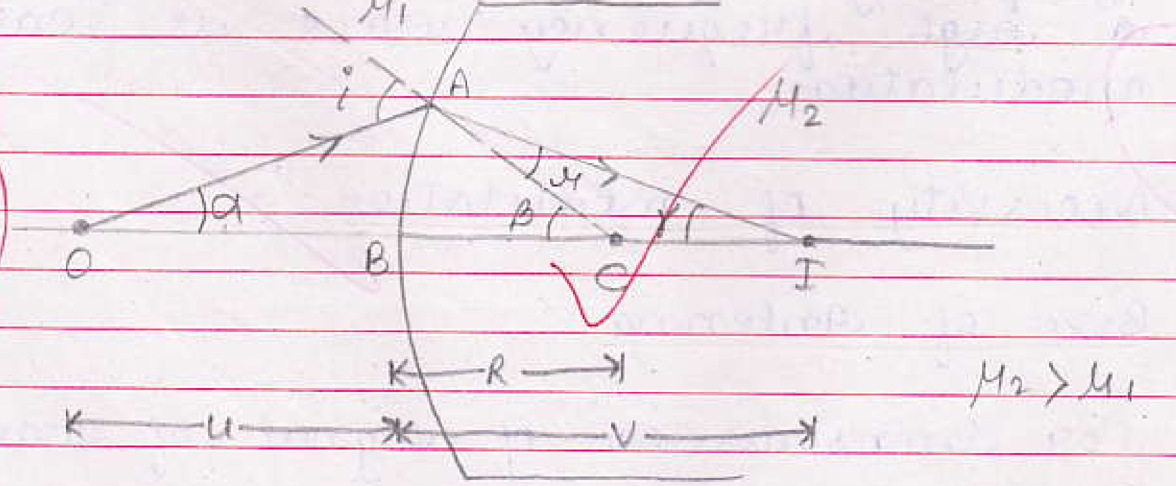
2

For transmission of signal of wavelength λ, size of antenna should be at least λ/4. For signal of 20,000 Hz, the size of antenna is so large such that its formation & maintenance is not possible. For by the process of modulation, frequency is increased, λ decreases & hence ~~hen~~ size of antenna is comparatively smaller.

(b) Power radiated by antenna

For transmitting signal of wavelength λ, the power radiated is proportional to $1/\lambda^2$. Signal of large wavelength radiates less power.
By the process of modulation, the frequency of signal (carrier wave) increases & hence its wavelength decreases. Thus the power radiated is comparatively larger.

(20)



5

Consider a interface separating two media of refractive index μ_1 & μ_2. Light ray comes from point O and after refraction it forms image at point I as shown in fig.

Let,

i = angle of incidence

r = angle of refraction

OA = incident ray

AI = refracted ray

OB = u = object distance

BI = v = image distance

α = angle b/w OB & OA

β = angle b/w BC & AC

γ = angle b/w BI & AI

In ΔOBA,

$$\tan\alpha = \frac{AB}{OB}$$

In ΔBCA, $\tan\beta = \frac{AB}{BC}$ —— (I)

In ΔAIB, $\tan\gamma = \frac{AB}{BI}$

Since α, β & γ angles are very small.

$\therefore$ $\alpha = \frac{AB}{OB}$; $\beta = \frac{AB}{BC}$; $\gamma = \frac{AB}{BI}$ —— (II)

From the fig, In ΔAOB,

$$i = \alpha + \beta \quad \text{—— (III)}$$

In ΔACI, $\beta = r + \gamma$

or, $r = \beta - \gamma$ —— (IV)

From Snell's law,

$$\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$$

or, $$\frac{\sin(\alpha+\beta)}{\sin(\beta-\gamma)} = \frac{\mu_2}{\mu_1}$$ [from eqⁿ (iii) & (iv)]

∵ α, β & γ are very small,

∴ $$\frac{\alpha+\beta}{\beta-\gamma} = \frac{\mu_2}{\mu_1}$$

or, $$\mu_1\alpha + \mu_1\beta = \mu_2\beta - \mu_2\gamma$$

or, $$\frac{AB}{OB}\mu_1 + \frac{AB}{BC}\mu_1 = \frac{AB}{BC}\mu_2 - \frac{AB}{BI}\mu_2$$ [from eqⁿ (i)]

or, $$\frac{\mu_1}{OB} + \frac{\mu_1}{BC} = \frac{\mu_2}{BC} - \frac{\mu_2}{BI}$$

But, $OB = -u$, $BC = R$, $BI = v$
(By sign convention)

∴ $$-\frac{\mu_1}{u} + \frac{\mu_1}{R} = \frac{\mu_2}{R} - \frac{\mu_2}{v}$$

or, $$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2}{R} - \frac{\mu_1}{R}$$

or, $$\boxed{\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2-\mu_1}{R}} \quad \text{——— (v)}$$

Eqⁿ (v) is the required relation.

(19) Faraday's law of electromagnetic induction

According to this law,

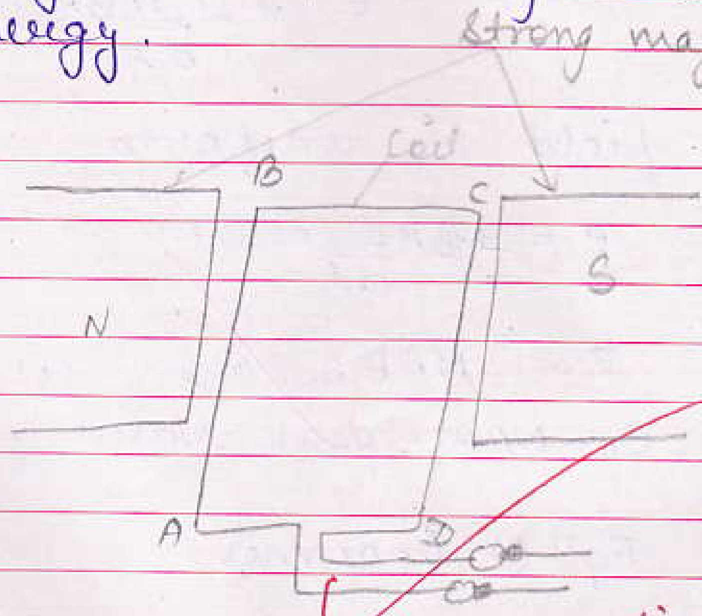
"Whenever magnetic flux through any coil changes, an emf is induced in the coil. The induced emf is equal to the rate of change of magnetic flux."

$$\epsilon = -\frac{d\phi}{dt}$$

ϵ = induced emf

$\frac{d\phi}{dt}$ = rate of change of magnetic flux in time dt.

-ve sign is according to law of conservation of energy.



Consider a coil ABCD which is rotated having no. of turns N

in a uniform magnetic field B.
At $t=0$, angle between area vector $\vec{A}$ of coil and magnetic field is zero.
After time t, coil is rotated through angle θ. If ω = angular speed of coil then,

$$\theta = \omega t \quad \text{—— (1)}$$

According to Faraday's law of electromagnetic Induction,

induced emf $$\epsilon = -\frac{N d\phi}{dt}$$

$$= -\frac{d N\vec{B}\cdot\vec{A}}{dt}$$

$$= -\frac{d NBA\cos\theta}{dt}$$

$$\epsilon = -\frac{d NBA\cos\omega t}{dt}$$

∵ Magnetic field is uniform,

$$\epsilon = -NBA\frac{d}{dt}\cos\omega t$$

$$\epsilon = NAB\sin\omega t \quad \text{—— (1)}$$

At $\omega t = 0$, $\epsilon_0 = NAB$ = peak value of emf

∴ Eqⁿ (1) becomes,

$$\boxed{\epsilon = \epsilon_0 \sin\omega t}$$

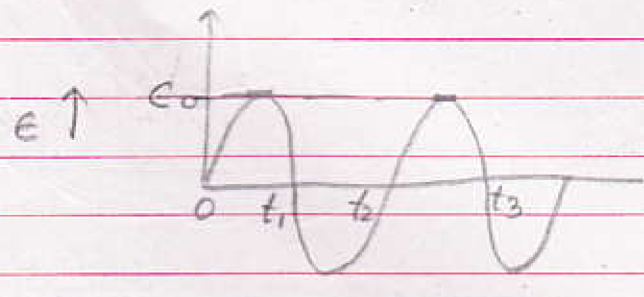
This emf varies at every angle of ωt.

* The emf is maximum when $\omega t = 90°$,

$$\boxed{\epsilon = \epsilon_0}$$

* When $\omega t = 0°$, then $\epsilon = 0$. [$\because \sin \omega t = 0$]

Due to this change in emf, current is induced in the coil.



(18)

Gauss's theorem

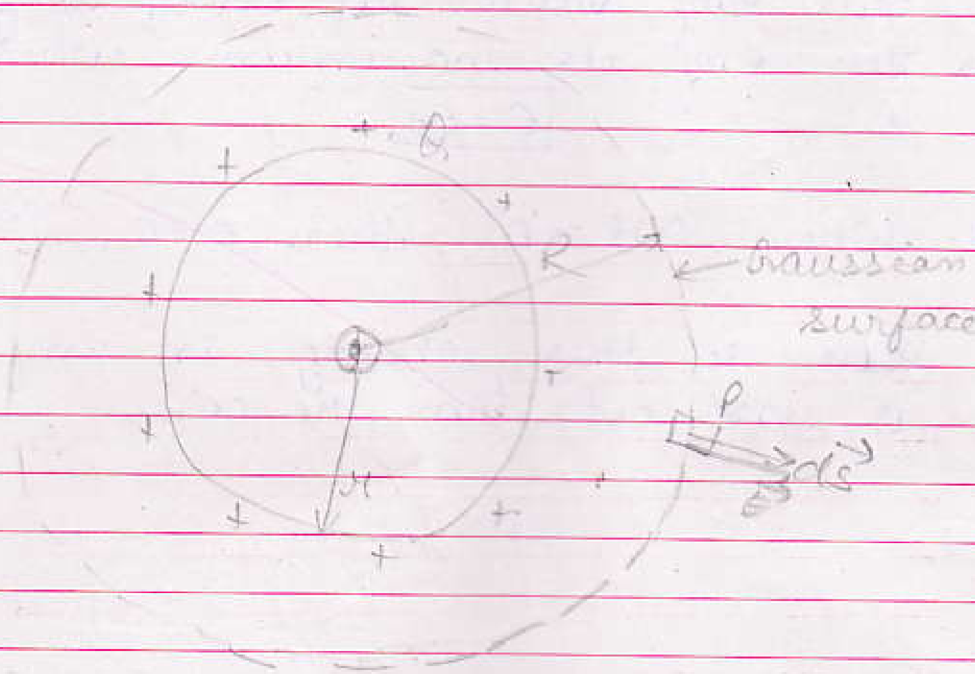
According to this theorem,

"The electric flux due to resultant electric field across closed surface is equal to the total charge enclosed by the surface divided by ϵ_0".

$$\boxed{\phi = \oint \vec{E} \cdot d\vec{S} = \frac{q_{in}}{\epsilon_0}}$$

E = Electric field
ds = area segment
q_{in} = charge enclosed by surface.

For outside of spherical shell



Let us consider a uniformly +vely charged spherical shell of radius r.
We have to find electric field at point P at a distance R from the centre of shell O as shown in fig.
At point P, ~~draw~~ let us draw Gaussian surface of radius R taking its centre O.
Let us take elementary section ds at point P.
The direction of $\vec{ds}$ & $\vec{E}$ is same at P.

$\therefore$ flux $\phi = \oint \vec{E} \cdot \vec{ds}$

$= \oint E ds \cos 0° = \oint E ds$

$$\phi = E \oint ds$$

$$\phi = E \times 4\pi R^2$$

According to Gauss theorem,

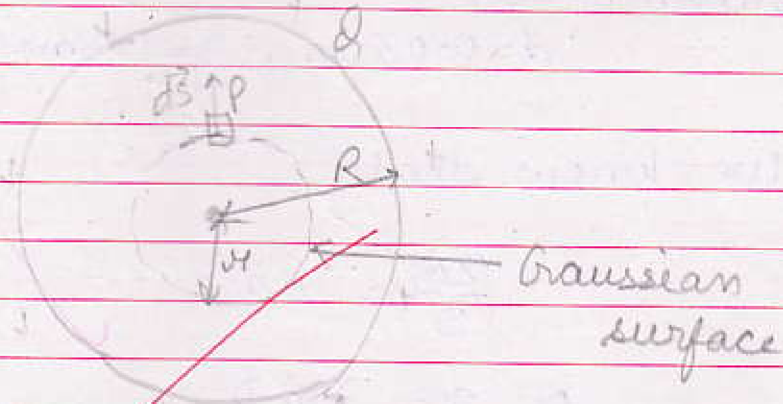
$$\phi = \frac{q_{in}}{\epsilon_0}$$

or, $$E\, 4\pi R^2 = \frac{Q}{\epsilon_0}$$

or, $$\boxed{E = \frac{1}{4\pi\epsilon_0}\frac{Q}{R^2}}$$

This is the electric field outside the spherical shell.

<u>For inside of spherical shell.</u>



Consider a uniformly +vely charged spherical shell of radius R.
We have to find electric field at point P inside the shell as shown in fig.
Let us draw Gaussian surface of radius

or passing through point P.
Let us take elementary section ds at P.

From Gauss's theorem,

$$\phi = \oint \vec{E} \cdot \vec{ds} = \frac{q_{in}}{\epsilon_0}$$

But $q_{in} = 0$ (charge inside conductor is always 0)

$\therefore$ $\boxed{E = 0}$

Electric field inside charged spherical shell is zero.

(14) Given that,

$d = 0.03\,cm$, $D = 1.5\,m = 150\,cm$, $x_4 - x_0 = 1\,cm$

We know that,

$$\frac{xd}{D} = n\lambda$$

or, $x = \frac{n\lambda D}{d}$

$x_4 = \frac{4\lambda D}{d}$, $x_0 = \frac{\lambda D}{d} \times 0 = 0$

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$$x_4 - x_0 = \frac{4\lambda D}{d}$$

or, $1 = \frac{4\lambda \times 150}{0.03}$

or, $\lambda = \frac{0.03}{4 \times 15000} = \frac{1}{20000}$ ~~$= 0.0833 \times 10^{-3}$~~ ~~$= 8.33 \times 10^{-5}$ cm~~

~~$\lambda = 8.33 \times 10^{-5}$ cm~~ $\boxed{\lambda = 5 \times 10^{-5} \text{ cm}}$

Q.15 (5) Microwave

Microwave is the electromagnetic wave whose wavelength is lower than radiowave & higher than Infra ray.

Uses of microwave

1) It is used in ovens for cooking food.

2) It is used in radar system.

(9). The base region of transistor is thin & lightly doped.
Because, for n-p-n & p-n-p transistor, base region allows the charge the carriers to flow across it. Since it is in the middle, it should be thin

for proper movement of charge carried.

It should be lightly doped so that holes or electron do not affect the no. of charge carrier passing through it. In n-p-n transistor, the some charge carrier electron get combined with holes in base region, thus amount of output current decreases. If base region is highly doped than, output current will be very less.

Thus in transistor, base region should be thin & lightly doped.

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