सीनियर स्कूल सर्टिफिकेट परीक्षा (कक्षा बारहवीं)

परीक्षार्थी प्रवेश–पत्र के अनुसार भरें

विषय Subject : PHYSICS

विषय कोड Subject Code : 042

परीक्षा का दिन एवं तिथि
Day & Date of the Examination : MONDAY, 09-03-2015

उत्तर देने का माध्यम
Medium of answering the paper : ENGLISH

प्रश्न पत्र के ऊपर लिखे कोड को दर्शाएं :
Write code No. as written on the top of the question paper :

Code Number	Set Number
55/1/2/D	① ● ③ ④

अतिरिक्त उत्तर–पुस्तिका (ओं) की संख्या
No. of supplementary answer-book(s) used: 1+1+1 = 3

विकलांग व्यक्ति : हाँ / नहीं
Person with Disabilities : Yes / No — NO

किसी शारीरिक अक्षमता से प्रभावित हो तो संबंधित वर्ग में ✓ का निशान लगाएं।
If physically challenged, tick the category

B	D	H	S	C	A

B = दृष्टिहीन, D = मूक व बधिर, H = शारीरिक रूप से विकलांग, S = स्पास्टिक
C = डिस्लेक्सिक, A = ऑटिस्टिक

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क्या लेखन – लिपिक उपलब्ध करवाया गया : हाँ / नहीं
Whether writer provided : Yes / No — NO

यदि दृष्टिहीन हैं तो उपयोग में लाए गये सॉफ्टवेयर का नाम :
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*एक खाने में एक अक्षर लिखें। नाम के प्रत्येक भाग के बीच एक खाना रिक्त छोड़ दें। यदि परीक्षार्थी का नाम 24 अक्षरों से अधिक है, तो केवल नाम के प्रथम 24 अक्षर ही लिखें।

Each letter be written in one box and one box be left blank between each part of the name. In case Candidate's Name exceeds 24 letters, write first 24 letters.

कार्यालय उपयोग के लिए
Space for office use

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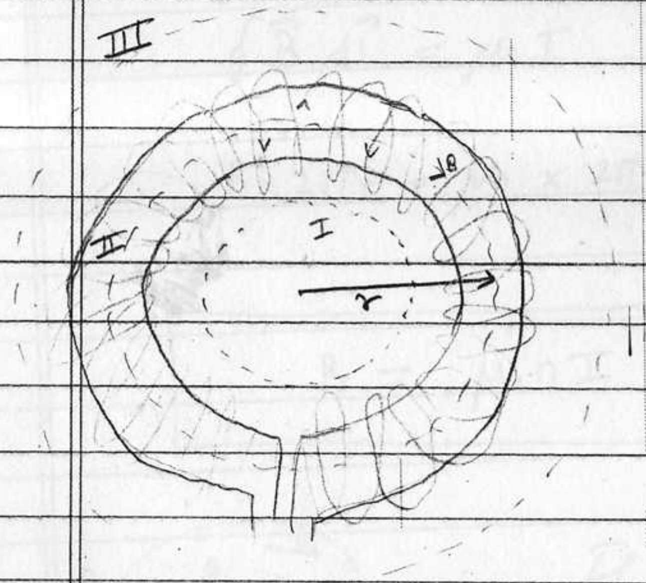
26 a.) Ampere's circuital law states that the closed-loop integral of the magnetic field along an Amperian loop equals the product of μ_0 and the current passing through the loop.

Mathematically, $$\oint \vec{B} \cdot \vec{dl} = \mu_0 I$$



The toroid is as shown.

Consider 3 amperian loops as shown.

For loop I,

current through loop = 0

$\therefore B_I = 0$

Similarly for loop III,

Total incoming current = Total out going current

$\therefore I_{net} = 0$

$\therefore B_{III} = 0$

For loop II,

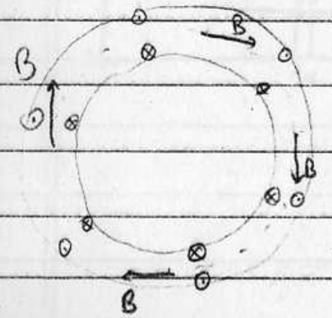
Applying ampere's circuital law.

$$\oint \vec{B}.\vec{dl} = \mu_0 I$$

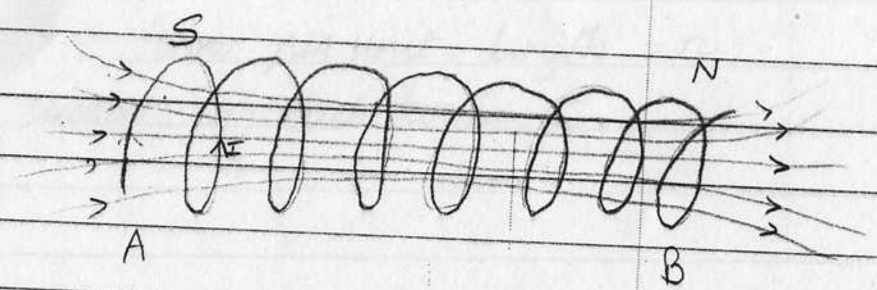
$$B \times 2\pi r = \mu_0 \times 2\pi r \times n \times I$$

[$n \rightarrow$ no. of turns per unit length,
$2\pi r \rightarrow$ length of loop
$I \rightarrow$ current]

$$\therefore B = \mu_0 n I$$

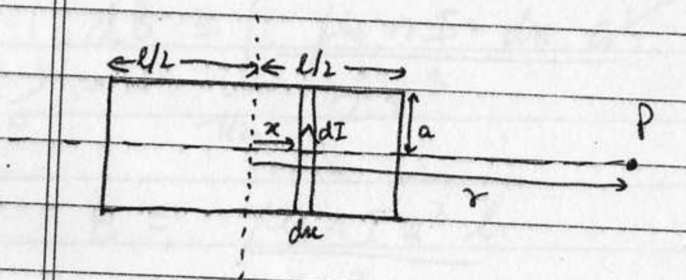


If direction of current is as shown, then $\vec{B}$ is clockwise b.)



The magnetic field lines will be as shown.
∵ Field lines ~~originate~~ begin from North.

hence end B is North.
end A is South



Consider a solenoid as shown.
Now take an elementary loop of width dx.

for this loop,
field at P,

$$dB = \frac{\mu_0 \, dI \, a^2}{2\left(a^2 + (r-x)^2 \right)^{3/2}}$$

if no. of turns per unit length $= n$
current in each turn $= I$.

then

$$dB = \frac{\mu_0 \, n I \, dx \, a^2}{2\left(a^2+(r-x)^2\right)^{3/2}}$$

$\because r >> x, a$

$\therefore \left(a^2+(r-x)^2\right)^{3/2} \simeq r^3$

$$\int_0^B dB = \int_{-l/2}^{l/2} \frac{\mu_0 \, n I \, dx \, a^2}{2r^3}$$

$$B = \frac{\mu_0 \, n I a^2 l}{2r^3}$$

$$= \frac{\mu_0}{4\pi} \times \frac{2 \, n I l \, \pi a^2}{r^3} = \boxed{\frac{\mu_0}{4\pi} \, 2 \times \frac{NAI}{r^3}}$$

$\left[\because n \times l = N, \; \pi a^2 = A\right]$

~~if we cons~~

for a bar magnet,

$$\boxed{B = \frac{\mu_0}{4\pi}\frac{2m}{r^3}} \quad \text{(on axis)}$$

$\therefore$ if we consider

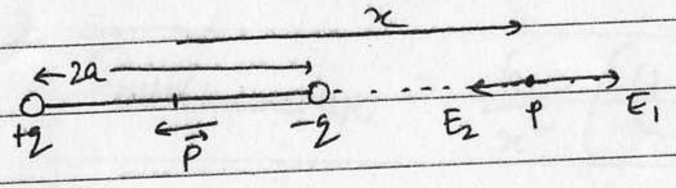
NAI as m,

Then in Solenoid,

$$\boxed{B = \frac{\mu_0}{4\pi}\frac{2m}{r^3}}$$

which is same as bar magnet.

Hence a Solenoid acts as a bar magnet of magnetic moment $\boxed{= NAI}$



At point P, on the axis,

E_1 (due to +ve charge) $= \frac{kq}{(x+a)^2}$

E_2 (due to -ve charge) $= \frac{kq}{(x-a)^2}$

E_{net} (towards ~~right~~ left) $= E_2 - E_1$

$= \frac{kq}{(x-a)^2} - \frac{kq}{(x+a)^2}$

$= \frac{kq}{x^2}\left(\frac{1}{(1-\frac{a}{x})^2} - \frac{kq}{(1+\frac{a}{x})^2}\right)$

$$\vec{E}_{net\,(\text{towards left})} = \frac{kq}{x^2}\left(\left(1-\frac{a}{x}\right)^{-2} - \left(1+\frac{a}{x}\right)^{-2}\right)$$

if $x >> a$,

then using binomial expansion

$$\vec{E}_{net} = \frac{kq}{x^2}\left(1+\frac{2a}{x} - 1 + \frac{2a}{x}\right)$$

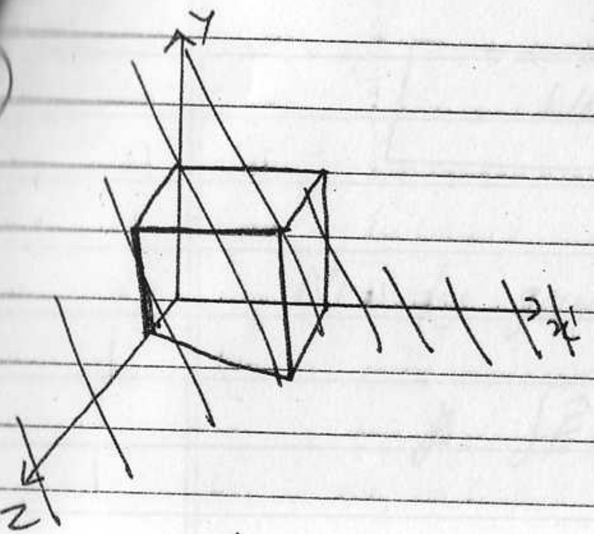
$$= \frac{kq}{x^2} \times \frac{4a}{x}$$

$$\vec{E}_{net} = \frac{kq \times 2a \times 2}{x^3}$$

also $\vec{E}_{net}$ is in the direction of $\vec{p}$. $\Rightarrow$ $2\vec{a}q = \vec{p}$

$$\therefore \quad \vec{E}_{net} = \frac{2k\vec{p}}{x^3}$$

$$\boxed{\vec{E}_{net} = \frac{2\vec{p}}{4\pi\epsilon_0 x^3}} \rightarrow \text{ANS}$$

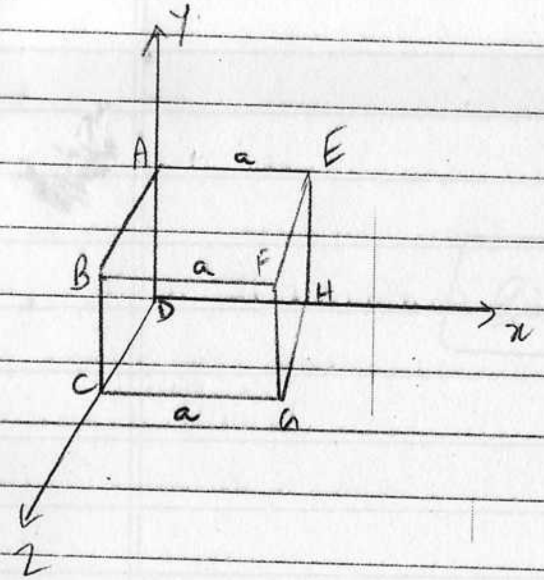


$\vec{E} = 2x\hat{i}$

For the faces AEFB, AEHD, DHGC, & BFGC, $\vec{ds}$ & $\vec{E}$ are $\perp$.

$\therefore \oint \vec{E}\cdot\vec{ds} = 0$

hence flux through these faces is zero.



For face ABCD,

$E = 0$

$\therefore$ flux is zero.

Now, through face EFGH,

$\vec{E} = 2a\hat{i}$

$\vec{S} = a^2\hat{i}$

$\oint \vec{E}\cdot\vec{ds} = 2a \times a^2 = 2a^3$

$\therefore$ Net flux $= 2a^3$ → ANS

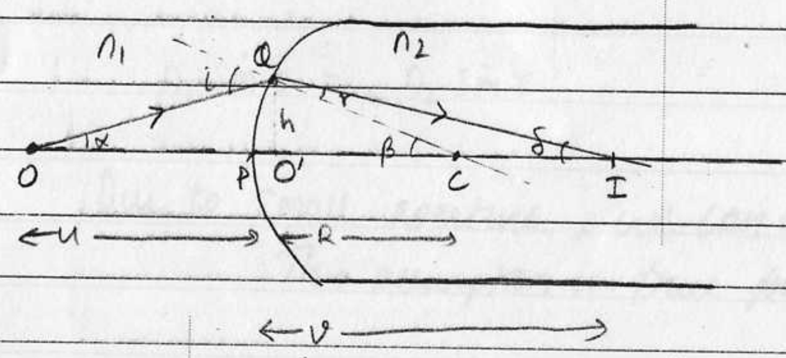
Now by gauss's law,

$$\oint \vec{E} \cdot d\vec{s} = \frac{q_{in}}{\epsilon_0}$$

$$\therefore \quad 2a^3 = \frac{q_{in}}{\epsilon_0}$$

$q_{in} = 2a^3 \epsilon_0$ → ANS

24a.)



Considering $n_2 > n_1$,
Image formed is as shown.

Now by exterior angle property of Δs,

$$i = \alpha + \beta \quad \text{——— (1)}$$

and,

$$\beta = r + \delta$$

$$\Rightarrow r = \beta - \delta \quad \text{——— (2)}$$

Applying snell's law at Q,

$n_1 \sin i = n_2 \sin r$

Due to small aperture, we can assume $\sin i \approx i \approx \tan i$

This assumption is true for all angles $\alpha, \beta, \delta, i, r$.

$\therefore n_1 i = n_2 r$

$n_1 (\alpha + \beta) = n_2 (\beta - \delta)$

$\Rightarrow n_1 (\tan\alpha + \tan\beta) = n_2 (\tan\beta - \tan\delta)$

$n_1 \left(\frac{h}{OO'} + \frac{h}{O'C} \right) = n_2 \left(\frac{h}{O'C} - \frac{h}{O'I} \right)$

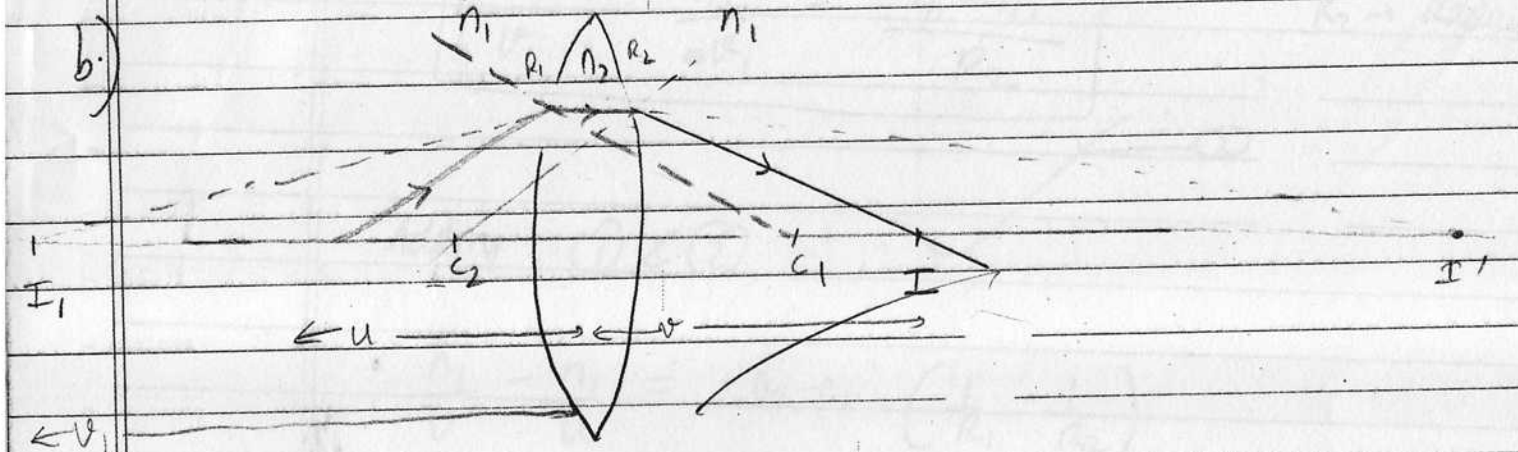
$n_1 \left(\frac{1}{PO} + \frac{1}{PC} \right) = n_2 \left(\frac{1}{PC} - \frac{1}{PI} \right)$

[due to small aperture, $OO' = OP$, $O'C = PC$ & $O'I = PI$]

$n_1 \left(\frac{-1}{u} + \frac{1}{R} \right) = n_2 \left(\frac{1}{R} - \frac{1}{v} \right)$

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R} \rightarrow \text{ANS}$$

b)



After refraction from convex surface, an image is formed at I, which acts as virtual object for the concave surface.

Using the above relation at convex surface

$$\frac{n_2}{v_1} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1} \quad \text{--- (1)}$$

now for concave surface,

$$\frac{n_1}{v} - \frac{n_2}{v_1} = \frac{n_1 - n_2}{R_2} \quad \text{--- (2)}$$

$R_2 \rightarrow$ Radius of ~~surf~~ curvature of concave surface.

Adding (1) & (2),

$$\frac{n_1}{v} - \frac{n_1}{u} = n_2 - n_1 \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

for ~~v = ∞~~ $u = \infty$

$v = f$

$$\therefore \frac{n_1}{f} - 0 = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

↳ lens maker's formula

23 i) Transformer is used for this purpose.

Principle :- The principle of working is that change in flux through one coil produces an emf in the neighbouring coil. This phenomena is called mutual induction.

ii) No. It cannot be used to bring down high DC voltages as DC voltage have fixed direction. Hence they do not change the flux of the coil. Hence phenomena of mutual induction is not observed with DC voltages.

iii) * Students show inquisitivity
* They show a desire to understand and learn new things.
* Teacher shows maturity.
* The teacher also shows awareness.

22.)

Fission	Fusion
* When a high mass nucleus dissociates into smaller nuclei, the process is known as fission.	* When small mass nuclei combine to form a heavy nucleus, the process is termed as fusion.
* The energy released is very high (of the order of 200 MeV).	* The energy released is lower than fission (of the order 20 MeV).
* Used in nuclear reactors.	* Fusion takes place in the core of stars.

Both these processes are exothermic i.e. energy is released.

We know that nuclei of medium masses (30 < A < 170) are very stable and have high BE per nucleon.

• When a nuclei of higher mass undergoes fission, then the products formed have higher BE per nucleon than the reactants. This increase in BE per nucleon is accompanied by release in energy.

$^{240}A \longrightarrow 2\,^{120}B + \text{Energy}$

- When two nuclei of lower mass combine to form a stable product, then again, the BE per nucleon of products is more than that of reactants. This increase in BE per nucleon is accompanied by release of energy.

eg: $^{2}_{1}H + ^{3}_{1}H \longrightarrow ^{4}_{2}He + n$

here mass of pd = $4.002603 + 1.008665$

$= 5.011268\ u$

mass of reactants = $3.016049 + 2.014102$

$= 5.030151\ u$

$\Delta m = 5.030151 - 5.011268$

$\Delta m = 0.018883\ u$

Energy released = $\Delta m c^2 = \Delta m \times 931.5$ MeV

$$E = 17.5893145 \text{ MeV}$$

21) Einstein's Eqⁿ.

$$KE_{max} = h\nu - \phi$$

KE_{max} → max energy of emitted photoelectrons

ν → frequency of incident light

h → planck's constant

ϕ → work function of metal.

* According to this equation, an electron absorbs a quantum of energy ($h\nu$) and if this exceeds the work function, then e^- are emitted with max energy. Since energy cannot be -ve, therefore there is a certain minimum frequency for which emission occurs. This is known as threshold frequency.

* Also, here KE_{max} is directly proportional to frequency, thus showing that KE_{max} is independent of intensity of light.

* Intensity is the no. of photoelectrons per unit area per second. Thus increasing intensity increases the no. of photo electrons and consequently photo current is directly proportional to intensity of light.

* Also since energy absorption by e^- is spontaneous, this also proves the spontaneity of the reaction.

$$KE_{max(1)} = \frac{hc}{\lambda_1} - \phi \quad \text{——} (1)$$

$$KE_{max(2)} = \frac{hc}{\lambda_2} - \phi \quad \text{——} (2)$$

$$KE_{max(2)} = 2\, KE_{max(1)}$$

$$\therefore \quad \frac{hc}{\lambda_2} - \phi = \frac{2hc}{\lambda_1} - 2\phi$$

$$\boxed{\phi = hc\left(\frac{2}{\lambda_1} - \frac{1}{\lambda_2}\right)} \rightarrow \text{ANS}$$

$$\phi = \frac{hc}{\lambda_0}$$

$$\frac{hc}{\lambda_0} = \frac{hc}{}\left(\frac{2\lambda_2 - \lambda_1}{\lambda_2\lambda_1}\right)$$

$$\lambda_0 = \frac{\lambda_2\lambda_1}{2\lambda_2 - \lambda_1}$$ → Ans

Threshold wavelength

20 i) $|m| = \left|\frac{f_o}{f_e}\right|$

f_o → focal length of objective
f_e → focal length of eyepiece

$$|m| = \frac{15 \times 100}{1} = 1500$$

∴ image formed is inverted

∴ angular magnification = +1500

ii) ~~angle im~~ ~~and~~ angle subtended by moon at obj = angle of img at objective.

$$\frac{D}{R} = \frac{d}{f_0}$$

$$\frac{3.4 \times 10^6}{3.8 \times 10^8} = \frac{d}{15}$$

$$d = \frac{3.4}{3.8} \times 10^{-2} \times 15 \text{ m}$$

$$d = 13.4 \text{ cm} \rightarrow \text{ANS}$$

19.) a) Microwaves

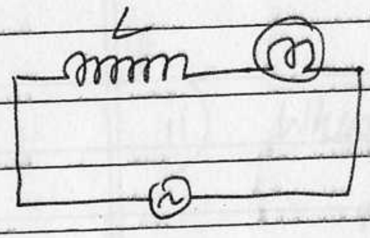
* These are produced by special tubes (klynstorn, magnetron & Gunn diodes)

b) Infrared waves

* These are produced by hot objects and bodies.

c.) X-rays

* These are produced by bombarding a metal target with high energy electrons.

18) 

i) $X_L = \omega L$ (inductive reactance)

also $L \propto n$ (n is no. of turns)

when $n \downarrow$ $L \downarrow$

$\therefore X_L \downarrow$

also current $= \dfrac{V}{\sqrt{X_L^2 + R^2}}$

as X_L reduces,
current increases.

$\therefore$ Brightness of bulb increases.

ii) When iron rod is inserted,

μ increases (as $\mu = \mu_r \mu_0$)

also $L \propto \mu$

$\therefore L$ also increases

$\Rightarrow X_L$ increases

$$i = \frac{V}{\sqrt{X_L^2 + R^2}}$$

$\therefore i$ reduces

$\Rightarrow$ hence bulb will glow less brightly.

ii) In an LCR circuit

$$\text{current} = \frac{V}{\sqrt{(X_C - X_L)^2 + R^2}}$$

initially, $i = \frac{V}{\sqrt{X_L^2 + R^2}}$

$\therefore X_C = X_L$

finally, $i = \frac{V}{R}$

$\therefore$ current increases

hence brightness also increases

17a.) In double slit experiment, angular fringe width $= \frac{\lambda}{d}$

$$0.1 = \frac{\lambda}{d}$$

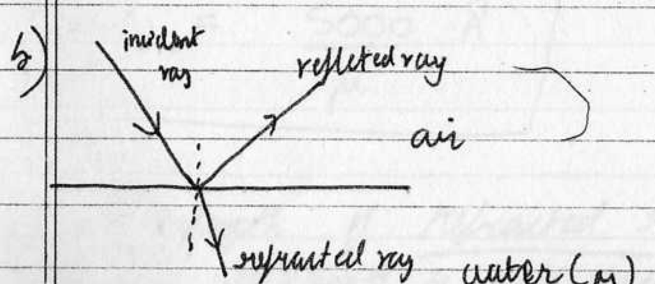
$$0.1 = \frac{600 \times 10^{-9}}{d}$$

$$d = ~~600 \times 10^{-10}\ m~~ \quad 600 \times 10^{-8}\ m$$

$$d = 6 \times 10^{-6}\ m$$

$$\boxed{d = 6\ \mu m}$$

b)



* We know that frequency of ~~reflected~~ light is same in all mediums.

21

* Therefore, frequency of reflected and refracted rays is same.

$$f = \frac{v}{\lambda} = \frac{3\times10^8}{5000\times10^{-10}} = 0.6\times10^{+15}$$

$$= \boxed{0.6\times10^{15}\ Hz}$$

* If wavelength in air is λ_1 & that in water is λ_2,

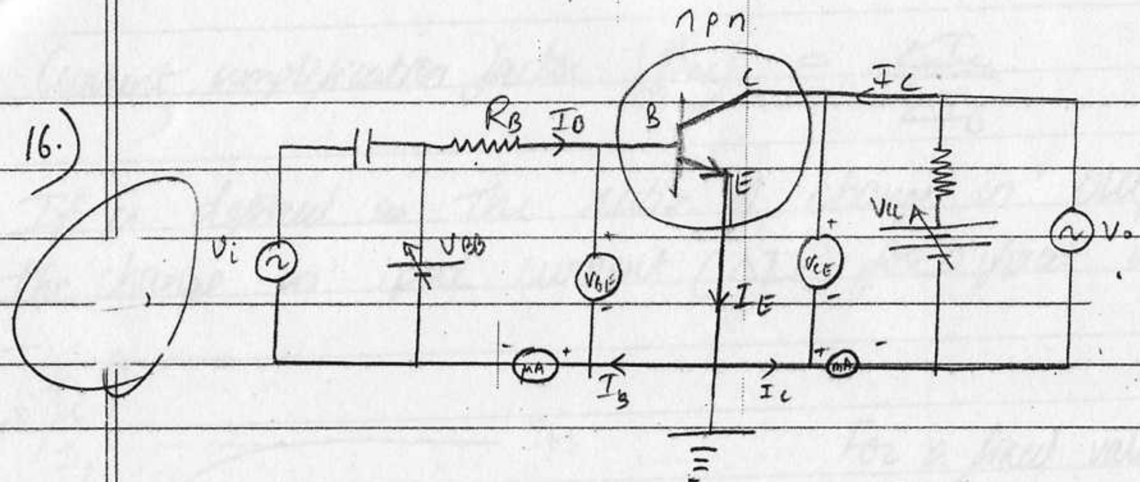
$$\frac{\mu_1}{\mu_2} = \frac{v_2}{v_1} = \frac{\lambda_2}{\lambda_1}$$

$$\therefore \frac{\mu_1}{\mu_2} = \frac{\lambda_2}{\lambda_1}$$

$$\boxed{\lambda_2 = \frac{5000}{\mu}\ Å}$$

$\therefore$ Wavelength of refracted ray decreases by a factor of μ while wavelength of reflected ray remains same.

16.)

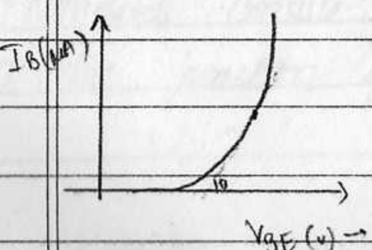


Transistor as amplifier in CE configuration.

i) Input Resistance $(R_i) = \left(\frac{\Delta V_{BE}}{\Delta I_B}\right)$

It is defined as the ratio of change in input voltage (ΔV_{BE}) and the change in base current (ΔI_B) for a fixed value of V_{CE}.

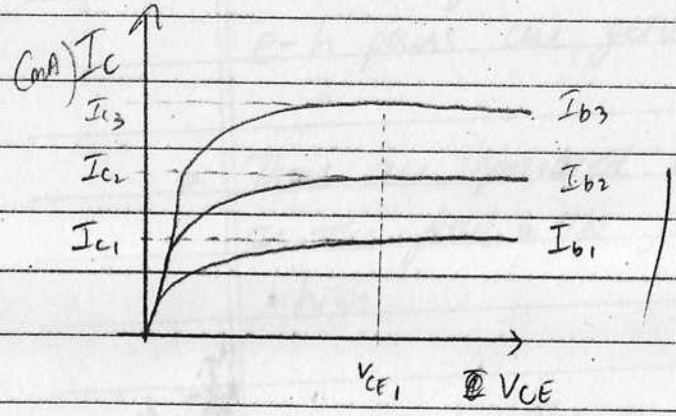
→ It can be determined from the graph of input characteristics



It is the ~~ratio~~ reciprocal of slope of the linear part of the graph.

(ii) Current amplification factor $(\beta_{ac}) = \frac{\Delta I_c}{\Delta I_B}$

It is defined as the ratio of change in output current (ΔI_c) to the change in input current (ΔI_B) for a fixed value of V_{CE}.



For a fixed value of ~~the~~ V_{CE}, we take the values of I_c & I_B

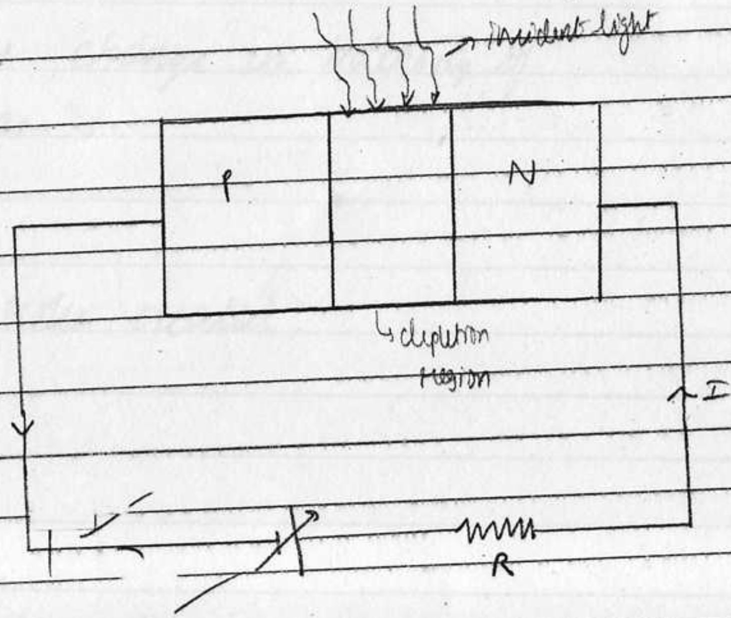
here clearly $\beta_{ac} = \frac{I_{c_3} - I_{c_1}}{I_{b_3} - I_{b_1}}$

15. *) Photodiode is a semiconductor device that is used to detect optical signals.

* Photodiode is operated in reverse bias

* Photodiode consists of a transparent window that allows light to fall on the junction of the diode.

→ Working:-



* When sunlight falls on the diode, e-h pairs are generated.

* These are separated before they combine as the field in the junction is very high.

* e^- reach the n-side while holes reach p side.

* When this is connected to an external circuit current flows and hence we can detect the optical signal.

The photodiode works in reverse bias as change in intensity of light is more detectable in reverse bias.

in forward bias $n >> h$

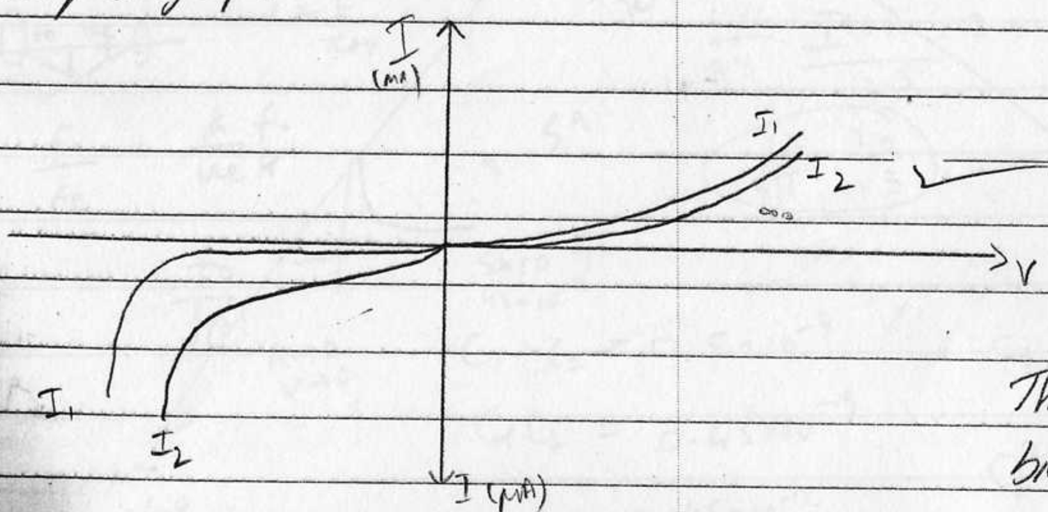
let Δn & Δh be the extra e^- & holes created,

then $\Delta n = \Delta h$.

$\Rightarrow \quad \frac{\Delta n}{n} << \frac{\Delta h}{h}$

Thus change in forward bias will be very less.

Also from graph



Thus, change in reverse bias is easily detectable.

0901

Fictitious Roll No.
(To be entered by Board)

अपना अनुक्रमाँक इस उत्तर-पुस्तिका पर न लिखें
Please do not write your Roll Number on this Answer-Book

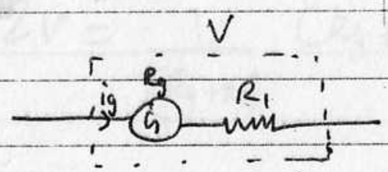
अतिरिक्त उत्तर-पुस्तिकाओं की संख्या ....
Supplementary Answer-Book(S) No. 1

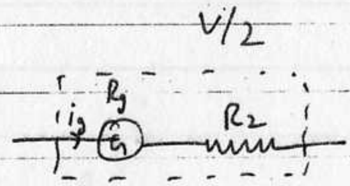
14.) The principle of Galvanometer is that when current is passed through a coil in uniform magnetic field, a torque ~~acts~~ acts on the coil.

$$\boxed{\vec{\tau} = \vec{m} \times \vec{B}}$$

$\vec{m} \rightarrow$ magnetic moment
$\vec{B} \rightarrow$ magnetic field

This way a galvanometer detects the flow of current in a circuit.





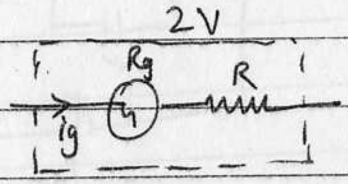
$V = i_g (R_g + R_1)$ —— ①

$\frac{V}{2} = i_g (R_g + R_2)$ —— ②

$\Rightarrow$ ~~2C~~ $2 \, i_g (R_g + R_2) = i_g (R_g + R_1)$

$2R_g + 2R_2 = R_g + R_1$

$$R_g = R_1 - 2R_2 \rightarrow \text{ANS}$$



$$2V = i_g (R_g + R)$$

from (1),

$$2V = \frac{V}{(R_g + R_1)} (R_g + R)$$

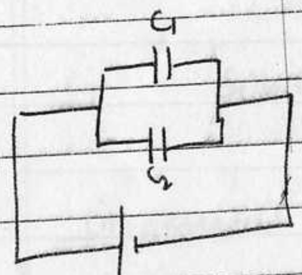
$$2R_g + 2R_1 = R_g + R$$

$$R = R_g + 2R_1$$

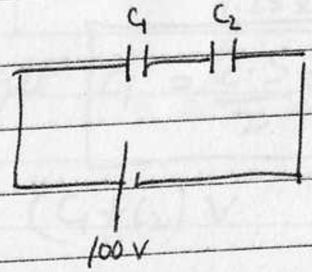
$$R = R_1 - 2R_2 + 2R_1$$

$$R = 3R_1 - 2R_2 \rightarrow \text{ANS}$$

13.



(I)



(II)

In (I) $C_{eq} = C_1 + C_2$

$E = \frac{1}{2} C_{eq} V^2$

$E = \frac{1}{2} (C_1 + C_2) V^2$

$0.25 = \frac{1}{2} (C_1 + C_2) \times 100 \times 100$

$C_1 + C_2 = 0.5 \times 10^{-4}$ ——— (1)

In (II), $C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$

$E = \frac{1}{2} C_{eq} V^2$

$0.045 = \frac{1}{2} \times \frac{C_1 C_2}{C_1 + C_2} \times 100 \times 100$

$0.09 \times 10^{-4} = \frac{C_1 C_2}{0.5 \times 10^{-4}}$

$C_1 C_2 = 0.045 \times 10^{-8}$ ——— (2)

Solving we get $C_1 = \frac{2.5\times10^{-5}}{2} F$, $C_2 = 3.6\times10^{-5} F$

($1.25\times10^{-5} F$, $3.6\times10^{-5} F$)

in parallel $q_{net} = (C_1+C_2)V = 5\times10^{-5}\times100 = 5\times10^{-3} C$

$q_1 = \frac{C_1}{C_1+C_2} q_{net}$

$q_2 = \frac{C_2}{C_1+C_2} q_{net}$

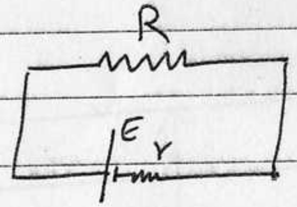
$q_2 = \frac{C_1}{5\times10^{-5}}\times5\times10^{-3} = C_1\times100 = \frac{2.5}{2}\times10^{-5}\times100 = \frac{2.5}{2}\times10^{-3} C$

$q_1 = C_2\times100 = 3.6\times10^{-5}\times100 = 3.6\times10^{-3} = 3.6 mC$

$q_2 = 1.25 mC$ → Charge on C_2

$q_1 = 3.6 mC$ → Charge on C_1

12)



$$V = E - ir$$

~~$V = E$~~ & $i = \frac{E}{R+r}$

$$\therefore V = E - \frac{Er}{R+r}$$

$$V = \frac{ER}{R+r}$$

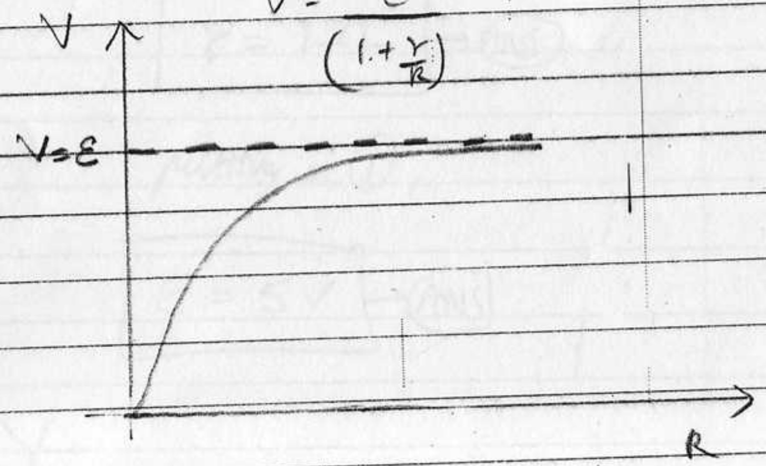
$$V = \frac{E}{\left(1+\frac{r}{R}\right)} \quad \text{(1)}$$

$$V = IR \quad \text{(2)}$$

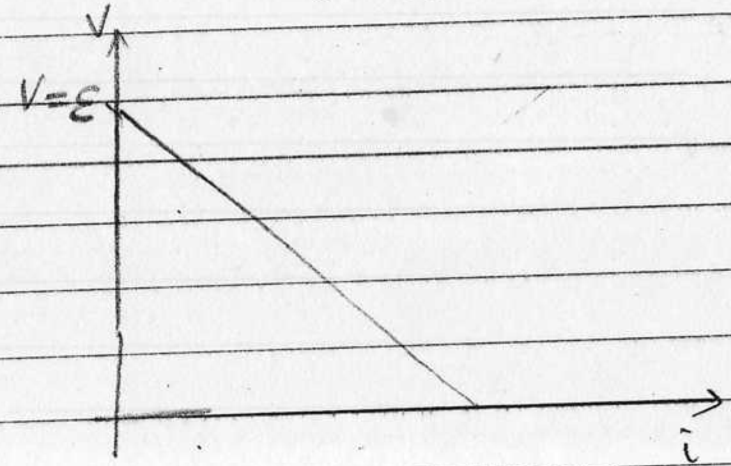
From (1) & (2),

The plots are :

$V = \dfrac{E}{\left(1 + \frac{r}{R}\right)}$



$V = IR$



$i = \dfrac{E}{R+r}$

When $R = 4\Omega$ $R = 9\Omega$

$i = 1A$ $i = 0.5A$

$\therefore \; 1 = \dfrac{E}{4+r}$ —— (1) $0.5 = \dfrac{E}{r+9}$ —— (2)

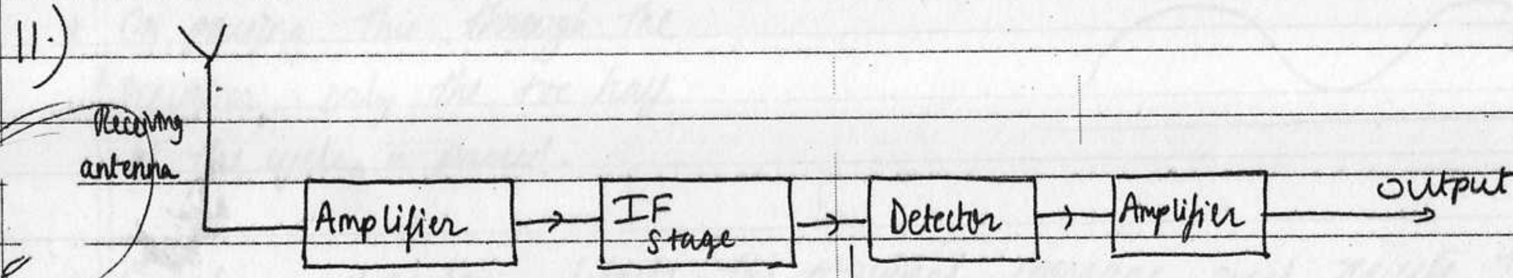
$\Rightarrow \dfrac{E}{4+r} = \dfrac{2E}{r+9}$ $\Rightarrow \; r+9 = 8+2r$

$r = 1\Omega$ → ANS

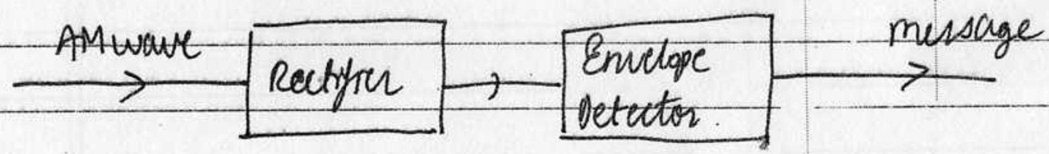
putting in (1),

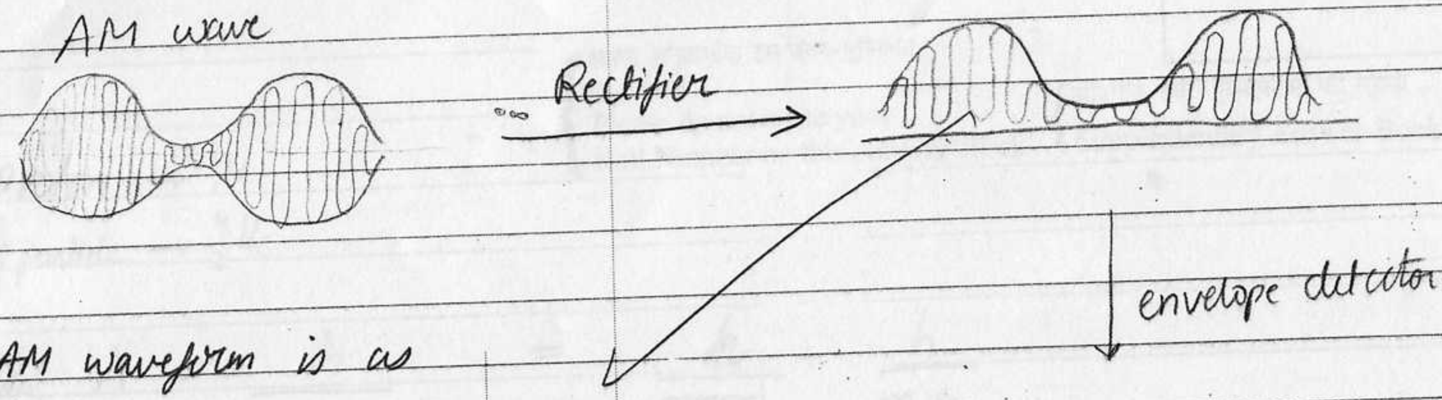
$E = 5V$ → ANS

11.)

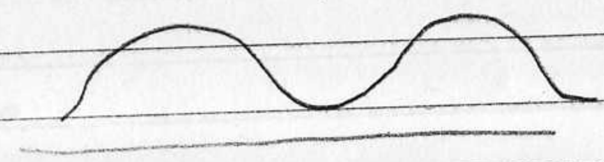


Detector :





* The AM waveform is as shown.
* On passing this through the rectifier, only the +ve half of the cycle is passed.



* Envelope detector detects the original message and rejects the sidebands.

This way, we get the original message from AM wave.

0901

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Supplementary Answer-Book(S) No. ..2..

10.) proton $\rightarrow {}^1_1H$

α particle $\rightarrow {}^4_2He$

also $\lambda = \frac{h}{\sqrt{2mqV}} = \frac{h}{mv}$

V → accelerating potential
λ → deBroglie wavelength

$\lambda_p = \lambda_\alpha$

$$\frac{h}{\sqrt{2m_p e V_p}} = \frac{h}{\sqrt{2m_\alpha 2e \times V_\alpha}}$$

$$\sqrt{\frac{2 m_\alpha 2e \times V_\alpha}{2 m_p e V_p}} = 1$$

also $m_\alpha / m_p = 4$

$$\sqrt{4 \times 2 \times \frac{V_\alpha}{V_p}} = 1$$

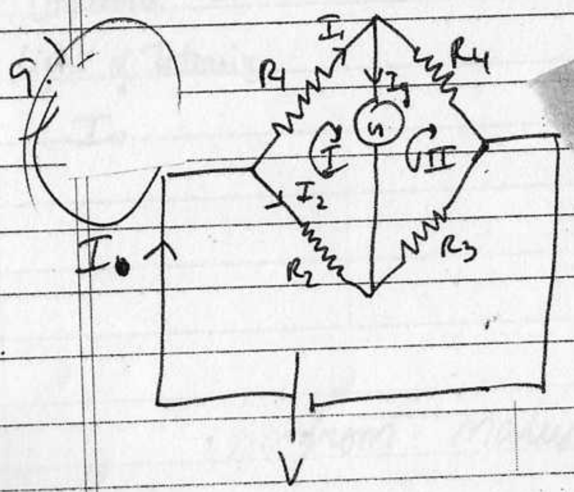
$$\Rightarrow \boxed{\frac{V_x}{V_p} = \frac{1}{8}} \rightarrow \text{ANS}$$

ii) $\frac{h}{m_x v_x} = \frac{h}{m_p v_p}$

$\frac{v_x}{v_p} = \frac{m_p}{m_x}$

$$\boxed{\frac{v_x}{v_p} = \frac{1}{4}} \rightarrow \text{ANS}$$

9)



In balance condition $I_g = 0$.

$\therefore I = I_1 + I_2$

also applying kirchoff's voltage law in I & II,

$I_1 R_1 = I_2 R_2$ —— (1)

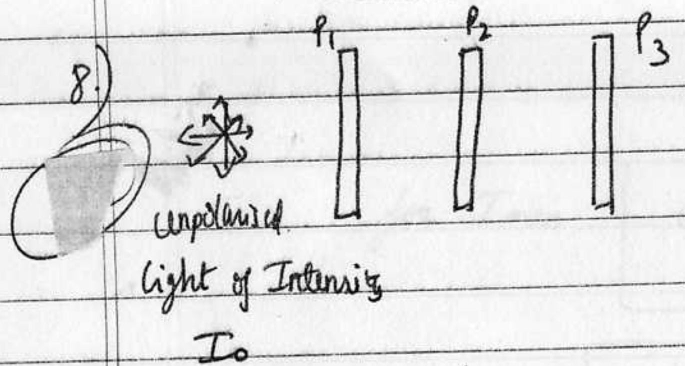
$I_1 R_4 = I_2 R_3$ —— (2)

① ÷ ②,

$$\frac{R_1}{R_4} = \frac{R_2}{R_3}$$

$$\Rightarrow \boxed{\frac{R_1}{R_2} = \frac{R_4}{R_3}} \rightarrow \text{condition for balanced Wheatstone bridge.}$$

8)



On passing ~~up~~ unpolarised light through P_1,

$$I' = I_o/2$$

If at any instance,

angle b/w P_1 & P_2 $= \theta$

Then angle b/w P_2 & P_3 $= 90 - \theta$

from malus's law,

Intensity transmitted from $P_2 = \frac{I_0}{2}\cos^2\theta$

Intensity transmitted from $P_3 = \frac{I_0}{2}\cos^2\theta \cos^2(90-\theta)$

$\therefore$ Final intensity of light obtained $= \frac{I_0}{2}\cos^2\theta \sin^2\theta$

$$I = \frac{I_0}{8}\sin^2 2\theta$$

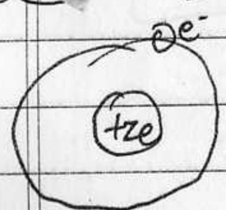
for I_{max} $\theta = \frac{\pi}{4}$

$\theta = 45^\circ$

7.)

Intrinsic	Extrinsic
* Pure semiconductors such as Si & Ge are called intrinsic semiconductors.	* Semiconductors that are doped with an external atom such as As or B, it is called extrinsic semiconductor.
* Only thermally generated holes & electrons.	* Both thermally generated as well as impurity donated holes/electrons.
* Low conductivity at room temp	* High conductivity.
* High band gap	* Lower band gap

6.) The centripetal force required is given by the coulomb force.



$$\therefore \frac{mv^2}{r} = \frac{kZe^2}{r^2} \quad \text{—— (1)}$$

also from Bohr theory, $mvr = \frac{nh}{2\pi}$ —— (2)

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

$mvr \times v = kZe^2$

$v = \frac{kZe^2 \times 2\pi}{nh}$

$\therefore \quad r = \frac{nh}{2\pi \times m \times kZe^2 \times 2\pi} nh$

$r = \frac{n^2}{Z} \frac{h^2}{4\pi^2 m e^2 k}$

Clearly $r \propto n^2$

5) $X_C = \frac{1}{\omega C}$

unit ⇒ ohm

capacitor reactance is the resistance offered by a capacitor to current in LCR circuit connect to AC power supply of ang frequency ω.

4) i) DE (∵ slope is -ve)

ii) BC (∵ $V \propto I$)

3.) In an Amplitude modulated wave, the frequencies present are ω_c, $\omega_c - \omega_m$, $\omega_c + \omega_m$

ω_c → ang. frequency of carrier wave

& ω_m → ang. frequency of message.

Here $\omega_c - \omega_m$ & $\omega_c + \omega_m$ are side bands

$$A_c^{x(t)} = (A_c + A_m \sin\omega_m t)\sin\omega_c t$$

$$x(t) = A_c(1 + \mu \sin\omega_m t)\sin\omega_c t$$

$$x_c(t) = A_c \sin\omega_c t + \mu A_c \cos(\omega_c - \omega_m)t - \mu A_c \cos(\omega_c + \omega_m)t$$

side bands.

2) $\frac{1}{f} = \left(\frac{\mu_L}{\mu_m} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ → Lens maker's formula.

$\mu_L = 1.5$

$\mu_m = 1.65$

$\therefore \frac{\mu_L}{\mu_m} - 1 < 0$

also $\frac{1}{R_1} - \frac{1}{R_2} < 0$ for concave lens

$\therefore f$ is +ve

hence it is a convex lens ~~or a diverging~~ (converging lens)

0901

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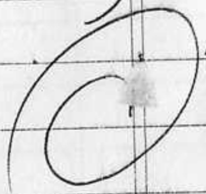
Supplementary Answer-Book(S) No. ..3....

1.) Since electric dipole is made up of $\pm q$



$\therefore q_{in} = 0$

$\therefore$ flux $= 0$

= FM

Full marks

34564