

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 दर्शाए :  
Write code No. as written on  
the top of the question paper :  
Code Number 55/1/2/D Set Number ① ● ③ ④

अतिरिक्त उत्तर-पुस्तिका (ओं) की संख्या  
No. of supplementary answer -book(s) used 1H1 = 3

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

किसी शारीरिक अक्षमता से प्रभावित हो तो संबंधित वर्ग में  का निशान लगाएँ।  
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  
B = Visually Impaired, D = Hearing Impaired, H = Physically Challenged  
S = Spastic, C = Dyslexic, A = Autistic

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 :  
If Visually challenged, name of software used :

\*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

1934474

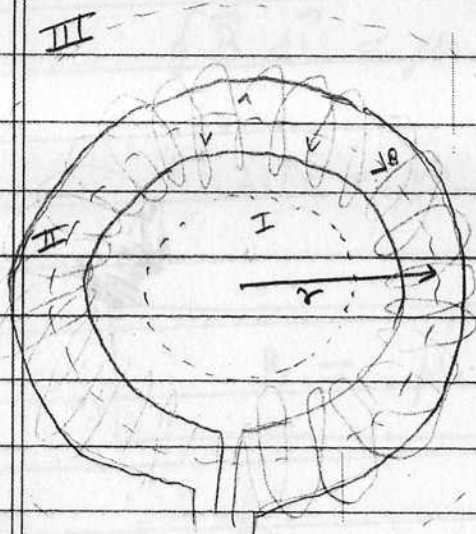
042 / 04170

26 a.)

Ampere's circuital law states that the closed-loop integral of the magnetic field along an Amperian loop equals the product of  $\mu_0$  and the current passing through the loop.

Mathematically,

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$



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 outgoing current

$$\therefore I_{net} = 0$$

$$\therefore B_{III} = 0$$

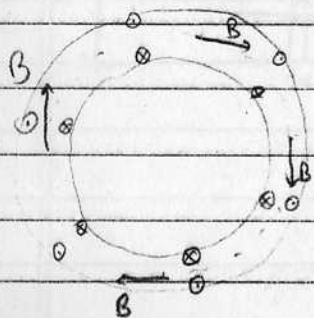
For loop II,

Applying ampere's circuital law.

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

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

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

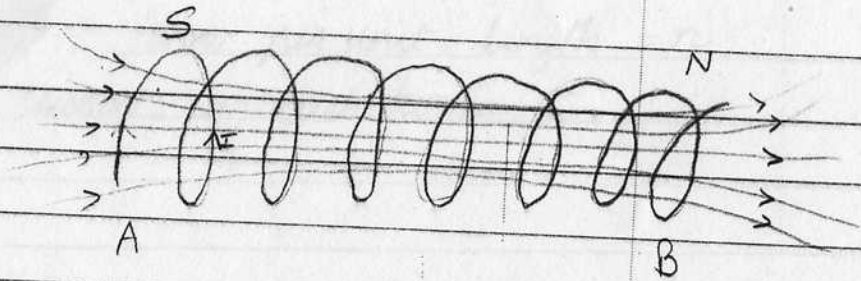


If direction of current is as shown,  
then  $\vec{B}$  is clockwise.

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



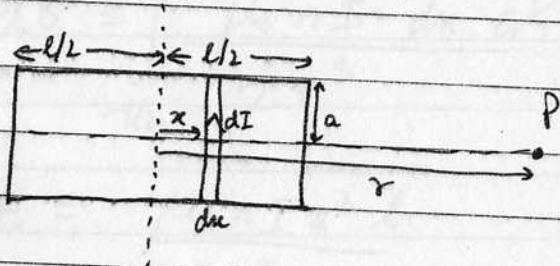
b.)



The magnetic field lines will be as shown.

∴ Field lines <sup>begin</sup> ~~originate~~ 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,

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



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

then

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

$$\because r \gg x, a$$

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

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

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

$$= \frac{\mu_0}{4\pi} \times \frac{2nIl \pi a^2}{r^3}$$

$$= \frac{\mu_0}{4\pi} \times \frac{2 \times NAI}{r^3}$$

$$[\because n \times l = N \\ \pi a^2 = A]$$

~~if we cons~~  
for a bar magnet,

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

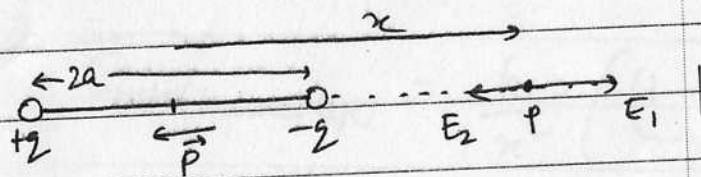
$\therefore$  if we consider  
NAI as  $m$ ,

Then in Solenoid,

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

Which is same as bar magnet.

Hence a solenoid acts as a bar magnet of magnetic moment  $=$  NAI



At point P, on the axis,

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

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

$$E_{\text{net (towards left)}} = E_2 - E_1$$

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

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



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

if  $x \gg a$ ,  
then using binomial expansion

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

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

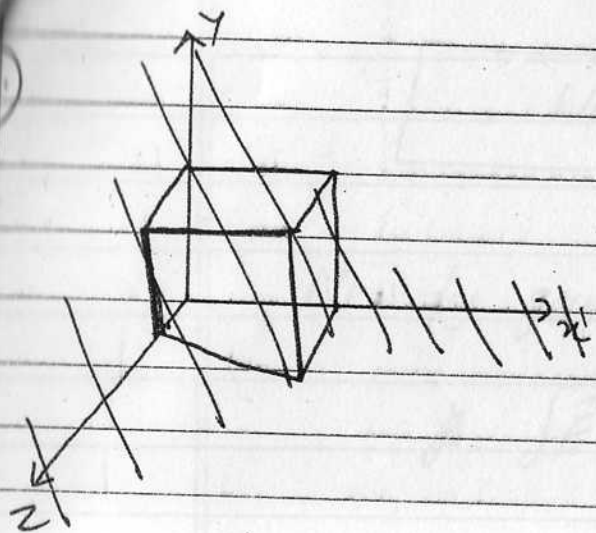
$$\vec{E}_{\text{net}} = \frac{kq \times 4a \times 2}{x^3}$$

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

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

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

→ (ANS)

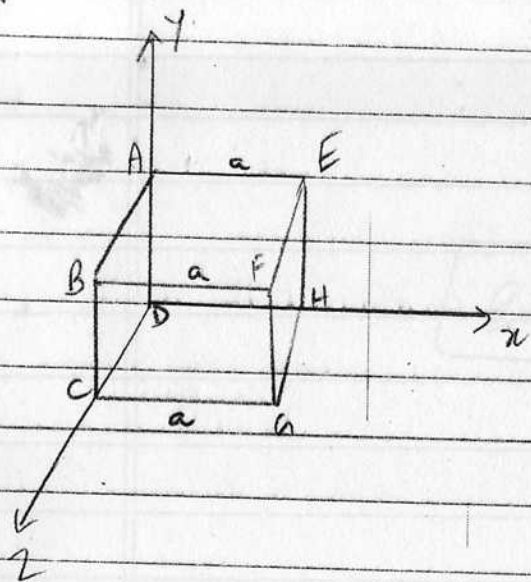


$$\vec{E} = 2x\hat{i}$$

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

$$\therefore \oint \vec{E} \cdot d\vec{s} = 0$$

hence flux through these faces is zero.



For face ABCD,

$$E = 0$$

$\therefore$  flux is zero.

Now, through face EFGH,

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

$$\vec{s}_B = a^2\hat{i}$$

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

$$\therefore \text{Net flux} = 2a^3 \rightarrow \text{ANS}$$

Now by Gauss's law,

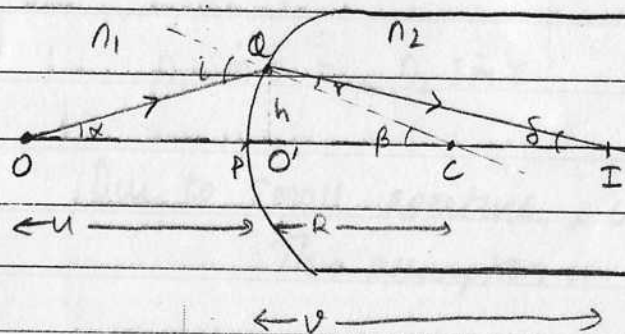
$$\oint \vec{E} \cdot d\vec{s} = \frac{q_{in}}{\epsilon_0}$$

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

$$q_{in} = 2a^3 \epsilon_0 \rightarrow \text{ANS}$$



24a.)



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

Now by exterior angle property of  $\Delta s$ ,

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

and,

$$\beta = r + \delta$$

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

Applying snell's law at  $a$ ,

$$n_1 \sin i = n_2 \sin r$$

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

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

$$\therefore n_1 i = n_2 r$$

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

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

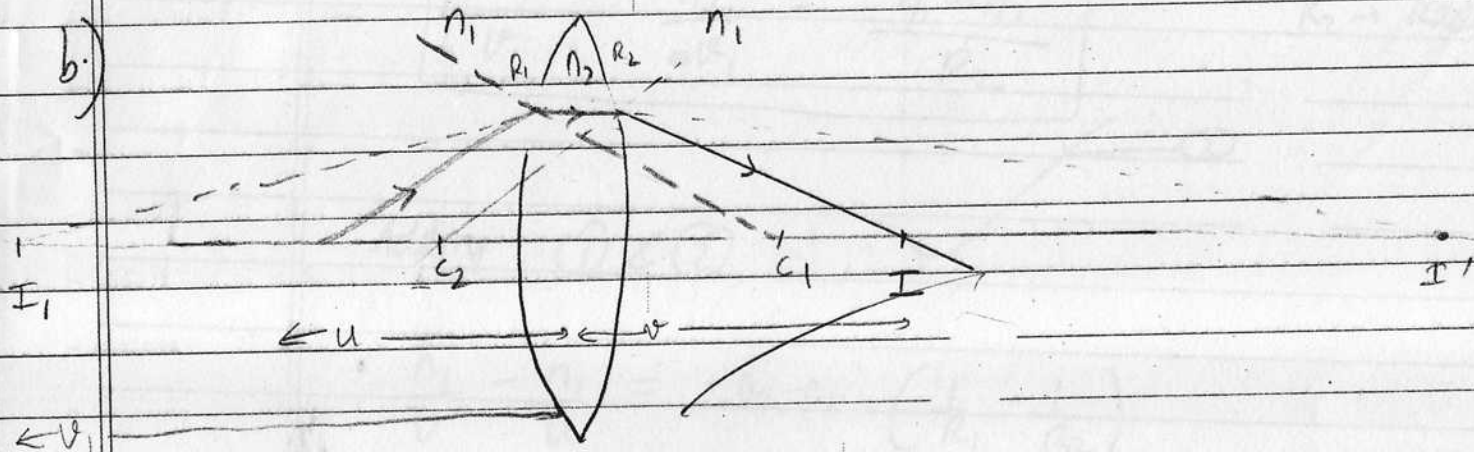
$$n_1 \left( \frac{h}{OO'} + \frac{h}{O'C} \right) = n_2 \left( \frac{h}{O'C} - \frac{h}{O'I} \right)$$

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

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

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

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



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,

$$\frac{n_1}{v} - \frac{n_2}{\infty} = \frac{n_1 - n_2}{R_2}$$

$R_2 \rightarrow$  Radius of ~~curvature~~ <sup>curvature</sup> 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 ~~object~~  $u = \infty$   
 $v = f$

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

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

$\hookrightarrow$  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 inquisitiveness
  - \* They show a desire to understand and learn new things.
  - \* Teacher shows maturity.
  - \* The teacher also shows awareness.

22.4

## Fission

## Fusion

\* When a high mass nucleus dissociates into smaller nuclei, the process is known as fission.

\* The energy released is very high (of the order of 200 MeV).

\* Used in nuclear reactors.

\* When small mass nuclei combine to form a heavy nucleus, the process is termed as fusion.

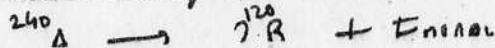
\* The energy released is lower than fission (of the order 20 MeV)

\* Fusion takes place in the core of stars.

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

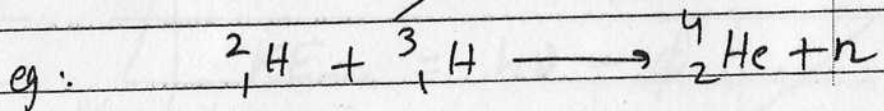
We know that nuclei of medium masses ( $30 < A < 170$ ) are very stable and have high BE per nucleon.

- 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.





- 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.



$$\text{here mass of pd} = 4.002603 + 1.008665$$

$$= 5.011268 \text{ u}$$

$$\text{mass of reactants} = 3.016049 + 2.014102$$

$$= 5.030151 \text{ u}$$

$$\Delta m = 5.030151 - 5.011268$$

$$\Delta m = 0.018883 \text{ u}$$

$$\text{Energy released} = \Delta mc^2 = \Delta m \times 931.5 \text{ MeV}$$

$$E = 17.589345 \text{ MeV}$$

21) Einstein's Eq<sup>n</sup>.

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

$KE_{\text{max}}$  → max energy of emitted photoelectrons

$\nu$  → frequency of incident light

$h$  → planck's constant

$\phi$  → 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  $KE_{\text{max}}$  is directly proportional to frequency, thus showing that  $KE_{\text{max}}$  is independent of intensity of light.

\* Intensity is the no. of photoelectrons per unit area per second. Thus increasing intensity increases the no. of photoelectrons 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.

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

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

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

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

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



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

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

$$\lambda_0 = \frac{\lambda_2 \lambda_1}{2\lambda_2 - \lambda_1} \quad \text{ANS}$$

↓  
Threshold wavelength

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

$f_o \rightarrow$  focal length of objective  
 $f_e \rightarrow$  focal length of eyepiece

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

$\therefore$  image formed is inverted

$$\therefore \text{angular magnification} = +1500$$

ii) ~~angle in~~ <sup>at</sup> angle subtended by moon at obj = angle of img at objective.

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

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

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

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

19.) a) Microwaves

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

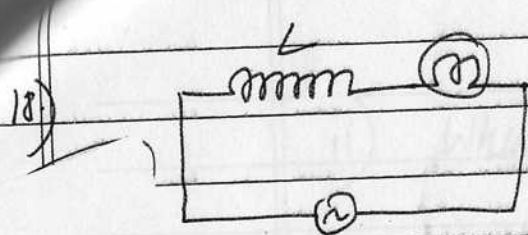
b) Infrared waves

\* These are produced by hot objects and bodies.

c) X-rays

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





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

as  $X_L$  reduces,  
current increases.

$\therefore$  Brightness of bulb increases.

ii) When iron rod is inserted,  
 $\mu$  increases (as  $\mu = \mu_r \mu_0$ )

$\therefore$  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

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

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

$$\therefore X_C = X_L$$

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

$\therefore$  Current increases

hence brightness also increases



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

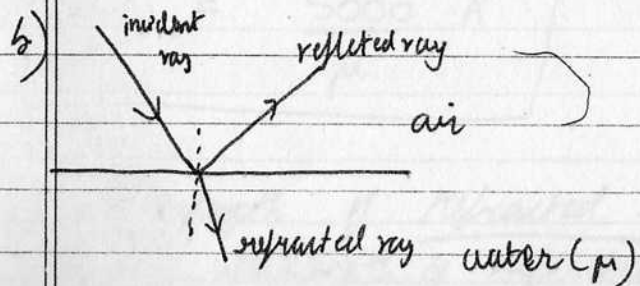
$$0.1 = \frac{\lambda}{d}$$

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

$$d = \frac{600 \times 10^{-9}}{0.1} = 600 \times 10^{-8} \text{ m}$$

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

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



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

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

$$f = \frac{v}{\lambda} = \frac{3 \times 10^8}{5000 \times 10^{-10} \times 10^{-7}} = 0.6 \times 10^{15}$$
$$= \boxed{0.6 \times 10^{15} \text{ Hz}}$$

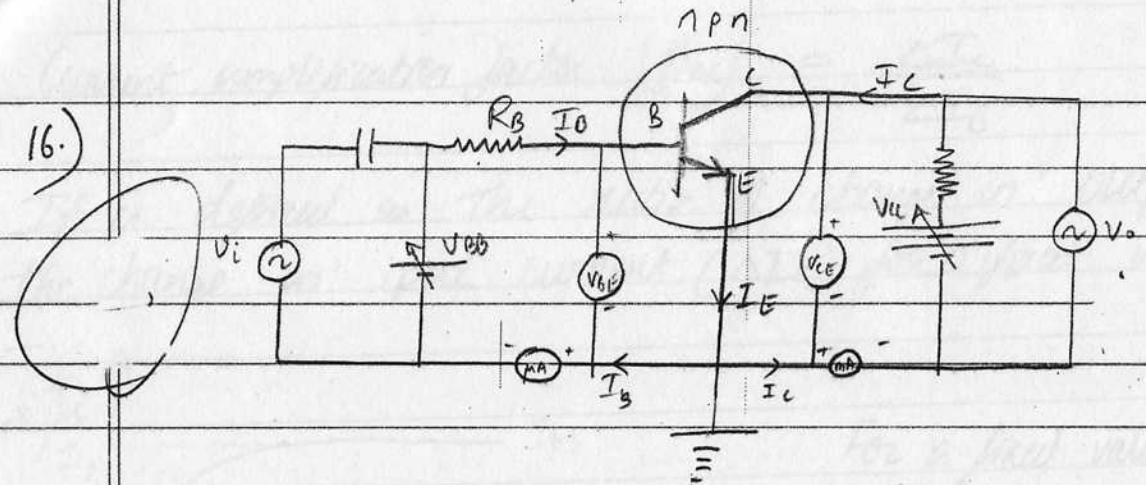
\* If wavelength in air is  $\lambda_1$  & that in water is  $\lambda_2$ ,

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

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

$$\lambda_2 = \frac{5000 \text{ \AA}}{\mu}$$

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

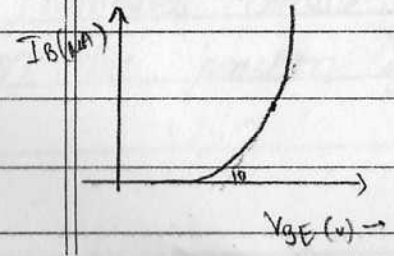


Transistor as amplifier in CE configuration.

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 ( $\Delta V_{BE}$ ) and the change in base current ( $\Delta I_B$ ) for a fixed value of  $V_{CE}$ .

→ It can be determined from the graph of input characteristics

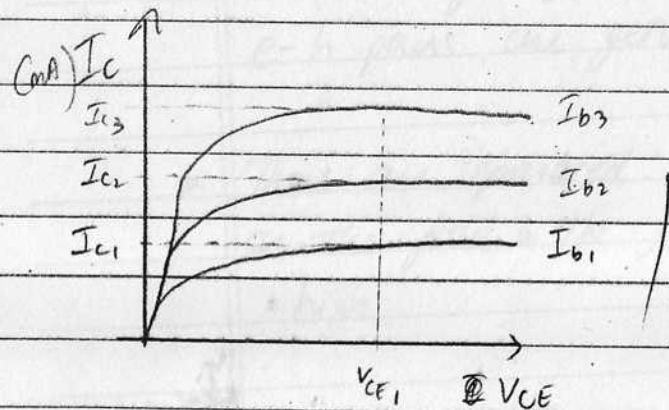


It is the <sup>reciprocal</sup> ratio of slope of the linear part of the graph.



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

It is defined as the ratio of change in output current ( $\Delta I_c$ ) to the change in input current ( $\Delta I_b$ ) for a fixed value of  $V_{CE}$ .



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

here clearly  $\beta_{ac} = \frac{I_{c3} - I_{c1}}{I_{b3} - I_{b1}}$

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.

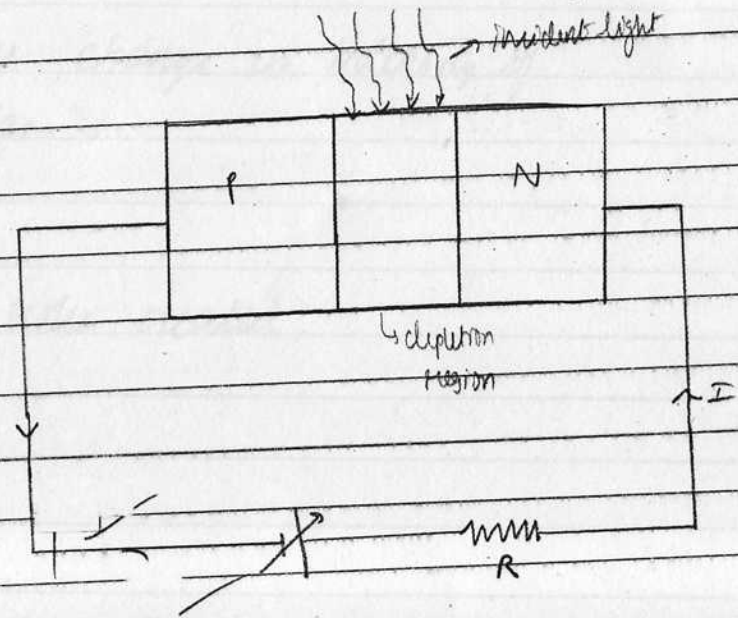
→ Working:-

\* 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.

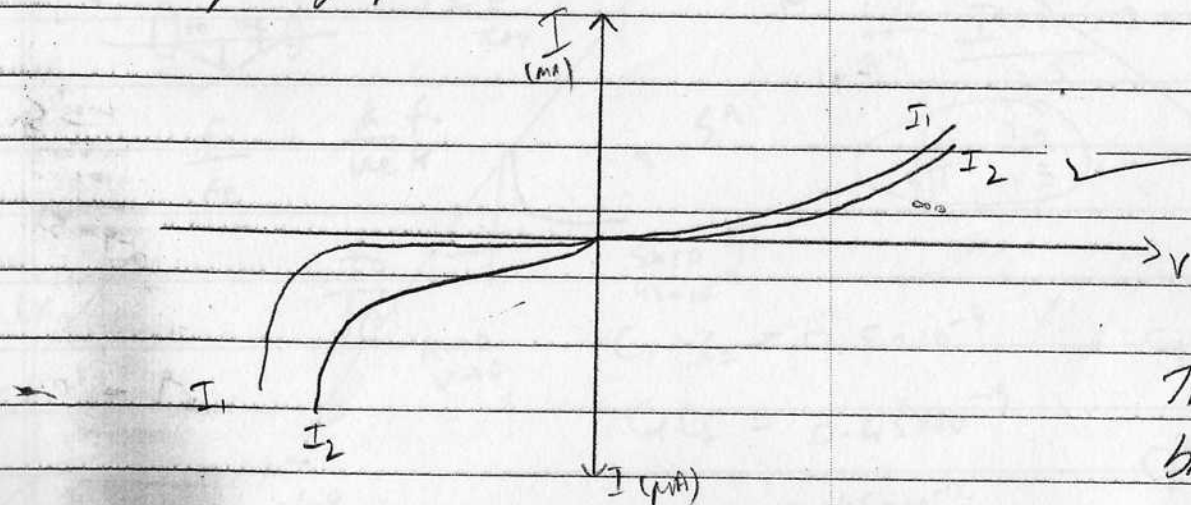
in forward bias  $n \gg h$

let  $\Delta n$  &  $\Delta h$  be the extra  $e^-$  & holes created,  
then  $\Delta n = \Delta h$ .

$$\Rightarrow \frac{\Delta n}{n} \ll \frac{\Delta h}{h}$$

~~Thus change in forward bias will be very less.~~

Also from graph



Thus, change in reverse bias is easily detectable.



14.) The principle of Galvanometer

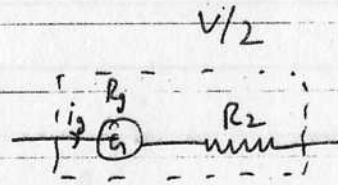
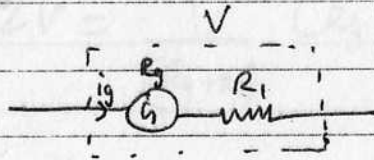
is that when current is passed through a coil in uniform magnetic field, a torque acts on the coil.

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

$\vec{m}$  → magnetic moment

$\vec{B}$  → magnetic field

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



$$V = i_g (R_g + R_1) \quad \text{--- (1)}$$

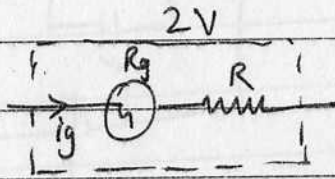
$$\frac{V}{2} = i_g (R_g + R_2) \quad \text{--- (2)}$$

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

$$2R_g + 2R_2 = R_g + R_1$$



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



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

from (1),

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

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

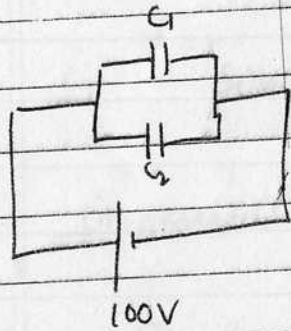
$$R = R_g + 2R_1$$

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

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



13.)



(I)

 $I_n$  (I)

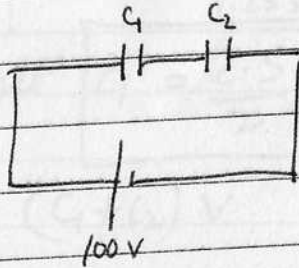
$$C_{eq} = C_1 + C_2$$

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

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

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

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



(II)

$$I_n \text{ (II)}, \quad C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$

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

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

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

$$C_1 C_2 = 0.045 \times 10^{-8}$$

(2)





$$\text{Solving we get } C_1 = \frac{2.5 \times 10^{-5} \text{ F}}{2}, C_2 = 3.6 \times 10^{-5} \text{ F}$$

$$\text{in parallel } q_{\text{net}} = (C_1 + C_2) V = 5 \times 10^{-5} \times 100 = 5 \times 10^{-3} \text{ C}$$

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

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

$$q_2 = \frac{C_2}{5 \times 10^{-5}} \times 5 \times 10^{-3} = C_2 \times 100 = \frac{2.5 \times 10^{-5} \times 100}{2} = \frac{2.5 \times 10^{-3} \text{ C}}{2}$$

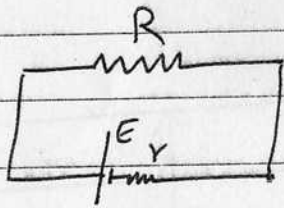
$$q_2 = C_2 \times 100 = 3.6 \times 10^{-5} \times 100 = 3.6 \times 10^{-3} = 3.6 \text{ mC}$$

$$q_2 = 1.25 \text{ mC} \rightarrow \text{Charge on } C_2$$

$$q_1 = 3.6 \text{ mC} \rightarrow \text{Charge on } C_1$$



12.)



$$V = E - ir$$

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

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

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

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

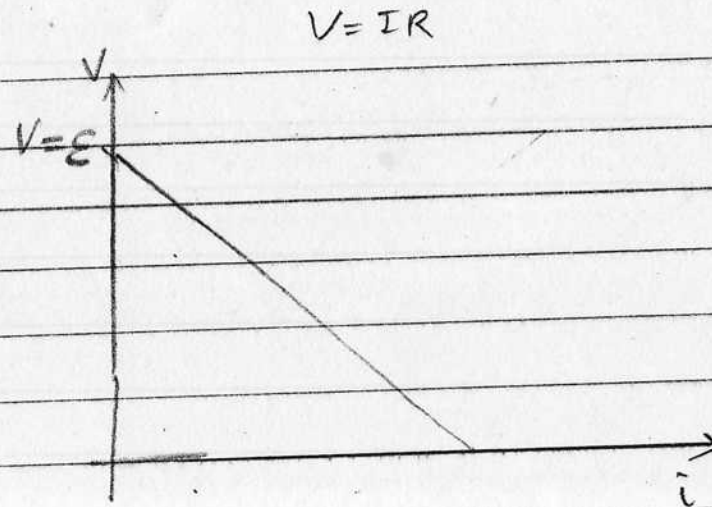
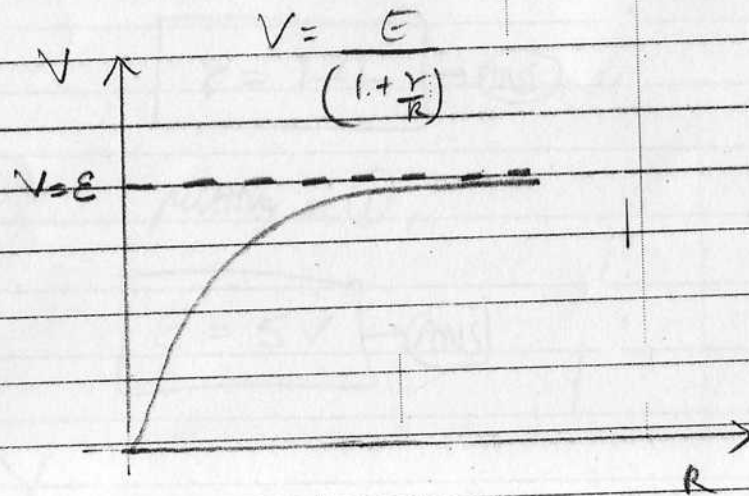
①

$$V = IR$$

②

From ① & ②,

the plots are: |



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

When  $R = 4\Omega$

$$i = 1A$$

$R = 9\Omega$

$$i = 0.5A$$

$$\therefore 1 = \frac{E}{4+r} \quad \text{--- (1)}$$

$$0.5 = \frac{E}{r+9} \quad \text{--- (2)}$$

$$\Rightarrow \frac{E}{4+r} = \frac{2E}{r+9}$$

$$\Rightarrow r+9 = 8+2r$$



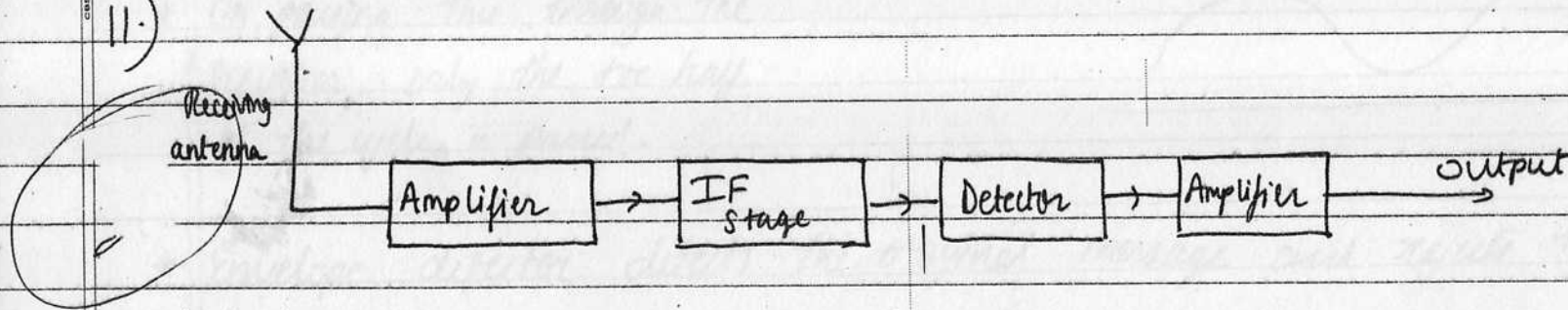


$$r = 1 - \Omega \rightarrow \text{ANS}$$

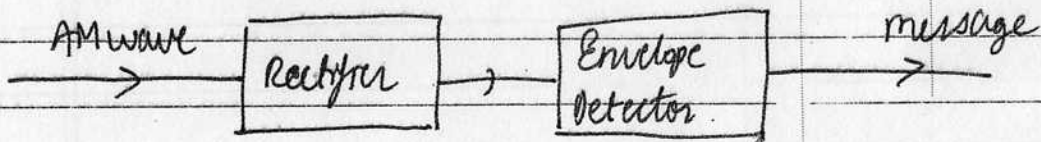
putting in (1),

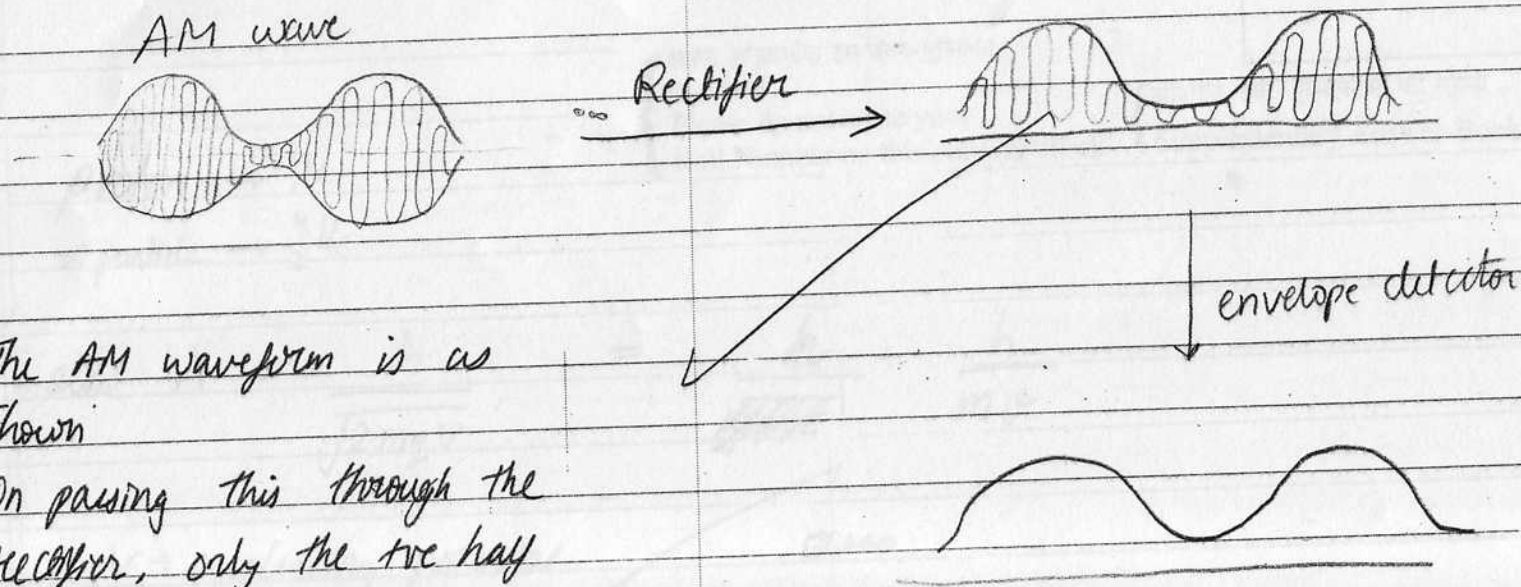
$$E = SV \rightarrow \text{ANS}$$

11.)



Detector :





\* The AM waveform is as shown

\* On passing this through the receiver, only the  $\text{+ve}$  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

Fictitious Roll No.  
(To be entered by Board)

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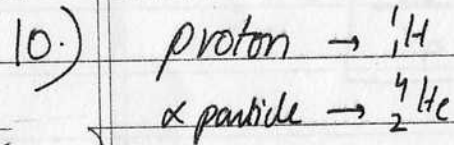
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Supplementary Answer-Book(S) No. ...2...



$$\text{also } \lambda = \frac{h}{\sqrt{2m_e V}} = \frac{h}{\cancel{m_e}} \frac{h}{m_e}$$

$V \rightarrow$  accelerating potential

$\lambda \rightarrow$  de Broglie wavelength

Zero

$$\lambda_p = \lambda_\alpha$$

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

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

$$\text{also } m_\alpha/m_p = 4$$

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



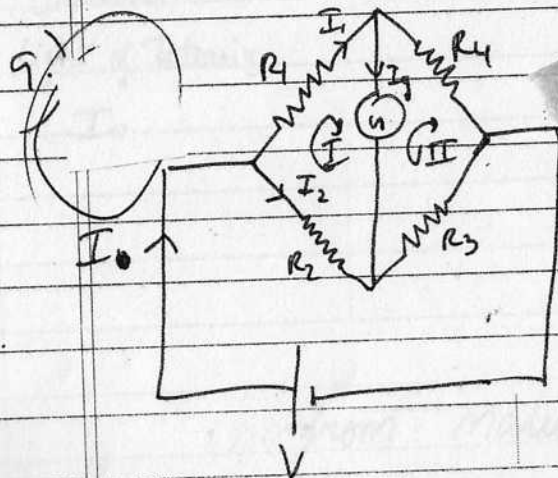


$$\Rightarrow \frac{V_x}{V_p} = \frac{1}{8} \rightarrow \text{ANS}$$

$$\text{ii) } \frac{V_x}{m_x V_x} = \frac{V_p}{m_p V_p}$$

$$\frac{V_x}{V_p} = \frac{m_p}{m_x}$$

$$\frac{V_x}{V_p} = \frac{1}{4} \rightarrow \text{ANS}$$



In balance condition  $I_g = 0$ .

$$\therefore I = I_1 + I_2$$

also applying kirchoff's voltage law in

I & II,

$$I_1 R_1 = I_2 R_2 \quad \text{--- (1)}$$

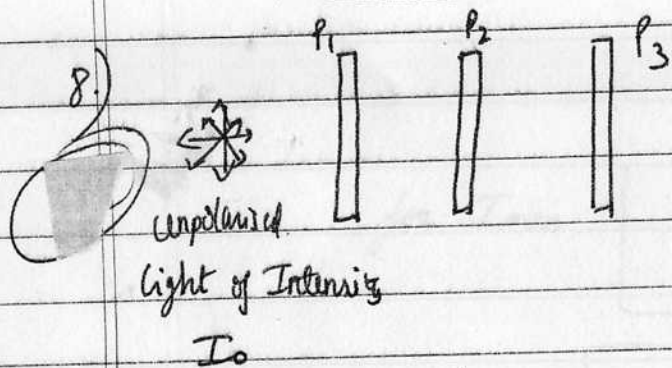
$$I_1 R_4 = I_2 R_3 \quad \text{--- (2)}$$



$$\textcircled{1} \div \textcircled{2},$$

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

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



On passing unpolarised light through  $P_1$ .

$$I' = I_0/2$$

If at any instance,

$$\text{angle b/w } P_1 \text{ \& } P_2 = \theta$$

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

from Malus's law,



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

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

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

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

for  $I_{\max}$

$$\theta = \frac{\pi}{4}$$

$$\theta = 45^\circ$$





## 7.) Intrinsic

\* Pure semiconductors such as Si & Ge are called intrinsic semiconductors.

\* Only thermally generated holes & electrons.

\* Low conductivity at room temp

\* High band gap

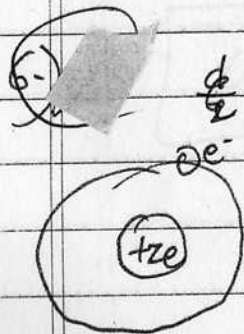
## Extrinsic

\* Semiconductors that are doped with an external atom such as As or B, it is called extrinsic semiconductor.

\* Both thermally generated as well as ~~the~~ impurity donated holes/electrons.

\* High conductivity.

\* Lower band gap



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)

$$mvr^2 = \frac{kze^2}{r}$$

$$mvr \times v = kze^2$$

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

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

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

clearly  $r \propto n^2$



5.)  $X_c = \frac{1}{\omega C}$

unit  $\Rightarrow$  ohm

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

(i) DE  $\therefore$  slope is -ve

(ii) BC  $\therefore V \propto I$

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

$\omega_c \rightarrow$  ang. frequency of carrier wave

$\omega_m \rightarrow$  ang. frequency of message.

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



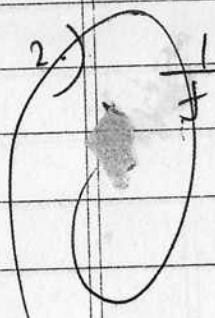


$$x_c(t) = (A_c + A_m \sin \omega_m t) \sin \omega_c t$$

$$A_{ce} = A_c (1 + \mu \sin \omega_m t) \sin \omega_c t$$

$$x_c(t) = A_c \sin \omega_c t + \underbrace{\mu A_c \cos(\omega_c - \omega_m)t - \mu A_c \cos(\omega_c + \omega_m)t}_{\text{side bands}}$$

side bands.

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

$$\mu_c = 1.5$$

$$\mu_m = 1.65$$

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

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

$$\therefore f \text{ is } +ve$$

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

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

$$\therefore q_{in} = 0$$

$$\therefore \text{flux} = 0$$





FM

Full marks

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