केन्द्रीय माध्यमिक शिक्षा बोर्ड, दिल्ली
सीनियर स्कूल सर्टिफिकेट परीक्षा (कक्षा बारहवीं)
परीक्षार्थी प्रवेश–पत्र के अनुसार भरे

विषय Subject : PHYSICS

विषय कोड Subject Code : 042

परीक्षा का दिन एवं तिथि
Day & Date of the Examination : WEDNESDAY, 15.03.2017

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	Set Number
55/3	① ② ● ④

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

विकलांग व्यक्ति :
Person with Disabilities : हाँ / नहीं 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
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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 :
If Visually challenged, name of software used : NO

*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
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Previous Pathshala

Section A

10

Angle of minimum deviation represented by δ_m. The refractive index of the material of the prism is given by

$$n = \frac{\sin\left[\frac{A+\delta m}{2}\right]}{\sin A/2}$$

For a small prism, the deviation produced
For deviating: $n = \frac{\frac{A+\delta m}{2}}{\frac{A}{2}}$

$$n = \frac{A+\delta m}{A}$$

$$nA = A + \delta m$$

$$\delta_m = (n-1)A.$$

δ_m depends on $n-1$ for a constant value of A

$\delta_m = (n-1)A$; $n \propto \frac{1}{\lambda}$ for $\lambda_v < \lambda_r$

H So $n_v > n_r$

Refractive index of the material of the prism is greater for violet. So for violet light, $(n-1)$ is greater, δ_m is greater. violet replaced by red, $(n-1)$ decreases and angle of minimum deviation is also decreased.

2. The quantum nature of electromagnetic radiation is shown by the phenomenon of photoelectric effect.

3. When current is increasing, magnetic flux linked with the two coils also increases. The $\vec{B}$ due to the current element in 2 is into the plane and 1 is out of the plane. Since flux increases, direction of induced current is oppo such that the $\vec{B}$ due to it is opposite to the original flux. So the induced current in the loop 1 is in clockwise direction and 2 is in anticlockwise direction

4. Electric and magnetic field vectors are perpendicular to the direction of propagation of the wave.

The electric field vector is along positive Y-axis and the magnetic field is oscillating along the positive z axis. So that $(E\hat{j} \times B\hat{k}) = EB\hat{i}$. The wave is propagating along the +ve x axis.

5. I is same in both.
when I constant
The heat produced in time t
$H = I^2Rt$
$H \propto R$
$R \propto \rho$ ρ is higher for nichrome.
So R is higher for nichrome.
More heat is produced in Nichrome wire.

Section - B

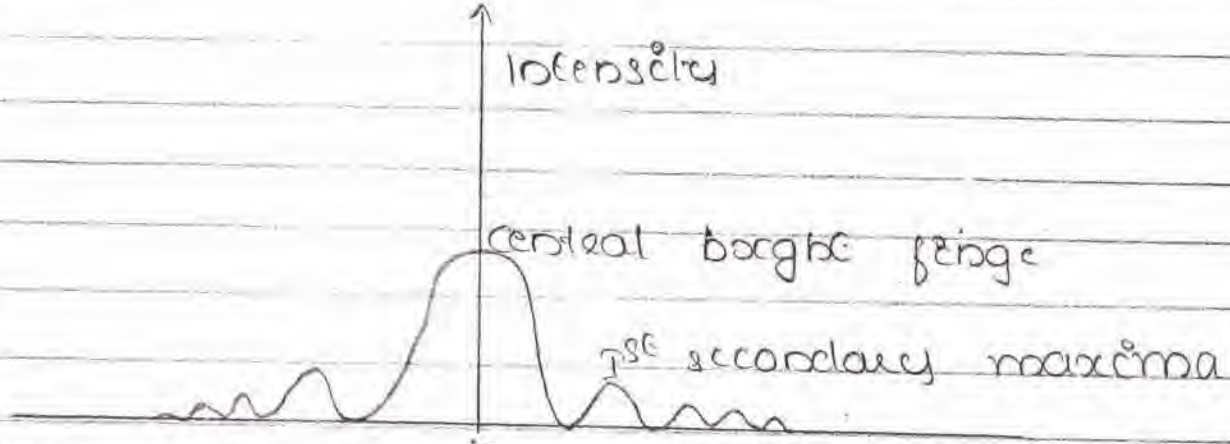
6. Making a permanent magnet
Usually steel is used for making the permanent magnet. Because the material used

shows require high retentivity
high coercivity
intensive magnetism

For making electromagnets.
Soft Iron cores is mainly used for making an electromagnet because of the following properties.
high permeability
less area of the covered hysteresis loop
in order to minimise the energy loss
High retentivity
Low coercivity
Mainly the relative permeability of the material should be very high in order to permit more magnetic field lines to pass through them

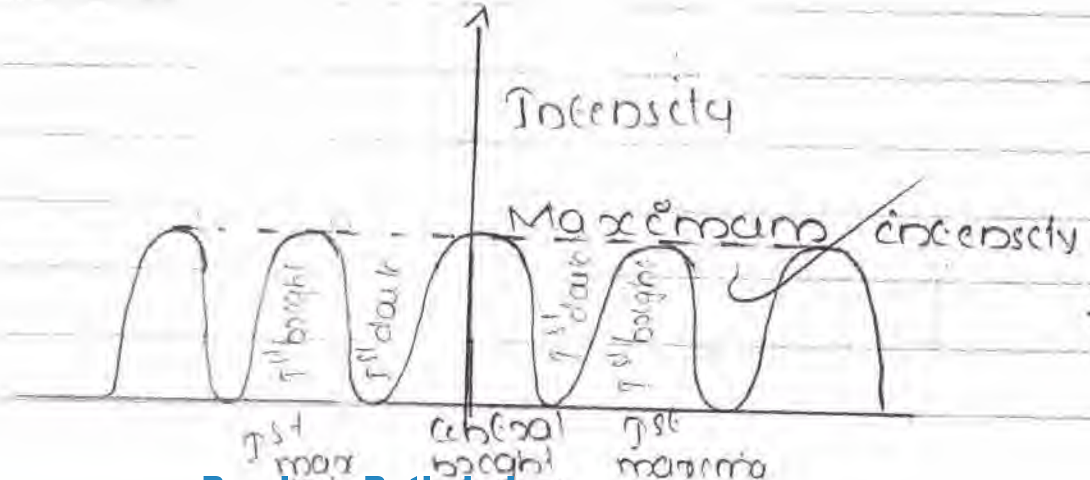
7. Intensity pattern of single slit diffraction
The central bright fringe has the maximum intensity and the intensity decreases as we move on to the either sides of the central

maximum.



Intensity pattern for double slit interference.

All the bright fringes possess the same intensity



Interference	Diffraction
All the bright fringes are of equal intensity	The principal maxima possess the highest intensity and the intensity decreases as we go on to either sides from the principal maxima
All b	
All bright fringes are of equal width	The width of fringes also increases from principal maxima to either sides.
Maxima occurs at $\theta_n = \frac{n\lambda}{d}$	Minima occurs at $\theta_n = \frac{n\lambda}{d}$
Good contrast between bright and dark fringes	Poor contrast between bright and dark fringes

8. A battery always supply a dc current. But the capacitive reactance of the capacitor

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

For d.c

$$f = 0$$

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

$$X_C = \frac{1}{0}$$

$$X_C = \infty$$

A capacitor always block dc. Current in a steady state has a constant value if I is constant f = 0 and current does not flow in a capacitor. However during charging and discharging current suddenly increases or decreases in a small time it causes a change in flux. An emf is induced which causes an induced current. And also during charging and discharging capacitor shows oscillatory properties. So there is a variation in current for an instant of time. It is momentary. It lasts only for a short time. Due to the induced emf, a momentary current is set up.

9. $E_1 = -13.6\,eV$

$E_i = -1.51\,eV$

$E_f = -3.4\,eV$

change in energy $= E_i - E_f = -1.51\,eV - 3.4\,eV$

$= 3.4\,eV - 1.51\,eV$

$= 1.89\,eV$

$h\nu = 1.89\,eV$

$h\frac{c}{\lambda} = 1.89 \times 1.6 \times 10^{-19}\,J$

$\lambda = \frac{hc}{1.89 \times 1.6 \times 10^{-19}\,J} = \frac{6.636 \times 10^{-34} \times 3 \times 10^{8}\,ms^{-1}\,kg\,m^2 s^{-1}}{1.89 \times 1.6 \times 10^{-19}\,kg\,m^2 s^{-2}}$

Previous Pathshala

$$\frac{19.908 \times 10^{-26}}{30.24 \times 10^{-1} \times 10^{-19}} m$$

6.636
19.908
5.189
16
1.1.34
1.89
30.27

$$\frac{19.908 \times 10^{-26}}{3.024 \times 10^{-19}} m$$

302 ⟌ 1990

$= 6.58 \times 10^{-7} m$

$= 6.58 \times 10^{-7} m$.

It belongs to visible light and hence it belongs to Balmer series of Hydrogen spectrum

Since 658 nm belongs to 400 nm to 700 nm.

10. A beam of charged particles move undeflected in the presence of crossed electric and magnetic fields when the net force acting on it is zero ie $F_m = F_e$

ie $qVB\sin\theta = qE$

$$vB\sin\theta = E$$

If crossed and the particle moves perpendicular to the both the fields, then $\theta = 90^\circ$

so $vB = E$

$$v = \frac{E}{B}$$

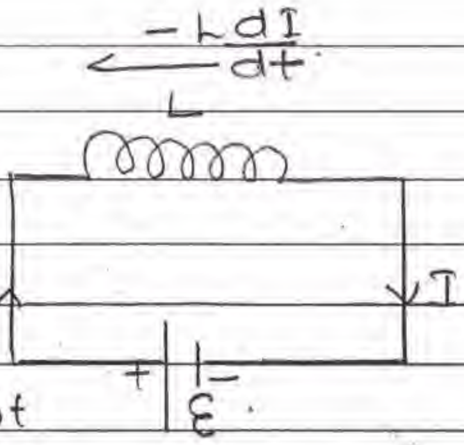
The particles moving with a speed $v = \frac{E}{B}$ or $v = \frac{E\sin\theta}{B}$ moves undeflected and it can be obtained on the screen without any deflection. This principle is used for velocity selector. The particles moving with this velocity can be easily determined.

Section- C

12. Self inductance of a coil:

~~When a~~

$$\varepsilon = -L\frac{dI}{dt}$$



Self inductance of a coil or coefficient of self inductance is defined as the emf induced across a coil when the current in the coil is changing at the rate of 1 A/s.

i.e. $|\varepsilon| = L\frac{dI}{dt}$

$$L = \frac{|\varepsilon|}{dI/dt} \quad \text{when } \frac{dI}{dt} = 1\,A/s$$

$$L = \varepsilon$$

S.I unit is Henry.

Consider the coil of inductance L. A back emf $|\varepsilon| = L\frac{dI}{dt}$ is set up in the coil against the current provided by the source. If the current need to be flow through the coil work has to be done against the coil, against the emf $\varepsilon = L\frac{dI}{dt}$

So $dW = P\,dt$

$= \varepsilon I\,dt$

$= L\frac{dI}{dt} \cdot dt \times I$

$= L\,dI \times I$

$dW = L\,dI \times I$

The total work done is

$\int_0^{I_0} dW = \int_0^{I_0} L\,dI \times I = \int_0^{I_0} LI\,dI$

$L\int_0^{I_0} I\,dI$

$L\frac{I_0^2}{2}$

$= \frac{1}{2}LI_0^2$

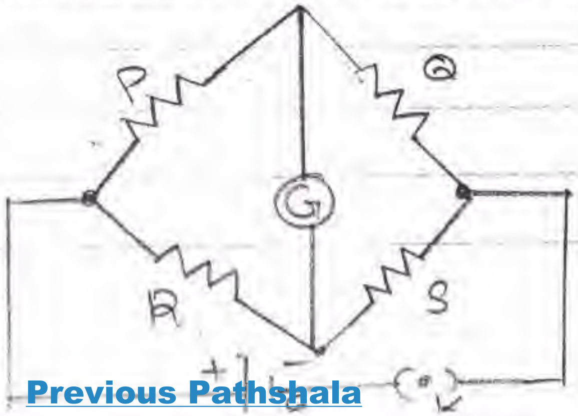
The work done $\frac{1}{2}LI^2$ is stored as the magnetic potential energy in the circuit.

13. Principle of working of a metre bridge.

The principle is Wheatstone principle. If four resistances P, Q, R and S are connected in the Wheatstone bridge in the following manner, then at balanced condition, i.e. current in the galvanometer is zero, the

$$\frac{P}{Q} = \frac{R}{S}$$

The unknown resistance can be found.



(b)

If AB is taken as 100 cm
In the balanced condition

$$\frac{R}{S} = \frac{l_1}{100-l_1} \Rightarrow R = \frac{l_1}{100-l_1} \times S$$

Now S changes to

$$S' = \frac{SX}{S+X}$$

So $\frac{R}{S'} = \frac{l_2}{100-l_2}$

ie $\frac{R(S+X)}{SX} = \frac{l_2}{100-l_2}$

So $\frac{l_1}{(100-l_1)} \cancel{S} \left[\frac{S+X}{\cancel{S}X}\right] = \frac{l_2}{100-l_2}$

$$\frac{l_1[S+X]}{X[100-l_1]} = \frac{l_2}{100-l_2}$$

$$\frac{l_1 S + l_1 x}{100x - x l_1} = \frac{l_2}{100 - l_2}$$

$$(l_1 S + l_1 x)(100 - l_2) = l_2 (100x - x l_1)$$

$$100 l_1 S - l_1 l_2 S + l_1 x 100 - l_1 l_2 x = l_2 100 x - x l_1 l_2$$

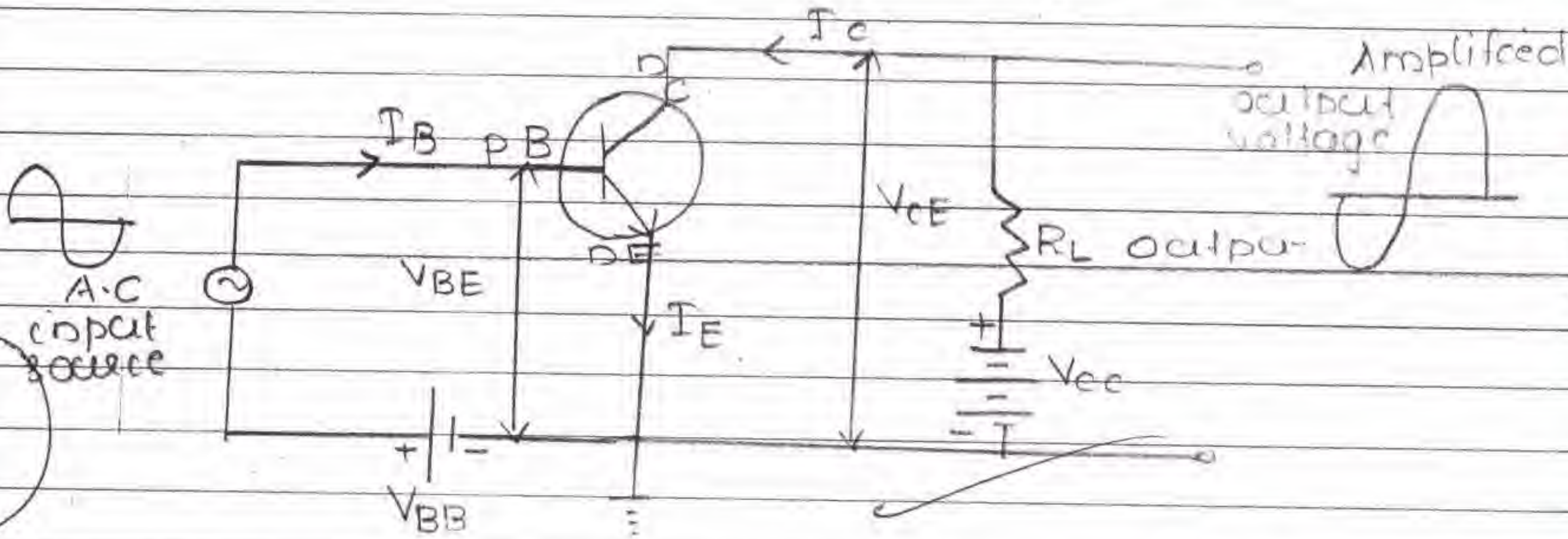
$$x = \frac{100 l_1 S - l_1 l_2 S + 100 l_1}{100 l_2}$$

$$100 l_1 x - 100 l_2 x = l_1 l_2 S - 100 l_1 S$$

$$x [100 l_1 - 100 l_2] = l_1 l_2 S - 100 l_1 S$$

$$x = \frac{l_1 l_2 S - 100 l_1 S}{100 [l_1 - l_2]}$$

14. (a) npn transistor amplifier in common emitter configuration.



(b) We know by using kirchoff's laws

$$V_{CE} = V_{CC} - I_C R_L$$

Voltage gain of an amplifier is defined as the ratio of small change in V_{CE} to the small change in V_{BE} ie $A_V = \frac{\Delta V_{CE}}{\Delta V_{BE}}$

For the output circuit

$$V_{CE} = V_{CC} - I_C R_L$$

$\Delta V_{CC} = 0$

$$\Delta V_{CE} = 0 - R_L \times \Delta I_C$$

$$\Delta V_{CE} = -R_L \cdot \Delta I_C$$

when V_i is superimposed with V_{BE}

$$V_i + V_{BE} = V_i + I_b (R + R_{in})$$

$$\Delta V_{BE} = \Delta I_b (r_{in})$$

$$\Delta V_{BE} = \Delta I_b \cdot r_{in}$$

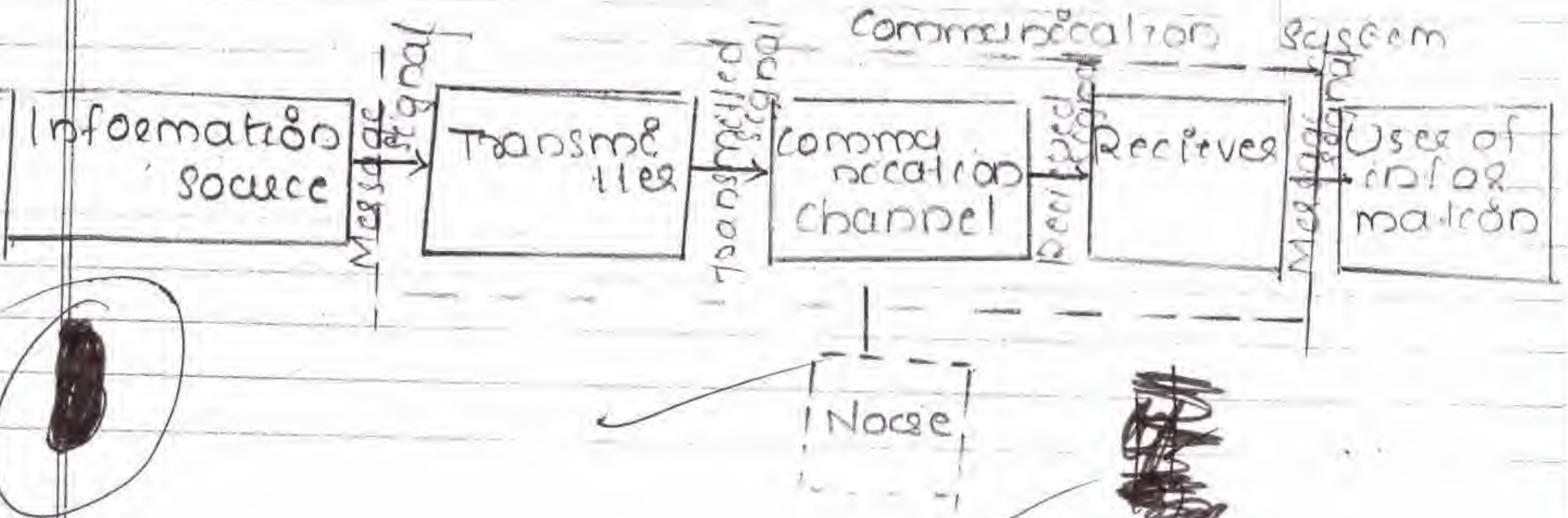
So $A_v = \dfrac{\Delta V_{CE}}{\Delta V_{BE}} = \dfrac{-R_L \cdot \Delta I_C}{\Delta I_b r_{in}} = -\dfrac{\Delta I_C}{\Delta I_b} \cdot \dfrac{R_L}{r_{in}}$

$$= -\beta_{ac} \cdot \frac{R_L}{r_{in}}$$

$$A_v = -\beta_{ac} \cdot \frac{R_L}{r_{in}}$$

The negative sign shows that the output phase is in opposite phase with the input voltage.

16. Communication system:



(a) Transmitter

A transmitter transmits the recieved message signal and transmits it into a suitable form so that it can easily pass through the communication channel or Transmission medium

(b) Channel

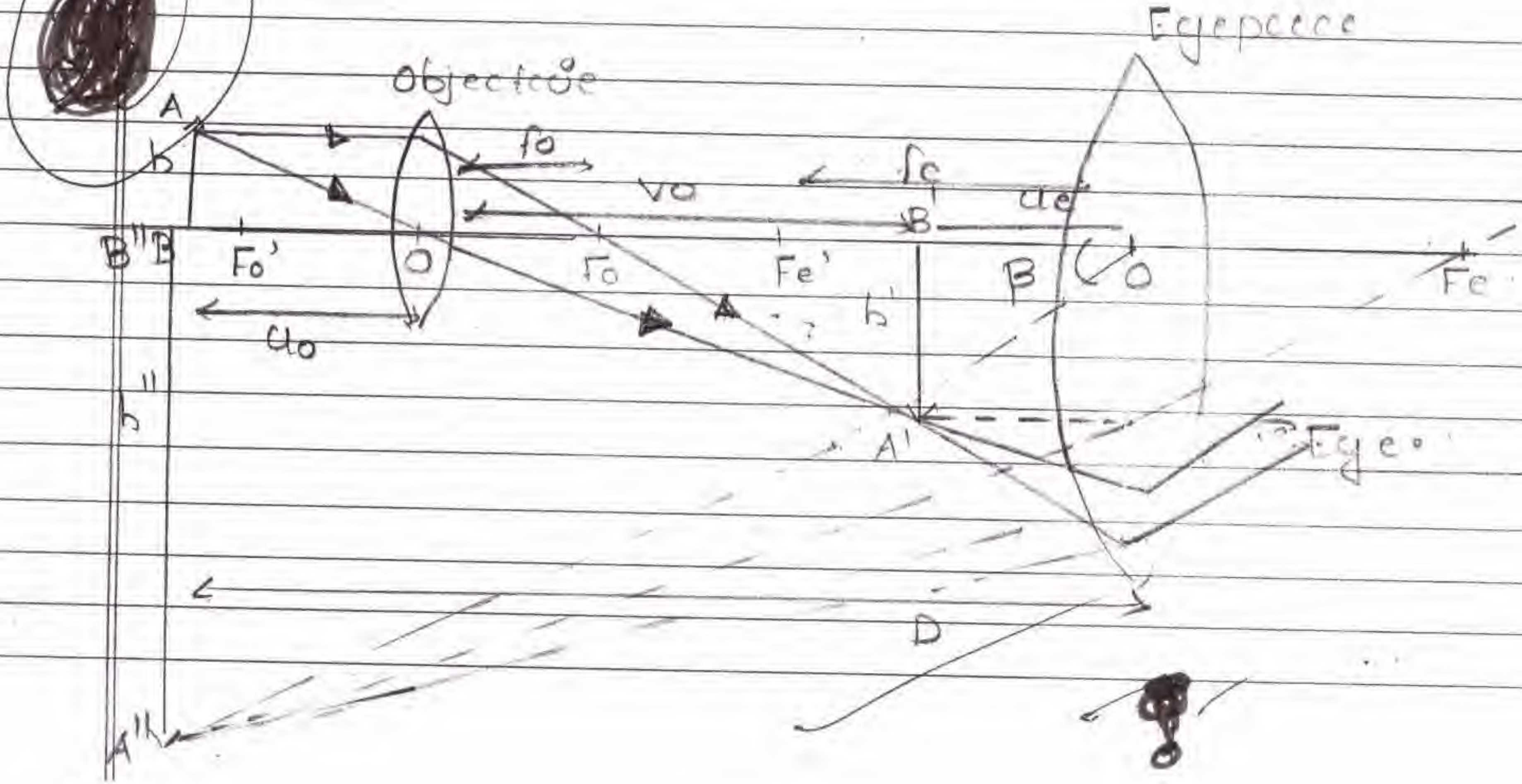
A channel or transmission medium is the physical medium or contact between the transmitter and receiver through which the transmitted message signal reaches the receiver. It can be coaxial cables.

(c) Reciever

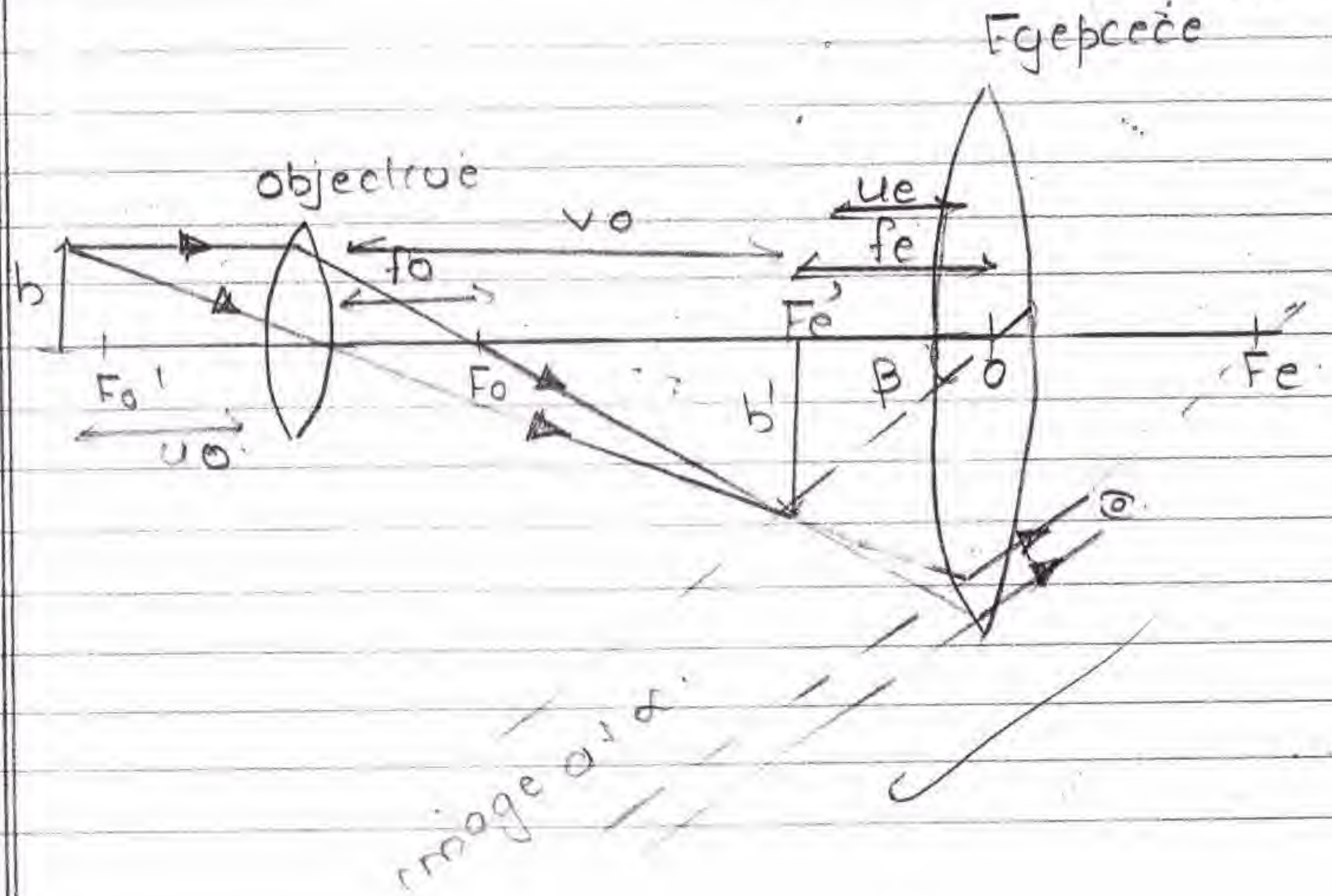
A receiver receives the transmitted signal and converts it into the original message signal to be given it to the user of information

It seperates the base message signal and give it to the user of information.

14 Image formed at least distance of distinct



(b) Image formed at infinity



(b) Focal lengths are

$L_1 = \frac{1}{3} = 0.33$ i.e. 33 cm.

$L_2 = \frac{1}{6} =$ 16.66 cm

$L_3 = \frac{1}{10} =$ 10 cm

The two lenses with short focal lengths are used. So L_2 and L_3 are used as the eyepiece and L_3 is used as the objective. L_2 is used The objective should have small focal length and aperture as compared to the eyepiece.

(c) The resolving power of a microscope.

$$R.P = \frac{1}{d} = \frac{2\mu \sin\theta}{\lambda}$$

$$R.P \propto \mu \sin\theta$$

RP ∝ Refractive index of the material of optical instrument

$$R.P \propto \frac{1}{\lambda}$$

The resolving power is inversely proportional to the wavelength of light used.

Resolving power of a microscope is defined as the shortest reciprocal of the minimum distance d between the two objects at which the images of the two objects can be seen distinct when seen through the microscope.

(22) Biot - Savart Law

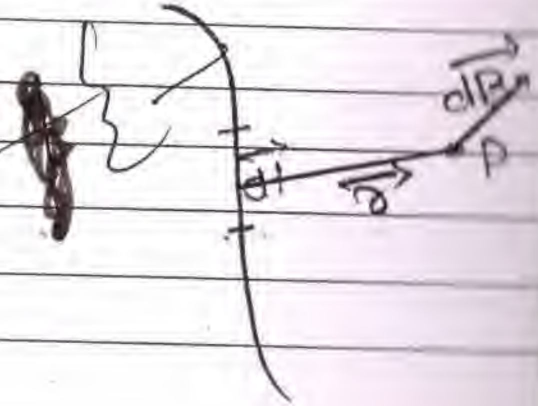
Biot Savart's Law states that the magnetic field due to a current element $d\vec{l}$ at a distance $\vec{r}$ from it is given by

$\vec{dB} \propto$ $dB \propto I$ $dB \propto dl$ $dB \propto \sin\theta$

$$dB \propto \frac{1}{r^2}$$

$$dB \propto \frac{I\,dl\sin\theta}{r^2}$$

$$dB = \frac{\mu_0}{4\pi}\frac{I\,dl\sin\theta}{r^2}$$

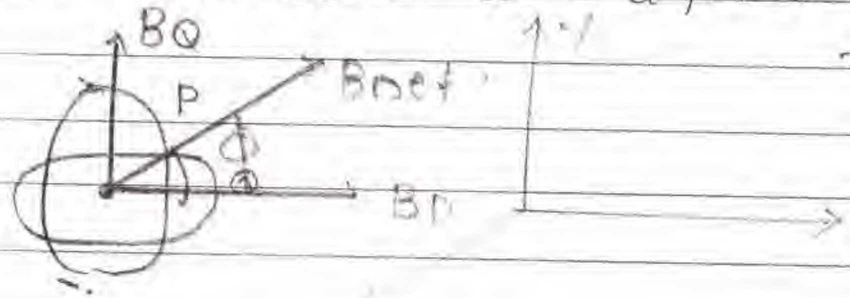


In vector form

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I (d\vec{l} \times \vec{r})}{r^3}$$

Biot Savart's law gives the magnetic field due to a current element at a point r distance from it.

(b)



The magnetic field due to the coil P at the centre

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

$$B_Q = \frac{\mu_0 I}{2R} = \frac{\mu_0 \times \sqrt{3}}{2R} = \frac{\sqrt{3}\mu_0}{2R}.$$

$$B_{net} = \sqrt{B_1^2 + B_2^2} = \sqrt{\frac{\mu_0^2}{4R^2} + \frac{3\mu_0^2}{4R^2}} = \sqrt{\frac{4\mu_0^2}{4R^2}}$$

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

The direction is along B_{net} making ~~45°~~ 60° with the B_P in the plane of the two coils.

$$\tan\phi = \frac{B_Q}{B_P} = \frac{\sqrt{3}H_0}{2R} \times \frac{2R}{H_0} = \sqrt{3}$$

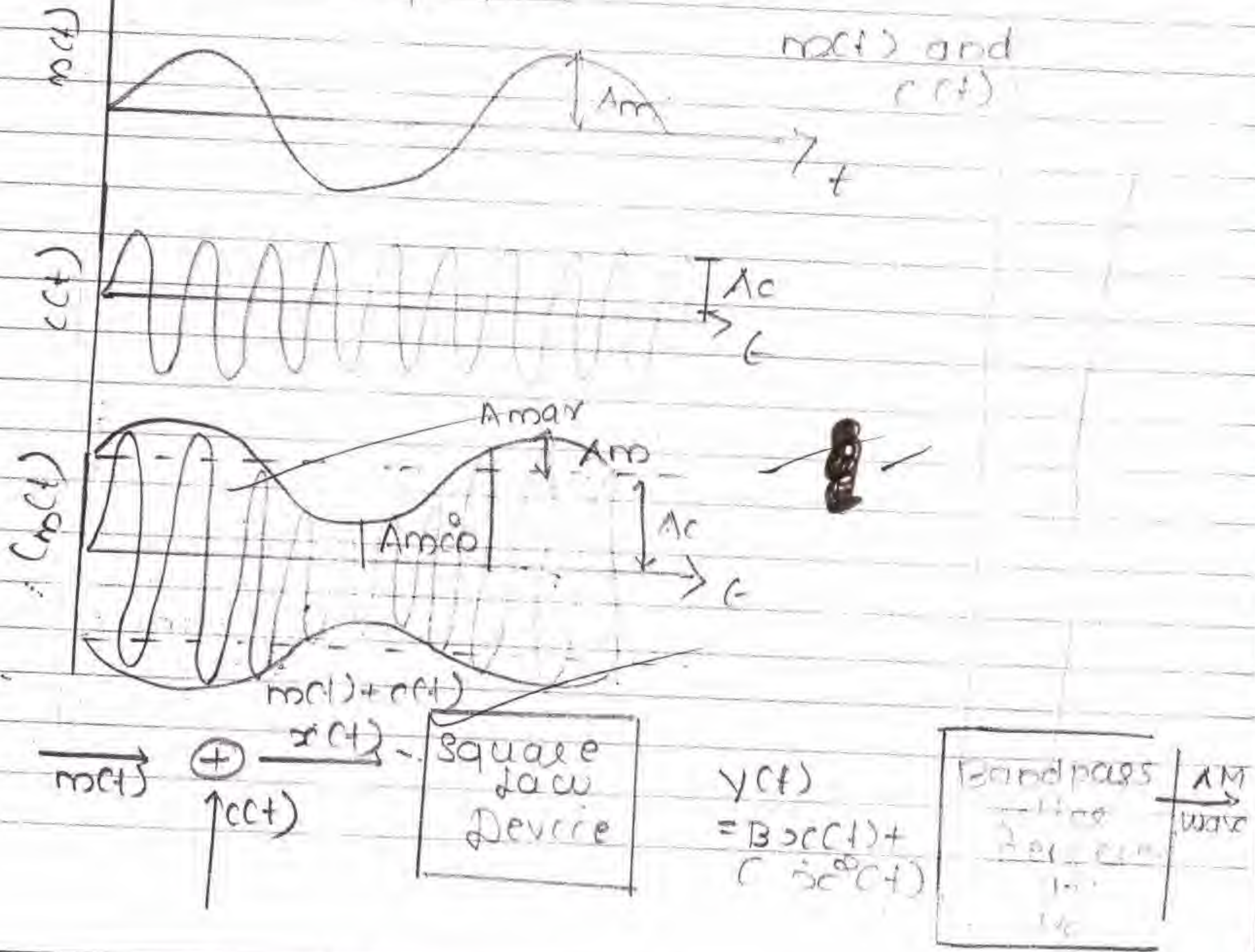
$$\phi = 60^\circ$$

B_{net} is making 60° with B_P, making 30° with B_Q. If reverse considered making 30° with B_Q and 60° with B_P. According to

20 Amplitude modulation is achieved by superimposing a low frequency message signal with a high frequency carrier wave of frequency f_c.

In amplitude modulation, the amplitude of a high frequency carrier wave is varied in accordance with the instantaneous values of low frequency message signal.

(b) Superposition of m(t) and c(t)



(b) ~~$f_c + f_m = 640$ KHz~~

~~$f_c - f_m = 60$~~

$f_c + f_m = 660$ KHz —— ①

$f_c - f_m = 640$ KHz —— ②

Adding ① and ②

$2f_c = 1300$ KHz

$f_c = \frac{1300}{2} = 650$ KHz Carrier signal frequency

$f_c + f_m = 660$ KHz

$f_m = 50$ KHz. Modulating signal frequency

$f_c + f_m - (f_c - f_m) =$ Bandwidth

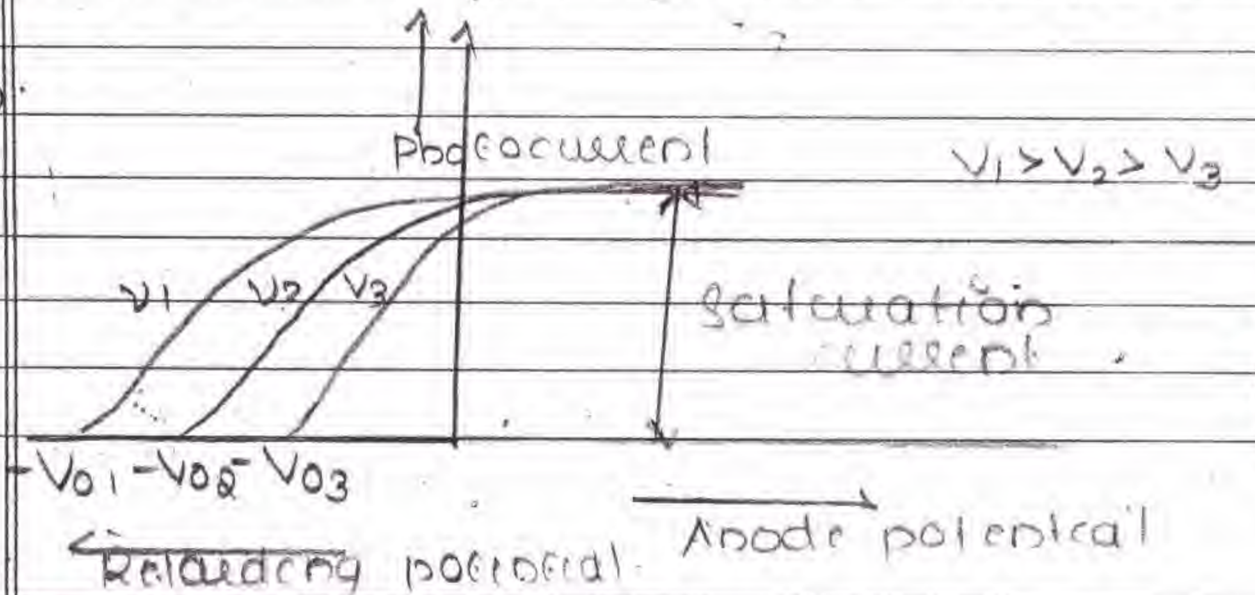
$= 660$ KHz $- 640$ KHz

20 KHz

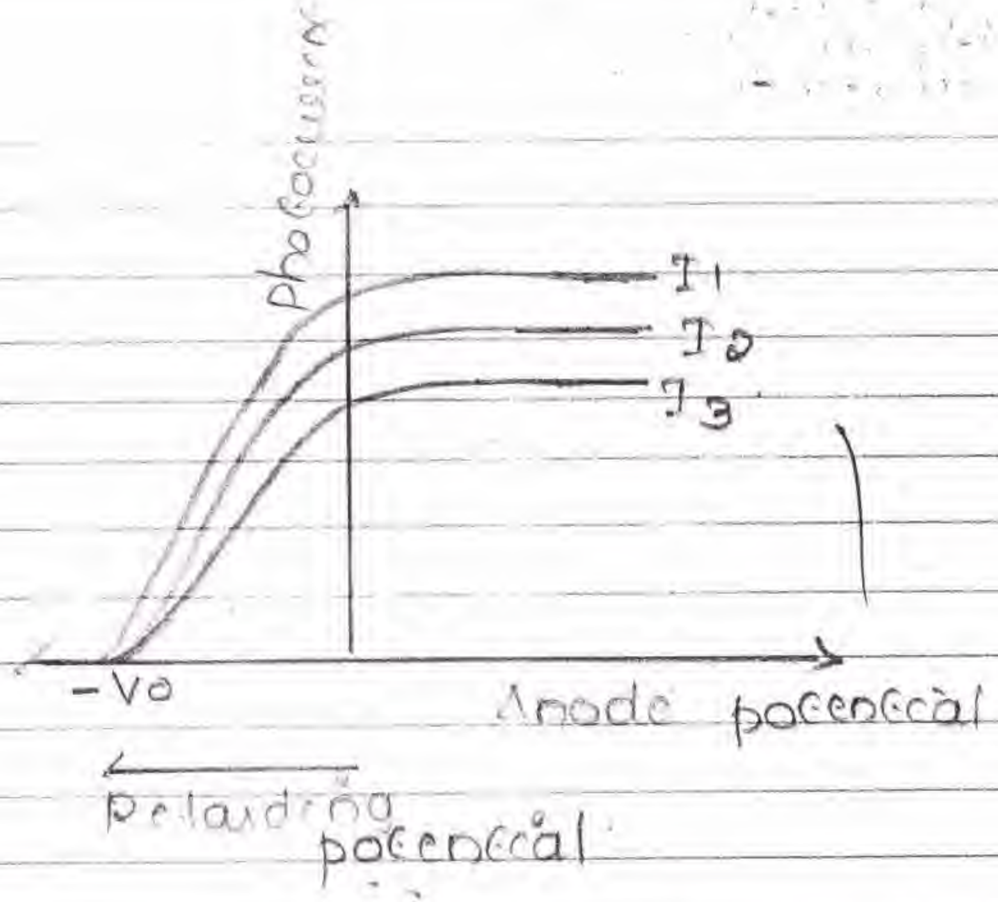
18. (a) The variable x is collector plate potential or Anode potential. On the other side, it is retarding potential.

(b) The point A represents stopping potential or cut off potential. The minimum negative potential at which the photocurrent becomes zero.

(c)



(d):



15 (a) Heat per second is $\frac{V^2}{R}$

Initially $H_1 = \frac{V_1^2}{R}$ The R is fixed.

Then $H_2 = 9H_1 = \frac{9V_1^2}{R} = \frac{V_2^2}{R} = \frac{(3V_1)^2}{R}$.

The potential difference is increased by a factor of 3.

(b) $V = \varepsilon - Ir$

Total current = $\frac{\text{Total emf}}{\text{Total resistance}}$

$= \frac{12}{2+4}$

$= \frac{12}{6} = 2A$

The ammeter reading is 2A

The voltmeter reading is $V = \varepsilon - Ir$

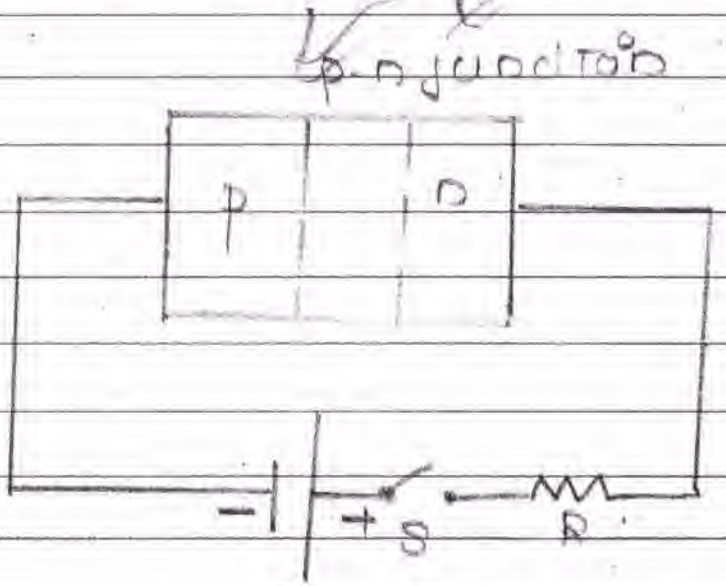
$= 12 - 2\times2$

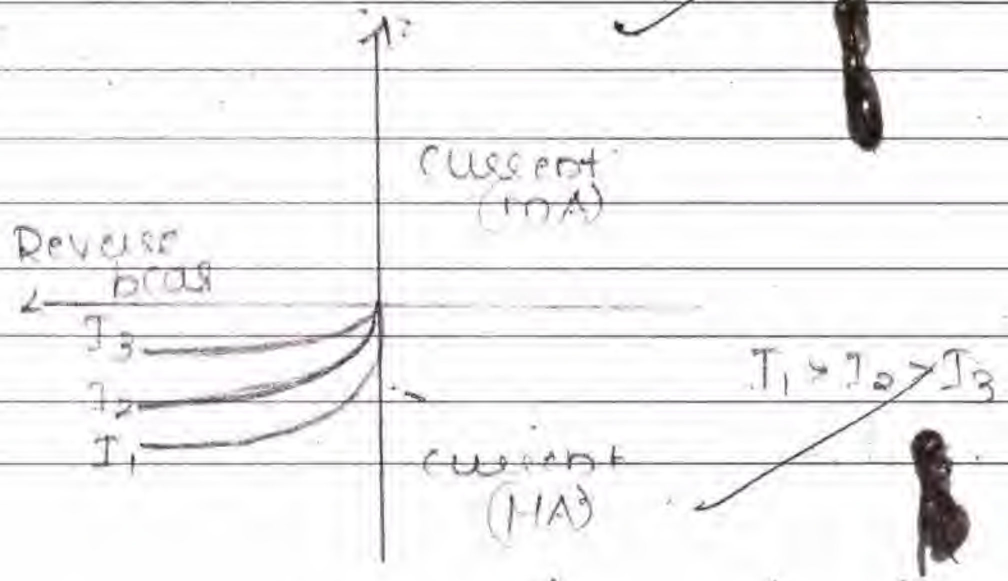
$= 12 - 4$

$= 8V$

21°

(b) Photodiode





(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–पुस्तिका (ओं) की संख्या
Supplementary Answer-Book(s) No.

In photodiode, the p-n junction diode is reverse biased. The bias voltage is kept below the reverse breakdown voltage. When the photons are incident on the p-n junction diode the electron hole pairs are generated. electrons move towards the n side and holes move towards the p side under the influence of an external electric field directed from n to p. A potential difference is set up across the junction and the photocurrent begins to flow through the current. The photocurrent is directly proportional to the intensity.

(a) When S is heated, the temperature increases. The resistivity decreases. The resistance of the circuit decreases. So more current tend to flow. In order to keep the current value as constant, the resistance R should be increased

So R is increased to keep the ammeter reading as constant.

19. Initially,

$$C_A^0 = \frac{\varepsilon_0 A}{d} = C \quad V_0$$

$$C_B^0 = \frac{\varepsilon_0 A}{d} = C \quad V_0$$

Later

$$C_A = K C_A^0 = KC$$

$$C_B = KC$$

Total electrostatic energy stored before dielectric

$= \frac{1}{2}C_A V_A^2 + \frac{1}{2}C_B V_B^2$

$\frac{1}{2} \times CV^2 + \frac{1}{2}CV^2$

$\times 2 \times \frac{1}{2}CV^2 = CV^2$

After across A

$\frac{1}{2} \times C_A \cdot V^2$

$\frac{1}{2} \times KC \times V^2$

$= K \times \frac{1}{2}CV^2$

across B $\frac{1}{2}C_B \times V_{new}^2$

$\frac{1}{2}C_B \times \frac{V_0^2}{K^2} = \frac{1}{2} \times KC \times \frac{V_0^2}{K^2}$

$\frac{1}{2}\frac{CV_0^2}{K} = \frac{1}{2}\frac{CV^2}{K}$

Total energy after insertion $= \frac{KCV^2}{2} + \frac{CV^2}{2K}$

$\frac{CV^2}{2}\left[K + \frac{1}{K}\right]$

$\frac{CV^2}{2}\left[\frac{K^2+1}{K}\right]$

Ratio is $= \frac{CV^2 \times 2K}{CV^2(K^2+1)}$

$= \frac{2K}{K^2+1}$

Section-D

23\. (a) The installation at Chernobyl was a nuclear reactor. In a nuclear reactor, nuclear fission or nuclear reaction takes place. Large amount of energy is released by this process. The large amount of energy may cause any sort of explosion. The fast moving neutrons are produced in the process and are also used. Some penetrating radiations are emitted by this process.

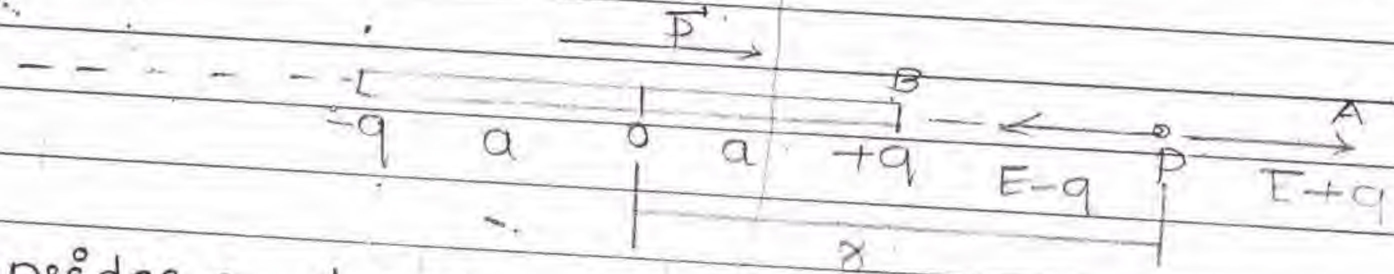
(b) The binding energies on the both sides i.e. reactants and products are different. In this process, a heavier nuclei disintegrates into two lighter nuclei with higher binding energy. These nuclei are stable as compared to the initial. So a large amount of energy is is released. The change in binding energy is released as the energy.

In nuclear fusion, the two lighter nuclei combine together to form a heavier nuclei. Here binding energy is ~~decreased~~ increased and a large amount of energy is released.

(c) Asha is very caring, very sensitive, handles physics very carefully, have much and deep knowledge. She is practical and kindhearted. She is genius and wise.

26 (a)

Section-E



Consider a dipole having dipole moment p. Electric field due to -q at the point P is along PB.

$$E_{-q} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r+a)^2} \text{ along PB}$$

Electric field due to +q at the point P is along PA.

$$E_{+q} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2} \text{ along PA}$$

The net electric field

$$= E_{+q} - E_{-q}$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2} - \frac{1}{4\pi\varepsilon_0}\frac{q}{(r+a)^2}$$

$$\frac{1}{4\pi\varepsilon_0} q\left[\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2}\right]$$

$$\frac{q}{4\pi\varepsilon_0}\left[\frac{(r+a)^2 - (r-a)^2}{(r^2-a^2)^2}\right]$$

$$\frac{q}{4\pi\varepsilon_0}\frac{4ar}{(r^2-a^2)^2}$$

$$\frac{2aq \cdot r \times 2}{4\pi\varepsilon_0(r^2-a^2)^2}$$

$$\frac{2pr}{4\pi\varepsilon_0(r^2-a^2)^2}$$ along PA.

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Electric field at point P is

$$E = \frac{1}{4\pi\varepsilon_0} \frac{2pr}{(r^2-a^2)^2}$$ in the direction of $\vec{P}$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{2\vec{P}r}{(r^2-a^2)^2}$$

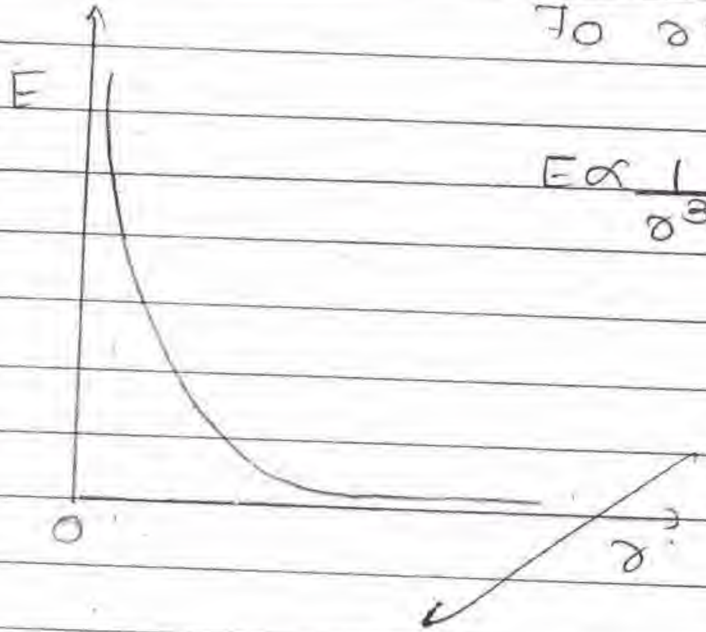
(b) For $r \gg a$

$$E = \frac{1}{4\pi\varepsilon_0} \frac{2pr}{r^4}$$

$$= \frac{1}{4\pi\varepsilon_0} \frac{2p}{r^3}$$

$$E \propto \frac{1}{r^3}$$

For $r >> a$



$E \propto \frac{1}{r^3}$

(c) When $\theta = 0$

energy $= -pE$

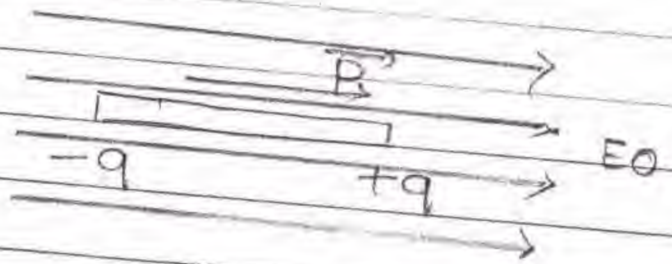
Torque $= 0$.

It is stable equilibrium

When dipole is in stable equilibrium

potential energy $P.E = -pE$

Torque $= 0$



$\vec{p}$ is parallel to $\vec{E_0}$

The dipole is placed parallel to the electric field.

In unstable equilibrium

$$\theta = 180^\circ$$

$$p \cdot E = -PE\cos 180$$

$$= -PE \times -1$$

$$= PE$$

potential energy is maximum

The dipole is placed antiparallel to the field

Torque

$\tau = P \times E$

$PE\sin\theta$

In I^{st} case $\tau = PE\sin 0$

$= 0$

In II^{nd} case $\tau = PE\sin 180$

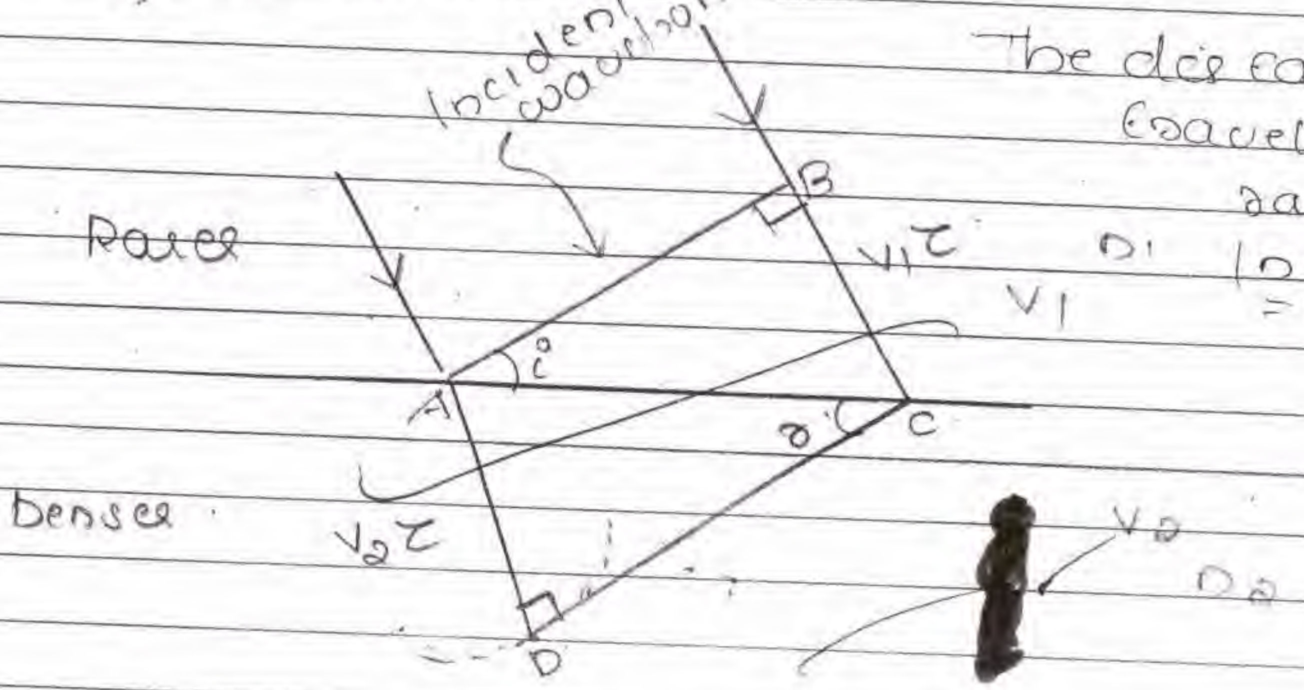
$= 0$

25(a) Wavefront: Wavefront is a locus surface having the locus of all points vibrating in the same phase. Wavefront is a surface of constant phase. The rays are always perpendicular to the wavefront.

Huygen's principle

Each point on the wavefront is a source of secondary disturbance and the wavelets emanating from all the points spread out in all directions with the speed of the wave.

When we draw a common tangent to all these spheres we obtain the new position of the wavefront at a time t.



The distance travelled in rarer $= v_1\tau$

In denser $= v_2\tau$

$n_1 < n_2$

$v_1 < v_2$

In Δ ABC, $\sin i = \frac{BC}{AC} = \frac{v_1\tau}{AC}$ —— ①

In Δ ADC, $\sin r = \frac{AD}{AC} = \frac{v_2\tau}{AC}$ —— ②

$\frac{①}{②} \Longrightarrow \frac{\sin i}{\sin r} = \frac{v_1\tau}{AC} \times \frac{AC}{v_2\tau} = \frac{v_1}{v_2} = \frac{n_2}{n_1}$

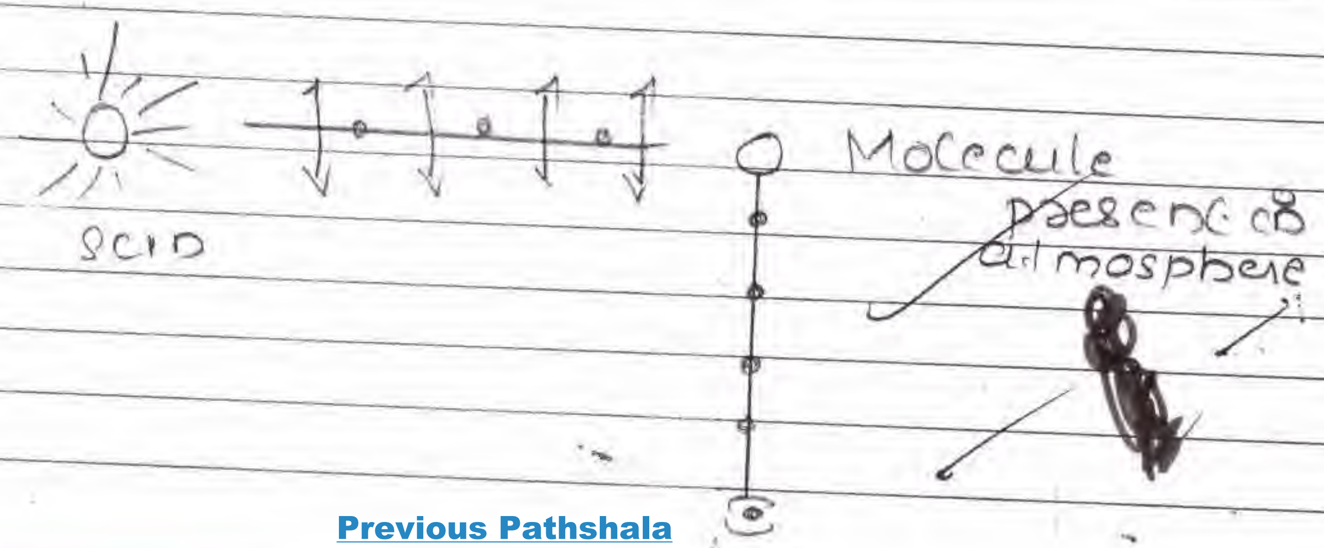
$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = \frac{v_1}{v_2}$$

$$\frac{\sin i}{\sin r} = n_{21}$$

This is Snell's law.

Also the refract: incident rays the refracted ray and the normal at the point of incidence which are perpendicular to incident wavefronts refracted wavefront and seperating surface all lie on the same plane.

(b)



The sunlight coming [illegible] the Sun is unpolarised. It contains vibrations in perpendicular and parallel directions. The electrons which are present in the scattering molecule only allows the vibration parallel to the double headed arrow to radiate energy towards the observer. The perpendicular components are absorbed.

According to Brewster law

$\tan i_p = \mu$

$1.5 = \tan i_p$

$\tan i_p = 1.5$

$i_p = \tan^{-1}(1.5)$

$^a n_g = 1.5$

Q4. Consider a coil rotating in a uniform magnetic field. The flux associated with the coil

$\phi = NBA\cos\theta$

The emf induced due to the flux change.

$\varepsilon = -\frac{d\phi}{dt} = -\frac{d}{dt}(NBA\cos\theta)$

$$-NBA \cdot \frac{d(\cos\phi)}{dt}$$

But the coil consists of N turns and also θ is a function of time θ = ωt

$$\text{So } \mathcal{E} = -NBA \frac{d(\cos\omega t)}{dt}$$

$$-NBA \times -\sin\omega t \times \omega$$

$$= NBA\omega\sin\omega t$$

$$= \mathcal{E}_0 \sin\omega t$$

$\mathcal{E} = \mathcal{E}_0 \sin\omega t$ where $\mathcal{E}_0$ is the maximum induced voltage or peak voltage

$$\mathcal{E}_0 = NBA\omega$$

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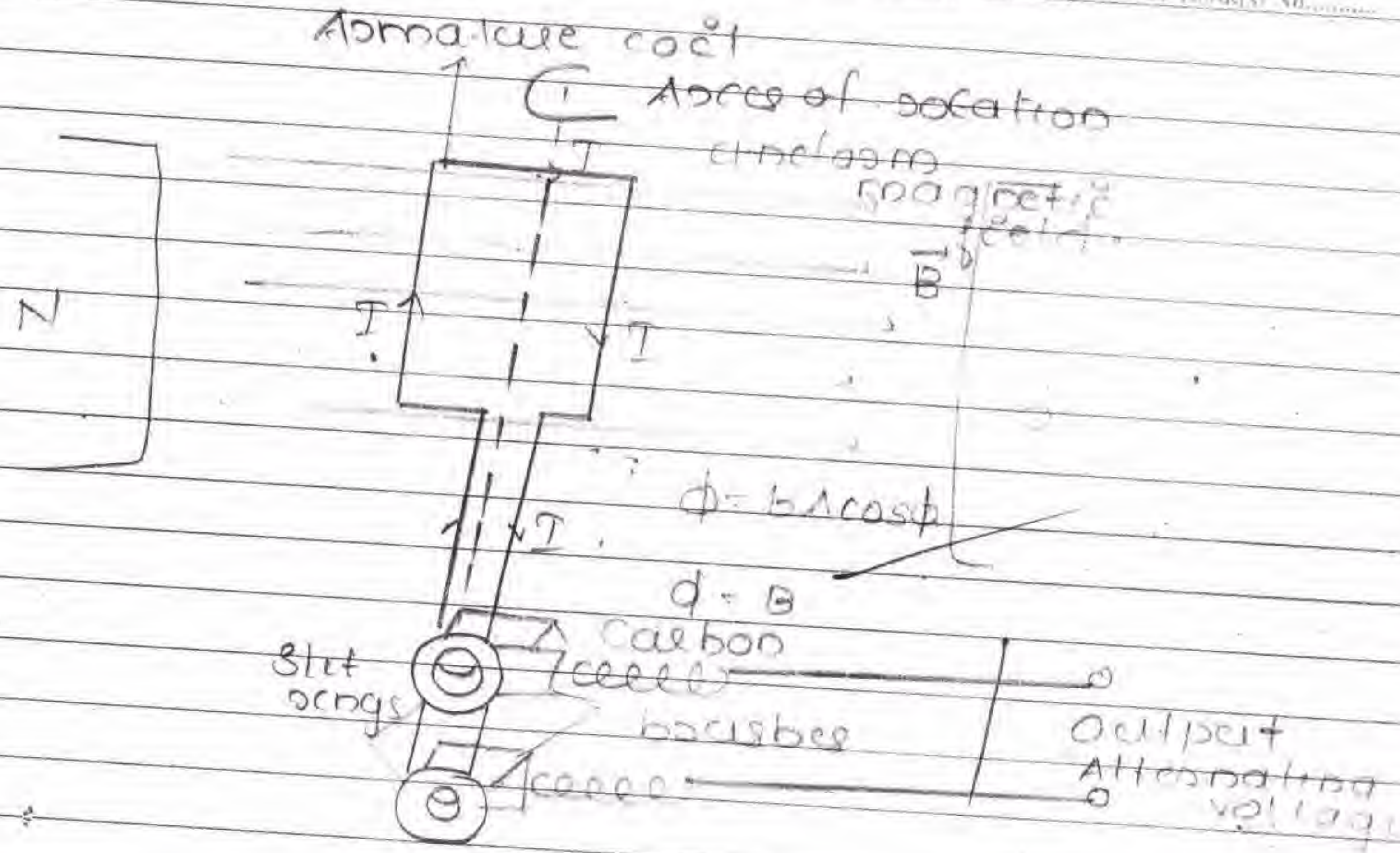

(b) The rod is moving perpendicular to the magnetic field
So

$\varepsilon = BlV$

$= 0.3 \times 10^{-4}\ Wbm^{-2} \times 10m \times 5ms^{-1}$

$= 0.3 \times 10^{-4} \times 10 \times 5\ V$

$= 1.5 \times 10^{-3}\ V$

Section – C

11.) (a) $\lambda = 589\ nm$

$= 589 \times 10^{-9} m$

The frequency of the refracted light is same as that of the incident light so $v = \frac{c}{\lambda}$

$v = \frac{3 \times 10^8}{589 \times 10^{-9}} = \frac{3 \times 10^8}{0.589 \times 10^{-6}} = \frac{3}{0.589} \times 10^{14} Hz$

$= \frac{3}{0.589} \times 10^{14}$ Hz $= 5.09 \times 10^{14}$ Hz

Wavelength is

$$\lambda' = \frac{\lambda}{\mu}$$

$$= \frac{589 \times 10^{-9} m}{1.33}$$

$$= \frac{5.89}{1.33} \times 10^{-7} m = 4.43 \times 10^{-7} m$$

Speed is

$$\frac{c}{v} = \mu$$

So $v = \frac{c}{\mu} = \frac{3 \times 10^{8}}{1.33} = 2.25 \times 10^{8}$ m/s

(b) $n = 1.55$

$R_1 = R \qquad R_2 = -R$

$f = 20$ cm

According to lens-maker's formula

$$\frac{1}{f} = (n_{21} - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\frac{1}{0.2} = (1.55 - 1)\left[\frac{1}{R} + \frac{1}{R}\right]$$

$$\frac{1}{0.2} = 0.55 \times \frac{2}{R}$$

$$\frac{1}{0.2} = \frac{1.1}{R}$$

$$R = 1.1 \times 0.2$$

$$= 0.22 m$$

$$= 22 cm$$