Section – A

A-1. Short wave broadcast services use sky wave propogation.

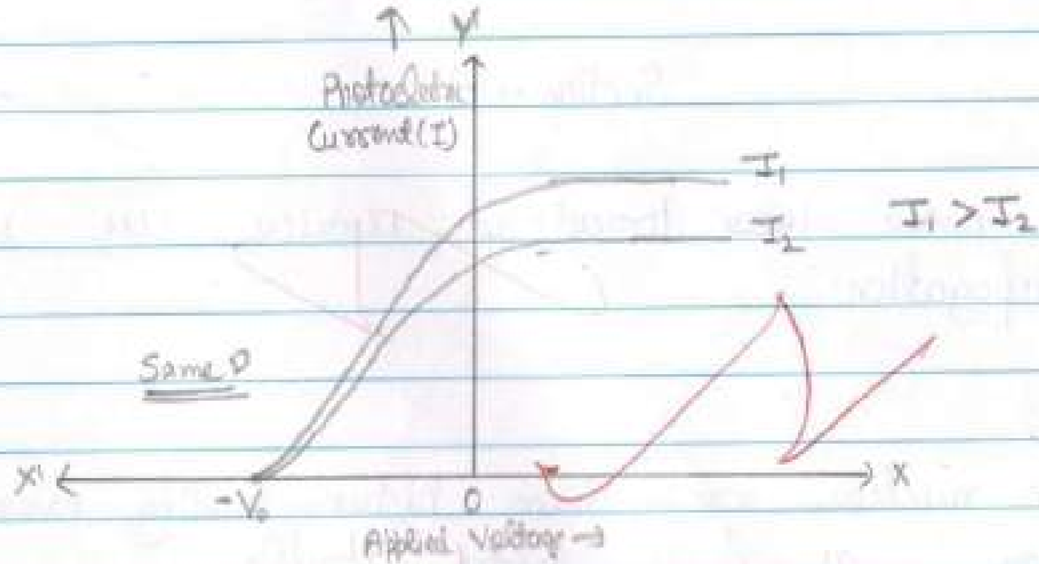
A-2. Daughter nucleus would have higher binding energy per nucleon, as it is more stable.

A-3. (a) UV Rays are used for water purification

(b) eye surgery requires high frequency waves like UV, X ray or γ rays.

A-4. Photoelectric current increases as the intensity of incident radiation increases.

4



A-5 We know that frequency ν is given by

$$\nu = \frac{qB}{2\pi m}$$

for a proton and electron entering the field, $q = e$, B is same for both

$$\Rightarrow \nu \propto \frac{1}{m}$$

i.e frequency is inversely proportional to mass.

Now, as $m_p > m_e \Rightarrow \nu_p < \nu_e$

Hence, electron will move in circular path with higher frequency.

A-6 Given: $A_c = 15\,V$ and modulation index $\mu = 60\% = \frac{60}{100}$

Now, we know that

$$\mu = \frac{A_m}{A_c}$$

$$\Rightarrow \frac{60}{100} = \frac{A_m}{15}$$

$$\Rightarrow A_m = 15 \times 0.6$$

$$\Rightarrow A_m = 9\,V$$

Hence, the peak voltage of modulating signal should be 9V in order to have a modulation index of 60%.

A-7 (2)

Given $\lambda = 412.5\, nm$

$= 412.5 \times 10^{-9}\, m$

Now, $E = \frac{hc}{\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{412.5 \times 10^{-9}}\, J$

$= \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{412.5 \times 10^{-9} \times 1.6 \times 10^{-19}}\, eV$

$= \frac{33 \times 3}{8 \times 4.125} \times 10^{-34+8+19+7}$

$= \frac{33}{8 \times 1.375} = \frac{4.125}{1.375}$

$= \frac{4125}{1375} = \frac{825}{275} = \frac{165}{55} = \frac{33}{11}$

$E = 3\, eV$

Now, for metals where $E > \phi$ will give photoelectric effect where ϕ is the work function

⇒ Na(1.92eV) and K(2.15eV) will give photoelectric emission when light of wavelength is incident on them.

A-8

2

Given, balancing point in open circuit = 350 cm

balancing point in closed circuit = 300 cm

where R(external resistance) = 9 Ω

Let K be the potential gradient

In ~~closed~~ open circuit, potentiometer measures Emf

$\Rightarrow E = Kl_1 = 350K$ — (1)

In closed circuit, potentiometer measures Voltage

$\Rightarrow V = Kl_2 = 300K$ — (2)

Now, $\frac{E}{R+r} = \frac{V}{R}$

$(E-V)R = Vr$

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

$\Rightarrow r = \left(\frac{350\cancel{K}}{300\cancel{K}} - 1\right) \times 9$

$= \frac{350-300}{300} \times 9$

$= \frac{50}{300} \times 9$

$= \frac{9}{6} = \frac{3}{2} = 1.5\,\Omega$

Hence internal resistance of the cell is $1.5\,\Omega$

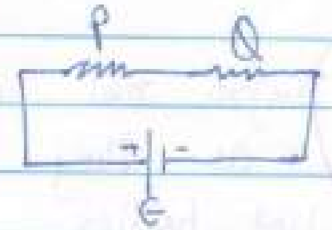
A-9 (a) Infra red waves are often called as heat waves as they are produced by moderately warm and hot bodies or by vibrating molecules about their mean position.

(b) "Electromagnetic waves transport momentum" as they travel from one place to another they carry along with them momentum and energy where momentum p is given by

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

10

A-10 Given $R_P : R_Q = 1:2$



let the ratio be k

$\Rightarrow R_P = k \times 1 = k$

$R_Q = k \times 2 = 2k$

Now, as in a series circuit current remains same in both the bulbs.

$Power_P : Power_Q$

$I^2 R_P : I^2 R_Q$

$= R_P : R_Q$

$= k : 2k$

$= \underline{1:2}$

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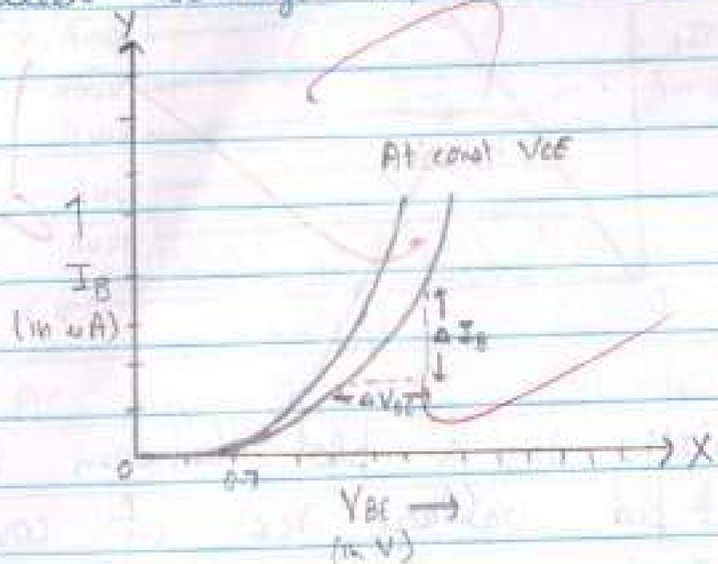
A-11 (b)

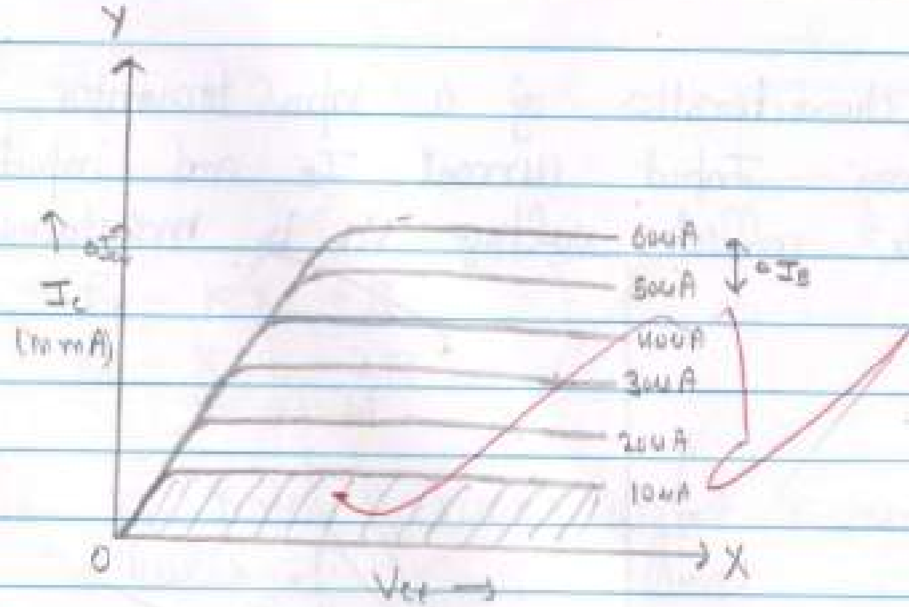
Input characterstics of a npn transistor is a plot between Input current I_B and input voltage V_{BE} while collector voltage V_{CE} is maintained constant.



Input resistance $R_i = \left(\frac{\Delta V_{BE}}{\Delta I_B}\right)_{V_{CE}}$

(a) Input resistance can be calculated by measuring the change in V_{BE} with respect to I_B, as shown in graph. with R_i is given by

$R_i = \left(\frac{\Delta V_{BE}}{\Delta I_B}\right)_{V_{CE}}$



Output characteristics is a plot between output current I_C and out put voltage V_{CE} at constant input Base current I_B

(b) Current amplification factor β is given by

$$\beta = \frac{\Delta I_C}{\Delta I_B}$$

Two corresponding lines from output characteristics can be choosen and change in base current ΔI_B can be found and corresponding to it change in collector current can be found.

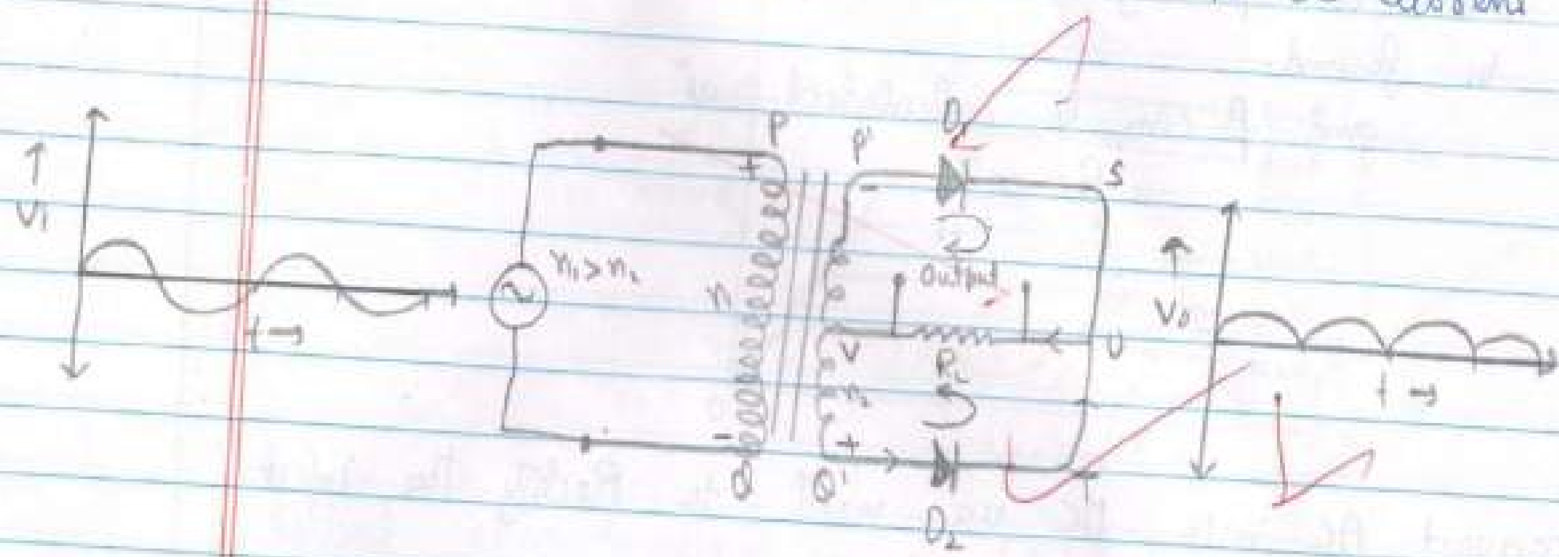
and β can be calculated as

$$\beta = \frac{\Delta I_c}{\Delta I_B}$$

A-12 (a) To convert AC into DC we need to Rectify the input voltages.

As two pn junctions are to be used, a full wave rectifier is a suitable device.

Principle — A full wave rectifier is based upon the principle that a pn diode conducts in forward bias and do not conduct in reverse bias. thus it can be used to convert AC voltage or current to DC current suitably.



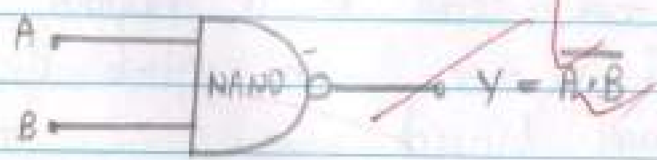
A step down transformer is used and it is central tapped such that only one diode conducts during one half of AC cycle and direction of flow of current through load is same in both the half cycles.

When the positive half cycle of input voltage pass say end P is +ve and Q is negative thus end P' will be -ve and Q' will be +ve and diode D_1 will conduct as it gets forward biased.

During negative half cycle of input ac P will be negative and Q positive thus, Q' will be negative and P' positive and the diode conducts this time will be D_2 as it gets forward biased.

In both the positive and negative half cycles of input AC we get the direction of flow of current as same and thus a pulsating D.C output is obtained.

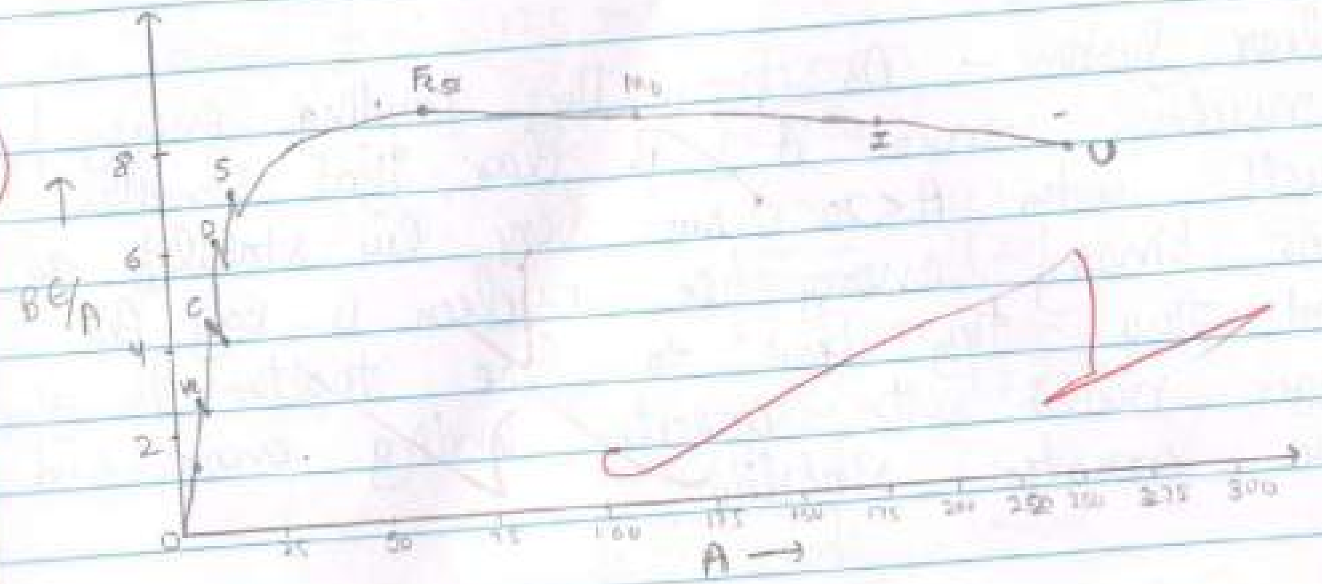
(b) NAND Gate $Y = \overline{A \cdot B}$



Truth table →

A	B	$Y=\overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

A-13



Nuclear fission → Heavier nuclei undergo nuclear fission to form two ~~stoo~~ stable daughter nuclei

As from the Binding energy per nucleon curve it is clear that for A>120 the binding energy per nucleon starts decreasing i.e. ~~they~~ their stability start decreasing and they tend to split themselves into smaller nuclei with greater binding energy per nuclei of range 20<A<120.

Nuclear fusion → As from the Binding energy per nucleon curve it is clear that smaller nuclei with $A<20$ have very less stability as their binding energy per nucleon is very less and thus they tend to fuse together to give bigger nuclei with greater binding energy and thus greater stability

(b) Given $T_{1/2} = 10$ years

Now, activity $R = \lambda N$

Also $\frac{R}{R_0} = \left(\frac{1}{2}\right)^n$ where n = no. of half life.

Now, given $R = 3.125\%$

$$\Rightarrow \frac{R}{R_0} = \left(\frac{3.125 R_0}{100 \times R_0}\right) = \left(\frac{1}{2}\right)^n$$

$$= \frac{3125}{100000} = \left(\frac{1}{2}\right)^n$$

$$= \frac{625}{20000} = \left(\frac{1}{2}\right)^n$$

$$= \frac{125}{4000} = \left(\frac{1}{2}\right)^n$$

$$\Rightarrow \frac{5}{80} = \left(\frac{1}{2}\right)^n$$

$$\Rightarrow \frac{1}{16} = \left(\frac{1}{2}\right)^n$$

$$\Rightarrow \left(\frac{1}{2}\right)^4 = \left(\frac{1}{2}\right)^n$$

$$\Rightarrow \boxed{n = 4}$$

$$\frac{25}{800} = \left(\frac{1}{2}\right)^n$$

$$\frac{5}{160} = \left(\frac{1}{2}\right)^n$$

$$\frac{1}{32} = \left(\frac{1}{2}\right)^n$$

$$\Rightarrow \left(\frac{1}{2}\right)^5 = \left(\frac{1}{2}\right)^n$$

$$\Rightarrow n = 5$$

Hence, 5 half life are required to reduce activity to 3.125%

$\Rightarrow$ Time taken $= T_{1/2} \times n$

$= 10 \times 5 = 50$ years

3

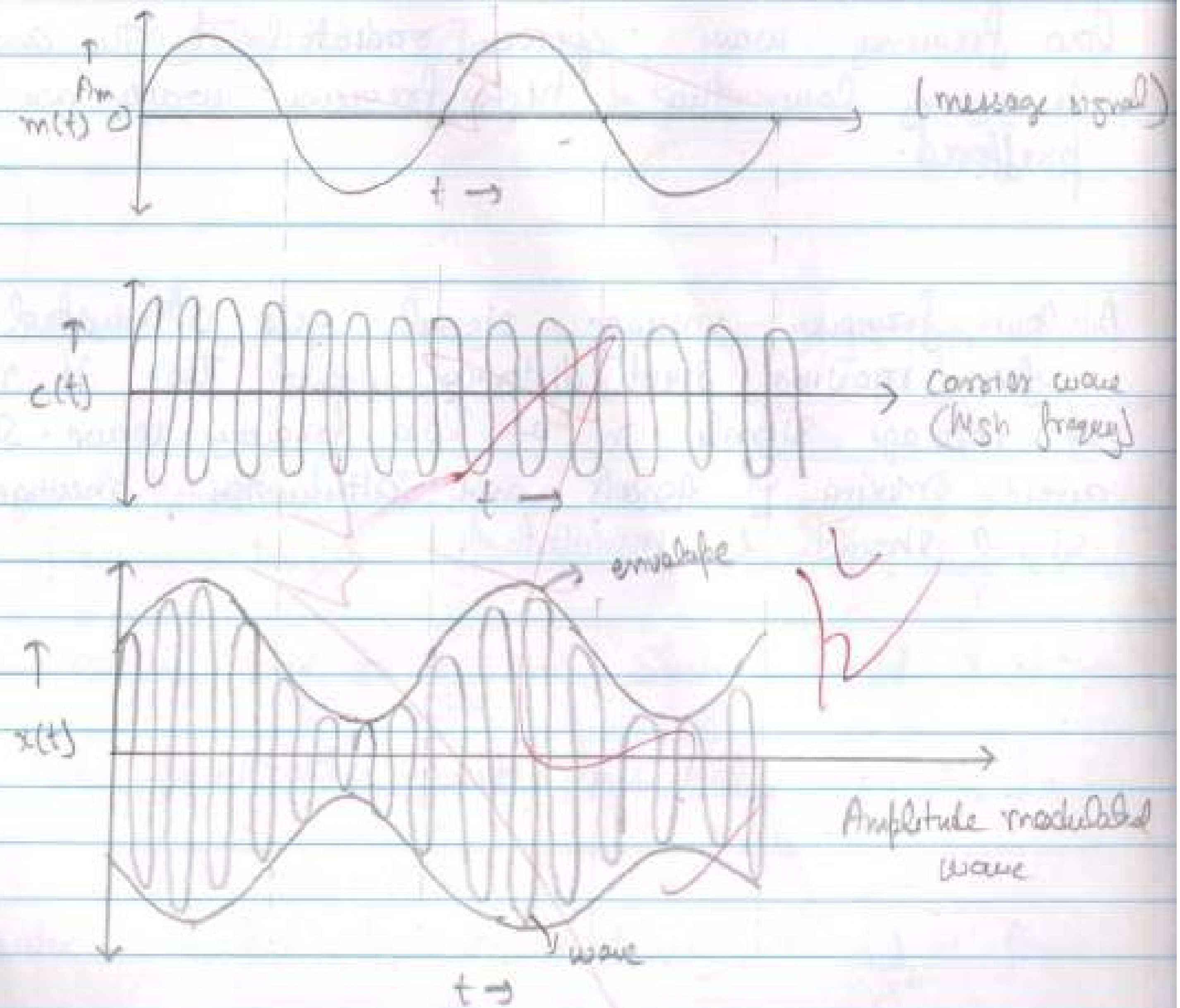
A-14 (a) Modulating a message signal is very important due to the following reasons

(i) Practical height of antenna — For a wave of about 20kHz frequency height of antena required is $\frac{\lambda}{4}$ which is nearly equal to 3.75 Km. Such a height of antenna is not practically possible and not economically feasible

(ii) Power radiated by an antenna is $\propto \frac{1}{\lambda^2}$, for a low frequency wave, power radiated by the antenna is very low, thus high frequency waves are preffered.

(iii) A low frequency message signal gets attenuated after moving short distance and there is mixing of message signals in a low frequency wave. So to avoid mixing of signals and attenuation, message signal should be modulated.

(b)


Am
m(t)
0
t →
(message signal)
c(t)
t →
Carrier wave
(high frequency)
envelope
x(t)
t →
wave
Amplitude modulated
wave

A-15 (a) We know that $\frac{I_1}{I_2} = \frac{a_1^2}{a_2^2} \Rightarrow \frac{a_1}{a_2} = \sqrt{\frac{I_1}{I_2}} = K$

3

Also, $\frac{I_{max}}{I_{min}} = \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2$

$= \left(\frac{a_1/a_2 + 1}{a_1/a_2 - 1}\right)^2$

$\Rightarrow \frac{I_{max}}{I_{min}} = \left(\frac{K+1}{K-1}\right)^2$

Now, let $I_1 = I$ as slit S_1 is covered with glass $I_2 = \frac{I}{2}$

$\Rightarrow \frac{I_1}{I_2} = \frac{I}{I/2} = 2 = K^2$

$\Rightarrow K = \sqrt{2}$

$\Rightarrow \frac{I_{max}}{I_{min}}$ becomes

$$= \left(\frac{\sqrt{2}+1}{\sqrt{2}-1}\right)^2$$

$$= \frac{2+1+2\sqrt{2}}{2+1-2\sqrt{2}}$$

$$\boxed{\frac{I_{max}}{I_{min}} = \frac{3+2\sqrt{2}}{3-2\sqrt{2}}}$$

(b) If monochromatic light is replaced with white light then the fringes formed due to various constituent colours will overlap. In the center we will get a bright white ~~fos~~ maxima, on moving further on both sides coloured fringes will be obtained.

A-16 (a) Bohr stated that electrons are permitted to revolve in only those orbits whose angular momentum is an integral multiple of $\frac{h}{2\pi}$

3

such that $mvr = \frac{nh}{2\pi}$ where n is a integer.

De Broglie's Hypothesis explained the stability of these orbits using dual nature of matter. He considered electrons to be matter wave such that their wavelength λ is given by

$$\lambda = \frac{h}{mv} \quad \text{--- (1)}$$

Now, as stationary waves are formed due to orbital motion of electrons, the circumference of

The orbit should be an multiple of wavelength of electron that is.

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

Now, λ from (1) $= \frac{h}{mv}$

$$\Rightarrow 2\pi r = \frac{nh}{mv}$$

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

This is the same condition which Bohr stated and thus DeBroglie explained it.

(f) We know that $E_3 - E_1 = \frac{-13.6}{n_2^2} - \frac{(-13.6)}{(n_1)^2}$ eV

$= \frac{-13.6}{(4)^2} + \frac{13.6}{1^2}$

$= 13.6 - \frac{13.6}{16}$

$= 13.6 - 0.85$

$= 12.75$ eV

Now, $E = h\nu$

$\Rightarrow 12.75 \times 1.6 \times 10^{-19}$ J $= h\nu$

$\Rightarrow \nu = \frac{12.75 \times 1.6 \times 10^{-19}}{6.6 \times 10^{-34}}$

$= \frac{12.75 \times 8}{33} \times 10^{15}$

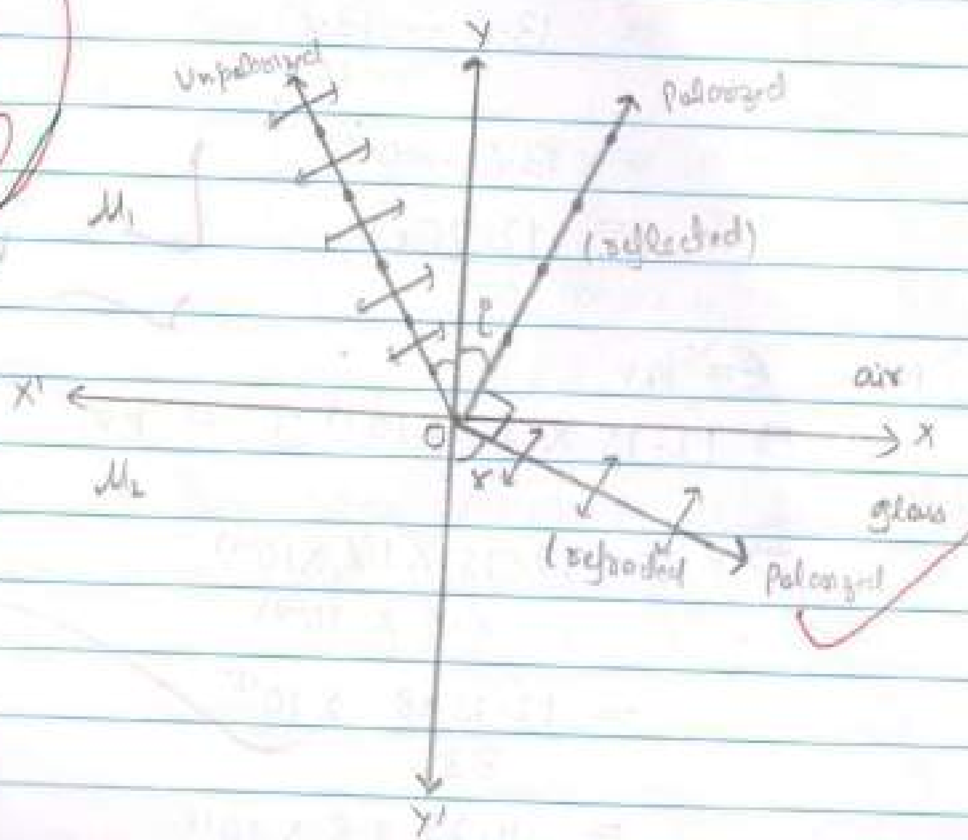
$= \frac{4.25}{11} \times 8 \times 10^{15}$

$= \frac{42.5}{11} \times 8 \times 10^{14}$

13.60
0.85
12.75

$3.8 \times 8 \times 10^{14}$
$= 30.4 \times 10^{14}$
$= 3.04 \times 10^{15}\ Hz$

A-17 (a) 3

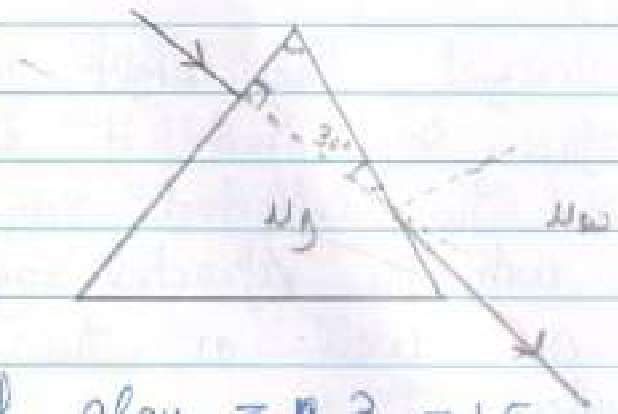


When an unpolarized light is incident on a plane surface such that it reflects as well as refracts and the reflected ray makes an angle of 90° with the refracted ray, then both the reflected as well as the refracted ray are plane polarized.

Condition for this is given by Brewster's law which says that the tangent of angle of incidence should be equal to the relative refractive index of the separating media then the light will be plane polarized.

$$\tan i_B = \mu_{21}$$

(b)



ref. index of glass $= \frac{3}{2} = 1.5$

ref index of water $= \frac{4}{3} = 1.33$

Now, $\theta_{ic} = \sin^{-1}\left(\frac{1}{\mu}\right)$

Using snells law, $r = 90°$

$\mu_g \sin i_c = \mu_w \sin r$

$\Rightarrow \mu_g \sin i_c = \mu_w \sin 90°$

$\frac{3}{2} \sin i_c = \frac{4}{3}$

$\sin i_c = \frac{8}{9} \Rightarrow i_c = \sin^{-1}\frac{8}{9}$

$= \sin^{-1} 0.9$

i.e $> 30°$

⇒ ~~as angle of i~~

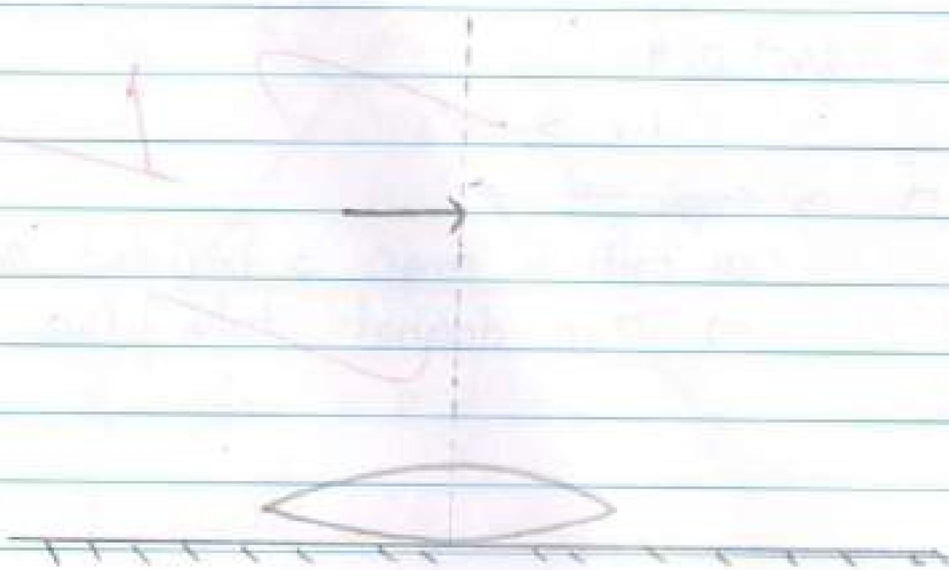
as critical angle > incident angle

⇒ TIR doesnot take place

1

A-18

2018



Given, R = Rad. of curvature, $\mu_g = 1.5$

$$\Rightarrow \frac{1}{f} = (\mu - 1)\left[\frac{1}{R} - \left(-\frac{1}{R}\right)\right]$$

$$= (1.5 - 1)\frac{2}{R}$$

$$= \frac{1}{R} \Rightarrow \boxed{f = R}$$

0902

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Supplementary Answer-Book(s) No. 1

Now, ~~the~~ ~~[illegible]~~
When image is formed at R then only it is of same size

in case of liquid ~~Rea~~ $x = \mu R$ —(1)

when liquid is removed.

$y = R$ —(2)

$\Rightarrow \frac{x}{y} = \frac{\mu R}{R}$

$\Rightarrow \boxed{\frac{x}{y} = \mu}$

2018

Q.11 (a)

Given no. of turns per unit length $= n$

current flowing $= I$

relative permiability $= \mu_r$

Now, using Ampere circuital law

$$\oint \vec{B} \cdot \vec{dl} = \mu I' \quad \text{---(1)}$$

I' = total current

$= n(2\pi r) I$

Now, $\mu = \mu_0 \mu_r$

where $n(2\pi r)$ = No. of turns

eqn (1) becomes.

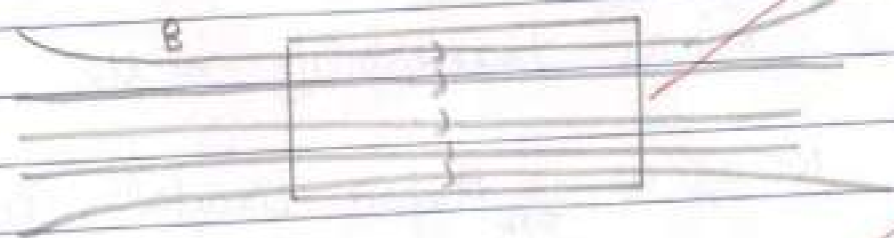
$$\oint \vec{B}\cdot\vec{dl} = \mu_0 \mu_r \times n \times 2\pi r \times I$$

$$B(2\pi r) = \mu_0 \mu_r \times n \times 2\pi r \times I$$

$$\Rightarrow \boxed{B = \mu_0 \mu_r n I}$$

2018

(b) Given $X = 0.9853$, material is paramagnetic



Magnetic field lines tend to pass through it then through

A-20 Given $M = 6 J/T$

$\theta = 60^\circ$

$B = 0.44 T$

3

(a) (i) $\theta_1 = 60^\circ$ $\theta_2 = 90^\circ$

$W = ~~pE[\cos\theta_1 - \cos\theta_2]~~$

$\Rightarrow MB[\cos\theta_1 - \cos\theta_2]$

$= 6 \times 0.44 [\cos 60^\circ - \cos 90^\circ]$

$= 6 \times 0.44 \times \frac{1}{2}$

$= 3 \times 0.44$

$= \underline{1.32 J}$

(ii) opposite to magn field $\Rightarrow$ $\theta_1 = 60^\circ$ $\theta_2 = 180^\circ$

$\Rightarrow W = ~~pE~~ \; MB[\cos 60^\circ - \cos 180^\circ]$

$= 6 \times 0.44 \times \left(\frac{1}{2} + 1\right)$

$= \frac{3}{2} \times 6 \times 0.44 = 3 \times 1.32 = \underline{3.96 J}$

(b) Torque on magnet when $\theta = 180^\circ$

$$= mB\sin\theta$$
$$= mB\sin 180^\circ$$
$$= 0$$

It is in unstable equilibrium.

201

21

(a) We know that $V = IR$

$$V = \rho \frac{l}{A} I$$

$$\sigma V = \frac{l}{A} I$$

$$\sigma = \frac{I}{V} \cdot \frac{l}{A}$$

Conductivity of metallic wire may be defined as ability to allow electric current to pass through it.
Its SI Unit is $\Omega^{-1} m^{-1}$

(b) Consider a conductor of length l and cross section area A.

Now, we know that

$$I = nAeV_d$$

$$I = \frac{nAe^2E\tau}{m} \qquad \because V_d = \frac{eE\tau}{m}$$

$$= \frac{nAe^2(El)\tau}{ml}$$

$$I = \frac{nAe^2\tau V}{ml}$$

$$V = \frac{ml}{nAe^2\tau} \times I$$

or $R = \frac{ml}{nAe^2\tau}$

But $R = \frac{\rho l}{A}$

$$\Rightarrow \frac{\rho l}{A} = \frac{ml}{ne^2\tau A}$$

$$\rho = \frac{m}{ne^2\tau}$$

$$\frac{1}{\sigma} = \frac{m}{ne^2\tau}$$

$$\Rightarrow \boxed{\sigma = \frac{ne^2\tau}{m}}$$

Now,

$$V = IR$$

$$V = I\rho\frac{l}{A}$$

$$V = J\rho l$$

$$\frac{V}{l} = \frac{J}{\sigma}$$

$$E = \frac{J}{\sigma}$$

$$\Rightarrow \boxed{J = \sigma E}$$

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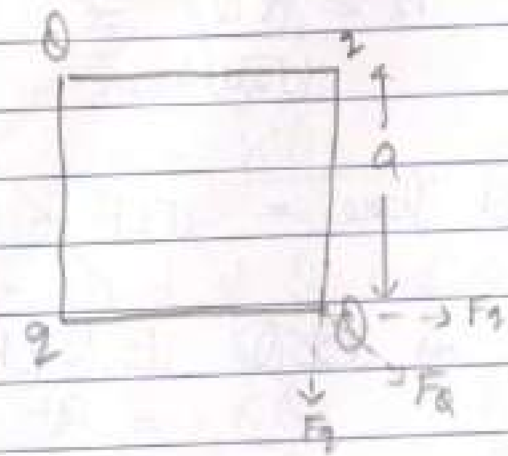
Q. 11.



(a) Force on Q acts due to q, q and Q

as the force due to both q are equal with angle of 90°

⇒ ~~Resultan~~ Resultand Force F is given by

$\sqrt{F^2 + F^2} = \sqrt{2}F$ (acts along diagonal)

where $F = \frac{KQq}{a^2}$

Now, force due to Q acts along diameter

$$\Rightarrow F_Q = \frac{KQ^2}{(\sqrt{2}a)^2} = \frac{KQ^2}{2a^2}$$

$\Rightarrow$ Net force $= \sqrt{2}F + F_Q$ (as they act along diameter)

$$\Rightarrow \frac{\sqrt{2}Qqk}{a^2} + \frac{KQ^2}{2a^2}$$

$$= \frac{K(2\sqrt{2}Qq + Q^2)}{2a^2}$$

$$= \frac{KQ}{2a^2}\left[2\sqrt{2}q + Q\right] N$$

along the diameter away from charge Q.

where $k = \frac{1}{4\pi\varepsilon_0}$

(ii) Potential energy of system is given by,
let first Q be brought

$\Rightarrow F_Q = 0$ — (1)

When q is brought in field of q,

$$W_1 = \frac{KQq}{a} \quad \text{— (2)}$$

When q is brought in field of Q and q

$$W_2 = \frac{KQq}{a} + \frac{Kq^2}{\sqrt{2}a} \quad \text{— (2)}$$

When Q is brought in field of q, q and Q

$$W_3 = \frac{KQ^2}{(\sqrt{2}a)} + \frac{KQq}{a} + \frac{KQq}{a} \quad \text{— (3)}$$

Now, Net work done $= W_1 + W_2 + W_3$

$\frac{1}{2}$

$$= \frac{4KQ_2}{a} + \frac{Kq^2}{\sqrt{2}a} + \frac{KQ^2}{\sqrt{2}a} \quad \text{when } K = \frac{1}{4\pi\varepsilon_0}$$

A-23 (a) Transformer can be used to step up and step down voltages.

4/5

Loss in the form of heat due to current in the copper windings called copper loss given by I^2R as even copper windings have some resistance and heat is dissipated.

(b) As AC voltage can be stepped up and step down we step up AC voltage such that V increases and I as power remains constant Is decreases and as loss of power is given by I^2R as I decreases loss of power also decreases but DC voltage on the other hand can't be stepped up or stepped down and loss of power or energy is maximum.

(c) Geeta was curious and a patient listner while ~~Geeta~~ Geeta's teacher was generous and ~~kno~~ knowledgable.

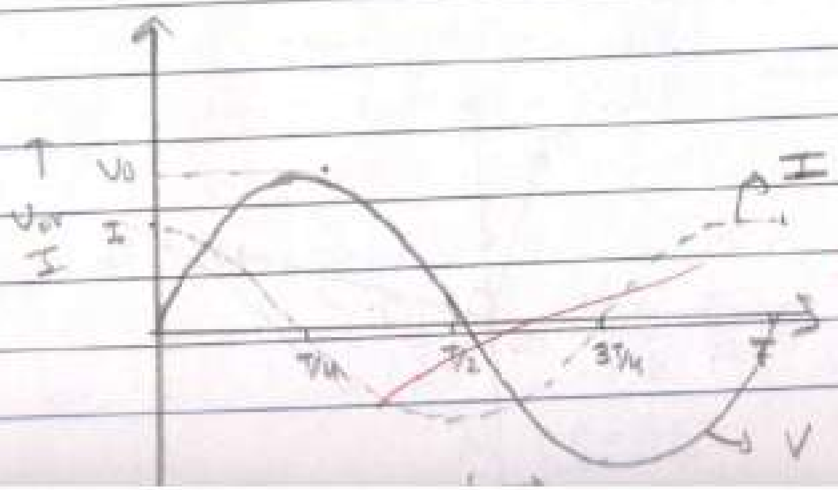
24(a) As current leads the applied voltage, X is a capacitor

$V = V_0 \sin\omega t$

$I = I_0 \sin(\omega t + \pi/2)$

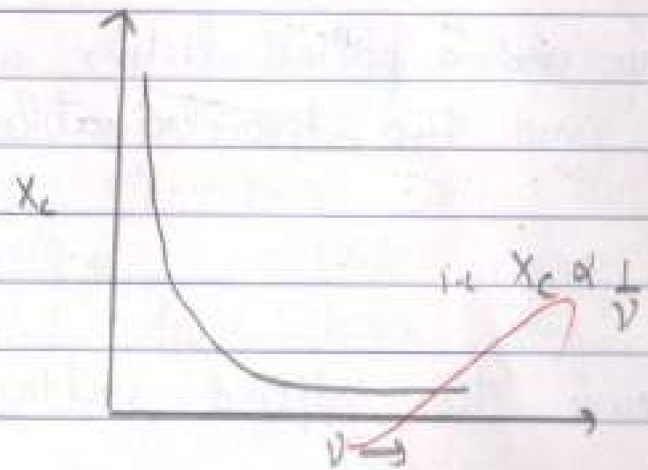
$= I_0 \cos\omega t$

(b)

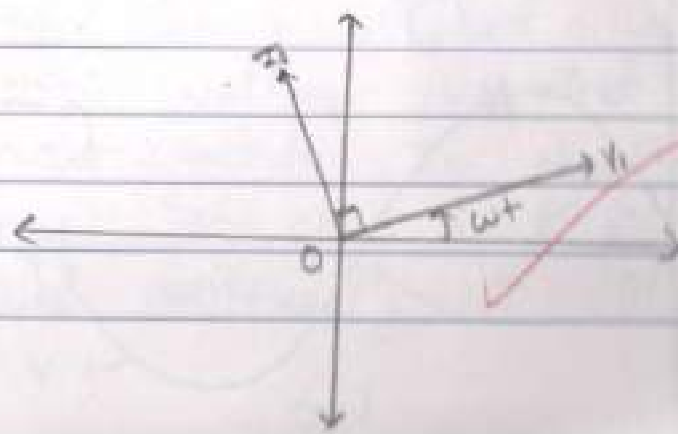


(c) We know that $X_c = \frac{1}{\omega C} = \frac{1}{2\pi\nu C}$

i.e $X_c \propto \frac{1}{\nu}$



(d)



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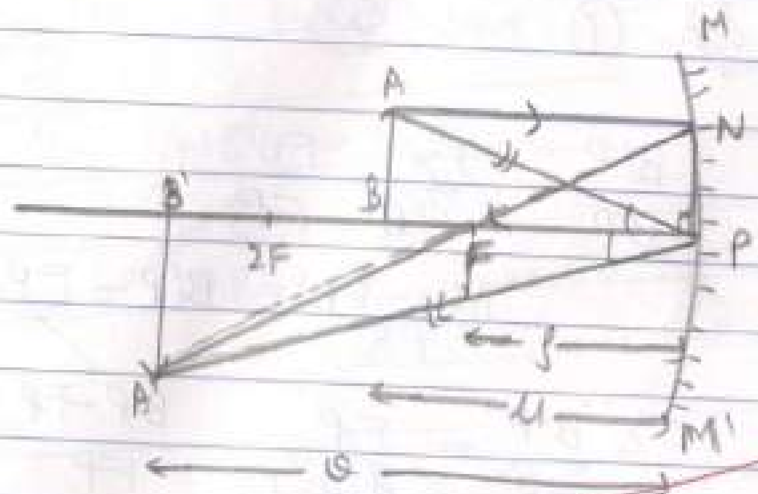
A-25 10(a)



(b) In order to derive the mirror formula consider the above ray diagram,

Now, Δ ABP $\sim$ A'B'P (By AA)

$$\Rightarrow \frac{A'B'}{AB} = \frac{B'P}{BP} \quad \text{--- (1)}$$

Also from Δ FNP $\sim$ Δ A'B'F (By AA)

$$\frac{A'B'}{NP} = \frac{FB'}{FP} \quad \text{--- (2)}$$

As NP = AB

from ① and ②

$$\frac{B'P}{BP} = \frac{FP}{FB'} \quad \frac{FB'}{FP}$$

Also $FB' = B'P - FP$

$$\Rightarrow \frac{B'P}{BP} = \frac{FP}{B'P - FP} \quad \frac{B'P - FP}{FP}$$

Now, $B'P = -v$, $FP = -f$

$BP = -u$

$$\Rightarrow \frac{-v}{-u} = \frac{-f}{-v+f} \quad \frac{-v+f}{-f}$$

$$vf = uv - uf$$

$$(v+u)f = uv$$

$$\Rightarrow \boxed{\frac{1}{f} = \frac{1}{v} + \frac{1}{u}}$$

0902

Fictitious Roll No.
(To be entered by Board)

01103906

अपना अनुक्रमांक 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.........

CBSE

Also from (1)

$$\frac{A'B'}{AB} = \frac{B'P}{BP}$$

$A'B' = -h'$, $AB = h$

$B'P = -v$, ~~BB~~ $BP = -u$

$$\Rightarrow \frac{-h'}{h} = m = \frac{-v}{-u}$$

$$\Rightarrow \boxed{m = \frac{h'}{h} = \frac{-v}{u}}$$

(c) (i) In reflecting telescope, chromatic abberation is reduced as use of mirror doesn't scatter colour.

(ii) Spherical abberation is reduced by use of parabolic mirrors as they converge rays to focus.

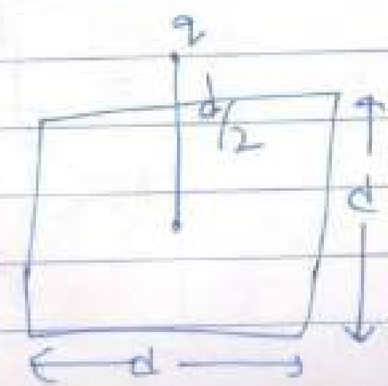
(iii) Mirror requires grinding and polishing only on one side.

A-26 (a)

Electric flux may be defined as the number of field lines passing through a closed surface.
Or mathematically, it may be defined as the surface integral of electric field over a closed surface.

i.e. $\phi_E = \oint \vec{E}\cdot\vec{ds}$

It is a scalar quantity.



Consider a cube of side d with 1 are as the square such that q lies on its centre

Now, acc. to gauss law.

$$\oint E \cdot ds = \frac{q}{\epsilon_0}$$

$$\Rightarrow E(6a^2) = \frac{q}{\epsilon_0} \qquad \because \int ds = 6a^2$$

$$\Rightarrow \phi_E = \frac{q}{\epsilon_0} \text{ (from entire cube)}$$

As square is only one face

$$\Rightarrow \phi_E' \text{ through square} = \frac{1}{6}\phi_E$$

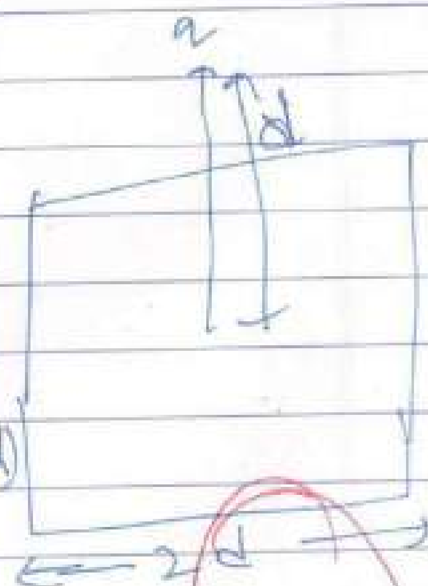
$$= \frac{1}{6}\frac{q}{\epsilon_0}$$

$$\boxed{\phi = \frac{q}{6\epsilon_0}}$$

(i) Ans Now As it is moved to a distance d from centre and new square has side 2d

Charge q still lies at centre of new square

Again a cube of side 2d can be assumed such that q lies at its centre



flux through cube

$= \phi = \frac{q}{\varepsilon_0}$ (charge enclosed)

Flux through one face

$= \frac{1}{6}\phi$

$= \frac{q}{6\varepsilon_0}$

i.e. flux through square remains unchanged.

70/70 Seventy only.

70/70