BSEH MODEL PAPER (2026-27)

Marking Scheme Physics

SECTION-A

1. (*a*)
2. (*a*)
3. (*a*)
4. (*d*)
5. (*b*)
6. (*c*)
7. (*b*)
8. (*a*)
9. (*a*)
10. Diffraction.
11. scaler
12. The direction of magnetic force is $\perp$ to plane containing $\vec{v}$ and $\vec{B}$ or is in the direction of $\left(\vec{V} \times \vec{B}\right)$.
13. $\lambda = \frac{h}{p}$.
14. Balmer.
15. decreases.
16. (*b*)
17. (*b*)
18. (*a*)

SECTION-B

19. Total charge present on a body is fixed. Total charge present on a body is intergral number of the smallest unit of charge *i.e.* electronic charge.

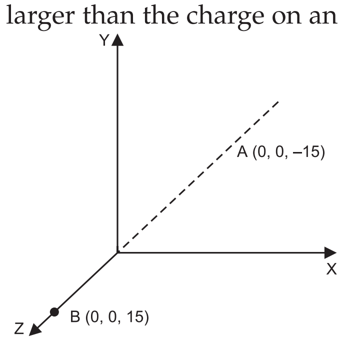
$$Q = \pm ne$$

n- integer
e-$1.6 \times 10^{-19} C$.

At macroscopic level, total charge present on a body is much larger than the charge on an electron. So, grainry nature of electrons destroy. Hence, it is ignored at macroscopic level.

Or

$$q_A = 2.5 \times 10^{-7}\, C$$
$$q_B = -2.5 \times 10^{-7}\, C$$
$$q = q_A + q_B = 0$$
$$AB = 2\,a = 15 + 15$$
$$= 30 \text{ cm} = 0.30 \text{ m}$$



$$q = q\,(2a)$$
$$= 2.5 \times 10^{-7} \times 0.30$$
$$= 7.5 \times 10^{-8} \text{ C-m along } -ve\ z\text{-axis.}$$

20. According to the Kirchhoff's first rule, the algebraic sum of various currents meeting at a junction in a closed electrical circuit is always zero. *i.e.,*

$$\Sigma I = 0$$

It is based on the law of conservation of charge.

According to Kirchhoff's second rule, the algebraic sum of emfs is equal to algebraic sum of products of various resistances and the respective currents flowing through them in a closed electrical circuit *i.e.,*

$$\Sigma E = \Sigma IR$$

It is based on the law of conservation of energy.

Or

$$R_{27} = 100\ \Omega$$
$$R_T = 117\ \Omega$$
$$\alpha = 1.70 \times 10^{-4}/°\text{C}$$

The temperature coefficient of resistance is given by

$$\alpha = \frac{dR/R_0}{dT} = \frac{R_T - R_{27}}{R_{27}\,(T-27)}$$

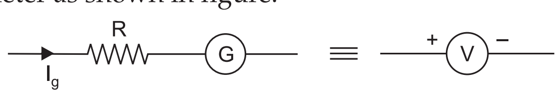
$$1.70 \times 10^{-4} = \frac{117-100}{100\,(T-27)}$$

$$1.70 \times 10^{-2}\,(T-27) = 17$$

$$T - 27 = \frac{17}{1.7 \times 10^{-2}}$$

$$T = 1000 + 27 = 1027\ °\text{C}.$$

21. When a very high value of resistance is connected in series with galvanometer then it works as a voltmeter as shown in figure. **2**



V = measured voltage

I_g = full scale deflection current

R = high value of resistance

G = resistance of galvanometer

R and G are in series combination and its total resistance is $R + G$. The measured voltage V is given by

$$V = I_g\,(R + G)$$

$$R + G = \frac{V}{I_g}$$

$$R = \frac{V}{I_g} - G$$

The effective resistance of converted voltmeter is given by

$$R_{\text{eff}} = R + G$$

22. Microwaves are electromagnetic waves of frequency range 1 GHz to 300 GHz. **2**

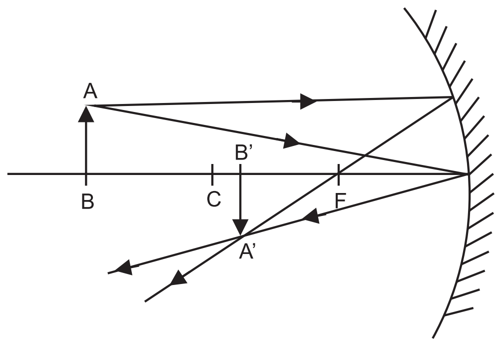
Uses of Microwaves:

(*i*) Microwave ovens are used for cooking.

(*ii*) Microwaves are used in radar systems for aircraft navigation.

(*iii*) Microwaves are used for observing the movement of trains.

23.



2

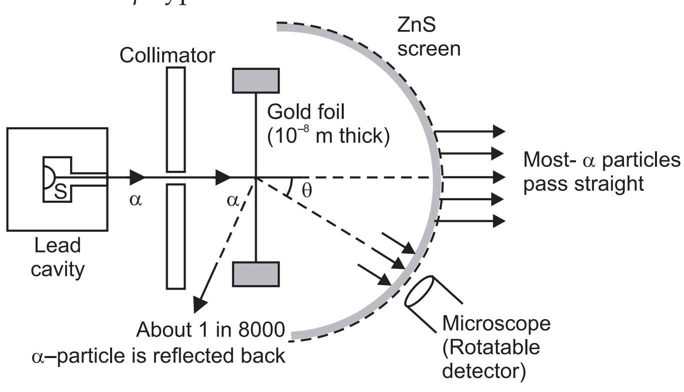
Position of the image doesnot change and intersity (brighness) of the image will decrease, if the lower half of the mirror's reflecting surface is painted black.

OR

Dentists use concave mirrors because concave mirror produces a highly magnified, virtual and erect image of tooth. Convex mirrors are used as side-view mirrors in car because convex mirrors form a virtual, erect and diminished image, it allows a driver to see a much wider field of view.

24. When pentavalent impurity is added into a pure semiconductor, we get *n*-type semiconductor. On the other hand, if trivalent impurity is added into a pure semiconductor, we get *p*-type semiconductor. Electrons are the majority charge carriers in *n*-type and holes are the majority carriers in *p*-type.

25.



As $$r_0 \propto \frac{1}{K.E.}$$

When the K.E. of α-particle is doubles, r_0 becomes halved.

SECTION-C

26. (*a*)

$$\text{Mass of rectants} = 2 \times 12.000000 = 24.000000 \text{ u}$$
$$\text{Mass of products} = 19.992439 + 4.002603 = 23.995042 \text{ u}$$
$$\text{Mass defect } (\Delta m) = 24.000000 \text{ u} - 23.995042 \text{ u} = 0.004958 \text{ u}$$

Since $\Delta m > 0$, mass is converted to energy, making it an exothermic reaction.

(*b*) Ratio of densities = 1 : 1.

Or

According to Bohr's postulate, electron can revolve only in certain discrete non-radiating orbits called stationary orbits for which total angular momentum of the revolving electron is an integral multiple of $h/2\pi$ where 'h' is Planck's constant.

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

The energy of electron revolving in a stationary orbit is of two types: kinetic energy which is due to the velocity and potential energy which is due to the position of electron. Total energy of electron in its orbit is given by

$$E = \text{K.E.} + \text{P.E.} \quad \ldots(i)$$

Potential energy of electron is given by

$$\text{P.E.} = -\frac{kZe^2}{r}$$

According to Bohr's first postulate,

$$\frac{mv^2}{r} = \frac{kZe^2}{r^2} \Rightarrow \frac{1}{2}mv^2 = \frac{kZe^2}{2r}$$

From eqn. (*i*), we have

$$E = \frac{kZe^2}{2r} - \frac{kZe^2}{r} = -\frac{1}{2}\frac{kZe^2}{r} \quad \ldots(ii)$$

But, $$r = \frac{n^2h^2}{4\pi^2 mkZe^2}$$

Now, substituting value of r in eqn. (*ii*) we have

$$E = \frac{-1}{2}kZe^2 . \frac{4\pi^2 mkZe^2}{n^2h^2}$$
$$= \frac{-2\pi^2 mk^2Z^2e^4}{n^2h^2} = \frac{-13.6}{n^2} \text{ eV}$$

27. Principle: It is based on the principle of electromagnetic induction.

Let

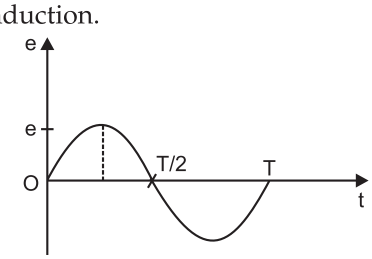
N = no. of turns in the coil

A = area of each turn

$\vec{B}$ = strength of mag field

$\phi = N(\vec{B}.\vec{A}) = NBA \cos\theta$

$= NBA \cos \omega t$



$$e = \frac{d\phi}{dt} \frac{-d}{dt}(NBA \cos \omega t)$$

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

e will be max. if $\sin \omega t = 1$

$\therefore \qquad e_{max} = e_0 = NBA\omega$

$\therefore \qquad e = e_0 \sin \omega t$

Or

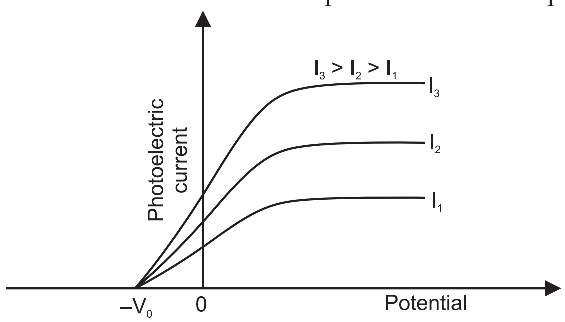
Transformer is based on the principle of mutual induction. Step-up transformer converts low input voltage into high output voltage. Step-down transformer converts high input voltage into low output voltage.

Factors responsible for energy loss in transformer:

(*i*) Copper loss.

(*ii*) Eddy current loss (Any two).

28. The phenomenon of emission of electrons from the metal surface when electromagnetic radiation of suitable frequency falls on it, is called photoelectric effect. The emitted electrons are called photoelectrons and the current so produced is called photoelectric current.



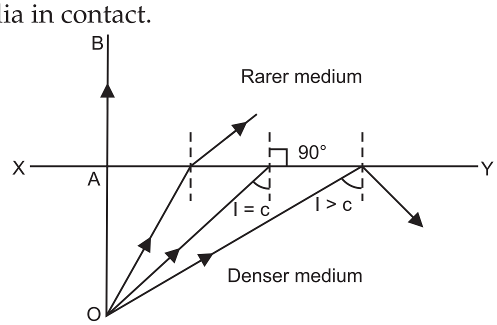
Stopping Potential:

The minimum negative potential given to anode for which the photoelectric current becomes zero is called cut-off potential or stopping potential. Its value is different for different metals and is independent of the intensity of incident light.

29. (*i*) It is the phenomenon of reflection of light into a denser medium from an interface of this denser medium and a rarer medium.

Two essential conditions of TIR:

1. Light should travel from denser to rarer medium.
2. Angle of incidence in denser medium should be greater than critical angle for the pair of media in contact.



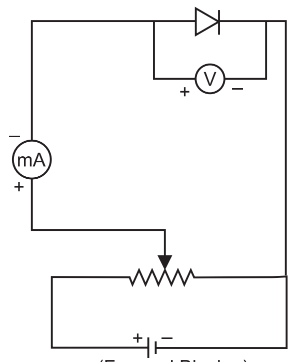
(*ii*)

$$\mu = \frac{1}{\text{Sin } C} = \frac{1}{\text{Sin } 45^\circ} = \sqrt{2}$$

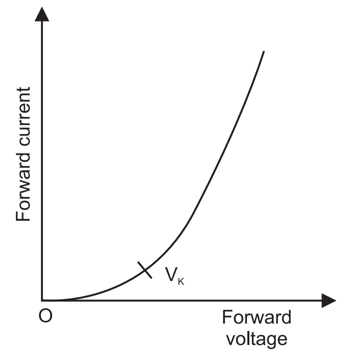
$$\mu = \frac{C}{v} \Rightarrow v = \frac{C}{\mu}$$

$$\therefore \quad v = \frac{3 \times 10^8}{\sqrt{2}} \text{ m/s.}$$

30.



(Forward Biasing)



The threshold voltage (or cut-in voltage) of a diode is the minimum forward voltage required to overcome the built in potential barrier, allowing significant current to flow through the diode.

For $Si = 0.7$ V

For $Ge = 0.3$ V.

SECTION-D (CASE STUDY)

31. (*i*) (*a*) $\frac{I}{A}$.

(*ii*) (*c*) 0.1 Ω

(*iii*) (*b*) $[ML^3 T^{-3} A^{-2}]$

Or

(*c*) *CD*.

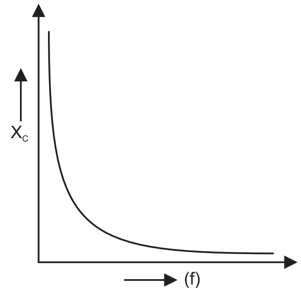
(*iv*) $$r = \left(\frac{E}{V} - 1\right)R$$

32. (*i*) (*b*) 311 V

(*ii*) (*c*) Zero.

(*iii*) (*a*) 0

(*iv*)



Or

$$X_L = \omega L = 2\pi\nu L$$
$$= 2 \times \frac{22}{7} \times 100 \times 14 \times 10^{-3}$$
$$= 8.8\ \Omega.$$

SECTION-E

33. The ratio of electric force in free space (F_0) to electric force in medium (F) is called dielectric constant.

$$K = \frac{F_0}{F}$$

Consider two parallel plates each of area A and separated by small distance d. The plates of capacitor are oppositely charged. The electric field across parallel plates without dielectric slab is given by

$$E_0 = \frac{q}{\epsilon_0 A} \qquad ...(i)$$

The electric potential difference across parallel plates capacitor without dielectric slab is given by

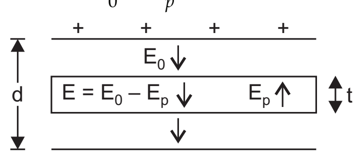
$$V_0 = E_0 d \qquad ...(ii)$$

Substituting the value of E_0 in eqn. (ii), we have

$$V_0 = \frac{q}{\epsilon_0 A} d$$
$$\frac{q}{V_0} = \frac{\epsilon_0 A}{d}$$
$$C_0 = \frac{\epsilon_0 A}{d} \qquad ...(iii) \left(\because C_0 = \frac{q}{V_0}\right)$$

When a dielectric slab of dielectric constant k, thickness t and have same area as plates of capacitor is placed between parallel plate capacitor then induced electric field E_p is produced in opposite direction of E_0 and the dielectric constant is given by

$$k = \frac{E_0}{E_0 - E_p} = \frac{E_0}{E} \qquad ...(iv)$$



The electric potential difference across the parallel plate capacitor with dielectric slab is given by

$$V = E_0(d - t) + Et$$
$$V = E_0\left[d - t + \frac{E}{E_0} t\right] \qquad ...(v)$$

Substituting the value of E_0 and k in the eqn. (v), we have

$$V = \frac{q}{\epsilon_0 A}\left[d - t + \frac{t}{k}\right] \Rightarrow \frac{q}{V} = \frac{\epsilon_0 A}{d - t + \dfrac{t}{k}}$$

$$C = \frac{\epsilon_0 A}{d\left[1 - \dfrac{t}{d} + \dfrac{t}{kd}\right]} \qquad \left(\because C = \frac{q}{V}\right)$$

$$\therefore \qquad C = \frac{C_0}{d\left[1 - \dfrac{t}{d} + \dfrac{t}{kd}\right]} \qquad \left(\because C_0 = \frac{\epsilon_0 A}{d}\right)$$

Thus the capacitance of parallel plate capacitor with dielectric slab increases.

Or

(i) It states that the surface integral of electric field over closed surface is equal to $\frac{1}{\epsilon_0}$ times the charge enclosed in closed surface.

$$\oint \vec{E}.\vec{ds} = \frac{q}{\epsilon_0}.$$

(ii)

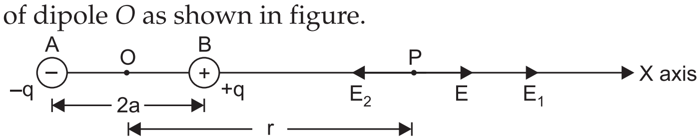
$$V_B - V_A = \frac{W_{AB}}{q_0}$$

If points A and B lie on equipotential surface, then $V_B = V_A$

$$W_{AB} = 0$$

Hence no work is done in moving the test charge from one point of equipotential surface to the other.

(iii) Suppose an electric dipole consists of two opposite charges (*i.e.,* q and $-q$) which are separated by small gap *i.e.,* $2a$. Let P be a point on axial line at distance r from the centre of dipole O as shown in figure.



$$BP = r - a$$
$$AP = r + a$$

The electric field E_1 at point P due to positive charge is given by

$$E_1 = \frac{q}{4\pi \epsilon_0 (BP)^2}$$
$$= \frac{q}{4\pi \epsilon_0 (r-a)^2} \quad \text{along +ve } X \text{ axis}$$

The electric field E_2 at point P due to negative charge is given by

$$E_2 = \frac{q}{4\pi \epsilon_0 (AP)^2}$$
$$= \frac{q}{4\pi \epsilon_0 (r+a)^2} \quad \text{along –ve } X \text{ axis}$$

The electric field intensity at point P on axial line of dipole is the resultant of E_1 and E_2.

$$\therefore \quad E = E_1 - E_2 \text{ along +ve } X \text{ axis}$$

$$= \frac{q}{4\pi \in_0 (r-a)^2} - \frac{q}{4\pi \in_0 (r+a)^2}$$

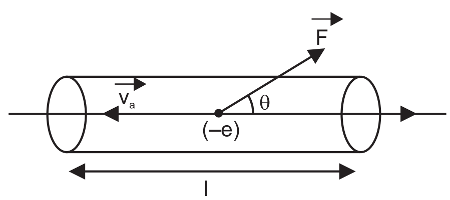
$$= \frac{q}{4\pi \in_0}\left[\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2}\right] = \frac{q}{4\pi \in_0}\left[\frac{(r+a)^2-(r-a)^2}{(r^2-a^2)^2}\right]$$

$$= \frac{q}{4\pi \in_0}\left[\frac{r^2+a^2+2ar-r^2-a^2+2ar}{(r^2-a^2)^2}\right]$$

$$= \frac{q}{4\pi \in_0}\left[\frac{4ar}{(r^2-a^2)^2}\right] = \frac{2\,(2aq)\,r}{4\pi \in_0 (r^2-a^2)^2}$$

$$= \frac{2pr}{4\pi \in_0 (r^2-a^2)^2}$$

34. (*i*) Let us consider a conductor of length l, carrying current I kept in uniform magnetic field $\vec{B}$.



If n is the No. of free electrons per unit volume, then total no. of electrons in the conductor is

$$N = n\,Al$$

Force experienced by each electron,

$$\vec{F} = -ne\,Al\left(\vec{V}_d \times \vec{B}\right)$$

Total force
$$\vec{F} = N\vec{f} = -ne\,Al\left(\vec{V}_d \times \vec{B}\right) \quad \text{...}(i)$$

We know that
$$I = n\,eA\,V_d$$

$$I\,\vec{l} = -ne\,Al\,\vec{V}_d$$

Put in (*i*)

$$\vec{F} = I\,(\vec{l} \times \vec{B})$$

$$\vec{F} = I\,lB\,\text{Sin}\,\theta$$

If
$$\theta = 90^\circ$$

$$\text{Sin } 90^\circ = 1$$

$$\therefore \quad F = Ilb = \text{maximum.}$$

(*ii*)

Diamagnetic substance	Paramagnetic substance
1. They are feebly repelled by magnets	1. They are feebly attracted by magnets
2. Susceptibility is small and negative	2. Susceptibility is small and positive.

(Write any two differences).

OR

Consider a rectangular coil of length l breadth b.

$$SP = QR = l; \quad PQ = RS = b$$

θ angle made by plane of coil with mag. field.

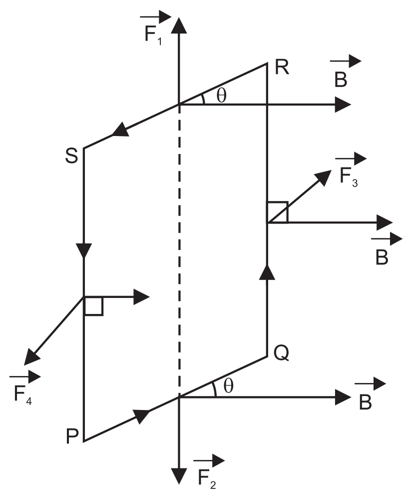
$\vec{F_1}$ = $IbB \sin\theta$ on RS acting ⊥ to both acting upward given by Right-hand Thumb Rule

$\vec{F_2}$ = $IbB \sin\theta$ on PQ acting downward given by Right-hand Thumb Rule.

$\vec{F_1}$ & $\vec{F_2}$ are equal and opposite hence cancel each other.

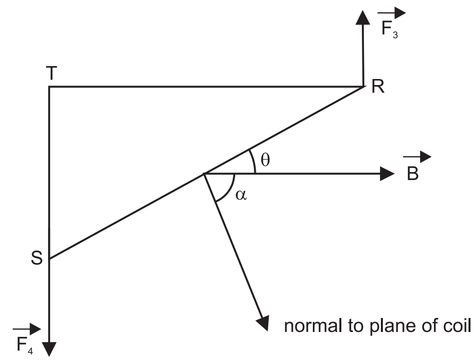
$\vec{F_3}$ = $I\,lB \sin 90° = IlB$ acting on QR inwards by Fleming Left-hand Rule.

$\vec{F_4}$ = $I\,lB \sin 90° = IlB$ acting on SP outwards by Fleming Left-hand Rule.



$\vec{F_3}$ and $\vec{F_4}$ are equal but not acting along same line and form a couple which moves the coil in magnetic field.

$$\text{Torque} = \text{force} \times \text{arm of couple}$$
$$\tau = I\,lB\,(RT)$$
$$= I\,lB\,b \cos\theta$$
$$\tau = I\,AB \cos\theta$$



where $A = lB$ = area of coils

Let α is the angle b/w normal to the coil and magnetic field

then $\alpha + \theta = 90°$

$\therefore$ $\theta = 90 - u$

If n– no. of turns then

$$\therefore \quad \tau = n\, I\, AB \cos(90 - \alpha)$$
$$= n\, I\, AB \sin\alpha$$
$$\tau = MB\sin\alpha \quad \text{M-mag dipole moment}$$
$$\vec{\tau} = \vec{M} \times \vec{B}.$$

35. (*i*) Two sources must be Coherent sources of light for sustained interference of light.

(*ii*) Let the electric field vectors of the two waves be represented as

$$y_1 = a_1 \sin\omega t \quad \text{and} \quad y_2 = a_2 \sin(\omega t + \phi)$$

where a_1 and a_2 = amplitudes of two waves

ϕ = phase difference between the waves

The resultant wave at point P is given by

$$Y = y_1 + y_2 = a_1 \sin\omega t + a_2 \sin(\omega t + \phi)$$
$$Y = a_1 \sin\omega t + a_2 \sin\omega t \cos\phi + a_2 \text{ cost } \omega t \sin\phi$$
$$Y = (a_1 + a_2\cos\phi)\sin\omega t + a_2 \sin\phi\cos\omega t \quad ...(i)$$

Substitute $a_1 + a_2 \cos\phi = A\cos\theta$ ...(*ii*)

and $a_2 \sin\phi = A\sin\theta$ ...(*iii*)

Equation (*i*) becomes

$$Y = A\cos\theta\sin\omega t + A\sin\theta\cos\omega t$$
$$Y = A(\sin\omega t\cos\theta + \cos\omega t\sin\theta)$$
$$Y = A\sin(\omega t + \theta) \quad ...(iv)$$

Now squaring and adding equations (*ii*) and (*iii*), we have

$$(A\sin\theta)^2 + (A\cos\theta)^2 = (a_2\sin\phi)^2 + (a_1 + a_2\cos\phi)^2$$
$$A^2 = a_2^2\sin^2\phi + a_1^2 + a_2^2\cos^2\phi + 2a_1a_2\cos\phi$$
$$A^2 = a_2^2(\sin^2\phi + \cos^2\phi) + a_1^2 + 2a_1a_2\cos\phi$$
$$A^2 = a_1^2 + a_2^2 + 2a_1a_2\cos\phi \quad ...(v)$$

The resultant intensity I is directly proportional to the square of the amplitude of the resultant wave, therefore

$$I \propto A^2$$

$$I = KA^2$$

Thus, the resultant intensity at a point P depends on the phase difference ϕ.

Condition for constructive interference: The intensity will be maximum if

$$\cos\phi = 1 \quad i.e., \quad \phi = 0, 2\pi, 4\pi$$

or $$\phi = 2n\pi \quad \text{where } n = 0, 1, 2, 3, ...$$

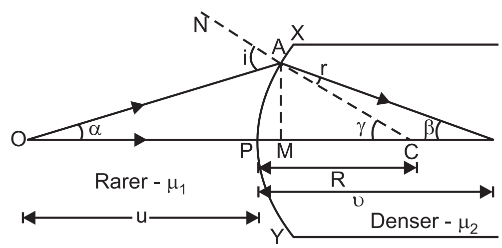
Condition for destructive interference: The intensity will be minimum if

$$\cos\phi = -1 \quad i.e., \quad \phi = \pi, 3\pi, ...$$

or $$\phi = (2n-1)\pi \quad \text{where} \quad n = 0, 1, 2, 3, ...$$

Or

Consider a point object O lying on the principal axis of surface. A ray of light OP passes straight and another ray OA refracted along AI. Both the rays meet at I to form real image of object O.



Let $\angle AOM = \alpha$, $\angle AIM = \beta$ and $\angle ACM = \gamma$

In $\Delta\, IAC$

$$\gamma = r + \beta$$

(External angle of triangle is equal to interior angles)

$$r = \gamma - \beta$$

In $\Delta\, OAC$

$$i = \alpha + \gamma$$

By snell's law,

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

As angles are small, therefore

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

$$\mu_1 i = \mu_2 r$$

Putting values of 'i' and 'r' from above equation, we have

$$\mu_1(\alpha + \gamma) = \mu_2(\gamma - \beta)$$

As angles α, β and γ are also small. Therefore,

$$\alpha = \frac{AM}{MO}, \quad \gamma = \frac{AM}{MC}, \quad \beta = \frac{AM}{MI}$$

So, $$\mu_1\left[\frac{AM}{MO} + \frac{AM}{MC}\right] = \mu_2\left[\frac{AM}{MC} + \frac{AM}{MI}\right]$$

$$\mu_1\left[\frac{1}{MO} + \frac{1}{MC}\right] = \mu_2\left[\frac{1}{MC} - \frac{1}{MI}\right]$$

As aperture of surface is small.

Therefore, $MO = PO, \quad MI = PI, MC = PC$

$$\frac{\mu_1}{PO} + \frac{\mu_1}{PC} = \frac{\mu_2}{PC} - \frac{\mu_2}{PI}$$

Using $PO = -u$, $PI = v$ and $PC = R$

we have, $$\frac{\mu_1}{-u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}.$$