TOPICS *to be covered*

① EMW
② semi
③ modern
④ optics — wave; geo

① EMW ≡ formula oriented

$\hat{v} \equiv +x$

$E = E_0 \sin(\omega t - kx)$

$B = B_0 \sin(\omega t - kx)$

phase same

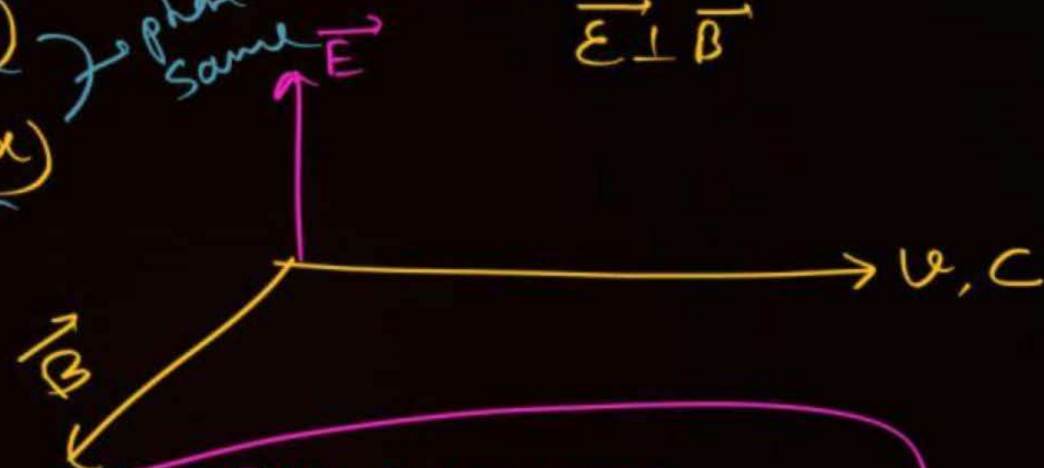
$E_0 = B_0 C$

$E = BC$

$B_0 = \dfrac{E_0}{C}$

$\vec{E} \perp \vec{v}$ $\quad \vec{B} \perp \vec{v}$

$\vec{E} \perp \vec{B}$



EBC EBC EBC

$\hat{E} = \hat{B} \times \hat{C}$

$\hat{B} = \hat{C} \times \hat{E}$

$\hat{C} = \hat{E} \times \hat{B}$

$\hat{B} = \hat{i} \times \hat{j}$

Electric field Energy density $= \frac{1}{2}\epsilon_0 E^2$

$E = E_0 \sin(\omega t - kx)$

$= \frac{1}{2}\epsilon_0 E_0^2 \sin^2(\omega t - kx)$

$B = B_0 \sin(\omega t - kx)$

$\langle Avg \rangle = \frac{1}{4}\epsilon_0 E_0^2$

magnetic field density $= \frac{1}{2}\frac{B^2}{\mu_0} = \frac{1}{2\mu_0} B_0^2 \sin^2 (\quad)$

$= \frac{1}{4}\frac{B_0^2}{\mu_0}$

$C = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$

$\frac{1}{4}\epsilon_0 E_0^2 = \frac{1}{4}\epsilon_0 (B_0 C)^2$

$= \frac{1}{4} \times \cancel{\epsilon_0} B_0^2 \times \frac{1}{\mu_0 \cancel{\epsilon_0}} = \frac{1}{4}\frac{B_0^2}{\mu_0}$

* Total Energy density $= \frac{1}{2}\epsilon_0 E_0^2 = \frac{B_0^2}{2\mu_0}$

Amp of EF.

* $I = \frac{1}{2}\epsilon_0 E_0^2 c$

$$\boxed{I = \frac{P}{4\pi r^2} = \frac{1}{2}\epsilon_0 E_0^2 c}$$

maxwell's equation

- Gauss Law for electricity $\equiv \oint \vec{E}\cdot d\vec{S} = \frac{q}{\epsilon_0}$
- Gauss Law for magnetism $\oint \vec{B}\cdot d\vec{S} = 0$
- Faraday's Law $\oint \vec{E}\cdot d\vec{l} = -\frac{d\phi_B}{dt} = -A\frac{dB}{dt}$
- Ampere's Law $\oint \vec{B}\cdot d\vec{l} = \mu_0 i + \epsilon_0 \mu_0 \frac{d\phi_E}{dt}$

- EMW are produced by accelerated charged particles.
- EMW are non-mechanical transverse waves.
- EMW does not required medium to propagates.
- In EMW, $\vec{E}$ & $\vec{B}$ oscillates perpendicular to each other and perpendicular to dirⁿ of wave propagation

$$\left.\begin{array}{l} - \ \vec{E} \perp \vec{B} \\ - \ \vec{E} \perp \vec{v} \\ - \ \vec{B} \perp \vec{v} \end{array}\right\}$$

- wave equation for light propogating in $+x$ direction in vaccume may be written as

$$E = E_0 \sin(\omega t - Kx) \qquad V_\omega = \frac{\omega}{K} = c \qquad E_{rms} = \frac{E_0}{\sqrt{2}}$$

$$E = E_0 \sin \omega\left(t - \frac{x}{c}\right)$$

→ Sinosoidal varying E.F at a position x at time 't'.

c → speed of light in vaccume.

* there is also a sinosoidally varying magnetic field. associated with E.F when light propagates given by

$$B = B_0 \sin \omega\left(t - \frac{x}{c}\right)$$

$$\boxed{E_0 = B_0 c}$$

$$\boxed{E = Bc}$$

phar

$$E = E_0 \sin(\omega t - kx)$$

$$B = B_0 \sin(\omega t - kx)$$

$$\boxed{E_0 = B_0 c} \qquad \boxed{c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}}$$

$$B = \frac{E_0}{c} \sin(\omega t - kx) \qquad B_0 = \frac{E_0}{c}$$

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

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

$$c = \frac{E}{B} \qquad B_0 = \frac{E_0}{c}$$

$$v = \frac{1}{\sqrt{\mu_0 \mu_r \epsilon_0 \epsilon_r}} = \frac{c}{\sqrt{\mu_r \epsilon_r}} = \frac{c}{\mu}$$

$E = 50 \sin(\omega t - kx)$

$$\boxed{B = \frac{50}{3\times10^{8}} \sin(\omega t - kx)}$$

$E = BC$

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

- Direction of propagation of wave is along $\vec{E} \times \vec{B}$

EBC EBC

$\hat{C} = \hat{E} \times \hat{B}$

- EF & M.F, ($\vec{E}$ & $\vec{B}$) are in same phase, they become zero simultaneously and their value reaches to peak simultaneously

$$E = E_0 \sin(\omega t - kx + \phi) \Longrightarrow B = B_0 \sin(\omega t - kx + \phi)$$

same phase

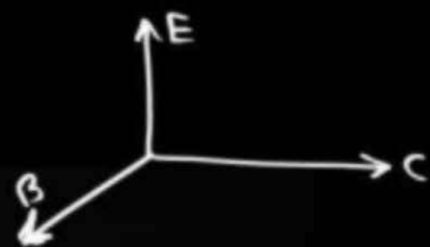
Same frequency

But different amplitude $\boxed{E_0 = B_0 C}$, $E = BC$

$E_0 \longrightarrow$ Amplitude of EF

$B_0 \longrightarrow$ " " M.F.

* $B = \dfrac{E}{C}$ $\quad B_0 = \dfrac{E_0}{C}$ $\longrightarrow$ (speed of light)



*

* $\boxed{\vec{E} = \vec{B} \times \vec{C}}$

* dir^n of wave is along $\vec{E} \times \vec{B}$

$E = BC$ ✓

$E_0 = B_0 C$ ✓

* $\vec{E} = \vec{B} \times \vec{C}$ ✓

* $\vec{B} = \dfrac{\vec{C} \times \vec{E}}{C^2}$

* $\vec{C} = \dfrac{\vec{E} \times \vec{B}}{B^2}$

EBC EBC EBC . . .

$$\text{dir}^n \equiv \begin{cases} \hat{E} = \hat{B} \times \hat{C} \\ \hat{B} = \hat{C} \times \hat{E} \\ \hat{C} = \hat{E} \times \hat{B} \end{cases}$$

$$\boxed{\vec{E} = \vec{B} \times \vec{C}}$$

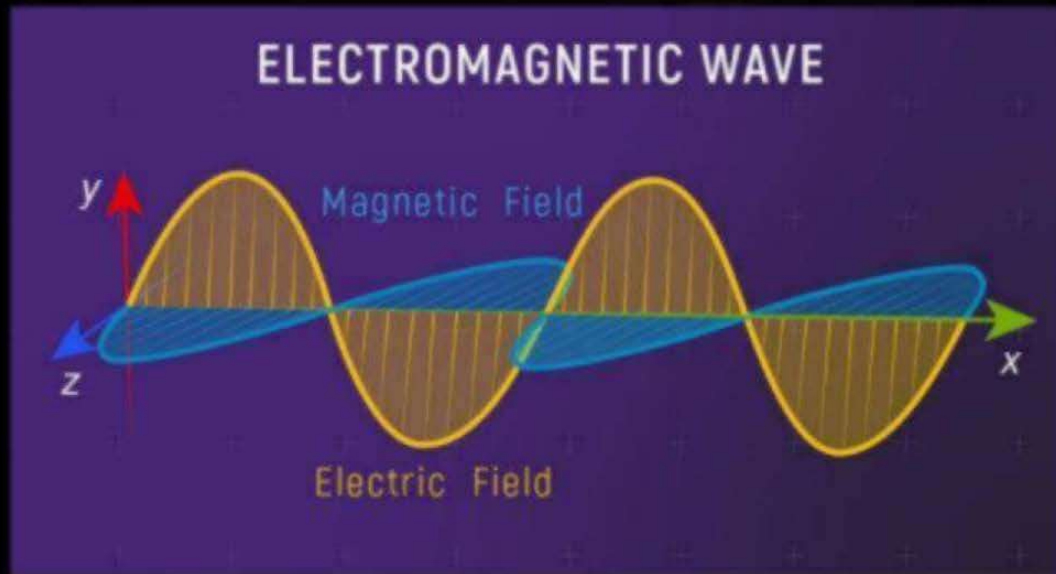
Q $\vec{B} = \hat{j}$

$\vec{E} = -\hat{k}$

EBCEBC

$\hat{C} = \hat{E} \times \hat{B} = -\hat{k} \times \hat{j}$

$= \hat{i}$


ELECTROMAGNETIC WAVE
y
Magnetic Field
z
x
Electric Field

- speed of light depends on electric & magnetic property of medium.

$$\boxed{c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}}$$

speed of light in Vaccum

$\epsilon_0 \longrightarrow$ permitivity of vaccume

$\epsilon_r \longrightarrow$ Relative permitivity of medium

$\mu_0 \longrightarrow$ permeability of vaccum

$\mu_r \longrightarrow$ Relative permeability of medium

$$v = \frac{1}{\sqrt{\mu \epsilon}} = \frac{1}{\sqrt{\mu_r \mu_0 \epsilon_r \epsilon_0}} = \frac{1}{\sqrt{\mu_r \epsilon_r}} \cdot \frac{1}{\sqrt{\mu_0 \epsilon_0}} = \frac{c}{\sqrt{\mu_r \epsilon_r}}$$

$$\boxed{v = \frac{c}{\sqrt{\mu_r \epsilon_r}}}$$

Refractive Index of medium $(n) = \frac{c}{v} = \sqrt{\mu_r \epsilon_r}$

$E = E_0 \sin(\omega t - kx)$

Electric field density $= \frac{1}{2}\epsilon_0 E^2$

$\left\langle \frac{1}{2}\epsilon_0 E_0^2 \sin^2(\omega t - kx) \right\rangle$

Avrg value of E.F density $= \frac{1}{2}\epsilon_0 \frac{E_0^2}{2}$

$\frac{1}{2}\epsilon_0 E_0^2 \times \frac{1}{2}$

$= \frac{1}{4}\epsilon_0 E_0^2 = \frac{1}{2}\epsilon_0 E_{rms}^2$

magnetic field density $= \frac{1}{2}\frac{B^2}{\mu_0} = \frac{1}{2}\frac{E^2}{c^2\mu_0} = \frac{E^2}{2\frac{1}{\cancel{\mu_0}\epsilon_0}\times\cancel{\mu_0}}$

$= \frac{1}{2}\epsilon_0 E^2$

$E = Bc$

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

$c = \frac{1}{\sqrt{\mu_0\epsilon_0}}$

$$\frac{1}{2}\epsilon_0 E^2 = \frac{1}{2}\epsilon_0 B^2 C^2 = \frac{1}{2}\epsilon_0 B^2 \frac{1}{\mu_0 \epsilon_0}$$

$$= \frac{B^2}{2\mu_0}$$

$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$, $E = BC$ $E = E_0 \sin(\omega t - kx)$

Electric field densit $= \frac{1}{2}\epsilon_0 E^2 = \frac{1}{2}\epsilon_0 \frac{E_0^2}{2} = \frac{1}{4}\epsilon_0 E_0^2$

M.F. Density $= \frac{1}{2}\frac{B^2}{\mu_0} \cdots\cdots = \frac{1}{4}\frac{B_0^2}{\mu_0} = \frac{1}{4}\epsilon_0 E_0^2$

Total energy density $= \frac{1}{2}\epsilon_0 E_0^2 = \frac{1}{2}\frac{B^2}{\mu_0}$

- Total energy of Emw is equally divided in E.F & m.F.
- Electric field density $= \frac{1}{2}\epsilon_0 E^2$

$\because$ E & B are time varying hence energy density also varries with time

- magnetic field density $= \frac{B^2}{2\mu_0}$
- Avrg electric Energy density $= \langle \frac{1}{2}\epsilon_0 E^2 \rangle = \frac{1}{2}\epsilon_0 \langle E^2 \rangle$

$= \frac{1}{4}\epsilon_0 E_0^2$

$E_{rms} = \frac{E_0}{\sqrt{2}}$

$B_{rms} = \frac{B_0}{\sqrt{2}}$

- Avrg magnetic energy density $= \frac{1}{4}\frac{B_0^2}{\mu_0}$
- As electric & magnetic energies are equal

So total energy is double of any energy $= \frac{1}{4}\frac{B_0^2}{\mu_0} + \frac{1}{4}\epsilon_0 E_0^2 = \frac{1}{2}\frac{B_0^2}{\mu_0} = \frac{1}{2}\epsilon_0 E_0^2$

Avg energy density $= \left(\frac{1}{2}\epsilon_0 E^2\right)_{Avg} = \frac{1}{2}\epsilon_0 \frac{E_0^2}{2} = \frac{1}{4}\epsilon_0 E_0^2$

$= \frac{1}{2}\epsilon_0 E_{rms}^2$

Energy per Unit vol^n

- Avrg e.m wave energy " density $(U) = \frac{1}{2}\epsilon_0 E_0^2 = \epsilon_0 E_{rms}^2 = \frac{B_0^2}{2\mu_0} = \frac{B_{rms}^2}{\mu_0}$

$$\boxed{U = \frac{1}{2}\epsilon_0 E_0^2 = \frac{1}{2}\frac{B_0^2}{\mu_0}}$$

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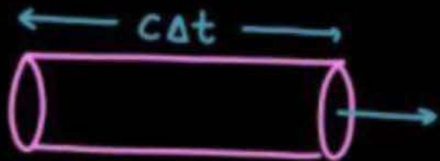
Intensity

- Energy crossing per unit area per unit time perpendicular to the direction of propogation



$$\text{Intensity} = \frac{\frac{1}{2}\epsilon_0 E_0^2 \times \text{Vol}^n}{\text{time}\cdot\text{Area}} = \frac{1}{2}\frac{\epsilon_0 E_0^2 \cdot A \cdot c\Delta t}{\Delta t \; A}$$

$$\boxed{I = \frac{1}{2}\epsilon_0 E_0^2 c}$$

- Power = Energy per unit time

$$P = \frac{1}{2}\epsilon_0 E_0^2 \cdot (Ac)$$

$$\text{Intensity} = I = \frac{\text{Power}}{\text{Area}} \Rightarrow \boxed{I = \frac{1}{2}\epsilon_0 E_0^2 c}$$

total

* Energy density $= \frac{1}{2}\epsilon_0 E_0^2 = \frac{B_0^2}{2\mu_0}$

  E/vol

* $I = \frac{1}{2}\epsilon_0 E_0^2 C$

$$I = \frac{P}{4\pi r^2} = \frac{1}{2}\epsilon_0 E_0^2 C$$

$$\boxed{E_0 = B_0 C}$$

$$C = \frac{1}{\sqrt{\mu_0 \epsilon_0}} \qquad v = \frac{C}{\sqrt{\mu_r \epsilon_r}}$$

* EBCEBCEBC

$$\hat{E} = \hat{B} \times \hat{C}$$

$$\hat{B} = \hat{C} \times \hat{E}$$

Q E.F in an EMW is given by

$$E = 50\left(\frac{N}{C}\right) \sin \omega\left(t - \frac{x}{c}\right)$$

$E = BC$

$E_0 = 50$

$B_0 = \frac{E_0}{C} = \frac{50}{3\times10^8}$

$B = \frac{50}{3\times10^8} \sin\left[\omega\left(t - \frac{x}{c}\right)\right]$

① Find energy density $= \frac{1}{2}\epsilon_0 E_0^2$

② Find energy contain in a cylinder of cross section $10\,cm^2$ and length $50\,cm$ along x-axis.

$= \frac{1}{2}\epsilon_0 E_0^2 \times (Vol^n)$

$= \frac{1}{2}\epsilon_0 E_0^2 \times (A\,\ell)$

④ Find magnetic field amplitude

$B_0 = \frac{E_0}{C} = \frac{50}{3\times10^8}$

③ Find intensity of wave. $= \frac{1}{2}\epsilon_0 E_0^2 C$

Q Find amplitude of EF and MF. in a parallel beam of light intensity $2\ watt/m^2$

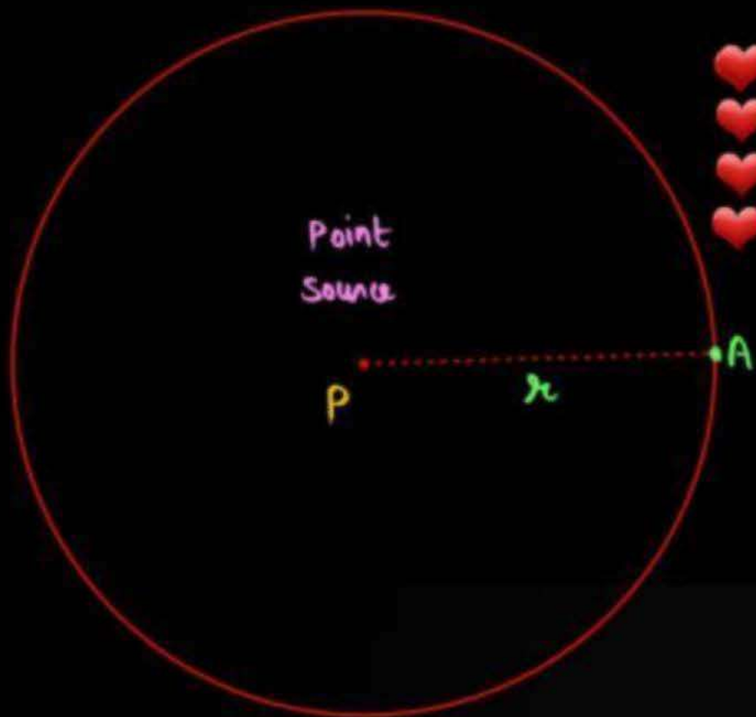
Sol^n

$$I = \frac{1}{2}\epsilon_0 E_0^2 . C$$

$$E_0 = \sqrt{\frac{2 I_0}{\epsilon_0 \times C}}$$

Electric field amplitude at distance r from point source

$$\boxed{E_0 = B_0 C}$$



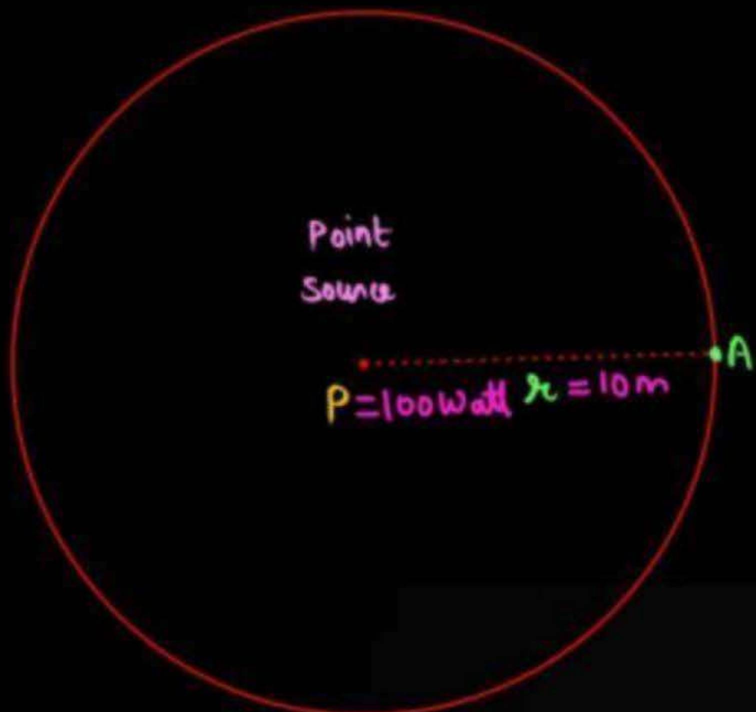
At point A

Intensity $= \dfrac{P}{4\pi r^2} = \dfrac{1}{2}\epsilon_0 E_0^2 C$

$$E_0 = \sqrt{\frac{2P}{4\pi r^2 \epsilon_0 C}} = \sqrt{\frac{2P \times 9 \times 10^9}{r^2 \times 3 \times 10^8}}$$

$$= \sqrt{\frac{60P}{r^2}}$$

Electric field amplitude at distance 10m from point source

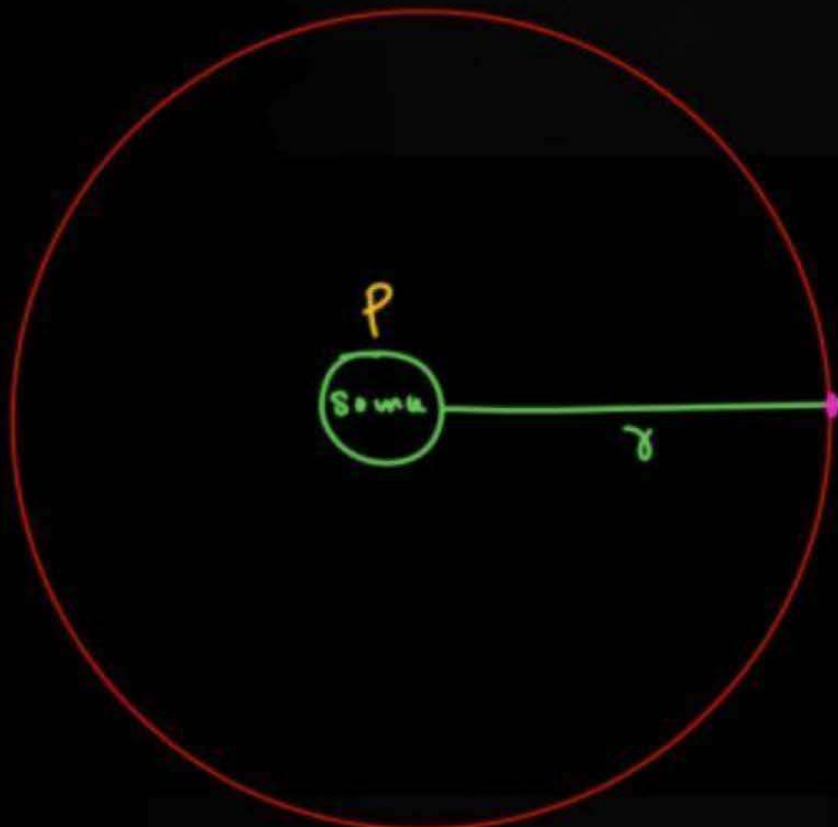


$$I = \frac{100}{4\pi(10)^2} = \frac{1}{2}\epsilon_0 E_0^2 \cdot c$$

$$E_0 =$$

$$E_0 = B_0 c$$

$$B_0 = \frac{E_0}{c}$$



$$I = \frac{P}{4\pi r^2} = \frac{1}{2}\epsilon_0 E_0^2 c$$

@ $E_0 =$

70% ques

(1) $E = 100 \sin(\omega t - kx)\hat{j}$

$\hat{v} \longrightarrow \hat{i}$

$E \longrightarrow \hat{j}$

$B = ?$

$\hat{B} = \hat{C} \times \hat{E}$

EBCEBC

(1) $E_0 = 100$

(2) $B_0 = ?$ $\quad E_0 = B_0 C \quad B_0 = \frac{E_0}{C} = \frac{100}{3 \times 10^8}$

$I = \frac{1}{2}\epsilon_0 E_0^2 C = \frac{P}{4\pi r^2}$

(3) Energy density $= \frac{1}{2}\epsilon_0 E_0^2 = \frac{1}{2}\epsilon_0 (100)^2$

(4) Vol 100 cm³ = कितनी Energy $= \frac{1}{2}\epsilon_0 E_0^2 \times \text{Vol}$

(5) Intensity $= \frac{1}{2}\epsilon_0 E_0^2 C = \frac{1}{2}\epsilon_0 (100)^2 \times 3 \times 10^8$

(6) $\vec{B} = \frac{100}{C}\sin(\omega t - kx)\hat{k}$

5 min Break

Electromagnetic spectrum ≡ 4 Qns

EMW
NCERT Last page
"
Readin ≡ Use ✓

Radio wave > micro wave > Infra Red > Visible > U.V > X-ray > γ rays

λ decreasing $\longrightarrow$

Question

EBC (EB)C

In a plane electromagnetic wave, the directions of electric field and magnetic field are represented by $\hat{k}$ and $2\hat{i} - 2\hat{j}$, respectively. What is the unit vector along direction of propagation of the wave.

(JEE Main-2020)

$\hat{E} = \hat{k}$

$\hat{B} = \dfrac{2\hat{i} - 2\hat{j}}{2\sqrt{2}}$

$\hat{C} = \hat{E} \times \hat{B}$

(A) $\frac{1}{\sqrt{2}}(\hat{i} + \hat{j})$

(B) $\frac{1}{\sqrt{5}}(\hat{i} + 2\hat{j})$

(C) $\frac{1}{\sqrt{5}}(2\hat{i} + \hat{j})$

(D) $\frac{1}{\sqrt{2}}(\hat{j} + \hat{k})$

Ans : (A)

Question

$\mathcal{E}BC \quad \hat{\mathcal{E}} = \hat{B} \times \hat{c} \quad \hat{j} \times \hat{k}$

A plane electromagnetic wave of frequency 25 GHz is propagating in vacuum along the z-direction. At a particular point in space and time, the magnetic field is given by $\vec{B} = 5 \times 10^{-8}\hat{j}$. The corresponding electric field $\vec{E}$ is (speed of light $c = 3 \times 10^{8}\ \mathrm{ms^{-1}}$) **(JEE Main-2020)**

$$\mathcal{E} = BC$$
$$= 5 \times 10^{-8} \times 3 \times 10^{8}$$
$$= 15$$

(A) $1.66 \times 10^{-16}\hat{i}\ \mathrm{V/m}$

(B) $15\hat{i}\ \mathrm{V}/m$

(C) $-1.66 \times 10^{-16}\hat{i}V/m$

(D) $-15\hat{i}V/m$

Ans : (B)

Question

The magnetic field of a plane electromagnetic wave is $\vec{B} = 3 \times 10^{-8} \sin[200\pi(y + ct)]\,\hat{i}T$. Where $c = 3 \times 10^{8}\ \text{ms}^{-1}$ is the speed of light. The corresponding electric field is:

(JEE Main-2020)

E $\quad \hat{E} = \hat{B} \times \hat{C}$

(A) $\vec{E} = -10^{-6} \sin[200\pi(y + ct)]\,\hat{k}\,v/m$ $\quad = \hat{i} \times -\hat{j}$

(B) $\vec{E} = -9 \sin[200\pi(y + ct)]\,\hat{k}\,v/m$ $\quad = -\hat{k}$

(C) $\vec{E} = 9 \sin[200\pi(y + ct)]\,\hat{k}\,v/m$

(D) $\vec{E} = 3 \times 10^{-8} \sin[200\pi(y + ct)]\,\hat{k}\,v/m$

Ans : (B)

Question

$\hat{\varepsilon} = -\hat{j}$

The electric field of a plane electromagnetic wave propagating along the x direction in vacuum is $\vec{E} = E_0\hat{j}\cos(\omega t - kx)$. The magnetic field $\vec{B}$, at the moment $t = 0$ is:

(JEE Main-2020)

$B_0 = \frac{E_0}{c} = \frac{E_0}{\frac{1}{\sqrt{\mu_0\epsilon_0}}}$

(A) $\vec{B} = E_0\sqrt{\mu_0\epsilon_0}\cos(kx)\hat{j}$

(B) $\vec{B} = \cancel{\frac{E_0}{\sqrt{\mu_0\epsilon_0}}}\cos(kx)\hat{k}$

(C) $\vec{B} = E_0\sqrt{\mu_0\epsilon_0}\cos(kx)\hat{k}$

(D) $\vec{B} = \cancel{\frac{E_0}{\sqrt{\mu_0\epsilon_0}}}\cos(kx)\hat{j}$

Ans : (C)

Question Same prop

The electric field of a plane electromagnetic wave is given by $\vec{E} = E_0(\hat{x} + \hat{y})\sin(kz - \omega t)$ Its magnetic field is will be given by: **(JEE Main-2020)**

$E_0(\hat{i}+\hat{j})\sin(\quad)$

$\hat{E} = \frac{\hat{i}+\hat{j}}{\sqrt{2}}$

$\hat{C} = +\hat{k}$

EBCEBC

$\hat{B} = \hat{C} \times \hat{E}$

(A) $\frac{E_0}{c}(\hat{x} - \hat{y})\cos(kz - \omega t)$

(B) $\frac{E_0}{c}(-\hat{x} + \hat{y})\sin(kz - \omega t)$

(C) $\frac{E_0}{c}(\hat{x} - \hat{y})\sin(kz - \omega t)$

(D) $\frac{E_0}{c}(\hat{x} + \hat{y})\sin(kz - \omega t)$

Ans : (B)

Question

$\varepsilon B C \varepsilon B C$

$\hat{\varepsilon} = \hat{B} \times \hat{C}$ $\quad \hat{C} = \hat{\varepsilon} \times \hat{B}$

The magnetic field of a plane electromagnetic wave is given by $\vec{B} = 2 \times 10^{-8} \sin(0.5 \times 10^{3} x + 1.5 \times 10^{11} t) \hat{j} T$. The amplitude of the electric field would be

(JEE Main-2022)

$E = BC = 2 \times 10^{-8} \times 3 \times 10^{8}$

$= 6$

(A) $6 \mathrm{Vm}^{-1}$ along x-axis

(B) $3 \mathrm{Vm}^{-1}$ along z-axis

(C) $6 \mathrm{Vm}^{-1}$ along z-axis

(D) $2 \times 10^{-8} \mathrm{Vm}^{-1}$ along z-axis

Ans : (C)

Question

Sam

For a plane electromagnetic wave, the magnetic field at a point x and time t is $\vec{B}(x,t) = [1.2 \times 10^{-7} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)\hat{k}]t$ The instantaneous electric field $\vec{E}$ corresponding to $\vec{B}$ is :
(speed of light $c = 3 \times 10^8 \text{ ms}^{-1}$)

(JEE Main-2020)

(A) $\vec{E}(x,t) = [-36\sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)\hat{i}]\frac{V}{m}$

(B) $\vec{E}(x,t) = [-36\sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)\hat{j}]\frac{v}{m}$

(C) $\vec{E}(x,t) = [36\sin(1 \times 10^3 x + 1.5 \times 10^{11} t)\hat{k}]\frac{V}{m}$

(D) $\vec{E}(x,t) = [36\sin(1 \times 10^3 x + 1.5 \times 10^{11} t)\hat{j}]\frac{v}{m}$

Ans : (B)

Question

An electromagnetic wave of frequency 5GHz, is travelling in a medium whose relative electric permittivity and relative magnetic permeability both are 2. Its velocity in this medium is ________ $\times 10^7$ 7 m/s (JEE Main-2021)

$$v = \frac{c}{\sqrt{\mu_r \epsilon_r}} = \frac{3 \times 10^8}{\sqrt{2 \times 2}} = 1.5 \times 10^8$$

$$= 15 \times 10$$

Ans : (15)

Question

$\epsilon_r = 2.25 \quad \mu_r = 1$

An electromagnetic wave of frequency 3GHz enters a dielectric medium of relative electric permittivity 2.25 from vacuum. The wavelength of this wave in that medium will be ________ $\times 10^{-2}$ cm

(JEE Main-2021)

$v = f\lambda$

$c = f\lambda$

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

$\lambda \longrightarrow \frac{\lambda_0}{\mu}$

$\frac{c}{f\mu}$

$v = \frac{1}{\sqrt{\mu_r \epsilon_r \mu_0 \epsilon_0}} = \frac{c}{\sqrt{\epsilon_r \mu_r}} = \frac{c}{\mu}$

$\mu = \sqrt{\epsilon_r \mu_r}$

Ans : (667)

Question

A plane electromagnetic wave of frequency 500MHz is travelling in vacuum along y-direction. At a particular point in space and time, $\vec{B} = 8.0 \times 10^{-8} \hat{Z} T$. The value of electric field at this point is : (speed of light $= 3 \times 10^{8}\ \mathrm{ms}^{-1}$) $\hat{x}, \hat{y}, \hat{z}$ are unit vectors along x, y and z direction.

(JEE Main-2021)

$\hat{c} \rightarrow \hat{j}$

$E = 24$

(A) $-24\hat{X} V/m$

(B) $2.\cancel{6}\hat{x} v/m$

(C) $24\hat{x} V/m$

(D) $-\cancel{2.6}\hat{y} V/m$

Ans : (A)

Question

For an electromagnetic wave travelling in free space, the relation between average energy densities due to electric (U_e) and magnetic (U_m) fields is : **(JEE Main-2021)**

$\frac{1}{4}\epsilon_0 E_0^2$ $\frac{1}{4}\frac{B_0^2}{\mu_0}$

(A) $U_e = U_m$

(B) $U_e > U_m$

(C) $U_e < U_m$

(D) $U_e \neq U_m$

Ans : (A)

$$\mathcal{E} = BC$$

EBC EBC EBC

$\hat{\mathcal{E}} = \hat{B} \times \hat{C}$ $\qquad$ $\hat{B} = \hat{C} \times \hat{E}$

$\hat{C} = \hat{\mathcal{E}} \times \hat{B}$

$v \rightarrow$ dir^n Eq^n of wave

$\hat{\mathcal{E}} \longrightarrow -\hat{k}$

$\hat{C} \longrightarrow -\hat{i}$

$B = ?$

$\mathcal{E}\boxed{BC\mathcal{E}}BC$

$\hat{B} = \hat{C} \times \hat{E}$

$= -\hat{i} \times -\hat{k}$

$= -\hat{j}$

$$E = 10\sin(\omega t - kx) \qquad V_\omega = \frac{\omega}{k}\hat{i}$$

$$E = 10\sin(\omega t + kx) \qquad V_\omega = -\hat{i}\left(\frac{\omega}{k}\right)$$

$$E = 10\sin(-\omega t + kz) \qquad v_\omega \Rightarrow \hat{k}$$

Question

A plane electromagnetic wave of frequency 100MHz is travelling in vacuum along the x direction. At a particular point in space and time, $\vec{B} = 2.0 \times 10^{-8}\hat{k}T$. (where, $\hat{k}$ is unit vector along z direction) What is $\vec{E}$ at this point?

(JEE Main-2021)

Sol^{n}

(A) $\cancel{0.6\hat{j}}$ V/m

(B) $6.0\hat{k}$ V/m

(C) $6.0\hat{j}$ V/m

(D) $\cancel{0.6\hat{k}}$ V/m

Ans : (C)

Question

A plane electromagnetic wave propagating along y-direction can have the following pair of electric field ($\vec{E}$) and magnetic field (B) components.

(JEE Main-2021)

wave $\hat{c} = +\hat{j}$

E, B

x, z

(A) E_y, B_y or E_z, B_z

(B) E_y, B_x or E_x, B_y

(C) E_x, B_z or E_z, B_x

(D) E_x, B_y or E_y, B_x

Ans : (C)

Question

In an electromagnetic wave the electric field vector and magnetic field vector are given as $\vec{E} = E_0 \hat{i}$ and $\vec{B} = B_0 \hat{k}$ respectively. The direction of propagation of electromagnetic wave is along: **(JEE Main-2021)**

EBCEBC

$\hookrightarrow$ speed of light

$\hat{C} = \hat{E} \times \hat{B}$

$= \hat{i} \wedge \hat{k}$

(A) $(\hat{k})$

(B) $\hat{j}$

(C) $(-\hat{k})$

(D) $(-\hat{j})$

Ans : (D)

Question

इससे हमे V_w निकालनी है

Electric field in a plane electromagnetic wave is given by $E = 50\sin(500x - 10 \times 10^{10}t)\,\text{V/m}$. The velocity of electromagnetic wave in this medium is: (Given C = speed of light in vacuum) **(JEE Main-2021)**

$$V_w = \frac{\omega}{k} = \frac{10 \times 10^{10}}{500} = \frac{10^{11}}{500} \frac{\times C}{3 \times 10^8}$$

$$= \frac{1000}{1500} C$$

$$= \frac{2}{3} C$$

(A) $\frac{3}{2}C$

(B) C

(C) $\frac{2}{3}C$

(D) $\frac{C}{2}$

Ans : (C)

Question

A plane electromagnetic wave with frequency of 30MHz travels in free space. At particular point in space and time, electric field is $6\,V/m$. The magnetic field at this point will be $x \times 10^{-8}$ T. The value of x is $= 2$ **(JEE Main-2021)**

$E = Bc$

$6 = B \times 3 \times 10^{8}$

Ans : (2)

Question

The electric field in an electromagnetic wave is given by $E = (50 N^{-1}) \sin \omega(t - x/c)$. The energy contained in a cylinder of volume V is 5.5×10^{-12} J. The value of V is cm^3

(Given $\epsilon_0 = 8.8 \times 10^{-12} C^2 N^{-1} m^{-2}$)

(JEE Main-2021)

total energy $= \frac{1}{2} \epsilon_0 E_0^2 (\text{Vol}^n)$

Ans : (500)

Question

Light wave traveling in air along x-direction is given by $E_y = 540 \sin \pi \times 10^4 (x - ct) \mathrm{Vm}^{-1}$. Then, the peak value of magnetic field of wave will be (Given $c = 3 \times 10^8 \mathrm{~ms}^{-1}$) **(JEE Main-2022)**

$E = BC$

(A) 18×10^{-7} T

$B_0 = \frac{E_0}{C}$

(B) 54×10^{-7} T

(C) 54×10^{-8} T

(D) 18×10^{-8} T

Ans : (A)

Question

Silly mistake

The oscillating magnetic field in a plane electromagnetic wave is given by $B_y = 5 \times 10^{-6} \sin 1000\pi(5x - 4 \times 10^8 t)T$. The amplitude of electric field will be:

(JEE Main-2022)

$v_\omega = \frac{\omega}{k} = \frac{4 \times 10^8}{5}$

(A) $15 \times 10^2 \text{Vm}^{-1}$

$E = 5 \times 10^{-6} \times \frac{4 \times 10^8}{5}$

(B) $5 \times 10^{-6} \text{Vm}^{-1}$

$= 400$

(C) $16 \times 10^{12} \text{Vm}^{-1}$

(D) $4 \times 10^2 \text{Vm}^{-1}$

Ans : (D)

Question

$E = BC$ $\quad \frac{E}{B} = C$ $\quad \frac{B}{E} = \frac{1}{C}$

Identify the correct statements from the following descriptions of various properties of electromagnetic waves.

A. In a plane electromagnetic wave electric field and magnetic field must be perpendicular to each other and direction of propagation of wave should be along electric field or magnetic field.

B. The energy in electromagnetic wave is divided equally between electric and magnetic fields.

C. Both electric field and magnetic field are parallel to each other and perpendicular to the direction of propagation of wave.

D. The electric field, magnetic field and direction of propagation of wave must be perpendicular to each other. $E = BC$

E. The ratio of amplitude of magnetic field to the amplitude of electric field is equal to speed of light. $= \frac{1}{C}$ $\quad \frac{B}{E} = \frac{1}{C}$

Choose the most appropriate answer from the options given below:

(JEE Main-2022)

(A) D only thon

(B) B and D only

(C) B, C and E only

(D) A, B and E only

Ans : (B)

Question

The electric field in a electromagnetic wave is given by $E = 56.6 \sin \omega(t - x/c) N^{-1}$. Find the intensity of the wave if it is propagating along x-axis in the free space. (Given $\varepsilon_0 = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$)

(JEE Main-2022)

$\frac{1}{2}\epsilon_0 E_0^2 C$

(A) $5.65 \mathrm{Wm}^{-2}$

(B) $4.24 \mathrm{Wm}^{-2}$

(C) 1.9×10^{-7}

(D) $56.6 \mathrm{Wm}^{-2}$

Ans : (B)

Question

The electromagnetic waves travel in a medium at a speed of 2.0×10^8 m/s. The relative permeability of the medium is 1.0. The relative permittivity of the medium will be: (JEE Main-2022)

$$2\times10^8 = \frac{3\times10^8}{\sqrt{1\times\epsilon_r}}$$

$$v = \frac{c}{\sqrt{\mu_r \epsilon_r}}$$

(A) 2.25

(B) 4.25

(C) 6.25

(D) 8.25

Ans : (A)

Question

Given below are two statements:

Statement I: A time varying electric field is a source of changing magnetic field and vice-versa. Thus a disturbance in electric or magnetic field creates *EM* waves.

Statement II : In a material medium. wave travels with speed $v = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ In the light of the above statements, choose the correct answer from the options given below:

(JEE Main-2022)

(A) Both statement I and statement II are true.

(B) Both statement I and statement II are false.

(C) Statement I is correct but statement II is false.

(D) Statement I is incorrect but statement II is true.

Ans : (C)

Question

The intensity of the light from a bulb incident on a surface is $0.22\ \mathrm{W/m^2}$. The amplitude of the magnetic field in this light-wave is x_____ $10^{-9}\ T$.
(Given Permittivity of vacuum $\epsilon_0 = 8.85 \times 10^{-12} C^2\, N^{-1}\, m^{-2}$, speed of light in vacuum $= 3 \times 10^8\ \mathrm{ms^{-1}}$)

(JEE Main-2022)

$$I = \frac{1}{2}\epsilon_0 E_0^2 c$$

$$E_0 = \checkmark = B_0 c$$

Ans : (43)

Question

If $\vec{E}$ and $\vec{K}$ represent electric field and propagation vectors of the EM waves in vacuum, then magnetic field vector is given by : (ω – angular frequency) :

$\hat{c}$ K

(24 January 2023 - Shift 1)

(A) $\frac{1}{\omega}(\vec{K} \times \vec{E})$

(B) $\omega(\vec{E} \times \vec{K})$

(C) $\omega(\vec{K} \times \vec{E})$

(D) $\vec{K} \times \vec{E}$

$E = E_0 \sin(\omega t - kx)$

$E\,B\,C\,E\,B\,C$

$c = \frac{\omega}{k}$

$\hat{B} = \hat{k} \times \hat{E}$

$B = \frac{E}{c} = \frac{Ek}{\omega}$

Ans : (A)

Question

The electric field and magnetic field components of an electromagnetic wave going through vacuum is described by

$E_x = E_0 \sin(kz - \omega t)$ $\qquad E_0 = B_0 \frac{\omega}{k}$

$B_y = B_0 \sin(kz - \omega t)$

Then the correct relation between E_0 and B_0 is given by **(24 January 2023 - Shift 2)**

(A) $kE_0 = \omega B_0$

(B) $E_0 B_0 = \omega k$

(C) $\omega E_0 = kB_0$

(D) $E_0 = kB_0$

Ans : (A)

Question Easy

All electromagnetic wave is transporting energy in the negative z direction. At a certain point and certain time the direction of electric field of the wave is along positive y direction. What will be the direction of the magnetic field of the wave at that point and instant?

(25 January 2023 - Shift 1)

$\hat{c} = -\hat{k}$

$\hat{E} = +\hat{j}$

$B = ?$

(A) Positive direction of x

(B) Positive direction of z

(C) Negative direction of x

(D) Negative direction of y

Ans : (A)

Question

$\varepsilon_0 = B_0 c = B_0 \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

Given below are two statements:

Statement I : Electromagnetic waves are not deflected by electric and magnetic field.

Statement II : The amplitude of electric field and the magnetic field in electromagnetic waves are related to each other as $E_0 \cancel{=} \sqrt{\frac{\mu_0}{\varepsilon_0}} B_0$

In the light of the above statements, choose the correct answer from the options given below:

(29 January 2023 - Shift 2)

(A) Statement I is true but Statement II is false

(B) Both Statement I and Statement II are true

(C) Statement I is false but Statement II is true

(D) Both Statement I and Statement II are false

Ans : (A)

Question

The ratio of average electric energy density and total average energy density of electromagnetic wave is: **(01 February 2023 - Shift 2)**

(A) 2

(B) 1 ✗

(C) 3

(D) $\frac{1}{2}$ ✓

Ans : (D)

Question

The energy density associated with electric field $\vec{E}$ and magnetic field $\vec{B}$ of an electromagnetic wave in free space is given by
(ε_0- permittivity of free space, μ_0- permeability of free space)

(06 April 2023 - Shift 2)

(A) $U_E = \frac{E^2}{2\varepsilon_0}, U_B = \frac{B^2}{2\mu_0}$

(B) $U_E = \frac{\varepsilon_0 E^2}{2}, U_B = \frac{B^2}{2\mu_0}$

(C) $U_E = \frac{\varepsilon_0 E^2}{2}, U_B = \frac{\mu_0 B^2}{2}$

(D) $U_E = \frac{E^2}{2\varepsilon_0}, U_B = \frac{\mu_0 B^2}{2}$

Ans : (B)

Question

Eom

A plane electromagnetic wave of frequency 20 MHz propagates in free space along x-direction. At a particular space and time $\vec{E} = 6.6\hat{j}\ \mathrm{V\,m^{-1}}$. What is $\vec{B}$ at this point?

(11 April 2023 - Shift 2)

$\frac{E}{C}$

(A) $2.2 \times 10^{-8}\hat{k}\mathrm{T}$

(B) $-2.2 \times 10^{-8}\hat{i}\mathrm{T}$

(C) $-2.2 \times 10^{-8}\hat{k}\mathrm{T}$

(D) $2.2 \times 10^{-8}\hat{i}\mathrm{T}$

Ans : (A)

Question

EBCEBC

In an electromagnetic wave, at an instant and at a particular position, the electric field is along the negative z-axis and magnetic field is along the positive x-axis. Then the direction of propagation of electromagnetic wave is:

(13 April 2023 - Shift 2)

(A) Positive z-axis

$E = -\hat{k}$

$B = +\hat{i}$

(B) Positive y-axis

(C) at 45° angle from positive y–axis

$\hat{c} =$

(D) Negative y-axis

Ans : (D)

Question

The amplitude of magnetic field in an electromagnetic wave propagating along y-axis is 6.0×10^{-7} T. The maximum value of electric field in the electromagnetic wave is :

(10 April 2023 - Shift 2)

$\mathcal{E} = Bc$

(A) 2×10^{15} V m^{-1}

(B) 180 V m^{-1}

(C) 6.0×10^{-7} V m^{-1}

(D) 5×10^{14} V m^{-1}

Ans : (B)

Question

$q\vec{E} + q(\vec{v} \times \vec{B})$

The electric field of a plane electromagnetic wave is given by $\vec{E} = E_0 \frac{\hat{i}+\hat{j}}{\sqrt{2}} \cos(kz + \omega t)$ at $t = 0$, a positively charged particle is at the point $(x, y, z) = \left(0, 0, \frac{\pi}{k}\right)$. If its instantaneous velocity at $(t = 0)$ is $v_0 \hat{k}$, the force acting on it due to the wave is:

(JEE Main-2020)

(A) Zero

(B) parallel to $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

(C) antiparallel to $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

(D) parallel to $\hat{k}$

Ans : (C)

Question

Intensity of sunlight is observed as 0.092 Wm^{-2} at a point in free space. What will be the peak value of magnetic field at that point? ($\varepsilon_0 = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$)

(JEE Main-2021)

(A) $2.77 \times 10^{-8}\, T$

(B) $1.96 \times 10^{-8}\, T$

(C) $8.31\, T$

(D) $5.88\, T$

$$\frac{1}{2}\epsilon_0 E_0^2 C = I$$

$$E_0 = B_0 C$$

Ans : (A)

Question

NCERT Last pg EMW

Match List-I with List-II and choose the correct answer from the options given below:

(JEE Main-2022)

List-I		List-II	
(a)	Ultraviolet rays	(i)	Study crystal structure
(b)	Microwaves	(ii)	Greenhouse effect
(c)	Infrared wave	(iii)	Sterilizing surgical
(d)	x-rays	(iv)	Radar system

Question

Match List – I with List – II of Electromagnetic wave with corresponding Wavelength range:

(15 April 2023 - Shift 1)

List-I		List-II	
(A)	Microwave	(I)	400 nm to 1 nm
(B)	Ultraviolet	(II)	1 nm to 10^{-3} nm
(C)	X- rays	(III)	1 mm to 700 nm
(D)	Infra-red	(IV)	0.1 m to 1 mm

Choose the correct answer from the option given below:

A. (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

B. (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

C. (A)-(IV), (B)-(II), (C)-(I), (D)-(III)

D. (A)-(I), (B)-(IV), (C)-(II), (D)-(III)

Ans : (A)

Question

Choose the correct option relating wavelengths of different parts of electromagnetic wave spectrum: **(JEE Main-2020)**

(A) $\lambda_{\text{x-rays}} < \lambda_{\text{micro waves}} < \lambda_{\text{radio waves}} < \lambda_{\text{visible}}$

(B) $\lambda_{\text{visible}} > \lambda_{\text{x-rays}} > \lambda_{\text{radio waves}} > \lambda_{\text{micro waves}}$

(C) $\lambda_{\text{radio waves}} > \lambda_{\text{micro waves}} > \lambda_{\text{visible}} > \lambda_{\text{x-rays}}$

(D) $\lambda_{\text{visible}} < \lambda_{\text{micro waves}} < \lambda_{\text{radio waves}} < \lambda_{\text{x-rays}}$

Ans : (C)

Question

Which is the correct ascending order of wavelengths? (JEE Main-2022)

(A) $\lambda_{visible} < \lambda_{x-ray} < \lambda_{visible} < \lambda_{microwave}$

(B) $\lambda_{gama-ray} < \lambda_{x-ray} < \lambda_{visible} < \lambda_{microwave}$

(C) $\lambda_{x-ray} < \lambda_{gamma-ray} < \lambda_{visible} < \lambda_{microwave}$

(D) $\lambda_{microwave} < \lambda_{visible} < \lambda_{gamma-ray} < \lambda_{x-ray}$

Ans : (B)

Question

Match list – I with List – II. NCERT (JEE Main-2021)

1 mark

	I		II
(a)	Source of microwave frequency	(i)	Radioactive decay on nucleus
(b)	Source of infrared frequency	(ii)	Magnetron
(c)	Source of Gamma Rays	(iii)	Inner shell electrons
(d)	Source of X-rays	(iv)	Vibration of atoms and molecules
		(v)	Laser

Choose the correct answer from the option

A. (a)-(vi), (b)-(iv), (c)-(i), (d)-(v)

B. (a)-(vi), (b)-(v), (c)-(i), (d)-(iv)

C. (a)-(ii), (b)-(iv), (c)-(vi), (d)-(iii)

D. (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

Ans : (D)

Question

A radiation is emitted by 1000 W bulb and it generates an electric field and magnetic field at P, placed at a distance of 2 m. The efficiency of the bulb is 1.25%. The value of peak electric field at P is $x \times 10 - 1$ V/m. Value of x is. (Rounded-off to the nearest integer)

[Take $\varepsilon_0 = 8.85 \times 10^{-12} C_2 N^{-1} m^{-2}, c = 3 \times 10^8 ms^{-1}$] **(JEE Main-2021)**

$$I = \frac{P \times \frac{1.25}{100}}{4\pi r^2} = \frac{1}{2}\epsilon_0 E_0^2 c$$

Ans : (137)

Question

NCERT

Lant pg

Emw

Match List –I with List–II.

(31 January 2023 - Shift 2)

them

List-I		List-II	
A.	Microwaves	I.	Physiotherapy
B.	UV rays	II.	Treatment of cancer
C.	Infra-red rays	III.	Lasik eye surgery
D.	X- rays	IV.	Aircraft navigation

Choose the correct answer from the option given below:

(A) A–II, B–IV, C–III, D–I

(B) A–IV, B–I, C–II, D–III

(C) A–IV, B–III, C–I, D–II

(D) A–III, B–II, C–I, D–IV

Ans : (C)

Question

NCER lent 18

Match the List –I with List–II. **(01 February 2023 - Shift 1)**

List-I		List-II	
A.	Microwaves	I.	Radio active decay of the nucleus
B.	Gamma rays	II.	Rapid acceleration and deceleration of electron in aerials
C.	Radio waves	III.	Inner shell electrons
D.	X- rays	IV.	Klystron valve

Choose the correct answer from the option given below:

(A) A–I, B–II, C–III, D–IV

(B) A–IV, B–I, C–II, D–III

(C) A–I, B–III, C–IV, D–II

(D) A–IV, B–III, C–II, D–I

Ans : (B)

Question

Which of the following Maxwell's equation is valid for time varying conditions but not valid for static conditions:

(13 April 2023 - Shift 1)

$\oint \varepsilon \cdot dl = A\frac{dB}{dt} = \frac{d\Phi}{dt}$

(A) $\oint \vec{B}.\vec{d}l = \mu_0 I$

(B) $\oint \vec{E}.\vec{d}l = 0$

(C) $\oint \vec{D}.\overrightarrow{dA} = Q$

(D) $\oint \vec{E}.\overrightarrow{dl} = -\frac{\partial \phi_B}{\partial t}$

Ans : (D)

modern physics

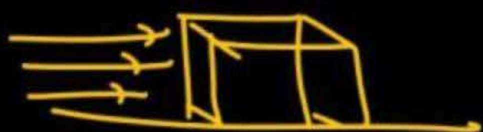
- Radiation Pressure photon theory
- photoelectric
- Bohr Model
- X-ray
- Nuclear physics

$\Delta E = \Delta m c^2$

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

$E = \frac{hc}{\lambda} = \frac{1240}{\lambda} eV \quad = \frac{12400}{\lambda} eV$

$\lambda \rightarrow (nm) \qquad \lambda \rightarrow A^{o}$



$a = 1$

$P = I/c$

$r = 1$

$P = \frac{2I}{c}$

$E = \phi + (KE)_{max}$

$E = \frac{hc}{\lambda} = h\nu$

$\phi = \frac{hc}{\lambda_0} = h\nu_0$

$(KE)_{max} = eV_0$

$V_0 \rightarrow$ stopping pot.

Bohr model

- $r_n \propto \frac{n^2}{Z}$
- $v_n \propto \frac{Z}{n}$
- $mvr = \frac{nh}{2\pi}$
- $\frac{kZe\,e}{r^2} = \frac{mv^2}{r}$

- $E = -13.6\frac{Z^2}{n^2}$
- $\Delta E = 13.6\,Z^2\left(\frac{1}{n^2_{\text{छोटा}}} - \frac{1}{n^2_{\text{बड़ा}}}\right) = \frac{1240}{\lambda}$

Lymal $n \longrightarrow n=1$

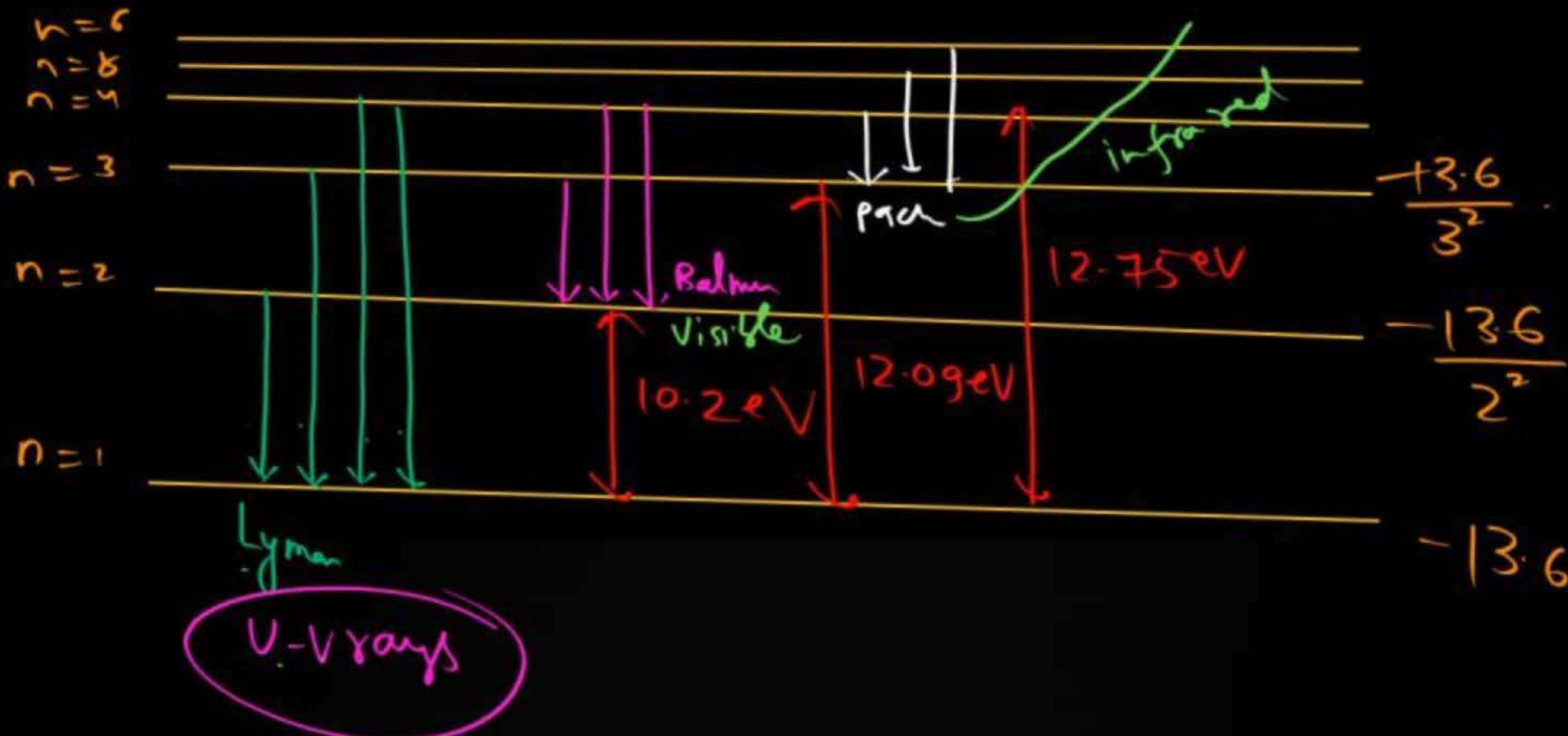
Balm $n \longrightarrow n=2$

Pan $\longrightarrow n=3$

2^{nd} line of balmer $= \dfrac{1240}{\lambda} = 13.6 \times 1^2\left(\dfrac{1}{2^2} - \dfrac{1}{4^2}\right)$

$4 \longrightarrow 2$

$Z = 1$

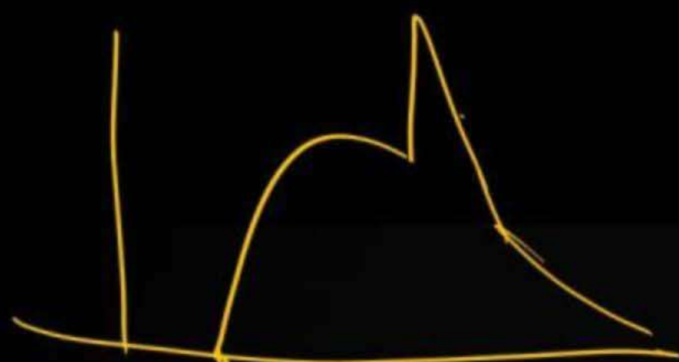


X-ray

$$\lambda_{min} = \frac{1240}{V_0} \text{ (nm)}$$

V_0 → वोल्ट

$$\Delta E = \frac{hc}{\lambda} = 13.6 (Z-b)^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

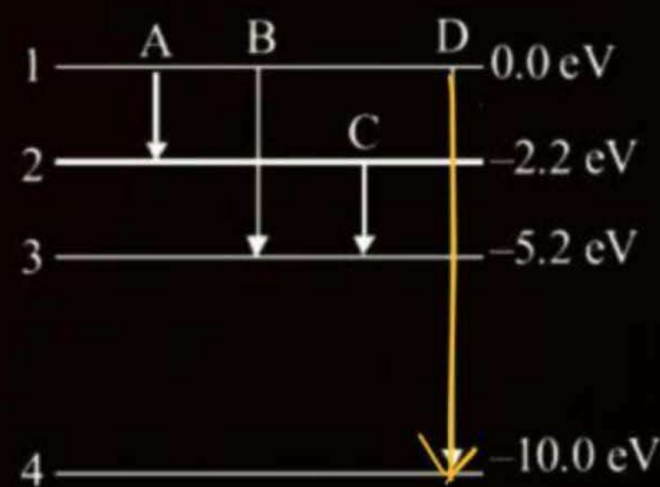


QUESTION

The energy levels of an atom is shown is figure. Which one of these transitions will result in the emission of a photon of wavelength 124.1 nm?
Given ($h = 6.62 \times 10^{-34}$ Js)

(25 January 2023 - Shift 2)

$$E = \frac{1240}{124.1} = 10\,eV$$



(1) B

(2) A

(3) C

(4) D

Ans. (4)

QUESTION

Speed of an electron in Bohr's 7^{th} orbit for Hydrogen atom is 3.6×10^6 m/s. The corresponding speed of the electron in 3^{rd} orbit, in m/s is: **(30 January 2023 - Shift 1)**

(1) (1.8×10^6)

(2) (7.5×10^6)

(3) (3.6×10^6)

(4) (8.4×10^6)

$$v \propto \frac{Z}{n}$$

$$\frac{v_1}{v_2} = \frac{n_2}{n_1}$$

$$\frac{3.6 \times 10^6}{v_2} = \frac{3}{7}$$

Ans. (4)

QUESTION

For hydrogen atom, λ_1 and λ_2 are the wavelengths corresponding to the transitions 1 and 2 respectively as shown in figure. The ratio of λ_1 and λ_2 is $\frac{x}{32}$. The value of x 27 is ________.

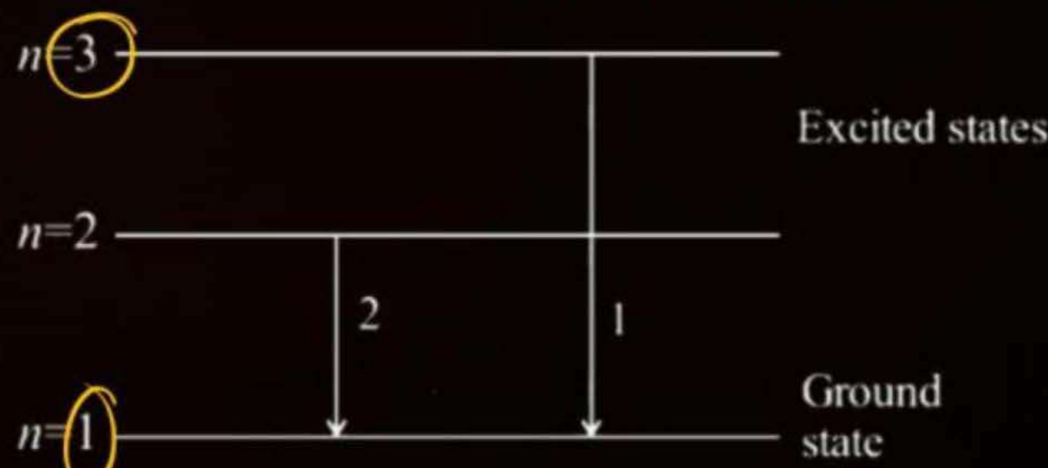
(31 January 2023 - Shift 1)

$$\frac{hc}{\lambda_1} = 13.6\,Z^2\left(\frac{1}{1^2}-\frac{1}{3^2}\right)$$

$$\frac{hc}{\lambda_2} = 13.6\,Z^2\left(\frac{1}{1^2}-\frac{1}{2^2}\right)$$

$$\frac{\lambda_2}{\lambda_1} = \frac{8\times 4}{9\times 3} = \frac{32}{27}$$

$$\frac{\lambda_1}{\lambda_2} = \frac{27}{\cancel{32}} = \frac{x}{\cancel{32}}$$



Ans. (27)

QUESTION

The radius of electron's second stationary orbit in Bohr's atom is R. The radius of 3^{rd} orbit will be ______.

(31 January 2023 - Shift 2)

1. R/3
2. 2.25R
3. 3R
4. 9R

$$r \propto \frac{n^2}{Z}$$

$$\frac{r_1}{r_2} = \frac{4}{9}$$

$$r_2 = \frac{9}{4} r_1$$

Ans. (2)

QUESTION

If the binding energy of ground state electron in a hydrogen atom is 13.6eV, then, the energy required to remove the electron from the second excited state of Li^{2+} will be: $x \times 10^{-1}$ eV. The value of x is 136.

(31 January 2023 - Shift 2)

$n = 3$

$Z = 3$

$$E = 13.6 \frac{Z^2}{n^2}$$

$$E = 13.6 \times \frac{3^2}{3^2} = 13.6 = 136 \times 10^{-1}$$

Ans. (136)

QUESTION

The mass of proton, neutron and helium nucleus are respectively 1.0073 u, 1.0087 u and 4.0015 u. The binding energy of helium nucleus is ______.

(01 February 2023 - Shift 1)

(1) 14.2 MeV

(2) 28.4 MeV

(3) 56.8 MeV

(4) 7.1 MeV

$$\begin{array}{r} 4.0320 \\ 4.0015 \\ \hline .0305 \end{array} \times 931.5 \qquad {}^4_2He \qquad \frac{503 \times 9315}{1000} = 27.945$$

$$\begin{matrix} p\ p \\ n\ n \end{matrix} \longrightarrow {}^4_2He + BE$$

free

$$BE = \left[(2m_p + 2m_n) - m_{He}\right] \times 931.5$$

$$= 2(2.0160 - 4.0015) \times 931.5$$

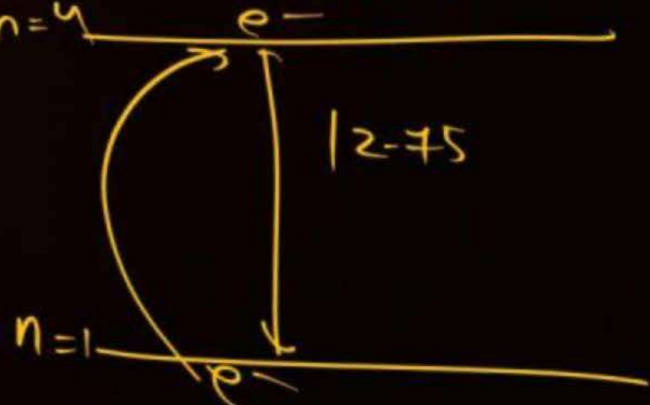
Ans. (2)

QUESTION

A light of energy 12.75eV is incident on a hydrogen atom in its ground state. The atom absorbs the radiation and reaches to one of its excited states. The angular momentum of the atom in the excited state is $\frac{x}{\pi} \times 10^{-17}$ eVs. The value of x is ______.
(use $h = 4.14 \times 10^{-15}$ eVs, $c = 3 \times 10^{8}\ ms^{-1}$).

(01 February 2023 - Shift 1)

$$\frac{nh}{2\pi} = \frac{4h}{2\cancel{\pi}} = \frac{x}{\cancel{\pi}} \times 10^{-17}$$



$$x = 2h \times 10^{17}$$

$$= 2 \times 4.14 \times 10^{-15} \times 10^{17}$$

$$= 828$$

Ans. (828)

QUESTION

Nucleus a having Z = 17 and equal number of protons and neutrons has 1.2MeV binding energy per nucleon.

Another nucleus B of Z = 12 has total 26 nucleons and 1.8MeV binding energy per nucleons.

The difference of binding energy of B and A will be MeV. **(01 February 2023 - Shift 2)**

$26 \times 1.8 - 34 \times 1.2$

Ans.

QUESTION

The energy levels of an hydrogen atom are shown below. The transition corresponding to emission of shortest wavelength is ____. **(06 April 2023 - Shift 1)**

(1) D

(2) A

(3) B

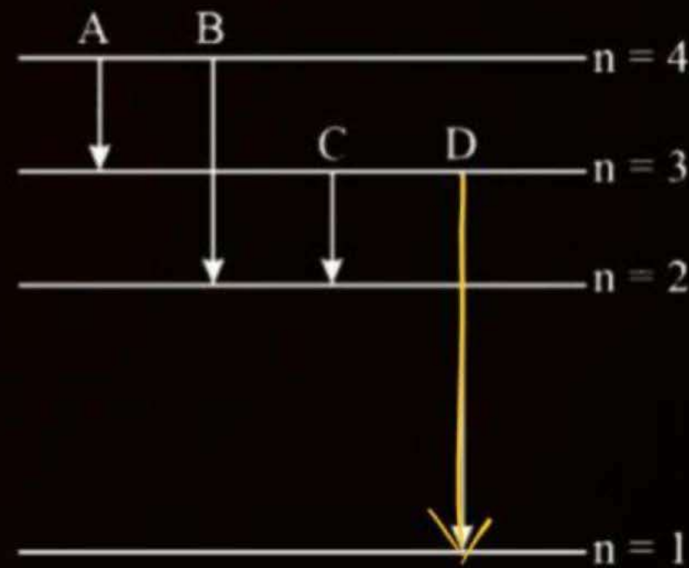
(4) C

(A) D

(B) A

(C) B

(D) C



Ans. (1)

QUESTION

The radius of fifth orbit of Li^{++} is 425 $\times 10^{-12}$ m. Take: radius of hydrogen atom = 0.51Å

(06 April 2023 - Shift 1)

$$r \propto \frac{n^2}{z}$$

$$\frac{r_2}{r_1} = \left(\frac{n_2}{n_1}\right)^2 \times \frac{z_1}{z_2}$$

$$\frac{r_2}{.51} = \left(\frac{5}{1}\right)^2 \times \frac{1}{3}$$

$$r_2 = \frac{25 \times \cancel{.51}^{.17} \times 10^{-10}}{\cancel{3}}$$

$$= 25 \times 17 \times 10^{-12}$$

$$= 425 \times 10^{-12}$$

17

Ans. (425)

QUESTION

27

The ratio of wavelength of spectral lines H_α and H_β in the Balmer series is $\frac{x}{20}$. The value of x is ________.

(08 April 2023 - Shift 2)

$\lambda_1 \Rightarrow 3 \longrightarrow 2$

$\lambda_2 \Rightarrow 4 \longrightarrow 2$

$$\frac{hc}{\lambda_1} = 13.6 z^2 \left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

$$\frac{hc}{\lambda_2} = 13.6 z^2 \left(\frac{1}{2^2} - \frac{1}{4^2}\right)$$

$$\frac{\lambda_2}{\lambda_1} = \frac{\frac{1}{4} - \frac{1}{9}}{\frac{1}{4} - \frac{1}{16}}$$

$$\frac{\lambda_2}{\lambda_1} = \frac{5 \times 16}{36 \times 3}$$

$$\frac{\lambda_1}{\lambda_2} = \frac{36 \times 3}{80} = \frac{9 \times 3}{20}$$

Ans. (27)

QUESTION

The angular momentum for the electron in Bohr's orbit is L. If the electron is assumed to revolve in second orbit of hydrogen atom, then the change in angular momentum will be ______.

(10 April 2023 - Shift 1)

(1) Zero

(2) 2L

(3) L

(4) $\frac{L}{2}$

Ans. (3)

QUESTION

E_{max} $n=\infty \longrightarrow n=1$

If 917Å be the lowest wavelength of Lyman series then the lowest wavelength of Balmer series will be Å.

(10 April 2023 - Shift 2)

$$\frac{12400}{917} = 13.6\,z^2\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right)$$

$$\frac{12400}{\lambda} = 13.6\,z^2\left(\frac{1}{2^2} - \frac{1}{\infty^2}\right)$$

$$\frac{\cancel{12400}}{\lambda} = \frac{1}{4} \times \frac{\cancel{12400}}{917}$$

$$\lambda = 917 \times 4$$

$$= 3668$$

Ans. (3668)

QUESTION

$Z=2$ $\quad$ $n=2$

The energy of He$^+$ ion in its first state is, (The ground state energy for the Hydrogen atom –13.6 eV):

(11 April 2023 - Shift 2)

$$E = -13.6 \times \frac{\cancel{2}^2}{\cancel{2}^2} = -13.6$$

(1) -27.2 eV

(2) -3.4 eV

(3) -13.6 eV

(4) -54.4 eV

Ans. (3)

QUESTION

The radius of 2^{nd} orbit of He^+ of Bohr's model is r_1 and that of fourth orbit of Be^{3+} is represented as r_2. Now the ratio $\frac{r_2}{r_1}$ is x : 1. The value of x is ____.

(13 April 2023 - Shift 1)

$$\frac{r_2}{r_1} = \left(\frac{n_2}{n_1}\right)^2 \frac{Z_1}{Z_2} = \left(\frac{4}{2}\right)^2 \times \frac{2}{4}$$

$$= 4 \times \frac{1}{2} = 2$$

$x = 2$

He^+ (1)	(2)
$n_1 = 2$	$n_2 = 4$
$Z_1 = 2$	$Z_2 = 4$

Ans. (2)

Dual Nature of Radiation and Matter

$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2m(K.E)}} = \frac{h}{\sqrt{2m(eV)}}$$

$H \equiv m.$

deuteron $\equiv 2m$

$\alpha \equiv 4m.$

|| photoelectric

QUESTION

From the photoelectric effect experiment, following observations are made. Identify which of these are correct

A. The stopping potential depends only on the work function of the metal. $f \rightarrow$ same

B. The saturation current increases as the intensity of incident light increases. $N\uparrow$ $i_s\uparrow$

C. The maximum kinetic energy of a photo electron depends on the intensity of the incident light. $E = \phi + (KE)_{max}$

D. Photoelectric effect can be explained using wave theory of light.

Choose the correct answer from the options given below:

(24 January 2023 - Shift 1)

(1) B, C only

(2) A, C, D only

(3) B only

(4) A, B, D only

Ans. (3)

QUESTION

An α-particle, a proton and an electron have the same kinetic energy. Which one of the following is correct in case of their De-Broglie wavelength:

(24 January 2023 - Shift 2)

$$\lambda = \frac{h}{\sqrt{2m(KE)}}$$

(1) $\lambda_\alpha > \lambda_p > \lambda_e$ ✗

(2) $\lambda_\alpha < \lambda_p < \lambda_e$

$m\downarrow \ \lambda\uparrow$

(3) $\lambda_\alpha = \lambda_p = \lambda_e$

(4) $\lambda_\alpha > \lambda_p < \lambda_e$

Ans. (2)

QUESTION

Electron beam used in an electron microscope, when accelerated by a voltage of 20kV. has a de-Broglie wavelength of λ_0. If the voltage is increased to 40kV. then the de-Broglie wavelength associated with the electron beam would be:

(25 January 2023 - Shift 1)

$\lambda_0 = \frac{h}{\sqrt{2m\,eV_0}}$

double

$\frac{\lambda_0}{\sqrt{2}}$

1. $3\lambda_0$
2. $9\lambda_0$
3. $\frac{\lambda_0}{2}$
4. $\frac{\lambda_0}{\sqrt{2}}$

Ans. (4)

QUESTION

$(4m, 2e)$ (m, e)

The ratio of de-Broglie wavelength of an α-particle and a proton accelerated from rest by the same potential is $\frac{1}{\sqrt{m}}$, the value of m is ______. **(29 January 2023 - Shift 2)**

(1) 4

(2) 16

(3) 8

(4) 2

$$\lambda = \frac{h}{\sqrt{(2m)qV_0}}$$

same

$$\frac{\lambda_\alpha}{\lambda_p} = \sqrt{\frac{m_p q_p}{m_\alpha q_\alpha}} = \sqrt{\frac{m\,e}{4m\,2e}}$$

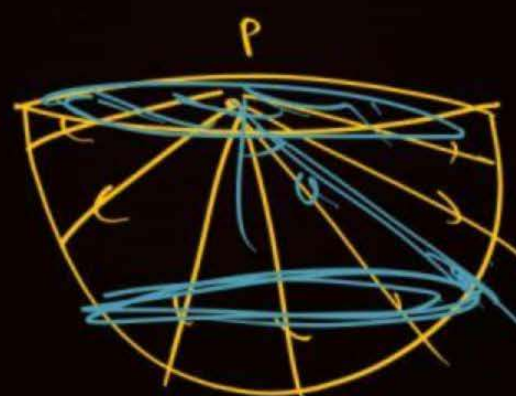
Ans. (3)

QUESTION

A point source of light is placed at the centre of curvature of a hemispherical surface. The source emits a power of 24W The radius of curvature of hemisphere is 10cm and the inner surface is completely reflecting. The force on the hemisphere due to the light falling on it is ______ $\times 10^{-8}$ N.

(30 January 2023 - Shift 1)

$$\frac{2I}{c} \times \pi R^2$$



$$\int dF = \int P\, dA \cos\theta$$

$$= \frac{2I}{c} \pi R^2$$

Ans. (4)

QUESTION

$\lambda_1 = 100$
$\lambda_2 = 150$

An electron accelerated through a potential difference V_1 has a de-Broglie wavelength of λ. When the potential is changed to V_2, its de-Broglie wavelength increases by 50%. The value of $\left(\frac{V_1}{V_2}\right)$ is equal to :

(30 January 2023 - Shift 2)

(1) 3

(2) 9/4

(3) 3/2

(4) 4

$$\lambda = \frac{h}{\sqrt{2mqV_1}}$$

$$1.5\lambda = \frac{h}{\sqrt{2mqV_2}}$$

$$\frac{1}{1.5} = \sqrt{\frac{V_2}{V_1}}$$

$$(1.5)^2 = \frac{V_1}{V_2}$$

$$\left(\frac{15}{10}\right)^2 = \frac{V_1}{V_2}$$

$$\frac{9}{4} = \frac{V_1}{V_2}$$

Ans. (2)

QUESTION

If the two metals A and B are exposed to radiation of wavelength 350nm. The work functions of metals A and B are 4.8eV and 2.2eV. Then choose the correct option.

(31 January 2023 - Shift 2)

$$\varepsilon = \frac{124\cancel{0}}{35\cancel{0}} = \frac{124}{35}$$

$35)\ 124\ (3.$
$\ \ \ \ \ \ 105$
$\ \ \ \ \ \ 190$

1. Metal B will not emit photo-electrons
2. Both metals A and B will emit photo-electrons
3. Both metals A and B will not emit photoelectrons
4. Metal A will not emit photo-electrons

Ans. (4)

QUESTION

A proton moving with one tenth of velocity of light has a certain de Broglie wavelength of λ. An alpha particle having certain kinetic energy has the same de-Brogle wavelength λ. The ratio of kinetic energy of proton and that of alpha particle is:

(01 February 2023 - Shift 1)

(1) 2 : 1

(2) 4 : 1

(3) 1 : 2

(4) 1 : 4

$$\lambda = \frac{h}{\sqrt{2m(K.E)}}$$

Same

$$m_p (KE)_p = m_\alpha (KE)_\alpha$$

$$\frac{(KE)_p}{(KE)_\alpha} = \frac{m_\alpha}{m_p} = \frac{4\cancel{m}}{\cancel{m}} = 4$$

Ans. (2)

QUESTION

$\phi = hf_0$

The threshold frequency of metal is f_0. When the light of frequency $2f_0$ is incident on the metal plate, the maximum velocity of photoelectron is v_1. When the frequency of incident radiation is increased to $5f_0$. the maximum velocity of photoelectrons emitted is v_2. The ratio of v_1 to v_2 is: **(01 February 2023 - Shift 2)**

1. $\frac{v_1}{v_2} = \frac{1}{2}$
2. $\frac{v_1}{v_2} = \frac{1}{8}$
3. $\frac{v_1}{v_2} = \frac{1}{16}$
4. $\frac{v_1}{v_2} = \frac{1}{4}$

$h2f_0 = hf_0 + \frac{1}{2}mv_1^2$

$h5f_0 = hf_0 + \frac{1}{2}mv_2^2$

$hf_0 = \frac{1}{2}mv_1^2$

$4hf_0 = \frac{1}{2}mv_2^2$

Ans. (1)

QUESTION

The kinetic energy of an electron, α-particle and a proton are given as 4K, 2K and K respectively. The de-Broglie wavelength associated with electron (λ_e), α-particle (λ_α) and the proton (λ_p) are as follows: **(06 April 2023 - Shift 1)**

$$\lambda = \frac{h}{\sqrt{2m\,KE}}$$

e	p	α
4K	K	2K
m_e	m	4m

(1) $\lambda_\alpha = \lambda p > \lambda_e$ ✗

(2) $\lambda_\alpha < \lambda p < \lambda_e$

(3) $\lambda_\alpha = \lambda p < \lambda_e$

(4) $\lambda_\alpha > \lambda p > \lambda_e$ ✗

Ans. (2)

QUESTION

The work functions of Aluminium and Gold are 4.1eV and 5.1eV respectively. The ratio of the slope of the stopping potential versus frequency plot for Gold to that of Aluminium is ______.

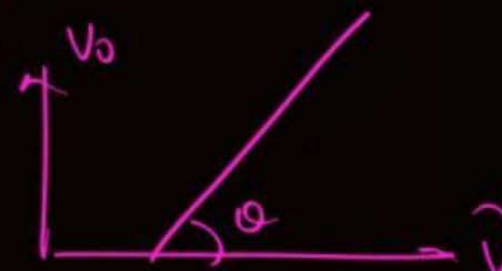
(06 April 2023 - Shift 2)

$$E = \phi + (KE)_{max}$$

$$h\nu = \phi + eV_0$$

$$V_0 = \frac{h\nu}{e} - \frac{\phi}{e}$$

$$\tan\theta = \frac{h}{e}$$



1. 1.24
2. 2
3. 1
4. 1.5

Ans. (3)

QUESTION

In photoelectric effect

A. The photocurrent is proportional to the intensity of the incident radiation.

B. Maximum kinetic energy with which photoelectrons are emitted depends on the intensity of incident light.

C. Max K.E. with which photoelectrons are emitted depends on the frequency of incident light.

freq

D. The emission of photoelectrons require a minimum threshold intensity of incident radiation.

E. Max K.E. of the photoelectrons is independent of the frequency of the incident light.

Choose the correct answer from the options given below: **(08 April 2023 - Shift 2)**

(1) A and B only

(2) A and E only

(3) A and C only

(4) B and C only

Ans. (3)

QUESTION

$\frac{33}{1.6} \times 10^{-1} = \frac{33}{16}$

The variation of stopping potential (V_0) as a function of the frequency (ν) of the incident light for a metal is shown in figure. The work function of the surface is

(10 April 2023 - Shift 2)

$E = \phi + (KE)_{max}$

$h\nu = \phi + eV_0$

$\frac{h\nu}{e} = \frac{\phi}{e} + V_0$

$\boxed{V_0 = \frac{h\nu}{e} - \frac{\phi}{e}}$

$V_0 = 0, \quad \frac{h\nu}{\cancel{e}} = \frac{\phi}{\cancel{e}}$

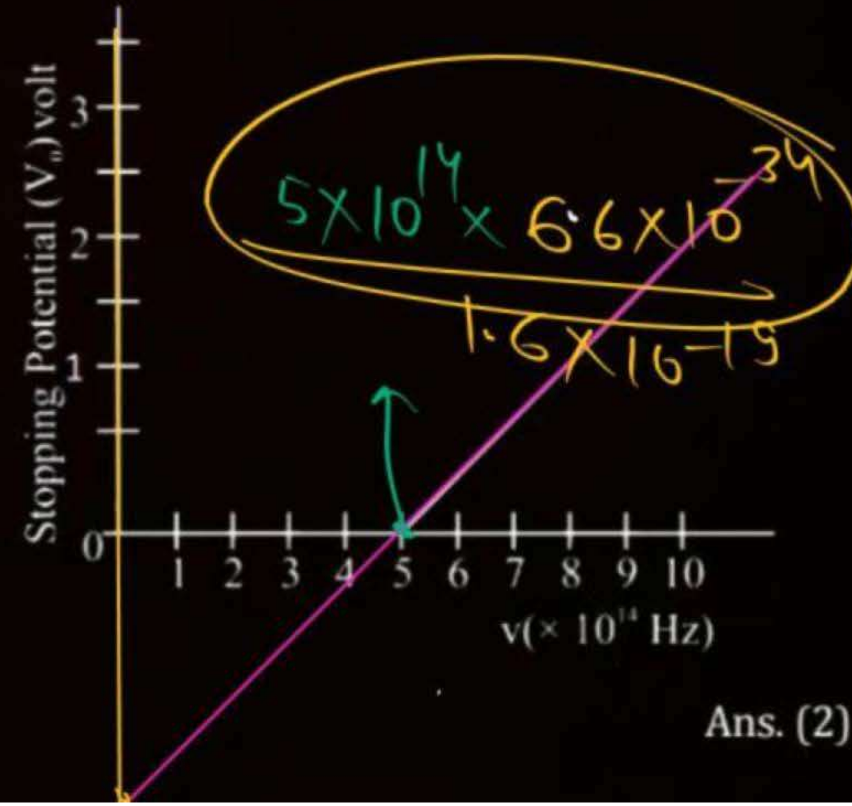
$\phi = h\nu$

(1) 2.98 eV

(2) 2.07 eV

(3) 1.36 eV

(4) 18.6 eV



Ans. (2)

QUESTION

A metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V_0. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential becomes $\frac{V_0}{4}$. The threshold wavelength for this metallic surface will be ______.

(11 April 2023 - Shift 1)

(1) 3λ

(2) 4λ

(3) $\frac{3}{2}\lambda$

(4) $\frac{\lambda}{4}$

$$\frac{hc}{\lambda} = \phi + eV_0 \qquad \frac{hc}{\lambda} - \phi = eV_0$$

$$\frac{hc}{2\lambda} = \phi + e\frac{V_0}{4} \qquad \frac{hc}{2\lambda} - \phi = \frac{eV_0}{4}$$

$$\frac{1}{\lambda} - \frac{1}{\lambda_0} = \frac{4}{2\lambda} - \frac{4}{\lambda_0} \qquad \frac{\frac{\cancel{hc}}{\lambda} - \frac{hc}{\lambda_0}}{\frac{hc}{2\lambda} - \frac{\cancel{hc}}{\lambda_0}} = 4$$

$$\frac{3}{\lambda_0} = \frac{1}{\lambda} \qquad \lambda_0 = 3\lambda$$

Ans. (1)

QUESTION

The ratio of the de-Broglie wavelengths of proton and electron having same kinetic energy: (Assume $m_p = m_e \times 1849$) (11 April 2023 - Shift 2)

(1) 1 : 43

(2) 1 : 30

(3) 1 : 62

(4) 2 : 43

$\lambda = \frac{h}{\sqrt{2m\,KE}}$

$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{m_2}{m_1}}$

$$\begin{array}{r} 43 \\ \times\ 43 \\ \hline 129 \\ 172\ \ \\ \hline 1849 \end{array}$$

Ans. (1)

QUESTION

Sol:

A proton and an α-particle are accelerated from rest by 2V and 4V potentials, respectively. The ratio of their de-Broglie wavelength is : (12 April 2023 - Shift 1)

$$\lambda = \frac{h}{\sqrt{2mq\Delta V}}$$

(1) 8 : 1

(2) 2 : 1

(3) 4 : 1

(4) 16 : 1

Ans. (3)

QUESTION

$$\phi = \frac{1240}{\lambda}$$

The difference between threshold wavelengths for two metal surfaces A and B having work function $\phi_A = 9eV$ and $\phi_B = 4.5eV$ in nm is: {Given, hc = 1242eVnm}

(13 April 2023 - Shift 1)

$$\left| \frac{1240}{9} - \frac{1240 \times 2}{4.5 \times 2} \right|$$

$$\frac{1240}{9} = 138$$

(1) 540

(2) 276

(3) 264

(4) 138

Ans. (4)

QUESTION

The de Broglie wavelength of an electron having kinetic energy E is λ. If the kinetic energy of electron becomes $\frac{E}{4}$, then its de-Broglie wavelength will be:

(15 April 2023 - Shift 1)

$$\lambda = \frac{h}{\sqrt{2m(K.E)}}$$

(1) $\sqrt{2}\lambda$

(2) $\frac{\lambda}{\sqrt{2}}$

(3) $\frac{\lambda}{2}$

(4) 2λ

Ans. (4)

QUESTION

The ratio of the density of oxygen nucleus ($^{16}_{8}O$) and helium nucleus ($^{4}_{2}He$) is ____.

(25 January 2023 - Shift 1)

1. $4:1$
2. $8:1$
3. $1:1$
4. $2:1$

Ans. (3)

QUESTION

A nucleus with mass number 242 and binding energy per nucleon as 7.6MeV breaks into two fragment each with mass number 121. If each fragment nucleus has binding energy per nucleon as 8.1MeV, the total gain in binding energy is _____ MeV.

(08 April 2023 - Shift 1)

$$\left|\left(7.6\times 242 - 121\times 8.1\times 2\right)\right|$$

Ans. (121)

QUESTION

$$^{238}_{92}A \rightarrow {}^{234}_{90}B + {}^{4}_{2}D + Q$$

In the given nuclear reaction, the approximate amount of energy released will be:
[Given, mass of $^{238}_{92}A = 238.05079 \times 931.5\,MeVc^{-2}$, mass of $^{234}_{90}B = 234.04363 \times 931.5\,MeVc^{-2}$, mass of $^{4}_{2}D = 4.00260 \times 931.5\,MeVc^{-2}$]

(13 April 2023 - Shift 1)

(1) 3.82MeV

(2) 5.9MeV

(3) 2.12MeV

(4) 4.25MeV

$$\frac{4.00260}{238.04623}$$

$$238.05079 = m_R$$
$$238.04623 = m_P$$
$$\frac{00456}{100000} \times 931.5$$

$$931 \times 456 = 5586 + 4655\times + 3724\times\times = 4.24536$$

Ans. (4)

Q.

A beam of electromagnetic radiation of intensity 6.4×10^{-5} W/cm^2 is comprised of wavelength, $\lambda = 310$ nm. It falls normally on a metal (work function $\varphi = 2$eV) of surface area of 1 cm^2. If one in 10^3 photons ejects an electron, total number of electrons ejected in 1 s is 10^x. ($hc = 1240$eVnm, 1eV = 1.6×10^{-19} J), then x is______.

(JEE Main-2020)

$$n_0 f e^- = \frac{I A \times t}{\frac{hc}{\lambda} \times 1000}$$

1000 phot $\longrightarrow$ 1

1 $\longrightarrow$ $\frac{1}{1000}$

Ans : (11)

Q.

An electron (of mass m) and a photon have the same energy E in the range of a few eV. The ratio of the de-Broglie wavelength associated with the electron and the wavelength of the photon is (c = speed of light in vacuum) **(JEE Main-2020)**

A $\left(\frac{E}{2m}\right)^{1/2}$

B $\frac{1}{c}\left(\frac{E}{2m}\right)^{1/2}$

C $c(2mE)^{1/2}$

D $\frac{1}{c}\left(\frac{2E}{m}\right)^{1/2}$

Ans : (B)

Q.

An electron (of mass m) and a photon have the same energy E in the range of a few eV. The ratio of the de-Broglie wavelength associated with the electron and the wavelength of the photon is (c = speed of light in vacuum) **(JEE Main-2020)**

A. $\left(\frac{E}{2m}\right)^{1/2}$

B. $\frac{1}{c}\left(\frac{E}{2m}\right)^{1/2}$

C. $c(2mE)^{1/2}$

D. $\frac{1}{c}\left(\frac{2E}{m}\right)^{1/2}$

e^-: $E = \frac{1}{2}mv^2$

photon: $E = \frac{hc}{\lambda}$

$\lambda = \frac{hc}{E}$

$$\frac{\lambda_{e^-}}{\lambda_p} = \frac{\cancel{h}}{\sqrt{2m(K.E)}} \times \frac{E}{\cancel{h}c}$$

$$= \frac{E}{\sqrt{2mE}\cdot c}$$

$$= \sqrt{\frac{E}{2m}} \times \frac{1}{c}$$

Ans : (B)

Q.

When radiation of wavelength λ is used to illuminate a metallic surface, the stopping potential is V. When the same surface is illuminated with radiation of wavelength 3λ, the stopping potential is $V/4$. If the threshold wavelength for the metallic surface is nλ then value of n will be ______. (JEE Main-2020)

$$\frac{hc}{\lambda} = \phi + eV$$

$$\frac{hc}{3\lambda} = \phi + \frac{eV}{4}$$

$$\frac{\frac{hc}{\lambda} - \frac{hc}{\lambda_0}}{\frac{hc}{3\lambda} - \frac{hc}{\lambda_0}} = 4$$

Ans : (9)

Q.

Particle A of mass $m_A = m/2$ moving along the x-axis with velocity v_0 collides elastically with another particle B at rest having mass $m_B = m/3$. If both particles move along the x-axis after the collision, the change $\Delta\lambda$ in de-Broglie wavelength of particle A, in terms of its de-Broglie wavelength (λ_0) before collision is: **(JEE Main-2020)**

A $\Delta\lambda = 4\lambda_0$

B $\Delta\lambda = \frac{5}{2}\lambda_0$

C $\Delta\lambda = 2\lambda_0$

D $\Delta\lambda = \frac{3}{2}\lambda_0$

Ans : (A)

Q.

An electron, a doubly ionized helium ion (He^{++}) and a proton are having the same kinetic energy. The relation between their respective de-Broglie wavelengths λ_e, $\lambda_{He^{++}}$ and λ_p is: **(JEE Main-2020)**

A $\lambda_e < \lambda_p < \lambda_{He^{++}}$

B $\lambda_p < \lambda_{He^{++}} = \lambda_p$

$$\lambda = \frac{h}{\sqrt{2m(K.E)}}$$

C $\lambda_e > \lambda_{He^{++}} > \lambda_p$

D $\lambda_e > \lambda_p > \lambda_{He^{++}}$

Ans : (D)

Q.

Given below are two statements:

Statement-I: Two photons having equal linear momenta have equal wavelengths.

Statement-II: If the wavelength of photon is decreased, then the momentum and energy of a photon will also decrease.

In the light of the above statements, choose the correct answer from the options given below. **(JEE Main-2021)**

A Both Statement I and Statement II are true

B Statement I is false but Statement II is true

C Both Statement I and Statement II are false

D Statement I is true but Statement II is false

Ans : (D)

Q.

The de Broglie wavelength of a proton and α-particle are equal. The ratio of their velocities is:

(JEE Main-2021)

A $4:3$

B $4:1$

C $4:2$

D $1:4$

Ans : (B)

Q. An α particle and a proton are accelerated from rest by a potential difference of 200 V. After this, their de Broglie wavelengths are λ_α and λ_p respectively. The ratio λ_p/λ_α is: **(JEE Main-2021)**

A 3.8

B 8

C 7.8

D 2.8

Ans : (D)

Q.

An electron of mass m_e and a proton of mass $m_P = 1836\, m_e$ are moving with the same speed. The ratio of their de Broglie wavelength $\frac{\lambda_{electron}}{\lambda_{proton}}$ will be:

(JEE Main-2021)

A 1836

B 1

C 918

D 1/1836

Ans : (A)

Q. The de-Broglie wavelength associated with an electron and a proton were calculated by accelerating them through same potential of 100 V. What should nearly be the ratio of their wavelengths? ($m_p = 1.00727\, u$, $m_e = 0.00055u$)

(JEE Main-2021)

A $1860 : 1$

B $(1860)^2 : 1$

C $41.4 : 1$

D $43 : 1$

Ans : (D)

Q.

An electron of mass m_e and a proton of mass m_p are accelerated through the same potential difference. The ratio of the de-Broglie wavelength associated with the electron to that with the proton is :- (JEE Main-2021)

A $\frac{m_p}{m_e}$

B 1

C $\sqrt{\frac{m_p}{m_e}}$

D $\frac{m_e}{m_p}$

$$\lambda = \frac{h}{\sqrt{2mq\Delta V}}$$

Ans : (C)

Q. What should be the order of arrangement of de-Broglie wavelength of electron (λ_e), an a-particle (λ_α) and proton (λ_P) given that all have the same kinetic energy? **(JEE Main-2021)**

A $\lambda_e = \lambda_p = \lambda_\alpha$

B $\lambda_e < \lambda_p < \lambda_\alpha$

C $\lambda_e > \lambda_p > \lambda_\alpha$

D $\lambda_e = \lambda_p > \lambda_\alpha$

Ans : (C)

Q.

A particle of mass 9.1×10^{-31} kg travels in a medium with a speed of 10^6 m/s and a photon of a radiation of linear momentum 10^{-27} kg m/s travels in vacuum. The wavelength of photon is ______ times the wavelength of the particle.

(JEE Main-2021)

Ans : (910)

Q.

A moving proton and electron have the same de-Broglie wavelength. If K and P denote the K.E. and momentum respectively. Then choose the correct option:

(JEE Main-2021)

A $K_p < Ke$ and $P_p = P_e$

B $K_p = K_e$ and $P_p = P_e$

C $K_p < K_e$ and $P_p < P_e$

D $K_p > K_e$ and $P_p = P_e$

Ans : (A)

Q. The ratio of de-Broglie wavelengths of proton and deuteron accelerated by potential V_P and V_d is $1 : \sqrt{2}$. Then the ratio of V_P to V_d will be **(JEE Main-2022)**

A $1 : 1$

B $\sqrt{2} : 1$

C $2 : 1$

D $4 : 1$

Ans : (D)

Q. A proton, a neutron, an electron and an α-particle have same energy. If λ_p, λ_n, λ_e and λ_α are the de-Broglie's wavelength of proton, neutron, electron and α particle respectively, then choose the correct relation from the following:

(JEE Main-2022)

A $\lambda_P = \lambda_n > \lambda_e > \lambda_\alpha$

B $\lambda_\alpha < \lambda_n < \lambda_p < \lambda_e$

C $\lambda_e < \lambda_p = \lambda_n > \lambda_\alpha$

D $\lambda_e = \lambda_p = \lambda_n = \lambda_\alpha$

Ans : (B)

Q.

An α particle and a carbon 12 atom has same kinetic energy K. the ratio of their de-Broglie wavelength $(\lambda_a : \lambda_{C12})$ is : **(JEE Main-2022)**

A $1 : \sqrt{3}$

B $\sqrt{3} : 1$

C $3 : 1$

D $2 : \sqrt{3}$

Ans : (B)

Q.

The de-Broglie wavelength for an electron and a photon are λ_e and λ_p respectively. For the same kinetic energy of electron and photon. Which of the following presents the correct relation between the de-Broglie wavelength of two?

(JEE Main-2022)

A $\lambda_p \propto \lambda_e^2$

B $\lambda_p \propto \lambda_e$

C $\lambda_p \propto \sqrt{\lambda_e}$

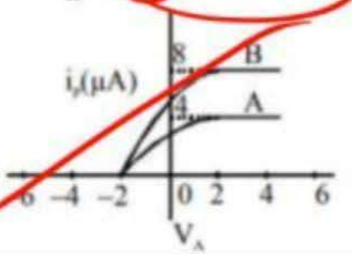
D $\lambda_p \propto \sqrt{\frac{1}{\lambda_e}}$

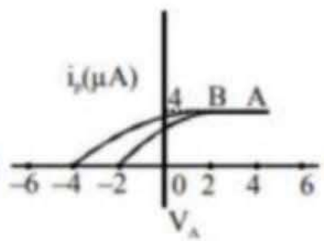
Ans : (A)

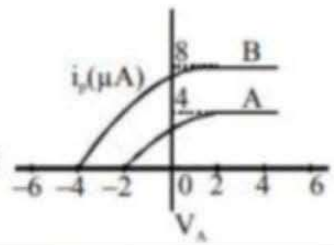
QUESTION

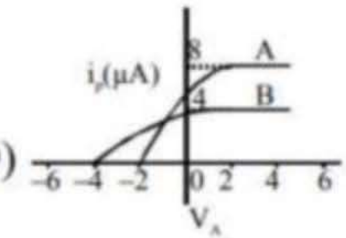
$I_0 \longrightarrow 4$

In a photoelectric effect experiment, photons of energy 5 eV are incident on the photo-cathode of work function 3 eV. For photon intensity $I_A = 10^{15}\ m^{-2}s^{-1}$, saturation current of 4.0 μA is obtained. Sketch of the variation of photocurrent i_p against the anode voltage V_a for photon intensity I_A (curve A) and $I_B = 2 \times 10^{15}\ m^{-2}s^{-1}$ (curve B) will be :

(A) 

(B) 

(C) 

(D) 

$\longrightarrow$ Same

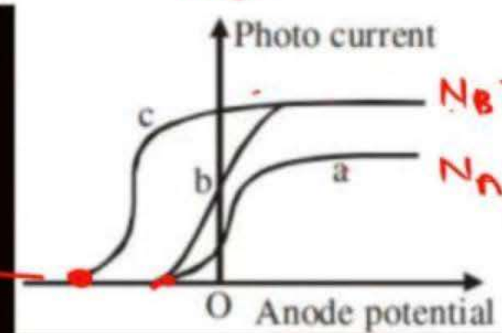
Ans : (A)

QUESTION

The figure shows the variation of photo current with anode potential for a photosensitive surface for three different radiations. Let I_a, I_b and I_c be the intensities and f_a, f_b and f_c be the frequencies for the curves a, b and c respectively. Choose correct options

(A) $f_a = f_b$ (B) $I_a < I_b$ (C) $f_c < f_b$ (D) $I_c > I_b$

$N_c =$



$N_B > N_A$

N_A

$f_c > f_a = f_b$

Ans : (A, B, D)

QUESTION

In photoelectric effect, stopping potential depends on

(A) frequency of the incident light

(B) intensity of the incident light by varies source distance

(C) emitter's properties

(D) frequency and intensity of the incident light

$(KE)_{max},\ eV_0$

$I\downarrow$ $f \longrightarrow$ same

$N \longrightarrow \downarrow$

$I \longrightarrow \downarrow$

Ans : (A, C)

QUESTION

Match the entries of column–I with the entries of column–II :-

	Column-I		Column-II
(I)	Characteristic X-ray	(P)	Inverse process of photoelectric effect
(II)	Photoelectric effect	(Q)	Emission of electrons
(III)	Thermo-ionic emission	(R)	Moseley's law
(IV)	Continuous X-ray	(S)	Emission of radiations

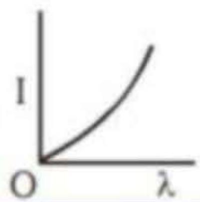
Then choose the correct matching.

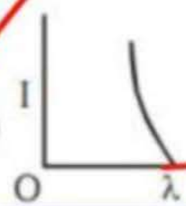
(A) (i) →(RS) ; (ii) → (RS) ; (iii) →(S) ; (iv) →(PS)
(B) (i) →(RS) ; (ii) → (Q) ; (iii) →(Q) ; (iv) →(PS)
(C) (i) →(RS) ; (ii) → (S) ; (iii) →(S) ; (iv) →(PRS)
(D) (i) →(RS) ; (ii) → (Q) ; (iii) →(Q) ; (iv) →(PRS)

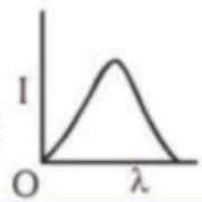
Ans : (B)

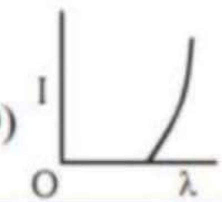
QUESTION

The anode voltage of a photocell is kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows : [AIEEE - 2006]

(A) 

(B*) 

(C) 

(D) 

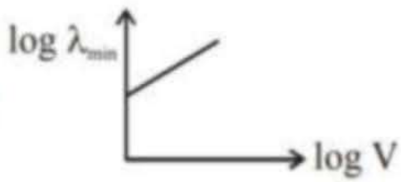
Ans : (B)

QUESTION

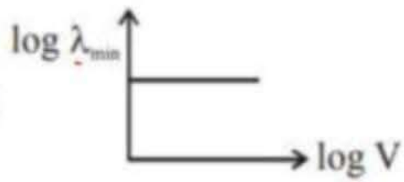
An electron beam is accelerated by a potential difference V to hit a metallic target to produce X-rays. It produces continuous as well as characteristic X-rays. If λ_{min} is the smallest possible wavelength of X-ray in the spectrum, the variation of $\log \lambda_{min}$ with $\log V$ is correctly represented in :

[JEE Main-2017]

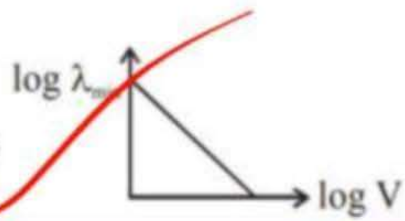
(1)



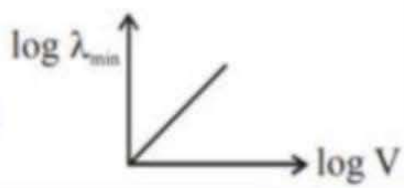
(2)



(3)



(4)



$$\lambda_{min} = \frac{1240}{V_0}$$

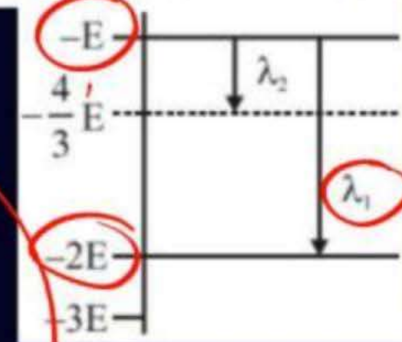
$$\ln \lambda_{min} = \ln 1240 - \ln V_0$$

Ans : (3)

QUESTION

Some energy levels of a molecule are shown in the figure. The ratio of the wavelengths $r = \lambda_1/\lambda_2$, is given by : **[JEE Main-2017]**

(1) $r = \frac{3}{4}$ (2) $r = \frac{1}{3}$ (3) $r = \frac{4}{3}$ (4) $r = \frac{2}{3}$



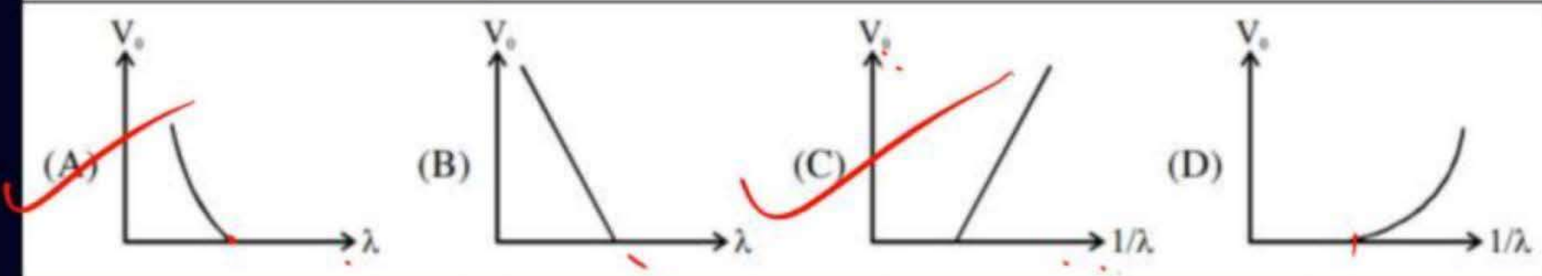
$\lambda_1 \equiv E_1 = \frac{hc}{\lambda}$

$\lambda_2 \equiv \frac{E}{3} = \frac{hc}{\lambda_2}$

Ans : (2)

QUESTION

For photo-electric effect with incident photon wavelength λ, the stopping potential is V_0. Identify the correct variation(s) of V_0 with λ and $1/\lambda$. **[JEE Advanced-2015]**



$$\mathcal{E} = \phi + (K\mathcal{E})_{max}$$

$$-\frac{\phi}{e} + \frac{hc}{e\lambda} = V_0$$

$$(-c) + mx = y$$

Ans : (A, C)

wave optics

* $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$ → phase diff

* $I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

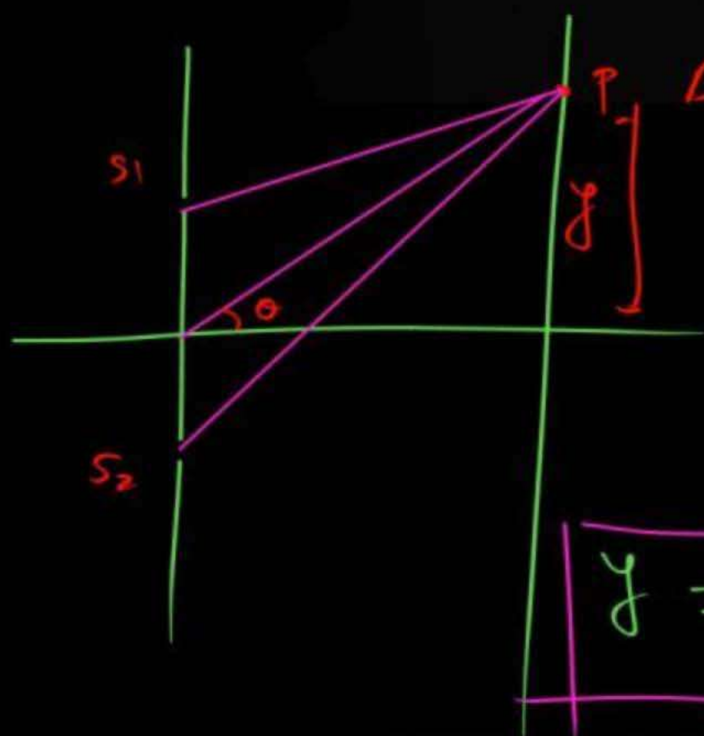
* $I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

* $\dfrac{I_{max}}{I_{min}} = \dfrac{\left(\sqrt{I_1} + \sqrt{I_2}\right)^2}{\left(\sqrt{I_1} - \sqrt{I_2}\right)^2}$

$I \propto A^2$

$$\boxed{\frac{\Delta x}{\lambda} = \frac{\Delta \phi}{2\pi}}$$

YDSE



$\Delta x = S_2P - S_1P = d\sin\theta = \Delta x$ — ①

$\tan\theta = y/D$ — ②

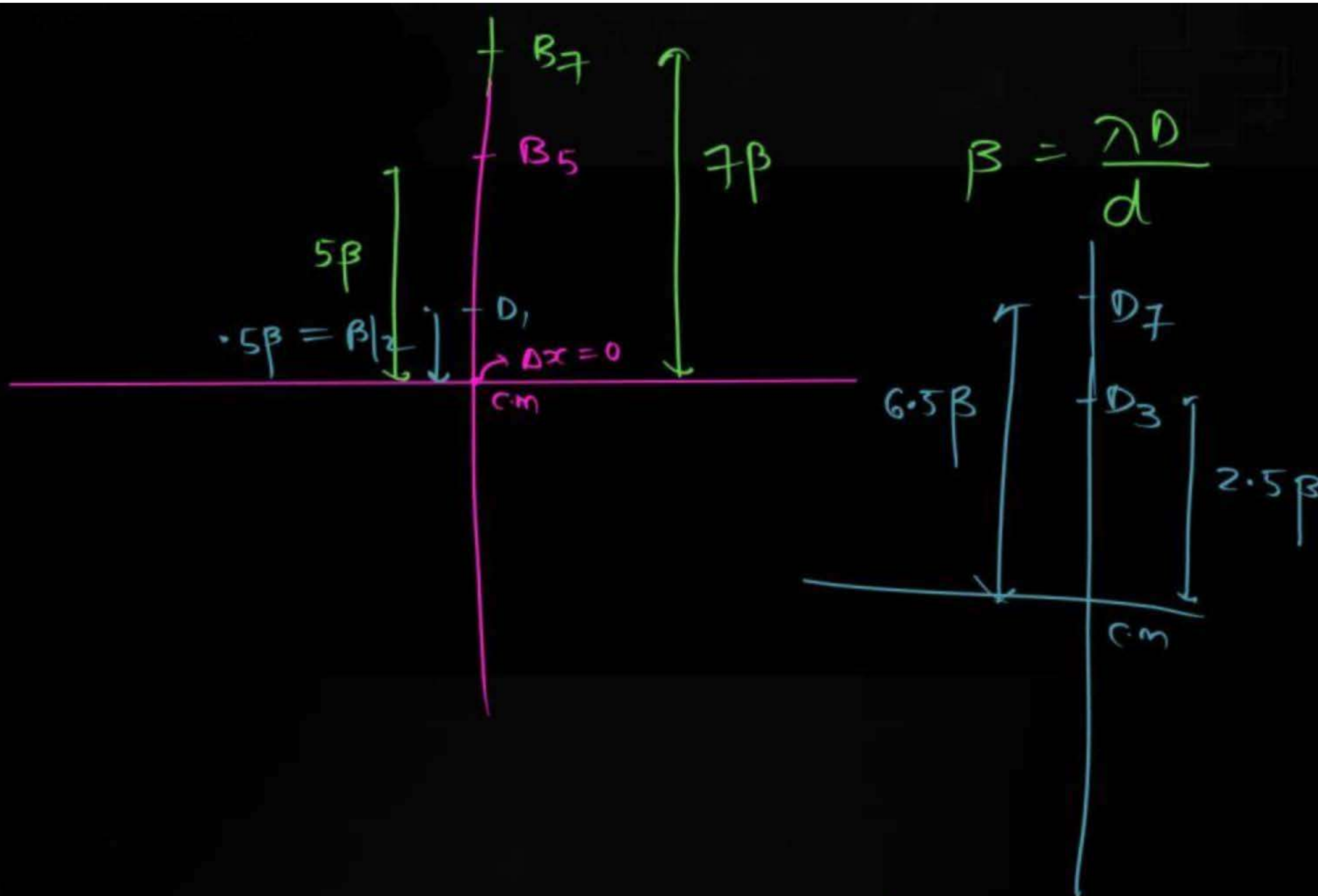
If θ very small

$\Delta x = d \times \frac{y}{D}$

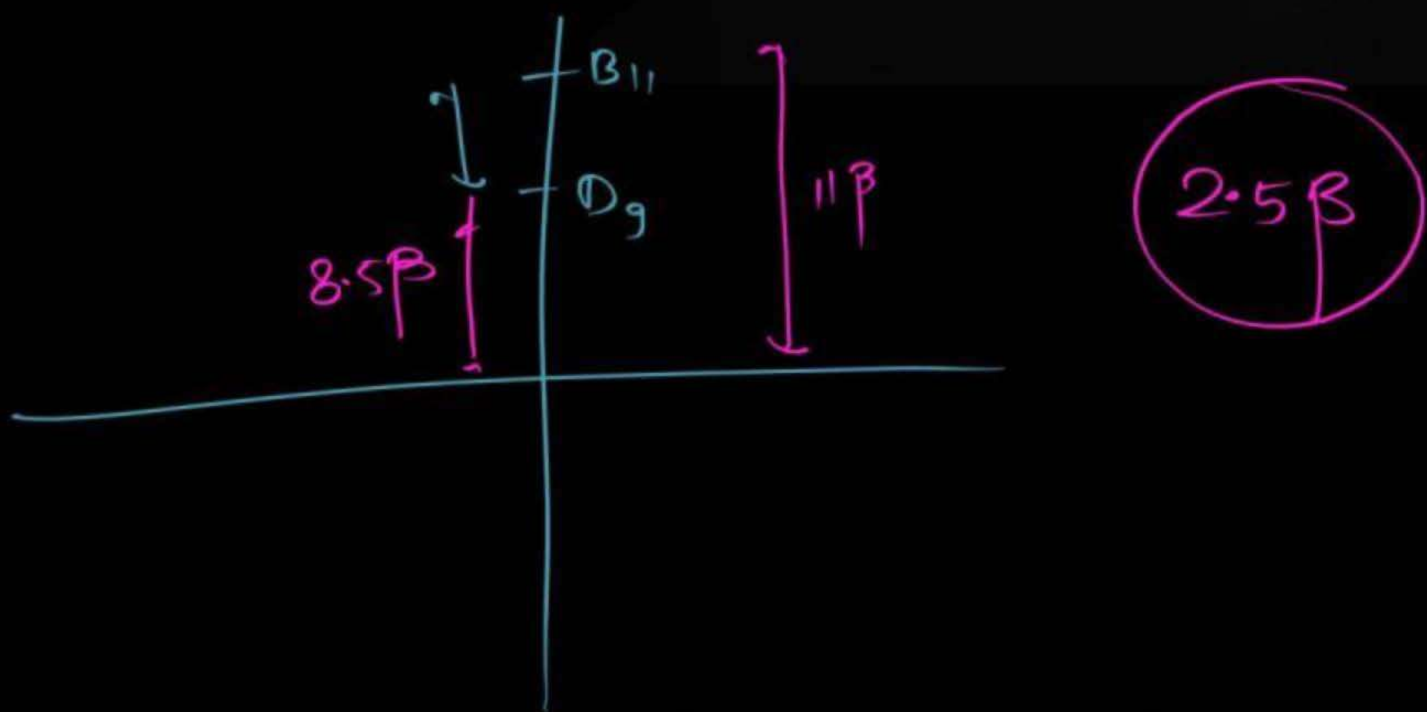
$$\boxed{y = \Delta x \frac{D}{d}} \Rightarrow \beta = \frac{\lambda D}{d}$$

$\Delta x = n\lambda$ (max)

$\Delta x = (\text{odd})\frac{\lambda}{2}$ (min)



B7
B5
7β
5β
D1
.5β = β/2
Δx = 0
c.m
β = λD/d
D7
D3
6.5β
2.5β
c.m



B11
D9
11β
8.5β
2.5β

$$\beta = \frac{\lambda D}{d}$$

$\lambda \uparrow \ \beta \uparrow$ = no. of max on screen $\downarrow$

$D \uparrow \ \beta \uparrow$

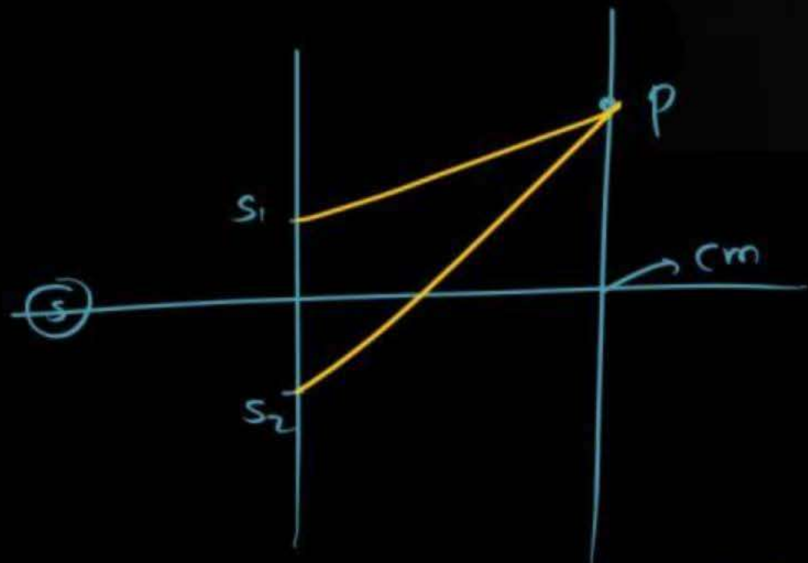
$\xrightarrow{\text{पानी मे}} \lambda/\mu \Rightarrow \beta_{\text{नया}} = \frac{\beta}{\mu}$

$I_1 = I_2 = I_0$

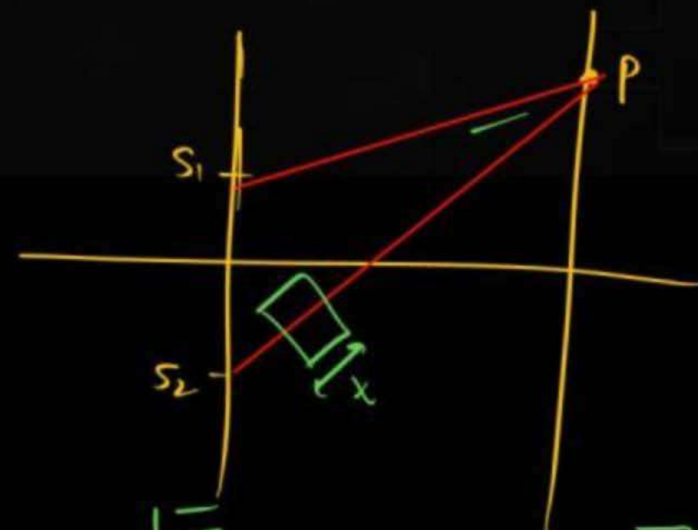
$$I = 4I_0 \cos^2(\phi/2)$$

maxima $I = 4I_0$

mini $I = 0$



$$\Delta x = S_2P - S_1P = d\frac{y}{D}$$

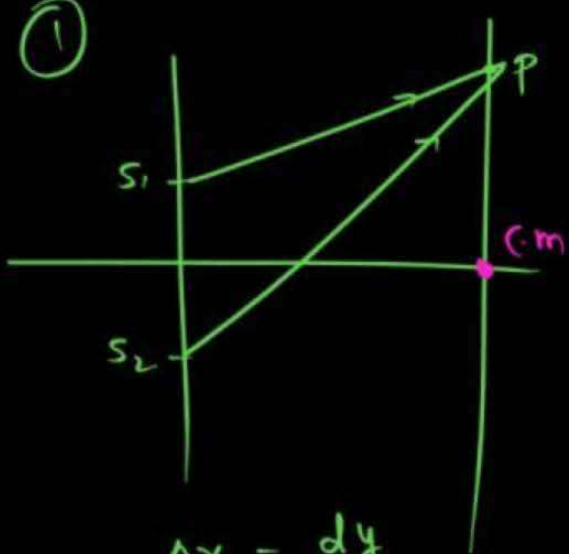


$$\Delta x = \left[(S_2P - t)_{\text{हवा}} + t_m\right] - (S_1P)_{\text{हवा}}$$

$$\Delta x = (S_2P - S_1P)_{\text{हवा}} - t_{\text{हवा}} + (\mu t)_{\text{हवा}}$$

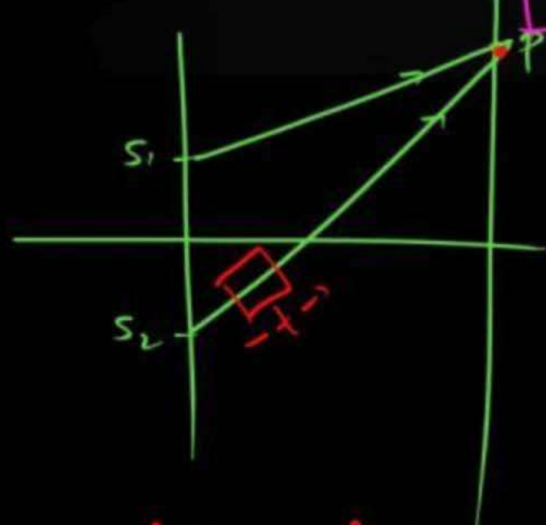
$$\Delta x = \frac{dy}{D} + (\mu - 1)t$$

(1)



$$\Delta x = \frac{dy}{D}$$

(2)



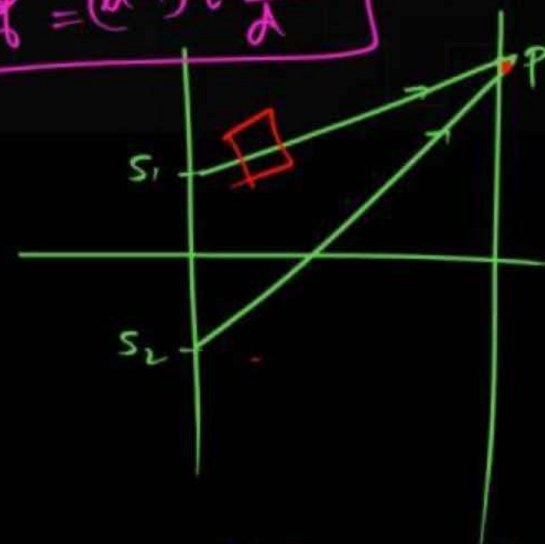
$$\boxed{\text{Shift of C.m} = (\mu-1)t\frac{D}{d}}$$

$$\Delta x = \frac{dy}{D} + (\mu-1)t$$

C.max $\Delta x = 0$

$$y = -\frac{(\mu-1)tD}{d}$$

C.m नीचे



$$\Delta x = \frac{dy}{D} - (\mu-1)t$$

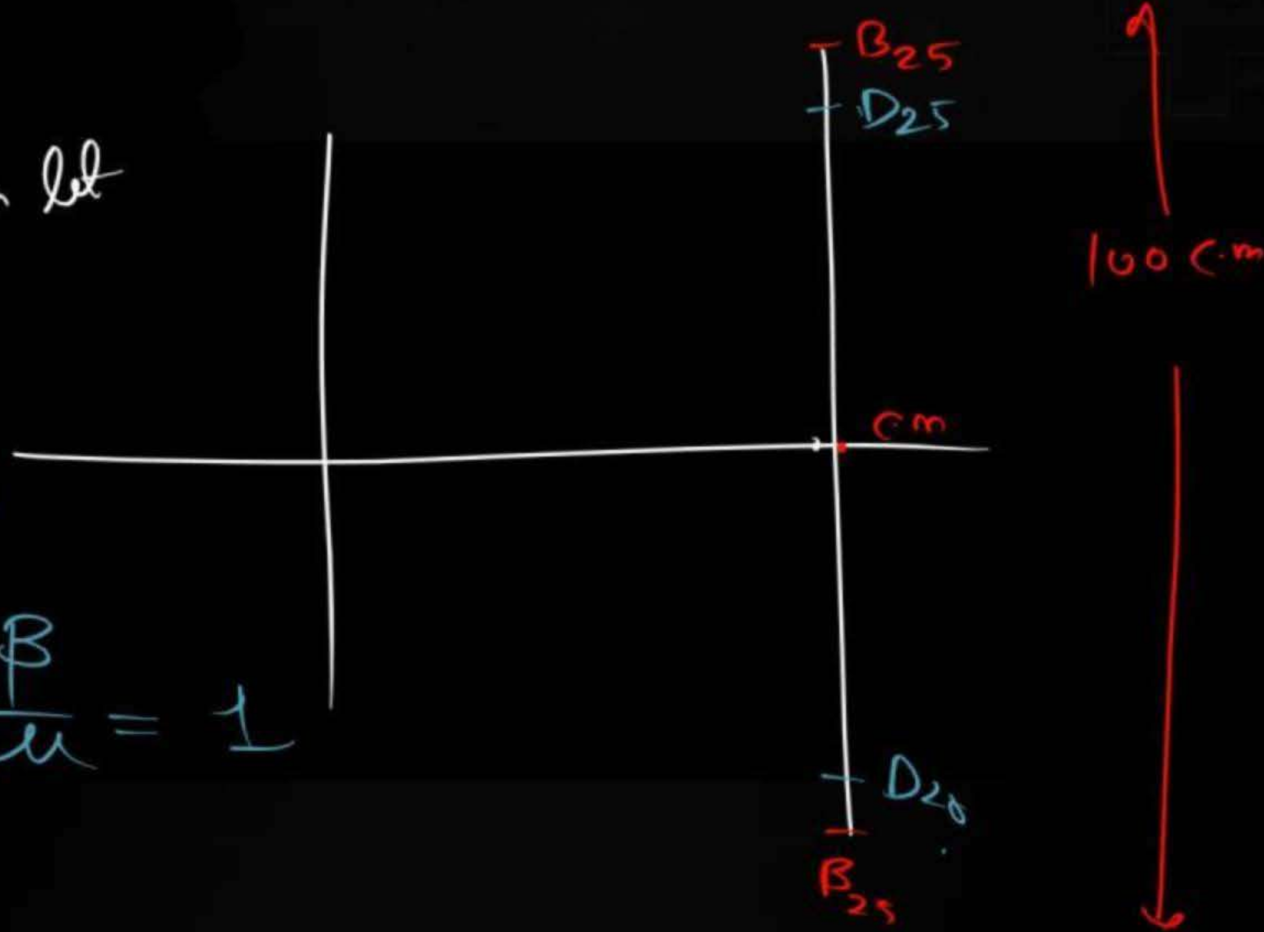
C.m $\equiv \Delta x = 0$

$$y = \frac{(\mu-1)tD}{d}$$

Q_2 $\beta = 2\,c.m$ let

पानी $\mu = 2$

$\beta_{पानी} = \frac{\beta}{\mu} = 1$



$$d\sin\theta = n\lambda$$

QUESTION

In a Young's double slit experiment, 16 fringes are observed in a certain segment of the screen when light of wavelength 700 nm is used. If the wavelength of light is changed to 400 nm, the number of fringes observed in the same segment of the screen would be:

[JEE Mains 2020]

$n_1\lambda_1 = n_2\lambda_2$

(1) 28

(2) 24

(3) 18

(4) 30

Ans. (1)

QUESTION

Two light waves having the same wavelength λ in vacuum are in phase initially. Then the first wave travels a path L_1 through a medium of refractive index n_1 while the second wave travels a path of length L_2 through a medium of refractive index n_2. After this the phase difference between the two waves is: [JEE Mains 2020]

(1) $\frac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$

(2) $\frac{2\pi}{\lambda}\left(\frac{L_2}{n_1} - \frac{L_1}{n_2}\right)$

(3) $\frac{2\pi}{\lambda}\left(\frac{L_1}{n_1} - \frac{L_2}{n_2}\right)$

(4) $\frac{2\pi}{\lambda}(n_1L_1 - n_1L_2)$

$$\Delta x = n_1L_1 - n_2L_2$$

$$\frac{\Delta\phi}{2\pi} = \frac{\Delta x}{\lambda}$$

$$\Delta\phi = \frac{2\pi}{\lambda}\left(n_1L_1 - n_2L_1\right)$$

Ans. (1)

QUESTION

A Young's double-slit experiment is performed using monochromatic light of wavelength λ. The intensity of light at a point on the screen, where the path difference is λ, is K units. The intensity of light at a point where the path difference is $\lambda/6$ given by $\frac{nK}{12}$, where n is an integer. The value of n is ______. **[JEE Mains 2020]**

max

$$I = 4I_0 \cos^2 \phi/2$$

$$\frac{\Delta\phi}{2\pi} = \frac{\Delta x}{\lambda}$$

Ans. 9

QUESTION

If the source of light used in a Young's double slit experiment is changed from red to violet: $\lambda \downarrow$

[JEE Mains 2021]

1. consecutive fringe lines will come closer.
2. the central bright fringe will become a dark fringe.
3. the fringes will become brighter.
4. the intensity of minima will increase.

Ans. (1)

QUESTION

Two coherent light sources having intensity in the ratio 2x produce an interference pattern. The ratio $\frac{I_{max}-I_{min}}{I_{max}+I_{min}}$ will be:

[JEE Mains 2021]

easy

(1) $\frac{2\sqrt{2}}{x+1}$

(2) $\frac{\sqrt{2x}}{2x+1}$

(3) $\frac{\sqrt{2x}}{x+1}$

(4) $\frac{2\sqrt{2x}}{2x+1}$

Ans. (4)

QUESTION

In a Young's double slit experiment two slits are separated by 2 mm and the screen is placed one meter away. When a light of wavelength 500 nm is used, the fringe separation will be:

[JEE Mains 2021]

$$\beta = \frac{\lambda D}{d}$$

(1) 0.25 mm

(2) 0.50 mm

(3) 0.75 mm

(4) 1 mm

Ans. (1)

QUESTION

In Young's double slit arrangement, slits are separated by a gap of 0.5 mm, and the screen is placed at a distance of 0.5 m from them. The distance between the first and the third bright fringe formed when the slits are illuminated by a monochromatic light of 5890 Å is:-

[JEE Mains 2021]

(1) 1178×10^{-9} m

$3\beta - \beta = 2\beta = 2 \times \frac{\lambda D}{d}$

(2) 1178×10^{-6} m

(3) 1178×10^{-12} m

(4) 5890×10^{-7} m

Ans. (2)

QUESTION

*

In the Young's double slit experiment, the distance between the slits varies in time as $\boxed{d(t) = d_0 + a_0 \sin\omega t;}$ where d_0, ω and a_0 are constants. The difference between the largest fringe width and the smallest fringe width obtained over time is given as:

[JEE Mains 2021]

(1) $\dfrac{2\lambda D(d_0)}{(d_0^2 - a_0^2)}$

(2) $\dfrac{2\lambda D a_0}{(d_0^2 - a_0^2)}$

(3) $\dfrac{\lambda D}{d_0^2} a_0$

(4) $\dfrac{\lambda D}{d_0 + a_0}$

$$\beta = \frac{\lambda D}{d}$$

$$\beta_{\text{बड़ा}} = \frac{\lambda D}{d_0 - a_0}$$

$$\beta_{\text{छोटा}} = \frac{\lambda D}{d_0 + a_0}$$

$$= \frac{\lambda D}{d_0 - a_0} - \frac{\lambda D}{d_0 + a} = \frac{\lambda D [2a_0]}{d_0^2 - a_0^2}$$

Ans. (2)

QUESTION

In Young's double slit experiment, if the source of light changes from orange to blue then:

[JEE Mains 2021]

Same

(1) the central bright fringe will become a dark fringe.

(2) the distance between consecutive fringes will decrease.

(3) the distance between consecutive fringes will increase.

(4) the intensity of the minima will increase.

Ans. (2)

QUESTION

White light is passed through a double slit and interference is observed on a screen 1.5 m away. The separation between the slits is 0.3 mm. The first violet and red fringes are formed 2.0 mm and 3.5 mm away from the central white fringes. The difference in wavelengths of red and violet light is ______ nm. **[JEE Mains 2021]**

$\beta_1 = 2 \times 10^{-3}$ $\beta_2 = 3.5 \times 10^{-3}$

$\beta_2 - \beta_1 = 1.5 \times 10^{-3}$

$\lambda_2 - \lambda_1 = (1.5 \times 10^{-3}) \frac{d}{D}$

Ans. 300

QUESTION

The light waves from two coherent sources have same intensity $I_1 = I_2 = I_0$. In interference pattern the intensity of light at minima is zero. What will be the intensity of light at maxima ?

[JEE Mains 2021]

(1) I_0

(2) $2\,I_0$

(3) $5\,I_0$

(4) $4\,I_0$

Ans. (4)

QUESTION

A fringe width of 6 mm was produced for two slits separated by 1 mm apart. The screen is placed 10 m away. The wavelength of light used is 'x' nm. The value of 'x' to the nearest integer is _____.

[JEE Mains 2021]

$$\beta = \frac{\lambda D}{d}$$

$$\lambda = \frac{\beta d}{D}$$

Ans. 600

QUESTION

In Young's double slits experiment, the position of 5^{th} bright fringe from the central maximum is 5 cm. The distance between slits and screen is 1 m and wavelength of used monochromatic light is 600 nm. The separation between the slits is:

[25 January 2023 - Shift 1]

$5\beta = 5\ cm$

$\beta = 10^{-2} = \frac{\lambda D}{d}$

$10^{-2} = \frac{600 \times 10^{-9} \times 1}{d}$

(1) 60 μm

(2) 48 μm

(3) 12 μm

(4) 36 μm

Ans : (1)

QUESTION

In a Young's double slit experiment, two slits are illuminated with a light of wavelength 800 nm. The line joining A_1P is perpendicular to A_1A_2 as shown in the figure. If the first minimum is detected at P, the value of slits separation 'a' will be :
The distance of screen from slits D = 5 cm

[29 January 2023 - Shift 1]

(1) 0.4 mm

(2) 0.5 mm

(3) 0.2 mm

(4) 0.1 mm

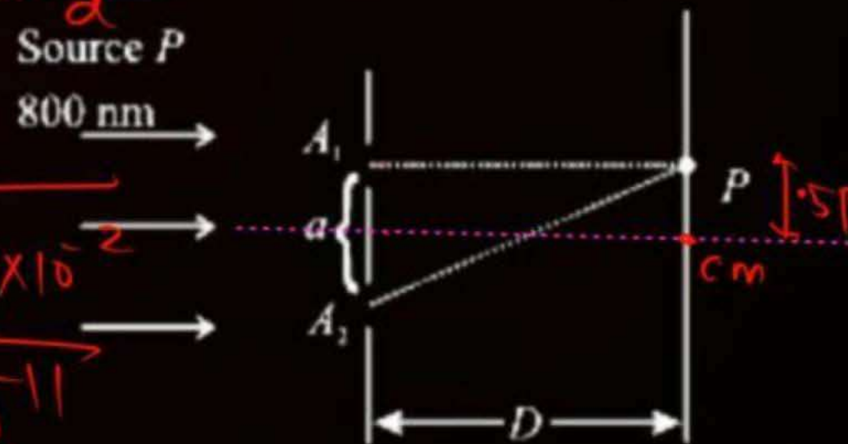
$$\frac{d}{2} = .5\beta = \frac{1}{2} \times \frac{\lambda D}{d}$$

$$d^2 = \lambda D$$

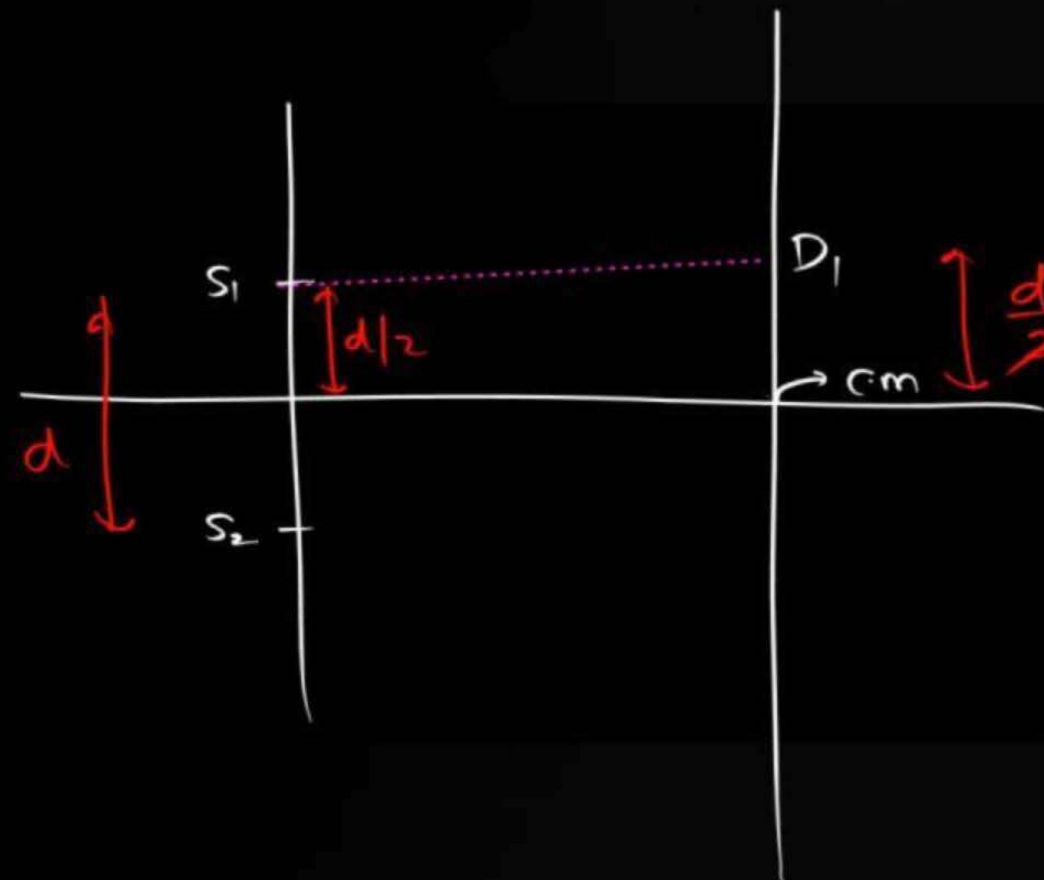
$$d = \sqrt{800 \times 10^{-9} \times 5 \times 10^{-2}}$$

$$= \sqrt{4000 \times 10^{-11}}$$

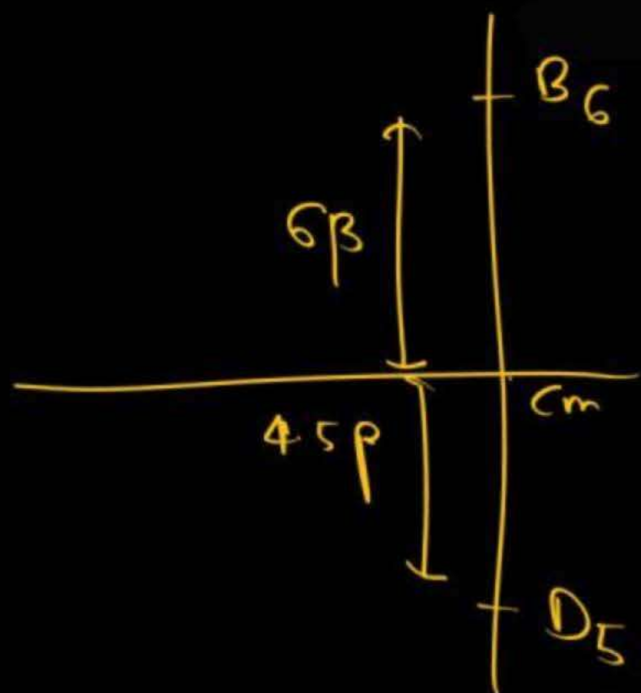
$$= \boxed{2 \times 10^{-4}}$$



Ans : (3)



$$\frac{d}{\cancel{2}} = \frac{\beta}{\cancel{2}}$$


B 6
6β
cm
4.5p
D 5

QUESTION

$\frac{\cancel{10^{-6}} \times 4 \times \cancel{10^{10}}}{4\cancel{000} \times} \quad \frac{40}{4} \quad 10$

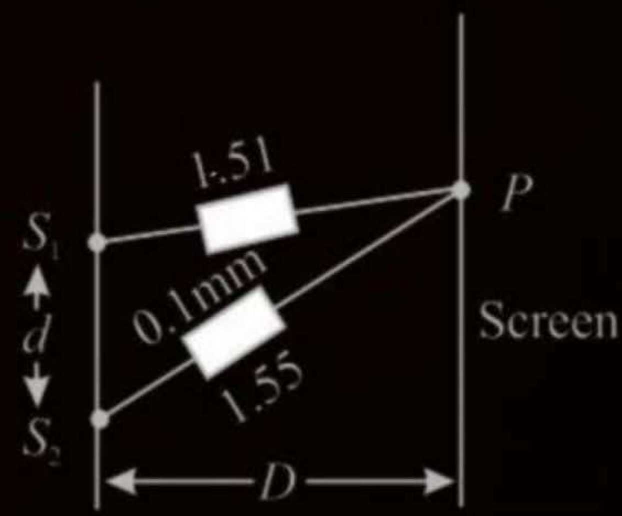
$[.55 \times .1 \times 10^{-3} - .51 \times .1 \times 10^{-3}] / 4000 \times 10^{-10}$

In Young's double slit experiment, two slits S_1 and S_2 are 'd' distance apart and the separation from slits to screen is D (as shown in figure). Now if two transparent slabs of equal thickness 0.1 mm but refractive index 1.51 and 1.55 are introduced in the path of beam $\boxed{(\lambda = 4000 \text{Å})}$ from S_1 and S_2 respectively. The central bright fringe spot will shift by number of fringes.

[30 January 2023 - Shift 1]

$$\cancel{\Delta x} = \frac{dy}{D} + (\mu_1 - 1)t_1 - (\mu_2 - 1)t_2$$

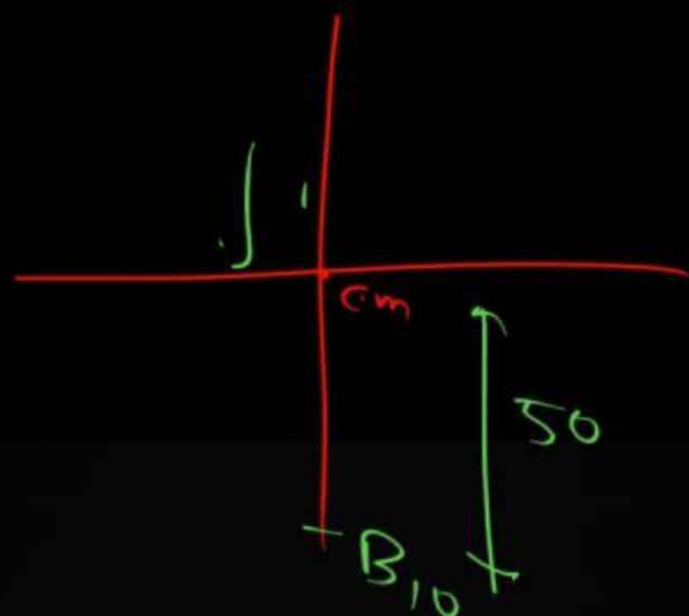
$$\frac{y}{\beta} = \frac{[(\mu_2 - 1)t_2 - (\mu_1 - 1)t_1]\frac{\cancel{D}}{\cancel{d}}}{\lambda \frac{\cancel{D}}{\cancel{d}}}$$

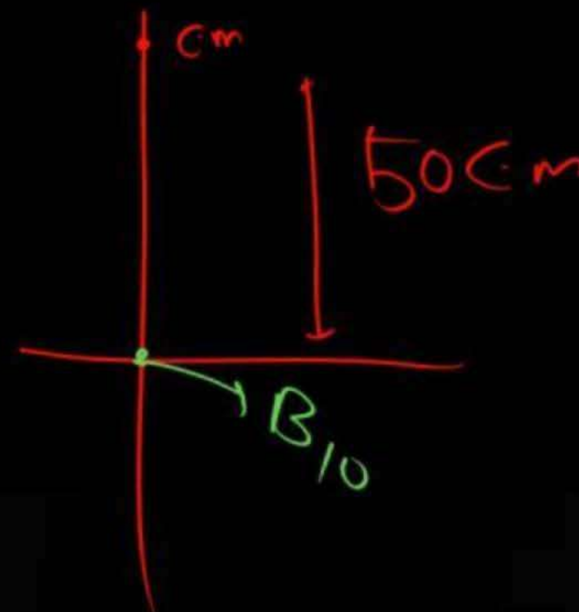


Ans : (10)

$\beta = 5$ cm lt

Shift of c.m = 50 cm lt





QUESTION

$\frac{\Delta\phi}{2\pi} = \frac{\Delta x}{\lambda}$ $\Delta\phi_1 = \frac{2\pi}{\lambda}\frac{\lambda}{4} = \frac{\pi}{2}$ $\Delta\phi_2 = \frac{2\pi}{3}$

In a Young's double slit experiment, the intensities at two points, for the path difference $\frac{\lambda}{4}$ and $\frac{\lambda}{3}$ (λ being the wavelength of light used) are I_1 and I_2 respectively. If I_0 denotes the intensity produced by each one of the individual slits, then $\frac{I_1+I_2}{I_0} =$ ______.

[30 January 2023 - Shift 2]

$I = 4I_0 \cos^2 \phi/2$

$I_1 = 4I_0 \cos^2 45° = 2I_0$

$I_2 = 4I_0 \cos^2 60 = I_0$

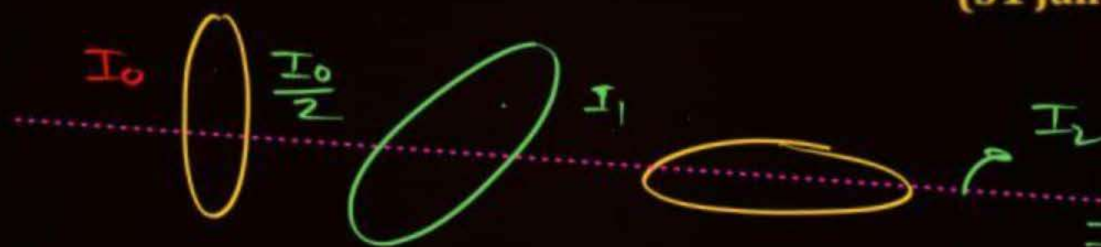
$\frac{2I_0 + I_0}{I_0} = 3$

Ans : (3)

QUESTION

Two polaroide A and B are placed in such a way that the pass-axis of polaroids are perpendicular to each other. Now, another polaroid C is placed between A and B bisecting angle between them. If intensity of unpolarised light is I_0 then intensity of transmitted light after passing through polaroid B will be :

(31 January 2023 - Shift 1)



$I_2 = I_1 \cos^2 45^\circ$

$= \frac{I_0}{4} \times \frac{1}{2}$

$I_1 = \frac{I_0}{2} \cos^2 45 = \frac{I_0}{4}$

(1) $\frac{I_0}{4}$

(2) $\frac{I_0}{2}$

(3) $\frac{I_0}{8}$

(4) Zero

Ans : (3)

QUESTION

(Last year Class)

'n' polarizing sheets are arranged such that each makes an angle 45° with the proceeding sheet. An unpolarized light of intensity I is incident into this arrangement. The output intensity is found to be $\frac{I}{64}$. The value of n will be:

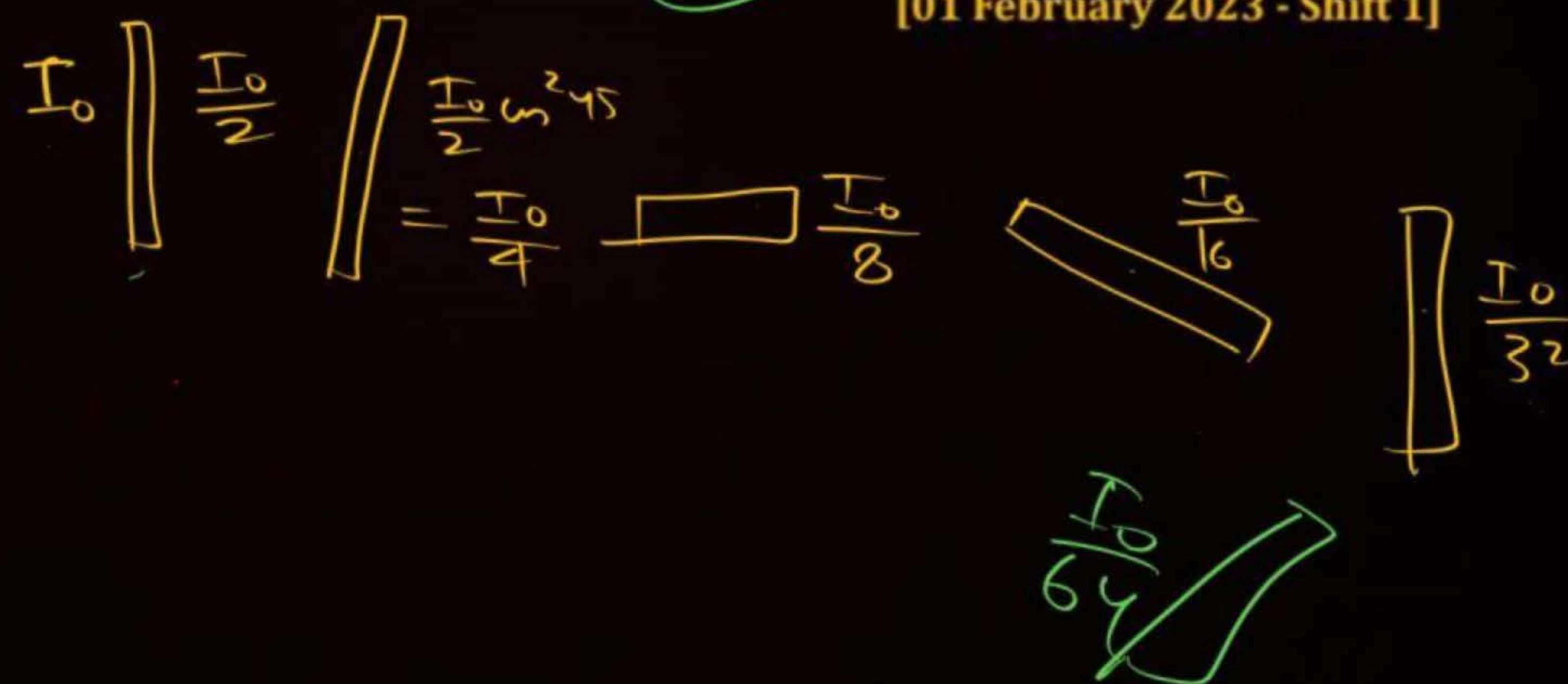
[01 February 2023 - Shift 1]

(1) 3

(2) 6

(3) 5

(4) 4



Ans : (2)

QUESTION

बेहतर Q था हर बार आता है

$3 \times \frac{\lambda_1 D}{d} = \frac{3 \times 800 \times 10^{-9} \times 7}{.35 \times 10^{-3}}$

Two light waves of wavelengths 800 and 600 nm are used in Young's double slit experiment to obtain interference fringes on a screen placed 7 m away from plane of slits. If the two slits are separated by 0.35 mm, then shortest distance from the central bright maximum to the point where the bright fringes of the two wavelength coincide will be 48 mm.

[31 January 2023 - Shift 2]

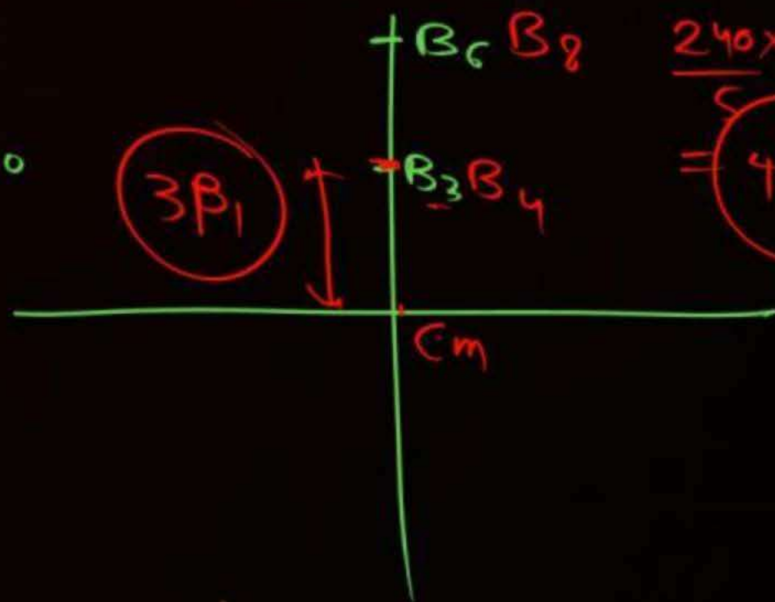
$$y = \frac{n_1 \lambda_1 D}{d} = \frac{n_2 \lambda_2 D}{d}$$

$$\boxed{n_1 \lambda_1 = n_2 \lambda_2}$$

$n_1 \times 800 = n_2 \times 600$

$4n_1 = 3n_2$

n_1	n_2
3	4
6	8
9	12



$\frac{240 \times 10^{-3}}{5} = 48$

Ans : (48)

QUESTION

A beam of light consisting of two wavelengths 7000Å and 5500Å is used to obtain interference pattern in Young's double slit experiment. The distance between the slits is 2.5 mm and the distance between the plane of slits and the screen is 150 cm. The least distance from the central fringe, where the bright fringes due to both the wavelengths coincide, is $n \times 10^{-5}$ m. The value of n is ________.

[06 April 2023 - Shift 2]

$14 n_1 = 11 n_2$

$11 \beta_1$ Ans

$14 \beta_2$

Ans

Ans : (462)

QUESTION

The width of fringe is 2 mm on the screen in a double slit experiment for the light of wavelength of 400 nm. The width of the fringe for the light of wavelength 600 nm will be:

[08 April 2023 - Shift 2]

$$\beta = \frac{\lambda D}{d}$$

$$\frac{\beta_2}{\beta_1} = \frac{\lambda_2}{\lambda_1}$$

$$\frac{\beta_2}{2} = \frac{600}{400}$$

(1) 4 mm

(2) 2 mm

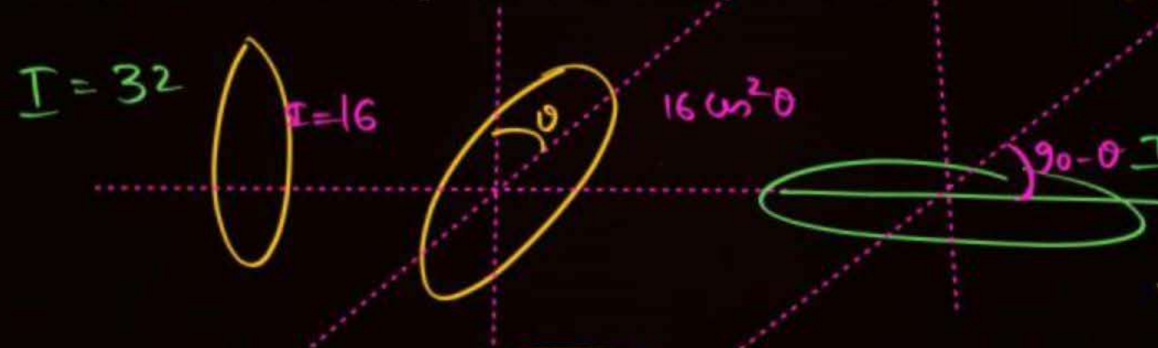
(3) 1.33 mm

(4) 3 mm

Ans : (4)

QUESTION

Unpolarised light of intensity 32 Wm^{-2} passes through the combination of three polaroids such that the pass axis of the last polaroids is perpendicular to that of the pass axis of first polaroids. If intensity of emerging light is 3 Wm^{-2}, then the angle between pass axis of first two polaroids is $\underline{\ 30\ }$°. [10 April 2023 - Shift 1]



$I = 3 = 16\cos^2\theta\sin^2\theta$

$3 = 16 \times \frac{4\cos^2\theta\sin^2\theta}{4}$

$\frac{3}{4} = \sin^2 2\theta$

$\sin 2\theta = \frac{\sqrt{3}}{2}$

$2\theta = 60$

$\theta = 30.$

Ans : (30)

QUESTION

The ratio of intensities at two points P and Q on the screen in a Young's double slit experiment where phase difference between two waves of same amplitude are $\frac{\pi}{3}$ $= 60°$ and $\frac{\pi}{2}$, respectively are

$45°$

90

$I = 4I_0 \cos^2 \phi/2$

[10 April 2023 - Shift 2]

$$\frac{\cos^2 30}{\cos^2 45} = \frac{3}{4 \times \frac{1}{2}}$$

(1) 2 : 3

(2) 1 : 3

(3) 3 : 1

(4) 3 : 2

Ans : (4)

QUESTION

In a Young's double slit experiment, the ratio of amplitude of light coming from slits is 2 : 1. The ratio of the maximum to minimum intensity in the interference pattern is.

[13 April 2023 - Shift 2]

$\frac{A_1}{A_2} = \frac{2}{1}$

(1) 9 : 4

(2) 25 : 9

(3) 2 : 1

(4) 9 : 1

$\sqrt{\frac{I_1}{I_2}} = \frac{A_1^2}{A_2^2} = \frac{4}{1}$

$\frac{(\sqrt{I_1} + \sqrt{I_2})^2}{(\sqrt{I_1} - \sqrt{I_2})^2} = \left(\frac{\sqrt{\frac{I_1}{I_2}} + 1}{\sqrt{\frac{I_1}{I_2}} - 1}\right)^2$

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

Ans : (4)

QUESTION

A single slit of width a is illuminated by a monochromatic light of wavelength 600 nm. The value of a for which first minimum appears at $\theta = 30°$ on the screen will be: [15 April 2023 - Shift 1]

(1) 1.2 μm

(2) 3 μm

(3) 1.8 μm

(4) 0.6 μm

$d \sin\theta = n\lambda$

$d \sin 30 = 1 \times 600 \times 10^{-9}$

$d = 1200 \times 10^{-9}$

$= 1.2 \times 10^{-6}$

Ans : (1)

QUESTION

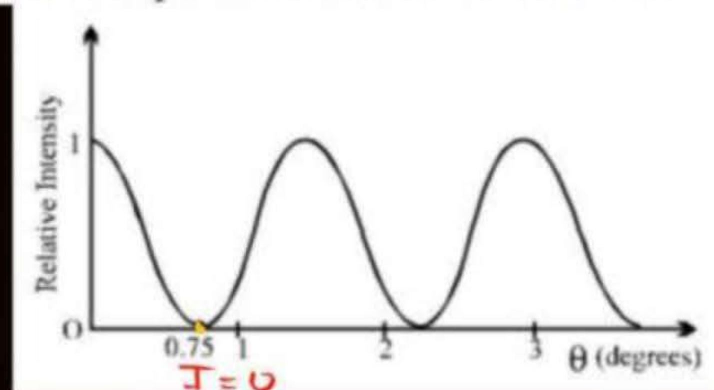
In a Young's double slit experiment for interference of light, the slits are 0.2 cm apart and are illuminated by yellow light ($\lambda = 600$ nm). What would be the fringe width on a screen placed 1 m from the plane of slits if the whole system is immersed in water of index 4/3?

$$\frac{\beta}{\mu} = \frac{\lambda D}{d \cdot \mu}$$

Ans : 0.225 mm

QUESTION

Light of wavelength 520 nm passing through a double slit, produces interference pattern of relative intensity versus angular position θ as shown in the figure. Find the separation d between the slits.



$I = 0$

min

$\theta = .75$

$\Delta x = d\sin\theta = \frac{\lambda}{2}$

$d \times .75 = \frac{\lambda}{2}$

$d = \frac{\lambda}{2 \times .75} = \frac{\lambda}{1.5} = \frac{520}{1.5} =$

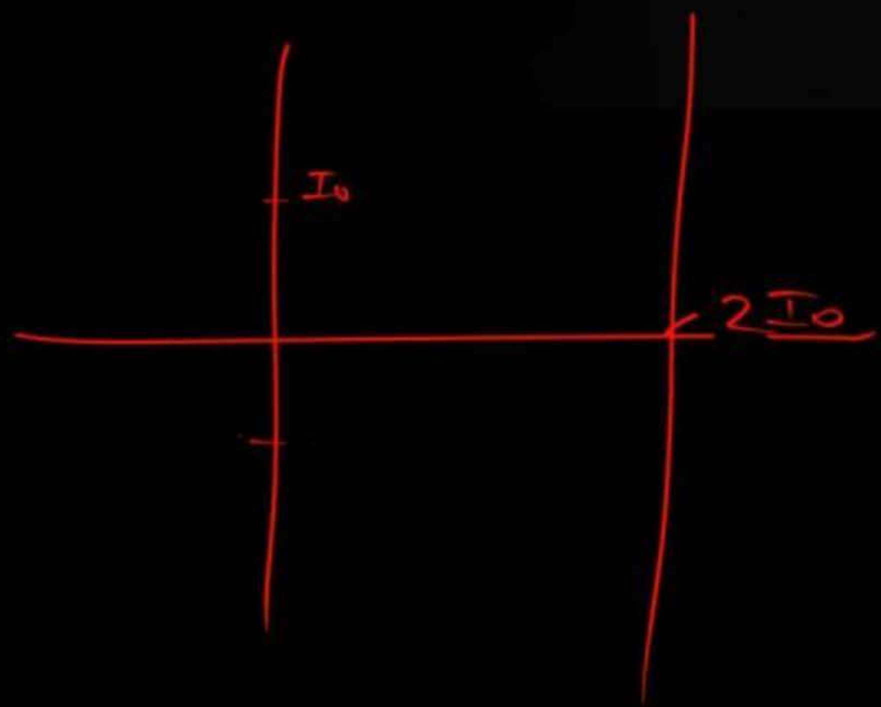
Ans : 1.99×10^{-2} mm

QUESTION

In a Young's double slit experiment, a small detector measures an intensity of illumination of I units at the centre of the fringe pattern. If one of the two (identical) slits is now covered, the measured intensity will be :-

(A) 2I (B) I (C*) I/4 (D) I/2

Ans : (C)



I_0
$2I_0$

QUESTION

In Young's double slit arrangement, water is filled in the space between screen and slits. Then :

(A) fringe pattern shifts upwards but fringe width remains unchanged.

(B) fringe width decreases and central bright fringe shifts upwards.

(C) fringe width increases and central bright fringe does not shift.

(D*) fringe width decreases and central bright fringe does not shift.

$\frac{\lambda}{\mu}$, β/μ ,

Ans : (D)

QUESTION

In YDSE, the source placed symmetrically with respect to the slit is now moved parallel to the plane of the slits so that it is closer to the upper slit, as shown. Then,

(A) the fringe width will increase and fringe pattern will shift down.

(B) the fringe width will remain same but fringe pattern will shift up.

(C) the fringe width will decrease and fringe pattern will shift down.

(D*) the fringe width will remain same but fringe pattern will shift down.

Ans : (D)

QUESTION

If the source of light used in a Young's Double Slit Experiment is changed from red to blue, then

(A) the fringes will become brighter

(B*) consecutive fringes will come closer

(C*) the number of maxima formed on the screen increases

(D) the central bright fringe will become a dark fringe.

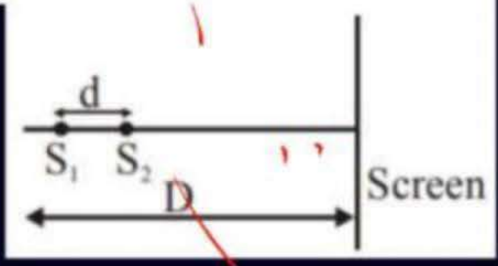
$\lambda\downarrow$ $\beta\downarrow$ $n\uparrow$

Ans : (B, C)

QUESTION

Two coherent point sources S_1 and S_2 are separated by a small distance 'd' as shown. The fringes obtained on the screen will be : **[JEE-Mains 2013]**

(1) points (2) straight lines (3) semicircles (4*) concentric circles



Ans : (4)

QUESTION

VIBGYOR

Young's double slit experiment is carried out by using green, red and blue light, one color at a time. The fringe widths recorded are β_G, β_R and β_B, respectively. Then [IIT-JEE-2012]

(A) $\beta_G > \beta_B > \beta_R$ (B) $\beta_B > \beta_G > \beta_R$ (C) $\beta_R > \beta_B > \beta_G$ (D) $\beta_R > \beta_G > \beta_B$

β_R

Ans : (D)

QUESTION

P

In the Young's double slit experiment using a monochromatic light of wavelength λ, the path difference (in terms of an integer n) corresponding to any point having half the peak intensity is :-

(A) $(2n+1)\frac{\lambda}{2}$ (B) $(2n+1)\frac{\lambda}{4}$ (C) $(2n+1)\frac{\lambda}{8}$ (D) $(2n+1)\frac{\lambda}{16}$ [JEE Advanced 2013]

$$I = 4I_0 \cos^2 \phi/2$$

$$2I_0 = 4I_0 \cos^2 \phi/2$$

$$\boxed{\cos \phi/2 = \pm \frac{1}{\sqrt{2}}}$$

$$\frac{\phi}{2} = \frac{\pi}{4}, \pi - \frac{\pi}{4}, \pi + \frac{\pi}{4}$$

$$\phi = \frac{\pi}{2}$$

Ans : (B)

QUESTION

β कम = $n \uparrow$

A light source, which emits two wavelengths $\lambda_1 = 400$ nm and $\lambda_2 = 600$ nm, is used in a Young's double slit experiment. If recorded fringe widths for λ_1 and λ_2 are β_1 and β_2 and the number of fringes for them within a distance y on one side of the central maximum are m_1 and m_2, respectively, then :- **[JEE Advanced 2014]**

$\lambda_1 < \lambda_2$

$\beta_1 < \beta_2$ $\quad \beta = \frac{\lambda D}{d}$

(A) $\beta_2 > \beta_1$

(B) $m_1 > m_2$

(C) From the central maximum, 3rd maximum of λ_2 overlaps with 5th minimum of λ_1

(D) The angular separation of fringes of λ_1 is greater than λ_2

$$\boxed{\theta = \frac{\beta}{D} = \frac{\lambda}{d}}$$

Ans : (A, B, C)

wave optics

* $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$ → phase diff

* $I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

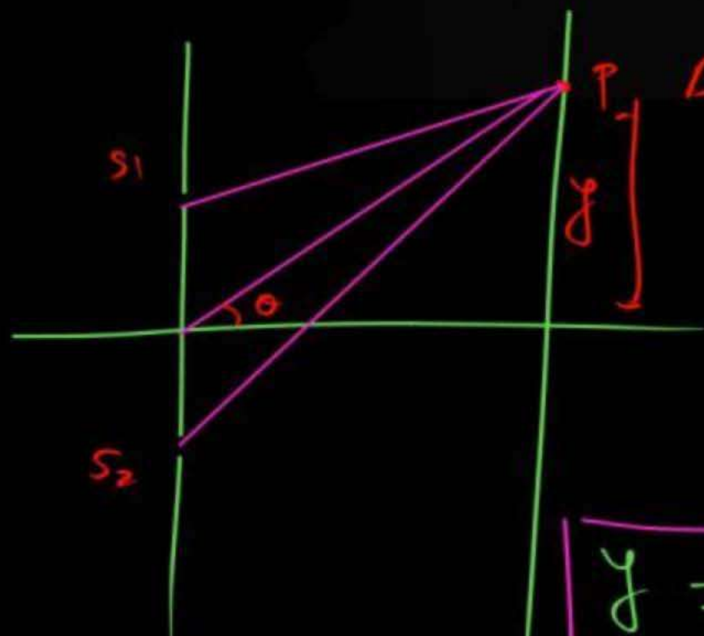
* $I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

* $\dfrac{I_{max}}{I_{min}} = \dfrac{\left(\sqrt{I_1} + \sqrt{I_2}\right)^2}{\left(\sqrt{I_1} - \sqrt{I_2}\right)^2}$

$I \propto A^2$

$$\boxed{\frac{\Delta x}{\lambda} = \frac{\Delta \phi}{2\pi}}$$

YDSE



$\Delta x = S_2P - S_1P = d\sin\theta = \Delta x$ — (1)

$\tan\theta = y/D$ — (2)

If θ very small

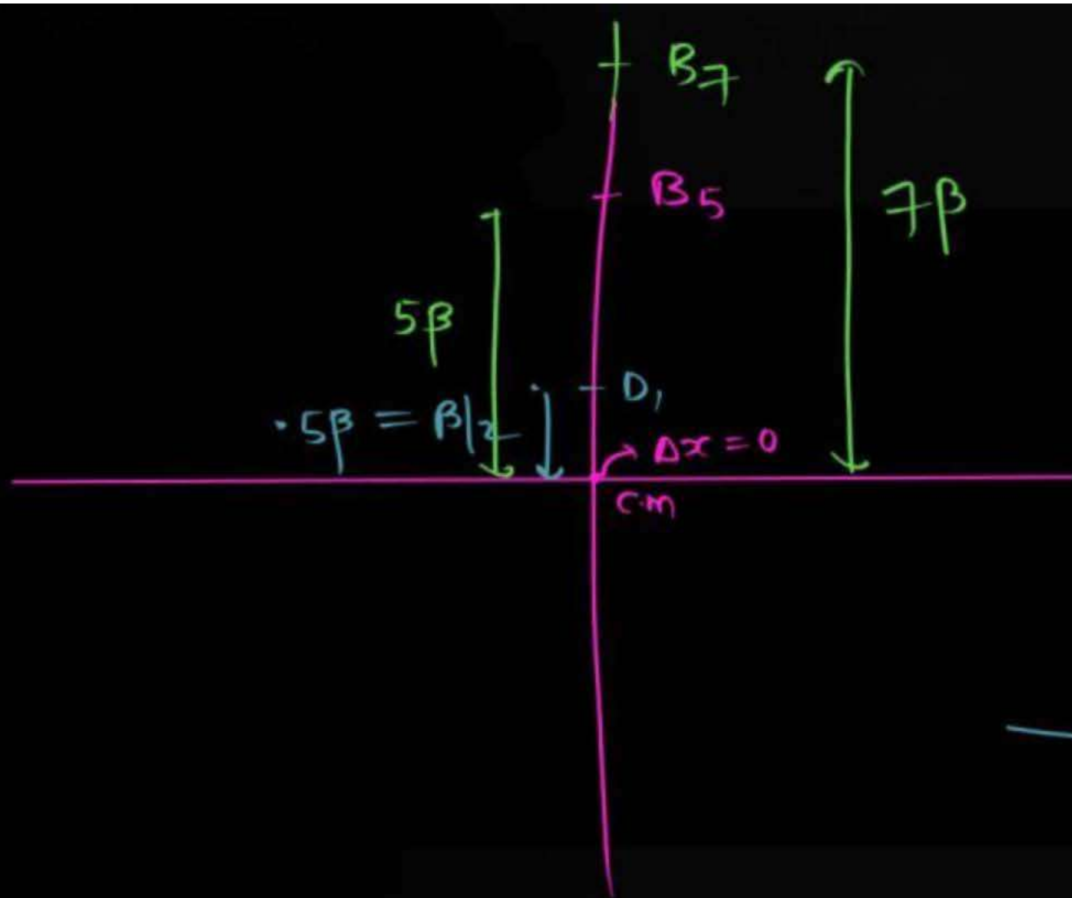
$\Delta x = d \times \frac{y}{D}$

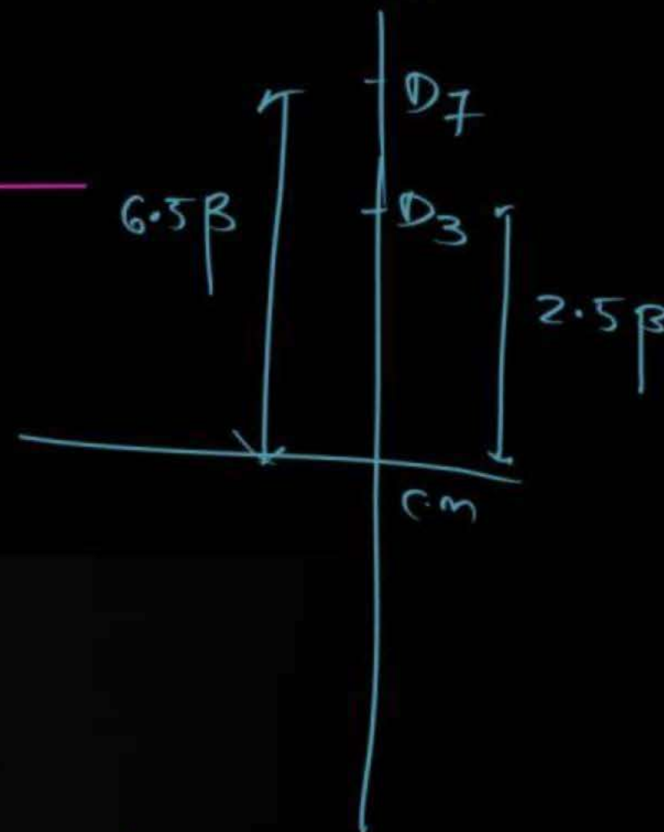
$$\boxed{y = \Delta x \frac{D}{d}} \Rightarrow \beta = \frac{\lambda D}{d}$$

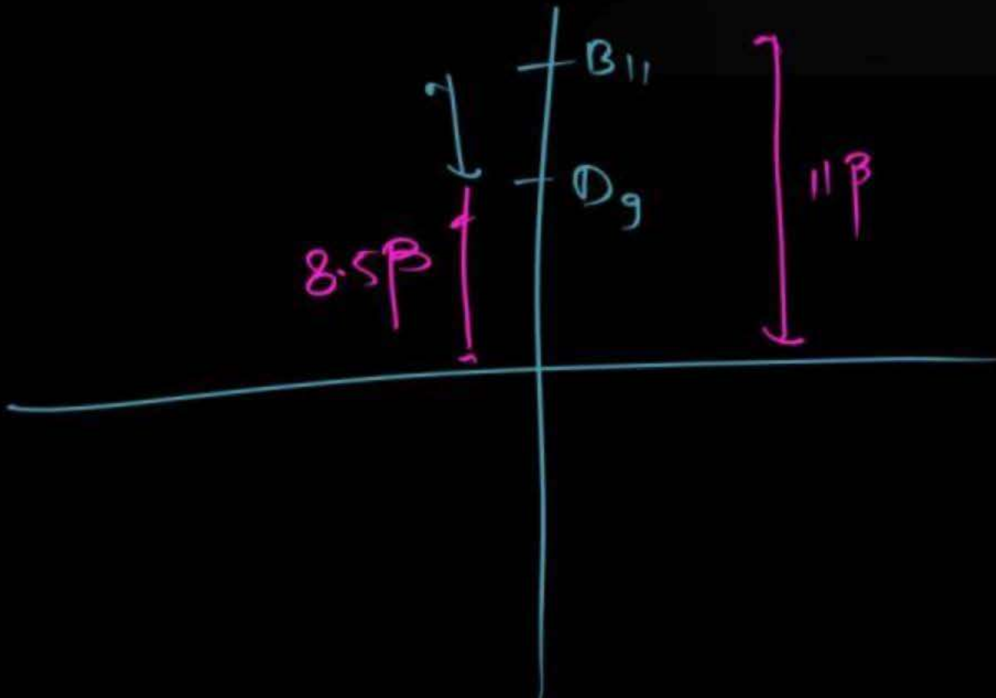
$\Delta x = n\lambda$ (max)

$\Delta x = (\text{odd})\frac{\lambda}{2}$ (min)

$$\beta = \frac{\lambda D}{d}$$







2.5β

$$\beta = \frac{\lambda D}{d}$$

$\lambda \uparrow \ \beta \uparrow$ = no. of max on screen ↓

$D \uparrow \ \beta \uparrow$

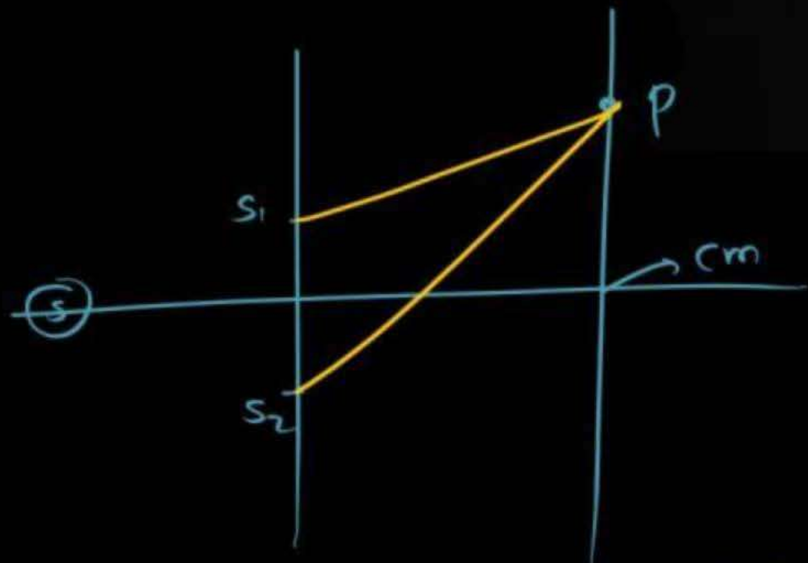
पानी मे → $\lambda/\mu \Rightarrow \beta_{\text{नया}} = \frac{\beta}{\mu}$

$I_1 = I_2 = I_0$

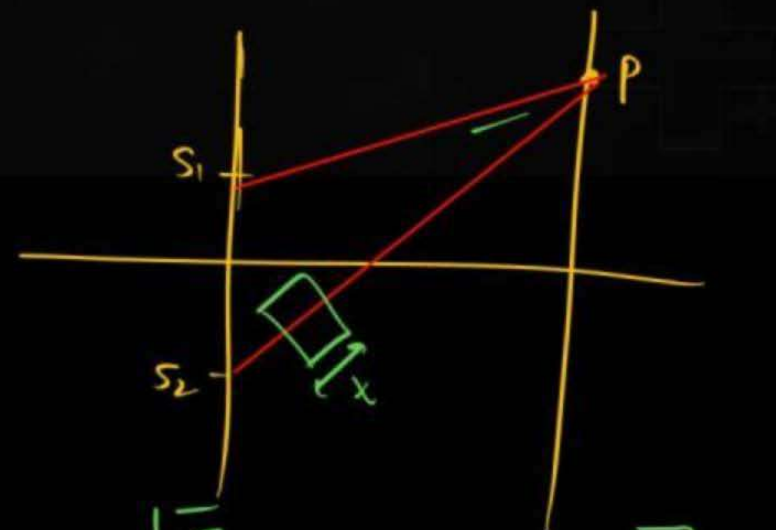
$$I = 4I_0 \cos^2(\phi/2)$$

maxima $I = 4I_0$

mini $I = 0$



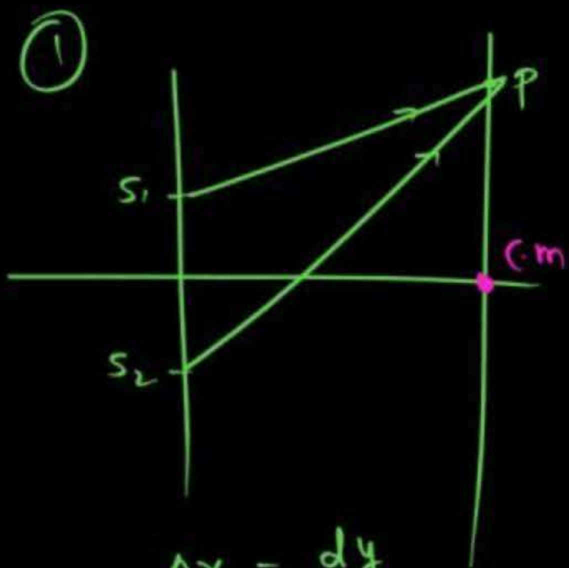
$$\Delta x = S_2P - S_1P = d\frac{y}{D}$$



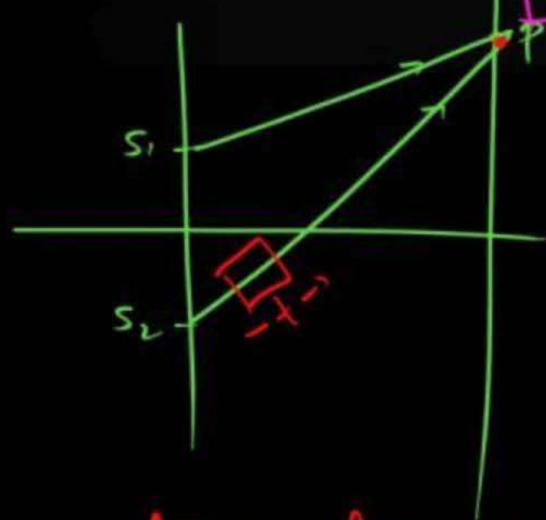
$$\Delta x = \left[(S_2P - t)_{\text{हवा}} + t_m\right] - (S_1P)_{\text{हवा}}$$

$$\Delta x = (S_2P - S_1P)_{\text{हवा}} - t_{\text{हवा}} + (\mu t)_{\text{हवा}}$$

$$\Delta x = \frac{dy}{D} + (\mu - 1)t$$

① 

$$\Delta x = \frac{dy}{D}.$$

② 

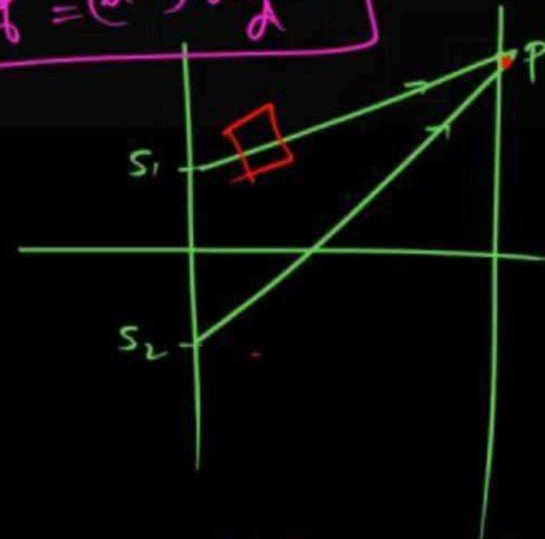
$$\boxed{\text{Shift of C.m} = (\mu-1)t\frac{D}{d}}$$

$$\Delta x = \frac{dy}{D} + (\mu-1)t$$

C.max $\Delta x = 0$

$$y = \frac{-(\mu-1)tD}{d}$$

C.m नीचे



$$\Delta x = d\times\frac{y}{D} - (\mu-1)t$$

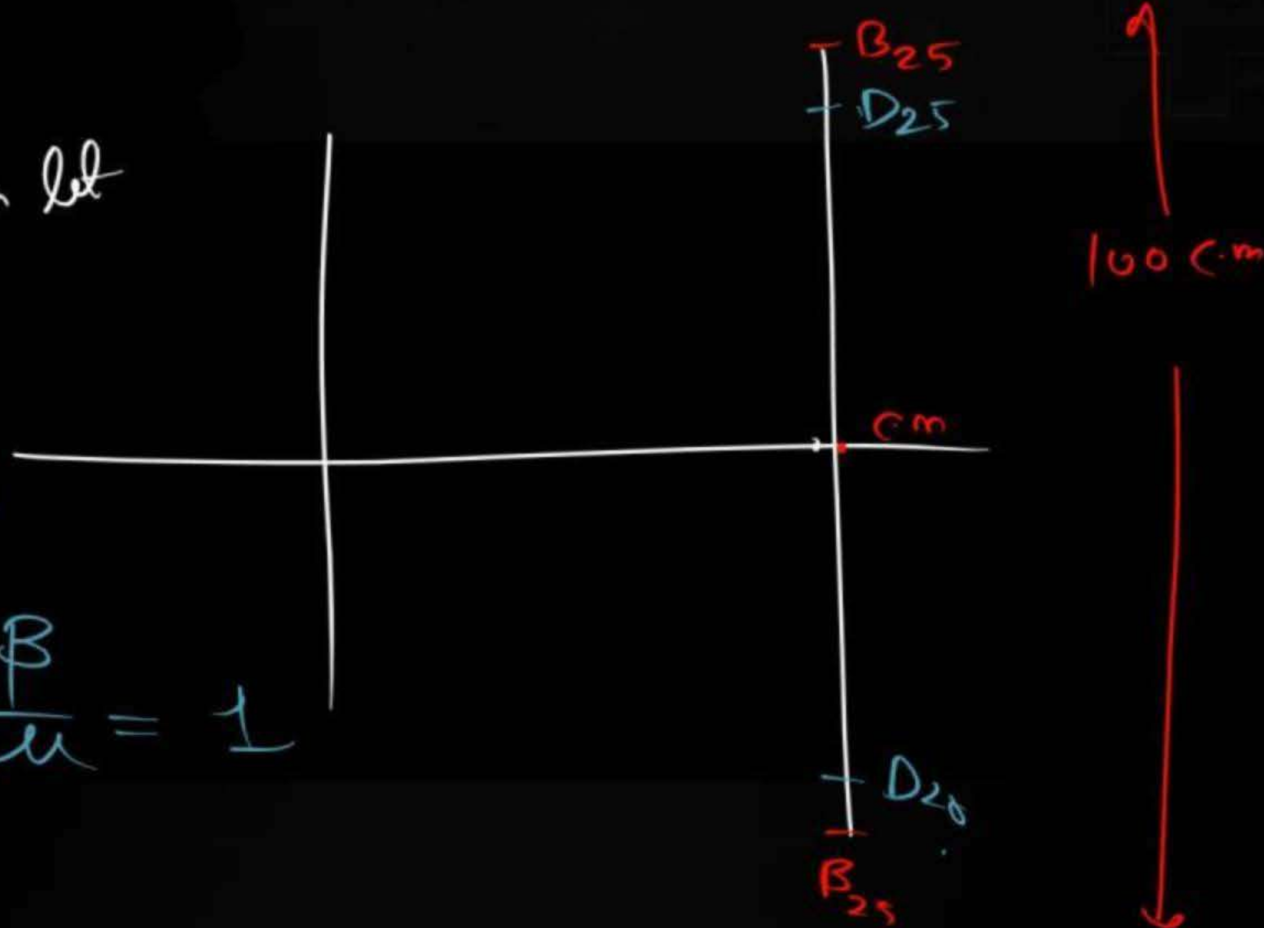
C.m $\equiv \Delta x = 0$

$$y = \frac{(\mu-1)tD}{d}$$

Q2 $\beta = 2\,cm$ let

पानी $\mu = 2$

$\beta_{पानी} = \dfrac{\beta}{\mu} = 1$



$$d\sin\theta = n\lambda$$

QUESTION

In a Young's double slit experiment, 16 fringes are observed in a certain segment of the screen when light of wavelength 700 nm is used. If the wavelength of light is changed to 400 nm, the number of fringes observed in the same segment of the screen would be: **[JEE Mains 2020]**

$n_1 \lambda_1 = n_2 \lambda_2$

(1) 28

(2) 24

(3) 18

(4) 30

Ans. (1)

QUESTION

Two light waves having the same wavelength λ in vacuum are in phase initially. Then the first wave travels a path L_1 through a medium of refractive index n_1 while the second wave travels a path of length L_2 through a medium of refractive index n_2. After this the phase difference between the two waves is: [JEE Mains 2020]

(1) $\frac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$

(2) $\frac{2\pi}{\lambda}\left(\frac{L_2}{n_1} - \frac{L_1}{n_2}\right)$

(3) $\frac{2\pi}{\lambda}\left(\frac{L_1}{n_1} - \frac{L_2}{n_2}\right)$

(4) $\frac{2\pi}{\lambda}(n_1L_1 - n_1L_2)$

$\Delta x = n_1L_1 - n_2L_2$

$\frac{\Delta\phi}{2\pi} = \frac{\Delta x}{\lambda}$

$\Delta\phi = \frac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$

Ans. (1)

QUESTION

A Young's double-slit experiment is performed using monochromatic light of wavelength λ. The intensity of light at a point on the screen, where the path difference is λ, is K units. The intensity of light at a point where the path difference is $\lambda/6$ given by $\frac{nK}{12}$, where n is an integer. The value of n is ______. **[JEE Mains 2020]**

max

$$I = 4I_0 \cos^2 \phi/2$$

$$\frac{\Delta\phi}{2\pi} = \frac{\Delta x}{\lambda}$$

Ans. 9

QUESTION

If the source of light used in a Young's double slit experiment is changed from red to violet: $\lambda \downarrow$ **[JEE Mains 2021]**

(1) consecutive fringe lines will come closer.

(2) the central bright fringe will become a dark fringe.

(3) the fringes will become brighter.

(4) the intensity of minima will increase.

Ans. (1)

QUESTION

Two coherent light sources having intensity in the ratio 2x produce an interference pattern. The ratio $\frac{I_{max}-I_{min}}{I_{max}+I_{min}}$ will be: **[JEE Mains 2021]**

easy

(1) $\frac{2\sqrt{2}}{x+1}$

(2) $\frac{\sqrt{2x}}{2x+1}$

(3) $\frac{\sqrt{2x}}{x+1}$

(4) $\frac{2\sqrt{2x}}{2x+1}$

Ans. (4)

QUESTION

In a Young's double slit experiment two slits are separated by 2 mm and the screen is placed one meter away. When a light of wavelength 500 nm is used, the fringe separation will be:

[JEE Mains 2021]

$$\beta = \frac{\lambda D}{d}$$

(1) 0.25 mm

(2) 0.50 mm

(3) 0.75 mm

(4) 1 mm

Ans. (1)

QUESTION

In Young's double slit arrangement, slits are separated by a gap of 0.5 mm, and the screen is placed at a distance of 0.5 m from them. The distance between the first and the third bright fringe formed when the slits are illuminated by a monochromatic light of 5890 Å is:-

[JEE Mains 2021]

(1) 1178×10^{-9} m

$3\beta - \beta = 2\beta = 2 \times \frac{\lambda D}{d}$

(2) 1178×10^{-6} m

(3) 1178×10^{-12} m

(4) 5890×10^{-7} m

Ans. (2)

QUESTION

In the Young's double slit experiment, the distance between the slits varies in time as $\boxed{d(t) = d_0 + a_0 \sin\omega t;}$ where d_0, ω and a_0 are constants. The difference between the largest fringe width and the smallest fringe width obtained over time is given as:

[JEE Mains 2021]

(1) $\dfrac{2\lambda D(d_0)}{(d_0^2 - a_0^2)}$

(2) $\dfrac{2\lambda D a_0}{(d_0^2 - a_0^2)}$

(3) $\dfrac{\lambda D}{d_0^2} a_0$

(4) $\dfrac{\lambda D}{d_0 + a_0}$

$\beta = \dfrac{\lambda D}{d}$

$\beta_{\text{बड़ा}} = \dfrac{\lambda D}{d_0 - a_0}$

$\beta_{\text{छोटा}} = \dfrac{\lambda D}{d_0 + a_0}$

$= \dfrac{\lambda D}{d_0 - a_0} - \dfrac{\lambda D}{d_0 + a} = \lambda D \dfrac{[2a_0]}{d_0^2 - a_0^2}$

Ans. (2)

QUESTION

In Young's double slit experiment, if the source of light changes from orange to blue then:

Same

[JEE Mains 2021]

(1) the central bright fringe will become a dark fringe.

(2) the distance between consecutive fringes will decrease.

(3) the distance between consecutive fringes will increase.

(4) the intensity of the minima will increase.

Ans. (2)

QUESTION

White light is passed through a double slit and interference is observed on a screen 1.5 m away. The separation between the slits is 0.3 mm. The first violet and red fringes are formed 2.0 mm and 3.5 mm away from the central white fringes. The difference in wavelengths of red and violet light is _____ nm. **[JEE Mains 2021]**

$$\beta_1 = 2\times10^{-3} \qquad \beta_2 = 3.5\times10^{-3}$$

$$\beta_2 - \beta_1 = 1.5\times10^{-3}$$

$$\lambda_2 - \lambda_1 = (1.5\times10^{-3})\frac{d}{D}$$

Ans. 300

QUESTION

The light waves from two coherent sources have same intensity $I_1 = I_2 = I_0$. In interference pattern the intensity of light at minima is zero. What will be the intensity of light at maxima?

[JEE Mains 2021]

(1) I_0

(2) $2 I_0$

(3) $5 I_0$

(4) $4 I_0$

Ans. (4)

QUESTION

A fringe width of 6 mm was produced for two slits separated by 1 mm apart. The screen is placed 10 m away. The wavelength of light used is 'x' nm. The value of 'x' to the nearest integer is ____.

[JEE Mains 2021]

$$\beta = \frac{\lambda D}{d}$$

$$\lambda = \frac{\beta d}{D}$$

Ans. 600

QUESTION

In Young's double slits experiment, the position of 5^{th} bright fringe from the central maximum is 5 cm. The distance between slits and screen is 1 m and wavelength of used monochromatic light is 600 nm. The separation between the slits is:

[25 January 2023 - Shift 1]

(1) 60 μm

(2) 48 μm

(3) 12 μm

(4) 36 μm

$$5\beta = 5 \text{ cm}$$

$$\beta = 10^{-2} = \frac{\lambda D}{d}$$

$$10^{-2} = \frac{600 \times 10^{-9} \times 1}{d}$$

Ans : (1)

QUESTION

In a Young's double slit experiment, two slits are illuminated with a light of wavelength 800 nm. The line joining A_1P is perpendicular to A_1A_2 as shown in the figure. If the first minimum is detected at P, the value of slits separation 'a' will be : The distance of screen from slits D = 5 cm

[29 January 2023 - Shift 1]

(1) 0.4 mm

(2) 0.5 mm

(3) 0.2 mm

(4) 0.1 mm

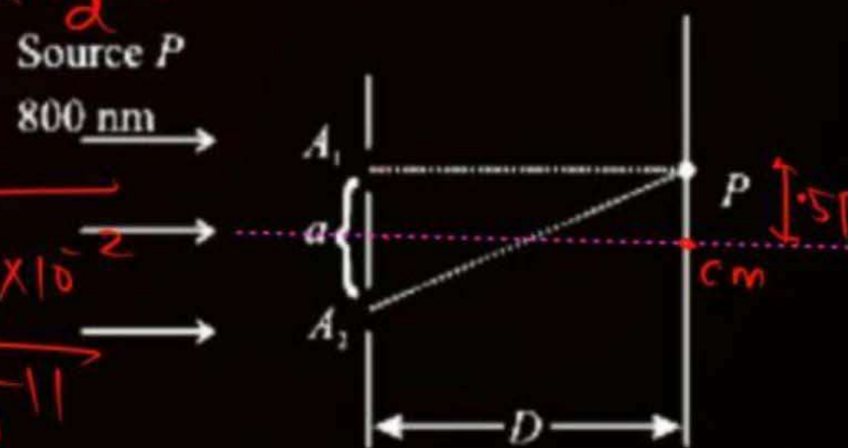
$$\frac{d}{2} = .5\beta = \frac{1}{2} \times \frac{\lambda D}{d}$$

$$d^2 = \lambda D$$

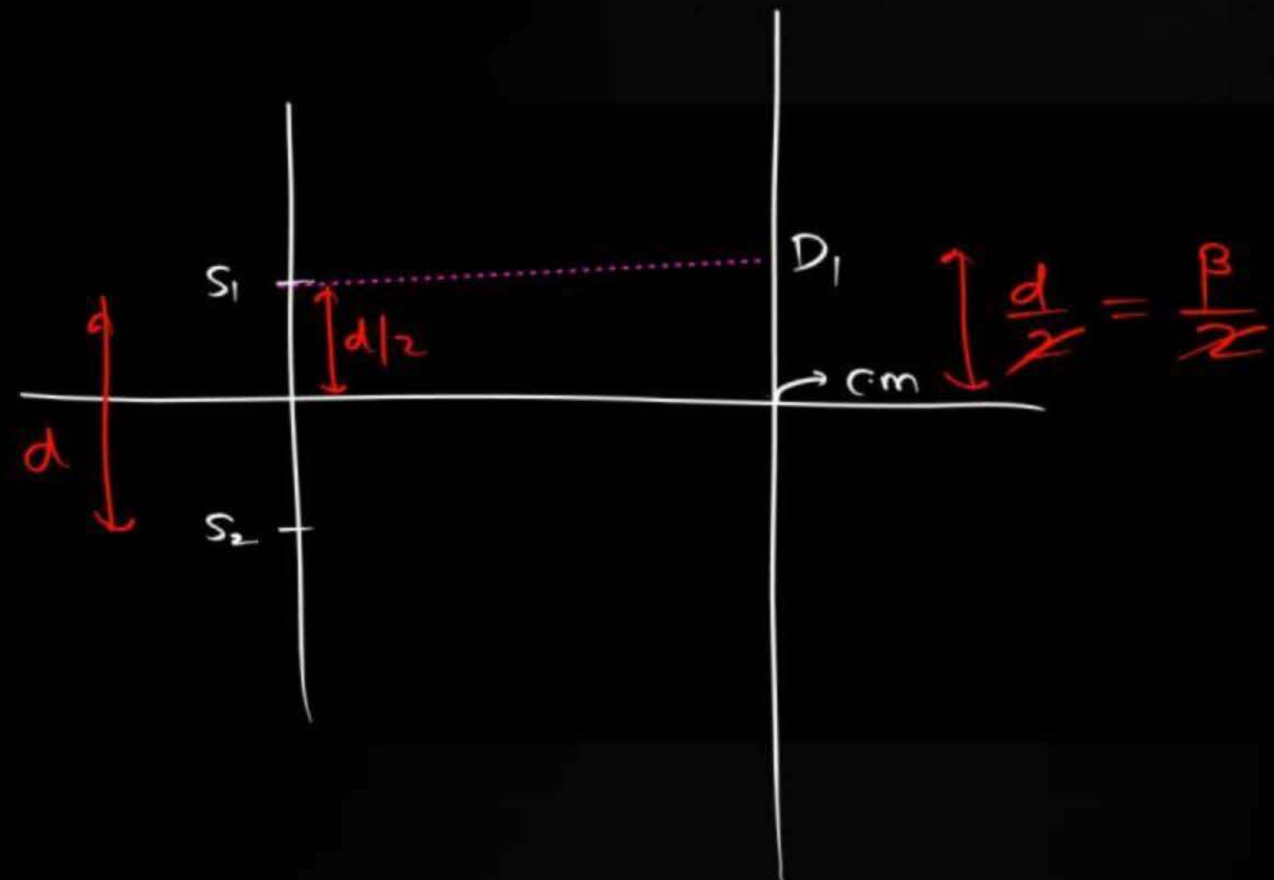
$$d = \sqrt{800 \times 10^{-9} \times 5 \times 10^{-2}}$$

$$= \sqrt{4000 \times 10^{-11}}$$

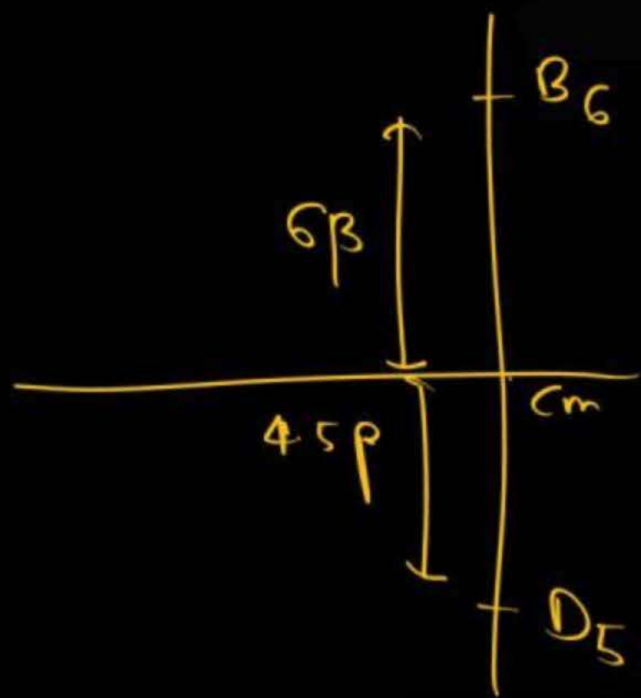
$$= \boxed{2 \times 10^{-4}}$$



Ans : (3)



S_1
S_2
$d/2$
d
D_1
$c.m$
$\frac{d}{\cancel{2}} = \frac{\beta}{\cancel{2}}$



B 6
6β
cm
4.5β
D 5

QUESTION

$\frac{\cancel{10^{-6}} \times 4 \times 10^{10}}{4000 \times}$ $\frac{40}{4}$ 10 $\left[.55 \times .1 \times 10^{-3} - .51 \times .1 \times 10^{-3}\right] / 4000 \times 10^{-10}$

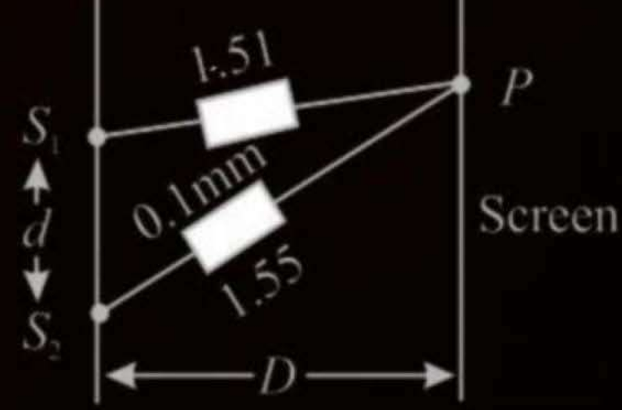
In Young's double slit experiment, two slits S_1 and S_2 are 'd' distance apart and the separation from slits to screen is D (as shown in figure). Now if two transparent slabs of equal thickness 0.1 mm but refractive index 1.51 and 1.55 are introduced in the path of beam $\boxed{(\lambda = 4000\text{Å})}$ from S_1 and S_2 respectively. The central bright fringe spot will shift by number of fringes.

[30 January 2023 - Shift 1]

$$\cancel{\Delta x} = \frac{dy}{D} + (\mu_1 - 1)t_1 - (\mu_2 - 1)t_2$$

0

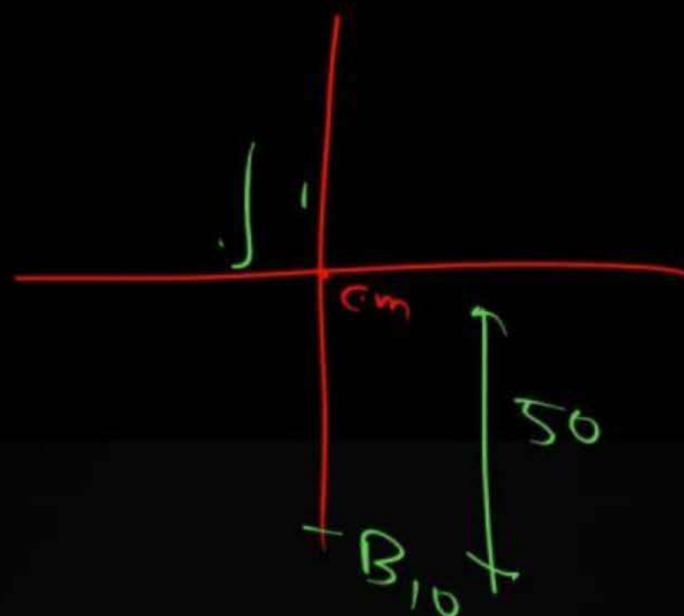
$$\frac{y}{\beta} = \frac{\left[(\mu_2 - 1)t_2 - (\mu_1 - 1)t_1\right]\cancel{\frac{D}{d}}}{\lambda \cancel{\frac{D}{d}}}$$

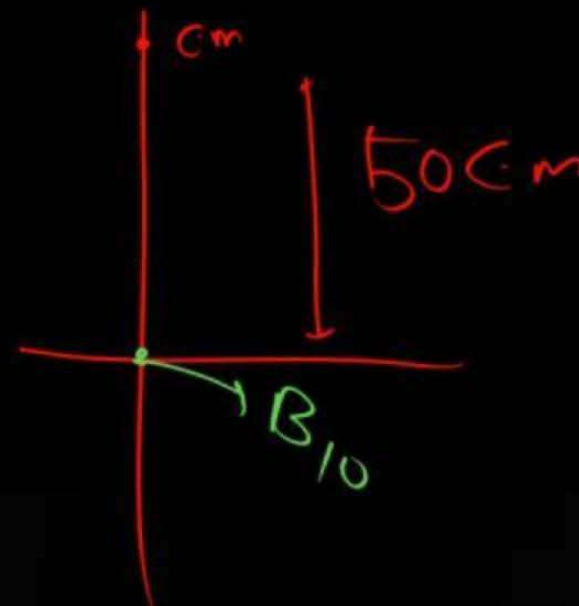


Ans : (10)

$\beta = 5$ c.m lit

shift of c.m = 50 c.m lit





QUESTION

$$\frac{\Delta\phi}{2\pi} = \frac{\Delta x}{\lambda} \qquad \Delta\phi_1 = \frac{2\pi}{\lambda}\frac{\lambda}{4} = \frac{\pi}{2} \qquad \Delta\phi_2 = \frac{2\pi}{3}$$

In a Young's double slit experiment, the intensities at two points, for the path difference $\frac{\lambda}{4}$ and $\frac{\lambda}{3}$ (λ being the wavelength of light used) are I_1 and I_2 respectively. If I_0 denotes the intensity produced by each one of the individual slits, then $\frac{I_1+I_2}{I_0}$ = ______.

[30 January 2023 - Shift 2]

$$I = 4I_0\cos^2\phi/2$$

$$I_1 = 4I_0\cos^2 45^\circ = 2I_0$$

$$I_2 = 4I_0\cos^2 60 = I_0$$

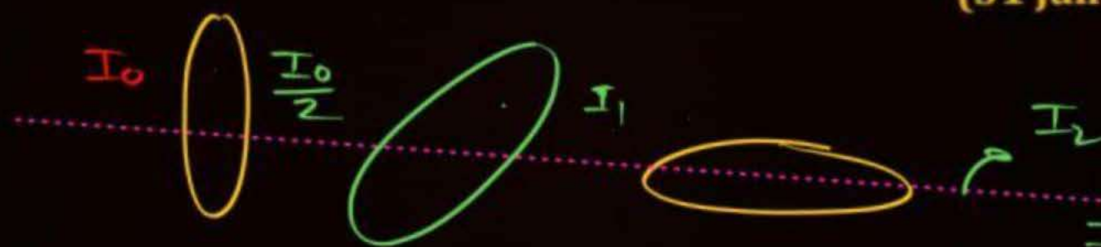
$$\frac{2I_0 + I_0}{I_0} = 3$$

Ans : (3)

QUESTION

Two polaroide A and B are placed in such a way that the pass-axis of polaroids are perpendicular to each other. Now, another polaroid C is placed between A and B bisecting angle between them. If intensity of unpolarised light is I_0 then intensity of transmitted light after passing through polaroid B will be :

(31 January 2023 - Shift 1)



(1) $\frac{I_0}{4}$

(2) $\frac{I_0}{2}$

(3) $\frac{I_0}{8}$

(4) Zero

$I_2 = I_1 \cos^2 45^\circ$

$= \frac{I_0}{4} \times \frac{1}{2}$

$I_1 = \frac{I_0}{2} \cos^2 45 = \frac{I_0}{4}$

Ans : (3)

QUESTION

(Last year Class)

'n' polarizing sheets are arranged such that each makes an angle 45° with the proceeding sheet. An unpolarized light of intensity I is incident into this arrangement. The output intensity is found to be $\frac{I}{64}$. The value of n will be:

[01 February 2023 - Shift 1]

I_0 $\quad \frac{I_0}{2} \quad \frac{I_0}{2}\cos^2 45 = \frac{I_0}{4} \quad \frac{I_0}{8} \quad \frac{I_0}{16} \quad \frac{I_0}{32} \quad \frac{I_0}{64}$

(1) 3

(2) 6

(3) 5

(4) 4

Ans : (2)

QUESTION

ऐसे Qus हर बार आता है

$3\times\frac{\lambda_1 D}{d} = \frac{3\times 800\times10^{-9}\times 7}{.35\times10^{-3}}$

Two light waves of wavelengths 800 and 600 nm are used in Young's double slit experiment to obtain interference fringes on a screen placed 7 m away from plane of slits. If the two slits are separated by 0.35 mm, then shortest distance from the central bright maximum to the point where the bright fringes of the two wavelength coincide will be 48 mm.

[31 January 2023 - Shift 2]

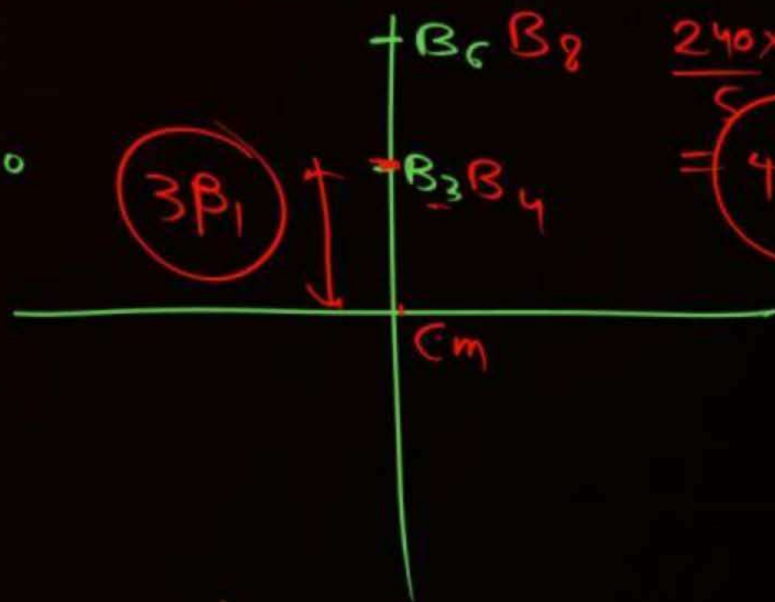
$$y = \frac{n_1\lambda_1 D}{d} = \frac{n_2\lambda_2 D}{d}$$

$$\boxed{n_1\lambda_1 = n_2\lambda_2}$$

$n_1\times 800 = n_2\times 600$

$4n_1 = 3n_2$

n_1	n_2
3	4
6	8
9	12



$\frac{240\times10^{-3}}{5} = 48$

Ans : (48)

QUESTION

A beam of light consisting of two wavelengths 7000Å and 5500Å is used to obtain interference pattern in Young's double slit experiment. The distance between the slits is 2.5 mm and the distance between the plane of slits and the screen is 150 cm. The least distance from the central fringe, where the bright fringes due to both the wavelengths coincide, is $n \times 10^{-5}$ m. The value of n is ________.

[06 April 2023 - Shift 2]

$14 n_1 = 11 n_2$

$11\beta_1$ Ans

$14\beta_2$

Ans

Ans : (462)

QUESTION

The width of fringe is 2 mm on the screen in a double slit experiment for the light of wavelength of 400 nm. The width of the fringe for the light of wavelength 600 nm will be:

[08 April 2023 - Shift 2]

$$\beta = \frac{\lambda D}{d}$$

$$\frac{\beta_2}{\beta_1} = \frac{\lambda_2}{\lambda_1}$$

$$\frac{\beta_2}{2} = \frac{600}{400}$$

(1) 4 mm

(2) 2 mm

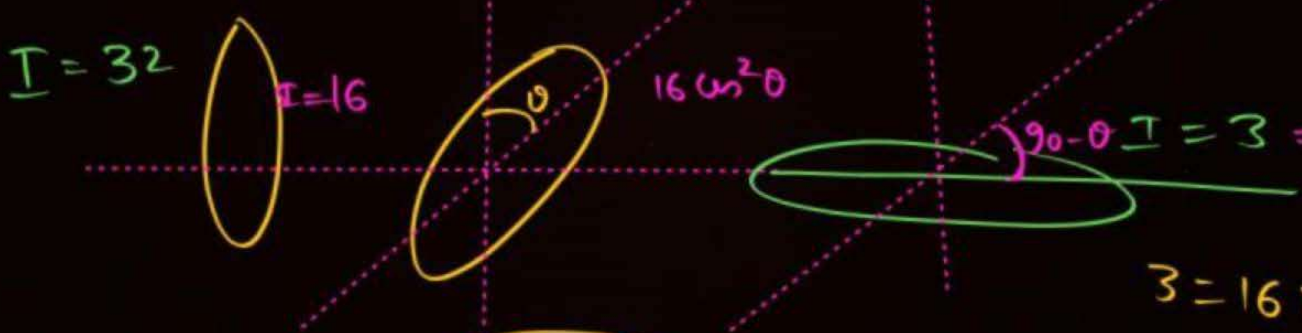
(3) 1.33 mm

(4) 3 mm

Ans : (4)

QUESTION

Unpolarised light of intensity 32 Wm^{-2} passes through the combination of three polaroids such that the pass axis of the last polaroids is perpendicular to that of the pass axis of first polaroids. If intensity of emerging light is 3 Wm^{-2}, then the angle between pass axis of first two polaroids is 30 ______°. [10 April 2023 - Shift 1]



$I = 3 = 16\cos^2\theta \sin^2\theta$

$3 = 16 \times \frac{4\cos^2\theta \sin^2\theta}{4}$

$\frac{3}{4} = \sin^2 2\theta$

$\sin 2\theta = \frac{\sqrt{3}}{2}$

$2\theta = 60$

$\theta = 30$

Ans : (30)

QUESTION

The ratio of intensities at two points P and Q on the screen in a Young's double slit experiment where phase difference between two waves of same amplitude are $\frac{\pi}{3} = 60^\circ$ and $\frac{\pi}{2}$, respectively are [10 April 2023 - Shift 2]

45° $\rightarrow 90$

$I = 4I_0 \cos^2 \phi/2$

$$\frac{\cos^2 30}{\cos^2 45} = \frac{3}{4 \times \frac{1}{2}}$$

(1) 2 : 3

(2) 1 : 3

(3) 3 : 1

(4) 3 : 2

Ans : (4)

QUESTION

In a Young's double slit experiment, the ratio of amplitude of light coming from slits is 2 : 1. The ratio of the maximum to minimum intensity in the interference pattern is. [13 April 2023 - Shift 2]

$$\frac{A_1}{A_2} = \frac{2}{1}$$

(1) 9 : 4

(2) 25 : 9

(3) 2 : 1

(4) 9 : 1

$$\sqrt{\frac{I_1}{I_2}} = \frac{A_1^2}{A_2^2} = \frac{4}{1}$$

$$\frac{(\sqrt{I_1} + \sqrt{I_2})^2}{(\sqrt{I_1} - \sqrt{I_2})^2} = \left(\frac{\sqrt{\frac{I_1}{I_2}} + 1}{\sqrt{\frac{I_1}{I_2}} - 1}\right)^2$$

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

Ans : (4)

QUESTION

A single slit of width a is illuminated by a monochromatic light of wavelength 600 nm. The value of a for which first minimum appears at $\theta = 30°$ on the screen will be: [15 April 2023 - Shift 1]

$d \sin\theta = n\lambda$

$d \sin 30 = 1 \times 600 \times 10^{-9}$

$d = 1200 \times 10^{-9}$

$= 1.2 \times 10^{-6}$

(1) 1.2 μm

(2) 3 μm

(3) 1.8 μm

(4) 0.6 μm

Ans : (1)

QUESTION

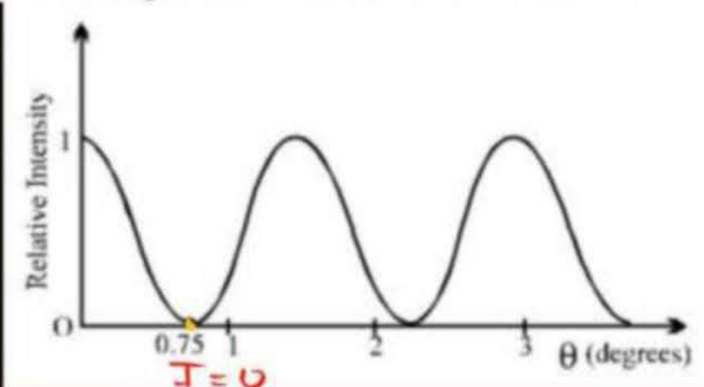
In a Young's double slit experiment for interference of light, the slits are 0.2 cm apart and are illuminated by yellow light ($\lambda = 600$ nm). What would be the fringe width on a screen placed 1 m from the plane of slits if the whole system is immersed in water of index 4/3?

$$\frac{\beta}{\mu} = \frac{\lambda D}{d \cdot \mu}$$

Ans : 0.225 mm

QUESTION

Light of wavelength 520 nm passing through a double slit, produces interference pattern of relative intensity versus angular position θ as shown in the figure. Find the separation d between the slits.



$I = 0$

min

$\theta = .75$

$\Delta x = d\sin\theta = \frac{\lambda}{2}$

$d \times .75 = \frac{\lambda}{2}$

$d = \frac{\lambda}{2 \times .75} = \frac{\lambda}{1.5} = \frac{520}{1.5} = \checkmark$

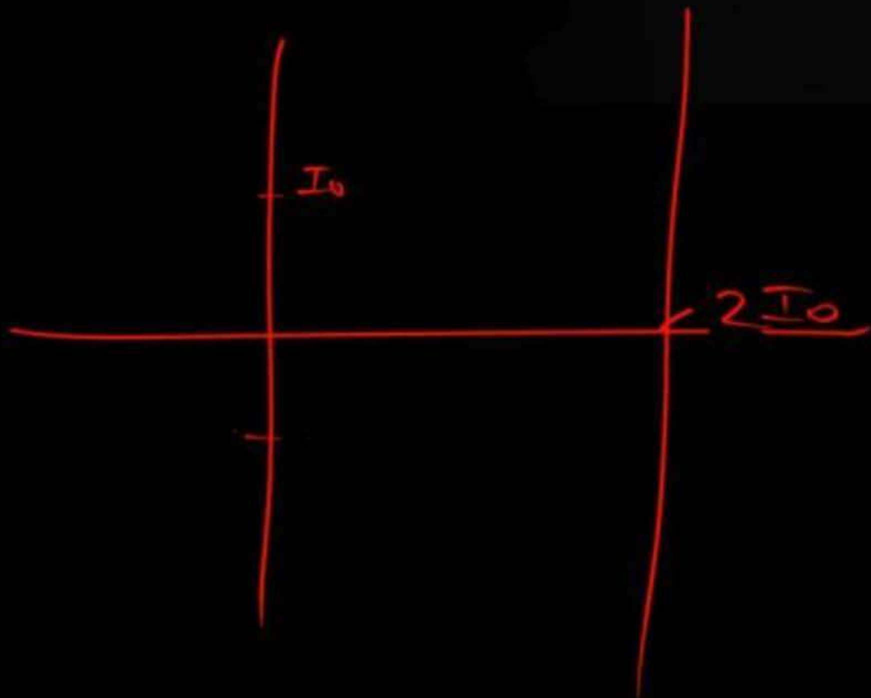
Ans : 1.99×10^{-2} mm

QUESTION

In a Young's double slit experiment, a small detector measures an intensity of illumination of I units at the centre of the fringe pattern. If one of the two (identical) slits is now covered, the measured intensity will be :-

(A) 2I (B) I (C*) I/4 (D) I/2

Ans : (C)


I_0
$2I_0$

QUESTION

In Young's double slit arrangement, water is filled in the space between screen and slits. Then :

(A) fringe pattern shifts upwards but fringe width remains unchanged.

(B) fringe width decreases and central bright fringe shifts upwards.

(C) fringe width increases and central bright fringe does not shift.

(D*) fringe width decreases and central bright fringe does not shift.

$\frac{\lambda}{\mu}$, β/μ,

Ans : (D)

QUESTION

In YDSE, the source placed symmetrically with respect to the slit is now moved parallel to the plane of the slits so that it is closer to the upper slit, as shown. Then,

(A) the fringe width will increase and fringe pattern will shift down.

(B) the fringe width will remain same but fringe pattern will shift up.

(C) the fringe width will decrease and fringe pattern will shift down.

(D*) the fringe width will remain same but fringe pattern will shift down.

Ans : (D)

QUESTION

If the source of light used in a Young's Double Slit Experiment is changed from red to blue, then

(A) the fringes will become brighter $\lambda \downarrow$ $\beta \downarrow$ $n \uparrow$

(B*) consecutive fringes will come closer

(C*) the number of maxima formed on the screen increases

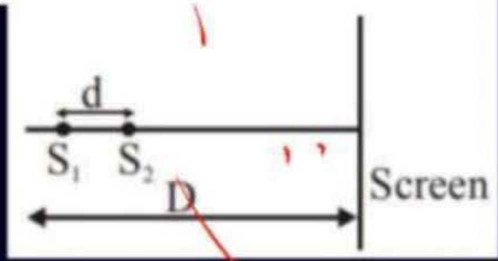
(D) the central bright fringe will become a dark fringe.

Ans : (B, C)

QUESTION

Two coherent point sources S_1 and S_2 are separated by a small distance 'd' as shown. The fringes obtained on the screen will be : **[JEE-Mains 2013]**

(1) points (2) straight lines (3) semicircles (4*) concentric circles



Ans : (4)

QUESTION

VIBGYOR

Young's double slit experiment is carried out by using green, red and blue light, one color at a time. The fringe widths recorded are β_G, β_R and β_B, respectively. Then [IIT-JEE-2012]

(A) $\beta_G > \beta_B > \beta_R$ (B) $\beta_B > \beta_G > \beta_R$ (C) $\beta_R > \beta_B > \beta_G$ (D) $\beta_R > \beta_G > \beta_B$

β_R

Ans : (D)

QUESTION

P

In the Young's double slit experiment using a monochromatic light of wavelength λ, the path difference (in terms of an integer n) corresponding to any point having half the peak intensity is :-

(A) $(2n+1)\frac{\lambda}{2}$ (B) $(2n+1)\frac{\lambda}{4}$ (C) $(2n+1)\frac{\lambda}{8}$ (D) $(2n+1)\frac{\lambda}{16}$ [JEE Advanced 2013]

$$I = 4I_0 \cos^2 \phi/2$$

$$2I_0 = 4I_0 \cos^2 \phi/2$$

$$\boxed{\cos \phi/2 = \pm \frac{1}{\sqrt{2}}}$$

$$\frac{\phi}{2} = \frac{\pi}{4}, \pi - \frac{\pi}{4}, \pi + \frac{\pi}{4}$$

$$\phi = \frac{\pi}{2} \cdot \_\_\_$$

Ans : (B)

QUESTION

A light source, which emits two wavelengths $\lambda_1 = 400$ nm and $\lambda_2 = 600$ nm, is used in a Young's double slit experiment. If recorded fringe widths for λ_1 and λ_2 are β_1 and β_2 and the number of fringes for them within a distance y on one side of the central maximum are m_1 and m_2, respectively, then :- **[JEE Advanced 2014]**

$\lambda_1 < \lambda_2$

$\beta_1 < \beta_2$ $\qquad \beta = \frac{\lambda D}{d}$

(A) $\beta_2 > \beta_1$

(B) $m_1 > m_2$

(C) From the central maximum, 3rd maximum of λ_2 overlaps with 5th minimum of λ_1

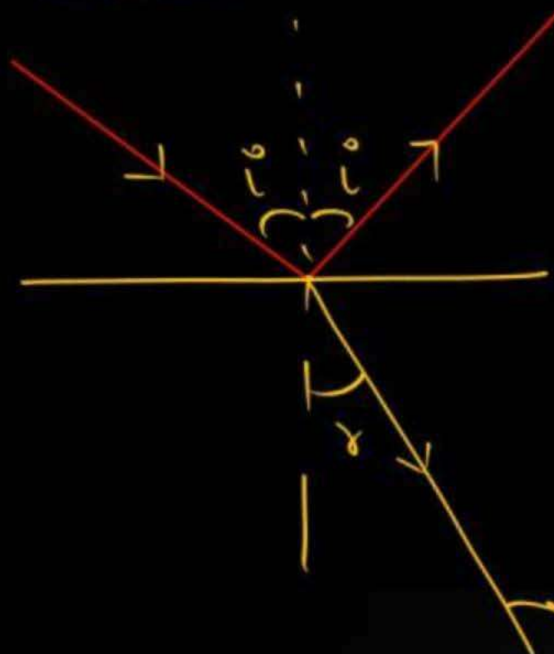
(D) The angular separation of fringes of λ_1 is greater than λ_2

$$\boxed{\theta = \frac{\beta}{D} = \frac{\lambda}{d}}$$

Ans : (A, B, C)

Optics.

$\delta = 180 - 2i$



$\delta = |i - r|$

mirror formula

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\qquad m = -\frac{v}{u} = \frac{h_I}{h_o}$

$$\boxed{v = \frac{uf}{u-f}}$$

Concave $\Rightarrow f < 0$
Convex $f > 0$

$$\boxed{v_{I/m} = -m^2 v_{O/m}}$$

$u < 0 \longrightarrow$ RO
$v < 0 \longrightarrow$ RI
$u > 0 \longrightarrow$ VO
$v > 0 \longrightarrow$ V.I

$$v_{I/L} = m^2 v_{O/L}$$

Lens form

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

$u < 0 \longrightarrow$ RO

$u > 0 \longrightarrow$ VO

$v > 0 \longrightarrow$ RI

$v < 0 \longrightarrow$ V.I

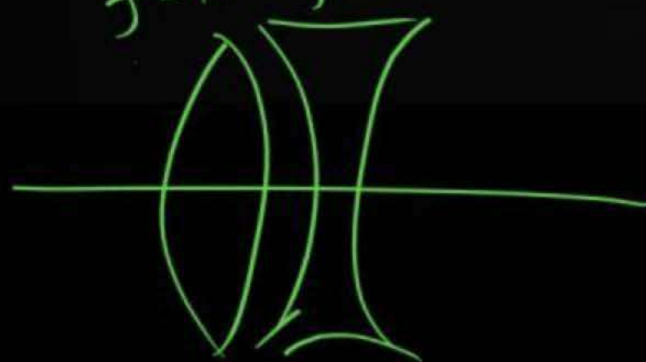
$$v = \frac{uf}{u+f}$$

$$m = \frac{v}{u} = \frac{h_I}{h_O}$$

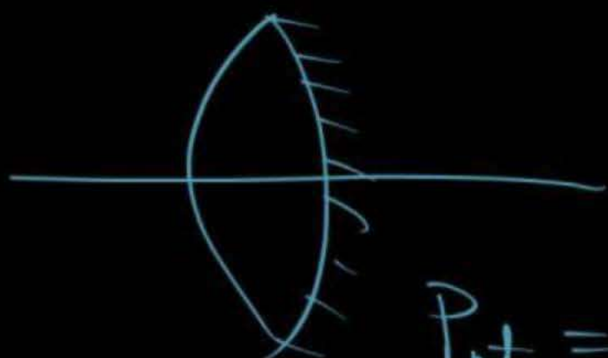
$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \text{Air}$$

$$\frac{1}{f} = \left(\frac{\mu}{\mu_m} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$



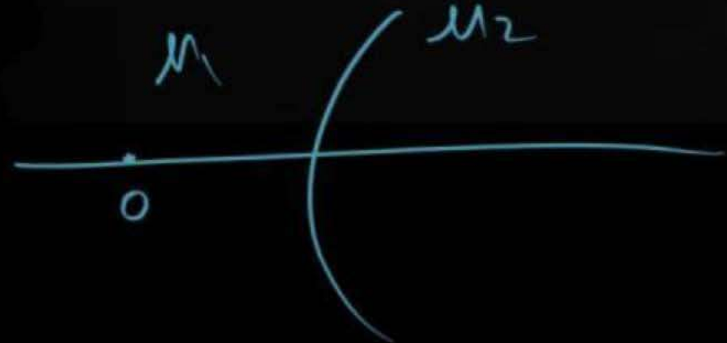
$$\frac{1}{f_{eq}} = \frac{1}{+10} + \frac{1}{-30}$$



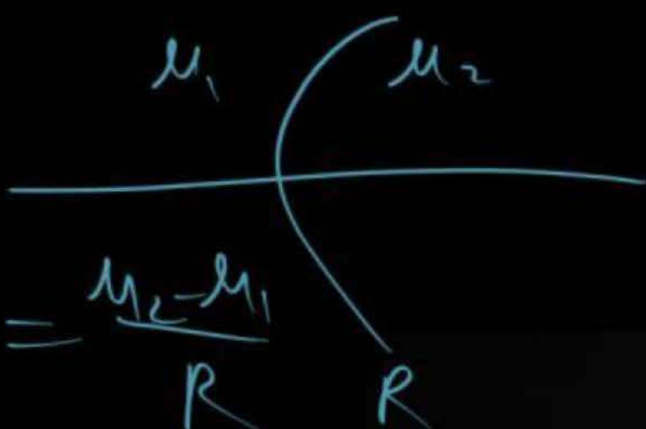
$$P_{net} = 2P_L + P_m$$

$$P_L = \frac{1}{f}$$

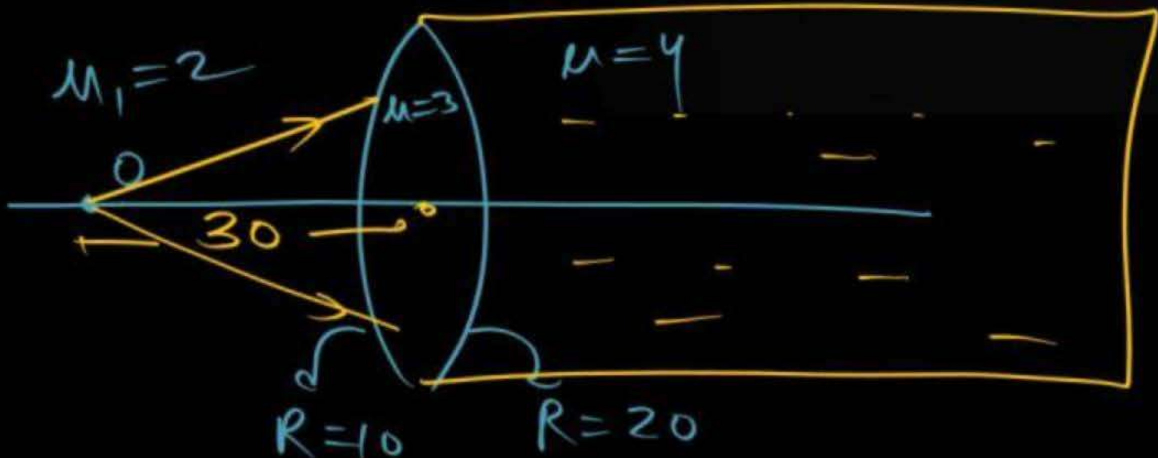
$$P_m = -\frac{1}{f}$$



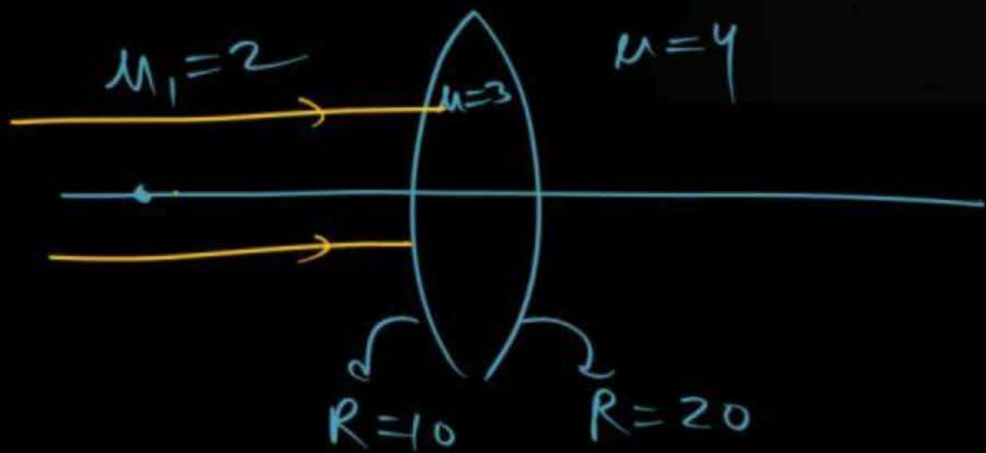
$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$



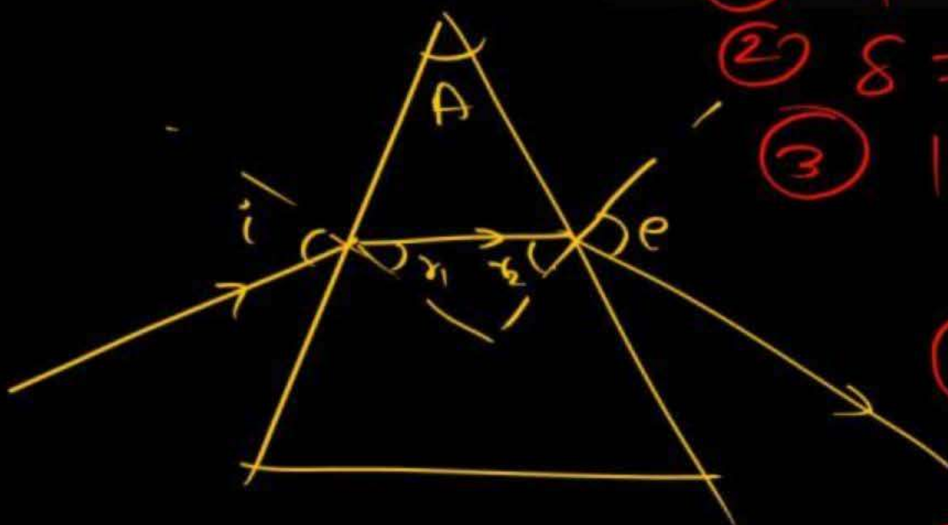
$$P = \frac{\mu_2 - \mu_1}{R}$$

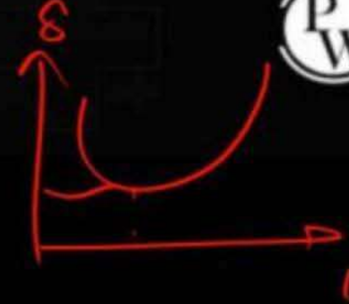


$$\frac{4}{V_f} - \frac{2}{-30} = \frac{4-3}{-20} + \frac{3-2}{+10}$$



$$\frac{4}{f} - \frac{2}{\infty} = \frac{4-3}{-20} + \frac{3-2}{+10}$$





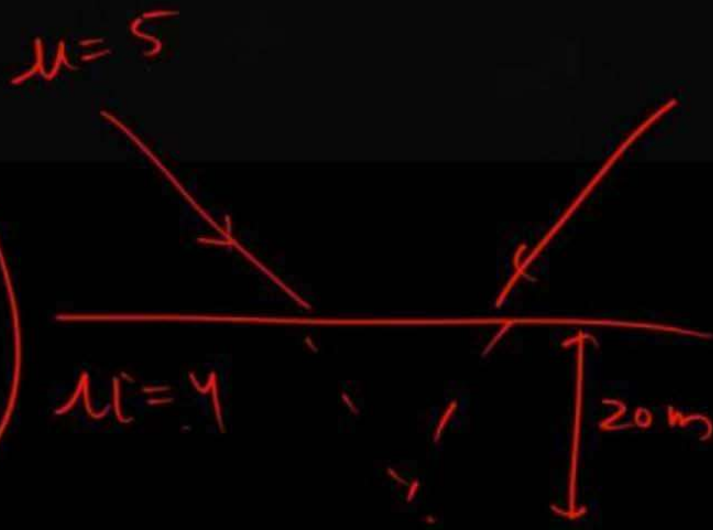
1. $r_1 + r_2 = A$
2. $\delta = i + e - A$
3. $1 \cdot \sin i = \mu \sin r_1$

   $\mu \sin r_2 = 1 \cdot \sin e$
4. $\delta_{min} \equiv r_1 = r_2 = A/2$

   $i = e$
5. thin lens

   $\delta = (\mu - 1)A$

$$h_{app} = h_0 \frac{\mu_{\text{जाने}}}{\mu_{\text{आने}}}$$

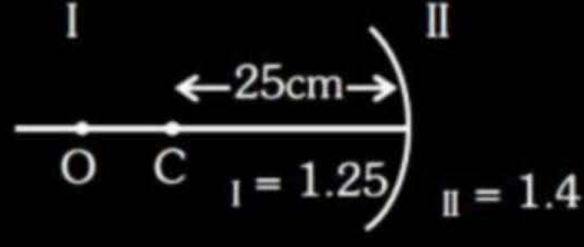


$$h_{app} = 20 \times \frac{4}{5} = \underline{16}$$

Question

Region I and II are separated by a spherical surface of radius 25 cm. An object is kept in region I at a distance of 40 cm from the surface. The distance of the image from the surface is:

(JEE Main-2021)



(1) 55.44 cm

(2) 9.52 cm

(3) 18.23 cm

(4) 37.58 cm

Ans : (4)

Question

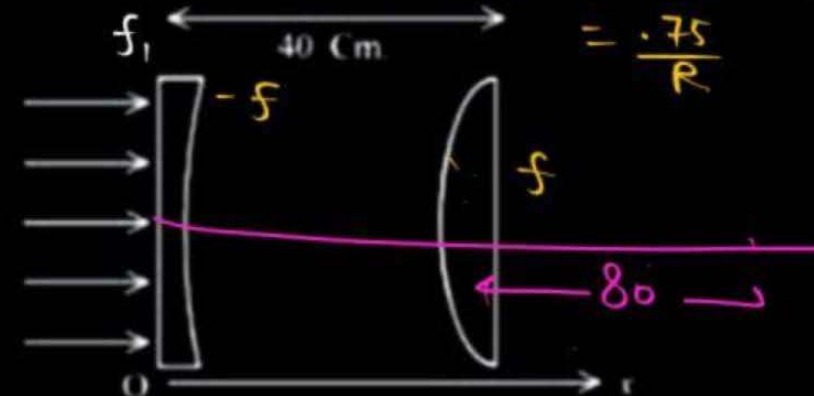
As shown in the figure, a combination of a thin plano concave lens and a thin plano convex lens is used to image an object placed at infinity. The radius of curvature of both the lenses is 30 cm and refraction index of the material for both the lenses is 1.75 . Both the lenses are placed at distance of 40 cm from each other. Due to the combination, the image of the object is formed at distance x = 120 cm, from concave lens.

(24 January 2023 - Shift 1)

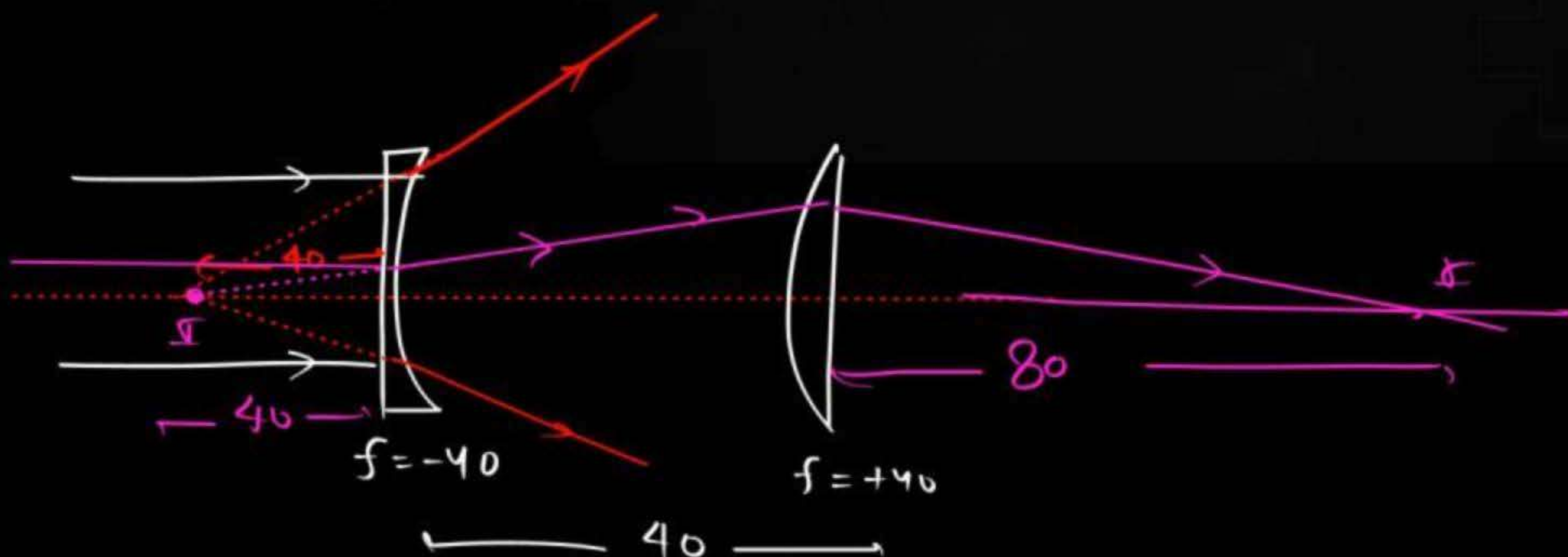
$$\frac{1}{f_1} = .75\left(\frac{1}{\infty} - \frac{1}{+R}\right) = \frac{-.75}{R}$$

$$f_1 = \frac{-R}{.75} = \frac{-3000}{75} = -40$$

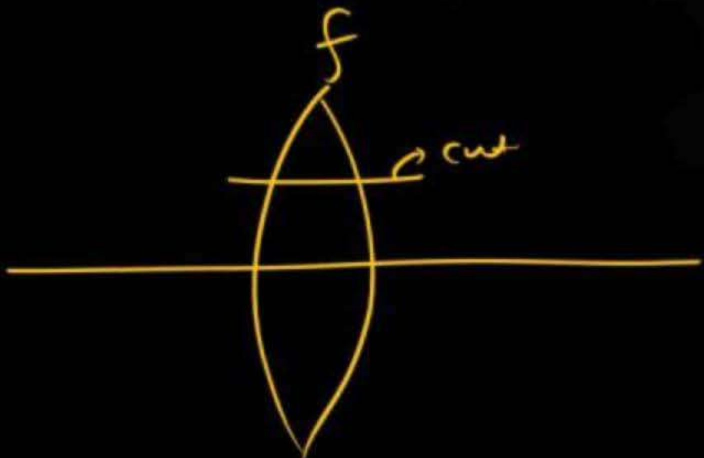
$$\frac{1}{f_2} = .75 \times \left(\frac{1}{R} - \frac{1}{\infty}\right) = \frac{.75}{R}$$



Ans : (120)



40
I
40
f = -40
f = +40
80
40



$$\frac{1}{f_{\text{नया}}} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right)$$

$$\frac{R}{\mu-}$$

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

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

$$f_{\text{पुराना}} = \frac{R}{2(\mu - 1)}$$

Question $72-18=54$

A convex lens of refractive index 1.5 and focal length 18 cm in air is immersed in water. The change in focal length of the lens will be ____ cm. 54

(Given refractive index of water $=\frac{4}{3}$)

(24 January 2023 - Shift 2)

$$\frac{1}{18}=(1.5-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

$$\frac{1}{R_1}-\frac{1}{R_2}=\frac{1}{9}$$

$$\frac{1}{f_2}=\left(\frac{1.5}{4/3}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

$$\frac{1}{f_2}=\left(\frac{45}{40}-1\right)\left(\frac{1}{9}\right)=\frac{5}{40}\times\frac{1}{9}$$

$$f_2=72$$

Ans : (54)

Question

The light rays from an object have been reflected towards an observer from a standard flat mirror, the image observed by the observer are :-

A. Real

B. Erect

C. Smaller in size then object

D. Laterally inverted

Choose the most appropriate answer from the options given below :

(25 January 2023 - Shift 2)

(A) B and D only

(B) B and C only

(C) A and D only

(D) A, C and D only

Ans : (A)

Question

An object is placed on the principal axis of convex lens of focal length 10 cm as shown. A plane mirror is placed on the other side of lens at a distance of 20 cm. The image produced by the plane mirror is 5 cm inside the mirror. The distance of the object from the lens is ______ cm.

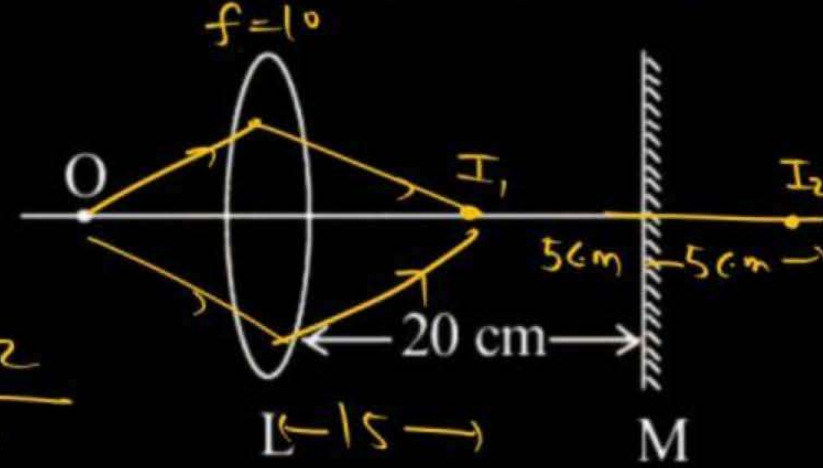
(25 January 2023 - Shift 2)

$$f = 10$$
$$v = 15$$

$$\frac{1}{+15} - \frac{1}{-x} = \frac{1}{10}$$

$$\frac{1}{x} = \frac{1}{10} - \frac{1}{15} = \frac{3-2}{30}$$

$$x = 30$$



Ans : (30)

Question

$-25 + 20$

Two objects A and B are placed at 15 cm and 25 cm from the pole in front of a concave mirror having radius of curvature 40 cm. The distance between images formed by the mirror is: (01 February 2023 - Shift 2)

$f = 20$

$$v_1 = \frac{uf}{u-f} = \frac{-15 \times -20}{-15+20} = \frac{300}{5} = 60$$

$$v_2 = \frac{500}{-5} = -100$$

(A) 40 cm

(B) 60 cm

(C) 160 cm

(D) 100 cm

Ans : (C)

Question

A monochromatic light wave with wavelength λ_1 and frequency ν_1 in air enters another medium. If the angle of incidence and angle of refraction at the interface are $45°$ and $30°$ respectively, then the wavelength λ_2 and frequency ν_2 of the refracted wave are: **(06 April 2023 - Shift 1)**

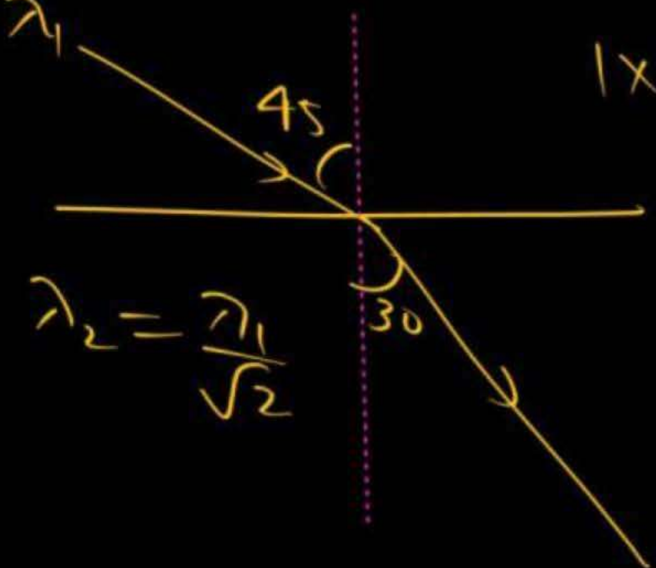
$\lambda \longrightarrow \lambda/\mu$

(A) $\lambda_2 = \sqrt{2}\lambda_1, \nu_2 = \nu_1$

(B) $\lambda_2 = \lambda_1, \nu_2 = \cancel{\frac{1}{\sqrt{2}}}\nu_1$

(C) $\lambda_2 = \lambda_1, \nu_2 = \cancel{\sqrt{2}}\nu_1$

(D) $\lambda_2 = \frac{1}{\sqrt{2}}\lambda_1, \nu_2 = \nu_1$



$\lambda_2 = \frac{\lambda_1}{\sqrt{2}}$

$1 \times \frac{1}{\sqrt{2}} = \mu \times \frac{1}{2}$

$\mu = \sqrt{2}$

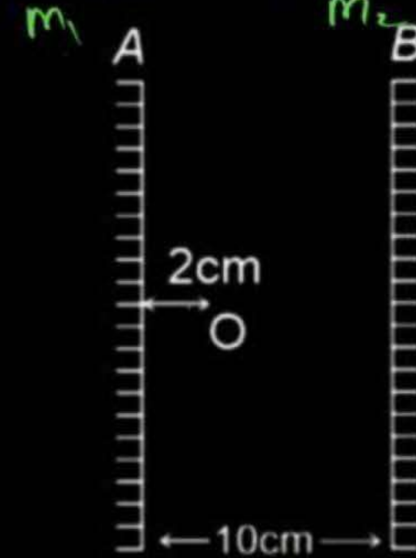
Ans : (D)

Question

Two vertical parallel mirrors A and B are separated by 10 cm. A point object O is placed at a distance of 2 cm from mirror A. The distance of the second nearest image behind mirror A from the mirror A is cm.

(08 April 2023 - Shift 1)

m_1	m_2
2	8
18	12
22	28
38	32



Ans : (18)

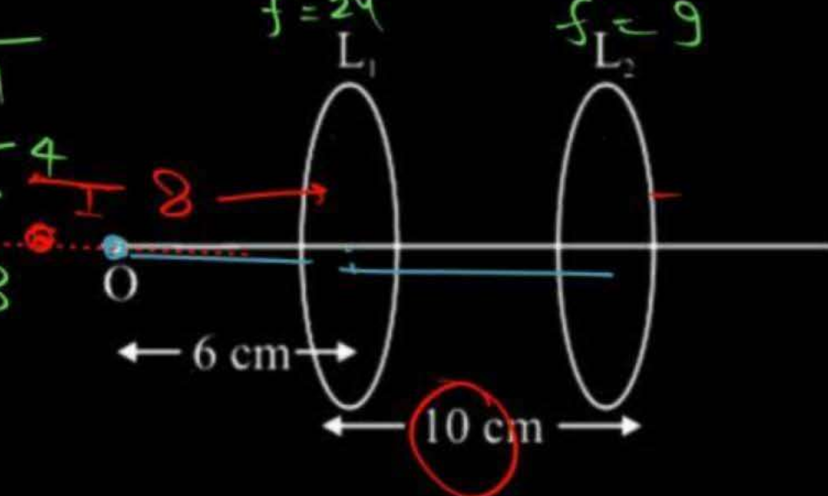
Question

A point object O is placed in front of two thin symmetrical coaxial convex lenses L_1 and L_2 with focal length 24 cm and 9 cm respectively. The distance between two lenses is 10 cm and the object is placed 6 cm away from lens L_1 as shown in the figure. The distance between the object and the image formed by the system of two lenses is 34 cm.

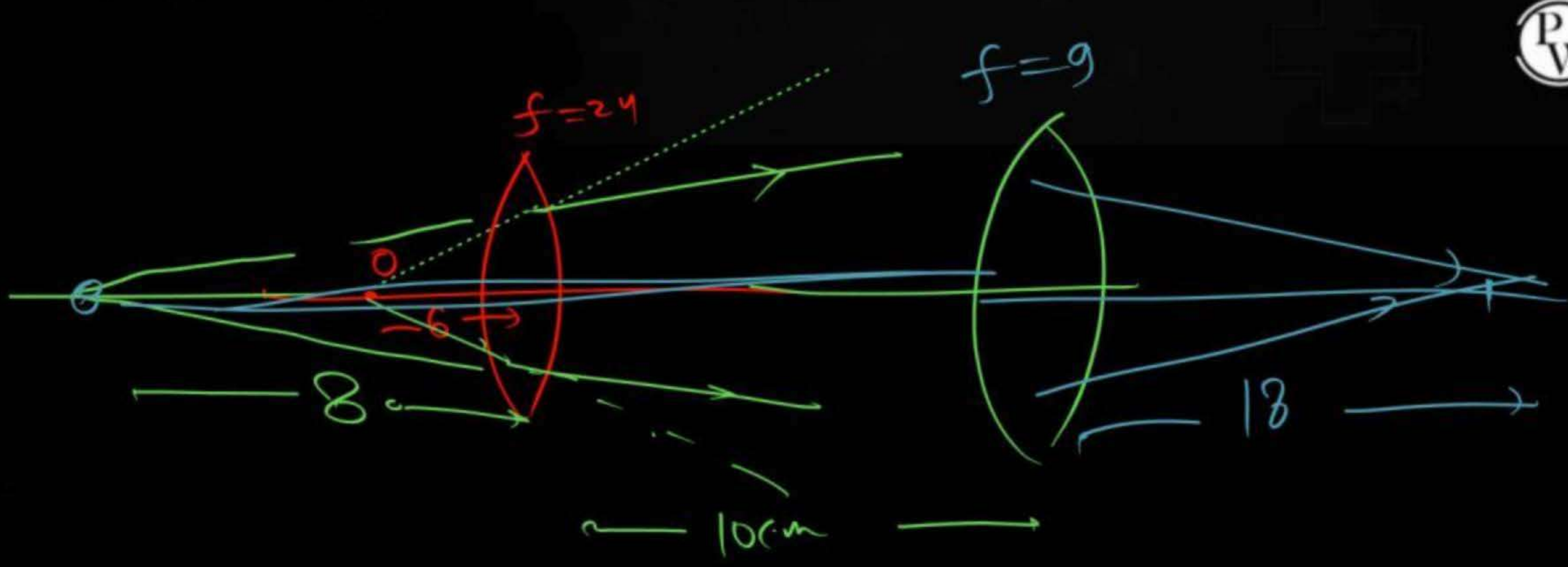
(10 April 2023 - Shift 2)

$6+10+18$

$$v = \frac{-6\times 24}{-6+24} = \frac{-6\times \cancel{24}^{\,4}}{\cancel{18}_{\,3}} = -8$$



Ans : (34)



f=24
f=9
O
-6
8
18
10cm

Question

The critical angle for a denser-rarer interface is 45°. The speed of light in rarer medium is 3×10^8 ms^{-1}. The speed of light in the denser medium is:

(11 April 2023 - Shift 1)

(A) 3.12×10^7 ms^{-1}

(B) 5×10^7 ms^{-1}

(C) 2.12×10^8 ms^{-1}

(D) $\sqrt{2} \times 10^8$ ms^{-1}

$$\sin\theta_c = \frac{\mu_{\text{छोटा}}}{\mu_{\text{बड़ा}}} = \frac{v_{\text{छोटी}}}{v_{\text{बड़ी}}}$$

$$\frac{1}{\sqrt{2}} = \frac{v}{3\times10^8}$$

$$\frac{3\sqrt{2}}{2}\times10^8 = v$$

$$\frac{3\times\cancel{1.4}\;.7}{\cancel{2}}$$

Ans : (C)

Question

The radius of curvature of each surface of a convex lens having refractive index 1.8 is 20 cm. The lens is now immersed in a liquid of refractive index 1.5 . The ratio of power of lens in air to its power in the liquid will be x : 1. The value of x is

(11 April 2023 - Shift 1)

$$P_{\text{हवा}} = \frac{1}{f} = (1.8-1)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$P_{\text{पानी}} = \left(\frac{1.8}{1.5} - 1\right)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$\frac{P_{\text{हवा}}}{P_{\text{पानी}}} = \frac{.8 \times 1.5}{.3} = 4$$

Ans : (4)

Question

When one light ray is reflected from a plane mirror with $30°$ angle of reflection, the angle of deviation of the ray after reflection is: **(11 April 2023 - Shift 2)**

$$\delta = 180 - 2i$$
$$= 180 - 2 \times 30$$
$$= 120$$

(A) $120°$

(B) $110°$

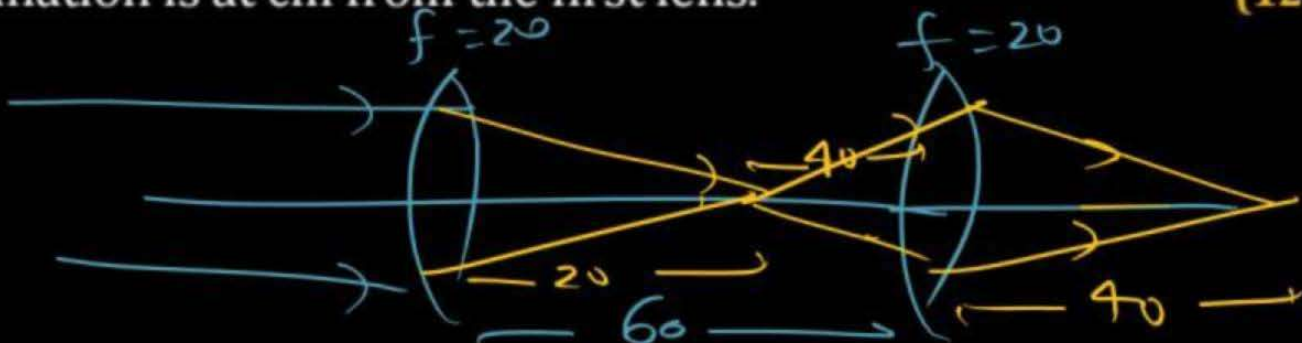
(C) $140°$

(D) $130°$

Ans : (A)

Question

Two convex lenses of focal length 20 cm each are placed coaxially with a separation of 60 cm between them. The image of the distant object formed by the combination is at cm from the first lens. (12 April 2023 - Shift 1)



$60 + 40 = 100$

Ans : (100)

Question

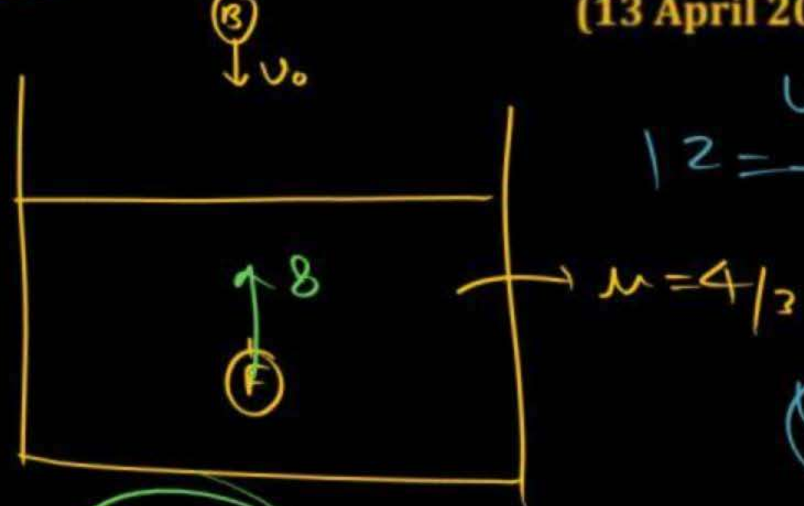
$v_{\text{Fish obsen by bird}} = 8\times\frac{1}{4/3}+3$

A fish rising vertically upward with a uniform velocity of 8 ms^{-1}, observes that a bird is diving vertically downward towards the fish with the velocity of 12 m s^{-1}. If the refractive index of water is 4/3, then the actual velocity of the diving bird to pick the fish, will be ______ ms^{-1}.

(13 April 2023 - Shift 1)

F ने B को ताड़ा = 12 m/s

$v_{B|F} = 12$



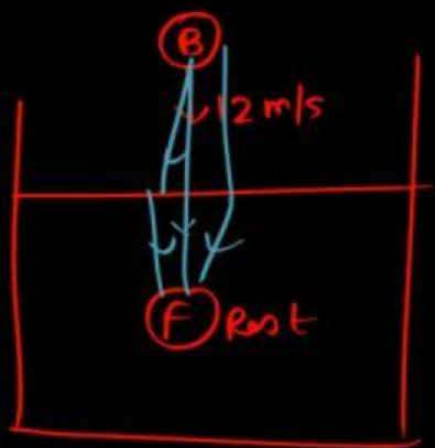
$12 = \frac{v_0\frac{4}{3}}{1} + 8$

$v_0 = 3$

$12 = \frac{v_0\times\frac{4}{3}}{1} + 8$

$v_0 = 3$

Ans : (3)



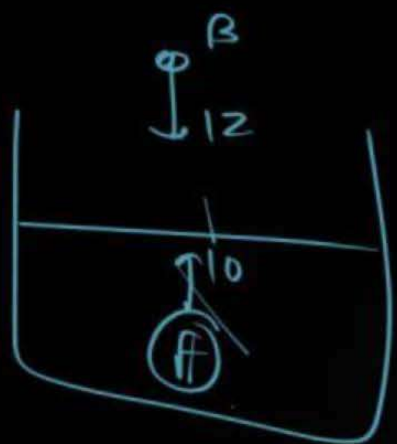
v of bird observed by fish $= v_0 \times \dfrac{\mu_{\text{जाने}}}{\mu_{\text{आने}}}$

देख कौन रहा है ≡ F

किसको ≡ B

$= 12 \times \dfrac{4/3}{1}$

$= 16$



$v_{B/F} = 16 + 10$

Question

A bi convex lens of focal length 10 cm is cut in two identical parts along a plane perpendicular to the principal axis. The power of each lens after cut is ______D.

(13 April 2023 - Shift 2)

$f \longrightarrow 2f$

$P \longrightarrow P/2$

$f_{नयी} = 20\text{ cm}$

$P = \frac{1}{.20} = 5$

Ans : (5)

Question

The refractive index of a transparent liquid filled in an equilateral hollow prism is $\sqrt{2}$. The angle of minimum deviation for the liquid will be ________°.

(15 April 2023 - Shift 1)

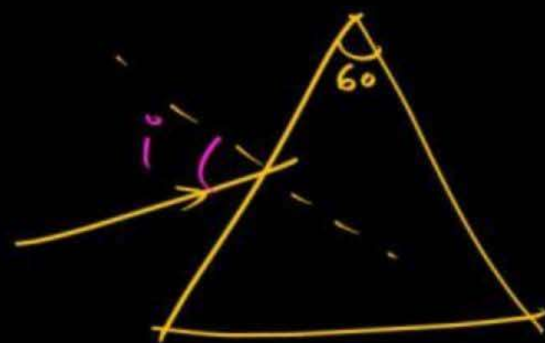
$A = 60$

$r_1 = 30$

$1 \cdot \sin i = \mu \sin r_1$

$\sin i = \sqrt{2} \times \frac{1}{2}$

$i = 45 = e$



$\delta = i + e - A$

$= 45 + 45 - 60$

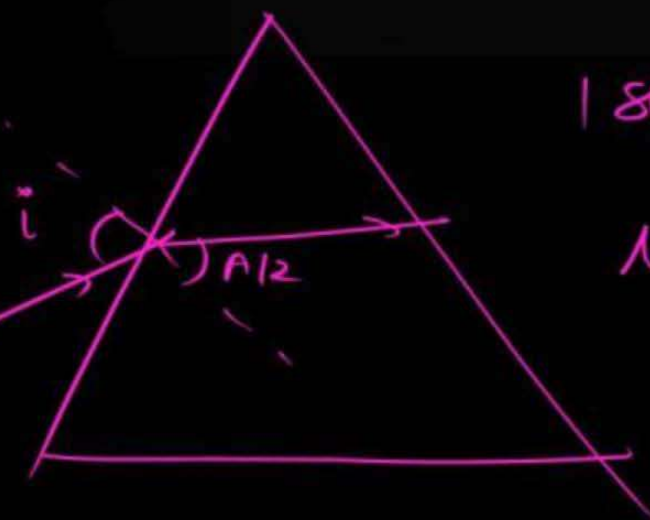
$= 30$

Ans : (30)

$\delta = i + e - A$

$\delta = 2i - A$

$i = \frac{\delta + A}{2}$



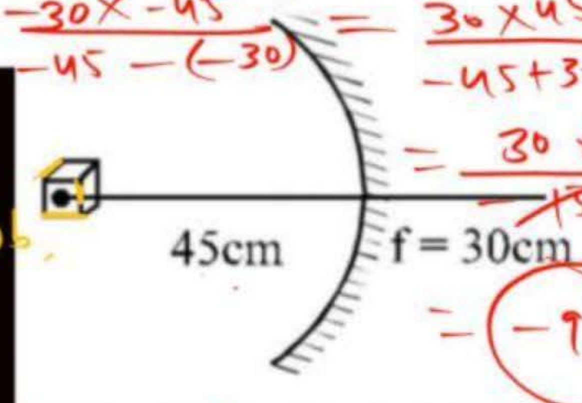
$1 \sin i = \mu \sin A/2$

$$\mu = \frac{\sin\left(\frac{\delta_{min} + A}{2}\right)}{\sin A/2}$$

QUESTION

16 tim

A cube of side length 1mm is placed on the axis of a concave mirror at a distance of 45 cm from the pole as shown in the figure. One edge of the cube is parallel to the axis. The focal length of the mirror is 30 cm. Find approximate volume of the image.



$$v = \frac{-30 \times -45}{-45-(-30)} = \frac{30 \times 45}{-45+30} = \frac{30 \times \cancel{45}^{3}}{-\cancel{15}} = -90$$

$$(\text{Vol})_I = (m \cdot m\, m^2)(\text{Vol})_{ob}$$

$$m = -\left(\frac{-90}{-45}\right) = -2$$

Ans : (*)

QUESTION

20. Figure shows graph of angle of deviation v/s angle of incidence for a light ray. Incident ray goes from medium 1 (μ_1) to medium 2 (μ_2). Mark the **correct** option(s).

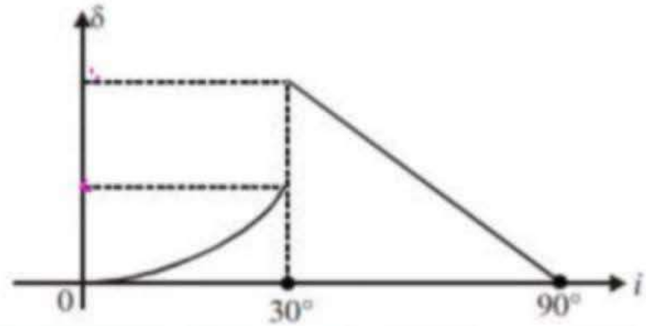
(A) $\frac{\mu_1}{\mu_2} = \frac{1}{2}$

TIR

(B) Critical angle is 30°

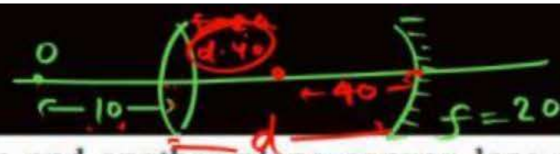
(C) $\mu_1 > \mu_2$

(D) Maximum deviation is 120°

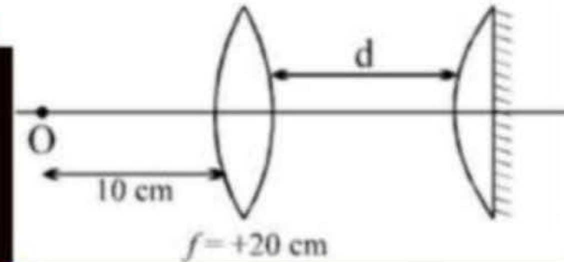


Ans : (B, C, D)

QUESTION

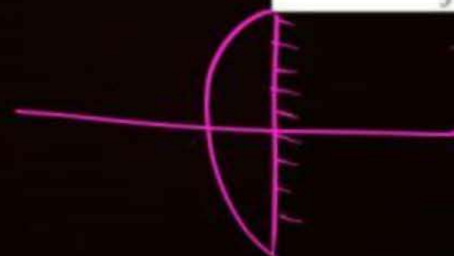


A convex lens of focal length 20 cm and another plano convex lens of focal length 40 cm are placed co-axially (see fig.). The plano convex lens is silvered on plane surface. What should be the 5d (in m) so that final image of the object 'O' is formed on O itself.



$f = 40$

$P_L = \frac{1}{40}$



$P_{net} = 2P_1 + \cancel{P_m}$

O

$P_{net} = \frac{2}{40} = \frac{1}{20} = -\frac{1}{f}$

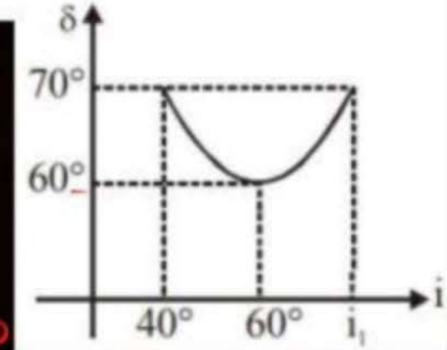
$f = -20$

Ans : 1

QUESTION

The curve of angle of incidence versus angle of deviation shown has been plotted for prism. The value of refractive index of the prism used is :

(A) $\sqrt{3}$ (B) $\sqrt{2}$ (C) $\frac{\sqrt{3}}{\sqrt{2}}$ (D) $\frac{2}{\sqrt{3}}$



$\delta_{min} = i + e - A$

$\cancel{60} = \cancel{60} + 60 - A$

$A = 60$

$\delta_{min} = 60$

$i = 60 = e$

$1 \times \sin 60 = \mu \sin 30$

$\mu = \sqrt{3}$

Ans : (A)

QUESTION

$e = \sin^{-1}\left(\frac{1}{2}\sec A/2\right)$

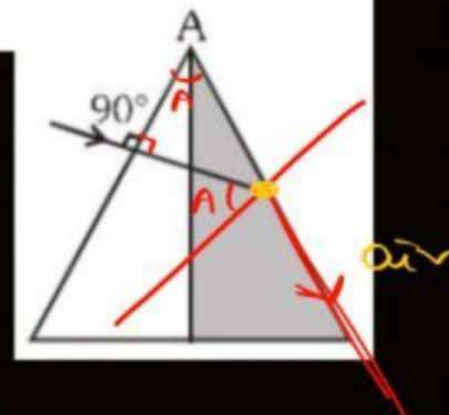
A ray of light is incident normally on the first refracting face of the prism of refracting angle A. The ray of light comes out at grazing emergence. If one half of the prism (shaded position) is knocked off, the same ray will :–

(A) Emerge at an angle of emergence $\sin^{-1}\left(\frac{1}{2}\sec A/2\right)$

(B) Not emerge out of the prism

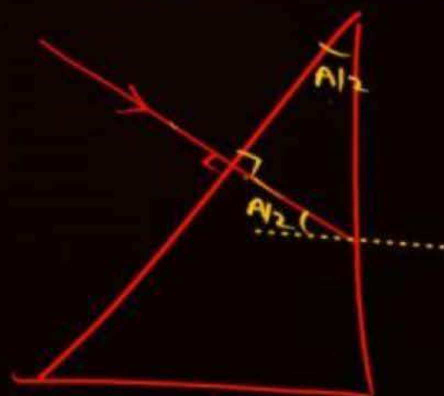
(C) Emerge at an angle of emergence $\sin^{-1}\left(\frac{1}{2}\sec A/4\right)$

(D) None of these



$A = \theta_c$

$\mu \sin A/2 = 1 \cdot \sin e$



$\frac{1}{\sin A} \sin A/2 = \sin e$

$\sin e = \frac{\cancel{\sin A/2}}{2 \cancel{\sin A/2} \cos A/2}$

$\mu \sin A = 1 \times \sin 90$

$\mu = \frac{1}{\sin A}$

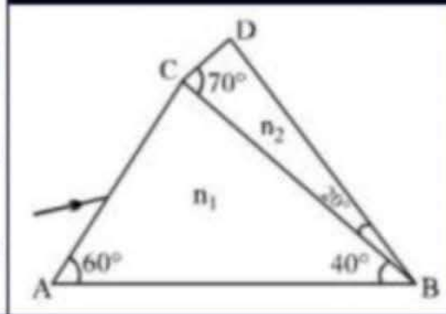
Ans : (A)

QUESTION

A prism of refractive index n_1 & another prism of refractive index n_2 are stuck together without a gap as shown in the figure. The angles of the prisms are as shown. n_1 & n_2 depend on λ, the wavelength of light according to $n_1 = 1.20 + \frac{10.8 \times 10^4}{\lambda^2}$ & $n_2 = 1.45 + \frac{1.80 \times 10^4}{\lambda^2}$ where λ is in nm. **[JEE 1998]**

(i) Calculate the wavelength λ_0 for which rays incident at any angle on the interface BC pass through without bending at that interface.

(ii) For light of wavelength λ_0, find the angle of incidence i on the face AC such that the deviation produced by the combination of prisms is minimum.



$n_1 = n_2$

Ans : (*)

QUESTION

A ray of light travelling in water is incident on its surface open to air. The angle of incidence is θ, which is less than the critical angle. Then there will be [IIT-JEE 2007]

(A) only a reflected ray and no refracted ray

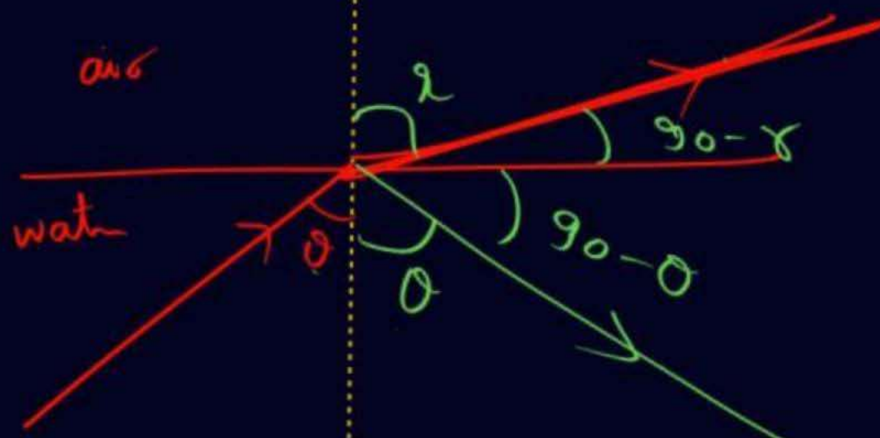
(B) only a refracted ray and no reflected ray

(C) a reflected ray and a refracted ray and the angle between them would be less than $180° - 2\theta$

(D) a reflected ray and a refracted ray and the angle between them would be greater than $180° - 2\theta$

$r > \theta$

$180 - r - \theta$



Ans : (C)

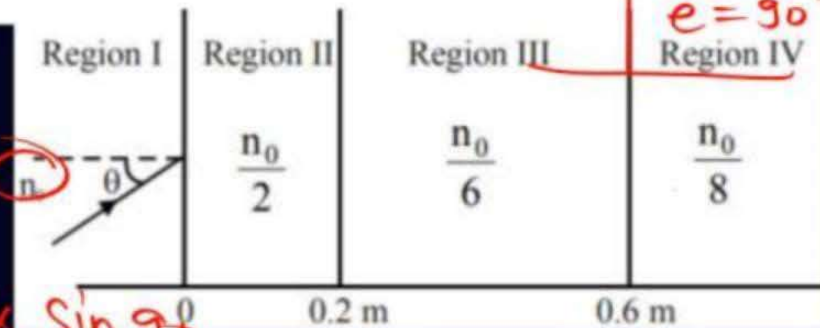
QUESTION

Eg JEE mains

A light beam is traveling from Region I to Region IV (Refer Figure). The refractive index in Regions I, II, III and IV are n_0, $\frac{n_0}{2}$, $\frac{n_0}{6}$ and $\frac{n_0}{8}$, respectively. The angle of incidence θ for which the beam just misses entering Region IV is figure

[IIT-JEE 2008]

$e = 90$



(A) $\sin^{-1}\left(\frac{3}{4}\right)$	(B) $\sin^{-1}\left(\frac{1}{8}\right)$
(C) $\sin^{-1}\left(\frac{1}{4}\right)$	(D) $\sin^{-1}\left(\frac{1}{3}\right)$

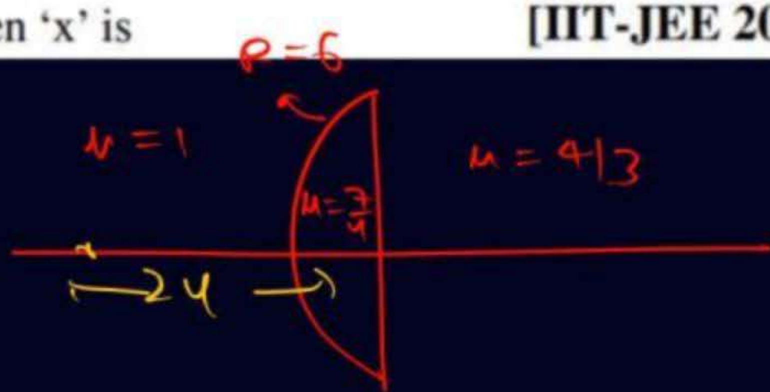
$$n_0 \times \sin\theta = \frac{n_0}{8} \times \sin 90$$

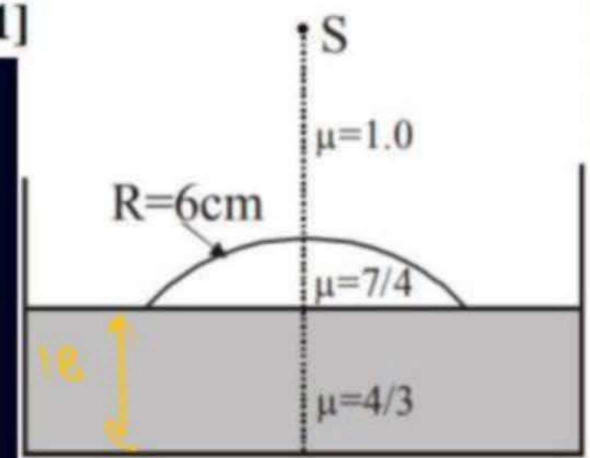
$$\theta = \sin^{-1}\left(\frac{1}{8}\right)$$

Ans : (B)

QUESTION

Water (with refractive index = $\frac{4}{3}$) in a tank is 18 cm deep. Oil of refractive index $\frac{7}{4}$ lies on water making a convex surface of radius of curvature 'R = 6 cm' as shown. Consider oil to act as a thin lens. An object 'S' is placed 24 cm above water surface. The location of its image is at 'x' cm above the bottom of the tank. Then 'x' is [IIT-JEE 2011]





Ans : 2

QUESTION

$\frac{1}{4}(1-3) = \frac{1}{2} \times 2 \times \frac{1}{2} \times B \cos$

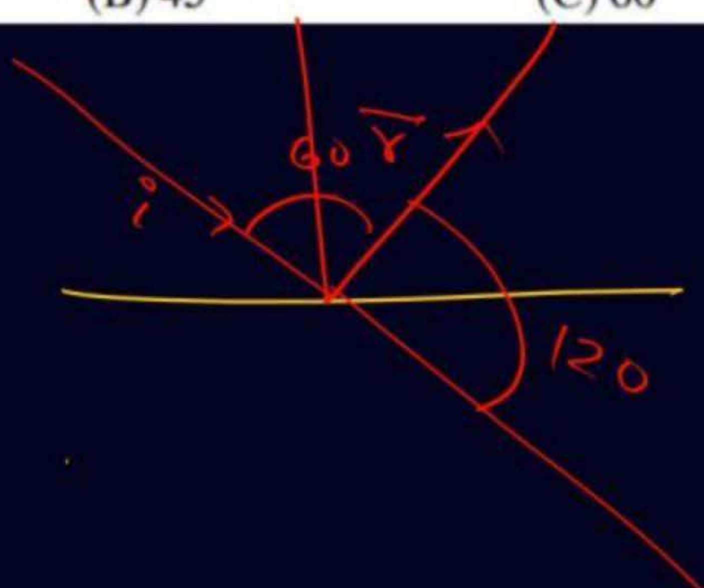
$\vec{A}$

A ray of light travelling in the direction $\frac{1}{2}\left(\hat{i}+\sqrt{3}\hat{j}\right)$ is incident on a plane mirror. After reflection, it

$\vec{B}$

travels along the direction $\frac{1}{2}\left(\hat{i}-\sqrt{3}\hat{j}\right)$. The angle of incidence is :- **[JEE-Advance-2013]**

(A) 30° (B) 45° (C) 60° (D) 75°



$\cos = -\frac{1}{2}$

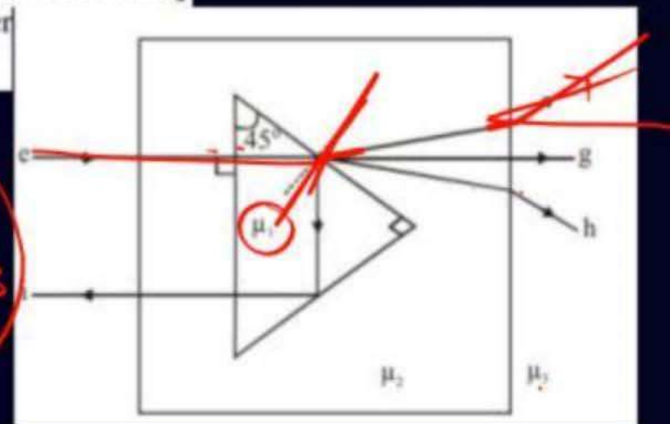
$\theta = 120$

Ans : (A)

QUESTION

A right angled prism of refractive index μ_1 is placed in a rectangular block of refractive index μ_2, which is surrounded by a medium of refractive index μ_3, as shown in the figure. A ray of light 'e' enters the rectangular block at normal incidence. Depending upon the relationships between μ_1, μ_2, and μ_3, it takes one of the four possible paths 'ef', 'eg', 'eh' or 'ei'. [JEE-Advance-2013]

Match the paths in List I with conditions of refractive indices in List II and select the correct answer using the codes given below the lists :



$\mu_1 < \mu_2$

$\mu_2 > \mu_3$

	List I		List II
P.	$e \rightarrow f$	1.	$\mu_1 > \sqrt{2}\mu_2$
Q.	$e \rightarrow g$	2.	$\mu_2 > \mu_1$ and $\mu_2 > \mu_3$
R.	$e \rightarrow h$	3.	$\mu_1 = \mu_2$
S.	$e \rightarrow i$	4.	$\mu_2 < \mu_1 < \sqrt{2}\mu_2$ and $\mu_2 > \mu_3$

Codes :

	P	Q	R	S
(A)	2	3	1	4
(B)	1	2	4	3
(C)	4	1	2	3
(D)	2	3	4	1

Ans : (D)

LED
photocell
Solar cell

working & graph

Semi Conductor

Logic gate
Zener diode
FB/RB

imp

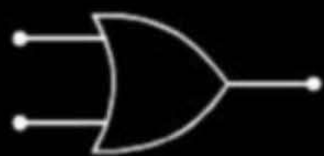
Transistor
p, np
npn
α, β
C.E.
C.B

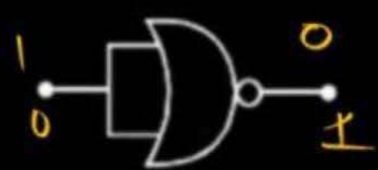
Remove

Question

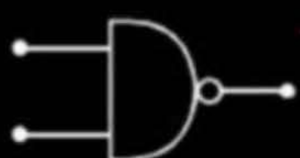
Which of the following gives a reversible operation? **(JEE Main-2020)**

Not

(A) 

(B) 

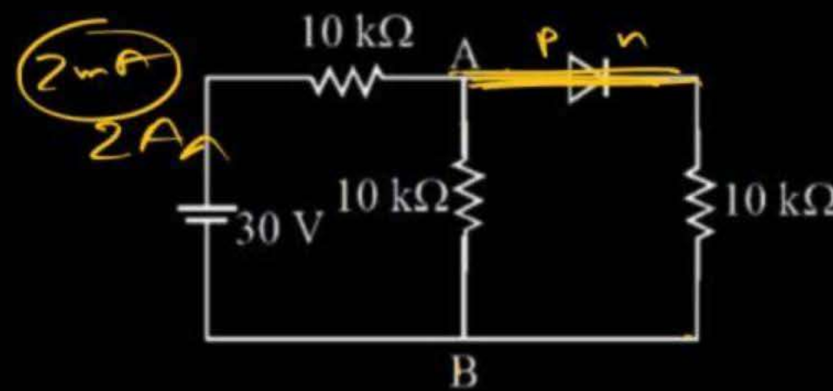
(C) 

(D) 

Ans : (B)

Question

In the figure, potential between A and B is: **(JEE Main-2020)**



(A) 5V

(B) 10 V

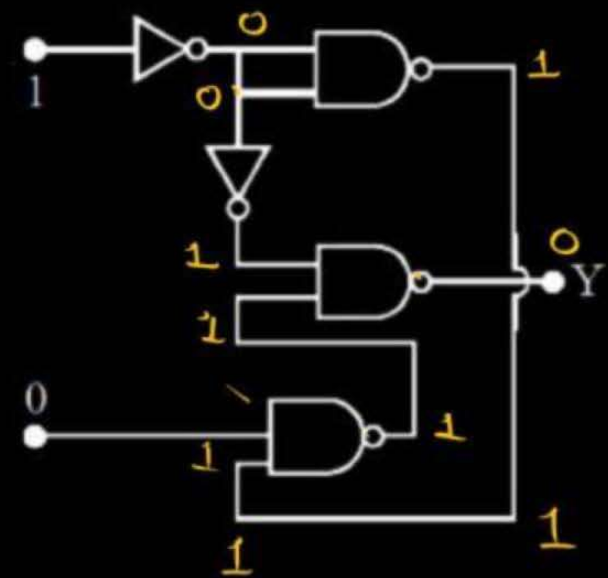
(C) Zero

(D) 15 V

Ans : (B)

Question

In the given circuit, value of Y is: **(JEE Main-2020)**



(A) will not execute

(B) 0

(C) toggles between 0 and 1

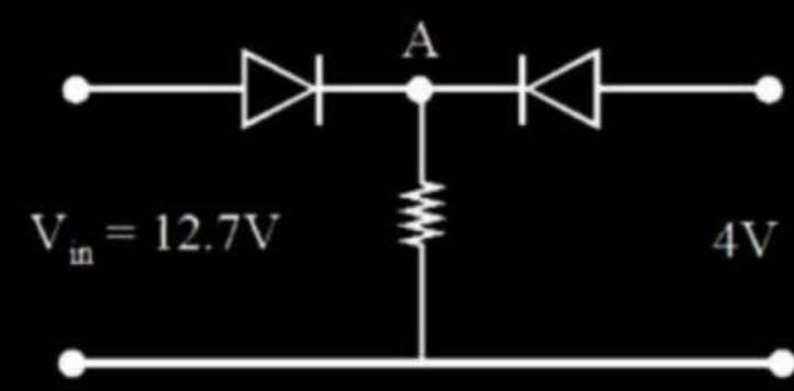
(D) 1

Ans : (B)

Question

Both the diodes used in the circuit shown are assumed to be ideal and have negligible resistance when these are forward biased. Built in potential in each diode is 0.7 V. For the input voltages shown in the figure, the voltage (in Volts) at point A is ____________.

(JEE Main-2020)



Ans : (12)

Question

The current i in n the network is:

(JEE Main-2020)

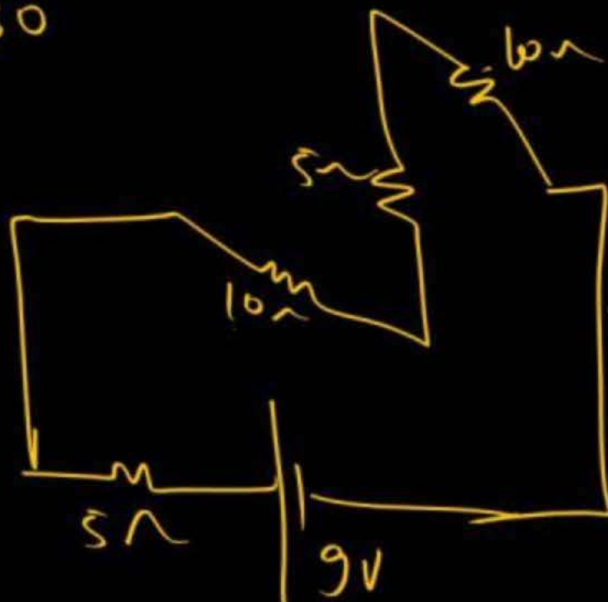
(A) 0 A

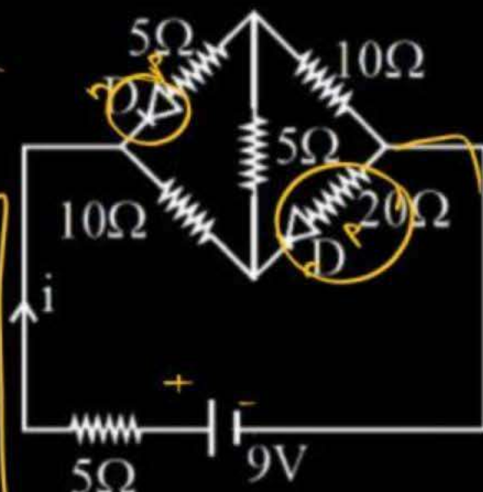
(B) 06 A

(C) 0.3 A

(D) 0.2 A

$$i = \frac{9}{30}$$





Ans : (C)

Question

If a semiconductor photodiode can detect a photon with a maximum wavelengt
of 400 nm, then its band gap energy is: Planck's constant $h = 6.63 \times 10^{-34}$ J.s
Speed of ligh $c = 3 \times 10^{8}$ m/s

(JEE Main-2020

(A) 2.0 eV

(B) 1.5 eV

(C) 3.1 eV

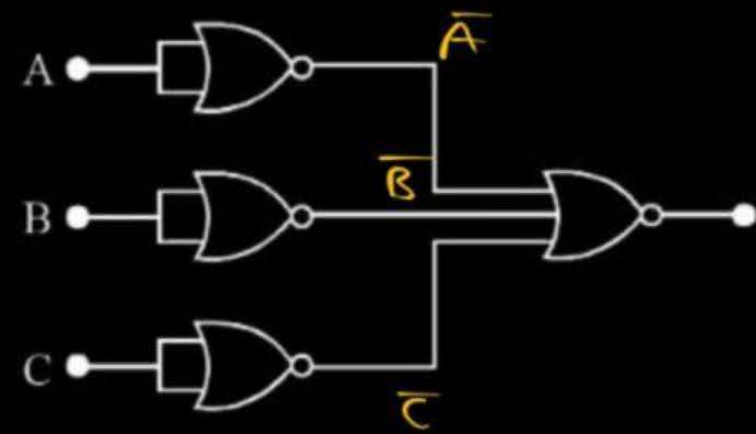
(D) 1.1 eV

$$E = \frac{1240}{\lambda} = \frac{1240}{400}$$

Ans

Question

identify the operation performed by the circuit given below: **(JEE Main-2020)**



(A) AND

(B) NAND

(C) OR

(D) NOT

$$\overline{\bar{A} + \underbrace{\bar{B} + \bar{C}}_{D}}$$

$$= \overline{\bar{A} + D}$$

$$= \bar{\bar{A}} \cdot \bar{D}$$

$$= A \cdot \overline{\bar{B} + \bar{C}}$$

$$= A \cdot \bar{\bar{B}} \cdot \bar{\bar{C}} = ABC$$

Ans : (A)

Question

With increasing biasing voltage of a photodiode, the photocurrent magnitude:

(JEE Main-2020)

(A) increases initially and saturates finally

(B) increases initially and after attaining certain value, it decreases

(C) increases linearly

(D) remains constant

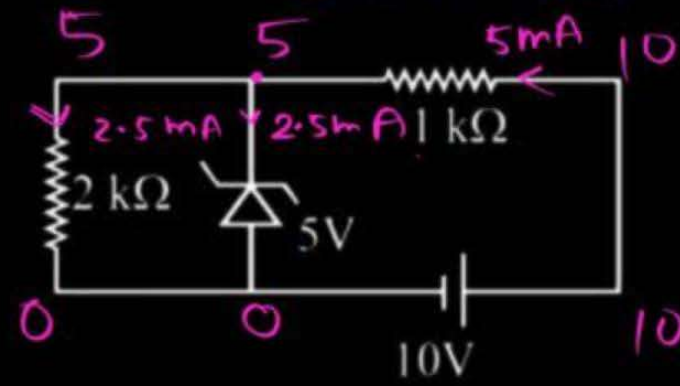
Ans : (A)

Question

In connection with the circuit drawn below, the value of current flowing through $2\ k\Omega$ resistor is ______ $\times 10^{-4}$ A.

(JEE Main-2021)

$2.5 \times 10^{-3} = 25 \times 10^{-4}$

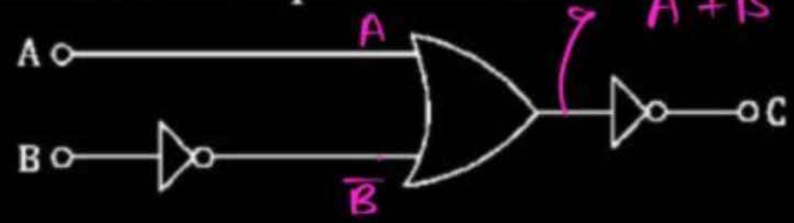


Ans : (25)

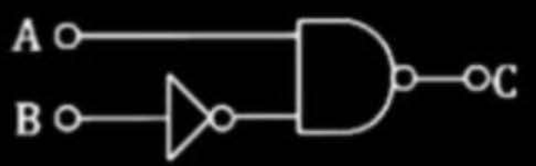
Question

The logic circuit shown above is equivalent to : (JEE Main-2021)

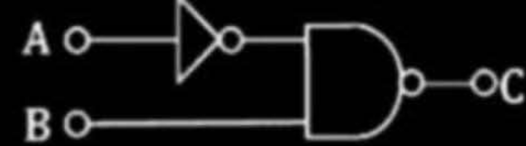
$\overline{A+\overline{B}} = \overline{A}\cdot\overline{\overline{B}} = \overline{A}\cdot B$



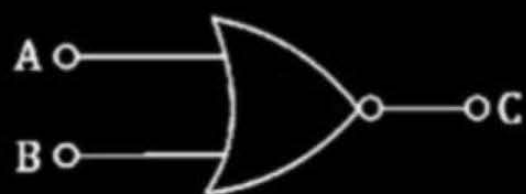
(A)



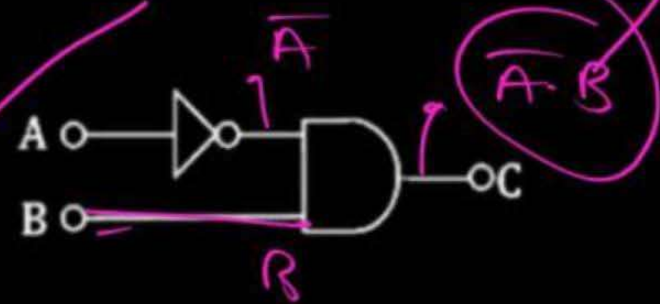
(B)



(C)



(D)



Ans : (D)

Question Rm

Zener breakdown occurs in a p-n junction having p and n both : **(JEE Main-2021)**

(A) lightly doped and have wide depletion layer.

(B) heavily doped and have narrow depletion layer.

(C) lightly doped and have narrow depletion layer.

(D) heavily doped and have wide depletion layer.

Ans : (B)

Question

The truth table for the following logic circuit is :

(JEE Main-2021)

(A)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(B)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

(C)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

(D)

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	1

Ans : (B)

Question

Match List I with List II. **(JEE Main-2021)**

List I		List II	
(a)	Rectifier	(i)	Used either for stepping up or stepping down the a.c. voltage
(b)	Stabilizer	(ii)	Used to convert a.c. voltage into d.c. voltage
(c)	Transformer	(iii)	Used to remove any ripple in the rectified output voltage
(d)	Filter	(iv)	Used for constant output voltage even when the input voltage or load current change

Choose the correct answer from the options given below :

A (a)–(ii), (b)–(iv), (c)–(i), (d)–(iii)

B (a)–(~~iii~~), (b)–(iv), (c)–(i), (d)–(ii)

C (a)–(ii), (b)–(i), (c)–(~~iv~~), (d)–(iii)

D (a)–(ii), (b)–(i), (c)–(~~iii~~), (d)–(iv)

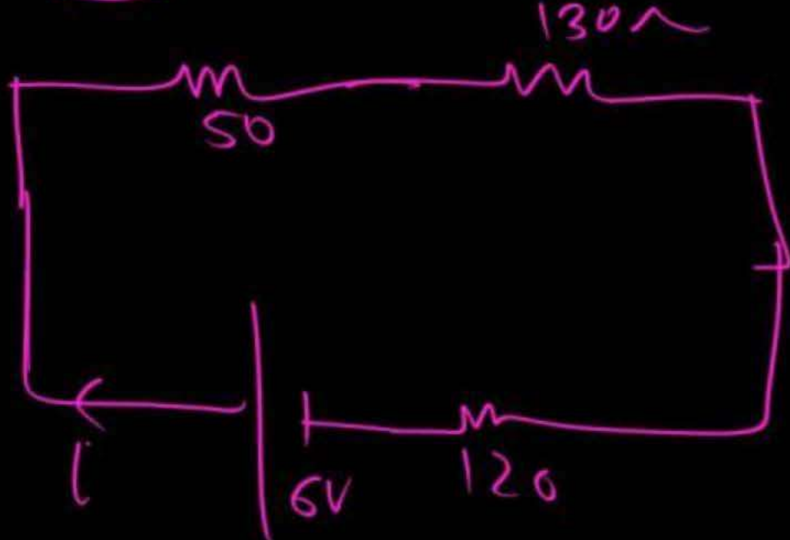
Ans : (A)

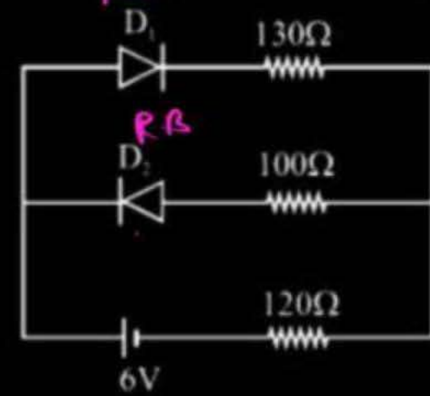
Question

The circuit contains two diodes each with a forward resistance of $50\ \Omega$ and with infinite reverse resistance. If the battery voltage is 6 V, the current through the $120\ \Omega$A resistance is 20 mA.

(JEE Main-2021)

$\frac{6\times1000}{300}\times10^{-3}$

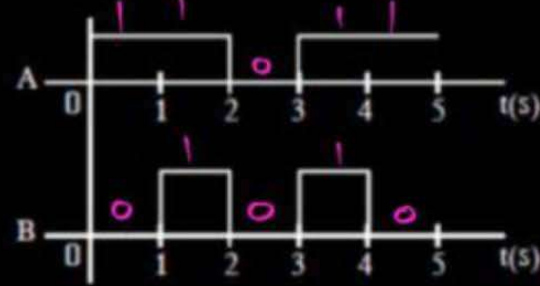


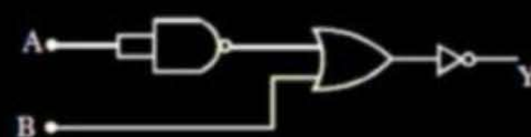


Ans : (20)

Question

Draw the output signal Y in the given combination of gates :- **(JEE Main-2021)**



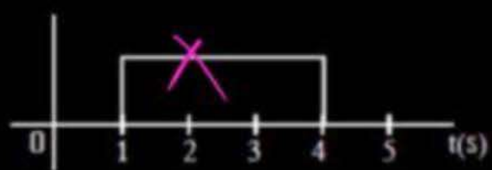


11011
01010

Y ⇒ 10

(A)

(B)



(C)

(D)

Ans : (D)

Question

The zener diode has a $V_z = 30$ V. The current passing through the diode for the following circuit is ...9... mA.

(JEE Main-2021)

Ans : (9)

Question

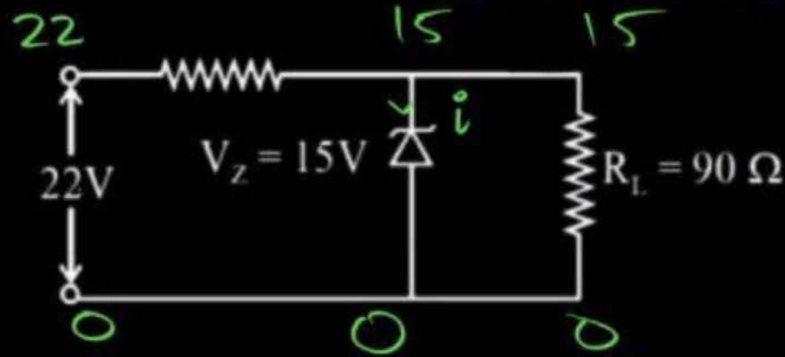
$P = Vi$

The value of power dissipated across the Zener diode ($V_z = 15$ V) connected in the circuit as shown in the figure is $x \times 10^{-1}$ watt.

The value of x, to the nearest integer, is ______.

(JEE Main-2021)

$P = 15i$

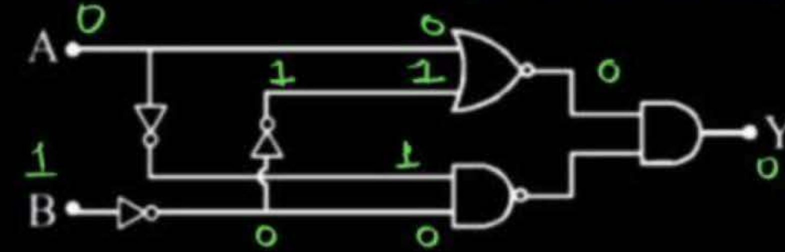


Ans : (5)

Question

In the logic circuit shown in the figure, if input A and B are 0 to 1 respectively, the output at Y would be 'x'. The value of x is ______.

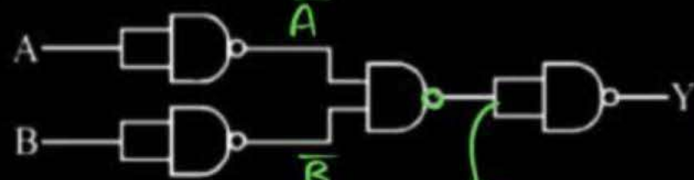
(JEE Main-2021)



Ans : (0)

Question

The following logic gate is equivalent to : (JEE Main-2021)



$Y = \overline{A+B}$ = NOR

$\overline{\bar{A}\cdot\bar{B}}$

$= \bar{\bar{A}} + \bar{\bar{B}}$

$= A+B$

(A) NOR Gate

(B) OR Gate

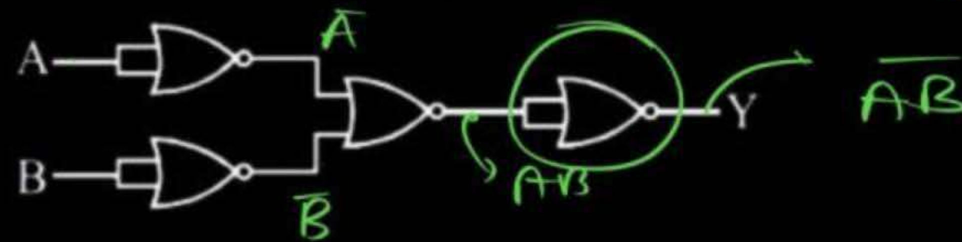
(C) AND Gate

(D) NAND Gate

Ans : (A)

Question

The output of the given combination gates represents : **(JEE Main-2021)**



$$\overline{\bar{A} + \bar{B}} = \bar{\bar{A}} \cdot \bar{\bar{B}} = AB$$

(A) XOR Gate

(B) NAND Gate

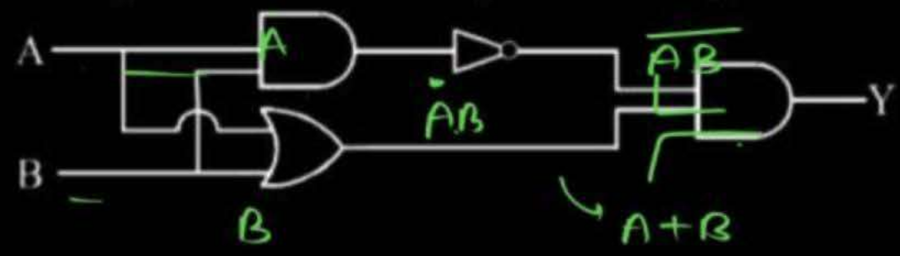
(C) AND Gate

(D) NOR Gate

Ans : (B)

Question

Which one of the following will be the output of the given circuit ? **(JEE Main-2021)**



(A) NOR Gate

(B) NAND Gate

(C) AND Gate

(D) XOR Gate

$$(\overline{AB})\cdot(A+B)$$

$$(\bar{A}+\bar{B})\cdot(A+B)$$

$$\bar{A}A+\bar{A}B+\bar{B}A+\bar{B}B$$

$$=\bar{A}B+\bar{B}A$$

Ans : (D)

Question

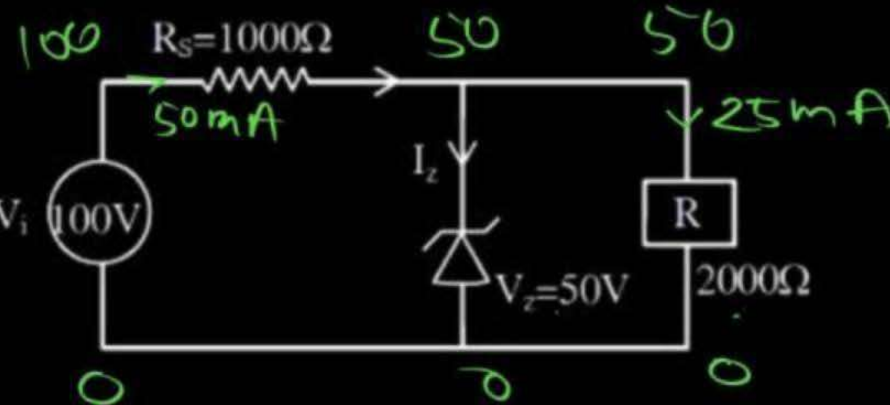
For the circuit shown below, calculate the value of I_z : $\frac{5\cancel{0}}{200\cancel{0}} = \frac{10^3}{40} \times 10^{-3} =$ (JEE Main-2021)

(A) 25 mA

(B) 0.15 A

(C) 0.1 A

(D) 0.05 A



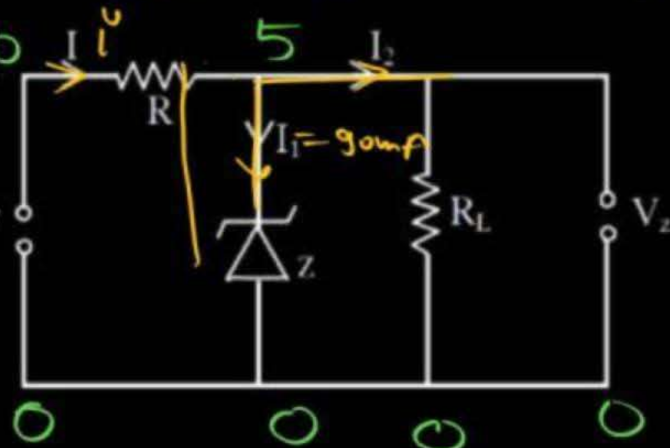
Ans : (A)

Question

In a given circuit diagram, a 5 V zener diode along with a series resistance is connected across a 50 V power supply. The minimum value of the resistance required, if the maximum zener current is 90 mA will be 500 Ω. **(JEE Main-2021)**

$$i > 90\,mA$$

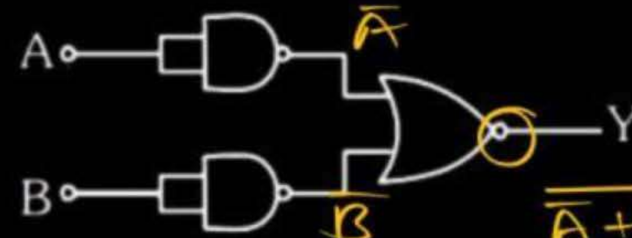
$$\frac{50-5}{R} \geq 90\times10^{-3}$$



Ans : (500)

Question

Identify the logic operation carried out. (JEE Main-2021)



$\overline{\overline{A}+\overline{B}}$

$= \overline{\overline{A}} \cdot \overline{\overline{B}}$

(A) OR

(B) AND

(C) NOR

(D) NAND

Ans : (B)

Question

In a semiconductor, the number density of intrinsic charge carriers at 27° C is $n_i =$ $1.5 \times 10^{16}/\text{m}^3$. If the semiconductor is doped with impurity atom, the hole density increases to $4.5 \times 10^{22}/\text{m}^3$. The electron density in the doped semiconductor is ______ $\times 10^9/\text{m}^3$.

(JEE Main-2021)

$$n_h n_{e^-} = n_i^2$$

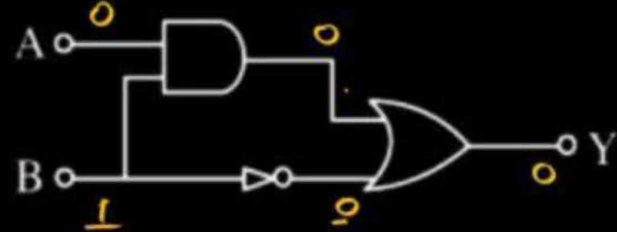
$$4.5 \times 10^{22} \times N_e = (1.5 \times 10^{+16})^2$$

Ans : (5)

Question

Find the truth table for the function Y of A and B represented in the following figure.

(JEE Main-2021)



(A)

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	0

(B)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	1

(C)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(D)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Ans : (B)

Question

Identify the logic operation carried out by the given circuit :- **(JEE Main-2021)**

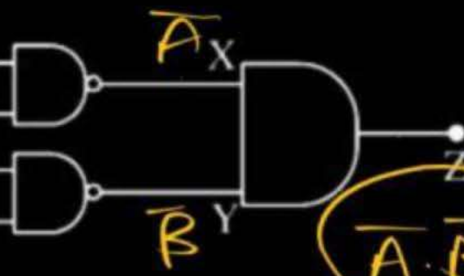
(A) OR

(B) AND

(C) NOR

(D) NAND

$$Y = \overline{A+B}$$
$$= \bar{A}\cdot\bar{B}$$



$\bar{A}\cdot\bar{B}$

Ans : (C)

Question

Statement-I : By doping silicon semiconductor with pentavalent material, the electrons density increases.

Statement-II : The n-type semiconductor has net negative charge.

In the light of the above statements, choose the most appropriate answer from the options given below :

(JEE Main-2021)

(A) Statement-I is true but Statement-II is false.

(B) Statement-I is false but Statement-II is true.

(C) Both Statement-I and Statement-II are true.

(D) Both Statement-I and Statement-II are false.

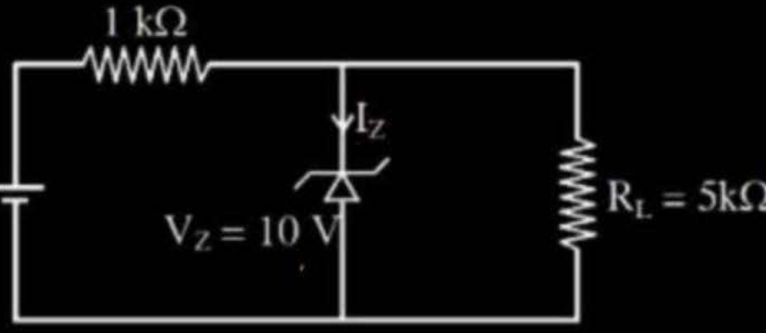
Ans : (A)

Question

Same

$10 \times I_Z$

For the given circuit, the power across Zener diode is .... mW. **(JEE Main-2021)**



Ans : (120)

Question

In the given figure, each diode has a forward bias resistance of 30Ω and infinite resistance in reverse bias. The current I_1 will be :

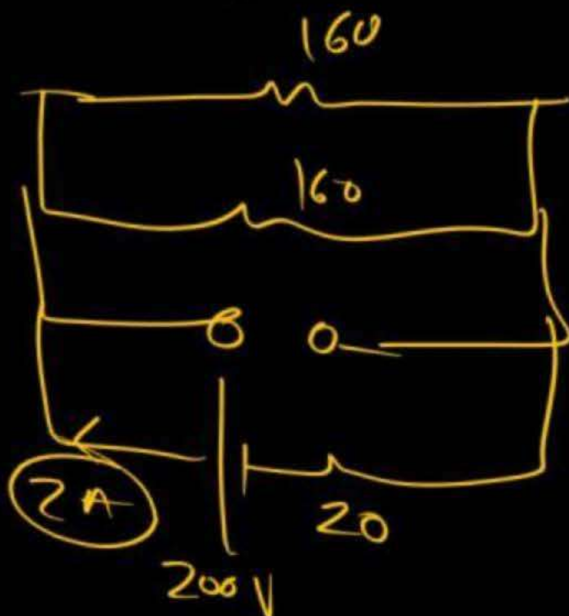
(JEE Main-2021)

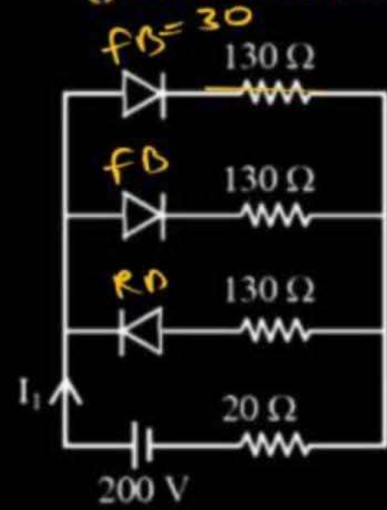
(A) 3.75 A

(B) 2.35 A

(C) 2 A

(D) 2.73 A



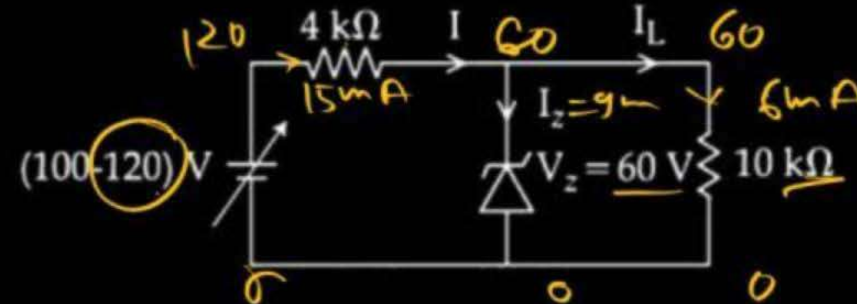


Ans : (C)

Question

In the circuit shown, maximum zener diode current will be ____mA. **(JEE Main-2022)**

9



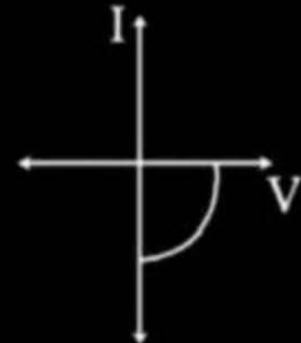
Ans : (9)

Question

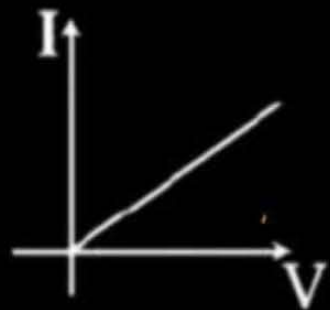
Identify the solar cell characteristics from the following options: **(JEE Main-2022)**

(A)

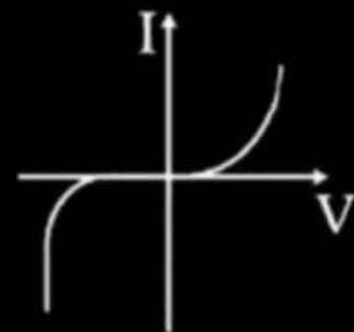
(B)



(C)



(D)

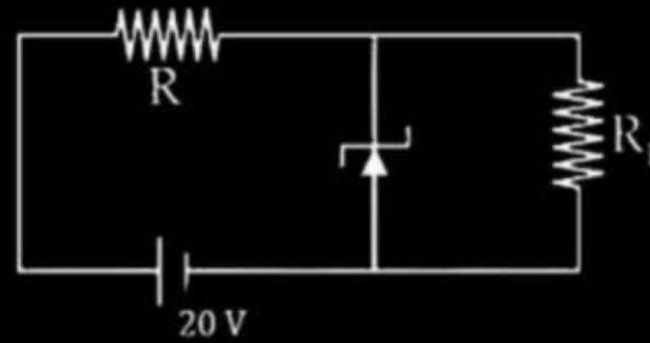


Ans : (B)

Question easy

A 8 V Zener diode along with a series resistance R is connected across a 20 V supply (as shown in the figure). If the maximum Zener current is 25 mA, then the minimum value of R will be ____ Ω.

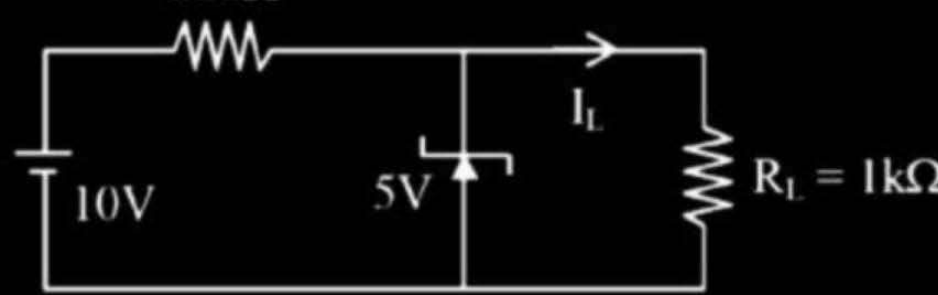
(JEE Main-2022)



Ans : (480)

Question Easy

In the given circuit-the value of current I_L will be______ mA. **(JEE Main-2022)**



Ans : (5)

Question

The photodiode is used to detect the optical signals. These diodes are preferably operated in revere biased mode because. **(JEE Main-2022)**

(A) fractional change in majority carriers produce higher forward bias current

(B) fractional change in majority carriers produce higher reverse bias current

(C) fractional change in minority carriers produce higher forward bias current

(D) fractional change in minority carriers produce higher reverse bias current

Ans : (D)

Question

Identify the logic operation performed by the given circuit: **(JEE Main-2022)**

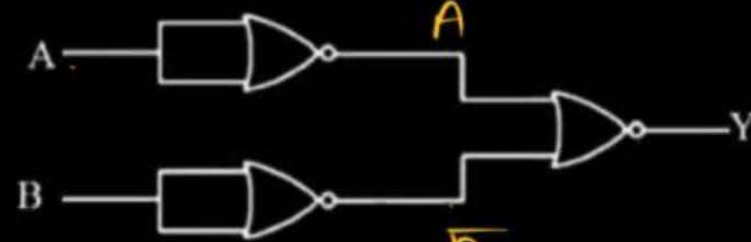
(A) AND gate

(B) OR gate

(C) NOR gate

(D) NAND gate

$\overline{A}$



$\overline{B}$

$\overline{\overline{A}+\overline{B}}$

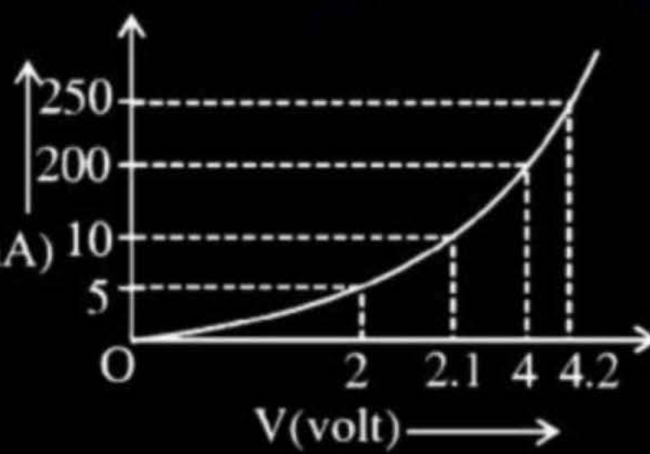
$= A \cdot B$

Ans : (A)

Question

The I-V characteristics of a p-n junction diode in forward bias is shown in the figure. The ratio of dynamic resistance, corresponding to forward bias voltages of 2V and 4V respectively, is :

(JEE Main-2022)



(A) $1:2$

(B) $5:1$

(C) $1:40$

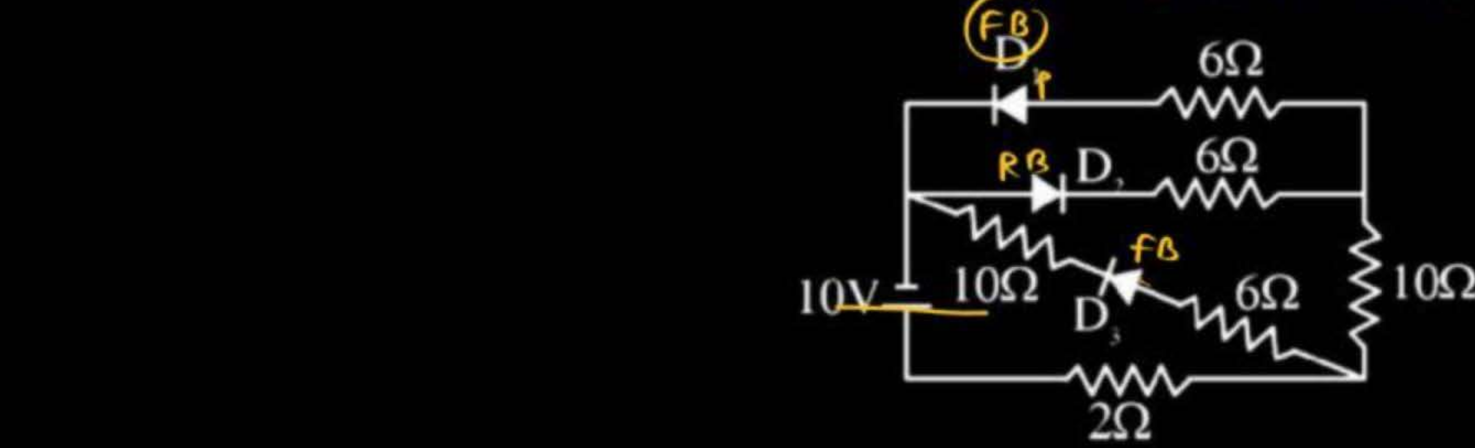
(D) $20:1$

Ans : (B)

Question

As per the given circuit, the value of current through the battery will be_____A.

(JEE Main-2022)

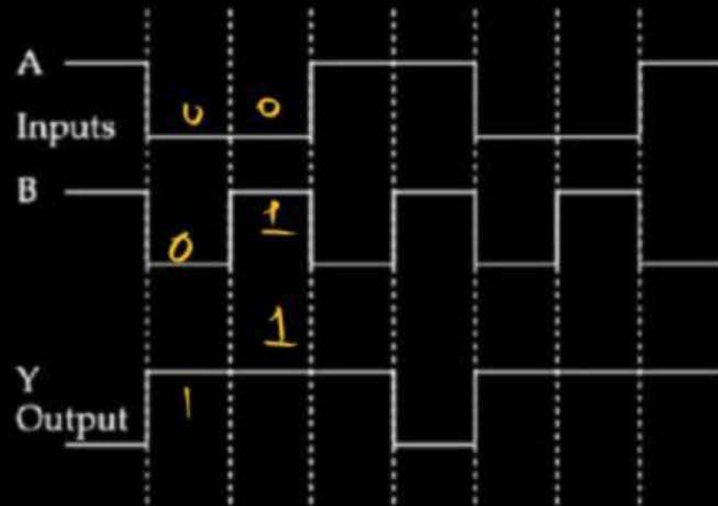


Ans : (1)

Question

Identify the correct Logic Gate for the following output (Y) of two inputs A and B.

(JEE Main-2022)

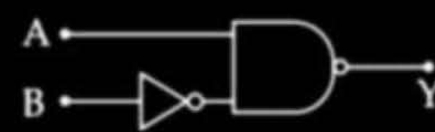


(A)

(B)

(C)

(D)



Ans : (B)

Question

The logic gate equivalent to the given circuit diagram is : **(24 January 2023 – Shift 2)**

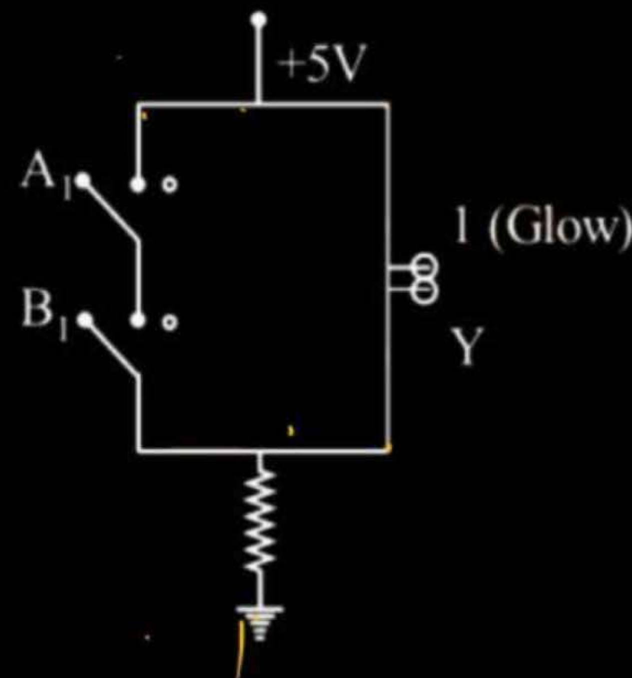
(A) OR

(B) NAND

(C) NOR

(D) AND

A	B	Bulb
0	0	✓
1	0	✓
1	0	✓
1	1	×



Ans : (B)

Question

For the given logic gates combination, the correct truth table will be

(29 January 2023 - Shift 2)

Eqn

(A)

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

(B)

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

(C)

A	B	X
0	0	1
0	1	0
1	0	1
1	1	0

(D)

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

Ans : (B)

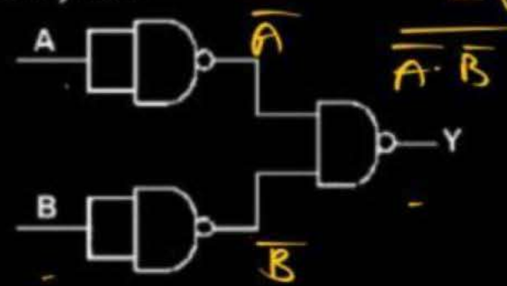
Question

Easy

The output waveform of the given logical circuit for the following inputs A and B as shown below, is :

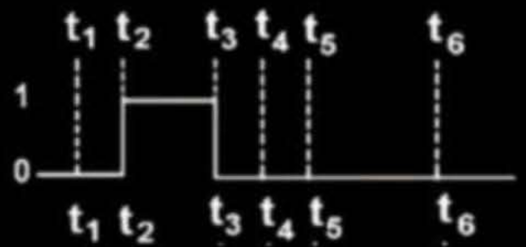
$= A+B$

(30 January 2023 - Shift 1)



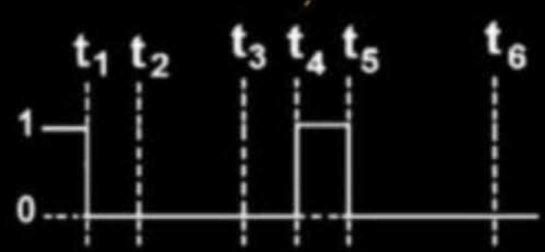
Inputs

(A)



(B)

(C)



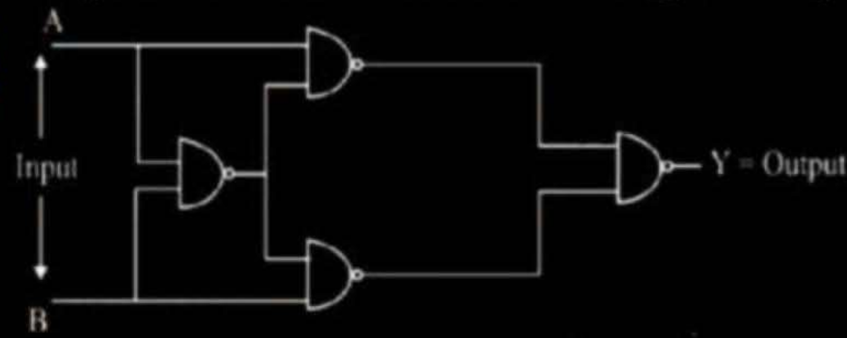
(D)

Ans : (D)

Question

The output Y for the inputs A and B of circuit is given by. True table of the shown circuit is:

(30 January 2023 - Shift 2)



(A)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

(B)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

(C)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(D)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

Ans : (D)

Question

theory

Match the List I with List II

(01 February 2023 - Shift 1)

	List I		List II
A.	Intrinsic Semiconductor	I.	Fermi-level near conduction band
B.	n-type semiconductor	II.	Fermi-level at middle
C.	p-type semiconductor	III.	Fermi-level near valence band
D.	Metals	IV.	Fermi-level inside conduction band

Choose the correct answer from the options given below:

A (A) → I, (B) → II, (C) → III, (D) → IV

B (A) → II, (B) → I, (C) → III, (D) → IV

C (A) → II, (B) → III, (C) → I, (D) → IV

D (A) → III, (B) → I, (C) → II, (D) → IV

Ans : (C)

Question

Choose the correct statement about Zener diode: **(01 February 2023 - Shift 1)**

(A) It works as a voltage regulator in reverse bias and behaves like simple pn junction diode in forward bias.

(B) It works as a voltage regulator in both forward and reverse bias.

(C) It works a voltage regulator only in forward bias.

(D) It works as a voltage regulator in forward bias and behaves like simple pn junction diode in reverse bias.

Ans : (A)

Question

Name the logic gate equivalent to the diagram attached. **(06 April 2023 - Shift 1)**

(A) NAND

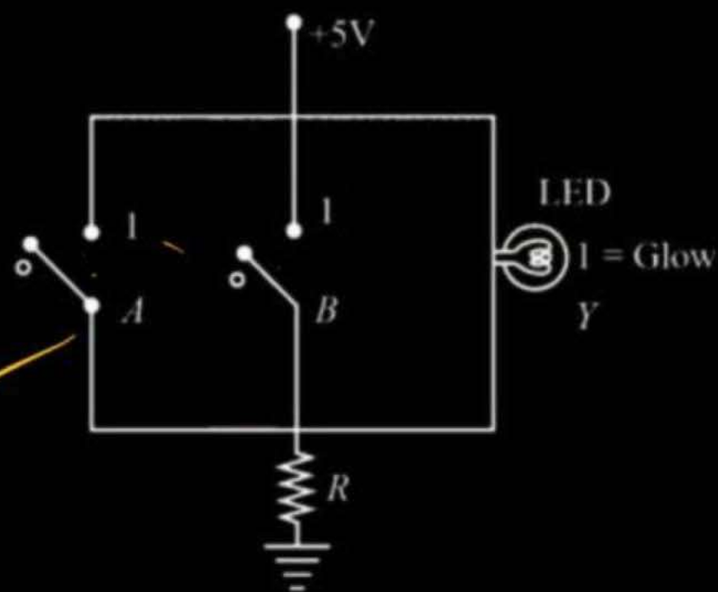
(B) AND

(C) NOR

(D) OR

1	1	X
1	0	X
0	1	X
0	0	

NOR

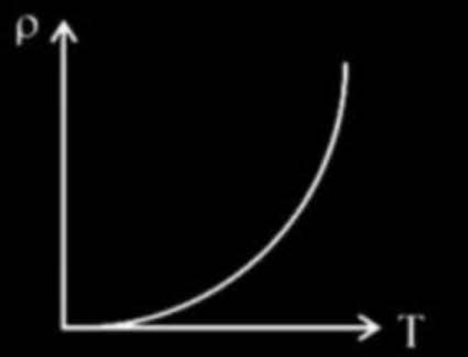


Ans : (C)

Question Rh

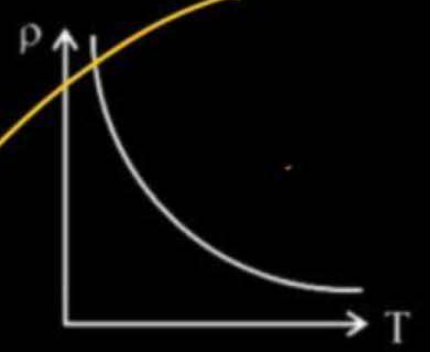
The resistivity (ρ) of semiconductor varies with temperature. Which of the following curve represents the correct behaviour? **(06 April 2023 - Shift 1)**

(A)

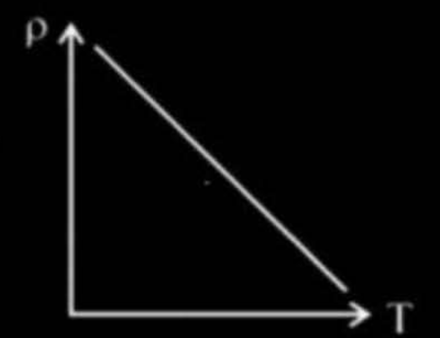


(B)

(C)



(D)



Ans : (C)

Question

If each diode has a forward bias resistance of 25Ω in the below circui
Which of the following options is correct?

(10 April 2023 - Shift 2

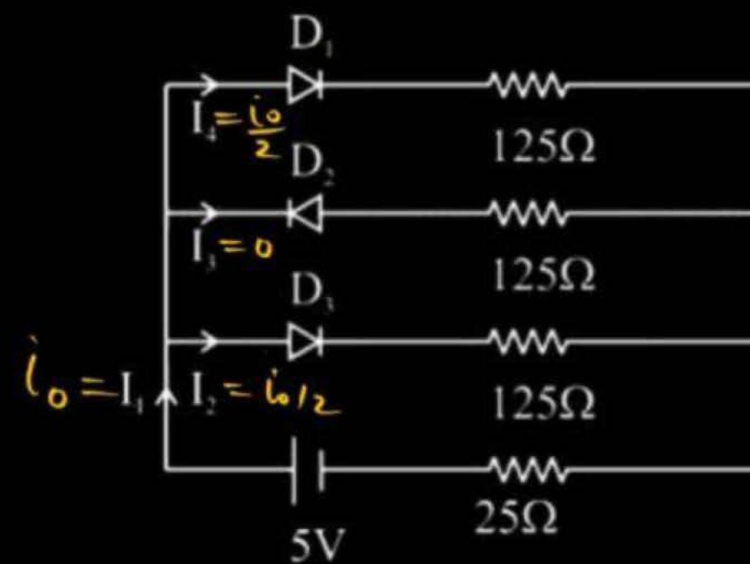
(A) $\frac{I_1}{I_2} = 1$

(B) $\frac{I_2}{I_3} = 1$

(C) $\frac{I_1}{I_2} = 2$

(D) $\frac{I_3}{I_4} = 1$

$$\frac{I_1}{I_2} = \frac{i_0}{i_0/2} = 2$$



An

Question

The logic performed by the circuit shown in figure is equivalent to

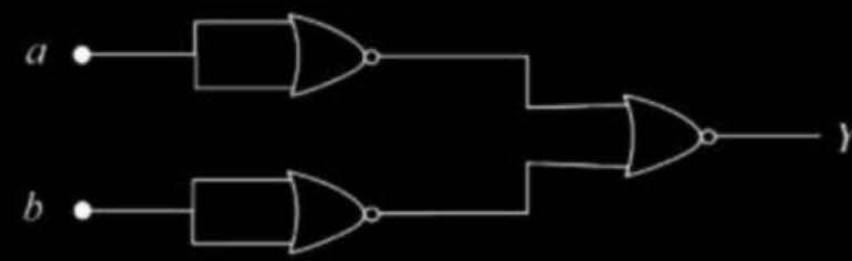
(11 April 2023 - Shift 1)

(A) AND

(B) NOR

(C) OR

(D) NAND

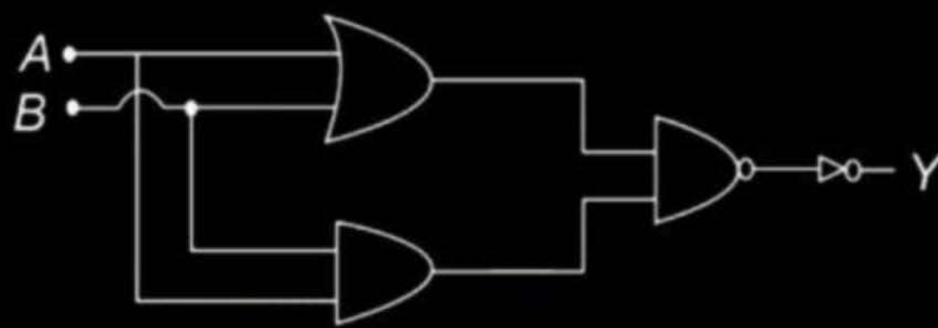


Ans : (A)

Question

The logic operations performed by the given digital circuit is equivalent to:

(11 April 2023 - Shift 2)



(A) NOR

(B) AND

(C) OR

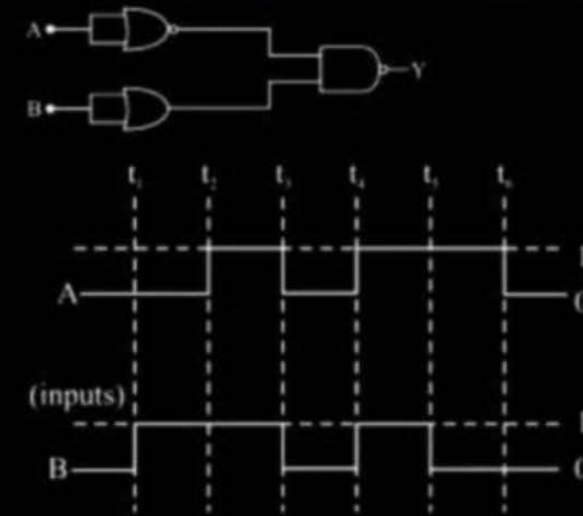
(D) NAND

Ans : (B)

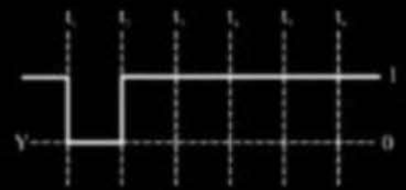
Question

For the following circuit and given inputs A and B, choose the correct option for output 'Y'

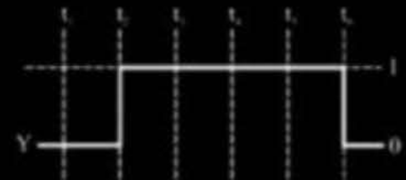
(13 April 2023 - Shift 1)



(A)

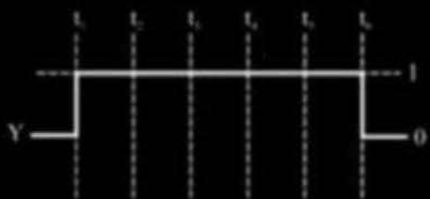


(B)



(C)

(D)



Ans : (A)

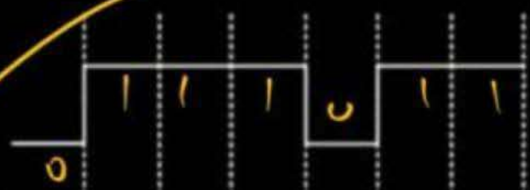
Question

The output from a NAND gate having inputs A and B given below will be,

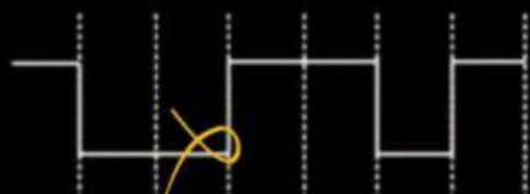
(13 April 2023 – Shift 2)

(A)

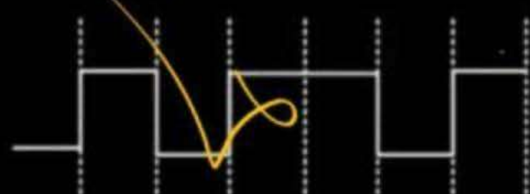
(B)

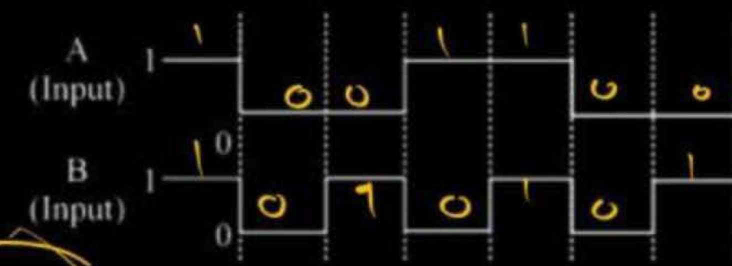


(C)



(D)





AND	1	0	0	0	1	0	1
NAND	0	1	1	1	0	1	0

Ans : (B)