

[SINGLE CORRECT CHOICE TYPE]

- Q.1 Consider two coherent monochromatic (wavelength λ) sources S_1 and S_2 separated by distance d . The ratio of intensities of S_1 and S_2 is 4. The distances of point P from S_1 where a detector is placed to have intensity equal to $\frac{9}{4}$ intensity of S_1 [Given $\angle S_2 S_1 P$ is 90°] [3]

(A) $\frac{d^2 - n^2 \lambda^2}{2n\lambda}$

(B) $\frac{d^2 + n^2 \lambda^2}{2n\lambda}$

(C) $\frac{n\lambda d}{\sqrt{d^2 - n^2 \lambda^2}}$

(D) $\frac{2n\lambda d}{\sqrt{d^2 - n^2 \lambda^2}}$



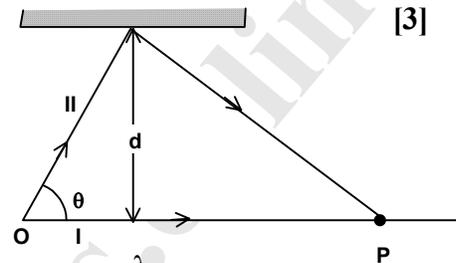
- Q.2 Two coherent rays of wavelength λ emits from source O to interfere at P constructively as shown. Which of the following is true of $n \in \mathbb{N}$ [3]

(A) $\text{Cosec}\theta - \cot\theta = (2n - 1) \frac{\lambda}{4d}$

(B) $\text{Cosec}\theta + \cot\theta = (2n - 1) \frac{\lambda}{4d}$

(C) $\text{Cosec}\theta - \cot\theta = n \frac{\lambda}{2d}$

(D) $\text{Cosec}\theta + \cot\theta = n \frac{\lambda}{2d}$

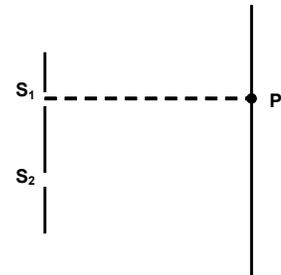


- Q.3 White light (wavelength $4000-7000\text{\AA}$) is incident normally on a glass plate of thickness one micron and refractive index 1.5. Number of strongly reflected wavelengths by the plate is- [3]
 (A) 1 (B) 2 (C) 3 (D) 4

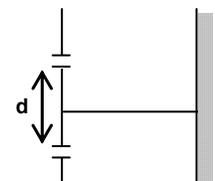
- Q.4 A thin plate of glass of refractive index 1.4 is placed normally in the path of one of the coherent interfering beam of a monochromatic light of wavelength 5000\AA . If central bright band of fringe system is formed at the position of second bright band from centre, when no plate is placed. The thickness of the glass plate is [3]
 (A) $25 \mu\text{m}$ (B) $5 \mu\text{m}$ (C) $250 \mu\text{m}$ (D) $2.5 \mu\text{m}$

- Q.5 Consider a Young's double slit experiment setup as shown in the figure. The light from S_1 and S_2 have equal intensities I . P is a point on the screen at the same horizontal level as of S_1 . Which of the following statement is true? [3]

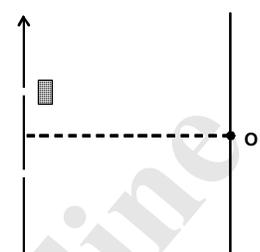
- (A) intensity at point P must be equal to I .
 (B) intensity at point P must be $2I$.
 (C) intensity at point P may be equal to I .
 (D) P will always be a dark spot.



- Q.6 In Young's double slit experiment d is the distance between the double slits. Intensity of central maxima is I_1 . If the system of double slits is displaced through $d/2$ along the plane of slit, then intensity of central maxima is I_2 . Then I_1/I_2 is [3]
 (A) 1 (B) 1 : 2
 (C) 2 : 1 (D) 1 : 4

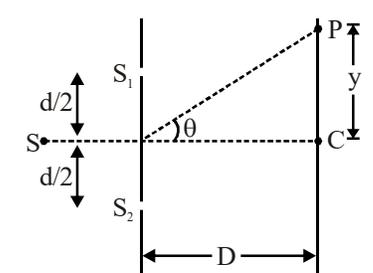
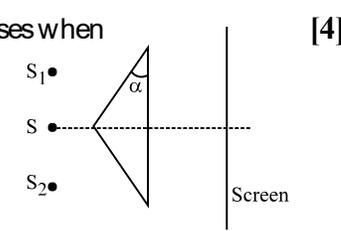
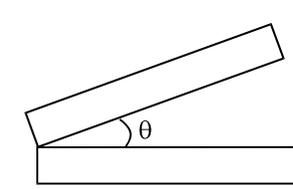


- Q.7 In a YDSE, having equal slit width the path difference at a point A is $(\lambda/2)$ and intensity is I_A and at point B, the path difference is $(\lambda/4)$ and intensity is I_B . The ratio of intensity I_A/I_B is [3]
 (A) 1/2 (B) 1/4 (C) zero (D) infinity
- Q.8 Three coherent beams of light get superposed on a point O. The intensity corresponding to each is I at point O. But phase of first wave is less than that of the second by $2\pi/3$ and greater than that of the third by $\frac{2\pi}{3}$. The resultant intensity at point O is [3]
 (A) $\sqrt{3}I$ (B) $3I$ (C) $9I$ (D) zero
- Q.9 When a perfectly transparent glass slab ($\mu = 1.5$) is introduced in front of upper slit of a usual double slit experiment, the intensity at 'O' reduces to 1/2 times of its earlier value. Minimum thickness of slab would be [3]
 (A) λ (B) $\lambda/2$
 (C) $\lambda/4$ (D) 2λ
- Q.10 A monochromatic light is used in Young's double slit experiment when one of the slits is covered by a transparent sheet of thickness 1.8×10^{-5} m, made of material of refractive index μ_1 number of fringes which shift is 18. When another sheet of thickness 3.6×10^{-5} m, made of material of refractive index μ_2 is used, number of fringes which shift is 9. Relation between μ_1 and μ_2 is given by [3]
 (A) $4\mu_2 - \mu_1 = 3$ (B) $4\mu_1 - \mu_2 = 3$ (C) $3\mu_2 - \mu_1 = 4$ (D) $2\mu_2 - \mu_1 = 4$



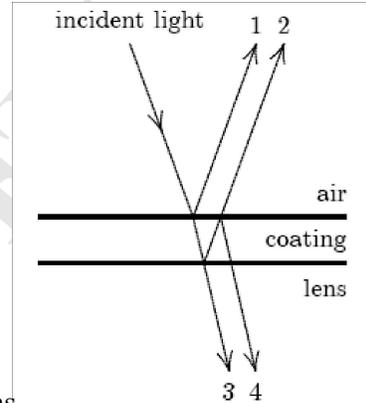
[MULTIPLE CORRECT CHOICE TYPE]

- Q.11 An observer looks down on two glass plates, one placed on top of the other. The top plate pivots about a line of contact at its edge as shown in the figure. The small angle created by the pivoting motion increases in time. Which is true?
 (A) The entire plate surface alternates between dark and bright as time advances.
 (B) The width of alternating bright and dark fringes aligned parallel to the line of contact increases with time.
 (C) The width of alternating bright and dark fringes aligned parallel to the line of contact decreases with time.
 (D) The width of alternating bright and dark fringes aligned perpendicular to the line of contact of constant in time, but become blurrier as time advances.
 (E) The line of contact is a bright fringe.
- Q.12 For the biprism experiment shown in the figure, the fringe width increases when [4]
 (A) Biprism is moved towards the slit
 (B) Screen is moved away from the biprism
 (C) A biprism having smaller angle α is used
 (D) The slit width is reduced.
- Q.13 Consider the standard Young's double slit experiment setup let Δx represent the path difference between the waves reaching P. Mark the correct statement(s): [4]
 (A) Path difference $\Delta x = d \sin \theta$ is applicable only when $D \gg d$
 (B) Path difference $\Delta x = yd/D$ is applicable only when $D \gg y$
 (C) Almost equally spaced fringes near C only when $D \gg y$
 (D) Total number of maxima on the screen is 5 when $d = 3\lambda$



- Q.14 Three coherent sources kept along the same line produce intensity I_0 each at point P on this line. When S_1 & S_2 are switched on simultaneously, intensity at point P is $2I_0$. When S_2 and S_3 are switched on simultaneously, intensity at point P is $2I_0$. Then [4]
- (A) When S_1 and S_3 are switched on simultaneously, intensity at point P can be $2I_0$
 (B) When S_1 and S_3 are switched on simultaneously, intensity at point P can be 0
 (C) When all 3 sources are switched on simultaneously, intensity at point P can be I_0
 (D) When all 3 sources are switched on simultaneously, intensity at point P can be $3I_0$

- Q.15 Binoculars and microscopes are frequently made with coated optics by adding a thin layer of transparent material to the lens surface as shown. One wants: [4]



- (A) Constructive interference between waves 1 and 2
 (B) Destructive interference between waves 3 and 4
 (C) Constructive interference between 3 and 4
 (D) The speed of light in the coating to be less than that in the lens

[MATRIX MATCH]

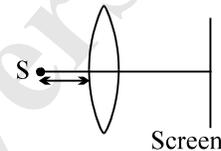
- Q.16 Light from source S ($|u| < |f|$) falls on lens and screen is placed on the other side. The lens is formed by cutting it along principal axis into two equal parts and are joined as indicated in column II. [9]

Column I

Column II

- (A) Plane of image move towards screen if $|f|$ is increased

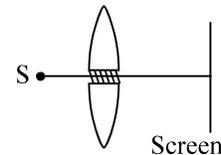
(P)



Small portion of each part near pole is removed. The remaining parts are joined.

- (B) Images formed will be virtual

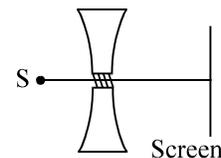
(Q)



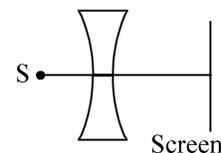
The two parts are separated slightly. The gap is filled by opaque material.

- (C) Interference pattern can be obtained if screen is suitably positioned.

(S)



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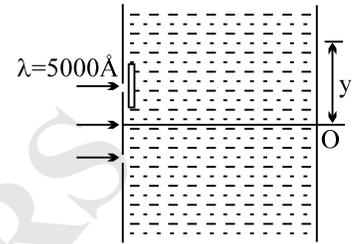


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[SUBJECTIVE TYPE]

- Q.17 In a YDSE the upper slit is covered with a $t = 2 \mu\text{m}$ thick sheet having refractive index $\mu_1 = 1.3$. The entire apparatus is filled with water (refractive index $\mu_2 = 4/3$). If distance between the slits $d = 0.4 \text{ mm}$, distance of plane of slits from the screen is $D = 2.4 \text{ m}$ and wave length of light used is $\lambda = 5000 \text{ \AA}$ in vacuum. Find
- the expression for phase difference as a function of y on screen.
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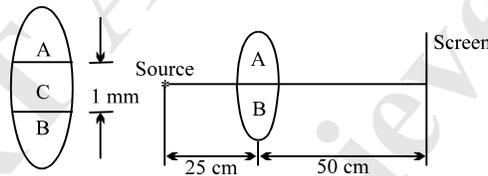
[5]

- Q.18 A radio receiver is set up on a mast in the middle of a calm lake to track the radio signal from a satellite orbiting the earth. As the satellite rises above the horizon, the intensity of the signal varies periodically. The intensity is at a maximum when the satellite is $\theta_1 = 0.01$ radian above the horizon and then again at $\theta_2 = 0.03$ radian above the horizon. What is the wavelength λ (in meters) of the satellite signal? The receiver is $h = 4.0 \text{ m}$ above the lake surface.

[5]

- Q.19 A convex lens of focal length 50 cm is cut along the diameter into two identical halves A and B and in the process a layer C of the lens thickness 1 mm is lost. Then the two halves A and B are put together to form a composite lens. Now in front of this composite lens a source of light emitting wavelength $\lambda = 6000 \text{ \AA}$ is placed at a distance of 25 cm as shown in the figure. Behind the lens there is a screen at a distance 50 cm from it. Find the fringe width of the interference pattern obtained on the screen.

[5]



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Q.1 Consider two coherent monochromatic (wavelength λ) sources S_1 and S_2 separated by distance d . The ratio of intensities of S_1 and S_2 is 4. The distances of point P from S_1 where a detector is placed to have intensity equal to intensity of S_1 [Given $\angle S_2 S_1 P$ is 90°] [3]

(A*)

(B)

(C)

(D)



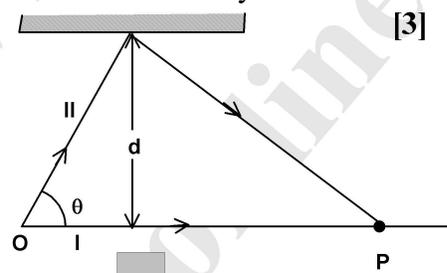
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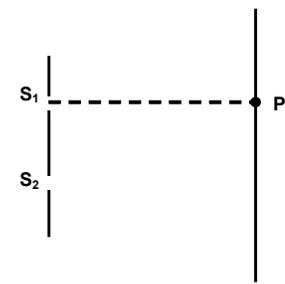


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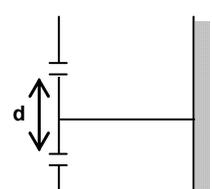
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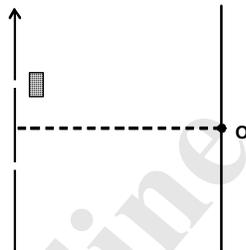
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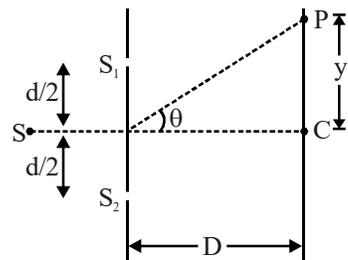
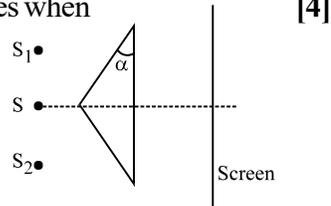
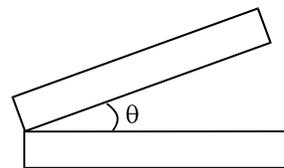


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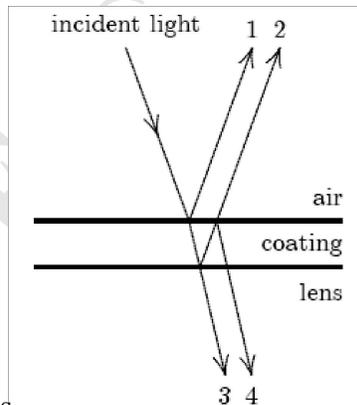
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[MATRIX MATCH]

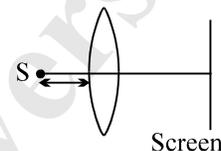
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- (A) Plane of image move towards screen if $|f|$ is increased

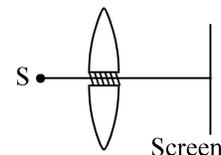
(P)



Small portion of each part near pole is removed. The remaining parts are joined.

- (B) Images formed will be virtual

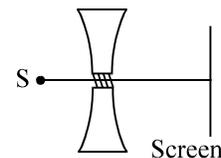
(Q)



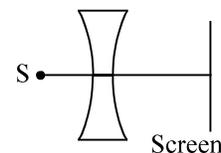
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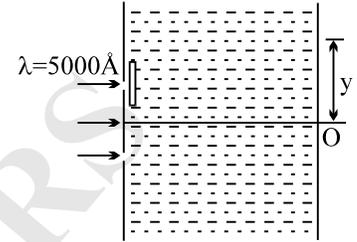
Small portion of each part near pole

is removed. The remaining parts are joined.

[Ans. (A) P,Q; (B) P,Q,R,S; (C) P]

[SUBJECTIVE TYPE]

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 - position (y) of central maxima (zero order maxima)



[5]

[Ans. (a) $\frac{2\pi}{\lambda} \left(\frac{yd}{D} \mu_2 - t(\mu_1 - \mu_2) \right)$; (b) 2.25 mm ; (c) -0.3 mm]

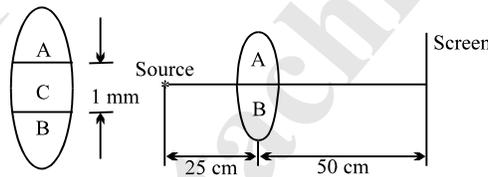
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[5]

[Ans. 0.16 m]

- Q.19 A convex lens of focal length 50 cm is cut along the diameter into two identical halves A and B and in the process a layer C of the lens thickness 1 mm is lost. Then the two halves A and B are put together to form a composite lens. Now in front of this composite lens a source of light emitting wavelength $\lambda = 6000 \text{ \AA}$ is placed at a distance of 25 cm as shown in the figure. Behind the lens there is a screen at a distance 50 cm from it. Find the fringe width of the interference pattern obtained on the screen.

[5]



[Ans 0.6 mm]