GUIDED REVISION

YDSE

1. Consider an YDSE that has different slits width, as a result, amplitude of waves from two slits are A and 2A, respectively. If I_0 be the maximum intensity of the interference pattern, then intensity of the pattern at a point where phase difference between waves is ϕ, is .

(A) $I_0\cos^2\phi$ (B) $\frac{I_0}{3}\sin^2\frac{\phi}{2}$

(C) $\frac{I_0}{9}[5+4\cos\phi]$ (D) $\frac{I_0}{9}[5+8\cos\phi]$

2. If one of the slits of a standard YDSE apparatus is covered by a thin parallel sided glass slab so that it transmit only one half of the light intensity of the other, then :

(A) the fringe pattern will get shifted towards the covered slit.

(B) the fringe pattern will get shifted away from the covered slit.

(C) the bright fringes will be less bright and the dark ones will be more bright.

(D) the fringe width will remain unchanged.

3. In a Young's double-slit experiment, let A and B be the two slits. A thin film of thickness t and refractive index μ is placed in front of A. Let β = fringe width. The central maximum will shift :

(A) towards A (B) towards B

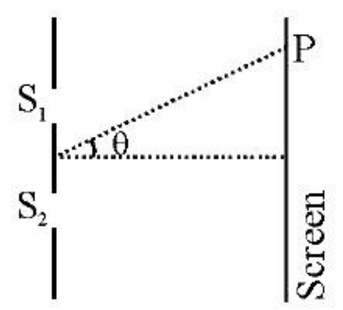
(C) by $t(\mu-1)\frac{\beta}{\lambda}$ (D) by $\mu t\frac{\beta}{\lambda}$

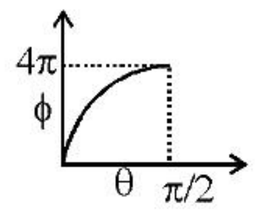
4. In a YDSE setup, we plot the phase difference (ϕ) between both waves at point P on the screen against the angular position (θ) of point P on the screen. The graph is as shown below.

(A) The distance $S_1S_2 = 2\lambda$

(B) There are a total of 4 minima on the screen

(C) The first maxima above the centre is at $\theta = \frac{\pi}{4}$





(D) At $\theta = \frac{\pi}{6}$, intensity is maximum

5. In Young's Double slit experiment, the interference pattern is found to have an intensity ratio between the bright and dark fringe is 9. This implies that

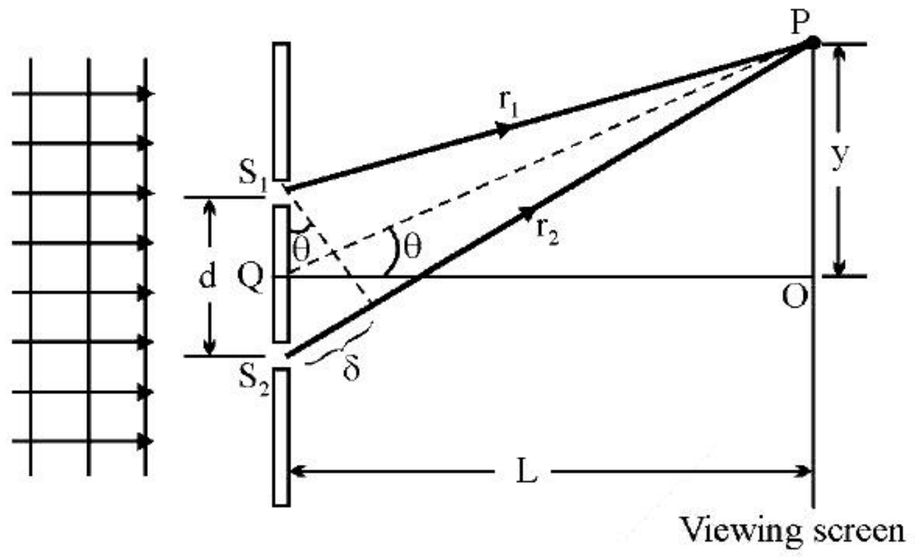
(A) the intensities at the screen due to the two slits are 5 and 4 units respectively.

(B) the intensities at the screen due to the two slits are 4 and 1 units respectively.

(C) the amplitude ratio is 3

(D) the amplitude ratio is 2

6. If you were to blow smoke into the space between the barrier of standard YDSE and the viewing screen of figure, the smoke would show :



(A) No evidence of interference between the barrier and the screen

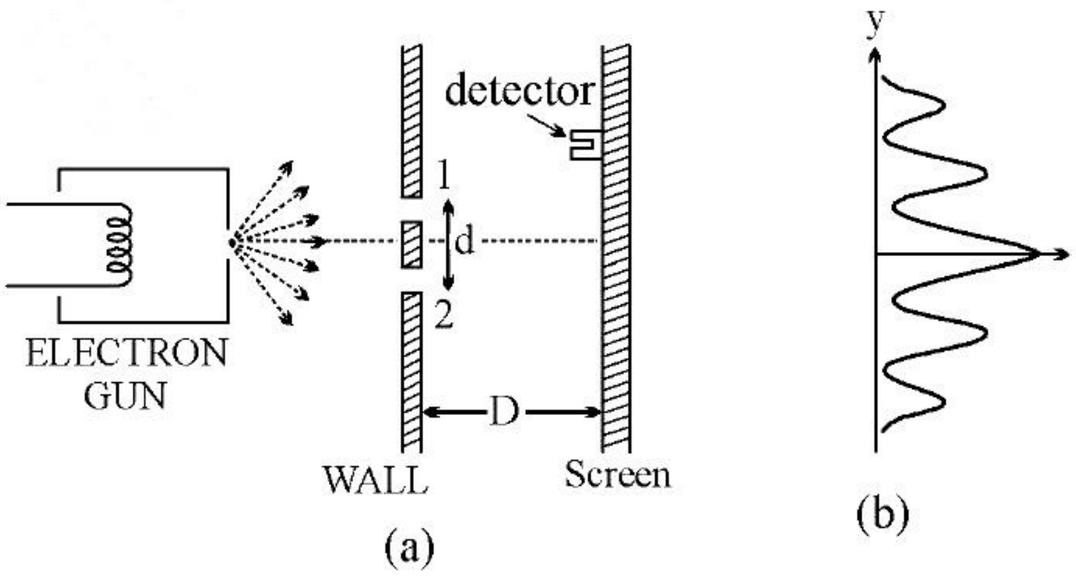
(B) Evidence of interference everywhere between the barrier and the screen.

(C) Maxima are localised and located on hyperboloids.

(D) Maxima are non-localised and located on hyperbolic planes.

Paragraph for question nos. 7 and 8

Let us do the Young's double slit experiment with electron rather than light waves. We make an electron gun which consists of a tungsten wire heated by an electric current and surrounded by a metal box with a hole in it. If the wire is at negative potential w.r.t. the box, electron emitted by the wire (thermionic emission) will be accelerated towards the walls and same will pass through the hole. All the electrons coming out of this gun will have the same energy, qV. In front of gun there is a wall with two slits in it as shown. Beyond the wall there is another plate which acts as a screen. The no. of electrons arriving at the screen/area/time can be measured. When the graph of this is plotted with y coordinate on the screen, we obtain the graph as seen in YDSE experiment. This can be explained using de broglie's hypothesis which states that electrons also behave like waves.



7. Which of following would increase fringe width, assuming that $\lambda << d$?

(A) Increase temperature of wire

(B) Decrease D

(C) Increase d

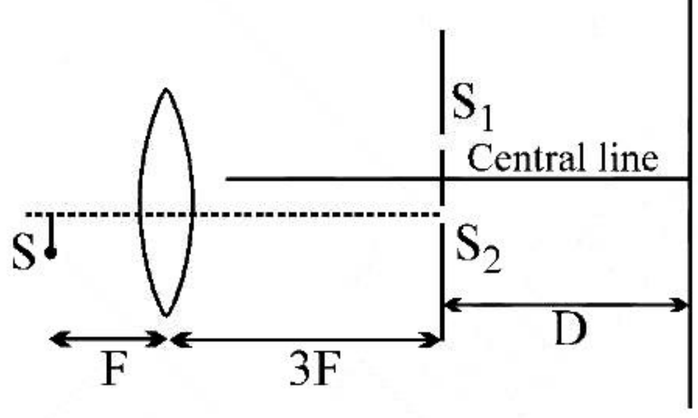
(D) Decrease voltage V

8. Suppose we go on increasing the voltage from a very low value.Beyond a certain voltage, we obtain 3 maxima on the screen. What is the voltage?

(A) $\frac{h^2}{2mqd^2}$ (B) $\frac{5h^2}{2mqd^2}$ (C) $\frac{9h^2}{2mqd^2}$ (D) $\frac{7h^2}{2mqd^2}$

9 In a Young's experiment, the upper slit is covered by a thin glass plate of refractive index 1.4 while the lower slit is covered by another glass plate having the same thickness as the first one but having refractive index 1.7 . Interference pattern is observed using light of wavelength 5400 Å . It is found that the point P on the screen where the central maximum (n = 0) fell before the glass plates were inserted now has 3/4 the original intensity . It is further observed that what used to be the 5th maximum earlier, lies below the point P while the 6th minimum lies above P. Calculate the thickness of the glass plate. (Absorption of light by glass plate may be neglected).

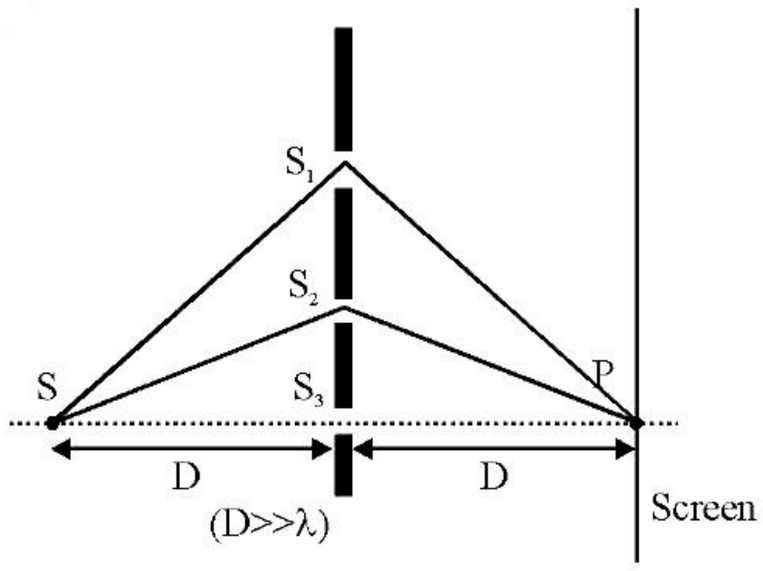
10. Observe the set up shown in the figure. What will be the position of the central maxima on the screen? Source S is d/2 distance below the optical axis and the optical axis is equal distance below the central line. (The separation between the slits is d and separation between the plane of slit and the screen is D and focal length of lens is F.) Also F >> d, D >>d



(A) $\frac{Dd}{2F}$ (B) $\frac{Dd}{F}$ (C) $\frac{Dd}{3F}$ (D) None

MODIFICATIONS OF YDSE

11. A monochromatic light source of wavelength λ is placed at S. Three slits S_1, S_2 and S_3, source S and point P is shown in the figure. If $S_1P - S_2P = \lambda/6$ and $S_1P - S_3P = 2\lambda/3$ and I be the intensity at P when only one slit is open, the intensity at P when all the three slits are open is :-



(A) 3I (B) 5I (C) 8I (D) 0

12. Two consequent plane waves of light of equal amplitude and each of wavelength $20\pi \times 10^{-8}$m propagating at an angle of $\frac{\pi}{1080}$ rad with respect to each other, fall almost normally on screen. The fringe width (in mm) on the screen is $\frac{108}{100n}$. Find the value of n.

13 Two monochromatic (wavelength = a/5) and coherent sources of electromagnetic waves are placed on the x-axis at the points (2a, 0) and (–a, 0). A detector moves in a circle of radius R(>>2a) whose centre is at the origin. The number of maximas detected during one circular revolution by the detector are :

(A) 60 (B) 15 (C) 64 (D) None

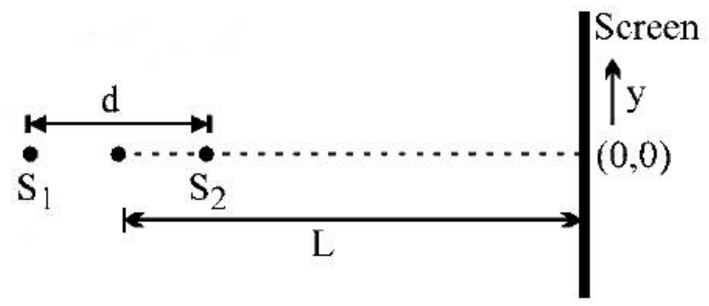
14. The figure shows two points source which emit light of wavelength λ in phase with each other and are at a distance $d = 5.5\ \lambda$ apart along a line which is perpendicular to a large screen at a distance L from the centre of the source. Assume that d is much less than L. Which of the following statement is (are) correct?

(A) Five bright fringes appear on the screen

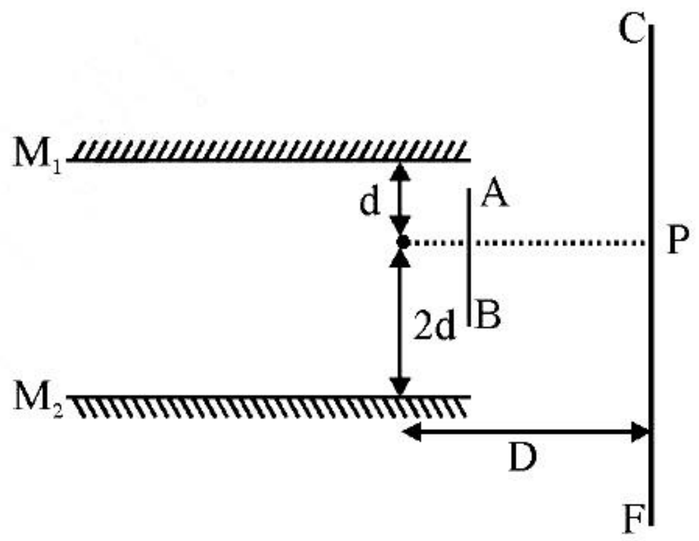
(B) Six bright fringes appear on the screen

(C) Point y = 0 corresponds to bright fringe

(D) Point y = 0 corresponds to dark fringe.



15. M_1 and M_2 are two plane mirror & S is monochromatic source. AB is a 'stop' which stops direct light to reach CF and allows reflected light from M_1 and M_2 to reach CF. P is a point on CF such that SP is parallel to M_1 & M_2 & perpendicular to CF :- (D >> d)



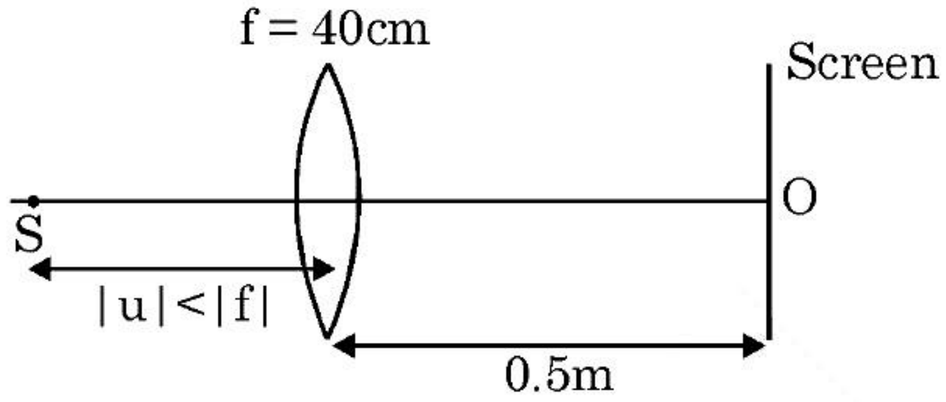
(A) Circular fringes will be formed on CF

(B) P will be central maxima

(C) P will be a point of maxima if $\lambda = \frac{6d^2}{D}$

(D) P will be a point of maxima if $\lambda = \frac{d^2}{D}$

16. A lens of focal length f = 40 cm is cut along the diameter into two equal halves. In this process, a layer of thickness t = 1mm is lost, then halves are put together to form a composite lens. In between focal plane and the composite lens a narrow slit is placed very close to the focal plane |u| < |f|. The slit is emitting monochromatic light of wavelength 0.6 μm. Behind the lens a screen is located at a distance L = 0.5 m from it as shown :-



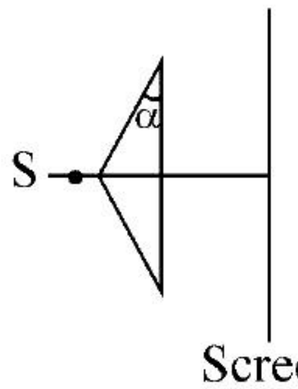
(A) Fringe width is 0.12 mm

(B) Fringe width is 0.24 mm.

(C) Length of interference pattern is 1/8 cm

(D) Length of interference pattern is 1/16 cm

17. For the biprism experiment shown in the figure, the fringe width increases when



(A) biprism is moved towards the slit

(B) entire apparatus is submerged in a liquid having R.I. less than that of prism

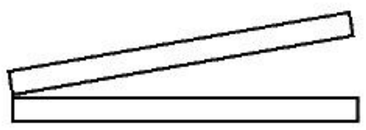
(C) a biprism having smaller angle α is used

(D) the slit width is reduced

18. It is necessary to coat a glass lens with a non-reflecting layer. If the wavelength of the light in the coating is λ, the best choice is a layer of material having an index of refraction between those of glass and air and a minimum thickness of :

(A) $\frac{\lambda}{4}$ (B) $\frac{\lambda}{2}$ (C) $\frac{3\lambda}{8}$ (D) λ

19 When monochromatic light is incident normally on a wedge-shaped thin air film, refer figure, an interference pattern may be seen by reflection. Which of the following is/are correct?



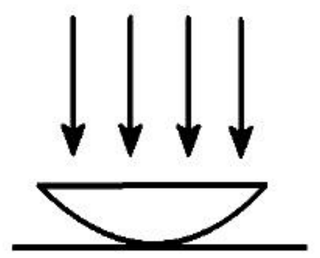
(A) Parallel fringes are observed

(B) If water is introduced into the region between the plates, the fringe separation decreases

(C) If the angle of the wedge is increased, the fringe separation decreases

(D) When white light is used there will not be a completely dark fringe

20 A thin slice is cut out of a glass cylinder along a plane parallel to its axis. The slice is placed on a flat glass plate as shown. The observed interference fringes from this combination shall be :



(A) straight

(B) circular

(C) equally spaced

(D) having fringe spacing which increases as we go outwards.

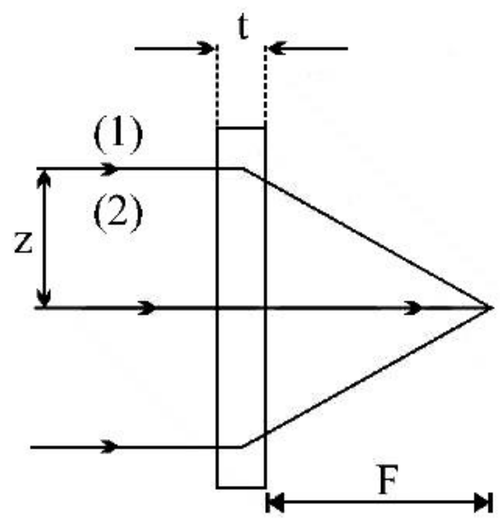
HUYGENS' PRINCIPLE

21. A parallel beam of light is incident on an equi-convex lens having radius of curvature R = 20 cm. Find the radius of curvature of emergent wavefront, just after emerging from lens: (reflective index of lens = 1.5)

(A) 10 cm (B) 5 cm (C) 1 cm (D) 20 cm

22 Plane wavefronts are incident on a glass slab which has refractive index as a function of distance Z, according to the relation $\mu = \mu_0^- (1-Z^2/Z_0^2)$, where μ_0 is the refractive index along the axis and Z_0 is a constant. This glass slab can act as lens of focal length F. By using the concept of optical path length calculate the focal length of the slab. Consider t to be very small as compared to F.

[**Hint :** Equate the OPL of ray (1) and ray (2)]



(A) $Z_0^2/(2\mu_0 t)$ (B) $Z_0^2/(\mu_0 t)$ (C) $\mu_0 Z_0^2/(2t)$ (D) None

WAVE OPTICS			ANSWER KEY
1. Ans. (C)	2. Ans. (A,C,D)	3. Ans. (A,C)	4 Ans. (A,B,D)
5. Ans. (B,D)	6. Ans. (B,D)	7. Ans. (D)	8. Ans. (A)
9. Ans. 9.3 mm	10. Ans. (A)	11. Ans. (A)	12. Ans. 5
13. Ans. (A)	14. Ans. (A,D)	15. Ans. (C, D)	16. Ans. (B, C)
17.Ans. (A,B,C)	18. Ans. (A)	19. Ans. (A,B,C)	20. Ans. (A)
21. Ans. (D)	22. Ans. (A)		