PHYSICS

BOOKS - HC VERMA PHYSICS (HINGLISH)

LIGHT WAVES

Examples

1. The refraction index of glass is 1.5. Find the speed of light in glass.

Watch Video Solution

2. In a Young's double slit experimetn the separation between te slits is 0.10 mm, the wavelength of light used is 600 mm and the interference patternn is observed on a screen 1.0 m away. Find the separation between the seccussive bright frings.

Watch Video Solution

3. The wavelength of light coming from a sodium source is 589 nm. What will be its wavelength in water? Refractive index of water 1.33.`

Watch Video Solution

4. Find the minimum thcknessof a film which will strongly reflect the light of wavelength 589 nm. The refractive index of the material of the film is 1.25.

Watch Video Solution

5. A parallel beam of monochromatic light of wavelength 450 m passes through a long slit of width 0.2 mm. find the angular divergence in which most of the light is diffracted.

Watch Video Solution

6. A beam of light of wavelength 590 nm is focussed by a converging lens of diameter 10.0 cm at a distnce of 20 cm from it. find the diameter of he disc image formed.

Watch Video Solution

Worked Out Examples

1. White light is a mixture of light of wavelengths between 400 nm and 700 nm. If this light goes through water $(\mu = 1.33)$` what are the limits of the wavelength there ?

Watch Video Solution

2. The optical path of a monochromatic light is the same if it goes through 2.00 cm of glass or 2.25 cm of water. If the refractive index of water is 1.33, what is the refractive index of glass?

Watch Video Solution

Watch Video Solution

3. White light is passed through a double slit and interference pattern is observed on a secreen 2.5 m away. The separation between the slits is 0.5 mm. The first violet and red frings are formed 2.0 mm and 3.5 mm away from the central white fringe. Calculate the wavelegths of the violet and the red light.

Watch Video Solution

4. A double slilt experiment is performed with sodium (yellow) light of wavelength 589.3 nm and the interference pattern is observed on a screen 100 cm away. The tenth bright fringe has its centre at a distance of 12 mm from the central maximum. Find the separation betwen the slits.

Watch Video Solution

5. The intensity of the light coming from one of the slits in a Young's double slit experiment is double the intensity from the other slit. Find the ratio of the maximum intensity to the minimum intensity in the interference fringe pattern observed.

Watch Video Solution

6. The width of one of the two slits in a Young's double slit experiment is double of the other slit. Assuming that the amplitude of the light coming from a slit is proportional to the slit width, find the ratio of the maximum to the minimum intensity in the interference pattern.

Watch Video Solution

7. Two sources S_1 and S_2 emitting light of wave length 600 nm are placed a distance $1.0x10^{-2}$ cm apart. A detector can be moved on the litre line S_1P which is perpendicular to S_1S_2. a.What would be the minimum and maximum path differrence at the detector as it is moved alog the line S_1P? b. Locate the position of the farthest minimum detect.

Watch Video Solution

8. A beam of light consisting of two wavelenths, 6500 Å and 5200 Å is used to obtain interference fringes in a Young's double slit experiment $(1\text{Å} = 10^{-10}m)$. The distance between the slits is 2.0 mm and the distance between the plane of the slits and the screen in 120 cm. (a) Find the distance of the third bright frings on the screen from the central maximum for the wavelength 6500 Å (b) What is the least distance from the central maximum where the bright frings due to both the wavlelengths coincide ?

Watch Video Solution

9. Monichromatic lightof wavelenght 600 nm is used ina Young's double slilt experient. One of the slits is covered by a transparent sheet of thicknes 1.8×10^{-5} m made of a material of refractive index 1.6. How many fringe will shift due to the introduction of the sheet?

Watch Video Solution

10. While light is incident normally on a glass plate of thickness 0.50×10^{-6} and index of refraction 1.50. Which wavelength in the visible region (400 nm - 700 nm) are strongly reflacted by the plate ?

Watch Video Solution

11. A parallel beam of gren light of wavelength 546 nm passes through a slit of width 0.40mm. The transmitted light is collected on a screen 40 cm away. Find the distance between the two first order minima.

Watch Video Solution

Short Answer

1. Is the Colour of 620 run light and 780 nm light same? Is the colour of 620 nm light and 621 nm light same? How many colours are there in white light?

Watch Video Solution

2. The wavelength of light in a medium is $\lambda = \frac{\lambda_0}{\mu}$ where λ is the wavelength in vacuum. A beam of red light $(\lambda_0 = 720nm)$ enters into water The wavelength in water is $\lambda = \frac{\lambda_0}{\mu} = 540nm.$ To a person under water does this light appear green?

Watch Video Solution

3. Whether the diffraction effects from a slit will be more clearly visible or less clearly, if the slit-width is increased ?

Watch Video Solution

4. If we put a cardboard $(say 20cm \times 20cm)$ between a light source and our eyes, we can't see the light. But when we put the same cardboard between a sound source and our ear, we hear the sound almost clearly, Explain.

Watch Video Solution

5. TV signals broadcast by Delhi studio cannot be directly received at Patna which is about 1000 km away. But the same signal goes some 36000 km away to a satellite, gets reflected and is then received at Patna. Explain.

Watch Video Solution

6. Can we perform Young's doubel slilt experiment with shound waves? To get a resonable fringe pattern what should be the order of separation between the slits? How can the bright fringes an the dark fringes be detected in this case?

Watch Video Solution

7. Is it necessary to have two waves of equal intensity to study interfrence pattern? Will there be an effect on clarity if the waves have unequal intensity?

Watch Video Solution

8. Can we conclude from the interference phenomenon whether light is a transverse wave or a longitudinal wave?

Watch Video Solution

9. Why don't we hav interference when two candles are placed close to each other and the intensity is seen at a distant scree? What happens if the candles are replaced by laser sources?

A. wave phenomenon

B. particle phenomenon

C. both particle and wave phenomenon

D. none of these

Answer:

Watch Video Solution

10. If the separation between the slits in a Young's douel slilt experiment is increased. What hasppenns to the fringe width? If the separation is increased too much will the fringe pasttern remin detectable?

A. on elasticity of the medium only

B. on inertia of the medium only

C. on elasticity as well as inertia

D. neither on elasticity nor on inertia

Answer:

Watch Video Solution

11. Suppose white light falls on a double sllit but one slit is covered by a violet filter (allowing $\lambda = 400nm$). Describe the nature of the fringe pattern observed.

Watch Video Solution

Objective 1

1. Light is

A. wave phenomenon

B. particle phenomenon

C. both particle and wave phenomenon

D. none of these

Answer: C

Watch Video Solution

2. The speed of ight deends

A. on elasticity of the medium only

B. on inertia of the medium only

C. on elasticity as well as inertia

D. neither on elasticity nor on inertia

Answer: D

Watch Video Solution

3. The equation of a light wave i written as $y = A \sin(kx - \omega t)$. Here y represents

A. displacement of either particles

B. pressure in the medium

C. density of the medium

D. electric field

Answer: D

Watch Video Solution

4. Which of the following properties show that light is a transverse wave?

A. Reflection

B. interference

C. Differaction

D. Polarization

Answer: D

Watch Video Solution

5. When light is refracted into a medium

A. its wavelength and frequency both increases

B. its wavelength increases but frequency remains unchanged

C. its wavelength decreases but frequency remains unchanged

D. its wavelength and frequency both decrease.

Answer: C

Watch Video Solution

6. When light is refracted which of the following does not change?

A. Wavelength

B. Frequency

C. Velocity

D. Amplitude

Answer: B

Watch Video Solution

7. The amplitude modulated (AM) radio wave bends apreciably round the cornes of a $1m \times 1m$ board but the frequency modulated (FM) wave only negligible bends.If the average wavelengths of AMandFM waves are $\lambda_0 \text{ and } \lambda_f$.

A. $\lambda_a > \lambda_f$

B. $\lambda_a = \lambda_f$

C. $\lambda_a < \lambda_f$

D. We don't have sufficient information to decide about the relation of $\lambda_a \text{ and } \lambda_f$.

Answer: A

Watch Video Solution

8. Which of the following sources gives best mionochromatic light?

A. A candle

B. A bulb

C. A mercury tube

D. A laser

Answer: D

Watch Video Solution

9. The wavefronts of a light wave travellilng in vacuum are given by $x + y + z = c$. The angle made by the direction of propagation of light with the X-axis is

A. 0°

B. 45°

C. 90°

D. $\cos^{-1}(1/\sqrt{3})$.

Answer: D

Watch Video Solution

10. The wavefronts of light coming from a distant source of unknown shape are nearly

A. Plane

B. elliptical

C. cylindrical

D. spherical.

Answer: A

Watch Video Solution

11. The inverse square law of intensity (i.e., the intensity $\propto \frac{1}{r^2}$) is valid for a

A. point source

B. line source

C. plane source

D. cylindrical source.

Answer: A

Watch Video Solution

12. Two sources are called coherent if they produce waves

A. of equal wavelength

B. of equal velocity

C. having same shape of wavefront

D. having a constant phase difference.

Answer: D

Watch Video Solution

13. When a drop of oil is spread on a water surface, it displays beautiful colours in daylight because of

A. disperson of light

B. reflaction of light

C. polarization of light

D. interference of light.

Answer: D

Watch Video Solution

14. Two coherent sources of different intensities send waves which interfere. The ratio of maximum intensity to the minimum intensity is 25. The intensities of the sources are in the ratio

A. $25:1$

B. $5:1$

C. $9:4$

D. $625:1$

Answer: C

Watch Video Solution

15. The slits in a Young's double slit experiemnt have equal width and the source is placed symmetrically with respect to the slits. The Intensty ast the central fringe is I_0. If one of the slits is closed, the intensit at this point will

A. I_0

B. $I_0 / 4$

C. $I_0 / 2$

D. $4I_0$

Answer: B

Watch Video Solution

16. A thin transparent sheet is placed in from of a Young's double slit. The fringe width will

A. increases

B. decrease

C. remain same

D. become nonuniform.

Answer: C

Watch Video Solution

17. If young's douel slit experiment is performed in water

A. the fringe width will decrease

B. the fringe width will increases

C. the fringe width will remain unchanged

D. there will be no fringe.

Answer: A

Watch Video Solution

Objective 2

1. A light wave can travel

A. in vacuum

B. in vacuum only

C. in a meterial medium

D. in a meterial medium only.

Answer: A::C

Watch Video Solution

2. Which of the following properties of light conclusively support wave theory of light?

A. Light obeys laws of reflection

B. speed of light in water is smaller then the speed in vacuum.

C. Light shows interference

D. Light shows photoelectric effect.

Answer: B::C

Watch Video Solution

3. When light propagates in vacuum there is an electric field and a magnetic field. These fields

A. are constant in time

B. have zero average value

C. are perpendicular to the direction of propagation of light

D. are mutually perpendicular.

Answer: B::C::D

Watch Video Solution

4. Huygen's priciple of secondary wavelets may be used to

A. find the velocity of light in vacuum

B. explain the particle behaviour of light

C. find the new position of wavefront

D. explain Snell's law

Answer: C::D

Watch Video Solution

5. Three observers A, B and C measure the speed of light coming from a source to be v_A, v_B and v_C. The observer A moves towards the source and C moves away from the soure at the same speed. The observer B stays stationary. The surrounding space is vacuum everywhere.

A. $v_A > v_B > v_C$

B. $v_A < v_B < v_C$

C. $v_A = v_B = v_C$

D. $v_B = \frac{1}{2}(upslion_A + v_c)$.

Answer: C::D

Watch Video Solution

6. Suppose the medium in the previous question is water. Select the correct option s from the list given in that question.

Watch Video Solution

7. Light waves travels in vacuum along the X-axis. Which of the following may represent the wavefronts?

A. x = c

B. y =c

C. z =c

D. x + y+ z =c.

Answer: A

Watch Video Solution

8. If the source of light used in a young's double slit experiment is changed from red to violet

A. the fringes will become brighter

B. consecutive fringes will come closer

C. the intensity of minima will increase

D. the central bright fringe will become a dark fringe

Answer: B

Watch Video Solution

9. A Young's double slit experiment is performed with white light.

A. The central fringe will be white

B. There will not be a completely dark fringe.

C. The fringe next to the central will be red

D. The fringe next to the central will be violet

Answer: A::B::D

Watch Video Solution

10. Four light waves are represented by

$i.\ y = a_1 \sin \omega t$

ii. $y = a_2 \sin(\omega t + \varepsilon)$

iii. $y = a_1 \sin 2\omega t$

iv.$y = a_2 \sin 2(\omega t + \varepsilon)$ Inteference fringes may be observed due to superposition of

A. (i) and (ii)

B. (i) and (iii)

C. (ii) and (iv)

D. (iii) and (iv).

Answer: A::D

Watch Video Solution

Exercises

1. Find the range of frequency of light that is visible to an average human being $(400nm < \lambda < 700nm)$

Watch Video Solution

2. The wavelength of sodium light in air is 589 nm. (a) Find its frquency in air. (b) Find its wavelength in water (refactive index = 1.33). (c) find its frequency in water : (d) Find its speed in water.

Watch Video Solution

3. The index of refraction of flised quartz is 1.472 for light of wavelength 400 nm and is 1.452 for light of wavelength 760 nm. Find the speeds of light of these wavelengths in fused quartz.

Watch Video Solution

4. The speed of the yellow light in a certain liquid is$2.4x108ms^{-1}$. Find the refractive index of the liquid.

Watch Video Solution

5. Two narrow slits emitting light in phase are separated by a distance of 1-0 cm. The wavelength of the light is $5.0x10^{-7}$ m. The interference pattern is observed on a screen placed at a distance of 1-0 m. (a) Find the separation between the consecutive maxima. Can you expect to distinguish between these maxima ? (b) Find the separation between the sources which will give a separation of 1.0 mm between the consecutive maxima.

Watch Video Solution

6. The separation between the. consecutive dark fringes in a Young's double slit experiment is PO m. he is placed at a distance of 2.5 m from the slits screen s and separation between the slits is 1.0 nn. Calculate the he wavelength of light used for the experiment.

Watch Video Solution

7. In a double slit interference experiment, the separation between the slits is 1.0 mm, the wavelength of light used is 5.0×10^{-7} m and the distance of the screen from the slits is 1.0 m. (a) Find the distance of the centre of the first minimum from the centre of the central maximum. (b) How many bright fringes are formed in one centimeter width on the screen ?

Watch Video Solution

8. In a Young's double slit experiment, two narrow vertical slits placed 0.800 mm apart are illuminated by the same source of yellow light of wavelength 589 run. How far are the adjacent bright bands in the interference pattern observed on a screen 2.00 m away ?

Watch Video Solution

9. Find the angular separation between the consecutive bright fringes in a Young's double slit experiment with blue-green light of wavelength 500 nm. The separation between the slits is $2.0x10^{-3}$ m.

Watch Video Solution

10. A source emitting light of wavelengths 480 nm and 600 nm is used in a double slit interference experiment. The separation between the slits is 0.25 mm and the interference is observed on a screen placed at 150 cm from the slits. Find the linear separation between the first maximum (next to the central maximum) corresponding to the two wavelengths.

Watch Video Solution

11. White light is used in a Young's double slit experiment. Find the minimum order of the violet fringe $(\lambda = 400nm)$ which overlaps with a red fringe$(\lambda = 700nm)$.

Watch Video Solution

12. Find the thickness of a plate which will produce a change in optical path equal to half the wavelength λ of the light passing through it normally. The refractive index of the plate is μ.

Watch Video Solution

13. A plate of thickness t made of a material of refractive index μ is placed in front of one of the slits in a double slit experiment. (a) Find the changes in he optical path due to introduction of the plate. (b) Wht should be the minimum thickness t which will make the intensity at the centre of the fringe pattern zero ? Wavelength of the light used is λ. Neglect any absorption of light in the plate.

Watch Video Solution

14. A transparent paper (refractive index = 1.45) of thickness 0-02 mm is pasted on one of the slits of a Young's double slit experiment which uses monochromatic light of wavelength 620 nm. How many fringes will cross through the centre if the paper is removed ?

Watch Video Solution

15. In a Young's double slit experiment using monochromatic light, the fringe pattern shifts by as certasin distance on the screen when a mica sheet of refractive inde 1.6 and thickness 1.964 micron (1 micron $= 10^{-6} m$) is introduced in the path of one of the interfering waves. The mica sheet is then removed and the distance between the screen and the slits is doubled. It is found that the distance between the successive maxima now is the same as the observed frige-shift upon the introduction of the mica sheet. Calculate the wavelength of the monochromatic light used in the experiment.

View Text Solution

16. A mica strip and a polysterence strip are fitted on the two slite of a double slit apparatus. The thickness of the strips is 0.50 mm and the separation between the slits is 0.12 cm. The refractive index of mica and polysterene are 1.58 and 1.55 respectively for the light of wavelength 590 nm which is used in the experiment. The interference is observed on a screen a distance one meter away. (a) What would be the fringe- width ? (b) At what distance from the centre will the first maximum be located ?

View Text Solution

17. Two transparent slabs having equal thickness but different refractive indices μ_1 and μ_2, are pasted side by side to form a composite slab. This slab is placed just after the double slit in a Young's experiment so that the light from one slit goes through one material and the light from the other slit goes through the other material. What should be the minimum

thickness of the slab so that there is a minimum at the point P_0 which is equidistant from the slits ?

Watch Video Solution

18. A thin paper of thickness 0.02 mm having a refractive index 1.45 is pasted across one of the slits in a YDSE. The paper transimits $4/9$ of the light energy falling on it.

a. Find the ratio of maximum intensity to the minimum intensity in interference pattern.

b. How many fringes will cross through the center if an indentical paper piece is pasted on the other slit also? The wavelength of the light used is 600 nm.

Watch Video Solution

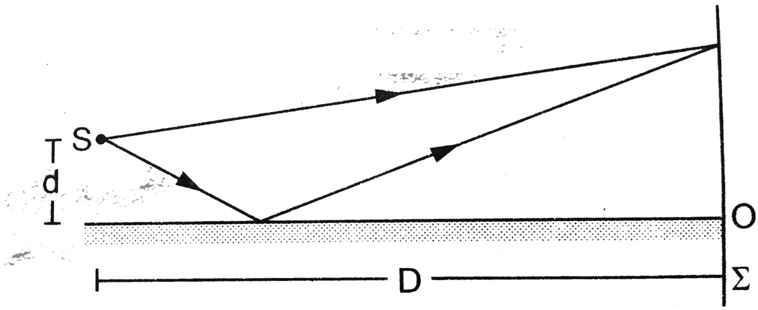
19. A Young's double slit apparatus has slits separated by 0.28 mm and a screen 48 cm away from the slits. The whole apparatus is immersed in water and the slits are illuminated by the red light ($\lambda = 700$ nm in vacuum). Find the fringe-width of the pattern formed on the screen.

Watch Video Solution

20. A parallel beam of monochromatic light is used in a Young's double slit experiment. The slits are separated by a distance d and the screen is placed parallel to the plane of the slits. Show that if the incident beam makes an angle $\theta = \sin^{-1}\left(\frac{\lambda}{2d}\right)$ with the normal to the plane of the slits, there will be a dark fringe at the centre Po of the pattern.

Watch Video Solution

21. A narrow slit S transmitting light of wavelength λ is placed a distance d above a large plane mirror as shown in figure. The light coming directly from the slit and that coming after the reflection interference at a screen $\sum$ placed at a distance LD from the slit. a. What will be the intensity at a point just above the mirror. i.e., just above O? b. At what distance from O does the first maximum occur?



?

Watch Video Solution

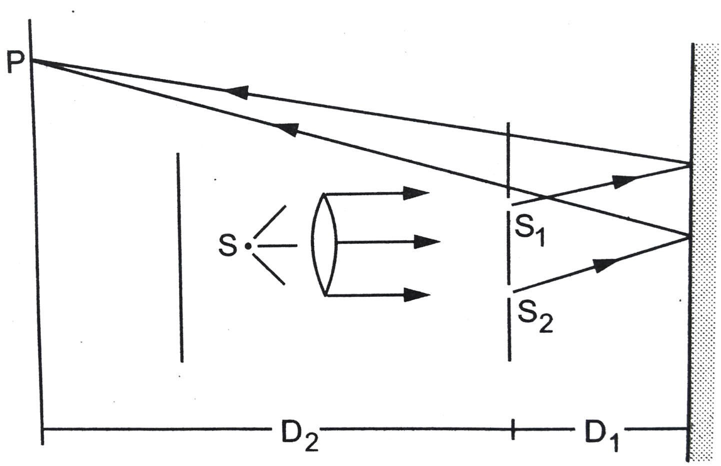
22. A long narrow horizontal slit is placed 1 mm above a horizontal plane mirror. The interference between the light coming directly from the slit and that after reflection is seen on a screen 1.0 in away from the slit, Find the fringe-width if the light used has a wavelength of 700 nm.

Watch Video Solution

23. Consider the situation of the previous problem, if the mirror reflects only 64% of the light energy falling on it, what will be the ratio of the maximum to the minimum intensity in the interference pattern observed on the screen ?

Watch Video Solution

24. A double slit $S_1 - S - 2$ is illuminated by a coherent light of wavelength λ. The slits are separated by a distance d. A plane mirror is placed in front of the double slit at a distance D_1, from it and a screen $\sum$ is placed behind the double slit at a distance D_2, from it . The screen $\sum$ receives only the light reflected by the mirror. Find the fringe-width of the interference pattern on the screen.

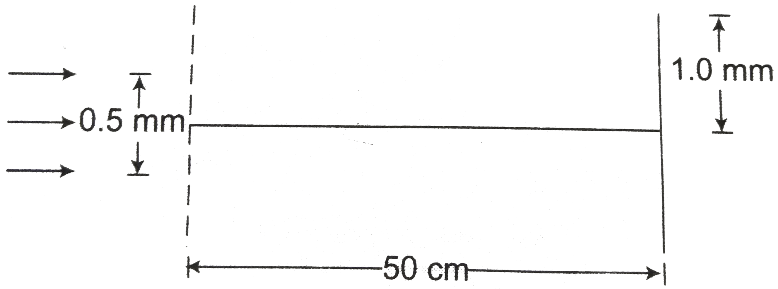


View Text Solution

25. White coherent light $(400 nm - 700 nm)$ is sent through the slits of a YDSE. $D = 0.5 mm$, D=50 cm. There is a hole in the screen at a point $1.0 mm$ away (along the width of the fringes) from the central line.

(a) Which wavelength will be absent in the light coming from the hole?

(b) Which wavelength(s) will have a strong intensity?



Watch Video Solution

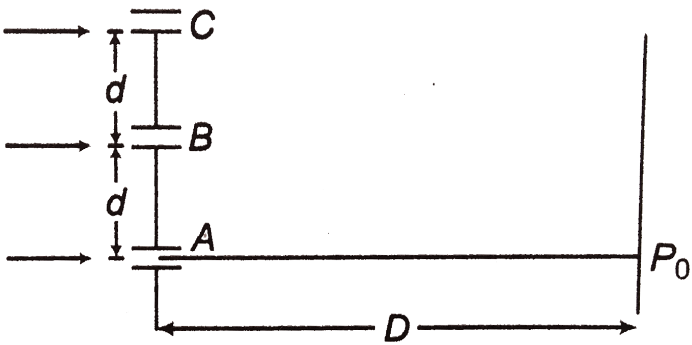
26. Consider the arrangement shown in figure. The distance D is large compared to the searated d between the slits. a. Find the minimum value of d so that there is a dark fringe at O. b. Suppose d has this value. Find the distance x at which the next bright firnnge is formed. c.Find teh fringe width.

View Text Solution

27. Two coherent point sources S_1 and S_2 emit light of wavelength λ. The separation between sources is 2λ. Consider a line passing through S_2 and perpendicular to the line S_1S_2. What is the smallest distance on this line from S_2 where a minimum of intensity occurs?

Watch Video Solution

28. figure shows three equidistant slits illuminated by a monochromatic parallel beam of light. Let $BP_0 - AP_0 = \frac{\lambda}{3}$ and $D > > \lambda$.



(a) Show that d = $\sqrt{(2\lambda D)/3}$

(b) Show that the intensity at P_0 is three times the intensity due to any of the three slits individually.

Watch Video Solution

29. In a Young's double slit experiment, the separation between the slits = 2.0 mm, the wavelength of the light = 600 nm and the distance of the screen from the slits = 2.0 m. If the intensity at the centre of the central maximum is $0.20 Wm^{-2}$, what will be the intensity at a point 0.5 cm away from this centre along the width of the fringes ?

Watch Video Solution

30. In a Young's double slit interference experiment the fringe pattern is observed on a screen placed at a distance D from the slits. The slits are separated by a distance d and are illuminated by monochromatic light of wavelength λ. Find the distance from the central point where the intensity falls to (a) half the maximum, (b) one fourth of the maximum.

Watch Video Solution

31. In a Young's double slit experiment $\lambda = 500nm, d = 1.0mm$ and $D = 1.0m$. Find the minimum distance from the central maximum for which the intensity is half of the maximum intensity.

Watch Video Solution

32. The line-width of a bright fringe is sometimes defined as the separation between the points on the two sides of the central line where the intensity falls to half the maximum. Find the line-width of a bright fringe in a Young's double slit experiment in terms of λ, d and D where the symbols have their usual meanings

Watch Video Solution

33. Consider the situation shown in figure. The two slits S_1 and S_2 placed symmetrically around the central line are illuminated by a monochromatic light of wavelength λ. The separation between the slits is d. The light transmitted by the slits falls on a screen Σ_1 placed at a distance D from the slits. The slit S_3 is at the placed central line and the slit S_4, is at a distance z from S_3. Another screenΣ_2 is placed a further distance D away from 1,1. Find the ratio of the maximum to minimum intensity observed on Σ_2 if z is equal to a. $z = \frac{\lambda D}{2d}$ b. $\frac{\lambda D}{d}$ c. $\frac{\lambda D}{4d}$

View Text Solution

34. Consider the arrangement shownin figure. By some mechanism,the separation between the slits S_3 and S_4 can be changed. The intensity in measured at the point P which is at the common perpendicular bisector of S_1S_2 and S_3S_4. $When z$=(Dlamda)/(2d) $the \int ensitymeasuredatPisI. F \in dthis \int ensitywhenzisequal \rightarrow a. \frac{D\lambda}{d}$,

View Text Solution

35. A soap film of thickness 00011 mm appears dark when seen by the reflected light of wavelength 580 nm.. What is the index of refraction of the soap solution, if it is known to be between 1-2 and 1.5 ?

View Text Solution

36. A parallel beam of light of wavelength 560 nm falls on a thin film of oil (refractive index = 1.4). What should be the minimum thickness of the film so that it strongly S4 T z reflects the light ?

Watch Video Solution

37. A parallel beam of white light is incident normally on a water film $1.0x10^{-4}$ cm thick. Find the wavelength in the visible range (400 nm-700 nm) which are strongly transmitted by the film Refractive index of water = 1.33.

Watch Video Solution

38. A glass surface is coated by an oil film of uniform thickness 1.00×10^{-4}cm. The index of refraction of the oil is 1.25 and that of the glass is 1.50. Find the wavelengths of light in the visible region `(400nm-750nm) which are completely transmitted by the oil film under normal incidence.

View Text Solution

39. Plane microwaves are incident on a long slit having a width of 5.0 cm. Calculate the wavelength of the microwaves if the first diffraction minimum is formed at $\theta = 30^\circ$.

Watch Video Solution

40. Light of wavelength 560 nm goes through a pinhole of diameter 0.20 mm and falls on a wall at a distance of 2.00 m. What will be the radius of the central bright spot formed on the wall ?

Watch Video Solution

41. A convex lens of diameter 8.0 cm is used to focus a parallel beam of light of wavelength 620 nm. If the light be focused at a distance of 20 cm from the lens, what would be the radius of the central bright spot formed ?

Watch Video Solution