PHYSICS

BOOKS - CHHAYA PHYSICS (BENGALI ENGLISH)

LIGHT WAVE AND INTERFERENCE OF LIGHT

Numerical Examples

1. A plane wavefront after being incident on a plane reflector at an angle of incidence i , reflects from it. Show that the incident wavefront and the reflected wavefront are inclined at an angle (180°-2i) with each other.

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2. The wavelength of a light ray in vacuum is 5896 Å . What will be its velocity and wavelength when it passes through glass ?

Given refractive index of glass =1.5 and dvelocity of light in vacuum = $3 \times 10^{8} ms^{-1}$.

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3. Refractive indices of glass with respect to water and air are 1.13 and 1.51 respectively. If velocity of light in air is $3 \times 10^{8} \mathrm{m}. s^{-1}$ what will be its velocity in water ?

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4. A screen is placed at a distance of 5 cm from a point source. A 5 mm thick piece of glass of refractive index 1.5 is placed between them. What is the length of optical path between the source and the screen ?

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5. Two straight and parallel slits 0.4 mm apart , are illuminated by a source of monochromatic light. Interfer- ence patter of fringe width 0.5

mm is produced 40 cm away from the slits . Find the wavelength of the light used.

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6. In a Young's double slit experiment on interference distance between two vertical slits was 0.5 mm and distance of the screen from the plane of slits was 100 cm . If was observed that the 4 th bright band was 2.945 mm away from the second dark band. Find the wavelength of light used.

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7. Monochromatic light of wavelength 6000Å was used to set up interference fringes. On the pasth of the interhering waves a mica sheet 12×10^{-5} cm thick was placed when the central bright fringe was found to be displaced by a distance equal to the width of a bright fringe. what is the refractive index of mica?

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8. A ray of light wavelength 6×10^{-5} cm after passing through two narrow slits, 1mm apart, forms interference fringes on a screen placed 1m away. Find the distance between two successive bright bands of the fringes.

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9. In a double slit experiment using a monochromatic light interference fringes are formed on a screen at a particular distance from the slits. If the screen is moved towards

the slits by 5×10^{-2} m then the fringe width changes by 3×10^{-5} m. If the distance between the two slits is 10^{-3} m then determine the wavelength of the light used.

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10. In Young's double slit experiment the width of the fringe is 2.0 mm. Find the distance between 9th bright band and 2nd dark band.

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11. Using light of wavelength 600 mm in Young's double slit experiment 12 bands are found on one part of the screen. If the wavelength of light is changed to 400 nm , then what will be the number of bands on that part of the screen?

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12. Green light of wavelength 5100 A from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen

200 cm away is 2 cm find the separation between the slits.

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13. The ratio of the intensities between two coherent light sources used in Young's double slit experiment is n. Find the ratio of the intensities of principal maximum and minima of the band.

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14. In Young's experiment with a monochromatic light of wavelength 5890 Å , the slits are separated by a distance 1 mm. Find the angular width between two successive interference fringes.

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15. In Young's double slit experiment angular width of a fringe formed on a distant screen is 0.1° . The wavelength of the light used in the

experiment is 6000 Å. What is the distance between the two slits ?

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16. In Young' s experiment, the path difference between two interfering waves at a point on the screen is 167.5 times the wavelength of the monochromatic light used. Is the point or bright? If the path difference is 0.101 mm , find the wavelength of light used.

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17. The optical paths traversed by a monochromatic of light are same while the ray either passes through a distance of 4 cm in glass or a distance of 4.5 cm in water .What is the refractive index of water if that of glass is 1.53?

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Section Related Questions

1. What do you understand by a wavefront ? Name the different kinds of wavefronts and their sources .

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2. State the properties of wavefronts.

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3. What do you mean by a ray ? What is the relation between a wavefront and a ray of light ?

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4. What is meant by backward wavefront ?

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5. use Huygens ' principal to explain reflection of light by a plane mirror .

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6. Describe Huygens, principle related to the propagation of light waves.

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7. The phase change in reflected wave, when lightwave suffers reflection at the interface from air to glass is

A. 0

B. $\pi/2$

C. π

D. 2π

Answer:

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8. Define coherent sources.

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9. What do you mean by constructive and destructive interferences ?

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10. Discuss two methods to form sustained interference.

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11. On which factors does the interence fringe width depend ?

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12. Mention the conditions to form constructive and destructive interference patterns in Young's experiment related to interence of light.

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13. What changes do occur in the interference fringe pattern when white light is used instead of monochromatic light in Young's double slit experiment ?

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Higher Order Thinking Skill Hots Questions

1. A point object is placed on the axis of a convex lens at a distance greater than the focal length of lens. What is the rerfracted wavefront?

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2. What will be the nature of wavefront of the direct sun light and why will it be so?

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3. Interference fringe does not contradict the law of conservation of energy. Justify.

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4. Two media of refractive indices μ_1 and $\mu_2(\nu_1 > \mu_2)$ are separated by a plane surface. If some part of a plane wavefront is in first medium and other part of wavefront in the second medium show the shape of the wavefront in this position diagramatically.

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5. Why do not two light sources of the same type produce interference pattern?

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6. what are non -localised fringes?

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7. Explain the change thet occurs in the interference pat tern in an Young's double slit experiment, if white light is used instead of monochromatic light.

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8. If all experiments related to young's double slit inter ference is performed under water, what change in fringe pattern will be observed?

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9. Two waves whose intensities are in the ratio 9:1 interfere.find the ratio of the intensities of bright and dark fringes.

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10. In a Young's double slit experiment one of the slits is covered (i) with a translucent paper and (ii) with an opaque plate. What changes

will be observed in the interference pattern in each case ?

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11. What is the effect on the interence pattern in Young's double slit experiment if

(i) screen is moved away from the slits

(ii) separation between the slits is increased

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12. In Young's double slit experiment if distance between the two slits is halved and distance between the screen and palne of slits is doubled how will the interference pattern be affected ?

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13. In Young's double slit experiment what is the path difference between the two light waves forming 5th bright band on the screen ?

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14. What is the significance of optical path?

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15. Two light beams of intersities I and 4I, respectively form interference fringes on a screen. For the two beams phase difference at point a is $\frac{\pi}{2}$ and at point B is π . Find the difference in resultant intensities at A and B.

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16. Ratio of the amplitudes of two waves emitted from a pair of coherent sources is 2:1. If the two waves superpose, what will be the ratio of maximum and minimum intensities? What would have been the intensity at different points on screen if the sources were not coherent?

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17. If ratio pf maximum to minimum intensities of the fringes, produced in a Young' s double slit experiment is 4:1 , what is the ration of the amplitudes of light waves of coherent sources?

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18. Light waves of different intensities from two coherent sources superpose to interfere. If ration of the maximum intensity to

minimum intensity is 25, find the ratio fo the intensities of the sources.

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19. In a laboratory, interference fringes are observed in air medium. The laboratory is now evacuated by removing air. If other conditions remain unaltered, what changes will be observed in fringe pattern?

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20. What change will be observed in the interference pattern produced in Young' s double slit experiment, if blue colour of the same intensity is used instead of yellow colour?

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21. In a double slit experiment using a white light, a white fringe is noticed on the screen. What will be the change in position of

thewhite fringe if the screen is shifted 0.05 m from the slits?

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22. Why did Huygens introduce the concept of secondary wavelets?

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23. What is the distance between the first bright fringe and first dark fringe in an

interference pattern?(use conventional symbols)

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24. In all interference patterns, the width of a dark fringe is y_1 and that a bright fringe is y_2. What will be the relation between y_1 and y_2?

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25. Monochromatic light was used in Young' s double slit experiment , for producing interference fringes. If a thin mica sheet is held on the path af any af the superposing light beams what change will be noticed in the fringe pattern?

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26. In interference pattern by two identical slits the intensity of central maximum is I.

what will be the intensity at the same spot if one of the slits is closed?

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27. In a double-slit experiment, instead of taking slits of equal width, one slit is made twice as wide as the other.then how will the maximum and minimum intensities change?

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Ncert Textbook Questions With Answer Hint

1. Monochromatic light of wavelength 589 nm is incident on a water surface from air the wavelength, frequency and speed of (a) reflected and

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2. Monochromatic light of wavelength 589 nm is incident on a water surface from air the

wavelength, frequency and speed of (b) refracted light?

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3. What is the shape of the wavefront in each of the following cases ?

Light diverging from a point source.

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4. What is the shape of the wavefront in each of the following cases ?

Light emerging out of a convex lens when a point source is placed at its focus.

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5. What is the shape of the wavefront in each of the following cases ?

The portion of the wavefront of light from a distant star intercepted by the earth .

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6. In Young's double slit experiment using monochromatic light of wavelength λ the intensity of light at point on the screen where path difference is λ is k units What the intensity of light at a point where the path difference is $\frac{\lambda}{3}$?

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7. In a double slit experiment ,the angular width of a fringe is found to be 0.2° on a screen I m away . the wavelength of light used is 600 nm .What will be the angular width of the fringe if the entire experiment apparatus is immersed in water? Take refractive index of water to be $\frac{4}{3}$.

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8. Use Huygens' principle to show that a point object placecd in front of a plane mirror produces a virtual image at the back of the mirror whose distance is equal to the distance of the object from the mirror.

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9. Following is a list of some fectors which could possibly influece the speed of wave propagation.

(i) Nature of source (ii) direction of propagation (iii) motion of the source and / or observeer (iv) wavelength , (v) intensity of the wave.

One which of these factors if any does (a) the speed of light in vacuum ,

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10. Following is a list of some fectors which could possibly influece the speed of wave propagation.

(i) Nature of source (ii) direction of propagation (iii) motion of the source and / or observeer (iv) wavelength , (v) intensity of the wave.

One which of these factors if any does the speed of light in any medium like glass or water depend?

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11. In double slit experiment using light of wavelegth 600 nm , the angular width of a

fringe formed on a distant screen is 0.1° .What is the spacing between the two slits ?

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12. What is the justification in applyin principle of linear superposition of wave displacement in explaining the distributions in interference and diffraction patterns.

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13. When a low flying aircraft passes overhead , sometimes a slight shaking of the pictures on our TV screen is observed . Why?

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Ncert Exemplar Questions With Answer Hint

1. In a Young's double slit experiment ,the source is white light It one of the slits is

covered by a red filter and the other by a blue filter, then

A. there shall be alternate interference patterns of red and blue

B. there shall be an interference fringes

C. there shall be no interference fringes

D. there shall be an interference pattern for red mixing with one for blue

Answer: C

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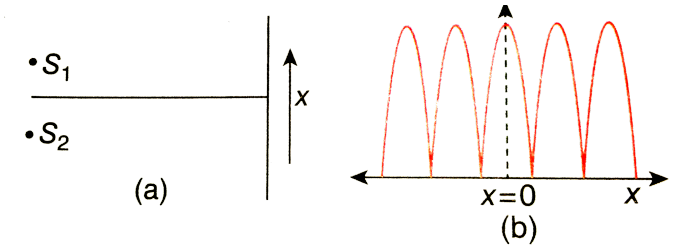
2. Two sources S_1 and S_2 of intensity I_1 and I_2 are placed font of a screen [fig .6.24(a)]. The pattern of intensity distrtbution seen in the central portion is given in fig.6.24(b). Which of the following statements are true?



A. S_1 and S_2 have same intensities

B. S_1 and S_2 have a constant phase difference

C. S_1 and S_2 have same phase

D. S_1 and S_2 have same wavelength

Answer: A::B

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3. For light diverging from a point source

A. the wavefront is spherical

B. the intensity decreases in proportion to the distance

C. the wavefront is parabolic

D. the intensity of the wavefront does not depend on distance

Answer: A::B

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Exercise Multiple Choice Questions

1. By Huygens's wave theory of light we cannot explain the phenomenon of

A. interference

B. diffraction

C. photoelectric effect

D. polarisation

Answer: C

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2. By a monochromatic wave we mean

A. a single ray

B. a single ray of single colour

C. wave having a single wavelength

D. many rays of a single colour

Answer: C

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3. If the distance between a point source and screen is doubled, then intensity of light on the screen will become

A. four

B. double

C. half

D. one -fourth

Answer: D

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4. Spherical wavefronts, from a point source, strike a reflecting plane. What will happen to these wavefronts immediately after reflection?

A. they will remain spherical with the same curvature

B. they will become plane wavefronts

C. they will remain spherical with the same curvature but sign of curvature reversed

D. they will remain spherical but with different curvature both in magnitude

and sign

Answer: C

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5. For a wave propagating in a medium, identify the property that is independent of the other

A. velocity

B. wavelength

C. frequency

D. all of these depend on each other

Answer: C

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Exercise Multiple Choice Questions In Terference Of Light

1. The maximum and minimum intensities of the resultant wave due to superposition of

two waves due to superposition of two waves having intensities I and $4I$ will be

A. $5I \text{and} 3I$

B. $9I$ and I

C. $9I$ and 3 I

D. $5I \text{and} I$

Answer: B

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2. If the ratio of maximum and minimum intensities of the interference fringes obtained in Young's double slit experiment is 4: 1 then the ratio of the amplitudes of the two coherent sources will be

A. $4:1$

B. $3:1$

C. $2:1$

D. $1:1$

Answer: B

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3. If the waves coming out from two sources of light having intensities $I \text{and} 4I$ undergo interference then the intensity at the points in the region of superposition where phase differece becomes $\pi / 2$ is

A. I

B. $3I$

C. $5I$

D. $\frac{5I}{2}$

Answer: C

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4. Two monochromatic lights coming out from two coherent sources can produce constructive inteructive interference when their phase difference becomes

A. $\frac{3\pi}{2}$

B. 2π

C. π

D. $\frac{\pi}{2}$

Answer: B

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5. Two waves of intensities I_1 and I_2 crosses a place in same direction and same time. The summation of maximum and minimum intensities is

A. $I_2 + I_2$

B. $\left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

C. $\left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

D. $2(I_1 + I_2)$

Answer: D

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6. The energy in the interference fringe

A. produced in bright band

B. destroyed in dark band

C. remains conserved only changes place from dark band to bright band

D. happens all the above

Answer: C

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7. The ratio of amplitudes of two waves emitted from two coherent sources is 2:1 . If

these two waves get superposed the ratio of maximum and minumum intensity will be

A. 2

B. 4

C. 9

D. 18

Answer: C

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8. If two waves represented by y_1 =4 sin ωt and $y_2 = 3\sin\left(\omega + \frac{\pi}{3}\right)$ interfere at a point the amplitude of the resulting wave will about

A. 7

B. 6

C. 5

D. 3.5

Answer: B

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Exercise Multiple Choice Questions Youngs Double Slit Experiment

1. Maximum intensity in Young's double slit experiment is I_0 . If one slit is closed the intensity would be

A. I_0

B. $\frac{I_0}{4}$

C. $\frac{I_0}{3}$

D. $\frac{I_0}{2}$

Answer: B

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2. If white light is used instead of monochromatic light in Young's double slit experiment then what change in the fringe width be observed ?

A. interference fringes will disappear

B. no change in interference fringes will occur

C. interference fringe become colourful

D. the central line of the interference fringe will be of yellow colour

Answer: C

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3. If the interference fringe width of the dark band is β_1 and that of the bright band is β_2 then

A. $2\beta_1 = \beta_2$

B. $2\beta_2 = \beta_1$

C. $\beta_1 = \beta_2$

D. $\beta_1 + 3\beta_2 = 1$

Answer: C

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4. The distance between the first bright band and the first dark band in interference fringe [symbols have usual meanings] is

A. $\frac{\lambda D}{2d}$

B. $\frac{\lambda D}{d}$

C. $\frac{\lambda D}{4d}$

D. $\frac{2\lambda D}{d}$

Answer: C

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5. In an ideal double slit experiment when a glass plate having refractive index 1.5 and thickness t is placed in the path of interfered

light rays of wavelength λ then the intensity remains unchanged at the place where the central maximum was previously formed. Then the minimum thickness of the glass plate is

A. 2λ

B. $\frac{2\lambda}{3}$

C. $\frac{\lambda}{3}$

D. λ

Answer: A

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6. In Young's double slit experiment an electron ray is used If the velocity of the electron is increased then fringe width

A. will increase

B. will decrease

C. will remain the same

D. fringes will not be visible

Answer: D

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7. In Young's double slit experiment the fringe width is found to be 0.4 mm. Now if the whole experiment is conducted by immersing the whole experiment set-up in water (μ=1.33) the magnitude of fringe width would be

A. 0.25 mm

B. 0.30 mm

C. 0.40 mm

D. 0.53 mm

Answer: B

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8. In Young's double slit experiment the fringe width is found to be 0.3 mm. Now if a thin glass plate of refracting index 1.5 is placed in the path of any one of light rays coming from the slits then the width of the fringe will be

A. 0

B. 0.3 mm

C. 0.45 mm

D. 0.15 mm

Answer: A

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9. In Young's double slit experiment with monochromatic light interference fringe are obtained on a screen placed at some distance from the slits. If the screen is moved by 5×10^{-2} m towards the slit the change in

fringe width is 3×10^{-5} m. If the distance between the slits is 10^{-3} m the wavelength of the used is

A. 6000 Å

B. 5000 Å

C. 3000 Å

D. 4500 Å

Answer: D

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10. In Young's double slit experiment the magnitude of the fringe width is β. If the whole set-up of the experiment is immersed in a liquid of refractive index μ then the magnitude of the fringe width will be

A. $\mu\beta$

B. $\frac{\beta}{\mu+1}$

C. $\frac{\beta}{\mu-1}$

D. $\frac{\beta}{\mu}$

Answer: D

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11. In Young's double slit experiment the distance between the slits is d. An interference fringe is obtained on a screen placed at a distance D from the slits . A dark band is noticed just opposite to one of the slits. The wavelength of the light used is

A. $\frac{D^2}{2d}$

B. $\frac{d^2}{2d}$

C. $\frac{D^2}{d}$

D. $\frac{d^2}{D}$

Answer: D

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12. Young's double slit experiment is conducted using green red andt blue lights in succession. The magnitude of fringe widths obtained are $\beta_G, \beta_R, \beta_B$ respectively. The observations will be

A. $\beta_G > \beta_B > \beta_R$

B. $\beta_B > \beta_G > \beta_R$

C. $\beta_R > \beta_B > \beta_G$

D. $\beta_R > \beta_G > \beta_B$

Answer: D

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13. What is not true for interfernce of light ?

A. the two sources must be coherent- this is a very important condition

B. the intensity of dark band of the interference fringe may not be zero

C. in interference energy is not destroyed only change of place takes place

D. the intensity of dark band of the interference fringe must be zero

Answer: D

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14. Fringe width of an interference fringe is y for the two given waves. If the frequency of the source becomes double then the fringe width have been

A. $\frac{1}{2}y$

B. y

C. 2 y

D. $\frac{3}{2}y$

Answer: A

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15. For red and blue colours of light distance of m th interfering fringe in Young's double slit experiment from the central maxima be X_{mr} and X_{mb}. Correct relation is

A. $X_{\mathrm{mr}} > X(\mathrm{mb})$

B. $X_{\mathrm{mr}} < X(\mathrm{mb})$

C. $X_{\mathrm{mr}} = X(\mathrm{mb})$

D. $X_{\mathrm{mr}} + X(\mathrm{mb}) = 0$

Answer: B

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16. Two wave sources S_1 and S_2 having zero phase difference coming from an isolated light source produces interference. If the common wavelength of the two source be λ then it is observed that a destructive interference has been taken place at point P. The value of $(S_2P - S_1P)$ is

A. $\frac{3\lambda}{4}$

B. $\frac{11\lambda}{2}$

C. 2λ

D. 5λ

Answer: A

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17. For the wavelength λ_1 in Young's double slit experiment seventh bright spot is situated at a distance d_1 from the central bright spot.

In the same experiment for the same number of bright sptot and for the different wavelength λ_2 the distance between two bright spot is d_2. Now the value of d_1 / d_2 is

A. $\frac{\lambda_1}{\lambda_2}$

B. $\frac{\lambda_2}{\lambda_1}$

C. $\frac{\lambda_1^2}{\lambda_2^2}$

D. $\frac{\lambda_2^2}{\lambda_1^2}$

Answer: A

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18. In Young's double slit experiment the distance between the two slits is d and wavelength of the light used is λ. The angular width of the fringe

A. $\frac{d}{\lambda}$

B. $\frac{\lambda}{d}$

C. $\frac{2\lambda}{d}$

D. $\frac{\lambda}{2d}$

Answer: D

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19. In Young's double slit experiment the two slits are d distance apart. Interence pattern is observed on a screen at a distance D from the slits. A dark fringe is observed on the screen directly opposite to one of the slits. The wavelength is

A. $\frac{D^2}{2d}$

B. $\frac{d^2}{2D}$

C. $\frac{D^2}{d}$

D. $\frac{d^2}{D}$

Answer: D

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Exercise Very Short Answer Type Questions Waves And Wavefronts

1. At what angle does a ray of light remain incilned to the wavefront ?

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2. What will be the nature of the wavefront of light emitted from a line source ?

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3. Can two wavefronts of same wave cut each other ?

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4. A plane wavefront is incident on a prism. What will be the nature of emergent wavefront ?

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5. What is the relationship between intensity and amplitude of a wave?

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6. The source of a spherical wavefront is _____ [Fill in the blank].

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7. If a spherical wavefront is propagated up to infinite distance, then a part of that wavefront is called _____wave front [fill in the blank].

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Exercise Very Short Answer Type Questions Interference Of Light

1. If the path difference is λ, what will be the phase difference?

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2. Do the two electric bulbs connected to the same electrence?

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3. What is the path difference between two waves for constructive interfernce?

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4. What is the path difference between two waves for destructive interference?

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5. What is the most important condition for interference of light?

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6. Two coherent monochromatic light sources produce constructive interference. When the path difference is odd multiples of half wavelength, then _____ interference takes place [fill in the blank].

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7. In case of interference of light when the path difference is odd multiples of half wavelength then _____ interference takes place [Fill in the of blank].

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8. In case of interfernce of light _____ remains conserved [Fill in the blank].

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Exercise Very Short Answer Type Questions Youngs Double Slit Experiment

1. If Young's double slit experiment is performed by using a source of white light then bright and dark fringe pattern is seen. Is the statement true or false ?

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2. What change will you observe if the whole arrangement used in Young's double slit

experiment is immersed in water?

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3. For which colour of light in the Young's double slit experiment will the fringe width be minimum ?

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4. In Young's double slit experiment if distance between the two sources is increased how will

the fringe width be changed?

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5. Does interference of light give any information about the nature of light waves? (whether it is longitudinal or tranverse)

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6. If the distance between the two slits in Young's double slit experiment is halved and

the distance between the slit and the screen is double then fringe width will be _____ times the previous fringe width [Fill in the blank].

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7. If light of smaller wavelength is used in Young's double slit experiment then fringe width will be _____ [Fill in of the blank].

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8. In Young's double slit experiment if a glass plate is placed perpendicular to the direction of propahation of light there will be a _____ of interference fringe and there would be _____ in the fringe width [Fill in the blanks].

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9. In Young's experiment the width of interference fringes does not depend on the _____ [Fill in the blank].

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Exercise Short Answer Type Questions I

1. How are light rays related with wavefronts ?

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2. What is the importance of optical path ?

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3. What would be the effect on interference fringes in Young's double slit experiment if the experiment is conducted immersing whole set -up in a liquid of refractive index 1.3 ?

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Exercise Short Answer Type Questions Ii

1. Why can two lamps of the same type not produce interference fringe?

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2. Explain how Newton's corpuscular theory predicts the speed of light in a medium say water to be greater than the speed of light in vacuum. Is the prediction confirmed by experimental determination of the speed of light in water? If not which alternative picture of light is consistent with experiment ?

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3. What is the effect on the interfernce fringes in a Young's double slit experiment when the width of two slits are increased ?

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4. In Young's double slit experiment what is the effect of the following operations on interference fringes ?

(i) The screen is moved away from the plane of the slits.

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5. In Young's double slit experiment what is the effect of the following operations on interference fringes ?

The monochromatic source is repalced by another monochromatic source of shorter wavelength .

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6. In Young's double slit experiment what is the effect of the following operations on interference fringes ?

The monochromatic source is replaced by a source of white light.

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7. In Young's double slit experiment what is the effect of the following operations on

interference fringes ?

The width of the source slit is made wider.

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8. In Young's double slit experiment what is the effect of the following operations on interference fringes ?

The separation between the slit is increased.

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9. In Young's double slit experiment what is the effect of the following operations on interference fringes ?

The distance between the source slit and the plane of the slits is increased.

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10. Why is interference pattern not detected when two coherent sources are far apart?

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Problem Set I Interference Of Light

1. The equations for displacement of two light waves forming interference pattern are y_1= 4 sin ω t and y_2=3 sin $\left(\omega t + \frac{\pi}{2}\right)$. Determine the amplitude of the resultant wave.

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2. The ratio of amplitude of two waves having the same frequency is 1:3. These two waves are

superposed. Determine the ratio of the maximum and minimum intensities.

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3. The ratio of intensities of two coherent sources is β. An interference fringe pattern is produced due to their superposition. Find the magnitude of $(I_{\max} - I_{\min}) / (I_{\max} + I_{\min})$.

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Problem Set I Youngs Double Slit Experiment

1. The distance between the two slits illuminated by a monochromatic source of ligth in Young's experiment for interference is 0.2 cm. Interference fringes of fringes width 0.295 mm is formed on the screen kept at a distance of 1 m from the slits. Determine the wavelength of light .

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2. The distance between the two slits illuminated by a monochromatic source of light in Young's experiment for interference is 0.1 mm. Distance of the screen from the plane of the slits is 1 m. The distance between the central maximum point to the first maximum point is 0.589 mm. Determine the wavelength of light.

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3. The distance between the two slits in Young's double slit experiment is 0.02 cm. Interference fringes for light of wavelength 6000 Å are formed on the screen at a distance of 80 cm from the slits. Determine the distance of the fifth bright fringe.

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4. Using monochromatic light of wavelength 4000 Å fringes of width 0.1 mm are formed on

the screen in Young's double slit experiment . If the screen is now shifted to twice the previous distance the what will be the fringe width of the interference pattern when a wavelength of 6000 Å is used ?

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5. In Young's double slit experiment the wavelenght of light used is 5000 Å the slit - separation is 0.2 mm and the screen is placed at a distance 200 cm from the slits . Central

maxima is at x=0 . If the central maxima is assumed as the zeroth bright band then what will be the distance of the third bright band?

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6. In Young's experiment when sodium light of wavelength 5893 Å is used 62 fringes are visible in the vision -field. How many fringes will be visible if violet light of wave length 4358 Å is used ?

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7. In Young's two slit experiment with monochromatic light fringes are obtained on a screen placed at a distance D from the slits . If the screen is moved by 5×10^{-2} m towards the slits the change in fringe width 3×10^{-5} m. If the distance between the slits is 10^{-3} m calulate the wavelength of the light used.

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8. A double slit is illuminated by a light of wavelength 6000 Å. The slits are 0.1 cm apart and the screen is 1 m away. Find (i) The angular position of 10th bright fringe and (ii) Distance between two successive dark bands.

Watch Video Solution

9. In Young's double slit experment red light of wavelenght 6000 Å is used and at point P on the screen n th bright bands is obtained.

Keeping the set -up of the experiment same now green light of wavelength 5000 Å is used and at point P on the screen (n+1) th bright band is obtained . Find the magnitude of n.

 Watch Video Solution

10. Two slits are kept 1 mm apart and the screen is placed 1m away. What would be the width of fringe if blue - green light of 500 nm wavelength is used ? What would be the width of each slit for 10 bright bands to be obtained

within the central maximum in a single slit arrangement ?

Watch Video Solution

Problem Set Ii

1. A plane wavefront ABC is incident on a plane ABC as shown in [fig.6.26]. velocity of light is $3 \times 10^8 . s^{-1}$

(ii) During that time what will be the distance covered by the wavelet ftom A ?

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2. A plane wavefront ABC is incident on a plane ABC as shown in [fig.6.26]. velocity of light is $3 \times 10^{8}. s^{-1}$

What will be the distance covered by wavelet from D at that moment? Draw the diagram of the reflected wavefront. Given that, AE = 12 m and AD = 6m

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3. In Young's double slit experiment, seperation between two coherent sources is 0.90 mm and fringes are formed at adistance I m from the slits . If the second dark fringe is formed at a distance I mm from the central band , then detemine the wavelength of the monochromatic light used.

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4. The whole arrangement of Young's double slit experiment remains immersed in a liquid of refractive index 1.33 . The distance between the slits is I mm and the distance of the screen from the plane of the slits is 1.33 m . If the slits are illuminated by a light of wavelength 6300 Å, what will be the frige width?

Watch Video Solution

5. Inteference fringes are firmed using a monochromatic light in Young's double slit experiment. Due to insertion of a mica plate of thichkness 1.964 μ and having refractive index 1.6 in the path of an interfering wave, the fringes are shifted by some distance. Now the mica plate is removed and the distance between the slits and the screen is dou-bled. Now it is seen that the distance between two consec-utive bright or dark bands dands becomes equal to the displacement of the fringes due to insertion of the mica plate.

Determine the wavelength of the monochromatic light used in this experiment.

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6. A dichromatic light of wavelengths $\lambda_1 = 250 \times 10^{-9}$ m and $\lambda_2 = 350 \times 10^{-9}$m are used in Young's double slit experiment. Calculate the ratio of overlapped fringes due to both the waves in the obtained interference fringes.

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7. In Young's double slit experiment one of the slits is covered with the help of a thin plate of thickess 4.8 mm . As a result the central dright band is shifted to the position of the 30th bright band. Determine the thickness of the plate required to shift the central dright band in the position of 20th bright dand.

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8. A thin plate of glass (μ=1.5) is placed normally in the path of one of the interfering beams producing fringes with light (λ = 5450 Å) and thereby the central bright band of the fringe system is found to move into the position previ-ously occuoied by the third bright from the centre. What is the thickness of the glass plate?

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Hots Numerical Problems

1. To prodce inteference fringes in Young' s double slit experiment light consisting of two wavelengths of 6500 Å and 5200 Å is used.

(i) Determine the distance of the third maxima from the central maxima for light of wavelength 6500 Å .

(ii) At what minimum distance from the central maxima will the bright points (maxima) for two waves superpose?

Given that distance between the two slits is 2 mm and the distance of the screen from the plane of the slits is 120 cm.

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2. In Young's double slit experiment, two slits are separted by 3 mm and illuminated by light of wevelength 480 nm. The screen is at 2 m from the plane of the slite. Calculate the distance between the 8th bright fringe and 3rd dark fringe.

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3. Two coherent sources of light having intensities, I and 4I interfere a fainge pattern on a screen. Find the resultant intensities at the points where the phere the phase- difference between the two waves are $\frac{\pi}{2}$ and π.

Watch Video Solution

4. In Young' s double slit experiment, two monochromatic light of wavelengths 650 nm and 520 nm are used to form an interference

pattern . Seprsation between the two slits is 2×10^{-3} m and screen is 1.20 m away from the slits. At what minimum distance apart from the central maxima, bright fringes due to both the waves will be overlapped?

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5. Mixture of lights consiosting of wavelengths 590 nm and an unknown wavelength illuminates young' s double slit and gives rise to two overlapping interference patterns on

the screen . The central maximum of both lights coincide. Further, it is observed that the third brright fringe of 590 m light conincides with the fourth bright fringe of the other light. From this data, calculate the unknown wave length.

Watch Video Solution

Entrance Corner Assertion Reason Type

1. Direction : These questions have statement I and statement II. Of the four choices given below , choose the one that best describes the two statements.

Statement I: A ray of light entering from glass to air suffers from change in frequency.

Statement II. Velocity of light in glass is less than that in air.

A. Statement I is true statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true statement II is true statement II is not a correct explanation for statement I.

C. Statement I is true statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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2. Statement I : If the phase difference between the light waves passing through the slits in the Young's experiment is π radian the central fringe will be dark.

Statement II. Phase differene is equal to $\frac{2\pi}{\lambda}$ times the path difference .

A. Statement I is true statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true statement II is true statement II is not a correct explanation for statement I.

C. Statement I is true statement II is false.

D. Statement I is false, statement II is true.

Answer: B

 Watch Video Solution

3. Statement I: Interference obeys the law of conservation of energy.

Statement II: The energy is redistributed in case of interference.

A. Statement I is true statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true statement II is true statement II is not a correct explanation for statement I.

C. Statement I is true statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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4. Statement :I When the apparatus in Young's double slit experiment are immersed in a liquid the fringe width will increase.

Statement II. Wavelength of light in a liquid is lesser than that in air. That is $\lambda = \frac{\lambda}{\mu}$

A. Statement I is true statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true statement II is true statement II is not a correct explanation for statement I.

C. Statement I is true statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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5. Statement I: Interference pattern is obtained on a screen due to two identical coherent sources of monochromatic light. The intensity at the central part of the screen becomes one -fourth if one of the sources is blocked.

Statement II: The resultant intensity is the sum of the intensities due to two sources.

A. Statement I is true statement II is true , statement II is a correct explanation for

statement I.

B. Statement I is true statement II is true statement II is not a correct explanation for statement I.

C. Statement I is true statement II is false.

D. Statement I is false, statement II is true.

Answer: C

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6. Statement I: If the two interfering waves have intensities in the ratio 9:4 the ratio of maximum to minimum amplitudes becomes 3:2.

Statement II. Maximum amplitude = $A_1 + A_2$

Minimum amplitude = $A_1 - A_2$.

Also $\frac{I_1}{I_2} = \frac{(A_1)^2}{(A_2)^2}$

A. Statement I is true statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true statement II is true statement II is not a correct explanation for statement I.

C. Statement I is true statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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Entrance Corner Multiple Correct Answers Type

1. Which of the following properties of light support wave nature of light ?

A. light obeys laws of reflection

B. light shows interference

C. light shows photoelectric effect

D. speed of light in water is smaller than that in vacuum

Answer: B::D

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2. Huygens's principle of secondary wavelets may be used to

A. find the speed of light in vacuum

B. explain the particle behaviour of light

C. find the subsequent position of a wavefront

D. explain Snell's law

Answer: C::D

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3. When light travels from air to glass a change occurs in its

A. wavelength

B. frequency

C. speed

D. amplitude

Answer: A::C::D

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4. White light is used in Young's double slit experiment. The separation between the slits is b and the screen is at a distance d (d $>$ b) from the slits. At a point on the screen directly in fron of the slits certain wavelengths are missing. Some of these missing wavelengths are:

A. $\lambda = \frac{b^2}{d}$

B. $\lambda = \frac{2b^2}{d}$

C. $\lambda = \frac{b^2}{3d}$

D. $\lambda = \frac{2b^2}{3d}$

Answer: A::C

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5. If young' s double slit experiment is performed using white light, then

A. the central fringe will be white

B. no fringe will be completely dark

C. the fringe adjacent to the central one will be red

D. the fringe adjacent to the central one will be violet

Answer: A::B::D

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6. In young' s double slit experiment, for the light of wavelength λ_1 fringe y_1 and for the light of wavelength λ_2 fringe width is y_2 . If the whole arrangement is dipped into a liquid of refractive index μ it is founded that for the

wavelength λ_1 fringe width becomes y_3 . Now the correct relation is Four light waves are represented by

(i) y= $a_1 \sin\omega t$ (ii) y= $a_2 \sin(\omega t+e)$

(iii) y=$a_1 \sin 2(\omega t)$ (iv) y= $a_2 \sin 2(\omega t + e)$

A. $y_2 = y_1 \frac{\lambda_1}{\lambda_2}$

B. $y_2 = y_1 \frac{\lambda_2}{\lambda_1}$

C. $y_3 = \frac{y_1}{\mu}$

D. $y_3 = \mu y_1$

Answer: B::C

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7. Interference fringe 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

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8. In Young's double slit experiment the ratio of intensities of bright and dark fringes is 9. This means

A. the ratio of the intensities of individual sources is 5:4

B. the ratio of the intensities of individual sources is 4:1

C. the ratio of the amplitudes of the light waves is 3:1

D. the ratio of their amplitudes is 2:1

Answer: B::D

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

A. towards A

B. towards B

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

D. by $\mu t \frac{\beta}{\lambda}$

Answer: A::C

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Entrance Corner Comprehension Type

1. In Young's double slit experiment the distance of the screen from the plane of the

slits is 1.0 m. The wavelength of light used and width of the fringe are 6000 Å and 2 mm respectively.

Distance between the slits is

A. 0.5 mm

B. 0.4 mm

C. 0.2 mm

D. 0.3 mm

Answer: D

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2. In Young's double slit experiment the distance of the screen from the plane of the slits is 1.0 m. The wavelength of light used and width of the fringe are 6000 Å and 2 mm respectively.

If the wavelength of the light used is 4800 Å, the width of the fringe will be

A. 1.6 mm

B. 2.2 mm

C. 2.0 mm

D. 1.8 mm

Answer: A

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3. In Young's double slit experiment the slits apart by 3 mm are illuminated with a source of monochromatic light of wavelength 6000 Å. Interference fringes are obtained on a screen at a distance of 1 m from the slits .

The width of the fringe will be

A. 0.15 mm

B. 0.2 mm

C. 0.29 mm

D. 0.12 mm

Answer: B

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4. In Young's double slit experiment the slits apart by 3 mm are illuminated with a source of monochromatic light of wavelength 6000 Å.

Interference fringes are obtained on a screen at a distance of 1 m from the slits .

If the whole experimental arrangement is immersed in water the fringe width will be .

A. 0.15 mm

B. 0.20 mm

C. 0.29 mm

D. 0.12 mm

Answer: A

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5. When waves from two coherent source of amplitudes a and b superimpose , the amplitude R of the resultant wave is given by R = $\sqrt{a^2 + b^2 + 2ab\cos\phi}$.

where ϕ is the constant phase angle between the two waves. The resultant intensity I is directly proportional to the square of the amplitude of the resultant wave i.e $I \propto R^2$ i.e,

$I \propto \left(a^2 + b^2 + 2ab\cos\phi\right)$

For constructive interference ,

$\phi = 2n\pi \quad \text{and} \quad I_{\max} = (a+b)^2$

For destructive interference ,

$\phi = (2n-1)\pi \text{and} I_{\min} = (a-b)^2$

If $I_1 I_2$ are intensities from two slits of width

$w_1 \text{and} w_2$ then

$$\frac{I_1}{I_2} = \frac{w_1}{w_2} = \frac{a^2}{b^2}$$

Light waves from two coherent sources of intensity ratio 81 : 1 produce interference. With the help of the passage choose the most appropriate alternative for each of the following questions

The ratio of amplitudes of two sources is

A. $9:1$

B. $81:1$

C. $1:9$

D. $1:81$

Answer: A

Watch Video Solution

6. When waves from two coherent source of amplitudes a and b superimpose , the amplitude R of the resultant wave is given by R = $\sqrt{a^2+b^2+2ab\cos\phi}$.

where ϕ is the constant phase angle between the two waves. The resultant intensity I is directly proportional to the square of the amplitude of the resultant wave i.e $I \propto R^2$ i.e,

$I \propto \left(a^2 + b^2 + 2ab\cos\phi\right)$

For constructive interference ,

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$\phi = (2n-1)\pi \text{and} I_{\min} = (a-b)^2$

If $I_1 I_2$ are intensities from two slits of width $w_1 \text{and} w_2$ then

$$\frac{I_1}{I_2} = \frac{w_1}{w_2} = \frac{a^2}{b^2}$$

Light waves from two coherent sources of

intensity ratio 81 : 1 produce interference. With the help of the passage choose the most appropriate alternative for each of the following questions

The ratio of slit widths of the two sources is

A. $9:1$

B. $81:1$

C. $1:9$

D. $1:81$

Answer: B

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7. When waves from two coherent source of amplitudes a and b superimpose , the amplitude R of the resultant wave is given by R = $\sqrt{a^2 + b^2 + 2ab\cos\phi}$.

where ϕ is the constant phase angle between the two waves. The resultant intensity I is directly proportional to the square of the amplitude of the resultant wave i.e $I \propto R^2$ i.e,

$I \propto \left(a^2 + b^2 + 2ab\cos\phi\right)$

For constructive interference ,

$\phi = 2n\pi \quad \text{and} \quad I_{\max} = (a+b)^2$

For destructive interference ,

$\phi = (2n-1)\pi \text{and} I_{\min} = (a-b)^2$

If $I_1 I_2$ are intensities from two slits of width $w_1 \text{and} w_2$ then

$$\frac{I_1}{I_2} = \frac{w_1}{w_2} = \frac{a^2}{b^2}$$

Light waves from two coherent sources of intensity ratio 81 : 1 produce interference. With the help of the passage choose the most appropriate alternative for each of the following questions

The ratio of maxima and minima in the interference pattern is

A. $9:1$

B. $81:1$

C. $25:16$

D. $16:25$

Answer: C

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8. When waves from two coherent source of amplitudes a and b superimpose , the amplitude R of the resultant wave is given by R

$= \sqrt{a^2 + b^2 + 2ab\cos\phi}.$

where ϕ is the constant phase angle between the two waves. The resultant intensity I is directly proportional to the square of the amplitude of the resultant wave i.e $I \propto R^2$ i.e,

$I \propto \left(a^2 + b^2 + 2ab\cos\phi\right)$

For constructive interference ,

$\phi = 2n\pi \quad \text{and} \quad I_{\max} = (a+b)^2$

For destructive interference ,

$\phi = (2n-1)\pi \text{and} I_{\min} = (a-b)^2$

If $I_1 I_2$ are intensities from two slits of width $w_1 \text{and} w_2$ then

$\frac{I_1}{I_2} = \frac{w_1}{w_2} = \frac{a^2}{b^2}$

Light waves from two coherent sources of intensity ratio 81 : 1 produce interference. With the help of the passage choose the most appropriate alternative for each of the following questions

If two slits in Young's experiment have width ratio 1:4 the ratio of maximum and minimum intensity in the interference pattern would be

A. $1:4$

B. $1:16$

C. $9:1$

D. $9:16$

Answer: C

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Entrance Corner Integer Answer Type

1. In Young's double slit experiment the coherent sources are 1.5 mm apart and the fringes are obtained on a screen at a distance 2.5 m from the plane of the sources. If the

sources is illuminated with a light of 589.3 nm wavelength , find the number of fringes in the interference pattern thus formed on the screen. Total length of the fringes are 4.9×10^{-3} m.

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2. In Young's experiment the fringe width for the wavelength of λ =6000 Å is 2.66 mm. What will be the fringe width (in mm) if the apparatus is immersed in a liquid of r.i 1.33 ?

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3. A beam of monochromatic light of wavelength 500 nm falls on two parallel slits. The distance between the slits is 0.15 mm. Determine the width of the interference fringes in mm unit on a screen placed at a distance of 1.5 m from the plane of the slits.

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4. Equations of two light waves are $y_1 = 4 \sin \omega t$ and $y_2 = 3\sin\left(\omega t + \frac{\pi}{2}\right)$. What is the amplitude of the resultant wave as they superpose on each other?

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Examination Archive With Solutions

1. What is the phase difference between two points situated on a wavefront ?

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2. What is interference of light? State the conditions for interference. Does the interference phenomenon obey the principle of conservation of energy?

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3. Describe Young's double slit experiment. State the nature of the distribution of intensity of light on the screen. What happens

of the distribution of intesity if one of the slits is covered?

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4. The width of an interference fringe is 1.5 mm . What would be the width of the fringe if the separation between the slits is made twice the original value?

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5. What are coherent sources ? Green light of wavelength 5100 Å is incident on a double slit. If the overall separation of 10 fringes on a screen 200 cm away from the slits is 2 cm find the distance between the slits.

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6. State Huygens ' principle for propagation of light wave.

Watch Video Solution

7. What is meant by interference of light? Write down the conditions of sustained interference.

Watch Video Solution

8. State one defect of Huygens's wave theory.

Watch Video Solution

9. Prove the laws of reflection by using Huygens' principle.

Watch Video Solution

10. In a certain medium the path difference 5×10^{-5} cm corresponds to a phase difference π. Estimate the speed of the light waves of frequency 3×10^{14} Hz in the medium.

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11. What is the importance of coherent sources in case of interference of light ? How are coherent sources produced ?

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12. In Young's double slit experiment the fringe width is 2.0 mm. Determine the separation between the 9th bright fringe and the 2nd dark fringe.

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Wbjee

1. Two coherent monochromatic beams of intensities I and 4 I respectively are superposed. The maximum and minimum intensities in the resulting pattern are

A. 5 I and 3 I

B. 9 I and 3 I

C. 4I and I

D. 9 I and I

Answer:

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2. A thin plastic of refractive index 1.6 is used to cover one of the slits of a double slit arrangement. The central point omn the screen is now occupied by what would have been the 7th bright fringe before the plastic was used. If the wavelength of light is 600 nm, what is the thickness (in μm) of the plastic?

A. 7

B. 4

C. 8

D. 6

Answer:

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3. Two monochromatic coherent light beams A and B have intensities L and $\frac{L}{4}$ respectively.If

these beams are superposed the maximum and minimum intensities will be

A. $\frac{9L}{4}, \frac{L}{4}$

B. $\frac{5L}{4}$

C. $\frac{5L}{2}$

D. 2L, $\frac{L}{2}$

Answer:

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4. If Young's double slit experiment is done with light, which of the following statements will be true?

A. All the bright fringes will be coloured

B. All the bright fringes will be white

C. The central fringe will be white

D. No stable interence pattern will be visible

Answer:

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Jee Main

1. On a hot summer night the refractive index of air is smallest near the ground and increases with height from the ground. When a light beam is directed horizontally the Huygen's principle leads us to conclude that as it travels the light beam

A. becomes narrower

B. goes horizontally without any deflection

C. bends downwards

D. bends upwards

Answer:

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2. In a Young's double slit experiment slits are separated by 0.5mm and the screen is placed 150 cm away. A beam of light consisting of two wavelength 650 nm and 520 nm is used to

obtain interference fringes on the screen. The least distance from the common central maximum to the point where the bright due to both the wavelengths coincide is

A. 1.56 mm

B. 7.8 mm

C. 9.75 mm

D. 15.6 mm

Answer:

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Aipmt

1. In Young's double slit experiment the intensity of light on the screen where the where the path difference is λ is k (λ being the wavelength of light used). The intensity at a point where the path difference is $\frac{\lambda}{4}$ will be

A. k

B. $\frac{k}{4}$

C. $\frac{k}{2}$

D. zero

Answer:

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Neet

1. The intensity at the maximum in a Young's double slit experiment is I_0. Separation between two slits is d = 5λ, where λ is the wavelength of light used in the experiment.

What will be the intensity in front of one of the slits on the screen placed at a distance D = 10 d?

A. $\frac{I_0}{4}$

B. $\frac{3}{4}I_0$

C. $\frac{I_0}{2}$

D. I_0

Answer:

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2. In Young's double slit experiment the separation d between the slits is 2 mm the wavelength λ of the light used is 5896 Å and distance D between the screen and slits is 100 cm. It is found that the angular width of the fringes is 0.20°. To increase the fringe angular width to 0.21° (with same λ and D) the separation between the slits needs to be changed to

A. 2.1 mm

B. 1.9 mm

C. 1.8 mm

D. 1.7 mm

Answer:

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Cbse Scanner

1. In Young's double slit experiment derive the condition for (i) constructive interference and

(ii) destructive interference at a point on the screen.

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2. A beam of light consisting of two wavelengths 800 nm and 600 nm is used to obtain the interference fringes in a Young's double slit experiment on a screen placed 1.4m away. If the two slits are separated by 0.28 mm, calulate the least distance from the central

bright maximum where the bright fringes of the two wavelengths coinside.

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3. How does the fringe width in Young's double slit experiment change when the distance of separation between the slits and screen is double ?

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4. In Young's double slit experiment describe briefly how bright and dark fringes are obtained on the screen kept in front of a double slit. Hence obtain the expression for the fringe width.

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5. The ratio of the intensities at minima to the maxima in the Young's double slit experiment

is 9:25. Find the ratio of the intensities of the two sources.

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6. Define a wavefront.

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7. Using Huygens principle draw the diagrams to show the nature of the wavefronts when an incident plane wavefront gets

(i) reflected from a concave mirror,

(ii) refracted from a convex lens.

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8. Draw a diagram showing the propagation of a plane wavefront from denser to a rarer medium and verify Snell's law of refraction.

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9. Derive snell' s law on the basis of Huygen ' s wave theory when light is travelling from a denser to a rarer medium.

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10. Draw the sktches to differentiate btween plane wavefront and spherical wavefront.

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11. Derive an expression for path difference in Young' s double slite experiment and obtain the conditions for constructive and destructive inteference at a point on the screen.

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12. The intensity at the central maxima in Young' s double slit experiment is I_0 . Find out

the intensity at a point where the path difference is $\frac{\lambda}{6}, \frac{\lambda}{4}$ and $\frac{\lambda}{3}$.

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13. Define a wavefront. Using Huygens' principle verify the laws of reflection at a plane surface.

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14. If one of tow identical slits producing interference in Young's expeiment is covered with glass, so that the light intensity passing through it is reduced to 50% , find the ratio of the maximum and minimum intensity of the fringe in the interence pattern.

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15. What kind of fringes do you expect to observe if white light is used instead of

monochromatic light?

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